ANALYSIS AND DESIGN OF WATER SUPPLY SYSTEM FOR AL BURJ VILLAGE

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ABSTRACT

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Al Burj Village faces great problems in water supply and water services due to population growth. Hence, no water distribution network servicing the village, and the people depend mainly on water tanking and constructed cisterns for water supply. In view of this bad condition, the need for water supply scheme that will supply the entire area of Al Burj Village with water requirements become pressing, and subsequently this work was conducted to study and evaluate the present situation and design a new water distribution system for Al Burj Village.

The present study considered the annual population growth and their water demand for the coming 25 years that will be the design period, along. The hydraulic calculation needed for the design of the main and sub main pipelines is carried out using water software (EPANET).

A complete design for water distribution network for Al Burj village is ready along with bill of quantities, cost estimate, and the suggested phases of construction.

ARABIC ABSTRACT

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قرية البرج تواجه مشاكل كبيرة فى امدادات المياه وخدماتها بسبب النمو السكانى.ويرجع السبب الرئيسى لذلك هو عدم توفر شبكة مياه تخدم احتياجات القريةفسكان القرية يعتمدون اساسا على بناء خزانات لتخزين المياه لسد احتياجاتهم من المياه.

وفي ضوء هذه الحالة السيئة ، فإن الحاجة إلى شبكة مياه تقوم بتزويد قرية البرج بأكملها أصبحت ملحة، وهذا العمل أجري لدراسة وتقييم الوضع الحالي وتصميم شبكة لتوزيع المياه لقرية البرج.

هذه الدراسة تأخذ بعين الاعتبار النمو السنوي للسكان والطلب على المياه لمدة 25 سنة القادمة، والتى ستكون فترة التصميم، الى جانب حساب الهيدروليكيه اللازمة لتصميم خطوط الأنابيب الرئيسية والفرعية باستخدام برنامج(EPANET).

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CHAPTER ONE
INTRODUCTION

1.1 General

Al Burj Village is located 25 km from Hebron in the south-west of Dora city. It is hilly areas with an average height of 500 meters above mean sea level (AMSL).The temperature is relatively high in summer (25-30 °C) and winter temperature is low. The average rainfall is around 400 mm and the present population is around 3000 with annual population growth of around 3.6 %.

Al Burj Village faces-like other villages and towns in the West Bank –water shortage. Water demand in the village is increasing from year to year due to increase in the population. At the same time, the development of additional water supplies has been however, far short of the increase in water demand.

The amount of water supplies to the village is very little because there is no water distribution network servicing the village, and the people depend mainly on water tanking and constructed cisterns for water supply.

In view of this bad condition, the need for water supply scheme that will supply the entire area of Al Burj Village with water requirements become pressing and subsequently, this work was conducted to study and evaluate the present situation and design a water distribution system for Al Burj Village.

1.2 Problem Statement

Water comprises the most basic and critical component of all aspects of human life and is an indispensable component of the global life support system. The original man satisfied his need of water from sources that nature provided for him in the form of rivers, lakes, streams, springs and water distribution system.

The wide expansion and accelerated development of Al Burj Village had led to an increase in amount of water consumption for domestic, public and irrigation uses. The average consumption of water in the Village for all purposes does not exceed 21.9 cubic meters per year (60 litter per capita per day) due to limited quantities of water and the Lack of water distribution system. This water demand was mostly met by cisterns, water tanking, and underground water.

In view of this bad condition, the need for water supply scheme that will supply the entire area of Al Burj Village with water requirements become pressing, and subsequently this work was conducted to study and evaluate the present situation and design a water distribution system for Al Burj Village.

In view of this bad condition, and since there is no water distribution system exist, along with the fast increase in the environmental and health problems, an evaluation and design of water distribution system study become a pressing necessity so as to solve all the problems that were mentioned above.

The present study includes evaluation and design considered the annual population growth and their water demand for the coming 25 years that will be the design period, along. These plans should be capable of supplying water required to all areas of the village.

1.3 Objectives of the Project

The overall objectives of this project are to produce feasible planning scheme for the water supply of Al Burj village. Achievement of this objective requires the water resources potential of the village, estimation the village population, water requirement for different purposes, location of the water source and topography of the village. More specifically, the main objectives of this project may be classified as follows:

1. Estimate the annual amount of water required per capita for all purposes up to the planning horizon of 2032 taking into consideration the present and future population.
2. Study and evaluation of the proposed water network in Al Burj village, and display the difficulties that Faces us.
3. Investigation and discussion of the appropriate water system proposed and presentation of the proposed water supply network, which meet the present and future water demand for all purposes and around 24 hour water supply.
4. Development of several plans for the construction of the proposed water supply scheme and prepare bill of quantities.

5. Finally, providing suggestions and recommendations regarding Al Burj village water supply.

1.4 Project Area

The study area, named Al Burj Village, at 14 km south-west of Dora city. The present total administrative area of the village is about 400 Hectare, Figure (1.1) shows the study area and its location, Elevation in the village ranges from 440 to 593 m above mean sea level. The total population within the administrative borders was estimated to be around 3000 persons in the year 2007. The total population is expected to grow substantially up to year 2032, which is planning horizon of this project. The average annual precipitation at Al Burj village for the last five years is approximately 400 mm.

1.5 Methodology

The main tasks, which had been under taken in order to develop this project, are as follows:

1. Make some visits to the village public committee to discuss the problems that faces them, and knowing the complaints which the consumers reports.
2. Obtaining on Al Burj village map from Dora municipality along with the detail Aerial photogrammetric map which shows the contour lines, roads, and houses, and its elevations.
3. Collection of previous statistically studies concerning the population distribution and describes it in zones in order to determine the population forecasts for Al Burj Village.
4. Estimate the water demand for the Village up to the design period of 2032 taking into consideration the present and future population, and the future water sources.
5. Filling up all the necessary data (demand, elevation, nodes, and coordinate) to the EPANET computer program for the analysis and design of the network.
6. Design the pipelines network completely for 25 years toward with all requirements.
7. Prepare bill of quantities to the proposed water distribution network.
8. Preparation of the report.

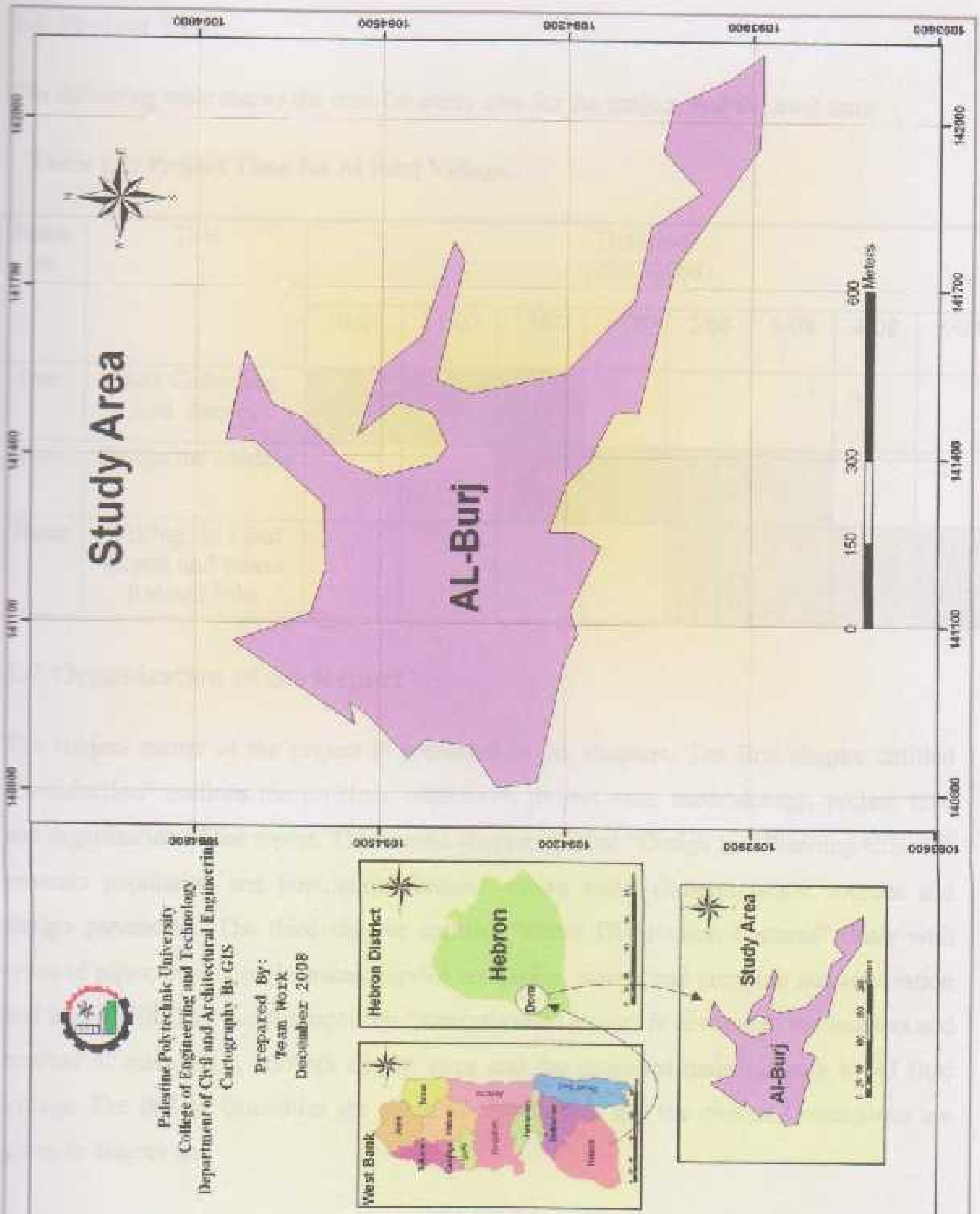


Figure (1.1): Location of the Study Area

1.6 Project Time

The following table shows the time for every step for the project, and the total time.

Table 1.1: Project Time for Al Burj Village.

Phase No	Title	Durations (2007-2008)							
		10/07	11/07	12/07	1/08	2/08	3/08	4/08	5/08
One	Data Collection And Survey								
Two	Design the Models								
Three	Writing the Final Report and others Related Jobs								

1.7 Organization of the Report

The subject matter of the project is presented in six chapters. The first chapter entitled "Introduction" outlines the problem, objectives, project area, methodology, project time and organization of the report. The second chapter entitled "Design and Planning Criteria" presents population and population forecast, future water demand, water sources and design parameters. The third chapter entitled "Water Distribution Systems" deals with types of pipes, pipe appurtenances, service reservoirs, pumps and pumping and excavation and backingfill. The fourth chapter on "Analysis and Design" is devoted to the analysis and method of calculation, network design steps and the proposed main network to Al Burj village. The Bill of Quantities are given in chapter five and the overall Conclusions are given in chapter six.

CHAPTER TWO

DESIGN AND PLANNING CRITERIA

CHAPTER TWO
DESIGN AND PLANNING CRITERIA

2.1 General

In the previous chapter, the problem of the study has been defined and the objectives of the study have been listed. The basic data for Al Burj Village have been described. In this chapter, design and planning criteria will be discussed including population and population forecasting, future water demand, water sources, and design parameters.

2.2 Population

The ideal approach for population forecasting is by the study and use of previous census records, which cover along period. The longer the period, the more comprehensive the census data, the more accurate will be the results, which will be obtained. In the analysis of these data, demographical, economical and political factors should be considered in order to develop a method of forecasting which will predict the expected growth rate, future population and its distribution in the different zones of the area under consideration.

In Al Burj Village, there is great uncertainty in the political and economical future. Additionally there were no accurate population data since the occupation of the West Bank in 1967, until 1997 when the Palestinian Central Bureau of Statistic(PCBS) conducted comprehensive census covering the West Bank and Gaza Strip.The final results of this census show that the total population of Al Burj Village is 3000 inhabitants.

Due to the unstable condition of the area during the last 50 years, it would be very difficult to develop a statistical interpretation to extrapolate future population. Some reasonable assumptions have, therefore, been made to project the future population of Al Burj Village over the next 25 years.

2.2.1 Population Forecast

Prediction of the future population of Al Burj Village is very difficult due to the lack of reliable historic data, and the political uncertainties, which will greatly influence future social and economic development At the same time, the available data on past population growth do not constitute a reliable basis for projecting the future population growth in Al Burj Village.

The base for the forecast is the 2007 population for Al Burj Village obtained from PCBS of 3000 inhabitants. The rate of population growth for the purpose of our study was based on estimation used for other Villages of similar population composition and characteristics. The rate of population growth in other Villages in the West Bank is 3.6%. Therefore, the rate of 3.6% per year was used for the future growth of the population of Al Burj Village.

To calculate the population at the end of the design period (year 2032), a geometric increase is assumed, represented by the following equation:

$$P = Po * (1 + r)^n \qquad (2.1)$$

Where, P is the future population, Po is the present population, r is the annual population growth rate, and n is the period of projection.

Using the above assumption and equation, Table 2.1 presents the population projection up to the design horizon of 2032. The data show that the population of Al Burj Village is estimated to be7263 in year 2032.

Table 2.1: Population Forecasts for Al Burj Village.

Year	2010	2015	2020	2025	2030	2032
Population	3336	3981	4751	5670	6767	7263

2.2.2 Population Density

When determining the density of population, it is either related to the total municipal area (gross density) or to the built—up area only (net density). The gross density related to the municipal area includes large industrial areas, agricultural areas, un-built areas, public parks, large water surfaces, forests ... etc. The net density is related to the built up area, but it includes small-scale industries, schools, public and commercial buildings, and roads.

Water supply system, however, is based on the net densities of population, because the provision of net works is limited to the built-up areas. The net density of population varies considerably from district to district. It is nearly (30 capita per hectare).

There are no studies done concerning the population densities in Al Burj Village. Population densities are based on the Village structure plan, which serves for issuing building permit the data for population density.

2.3 Future Water Demand

2.3.1 Introduction

Water consumption is not constant, yearly, monthly, weekly, daily, and hourly variations in water consumption are observed. Certain dry years cause more consumption. In hot months water is consumed in drinking, bathing, and watering lawns and gardens. On holidays and weekends the water consumption may be high Even during a day water use varies with high use during morning hours and close to noon and low use at night.

Maximum daily demand or maximum daily consumption usually occurs during summer months. The ideal approach to assess the existing and future per capita water consumption is by analyzing and extrapolating the available record on water consumption and demand in conjunction with the expected social and economical development. This approach can be adopted in areas having continuous supply systems where reliable information about population, population distribution and demand are known. There are problems in adopting this approach for Hebron area including Al Burj Village due to insufficient data and also the intermittent water supply.

Restrictions on the Palestinian use of the annual ground water resources of the West Bank led to the availability limited quantities of water and due to this condition, the average consumption of water in Al Burj Village for all purposes does not exceed 21.9 cubic meter per capita per year. Given these circumstances, the approach to determine per capita water consumption depends on the analysis of the existing information. The existing per capita consumption has already been assessed at (60 litter/capita, day).

2.3.2 Present Water Demand

According to the data obtained from the previous studies (Abu Sharkh, 1994) and municipality on water consumption in Al Burj Village, the per capita annual water consumption is approximately 21.9 cubic meter (60 l/c.d).

2.3.3 Future Water Demand

The present average consumption of water for domestic use in Al Burj Village is low (60 liter/capita.day) and does not represent the present and actual demand of water. So, the present water demand for domestic purposes of Al Burj Village where estimated with the assumption of better living standard and economic condition.

Subsequently figure of litter per capita per day water demand was employed (1.5 times present water consumption, which allow adequate (minimum) water demand in the present).

The forecast of future water consumption (demand) is made on the following Assumptions:

1. The living standard of the population will gradually improve leading to a corresponding increase of the per capita water demand.
2. The development of new water resources and design a network distribution system.
3. Present annual consumption is 21.9 cubic meter per capita (60 l/c.d), and the rate of increase in the annual water consumption per capita is equal to 1.5%
4. The population of the village in year 2007 is 3000 person, and population growth rate is 3.6%.
5. Design period (period or time of calculation) equal 25 years, up to 2032.

Based on the above assumptions, the population of Al Burj Village at years 2025, 2030 and 2032, and the annual residential water demand per capita for the same years were calculated along with water demand per capita per day. The data obtained were given in Table 2.2

Table 2.2: Future Water Demand for Al Burj Village.

Year	Population	Water Demand(m^3/year)		Water Demand(l/c.d)
		Per Capita	Total	
2007	3000	32.9	98700	90
2015	3981	36.9	146899	101
2025	5670	43.1	244377	118
2032	7263	47.5	347171	130

Note: (60l/c.d*1.5=90l/c.d)

It may be noted from Table 2.2 that the projected water demand for the design period (year 2032) is 130 liter per capita per day.

2.4 Water Sources

The water supply for Al Burj Village falls short of the requirements due to insufficient water sources and due to limited quantities of water supplied to the Village by the Hebron municipality. The water is provided to the Village by cisterns, water tanking, and underground water

2.5 Design Parameters

The design and planning assumptions used in this project are as follow:

1. Design period 25 year (from 2007-2032).
2. Present (2007) population of municipality of Al Burj Village is 3000 capita.
3. The growth rate will be 3.6% .
4. The existing per capita water consumption has been assessed 90 l/c.d.
5. Total administrative area of municipality of Al Burj Village 400 ha.
6. Future 2032 population of Al Burj Village 7263 capita.
7. Per capita water consumption by 2032 will reaches 130 l/c.d.
8. Formula to be used in design of pipes :(Hazen- William's formula)

$$V = 0.85\, C_H\, R^{0.63}\, S^{0.54} \quad (2.2)$$

9. Dimensionless coefficient (C_H) ranges between 110-150 according to the material of the pipes.
10. Minimum velocity 0.1 m/sec.
11. Maximum velocity 2 m/sec.
12. Minimum pressure = 0.5 bar (5m)
13. Maximum pressure = 9 bar (90m)
14. Minimum diameter of 2"(50 mm)

CHAPTER THREE

WATER DISTRIBUTION SYSTEMS

3.1 General Introduction

3.2 Types Of Pipes

3.3 Pipes Appurtenances

3.4 Service Reservoirs

3.5 Pumps And Pumping

3.6 Excavation And Backingfill

CHAPTER THREE
WATER DISTRIBUTION SYSTEMS

3.1 General Introduction

The term distribution system is used to describe collectively the facilities used to supply water from its source to the point of usage. To deliver water to individual consumers with appropriate quantity, quality, and pressure in a community setting requires an extensive system of pipes, storage reservoirs, pumps, and related appurtenances. It is the purpose of this chapter to explain these elements.

3.2 Types of Pipes

The pipe is a circular closed conduit, used for conveying water from a point to another one, under gravity or under pressure. The pipes are generally classified into three categories of usage:

(i) <u>Mains:</u> A large pipes which go through the main streets in cities or towns and used to convey water to other pipes (sub-mains) in the network, or from one reservoir to another.

(ii) <u>Sub-mains:</u> Smaller pipes connected to mains and supplies water to service pipes.

(iii) <u>Service pipes:</u> The pipes which supply water to consumers, houses, flats, and farms and connect to mains and sub-main pipes.

(iv) <u>Plumping pipes:</u> Pipes work within a building for the distribution of water of various appliances.

Pipes are also classified according to their material of construction. The following types of pipes are in use for construction of mains:

1. Cast iron pipes
2. Asbestos cement pipes
3. Steel pipes
4. Reinforced concrete pipes
5. Plastic pipes

The selection of particular types of material for a pipe depends mainly upon the first cost, maintenance cost, durability, carrying capacity, the maximum pressure, the maximum permissible size, availability of materials and labor for their construction, etc. The type of water to be conveyed and its possible corrosive effect upon the pipe material must be taken into account.

In Palestine, the use of steel pipes is more favorable considering the rocky terrain and steep slopes along most of the lines. Steel pipelines under such conditions are less exposed to damages by subsequent construction activities than other material pipes.

3.3 Pipes Appurtenances

In order to isolate and drain the pipeline sections for tests, inspection, cleaning and repairs, a number of appurtenances such as pipe fittings, valves, manholes, etc. are provided at various suitable places along the pipelines, as described below.

3.3.1 Pipe Fittings

The various pipe fittings such as bends, crosses, tees, elbows, wye, union, capes, reducers, plugs, etc. are frequently used in making service connections and bigger sized mains or sub-mains. Fittings are supplied in case of interruption of pipelines, such as change in diameters, materials, pipeline direction or if valve and water meters have to be installed. Various types of bends and other important pipe fittings are shown in Fig. 3.2 Proper selection and installation of joints and fittings is very important because they are often source of leakage (Steel and McGhee 1991).

3.3.2 Valves

A large number of different types of valves are required for the proper functioning of the pipelines. Generally, valves have three main tasks: flow and/or regulation (e.g. flow control valves, pressure reducing valves, etc.), exclusion of the parts of the network due to emergency or maintenance reasons, and protection of reservoirs and pumps in the system (e.g. float valves, non-return valves). With respect to the purpose, the following types of valves can be distinguished.

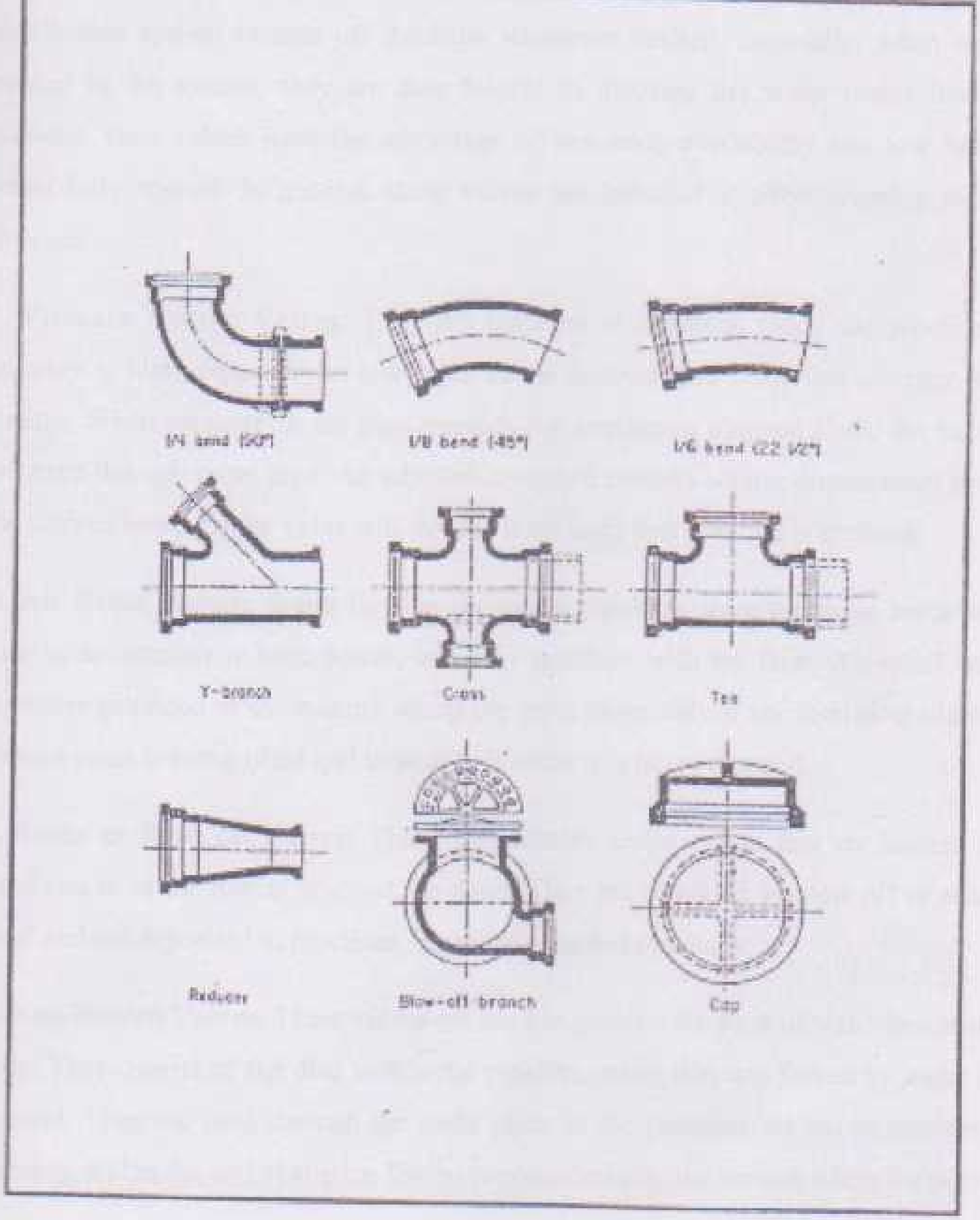


Figure 3.1: Various Pipe Fitting

1. Gate Valves or Sluice Valves: They are isolating valves, used most often in the distribution system to shut off the flow whenever desired, especially, when repairs are needed in the system, they are also helpful in dividing the water mains into suitable sections. Gate valves have the advantage of low cost, availability and low head losses when fully opened. In general, these valves are installed at street crossing where lines intersect.

2. Pressure Reduce Valves: They are installed at locations along the pipelines where pressure is high, especially at low point in the network and those that are near the pump station. When pressure in the pipe exceeds the maximum allowed limit, the valve relive pressure through cross pipe. An adjustable control permits setting downstream pressure at the desired level and the valve will throttle itself until that pressure is attained.

3. Air Relief Valves: Water flowing through a pipelines always contain some air which tries to accumulate at high points, and may interface with the flow. Air relief valves are therefore provided at the summit along the pipe, these valves are needed to discharge air when a main is being filled and to admit air when it is being emptied.

4. Scour or Blow off Valves: These are ordinary sluice valves that are located either at dead end or at the lowest point of the main. They are provided to blow off or remove the sand and silt deposited in pipelines. They are operated manually.

5. Non-Return Valves: These valves are used to primate the flow of water in one direction only. They consist of flat disc within the pipeline, when they are forced by water they are opened. They are used through the main pipes to the pumping station to prevent reverse flowing, and at the end of suction line to prevent draining the suction when the pump stops.

6. Float Valves: These valves are installed at the entrance of the storage reservoirs. There task is to close or open depending on the movement of a floating sphere on water to control the water surface inside the reservoir.

Water Meters

Purpose of metering in water distribution systems is twofold: it provides information about hydraulic behavior of the network, useful for the future design, as well as, it basis for water billing. In both cases the accuracy is vital, so the quality and good maintenance of these devices are very important (UNDP,1990).

Fire Hydrants

Fire hydrants are constructed in many different versions. They are generally distinguished as underground or ground installations. Under ground installations are better protected from frost and traffic damage, but on the other hand they can be covered by parked vehicle when being requested for use. Required capacity, pressure and distance for hydrants vary from case to case and they are related to the potential risks and consequences from fire. Generally, the capacities are within the range (30-500 m^3/h), and the distance between (100-300 m) (UNDP,1990).

Service Connections

Service connection link users within the distribution system. The standard set-up usually consists of: connection, pipe, outdoor and indoor stop valve and water meter. In newer installation, a non return valve may be added as well.

3.4 Service Reservoirs

3.4.1 Functions

Distribution reservoirs are the storage reservoirs ,which store the water for supplying water during emergencies, such as break-down of pumps, heavy fire demand, repairs, etc. and to help in absorbing the hourly fluctuation in the normal water demand. Storage reservoirs are also used to maintain pressure and reduce pressure variation within the distribution system. In large cites, distribution reservoirs may be used at several location within the system. Regardless of the locations, the water level in the reservoir must be at sufficient elevation to permit gravity flow at an adequate pressure. Types and storage capacity of the service reservoirs is explained in the following sections.

3.4.2 Types of Service Reservoirs

The service reservoirs may be made of steel, reinforcement cement concrete, or masonry. Depending upon their elevation with respect to the ground and local environmental conditions, storage reservoirs may be classified into the following two types:

1. Surface Reservoirs: Surface reservoirs are circular or rectangular tanks, constructed at ground level or below the ground level. They are generally constructed at high point in the city. In gravitational type of distribution system, water is stored in the ground service reservoir, and then directly sent from there into the distribution system.

2. Elevated Reservoirs: Elevated reservoirs are the rectangular, circular, or elliptical over head tank erected at a certain suitable elevation above the ground level and supported on the towers. They are constructed where the pressure requirements necessitate considerable elevation above the ground surface, and where the use of stand pipes becomes impracticable (Garge,1998).

3.4.3 Operating Storage of the Reservoirs

The total storage of a service reservoir is the summation of balancing storage (or equalizing or operating storage), breakdown storage, and fire storage. The main and primary function of a service reservoir is to meet the fluctuation in demand with a constant rate of water supply. The quantity of water required to be stored in the reservoir for balancing this variable demand against the constant supply is known as balancing storage or storage capacity of a reservoir. This balancing storage can be determined analytically or graphically. In the analytically solution method, the hourly excess of demand as well as the hourly excess of supply are worked out. The summation of maximum of the excess of demand and the maximum of excess of supply will give us the required storage capacity.

The breakdown storage or the emergency storage is the storage preserved in order to tide over the emergencies posed by the failure of pump, the electricity or any other mechanism driving the pump. The amount of breakdown storage is very difficult to assess. For this reason, a lump sum provision generally made for this storage. A value of about 25 percent of total storage capacity of the reservoir, or 2 times of the average hourly supply, may be considered as enough provision for accounting this storage, under all normal circumstances.

The third component of the total reservoir storage is the fire storage. In case of fires sufficient amount of water must remain available in the reservoir for throwing it over the fire. The total volume of water required for fire fighting is generally small, say of the order of 1 to 1.5 liters per day per person.

The total reservoir storage can finally obtained by adding all the three storage's, viz., balancing storage, emergency storage, and fire storage.

3.5 Pumps And Pumping

The transport of water from low lying sources, e.g. underground water, rivers and lakes, to the elevated water towers, reservoirs, directly to the consumers under pressure is accomplished with the help pumps. In a water supply scheme, pumps are required at one or more stages.

In the design of pumping works, stand-by units must be provided that in case of break dawn or during repairs the water supply is not effected. The number of units in reserve will depend upon the particular station and operational conditions.

3.5.1 Types of Pumps

There are various types of pumps, but the two types which the hydraulic engineers generally encounter, are :

1. Roto-dynamic pumps

A rotodynamic pump has a wheel or a rotating element which rotates the water in a casing, and thus imparting energy to the water. Such a pump may be of the following two types:

i) Centrifugal pumps

b) Axial-flow pumps

2. Displacement pumps

A displacement pumps works on the principle of mechanically inducing vacum in a chamber, thereby drawing in a volume of water which is then mechanically displaced and forced out of the chamber. Such a pump may be of the following two types:

a)The reciprocating pump

b)The rotary type pump

In addition to these two major types of pumps, other types, such as air lift pumps, jet pumps, hydraulic rams, etc. are also used under special conditions.

3.5.2 Guide for Selection of Pumps

The various factors which must be thoroughly considered while selecting a particular type of pump for a particular project are :

a) Capacity of pumps

b) Importance of water supply scheme

c) Initial cost of pumping arrangement

d) Maintenance cost

e) Space requirements for locating the pump

f) Number of units required

g) Total lift of water required

h) Quantity of water to be pumped

3.5.3 Pumping Station

The location of a pumping station is primarily governed by the location of the place from where it is to receive water, and also by the location of the place where it is to supply that water. The various points which are to be kept in mind while selecting a suitable site are enumerated below :

a) The site should be a ways from all the sources of contamination or pollution.

b) The site should be above the highest flood level of the rivers.

c) It should be so selected that its future growth and expansion is easily possible.

d) Possibilities of fire hazard should also be considered while selecting the site for the pumping stations.

e) The proximity of the site to the railways, from where the coal can be quickly made available for producing power, may also have be considered.

3.6 EXCAVATION AND BACKINGFILL

Great care is not necessary in lying water pipes accurately to grade, but sufficient cover is necessary to give protection against traffic loads and to prevent freezing. The filling height is usually between 1 to 1.5 m measured from the upper tip of the pipe, this depends mainly on the volume and density of the traffics in the area of the project, in addition to the material of pipes and type of filling materials.

Trenches or ditches should be wide enough to allow good workmanship. Required widths range from 0.5 to 1.2 m depends on pipe size. In rock excavation the rock should be removed so that it is at least 150 mm away from the finished pipeline. A cushion of sand or earth should be placed between rock and the pipe (Steel and McGhee,1991).

Backfill material should be free from cinders, refuse, or large stones. Backfill from the trench bottom to the centerline of the pipe should be with sand, gravel, shell or other satisfactory material laid in layers and tamped. This material should extend to the trench sides. Excavation material can be used as filling material depending on the type of soil excavation and this will save money.

CHAPTER FOUR

ANALYSIS AND DESIGN

CHAPTER FOUR
ANALYSIS AND DESIGN

4.1 General

In this project, an attempt is made to study and evaluate the proposed water distribution network in Al Burj Village and develop a future plans and appropriate technology for reconstruction and upgrading of the network, corresponding to population and population growth and water demand in the future, in order to supply all the inhabitants of Al Burj Village with a sufficient amount of good quality drinking water. In this chapter, the method of calculation will be described followed by discussion of the Proposed Main Network.

4.2 Method of Calculation

The computer program EPANET performs the calculations necessary for the network design. This computer program is develop by the Risk Reduction Engineering Laboratory, Office of Resource and Development, U.S Environmental protection Agency, Cincinnati, Ohio (Rossman, 1994).

EPANET is a computer program that performs extended period simulation of hydraulic and waters quality behavior within drinking water distribution system. A network can consist of pipes, nodes (pipe functions), pumps, valves, and storage tank or reservoirs. EPANET tracks the flow of water in each pipe, the pressure at each node, the height of water in each tank, and the concentration of the substance throughout the network during a multi-time period simulation. In addition to substance concentration, water age and source tracing can also performed. The water quality is equipped to the model such phenomena as reactions within the bulk flow, reactions at the pipe wall, and mass transport between the bulk flow and pipe wall.

The algorithm makes of the Hardy-Cross method. This method makes use of the Hazen-Williams formula. The computer program assumes distribution of flow in the network and balances the head losses. Pipe flow formulas are used to determine the actual head losses, correction will then be made in the flow until the heads losses are balanced. The flow corrections are based on the concept that the flow at a node will continue, which means that the sum of the incoming flows equals the sum of the outgoing flows.

The computer program facilitates the selection of the appropriate pipe diameter. A number of data is required before the program can start its calculations. The length of pipes, the reservoir level, the demand per node, the elevation of the nodes, the Hazen –Williams coefficient for the friction, the stopping criterion for the Hardy- Cross algorithm, and the expected diameter for each pipe are required for this computer program. The program uses a simplified layout of the network All significant components in the network were marked by nodes (Rossman, 1994)

The pipelines are divided from node to node. The reservoir is represented as a node. At these nodes the water supply or consumption of the surrounding area is linked.

The result of this approach is that every node has its share in (l/s) of the demand of the total area. The friction of the pipeline is taken into account by using the Hazen-Williame`s coefficient This dimensionless coefficient (C) ranges between 110-150 according to the material of the pipes. The chosen coefficient for this network is 130. The stopping criterion for the Hardy –Cross is chosen at 0.01.

Filling up the computer program only the pipe diameters remain. Varying these diameters enables then computer program to calculate the head losses, the velocity, the flow in each pipe and the pressure at each node. The velocity and the pressure are restricted between margins. These margins should be considered, but can be crossed if sensible. Finally the most suitable diameters are found, so that the pressure in the nodes will meet the requirements as close as possible (5-90 m) and the velocities will mostly be between the range of (0.1-2 m/s).

4.2.1 Pipe Hydraulics

As mentioned earlier, pipe hydraulic calculation has been carried out by the EPANET software, which uses the Hazen-Williams equation to calculate the friction head loss. The design criteria adopted for different parameters are:

(i)Velocity:

- Minimum velocity = 0.1 m/s to prevent deposits of silt in the pipe (achieve self-cleansing).
- Maximum velocity = 2.0 m/s to minimize friction loss and water hammer effect.

(ii) Pressure:

- Minimum pressure = 0.5 bar (5m)
- Maximum pressure = 9 bar (90m)

The minimum and maximum pressures in the distribution lines are defined as the pressure at the nodes in the model. The minimum value of 5 m is adopted to let the water rise at least one story and overcome the frictional resistance of the house connection pipes and small diameter distribution. The upper value is limited to 90 m in order to have excessive pressure in the network and so minimize the leakage from the system.

(iii) Pipe: The pipes of the distribution system are chosen to be steel pipes due to their advantages. Minimum diameter of 1"(25 mm) is taken. The Hazen –Williams constant of a new steel pipes is 130.

4.2.2 Reservoir

Reservoirs are required to provide emergency storage in case there is a temporary loss of bulk supplies or in case there are exceptional demand on the system (e.g. for fire fighting). It is also required for balancing storage to take account of normal and daily fluctuation in demand compared with average demand. In Al Burj Village, municipal water reservoirs are not available. Most households have cisterns and/or large roof tanks that provide additional storage in the system. At the same time, the availability of funds and land needed to build the reservoir are factors to be considered in deciding whether we need reservoir or not. In this project, it is suggested to build one reservoir on available land located in the highest point of Al Burj Village.

4.2.3 Valves

Gate valves are placed at the street corners where lines are intersected. Air relief valves are only fitted to main pump because taps of houses work as air relief valves for the distributing lines.

4.3 Network Design Steps

In general, the following steps must be done while planning and designing a municipal water supply scheme:

1. Estimated the future population of the study area to determine the quantity of water which is required to be provided by the project.
2. Located a reliable source of water, so as to fulfill the needs and requirements of the area.
3. Obtained a detailed map of the area to be served on which topographic contours and the locations of present and future are identified.
4. Based on the topography, selected possible locations for distribution reservoirs. If the area to be served is large it may be divided into several sub-areas to be served with separate distribution system.
5. Estimated the average and peak water use for the area or each sub-area, allowing for fire fighting and future growth.
6. Estimated pipe size on the basis of water demand and local code requirements.
7. Laied out a skeleton system of supply mains leading from the distribution reservoir or other source of supply.
8. Analyzed the flow and pressures in the supply network.
9. Suggested pipe sizes to reduce pressure irregularities in the basic grid.
10. Added distribution mains to the grid system.
11. Reanalyzed the hydraulic capacity of the system.
12. Added street mains for domestic service.
13. Located the necessary values and fire hydrants.
14. Prepared final design drawings and quantity takeoffs.

4.4 The Proposed Main Network

In the proposed study for the water distribution network, the trial is made to design the network for year 2032. the appropriate pipe diameters are found by use of the computer program filled with basic data (nodes water demand in year 2032, elevation of the nodes, the length of each pipe). So that, the pressure in the nodes and velocity in the links will meet the requirements as close as possible. The appropriate diameters for proposed network are found and given in Table 4.1.b, Table 4.1.c along with the elevation and demand data. The same data are shown in Figs. 4.2 and 4.3. The calculated velocities, head loss, grads, and pressure are given in Tables 4.2 and 4.3. The proposed water distribution network for year 2032 is plotted in Figure 4.1.

Table (4.1.a) Input Data for the Proposed Network (X,Y)

Node #	X coordinate	Y coordinate	Node #	X coordinate	Y coordinate
R	142159.40	93481.66	31	141290.95	94749.28
1	143046.77	93562.94	32	141231.03	94658.98
2	143010.51	93550.66	33	141402.91	94653.06
3	142857.42	93484.10	34	141295.98	94551.36
4	142774.94	93432.97	35	141358.37	94418.91
5	142706.71	93417.79	36	141722.93	94357.93
6	142643.23	93448.38	37	142068.57	94199.48
7	142540.86	93523.72	38	142505.40	94026.48
8	142461.84	93574.48	39	141360.69	94398.10
9	142336.29	93691.13	40	141602.97	94239.55
10	142336.29	93831.51	41	141873.93	94079.04
11	142143.63	93853.13	42	142053.98	93988.97
12	141916.11	93921.48	43	141567.041	93436.271
13	141666.05	94052.57	44	142151.303	93849.107
14	141482.41	94107.84	45	141726.616	93694.930
15	141378.29	94287.88	46	141136.05	94090.33
16	141280.69	94389.47	47	141699.27	93516.53
17	141170.69	94489.12	a	141022.43	94461.13
18	141136.94	94526.96			
19	141111.65	94525.60			
20	142867.33	93343.50			
21	142896.17	93001.10			
22	142855.85	93256.64			
23	141675.26	93700.70			
24	141729.40	93656.13			
25	141938.93	93523.28			
26	142121.37	93487.97			
27	141006.79	94321.71			
28	141117.91	94374.54			
29	140960.59	94562.74			
30	141159.64	94733.36			

Note:
R: reservoir , a: wash out

Table (4.1.b) Input Data for the Proposed Network (Nodes).

Node #	Elevation (m)	Demand (l /s)	Node #	Elevation (m)	Demand (l /s)
1	592.40	0.004	31	513.86	0.008
2	590.82	0.021	32	436.96	0.004
3	588.11	0.013	33	510.95	0.004
4	585.80	0.021	34	444.53	0.069
5	581.87	0.056	35	460.00	0.078
6	578.41	0.030	36	505.84	0.017
7	574.03	0.021	37	525.65	0.021
8	570.81	0.043	38	542.53	0.004
9	551.96	0.034	39	463.90	0.052
10	524.90	0.052	40	469.85	0.004
11	520.00	0.021	41	490.00	0.043
12	518.12	0.082	42	510.70	0.021
13	510.00	0.113	43	545.00	0.030
14	499.99	0.104	44	521.20	0.013
15	482.12	0.099	45	525.00	0.013
16	470.00	0.095	46	460.00	0.004
17	469.83	0.030	47	560.00	0.004
18	463.95	0.047	a	444.88	0.004
19	461.01	0.034			
20	595.63	0.017			
21	596.49	0.030			
22	587.92	0.069			
23	525.00	0.021			
24	524.74	0.047			
25	535.20	0.043			
26	544.49	0.047			
27	514.48	0.008			
28	470.00	0.017			
29	505.36	0.017			
30	523.31	0.004			

Table (4.1.c) Input Data for the Proposed Network (Pipes).

Pipe #	Head Node	Tail Node	Length (m)	Diameter (mm)
0	R	1	6	100
1	1	2	25	100
2	2	3	108	100
3	3	4	63	100
4	4	5	46	100
5	5	6	46	100
6	6	7	82	100
7	7	8	61	100
8	8	47	83	100
9	9	10	128	100
10	10	44	34	100
11	44	11	6	100
12	11	12	154	100
13	12	13	184	100
14	13	14	125	100
15	14	15	135	100
16	15	16	92	100
17	16	17	95	50
18	17	18	34	50
19	18	19	16	50
20	19	a	72	25
21	4	20	88	50
22	22	21	169	25
23	5	22	142	50
24	24	23	46	25
25	25	24	161	25
26	26	25	121	50
27	44	26	236	50
28	28	27	80	25
29	17	28	82	50

Table (4.1.c) - Continue.

Pipe #	Head Node	Tail Node	Length (m)	Diameter (mm)
30	19	29	101	25
31	32	31	69	25
32	32	30	66	25
33	34	33	98	25
34	34	32	82	25
35	34	35	95	25
36	46	36	186	25
37	36	37	247	25
38	37	38	305	25
39	40	39	188	25
40	41	40	205	25
41	42	41	131	50
42	24	45	28	25
43	9	43	188	50
44	35	46	96	25
45	18	34	104	50
46	11	42	106	50
47	47	9	44	100

Table (4.2) - Values of Velocity and Head Loss for the Proposed Network (Pipes).

Pipe #	Diameter (mm)	Flow (l/s)	Velocity (m/s)	Head loss (m/km)
0	100	1.66	0.21	1.11
1	100	1.65	0.21	1.10
2	100	1.63	0.21	1.08
3	100	1.62	0.21	1.06
4	100	1.58	0.20	1.01
5	100	1.42	0.18	0.83
6	100	1.39	0.18	0.80
7	100	1.37	0.17	0.78
8	100	1.33	0.17	0.73
9	100	1.26	0.16	0.66
10	100	1.20	0.15	0.61
11	100	1.02	0.13	0.45
12	100	0.87	0.11	0.34
13	100	0.79	0.10	0.28
14	100	0.68	0.09	0.21
15	100	0.57	0.07	0.16
16	100	0.47	0.06	0.11
17	50	0.38	0.19	2.10
18	50	0.32	0.16	1.56
19	50	0.06	0.03	0.06
20	25	0.00	0.01	0.02
21	50	0.02	0.01	0.01
22	25	0.03	0.06	0.58
23	50	0.10	0.05	0.18
24	25	0.02	0.04	0.31
25	25	0.08	0.17	3.67
26	50	0.03	0.06	0.27
27	50	0.17	0.09	0.50
28	25	0.01	0.02	0.06
29	50	0.03	0.05	0.44

Table (4.2) – Continue.

Pipe #	Diameter (mm)	Flow (l/s)	Velocity (m/s)	Head loss (m/km)
30	25	0.02	0.04	0.21
31	25	0.01	0.02	0.06
32	25	0.00	0.01	0.02
33	25	0.00	0.01	0.02
34	25	0.02	0.04	0.20
35	25	0.13	0.26	8.04
36	25	0.04	0.09	1.12
37	25	0.03	0.05	0.43
38	25	0.00	0.01	0.02
39	25	0.05	0.11	1.57
40	25	0.06	0.12	1.82
41	50	0.10	0.05	0.18
42	25	0.01	0.03	0.12
43	50	0.03	0.02	0.02
44	25	0.05	0.10	1.33
45	50	0.22	0.11	0.75
46	50	0.12	0.06	0.26
47	100	1.32	0.17	0.73

Table (4.3) The Pressure at Each Node for The Proposed Network (Nodes).

Node #	Demand (l/s)	Elevation (m)	Grade (m)	Pressure (m)
1	0.00	592.40	599.99	7.59
2	0.02	590.82	599.97	9.15
3	0.01	588.11	599.85	11.74
4	0.02	585.80	599.78	13.98
5	0.06	581.87	599.74	17.87
6	0.03	578.41	599.70	21.29
7	0.02	574.03	599.63	25.60
8	0.04	570.81	599.58	28.77
9	0.03	551.96	599.49	47.53
10	0.05	524.90	599.41	74.51
11	0.01	520.00	599.39	79.38
12	0.02	518.12	599.38	81.21
13	0.08	510.00	599.33	89.28
14	0.11	499.99	599.28	99.26
15	0.10	482.12	599.25	117.11
16	0.10	470.00	599.23	129.22
17	0.10	469.83	599.22	129.19
18	0.03	463.95	599.02	135.02
19	0.05	461.01	598.97	137.96
20	0.03	595.63	598.97	4.15
21	0.02	596.49	599.78	3.12
22	0.03	587.92	599.61	11.79
23	0.07	525.00	599.71	73.63
24	0.02	524.74	598.63	73.90
25	0.05	535.20	598.64	64.03
26	0.04	544.49	599.23	54.78
27	0.05	514.48	599.27	84.50
28	0.01	470.00	598.98	128.99
29	0.02	505.36	598.99	93.59
30	0.02	523.31	598.95	75.56

Table (4.3) – Continue.

Node #	Demand (l/s)	Elevation (m)	Grade (m)	Pressure (m)
31	0.00	513.86	598.87	85.01
32	0.01	436.96	598.87	161.91
33	0.00	510.95	598.87	87.94
34	0.00	444.53	598.89	154.36
35	0.07	460.00	598.89	138.13
36	0.08	505.84	598.13	91.95
37	0.02	525.65	597.79	72.03
38	0.02	542.53	597.68	55.15
39	0.00	463.90	597.68	134.76
40	0.05	469.85	598.66	129.11
41	0.00	490.00	598.96	109.33
42	0.04	510.70	599.33	88.66
43	0.02	545.00	599.36	54.49
44	0.03	521.20	599.49	78.19
45	0.01	525.00	598.64	73.64
46	0.00	460.00	598.00	138.00
47	0.00	560.00	599.52	39.52
a	0.00	444.88	598.97	154.09
R	-1.66	600.00	600.00	0.00

PALESTINE POLYTECHNIC UNIVERSITY
(PPU)
Graduation Project

ANALYSIS AND DESIGN OF WATER SUPPLY SYSTEM IN AL BURJ VILLAGE

DESIGNED BY : HADEEL BADRAN
HIBA ABDEEN
JANET AL-SALAIMEH

SUPERVISER :
Eng. Imad Al-Zeer

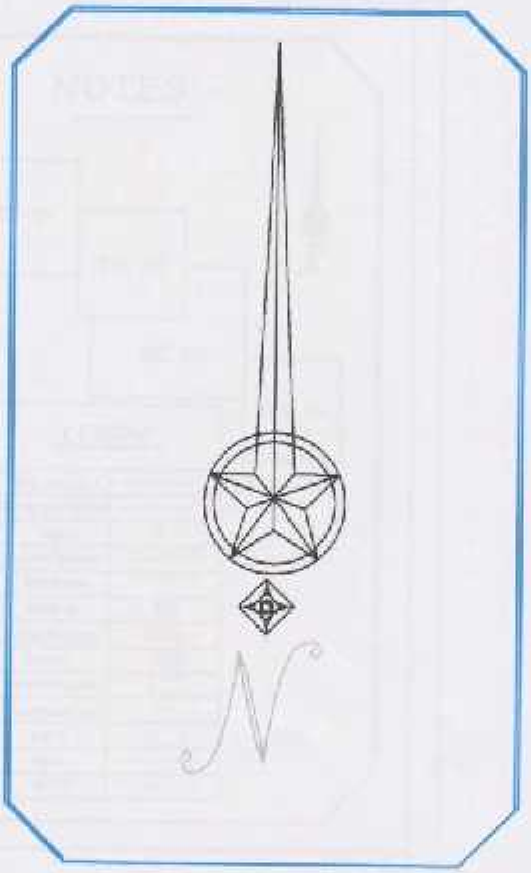
CLIENT : Al Burj Village Council

JOP TITLE :
The Proposed Water Distribution Network

DRAWING TITLE : Nodes

DATE : JUNE 2008 | FIGURE: 4.1


Elevation
450.00
500.00
550.00
600.00
m
Diameter
25.00
25.00
50.00
100.00
mm



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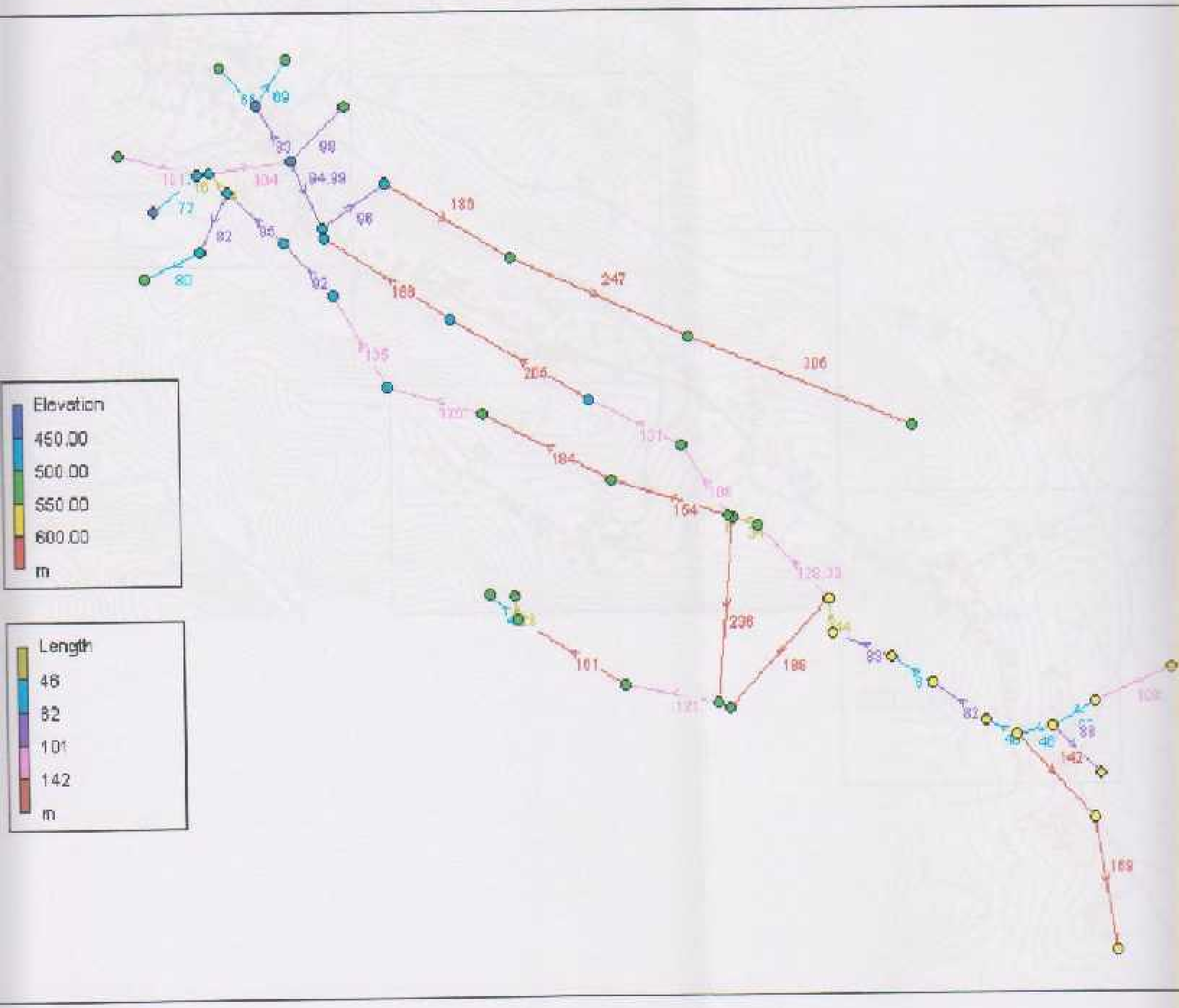
SUPERVISER :
Eng. Imad Al-Zeer

CLIENT :
Al Burj Village Council

JOP TITLE :
The Proposed Water Distribution Network

DRAWING TITLE :
Length of Pipes

DATE : JUNE. 2008 | **FIGURE:** 4.2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550.00
600.00
m
Length
46
82
101
142
m
189
247
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154
236
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161
135
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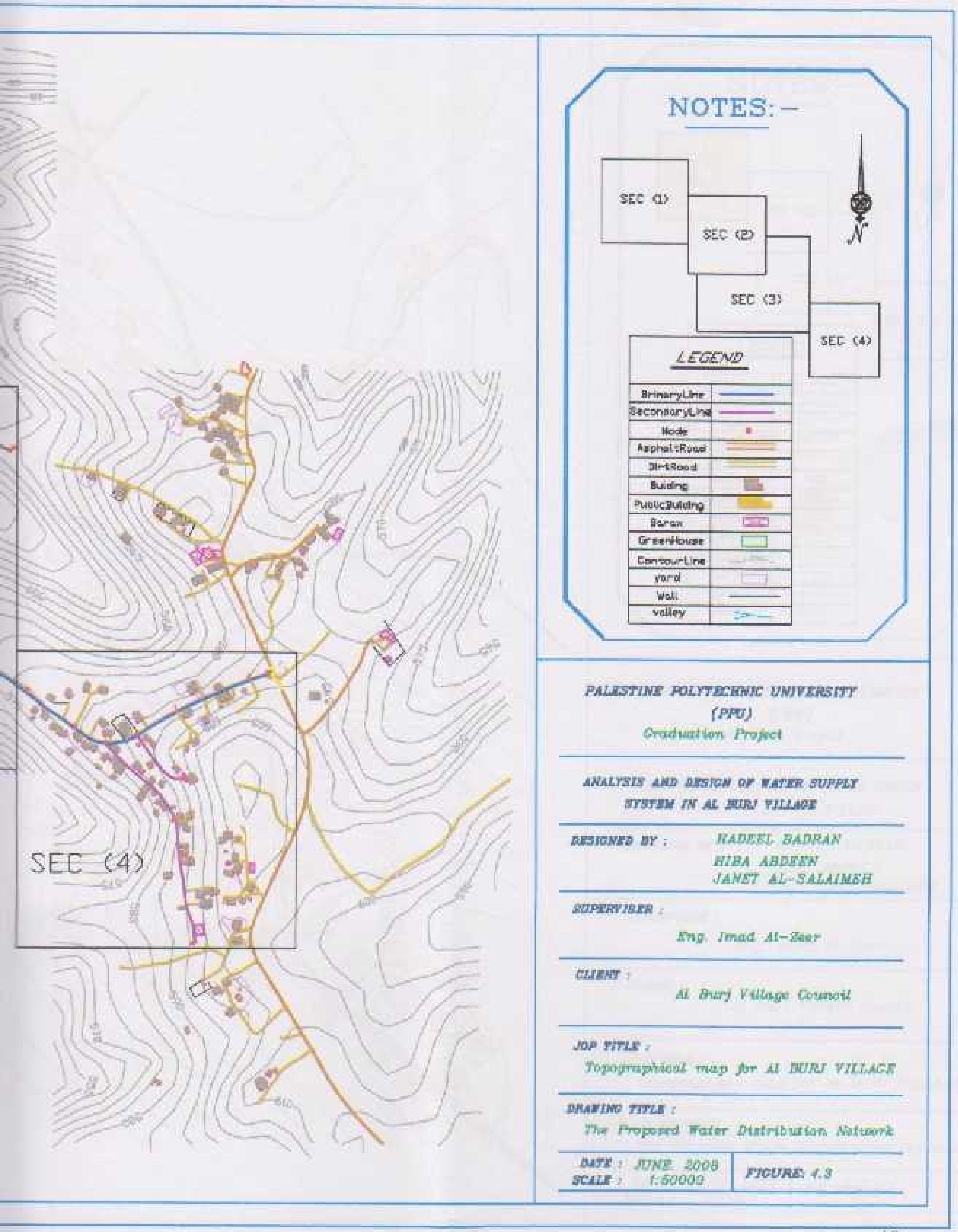
98
92
95
104
72
80
68
69
169


NOTES:-
SEC (1)
SEC (2)
SEC (3)
SEC (4)
N
LEGEND
PrimaryLine
SecondaryLine
Node
AsphaltRoad
DirtRoad
Building
PublicBuilding
Barax
GreenHouse
ContourLine
yard
Wall
valley
SEC (4)
PALESTINE POLYTECHNIC UNIVERSITY
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Graduation Project
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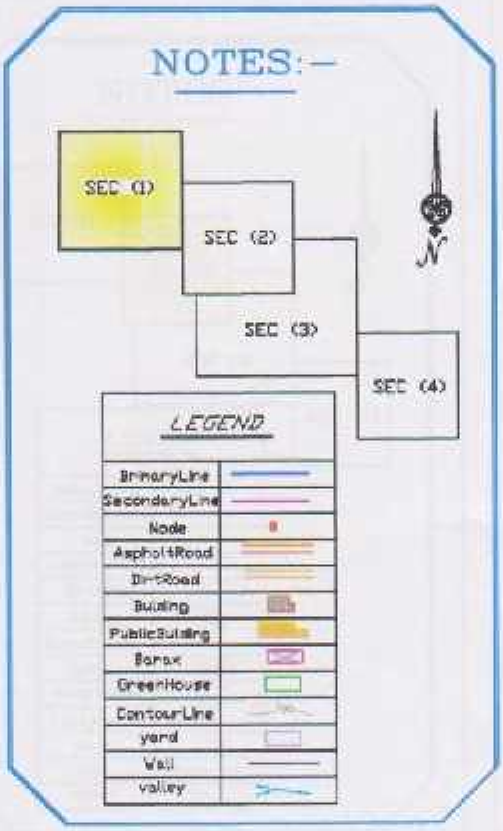
HIBA ABDEEN
JANET AL-SALAIMEH
SUPERVISER :
Eng. Imad Al-Zeer
CLIENT :
Al Burj Village Council
JOP TITLE :
Topographical map for Al BURJ VILLAGE
DRAWING TITLE :
The Proposed Water Distribution Network
DATE : JUNE 2008
SCALE : 1:50000
FIGURE: 4.3


SEC (1)
SEC (2)
SEC (3)
SEC (4)



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SUPERVISER : Eng. Imad Al-Zeer

CLIENT : Al Burj Village Council

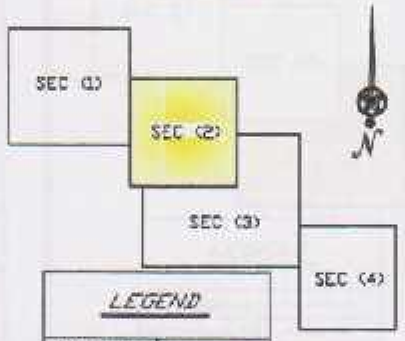
JOP TITLE : Topographical map for Al BURJ VILLAGE

DRAWING TITLE : The Proposed Water Distribution Network

DATE : JUNE 2008 **SCALE :** 1:10000	**FIGURE:** 4.3.a


SEC (1)
440
455
450
435
29
19
18
17
16
28
27
34
35

NOTES:-



LEGEND

PrimaryLine	
SecondaryLine	
Node	
AsphaltRoad	
DirtRoad	
Building	
PublicBuilding	
Borox	
GreenHouse	
ContourLine	
yard	
Wall	
valley	

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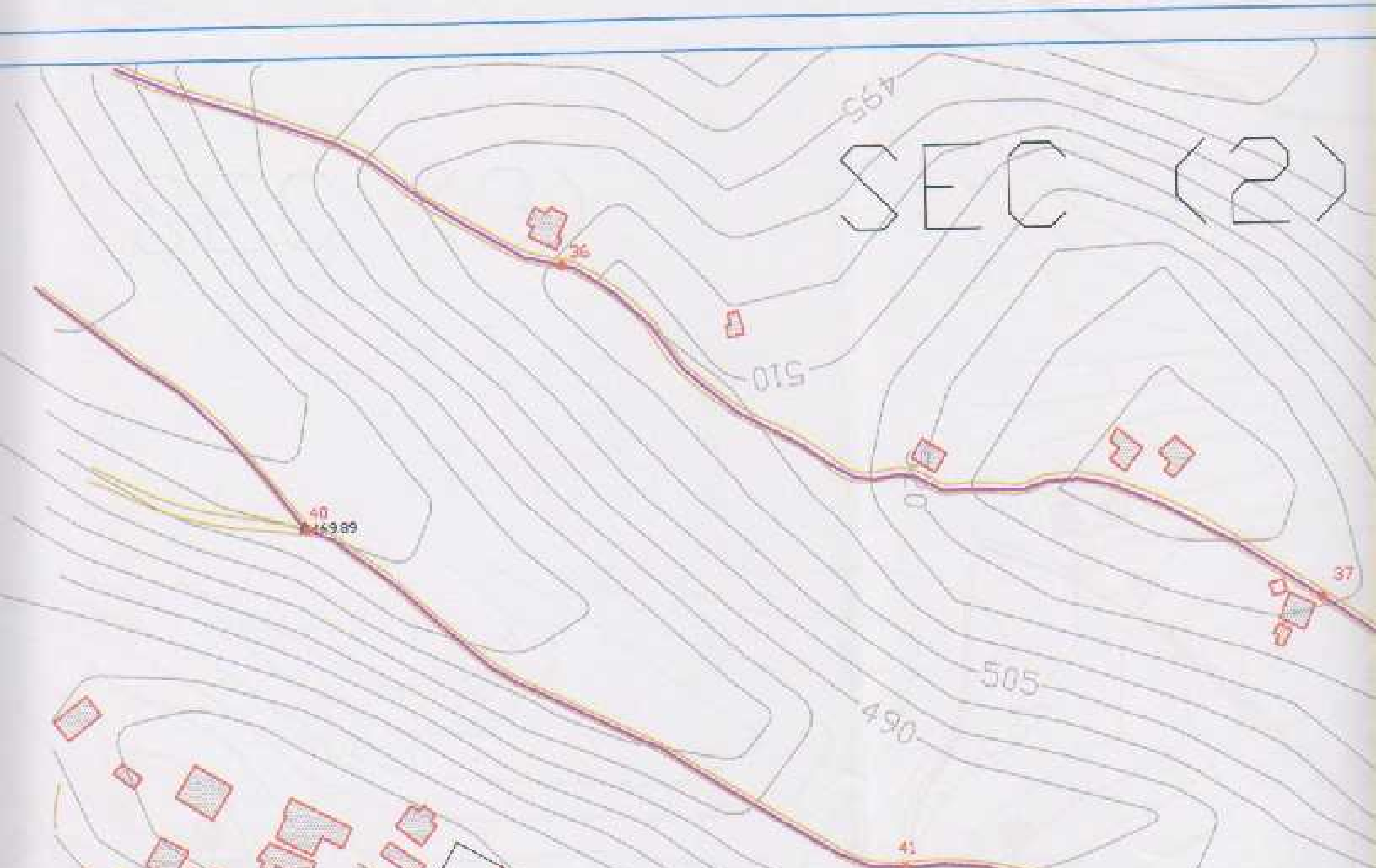
CLIENT : Al Burj Village Council

JOP TITLE : Topographical map for Al BURJ VILLAGE

DRAWING TITLE : The Proposed Water Distribution Network

DATE : JUNE. 2008 SCALE : 1:10000	FIGURE: 4.3.b



SEC (2)
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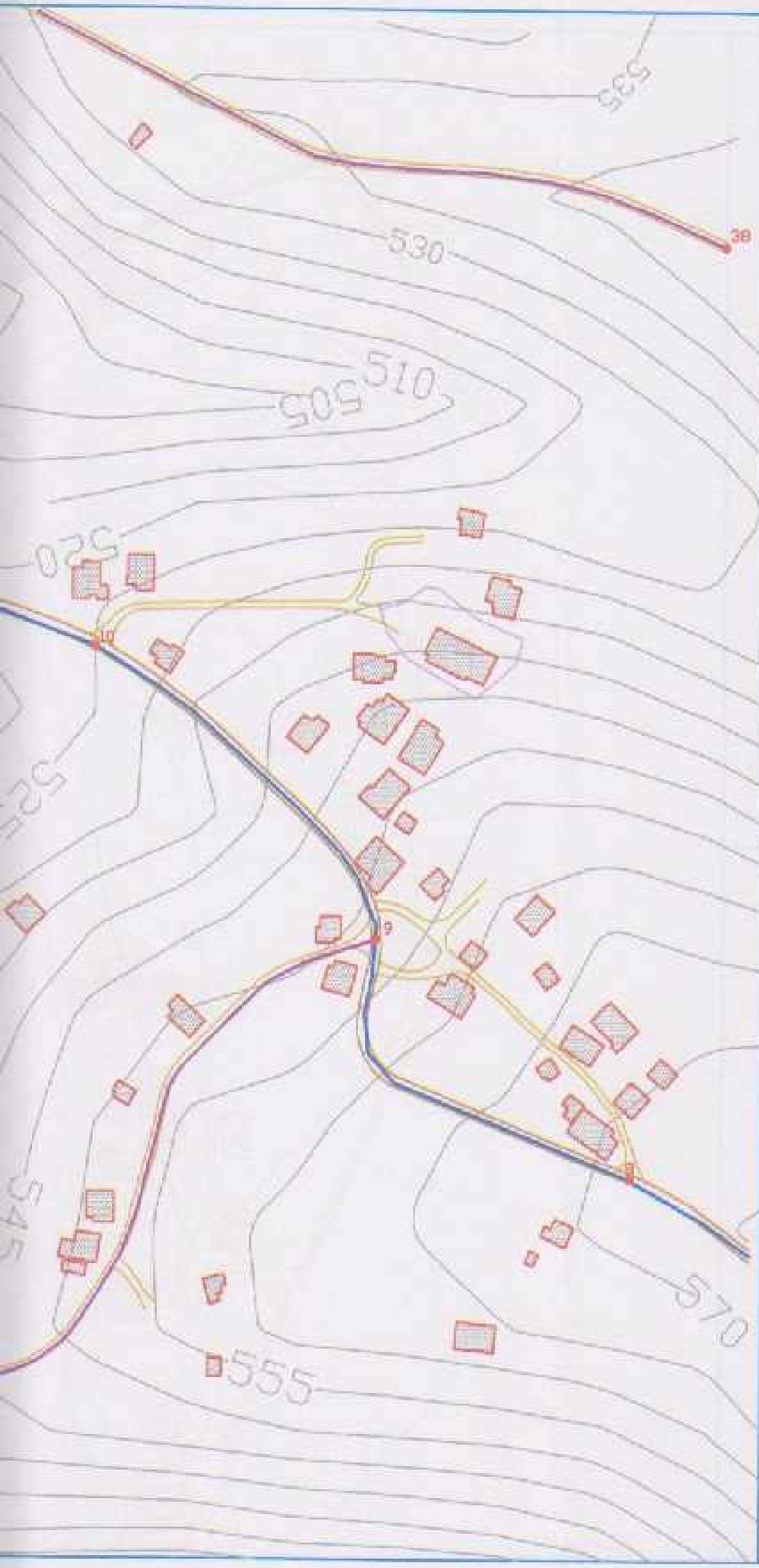
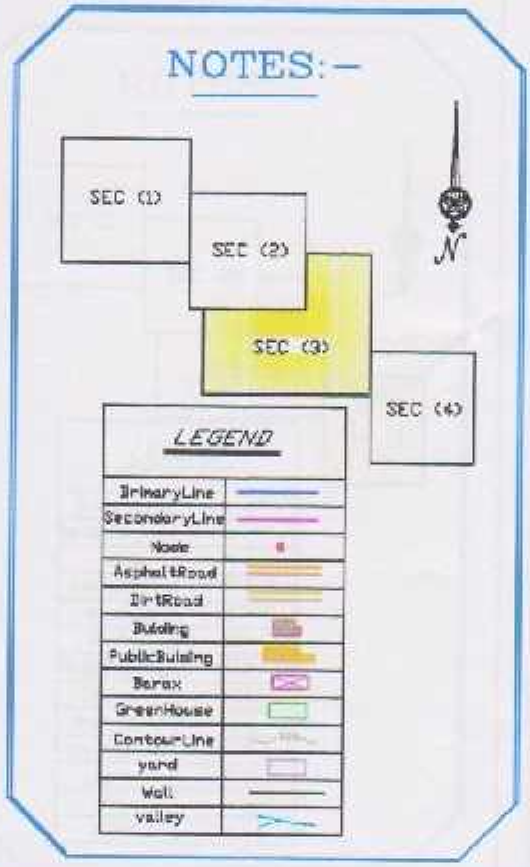
510
40
469.89
37
505
490
41
13
42
490
475
12
510





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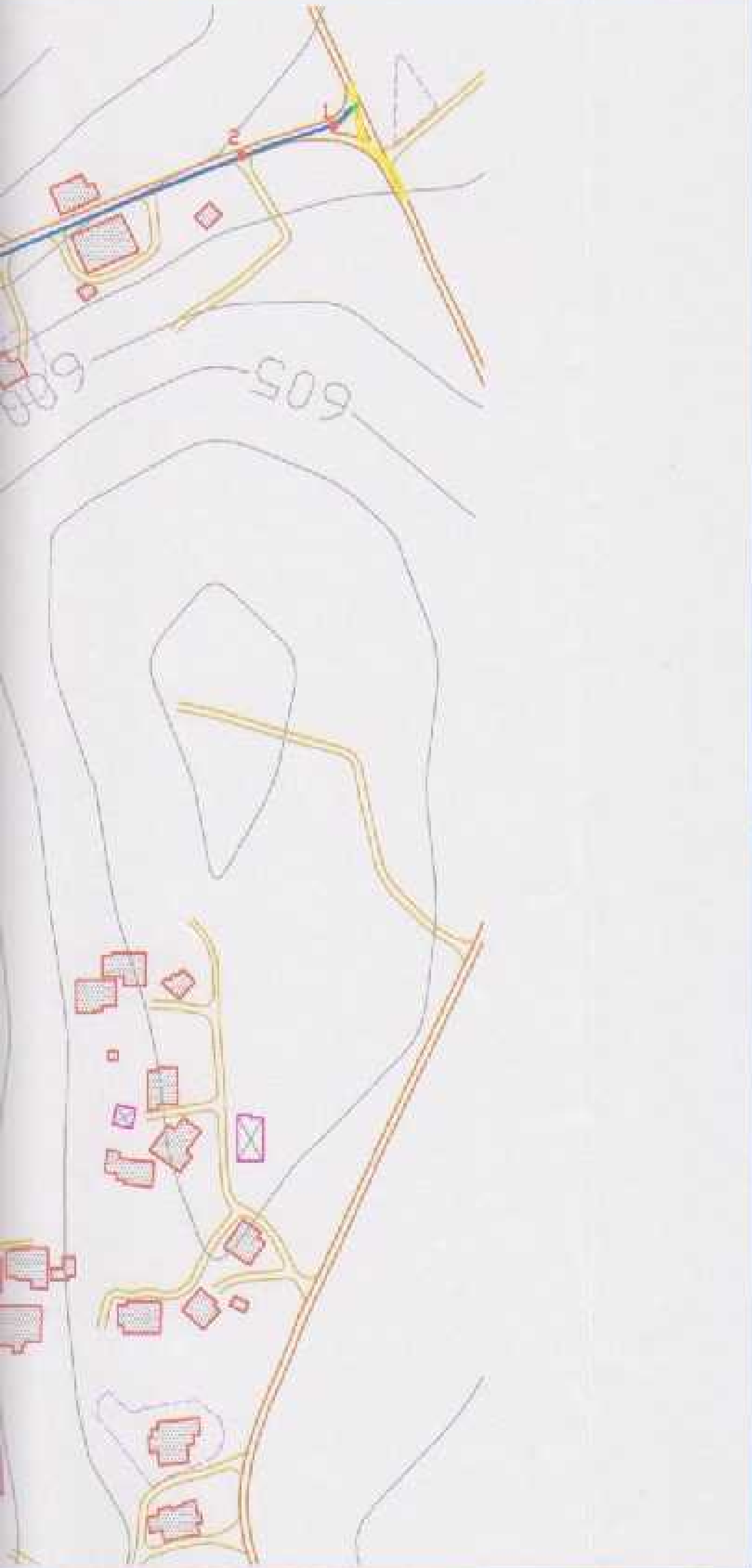
CLIENT :
Al Burj Village Council

JOP TITLE :
Topographical map for Al BURJ VILLAGE

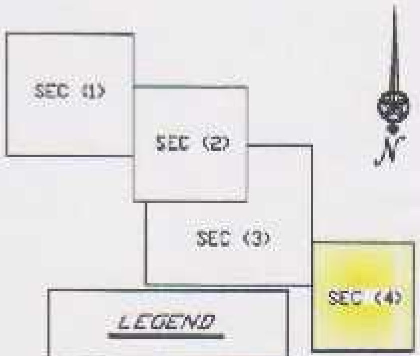
DRAWING TITLE :
The Proposed Water Distribution Network

DATE : JUNE. 2008
SCALE : 1:10000
FIGURE: 4.8.c

SEC (3)



NOTES:-



LEGEND	
BrimaryLine	
SecondaryLine	
Node	+
AsphaltRoad	
DirtRoad	
Bulding	
PublicBulding	
Barax	
GreenHouse	
ContourLine	
yard	
Wall	
valley	

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DESIGNED BY : HADEEL BADRAN
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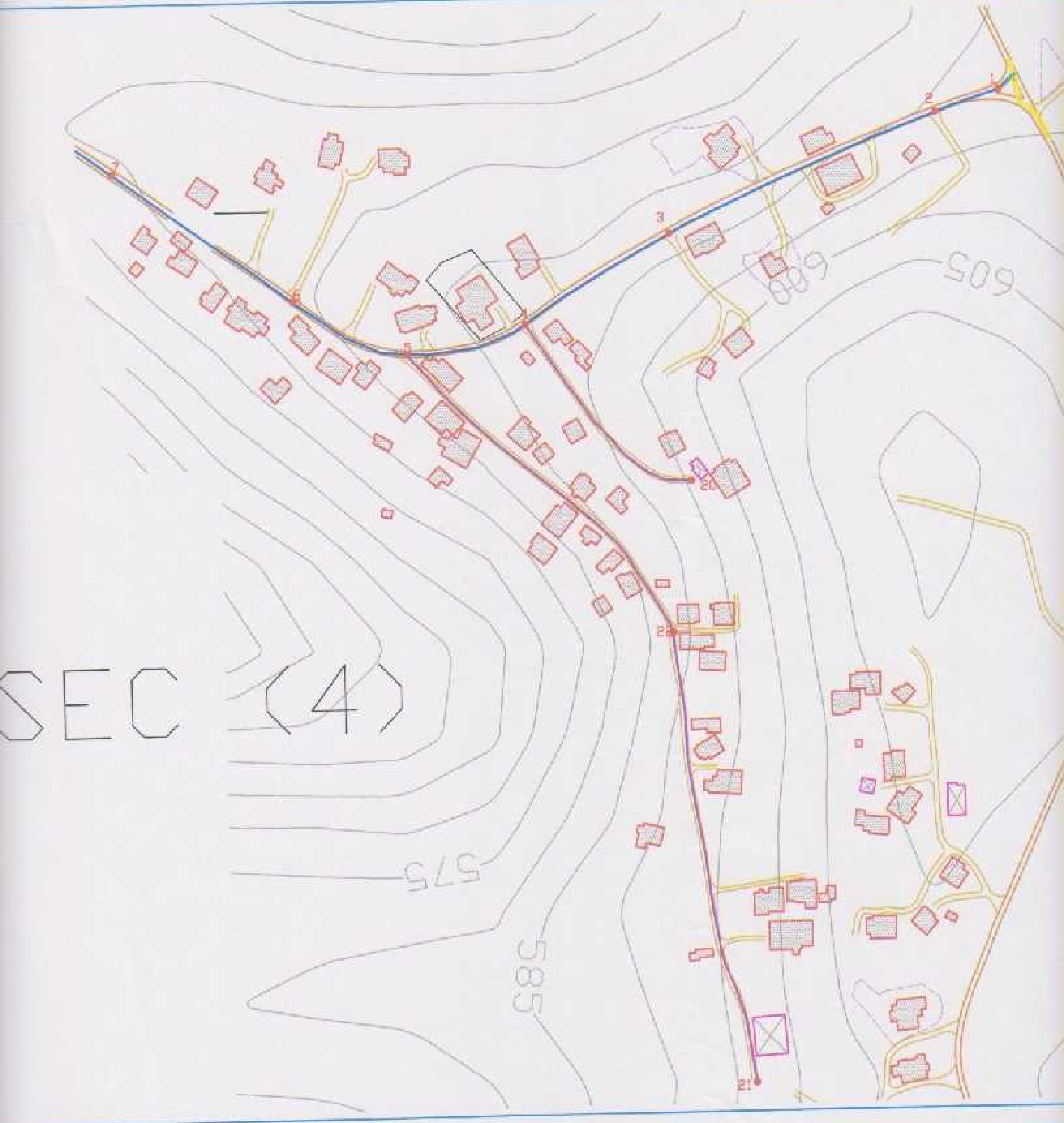
SUPERVISER :
Eng. Imad Al-Zeer

CLIENT :
Al Burj Village Council

JOP TITLE :
Topographical map for Al BURJ VILLAGE

DRAWING TITLE :
The Proposed Water Distribution Network

DATE : JUNE 2008 SCALE : 1:10000	FIGURE: 4.3.d


SEC (4)
605
575
585
20
21

4.5 SUMMARY

In this chapter, the proposed water distribution network for Al Burj Village has been studied and evaluated. The result of calculation necessary for the network design have been given and discussed.

CHAPTER FIVE

BILL OF QUANTITIES

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BILL OF QUANTITIES

FOR THE PROPOSED WATER DISTRIBUTION NETWORKS

Item	*Description*	*Unit*	*Qty.*	*Unit price*		*Total*	
				US$	*cent*	*US$*	*cent*
1. Earth works *General*							
a.	*Unit prices of all items of earth works shall include cleaning the site from all surplus backfill materials or result of excavation, restoring the area and public or private property damaged by his work to a condition at least equal to that existing prior to the beginning of operation , repairing of concrete or stone walls, concrete or asphalted yards, edges of asphalted roads, side walks ,existing water and sewage pipes, electric and telephone cables, cess pools ,cisterns, etc.. that will be damaged due to the execution.*						
b.	*Asphalt cutting machine must be used in excavation at asphalted areas.*						
1.1	*Excavation of pipe trenches for laying 4" inch diameter steel pipe . Depth of trench is not less than 110cm and width at bottom is not less than 70cm.Unit price includes excavating in all classes of soil .Whether hard(rock) or soft or in asphalted surfaces.*	*LM*	*5060*				
1.2	*Excavation for the valve chambers. Unit prices to be applicable on hard(rock)or soft soil and asphalted surfaces.*	*M^3*	*8*				

1.3	*Soft backfilling :lowering the 4" inch pipe inside the trench mentioned above in item 1.1 ,supporting pipes on sandbags each 10m,and sand backfill around pipes with a minimum of 15cm below the pipe and 20cm over the upper tangent of the pipe and shall be watered and performed for all the width of trench.* *Final backfill layer for the rest of the trench shall be of suitable selected backfill material approved by the Engineer and includes leveling and compacting. If the excavated material from the trench is not suitable to be used as backfill material or it contains more than 25%by volume stones bigger than 10cm in dimension, the Contractor shall replace it with suitable backfill material at his own expense.*	*LM*	*5060*				
Item	***Description***	***Unit***	***Qty.***	***Unit price***		***Total***	
				US$	***cent***	***US$***	***cent***
1.4	*Ditto ,but where pipe line of 4" diameter crosses or passes underneath asphalted roads, the final backfill over the sand surround shall be done with kurkar or base course. Placed in layers not exceeding 20cm after compaction, wetted as necessary and compacted to 95% of the modified AASHO density, The result of the excavation shall be transported and spreaded in layers at places chosen by the contractor at his own cost.*	*LM*	*1639*				
	Total of Earth Works						

Item	Description	Unit	Qty.	Unit price		Total	
				US$	cent	US$	cent
2. *Pipe Installation Works*							
2.1	*Stringing along the alignment and welding of 4" diameter, 5/32"wall thickness steel pipes. Lined from inside with cement concrete lining and extruded polyethylene outside coating. Unit price includes shaping and welding of elbows and tees, welding of 2" coupling with plug as directed by the Engineer on the distributing mains. Pipe outside coating shall be inspected and all welded joints, fittings and defects must be cleaned, heated and coated by applying the shrinkable tape. X-pando paste shall be applied to the inside of all joints before welding. Pipe lines shall be connected to the existing lines from both sides, and to the existing water tanks, if needed.*	LM	5060				
2.2	*Welding and installation of 4" gate valve with dresser coupling.*	No.	6				
2.3	*Installation of 2" air valve connection.*	No.	2				
	Total of Pipe Installation Works						

Item	Description	Unit	Qty.	Unit price		Total	
				US$	cent	US$	cent
3. Miscellaneous Works							
3.1	*Casting in-situ the valve chambers by using concrete B-200 .The unit price includes supplying and placing of the reinforcement, supplying, painting and fixing of vent pipes and steel steps ,Manhole covers and frames must be painted, placed and fixed to roof, and placing a layer of 20cm coarse gravel at the bottom of the manholes.*	M^3	8				
3.2	*Casting in situ concrete B-200 in certain areas(raods crossing,pipe encasement…,etc..)and at other places requested by the Engineer.*	M^3	1				
3.3	*Flushing, washing, disinfection, cleaning and performing pressure test for each of the executed pipe lines. the pressure will be raised by means of special pressure pump which shall be supplied by the contractor with all pressure gauges .Test pressure will 1.5 times the working pressure .All the prices of water needed for the job will be deducted from the account of the contractor if it is supplied by the Employer.*	Lump.	sum				
	Total of Miscellaneous Works						

Item	Description	Unit	Qty.	Unit price		Total	
				US$	cent	US$	cent
4.Supplying of Fittings All fittings and accessories to be supplied must be new and not used or renewed ,with "Techen" stamp on each.							
4.1	Supply of 4" gate valve for 16 atm working pressure complete with compaction flanges, gaskets , bolts and nuts ,product of Rafael ,model T-4001 or similar.	No.	2				
4.2	Supply of 2" compound air valve for 16 atm working pressure .Product of ARI ,Model D-030 or similar (with 2" valve).	No.	2				
4.3	Supply of 4" dresser coupling with 2 tie rods 60cm X 3/4"with nuts and 4 ears for each dresser .Product of Krous or similar.	No.					
4.4	Supply of 4" X 90 degree black steel elbow suitable for welding schedule 40 and lined with cement mortar from inside.	No.	10				
4.5	Supply of 4" X 45 degree black steel elbow suitable for welding schedule 40 and lined with cement mortar.	No.	4				
4.6	Supply of 6"-4" black steel reducer ,schedule 40,lined with cement mortar from inside.	No.	6				
4.7	Supply of 4" flange with companion blind flange ,gasket , bolts and nuts..	No.	2				
4.8	Supply of heavy duty cast iron cover with frame, weight not less than 100kg.,diameter of opening 55cm.	No.	2				
4.9	Supply of 4" Steel T sch 40 lined with cement mortar from inside.	No.	2				
Total of Supplying of Fittings							

Item	Description	Unit	Qty.	Unit price		Total	
				US$	cent	US$	cent
5. Supplying of pipes Supplying ,transporting ,unloading at site ,the following pipes ,all to be new and "Techen" stamped.							
5.1	*4" pressure steel pipes ,5/32" wall thickness ,with colloidal concrete lining from inside, and a layer of PE applied by the extrusion method 1.5 mm thickness wrapping from outside.* *Length of each pipe=12.2m with the Techen certificate for the production of the pipes themselves coating and the lining according to AWWA-C202 standard or other similar standards.*	LM	5060				
5.2	*Supply of shrinkable tape rolls 10 cm wide x 10 meters long each roll.*	No.	10				
	Total of Supplying of Pipes						

AL Burj Village Water Supply and Distribution Lines

BUDGET

Item	*Description*	*Price US $*
1.	*Earth Works*	
2.	*Installation of Pipes and Accessories*	
3.	*Miscellaneous Works*	
4.	*Supplying of Fittings*	
5.	*Supplying of Pipes*	
Total of all works		

CHAPTER SIX

CONCLUSIONS

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CONCLUSIONS

In this project, the proposed water distribution network in Al Burj Village has been studied and evaluated. The trial is also made to design the village network for year 2032. It is also brought out many important conclusions. The main conclusions drawn from the present study are summarized below:

1. Restrictions on the Palestinian use of the annual ground water resources of the West Bank led to limited quantities of water supplied to the village and due to this condition the average consumption of water in the village in general is very low and does not represent the present actual demand of water.

2. The present population of Al Burj village is around 3000 person. Prediction of the future population of Al Burj village is very difficult due the political uncertainties. The rate of population growth is taken as 3.6%.

3. The socio-economic survey shows that the total water demand for domestic use in the village for year 2007 is around 98700 cubic meter per year, 146899 cubic meter per year for year 2015, and 347171 cubic meter per year for year 2032, which means that water demand will be around four times the present quantity in year 2032 which is possible to arrange from our natural resources.

4. The length of the Proposed Network is 5060m, diameters of pipes in this network are divided into three sizes: 4" for 18 pipes, 2" for 18 pipes, 1" for 12 pipes.

5. Water source is available from the Water Authority.

6. In the future creation of a section within the waters of the village council to oversee the implementation of the water system and provide engineers, technicians and workers and equipment to maintain the sustainability of the network.

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REFERENCES

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