THE UNIVERSITY OF ZAMBIA

SCHOOL OF NATURAL SCIENCES

DEPARTMENT OF GEOGRAPHY

G421: RESEARCH PROJECT REPORT

TITLE: URBAN WATER SUPPLY AND UTILIZATION: A CASE STUDY OF WUSAKILE TOWNSHIP, KITWE

BY

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A RESEARCH PROJECT REPORT SUBMITTED TO THE GEOGRAPHY DEPARTMENT IN PARTIAL FULFILMENT OF THE BACHELOR OF ARTS DEGREE WITH EDUCATION

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DEDICATION

To my family for all their support both materially and being my source of inspiration. May the Lord bless you all.

ACKNOWLEDGEMENT

I am deeply indebted to the following people who helped in the production of this report: Mr Masialeti who supervised my work from the proposal stage up to the time this report was compiled. I appreciate his guidance and encouragement. The members of staff who encouraged me to work hard especially Dr.Mulenga. The members of cartographic office for guidance when I was drawing maps. My mother for all the love and support in all possible ways. My sister Chibwe for helping me during data collection. Mr Wakalala, from ZCCM, who did his best to make my research successful by providing all the relevant data and other officials from ZCCM who helped me.

I would like to thank also my pals for being a source of joy and encouragement. These are Mwaice, Fred, NGO, Baby, Tara, Toyota. Sr Kay, Mr Faulty and many others. Lastly my sincere gratitude to my beloved friend Noah for the love, support, encouragement and for typing and editing my work.

DECLARATION

" I **FLORENCE CHEMBO SIMWINGA** declares that this project has been composed by me and that the work recorded is my own. All maps and diagrams were drawn by me. All quotations have been appropriately acknowledged. The source of material have been specifically acknowledged and the project has not been previously submitted for any academic award."

Signature ....F.C.Simwinga.....

FLORENCE CHEMBO SIMWINGA

Date ....04/10/.95.....

ABSTRACT

Studies of urban water supply are essential. A modern city can barely survive without adequate piped water because alternative sources are unreliable.

The research assessed water supply and utilization in Wusakile. The emphasis was placed on adequacy, availability of water to users and problems faced in supplying water.

Water to Wusakile is supplied by ZCCM, Nkana Division. The source of this water is the Kafue river. The findings showed that water supplied was for domestic and non-domestic purposes. About 90 percent of the supply was for domestic and the 10 percent for non-domestic. Water for domestic purposes was adequate while that for non-domestic was inadequate.

Water was not readily available because of intermittent supply and low pressure. To cope with the problems domestic users store water, draw water and limit activities. These measures have proved successful but are quite inconveniencing.

The problem of water supply is not yet critical since water can be supplied quite adequately. The main problems are low pressure and intermittent supply. Others are burst pipes and few communal taps. Causes of these problems include aging water infrastructure, communal taps and toilets, seasons, location and financial difficulties.

ZCCM is aware of these problems and projects to tackle

them are under way to be implemented when funds are available.

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LIST OF ABBREVIATIONS

ADB -- African Development Bank

CMI -- Chr Michelsen Institute

CSO -- Central Statistical Office

ECD -- Environmental Control Department

GRZ -- Government of the Republic of Zambia

MITS -- Mining Industry Technical Services

NCDP -- National Commission for Development Planning

NRDC ---Natural Resources Development College

UN ---- United Nations

SC -- Special Commission

UNZA -- University of Zambia

WHO --- World Health Organization

ZCCM -- Zambia Consolidated Copper Mines

CHAPTER ONE

1.0.0 INTRODUCTION

1.1.0 BACKGROUND TO THE STUDY

In Zambia, various studies done on water supply tend to focus on urban areas. This is because water supply in urban areas has a couple of problem areas such as extraction, purification, distribution and shortages causing a lot of hardships to the community.

The government is quite aware of the water supply problem. Its overall objective in the provision of water is to ensure that there are permanent supplies of water of acceptable quality and adequate quantity to as many users as possible (GRZ, 1989). This objective is consistent with the UN Declaration on International Water Supply and Sanitation, 1981 to 1990. The target for Zambia is that, by the year 2000, all the urban population must have access to safe water and adequate facilities (GRZ, 1994). Currently it is estimated that only 43 percent of the urban population have access to safe water and sanitation facilities (GRZ 1990).

There are different institutions that provide water in the country and ZCCM is one of them. In Kitwe, ZCCM Nkana Division is responsible for supplying water to all mine residential areas and some council areas such as Ndeke.

The water is supplied to Wusakile by Nkana division.which has been supplying water since its establishment.

1.2.0 STATEMENT OF THE PROBLEM AND OBJECTIVE

This research investigates the water supply and utilization in Wusakile. Areas addressed include the adequacy of water supplied for domestic and non-domestic uses, its availability and problems affecting supply of water. The specific objectives are to:

(i) establish trends in water supply,

(ii) identify types of water users and how they use this resource,

(iii) identify factors that affect the level of water utilization and

(iv) identify the nature and extent of problems of water supply.

1.3.0 RATIONALE OF THE STUDY

The justification for this study lies in the importance of piped water supply for an urban community. Without a proper water supply system, the community faces hardships such as water shortages, walking long distances to fetch water and making dirty water sources as an alternative.

The paradox of urban water supply is that in one sense every one has water and in another most people do not have water (Feachem and Cairncross, 1983). It is vital to establish the water supply situation in Wusakile whether it is enough or not for most people in order to make appropriate recommendations. Such recommendations could help to improve the water supply.

Since water is supplied by ZCCM it is important to note the supply and utilization factors and see if there are problems. And since there is little literature on ZCCM activities outside the mine area, this research could form the basis for broader investigations and analysis. The findings and recommendations can be useful in improving water supply not only for ZCCM but also other institutions.

1.4.0 ORGANIZATION OF THE REPORT

The report consists of six chapters. Chapter one is the introduction, second is the literature review and the third is the description of the study area. The methodology and source of data are outlined in the fourth chapter, data presentation and discussion and analysis in the fifth chapter and conclusion and recommendations in the sixth.

CHAPTER TWO

2.0.0 LITERATURE REVIEW

Water is necessary for all living things, man inclusive. Quite a number of factors affect its supply and utilization. This chapter reviews some aspects related to the urban water supply and utilization.

2.1.0 AN OVERVIEW OF WATER SUPPLY AND UTILIZATION IN ZAMBIA

Most urban areas in Zambia today, it is argued, do not have efficient water supply systems. Most cities have water supply systems that are over worked and are operating above design capacity resulting in poor quality of the service (Carruthers, 1973). In Zambia, only about 43 percent of the urban population is supplied with adequate water and sanitation facilities (GRZ, 1994). This is due to the poor water supply failing to cope with demand.

The inadequate water supply as a problem is well noted by the government. The immediate focus by 1983 was the extension of water provision to 70 percent of the urban population (GRZ 1983). By 1989, the objective was to have permanent supplies of water of acceptable quality and adequate quantity to the all urban population by the year 2000 (GRZ, 1989).

There have been changes in pattern of water consumption which has affected the water supply. There has been increased demand for water by all category of users. Some factors which have led to increased demand include

rapidly growing urban population, improved standard of living and expanding non-domestic activities like industries and technological innovations (Leversedge, 1974). Increased demand while supply has lagged behind has adversely affected the urban population. The urban population experience hardships and diseases when water is inadequate because alternative water sources are absent, inadequate, distant, polluted or unreliable (Carruthers, 1973),

2.2.0 URBAN WATER SUPPLY

The process of water supply is quite complex. The objective of water supply is to provide safe water to all users in adequate quantity and make it readily available (Lanoix, 1959). The sources of water supplied is contained in the hydrological cycle. It is noted that fresh water constitutes only 0.65 percent of the total water. Fresh water in rivers and lakes constitutes 0.01 percent of total world supply and ground water makes up 0.64 percent (Pundon and Anderson, 1988). All water supplied for urban purposes is from the river or ground water sources.

Zambia has abundant water supply potential in the southern region to meet both short and long term requirements (GRZ, 1985). Despite this potential, water shortages will be experienced by the year 2000 if the growing demand due to increase in population and industrial pollution are not effectively controlled (GRZ, 1985).

As already noted, water supplied for urban purposes is

from rivers and underground water reserves. The source of fresh water available for supply is rainfall. Rainfall is received once in a year between the end of October and April. Annual rainfall varies from 1400 mm in the north to 700 mm in the south along the share of lake Kariba (Kasimona, 1993). Sources of water on the copperbelt is the Kafue river and its tributaries (SC 1960 and FAO 1968). The Kafue river feeds the copperbelt province with about 9090.9 million litre in wet years and 1210 million litres in dry years

2.2.1 **Distribution of Water**

The process of water distribution starts from the time water is extracted from the source to the time it reaches the user. The water extracted undergoes processes before it reaches the final user. The processes are sedimentation, flocculation, filtration and adding chemicals such as chlorine. These processes ensure that the water is adequately prepared for consumption. After treatment, the water is stored in reservoirs at various points before it reaches the consumers.

The distribution of water is not a straight process due to problems. These problems cause water supplied to be inadequate. The problems do not just affect consumers but also the engineers who are responsible. The major problem in distribution is the amount of water lost in the system which cause pressure to reduce and part of water may not reach all the areas. The following are some the factors

that lead to these problem:

(a) damaged public points cause water wastage through leaking taps,

(b) increased demand for water which often exceeds the capacity of the system,

(c) poor planning and construction of buildings over main supply lines make it impossible to carry out maintenance works,

(d) age of infrastructure can make it unreliable because of frequent breakdowns and

(e) funds to electrify problems are either inadequate or not available for most third world countries Feachem and Cairncross, 1988).

2.3.0 PROBLEMS OF WATER SUPPLY

There are numerous problem in supplying water. Causes of these problems vary from water source, distribution to consumption. World wide, the major problem identified is overburden water supply system. Climatic factors, affluence in the community, increasing population, rising water consumption and increasing waste disposal lead to overburdening of the system (Lanoix, 1959). In summary, the rate at which towns are growing increase demand for water and cause the system to be overburdened.

The problem of overburdening is universal but the magnitude differs. In Zambia, the problem is great and if nothing is done there would be an acute shortage of water. Conservationists have warned that a severe water shortage

looms by the year 2000 if this increased demand is left unchecked (GRZ, 1985).

The other problem is poor maintenance of the infrastructure. Maintenance is poor partially because of poor funding. Funds are insufficient for the day to day repair, maintenance and other costs. Since maintenance of infrastructure is a long term commitment but funds are usually unavailability. Many countries/institutions are left with the option to build a new system. The new systems have larger capabilities. But constructing the new systems is invalid if the capability to maintain and operate the them is lacking since the problems repeat (Feachem and Cairncross). In other instances, funds may be available but technical manpower would be missing or viable institutions to carry out the jobs of maintenance. In other situation it is difficult to acquire sophisticated equipment for spare parts and skilled manpower to install may not be easily available.

Another problem stems from unequal share between supplies and users in terms of water costs. Most of the users do not pay an economic price because the mechanism to assess the cost is absent or they use water illegally. Those who pay are few and their contribution is not substantial in relation to the total cost involved.

2.4.0 URBAN WATER SUPPLY MANAGEMENT

Water, like any other resource, must be managed effective to have a sustained water supply. Unfortunately

little is done about conservation of water.

> Everyday water is taken for granted and very little care is taken to conserve it. The importance of water is only realized when its not available or its in scarce quantities (GRZ, 1985; 54).

Water should be managed effectively to minimize problems such as shortages. The basic priorities in implementing management strategies are protection of water sources from pollution, introduction of loss detection surveys, law enforcement, regular inspection of customer service, effective metering of water used and early repairs of defects (CMI, 1986).

The success of management of programmes depends on participation of both the users and suppliers. The public should be made aware of the need to conserve water and to control consumption. Their compliance may reduce water shortages and hardships cause by inadequate water supply. The strategies which should be employed are those which reduce water wastage and unnecessary consumption.

Successful management of community education and technological aspects can lead to situation where users reduce their water while standard of the services remain the same but there is enough water for all users.

2.5.0 WATER UTILIZATION

2.5.1 Water Users and Water Usage

There are different users of water and ways of using water are uncountable. There are two types of users, domestic and trade users. Domestic users need water primarily for household purposes (cooking, washing) and others such as gardening and car washing. For trade, water is used in industries, business shops, offices and institutions (Twort, 1974).

The major ways of utilizing water are domestic or residential, industrial, commercial, electric power, public (municipal fire services) and irrigation. In Zambia, the major ways of using water include electricity production, drinking, industrial purposes and irrigation (Kasimona, 1993).

The research conducted in Adelaide metropolitan showed the following pattern of using water by different users (Driden, 1970):

User	Percentage
Industrial	20
Primary schools	4
Domestic premise	62
Hospital and other Institution	4

At domestic level, water was used in the following proportions:

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User	Percentage
Industrial	20
Primary schools	4
Domestic premise	62
Hospital and other Institution	4

At domestic level, water was used in the following proportions:

Usage	Percentage
Sanitation	20
gardening	70
Laundry & Miscellaneous	8

The use and quantity of water needed in trade depends on the type of industrial purposes. According to walker (1978), industries need water for four major activities: processing, cooling, boilers and portable water used in cafeterias, washrooms and for drinking.

In Zambia, data on consumption is either scanty or absent. Relatively there is information on domestic consumption than non-domestic consumption. The average consumption of water for domestic purposes is between 200 and 400 litres per person per day in large urban areas (Kasimona, 1993). Consumption of water in mine areas during colonial times was estimated by SC(1960) as:

Race	Quantity
Europeans	1909 litres /person/day
Advanced Africans	627 litres/person/day
Africa	227 litres/person/day

2.5.2 **Factors Affecting Water Utilization**

Consumption, like supply, is affected by some factors. These factors may either increase or decrease consumption. The volume of water is a factor of income and material wealth. Those with high incomes have access to large

amounts of safe water. Those in low income brackets may or may not have access to water (White, 1978). There are other factors affecting utilization of water. These were noted as:

(a) physical limitation of the distribution system,
(b) nature of supply; street stand pipes or individual house connections, continuous or intermittent supply,
(c) extent of leakage and
(d) amount users are called upon to pay for water (Twort, 1974).

In additional to the outlined factors, other factors that affect consumption in Kitwe are gardening and metering (ADB, 1977). Gardening increases consumption in the dry season since demand for water is high and rain to supplement is not available. Meters on consumer services measure consumption as well as cost of water used. The meter ensures that there is economic use of water and the cost of supplying water is checked proportional among interest groups. But few consumer services are metered and some have broken down, making it difficult to assess the appropriate cost of water used. As a result most people pay minimum charge as part of rent or not pay at all while they continue use water without restrictions.

CHAPTER THREE

3.0.0 LOCATION AND DESCRIPTION OF THE STUDY AREA

3.1.0 LOCATION

The study area is Wusakile township located in Kitwe town on the Copperbelt. The relative location of the study are is shown on the map (figure 1). The geographical position of the area is 12^0 51'S to 28^0 12'E (Topographic map No.1228C3).

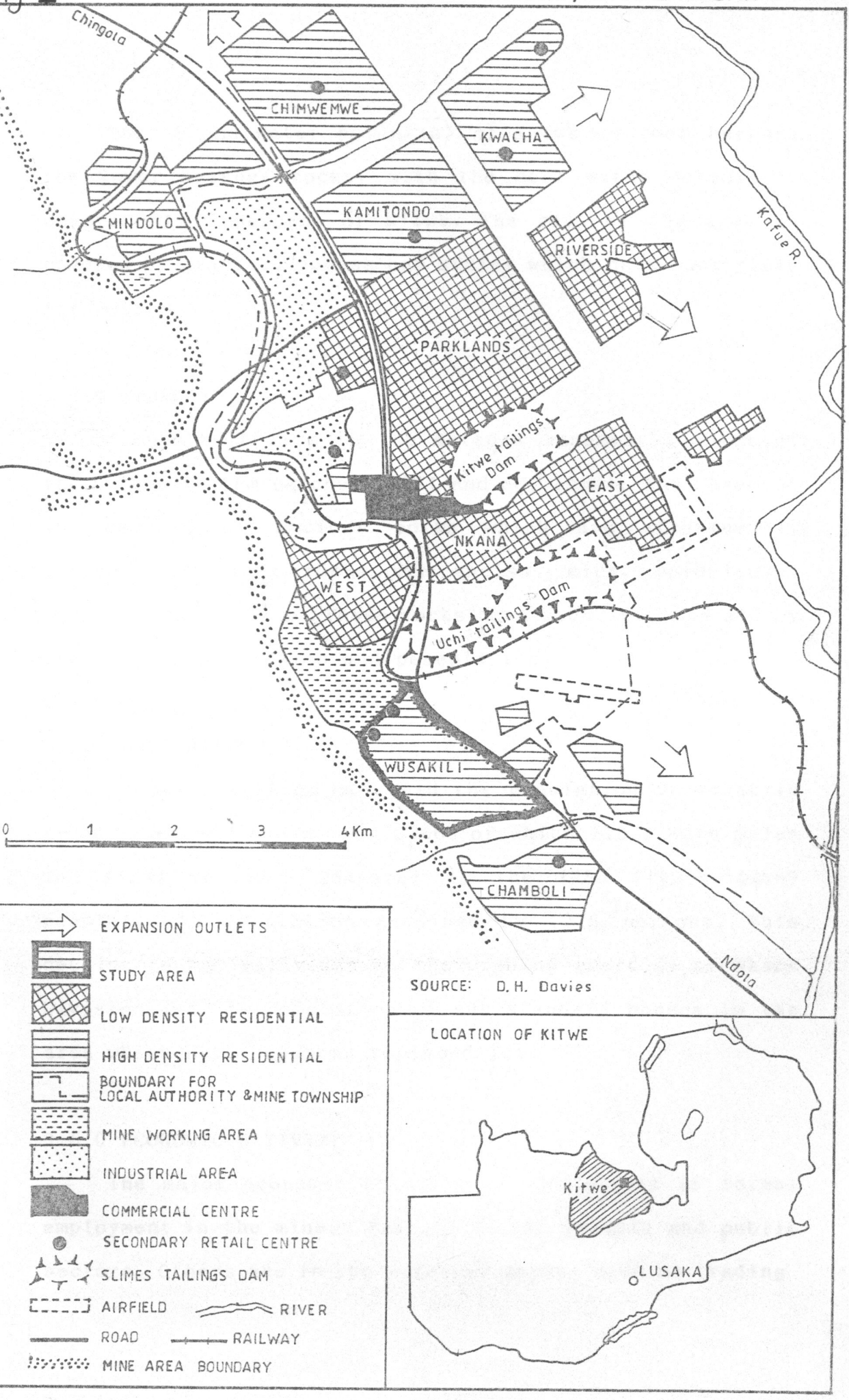
3.2.0 CLIMATE

The climate is described to have a cool dry, hot dry and hot wet seasons. Rains come in summer during the hot season which lasts from November to March. The mean annual rainfall for copperbelt between 1974 and 1983 was 1350 mm but experienced a decline 1984 to 1175 mm (MITS, 1984). It is predicted that this trend in rainfall is likely to continue (ECD, 1990). The mean temperature recorded range from 15^0C to 17.5^0C for winter months and 22.5^0C to 25^0C for summer months.

3.3.0 RELIEF AND DRAINAGE

Kitwe lies in a gentle sloping peneplain at an altitude of 1253 metres (SC, 1960). The area is undulating and dissected by the following rivers: Mwambashi, Mwambeshi and Luasobe which are tributaries of the Kafue river. The principal drainage is the Kafue river.

Fig 1 LOCATION OF WUSAKILE TOWNSHIP, KITWE URBAN



The ground water potential of Kitwe is poor because the lower Katanga rocks, with the best water potential, covers only 5 percent of Kitwe. The rest of the area is covered by granite, geness and schist which have poor yield for water.

3.4.0 GEOLOGY

Copperbelt lies in the Katanga basement complex of the Lufubu system (Archer, 1971 and SC, 1960). The basement is composed of ancient rocks which are structurally complex. The main rocks are gneiss, mica, hornblende, schist and quartzite. These rocks have been levelled off by the process of erosion and peneplation.

3.5.0 POPULATION

An official from CSO said the population of Wusakile as per the 1990 census was 23663 of which 12321 were males and 11324 females. Compared to the 1980 figure (24889 people), the population declined by 1226 persons. This decline is partially due to the pruning exercise at Nkana Division and the demolition of sub-standard houses in the area which have not been replaced yet.

3.6.0 ECONOMIC ACTIVITY

The major economic activity of the people is formal employment in the mines. Few are in the private and public sectors. Others are in the informal sector such as trading

3.7.0 BACKGROUND TO WUSAKILE AND ITS WATER SUPPLY

Wusakile township was established in the late 1920's after the mining operations began at SOB. It was built for labourers in the mine because of its proximity. Currently residents are the low and medium class workers from Nkana Division, Kalulushi Division, Nchanga house and subsidiaries of ZCCM.

Water is supplied by ZCCM to Wusakile township. The infrastructure used to supply water was installed in the 1960's. ZCCM supplies water because it is obligatory to provide incentives to workers. When the township was established it was assured to have adequate supply of water that time and in future (CS, 1960). Since then, little or nothing have been done in form of innovations or replacement of the infrastructure.

CHAPTER FOUR

4.0.0 METHODOLOGY AND DATA SOURCE

The chapter describes the methods and sources of data collected. Sources of data were the primary and secondary sources.

4.1.0 SAMPLE SIZE

The sample comprised 40 respondents. This sample size was viewed realistic since it was over the minimum considered of 30. It was also manageable to administer in terms of time and resources. The respondents represented the domestic and non-domestic water users and the supplier, ZCCM.

4.2.0 SAMPLING PROCEDURE

4.2.1 Domestic Users

A total of 25 respondents were picked randomly as domestic users. The random method was employed to give all domestic users an equal chance to be picked and thus get an unbiased sample. The respondents were picked with the help of a utilization map for Wusakile or the Street Map.

The residential area is divided into section A, B, C, D, E, F, T and XC as shown in figure 2. Sections have similarities in terms of water supply. Sections A, B, C and D are supplied with water from communal taps. There were 3 respondents from each section and 12 in all since the area

represented the highest number of households (5440).

Section E, F and T only have water taps outside the house. In this category, 3 respondents were picked to represent each section bringing the total to 9. Section XC is supplied with water from taps both inside and outside the house. There were 4 respondents to represent this category.

The sections are divided into subsections or roads. For example section A is divided into subsections A_1 to A_7 while section XC is divided into A, B, C or D road. The respondents were only picked from one subsection or road marked randomly. Also individual households were picked randomly from each subsection or road.

4.2.2 Non-domestic Users

The respondents were picked purposefully so that there was a wide representation of institutions. There were three types of categories: ZCCM, public and private sector respondents. An institution was selected based on the nature of activities It does or the frequency of occurrence. The table 1 below shows the institutions picked and the class to which they belong.

Table 1. Number of Sampled Institutions

Class	Institution	Total
ZCCM	Library, Hospital, Mine Club, Stadium, Women's club	5
Public	Market, School, Church	3
Private	Bakery, Hair salon, Bar, Grocery	4
Total		12

Source: Utilization Map

There were 12 respondents in the sample for non-domestic water users.

4.2.3 ZCCM

There were 3 respondents who were picked purposefully for water supply. The sample size constituted 3 respondent because water is supplied at 3 levels. Therefore, interviewing all of them meant that the supply aspect was adequately covered. The levels of water supply are:

(a) extraction of water from the river, treatment and distribution up to the main reservoir,
(b) distribution from reservoir to feeder pipes and
(c) distribution from feeder pipes to individual water users

4.3.0 QUESTIONNAIRE

Two types of questionnaire were used to collect the information on water supply and consumption. The questionnaire (Appendix II) was used to collect data from domestic category and questionnaire (Appendix III) for the non-domestic category. For both questionnaires, the head of the household or institution was interviewed but in the absence of this person the immediate or spouse was interviewed. The type of data collected included:

(a) water supply situation,

(b) level of consumption and

(c) factors that affect consumption.

4.4.0 INTERVIEW

Unstructured interviews (Appendix IV) were held with the following ZCCM officials: Head for Electrical Engineering Services and Township Maintenance. Foreman for Water services, Wusakile. The aim of the interview was to obtain data on the following:

(a) source of water supplied,

(b) consumption of water and

(c) problems in water supply.

4.5.0 FIELD OBSERVATION

The exercise of field observation was meant to cross check some problems which were cited by both supplies and domestic users. Some aspects observed included: crowding at communal stand taps and toilets, number of running taps and

broken taps.

4.6.0 SECONDARY DATA

The source of secondary data included UNZA, ZCCM, NRDC and CSO libraries. Other sources were discussions with friends and lecturers. Utilization map for Wusakile/Street map was used to sample points.

4.7.0 DATA PRESENTATION AND ANALYSIS

The data is presented in form of tables containing frequencies. Most of the information is qualitative and no test has been used.

4.8.0 DATA LIMITATIONS

Some of the problems encountered in data collection were the following:

(a) It was difficult to get permission from ZCCM community Services to conduct a research in Wusakile township. It was impossible to obtain statistics on consumption of water for different categories and amount of water supplied from ZCCM, officially. It was also impossible to get detailed latest utilization map of Wusakile because the person in charge could not give it away. Instead the one provided as figure 2 was compiled from an old map of the layout of Wusakile in 1972 and the Street map of Kitwe.

(b) The information obtained was mainly qualitative because respondents failed to give quantitative data in reference to the following questions:

Q9 ii- APPENDIX II. Amount of money paid for water.

Q5 - APPENDIX III, Q10 and Q13 APPENDIX IV). The level of consumption.

Q4 - APPENDIX IV. Amount of water supplied.

Q5 - APPENDIX IV. Population statistics.

Q8 - APPENDIX II was not asked since it could not be answered in the pilot survey.

CHAPTER FIVE

5.0.0 DATA PRESENTATION AND DISCUSSION

This chapter presents the results from the field and discusses them in relation to the objectives.

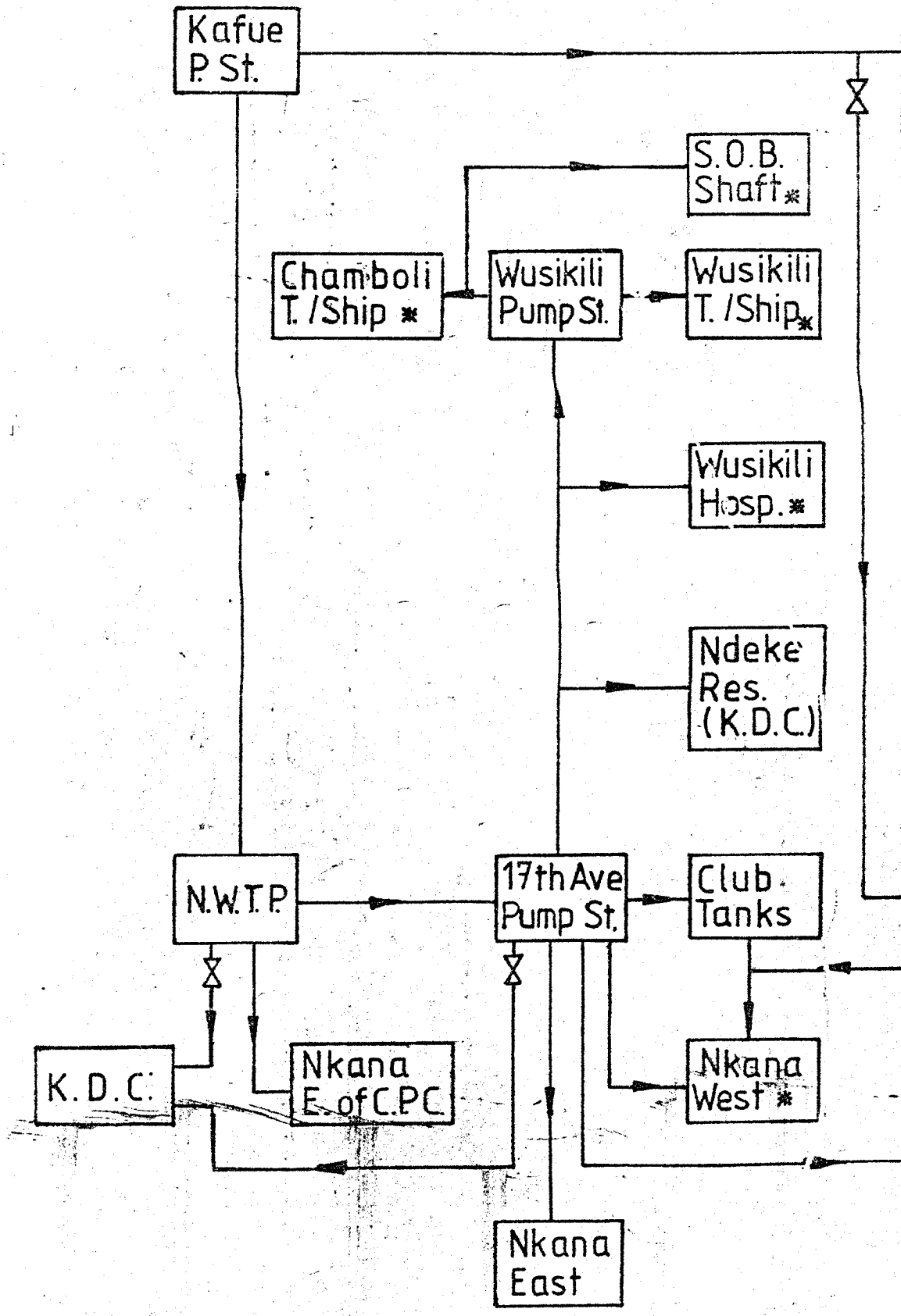
5.1.0 WATER SUPPLY

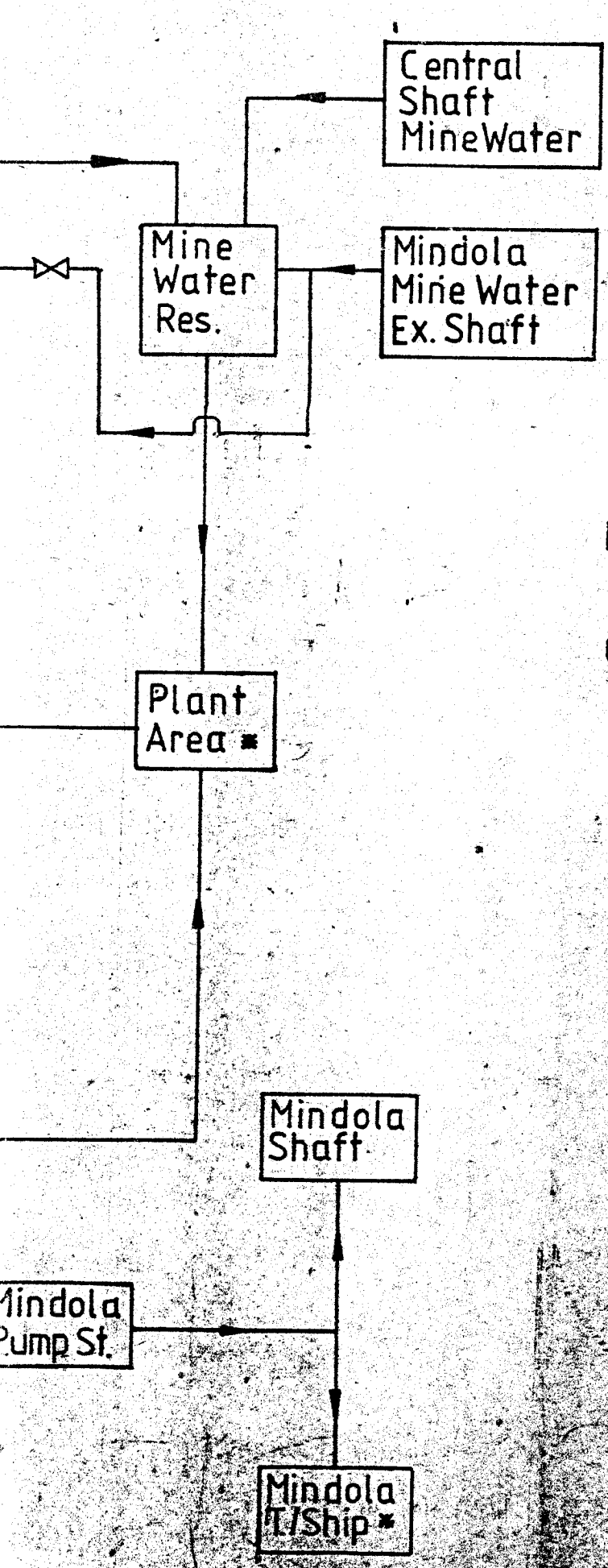
5.1.1 General: Supply of Treated Water

Water to Wusakile township is supplied by ZCCM. The two departments responsible are the electrical engineering services and maintenance departments. The electrical engineering services' major responsibility is to run all pumps of the water supply system. Its specific responsibilities include water extraction from the river, sedimentation, filtration, back washing and purification. In addition, it distributes water up to respective reservoir. The maintenance department is in charge of water distribution from feeder lines into individual pipes. It also services users' water appliances to ensure that they are good conditions. Due to differences in priorities between these departments water distribution is sometimes a problem. For instance, lack of maintenance of pipes by the maintenance department hinder the water supply and thus end users suffer.

The figures 3 and 4 show water reticulation system of Nkana division. The water moves from the source, the Kafue river, to the treatment plant through the booster pump at

Fig 3


Kafue P. St.
S.O.B. Shaft *
Chamboli T. /Ship *
Wusikili Pump St.
Wusikili T. /Ship *
Wusikili Hosp. *
Ndeke Res. (K.D.C.)
N.W.T.P.
17th Ave Pump St.
Club Tanks
K.D.C.
Nkana E. of C.P.C.
Nkana West *
Nkana East



Valves Normally
Open Only On De

N.W.T.P New Water Treat
Plant. (Kafue)

O.W.T.P Old Water Treat
Plant (Plant Are

K.D.C. Kitwe District C

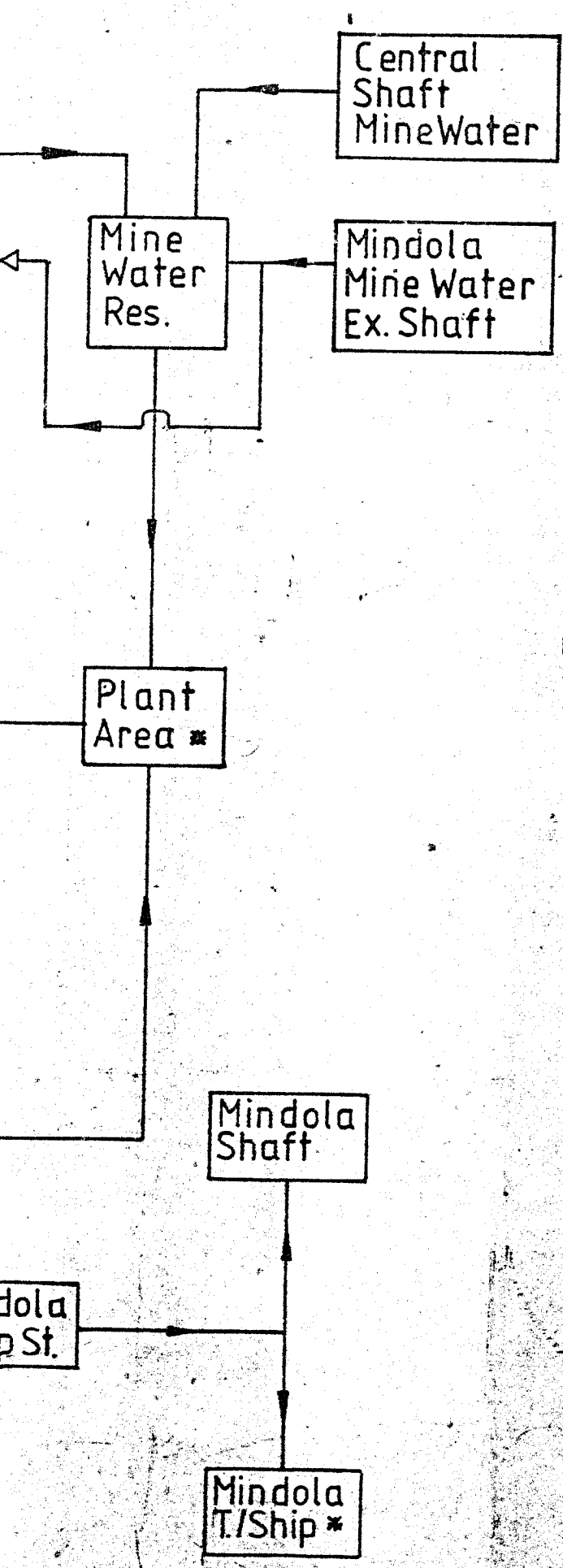
* Nkana Division
Responsible For
Pipe Maintenanc

K.D.C. Is Respor
For Domestic Su
Maintenance In
Other Areas Ex
Mindola North

General Wate

Flow Diagra

RC 37858 Drg



Valves Normally Closed. Open Only On Demand

N.W.T.P New Water Treatment Plant. (Kafue)

O.W.T.P Old Water Treatment Plant (Plant Area)

K.D.C. Kitwe District Council.

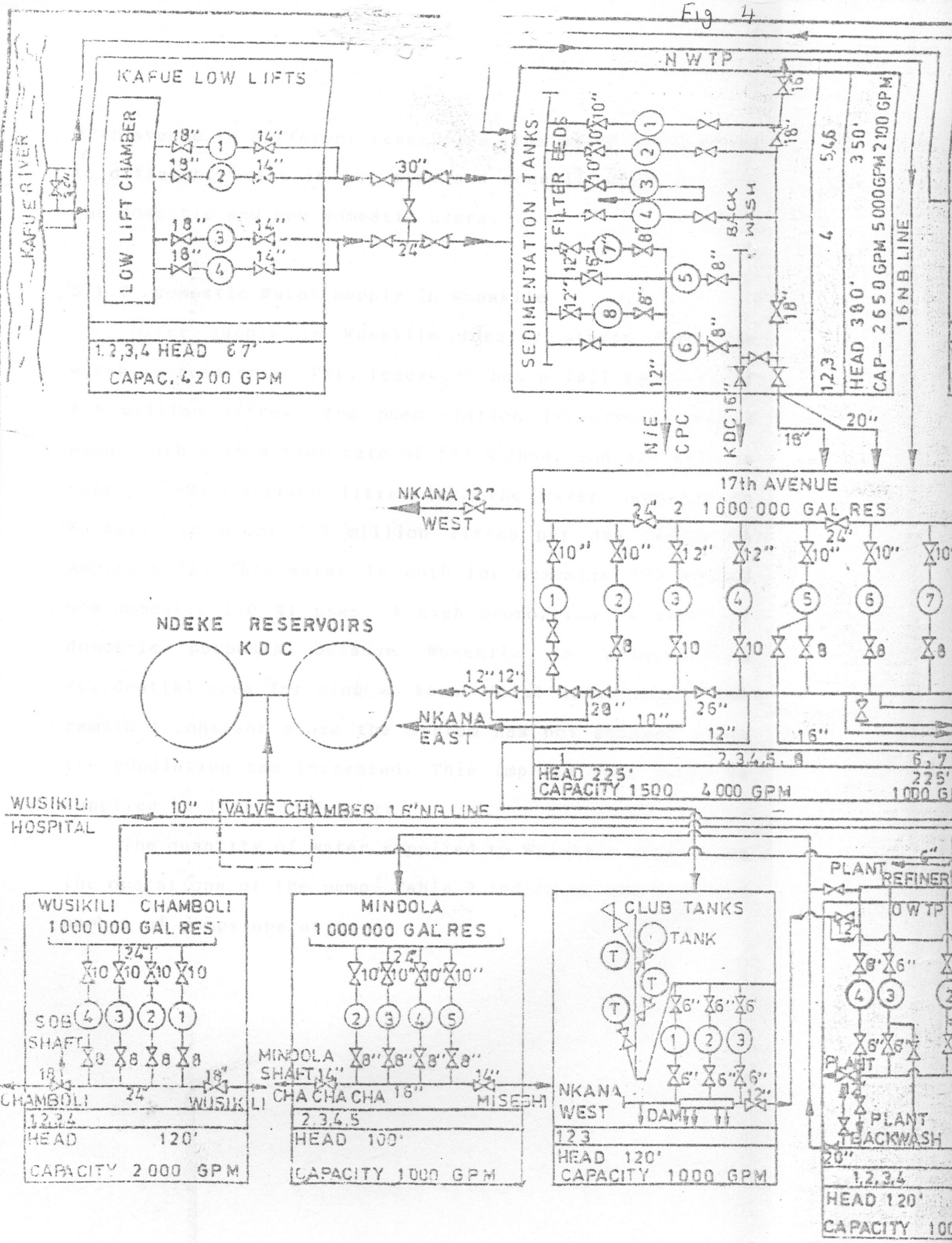
* Nkana Division Is Fully Responsible For Pumping & Pipe Maintenance.

K.D.C. Is Responsible For Domestic Supply Pipe Maintenance In All Other Areas Except Mindola North.

General Water Flow Diagram

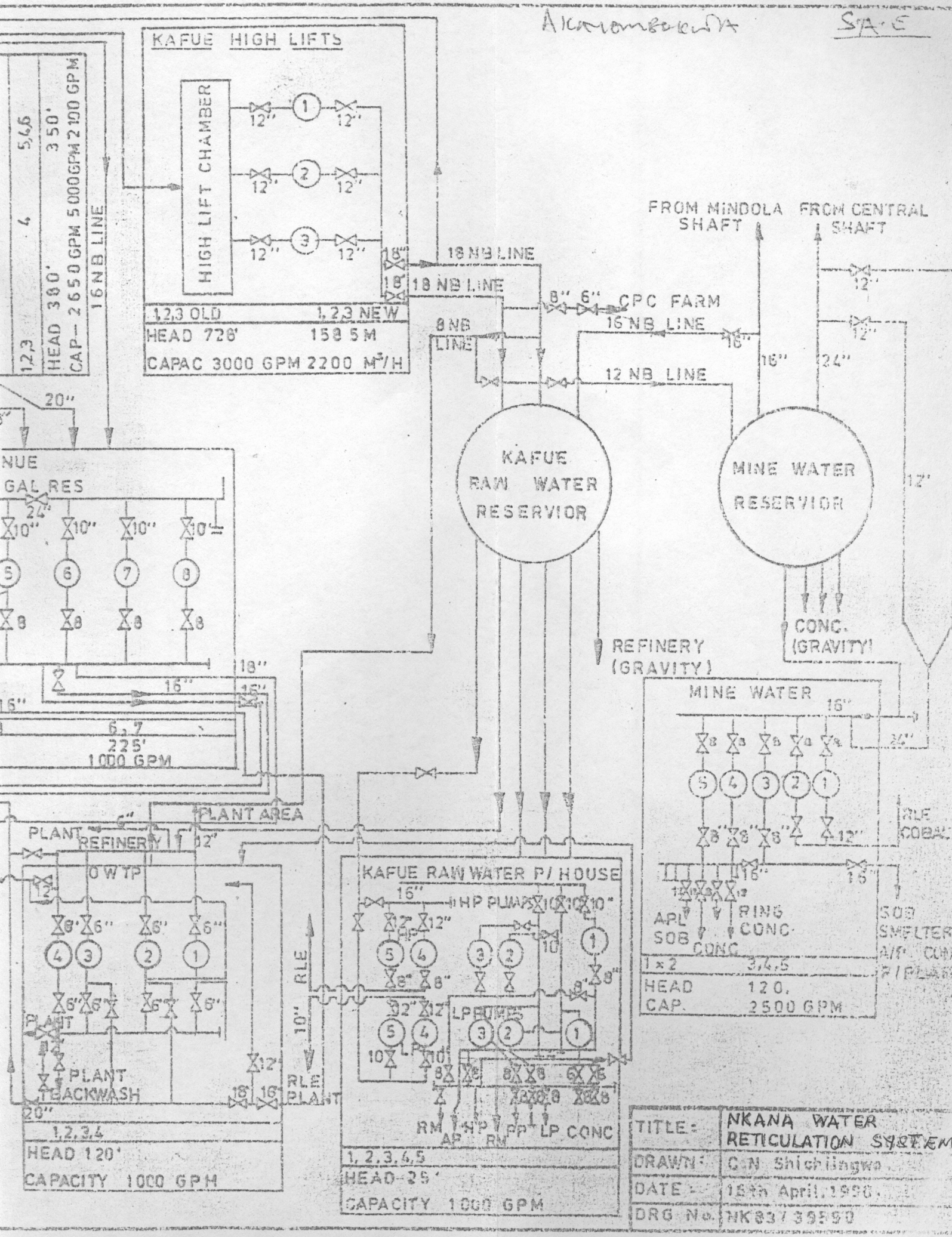
RC 37858 Drg. No

Fig 4


KAFUE LOW LIFTS
KAFUE RIVER
LOW LIFT CHAMBER
1,2,3,4 HEAD 67'
CAPAC. 4200 GPM
NWTP
SEDIMENTATION TANKS
FILTER BEDS
BACK WASH
HEAD 380'
CAP — 2650 GPM 5000GPM 2100 GPM
16 NB LINE
N/E
CPC
KDC
17th AVENUE
2 1000 000 GAL RES
NKANA 12" WEST
NKANA EAST
NDEKE RESERVOIRS
KDC
HEAD 225'
CAPACITY 1500 4000 GPM
WUSIKILI HOSPITAL
VALVE CHAMBER 16"NB LINE
WUSIKILI CHAMBOLI
1000 000 GAL RES
SOB SHAFT
CHAMBOLI
WUSIKILI
HEAD 120'
CAPACITY 2000 GPM
MINDOLA
1000 000 GAL RES
MINDOLA SHAFT
CHA CHA CHA
MISESHI
HEAD 100'
CAPACITY 1000 GPM
CLUB TANKS
TANK
NKANA WEST
DAM
HEAD 120'
CAPACITY 1000 GPM
PLANT
REFINER
OWTP
PLANT BACKWASH
HEAD 120'
CAPACITY

Alternative A

S/A-E



TITLE:	NKANA WATER RETICULATION SYSTEM
DRAWN:	C.N Shichilingwa
DATE:	16th April, 1998.
DRG No.	NK837 39590

17th avenue to different reservoirs. The water is supplied to different users in the mine and council areas who are the domestic and non domestic users.

5.1.2 Domestic Water Supply in Wusakile

Water supply in Wusakile ideally starts from the wusakile reservoir. This reservoir has a full capacity of 4.5 million litres. The pump station (reservoir) has 2 pumps each with a flow rate of 543 M^3/hour and are able to supply 19.1 million litres/day. The water supplied to Wusakile is about 7.2 million litres per day (refer to Appendix I). This water is both for domestic (90 %) and non-domestic (10 %) uses. A high proportion is used for domestic purposes because Wusakile is primarily a residential area for mine workers. Total water supply has remained constant since the system has not changed while the population has increased. This implies less water is supplied to individual users.

The quantity of water supplied to Wusakile depends on the operations of the pump. Table 2 indicates the time and number of pumps operating.

17th avenue to different reservoirs. The water is supplied to different users in the mine and council areas who are the domestic and non domestic users.

5.1.2 Domestic Water Supply in Wusakile

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The quantity of water supplied to Wusakile depends on the operations of the pump. Table 2 indicates the time and number of pumps operating.

Table 2. Pumping Schedule

Time (Hour)	No. of Pumps Operating
04:00 - 17:00	2
17:00 - 22:00	1
22:00 - 24:00	2
24:00 - 03:00	0

Source: ZCCM, Nkana Division

The quantity of water supplied varies within the day due to variation in demand. Two pumps are used between 04:00 and 17:00 hours and also from 22:00 and 24:00 hours as these are the periods of high demand. There is a high demand from early morning until to late afternoon for domestic purposes (bathing, washing of clothes, cooking etc) by almost all the households, institutions such as schools and hospital. A lot of water is also needed from 22:00 hours to 24:00 hours as this is the time when some miners knock off. Between 17:00 and 22:00 hours only one pump is used as the demand is low. At this time most of the household work (cooking, washing etc) have already been done and institutions such as schools are closed. Water pressure is generally low and few areas get water. The usage of one pump was also justified technically (ZCCM) so that water may accumulate in the reservoir otherwise it may switch off after total water reaches 13880 litres. The water supply is cut off between 24:00 and 03:00 hours to

ensure the reservoir fills up for the next day.

The users are not aware of this schedule. They view cuts in water supply as routine but they do no know the duration of the cut in supply. If they are aware of this schedule, they could adapt appropriately and appreciate its importance.

ZCCM believes the pumping schedule is realistic as it ensures that they is supply to meet the demand. However, its not followed sometimes due to certain factors. For instance, the availability of water in the reservoirs to be pumped greatly depends on the extraction process and its supply from 17th Avenue. So in times of extraction problems the time schedule is not strictly adhered to.

Water is supplied to domestic users through communal or individual standing taps. Table 3 below shows the model of supply to domestic users. About 52 percent of the households receive water from communal taps and 48 percent from individual taps at their homes. The communal taps are

Table 3. Mode of Water Supply to Domestic Users

Mode	Number of Respondents	Percentage
Communal	13	52
Individual	12	48
Total	25	100

Source: Field data

associated with the low income group living in sub-standard houses, which is the majority, built during colonial times. Houses built after independence have individual taps whose number and position varies.

5.1.3 Non-domestic Water Supply

Non-domestic water supply is both treated and untreated type through individual taps. Treated water is more purified than untreated. The stages of the untreated water supply is shown in figures 3 and 4. The sources of this supply include the Kafue river, Central shaft and Mindolo underground mine. This source is quite reliable. The general usage of untreated water, supplied in larger quantities, include copper processing, back washing, fire fighting and watering the stadium and agricultural show grounds. These activities use a lot of water. The water supplied is adèquate.

The supply of treated water is the same as outlined for domestic supply. Only about 10 percent of treated water, representing 715312.5 litres/day, is supplied for non-domestic use to institutions such as schools and hospitals. This is because most institutions use water just for part of the day during work days. Despite an increase in demand, this supply has remained constant.

5.1.4 Trends in Water Supply

The trend in water supply is assessed by the volume of water supplied. The water infrastructure installed in

1960's is the still used to supply water as thus the volume of water supply has remained the same. Due to inefficiencies (lack of repairs, leakages) and increased demand, water to users currently is inadequate. Domestic water consumption/head/day is estimated to have declined from 227 litre in 1960 to 163 litres in 1990.

As shown in table 4, the volume of water supplied also varies between seasons due the amount of water in the Kafue river.

Table 4. Nature of Supply during Seasons

Type of Supply	Wet Season		Dry Season	
	No. of Respondent	Percent	No. of Respondent	Perce-nt
Continuous	23	62.2	17	45.9
Intermittent	14	37.8	20	54.1
Total	37	100	37	100

Source: Field Data

Two types of supply referred to as continuous and intermittent were considered. Supply was noted to be continuous in the wet season than the dry season. In the wet season, compared to the dry season, the rate of water extraction is high as there is plenty of water in rivers. Also the demand for some activities such as gardening is

supplemented by rainfall. This point was consistent with over 60 percent of respondents. In the dry season high demand for water is also due to increased gardening activities.

Despite a high water extraction rate in the wet season, about 38 percent of the respondents argued that water supply was intermittent in this season. This view could be explained by the pumping schedule and the location of some respondents such as the XC section who experience problems as its on a uphill. In the dry season, due to a low rate of water extraction, supply is generally intermittent. This view concurs with the response of about 54 percent.

The volume of water supplied has changed due to changes in the amount of rainfall received. A reduction in rainfall leads to less water in rivers and in a proportional reduction in water supply. According to MITS (1984) the annual average rainfall reduced from 1350 mm between 1974 and 1983 to 1173 mm in 1984. ECD (1990) also registered this rainfall reduction and predicted the 1984 level to continue. According to the Nkana Gauging Station, this reduction in rainfall has resulted in decline of water in the Kafue river as measured at the station.

The volume of water in a river is also affected by high rainfall run-offs. Rainfall run-offs along he Kafue river is due to deforestation, agriculture and urbanization. Increased run-offs hinders ground water aquifers from retaining water to their maximum capacity.

Therefore in the dry season, there is less water from the kafue river as the supplementary water from the aquifer is not enough.

5.2.0 WATER CONSUMPTION

5.2.1 Domestic Water Consumption

About 90 percent of water supplied is for domestic use. All the respondents said they use water for the following basics: Drinking, cooking, washing, bathing and flushing he toilet. In additional to basics others uses are gardening (56 %), keeping ducks (8 %) and in home salons (4 %). Gardening is not extensive in the area since it is not conducive due to gases released from the mines.

It could be noted that water is primarily used for basics. This is because most users do not have high incomes to afford luxury lifestyles such as swimming pools. The residents are the middle and the low salary scale of ZCCM. Their average family sizes are about 5.4 persons per household (CSO). Its quite impossible to live a luxury life and look after such a family.

The average water consumption rate was noted to be 163 litres/head/day (Appendix 1). This rate is quite below average for large urban areas which range from 200 to 400/litre/head/day. The current average is also less than the 1960's average of 227 litres/head/day. Between 1960 and 1990, the consumption rate has reduced by about 64 litres/head/day. Reasons for this decrease include increase

in population and increased consumption per head.

The population of Wusakile has increased over the years. The population was low since Kitwe urban 's population was estimated to be 114,570 in 1960. In 1990 Wusakile's population was 23,663 while that of Kitwe urban was 346,341 (CSO, 1990). However between 1980 and 1990, Wusakile's population decreased by 1226 persons, Despite this increase or decrease, the volume of water supply has remained the same since water infrastructure installed in the 60's is still used.

The increased consumption per head as factor that has contributed to decrease in consumption per head/day head is explained in terms of changes in life style due to improved conditions of service. Some people have acquired new status which demands high use of water.

Whether the water supply is adequate in Wusakile has to be interpreted cautiously. About 96 percent of the respondents argued that the water was adequate to meet the intended purposes while only 4 percent disagreed. According to Walker (1978), water is considered adequate when it can meet demand. In line with Walker's view, water in wusakile could be considered adequate. As already noted, about 90 percent of the water is primarily for basic purposes (cooking, washing etc.). Despite pumping schedules, adequate water is available for this purpose. To cope with problems of intermittent supply and low pressure the users have adopted measures such as:

(a) store enough water to use during the dry spell,

(b) fetch water from the nearest sources and

(c) limit activities which require water to times when it is available.

However, such measures cause a lot of inconveniences to users and water wastage. Water kept for dry hours if not used may be thrown away when the water supply resumes.

5.2.2 Non-domestic Consumption of Treated Water

Apart from domestic consumption, treated water is used by institution such as schools, hospitals and groceries. Institutions use water differently due variations in their activities. Treated water may be used for general purposes such as drinking and cleaning. In addition there are specialized purposes like in baking and hair dressing. The quantity of water supplied and used by these institution was unknown as they did not have water meters.

Although consumption figures were not available, demand was noted to have increased. This view was based on increased small scale business such as hair dressing, restaurants and stores in the area. About 50 percent of the respondents said the water supply was adequate for institutions such as hospitals, market and stadium. For instance, the hospital receives water directly from the 17th pump station (refer to figure 3 or 4). About 25 percent argued that water was inadequate for some institutions such pubs as their fail to do most of their activities. Pubs require water almost at all times for it

not to stink.

5.3.0 NATURE OF PROBLEM IN WATER SUPPLY

There are numerous problems in water supply. About 92 percent of the respondents noted problem in water supply while 8 percent said none. The extent of the problem vary among domestic users. About 84 percent of the respondents thought the problem was minor while 16 percent considered to a major one. As pointed from table 5, the serious problem seemed to be intermittent supply (47 %) and low pressure (32.4 %) while broken pipes (8.8 %) was the least problem noted.

Table 5. Type of Problems

Type of Problem	No. of Respondents	Percentage
Low pressure	11	32.4
Broken pipes	3	8.8
Intermittent supply	16	47.0
Few communal taps	4	11.8
Totals	34	100.0

Source: Field data

These problems seemed, according to ZCCM, due to the following:

5.3.1 Aging Infrastructure

The water supply infrastructure has never been replaced or overhauled for 30 years. This has resulted in inefficiency within the system. The pumping system is made of steel pipes. Due to old age these pipes frequently burst and the resulting leakages contribute to an average of 25 percent of water supplied and wasted. The average volume of water lost is equivalent to 4.8 million litres/day. The other problem associated with aging pipes is siltation in small pipes. Siltation causes pipe blockage resulting in low pressure or cut in water supply.

The measures ZCCM took to reduce the problem of piping were noted to include replacement of steel pipes with synthetic pipe which are more durable. Also ZCCM had contracted a firm, as a short term measure, to replace all blocked small pipes with synthetic ones.

The pumps are old as well and consequently lost their efficiency. Part of the electrical energy is used to overcome friction within the parts of the pump. Despite pumping schedules, these pumps do not have the capacity to meet the demand.

The water supply infrastructure does not have measuring devices. The actual volume of water supplied, consumed and wasted is not known. The efficiency of the system is deduced from the quantity of water wasted. Even in situations where pumps were efficient but water wasted is not monitored, the system could still be inefficient.

5.3.2 Communal Stand Taps and Toilets

In Wusakile, despite the demolition exercise of communal toilets which started after 1964, about 540 communal toilets still exit. One of the problem associated with communal facilities is water wastage. It was estimated that about 40 percentage of water supplied though communal taps was wasted. Water was mainly wasted through the toilet system. The toilets have big cisterns and flus automatically as often as possible when water was available. If small cistern which could flushed manually were introduced, this problem is likely to be reduced. Initially the cost of such an exercise will be high but the benefits will be great in the long run since communal facilities are likely to be there for a long time as the demolition exercise is slow.

Other water wastage was noted through communal taps. Most of the taps were vandalized as thus water kept on running at all times. In some places taps were in good conditions but the attitude of people not closing taps contributed to wastage.

5.3.3 Natural Factors.

Natural factors such as seasons and the physical layout of the area also contribute to the problem of water distribution. The way seasons are a problem is already explained in section 5.1.4. More water is supplied in the wet season than in the dry season. Thus there are more problem of water supply in the dry season than the dry

demand,

(c) overhaul some pumps and replace others to improve efficiency of water supply systems and

(d) re-pipe all the houses and replace distribution pipes with synthetic pipes.

CHAPTER SIX

6.0.0 CONCLUSION AND RECOMMENDATIONS

6.1.0 CONCLUSION

Since Wusakile was established in 1920's, water has been supplied by ZCCM, Nkana Division. The water is drawn from the Kafue river into the Nkana reticulation system and then the reservoir in Wusakile. Water is distributed to the end users from the reservoir.

The trend in water supply is noted by two points. The first is that since the same infrastructure installed in 1960's is in use, the volume of water supplied is considered to have remained the same. But due to lack or poor maintenance it was concluded that water supply may have declined. This conclusion could also be supported by frequent leakages and blockage of pipes which contribute to water wastage.

Another aspect of the trend in water supply looked at was in relation to seasons. In the wet season the Kafue river is considered to have abundant water than the dry season. A high rate of water extraction and thus a high volume of water supplied was noted in the wet season than in the dry season. This was evidenced by a continuous water supply experienced in the wet season compared to the dry season.

Two types of users were identified. These were domestic and non-domestic users. Domestic users were

considered the residents and the non-domestic users the institution such as schools and hospital. Domestic usage of water activities included drinking, cooking, washing and bathing. Others were gardening, hair dressing and rearing of livestock. Activities under the non-domestic category were drinking, watering lawns, cafeteria and other specialized functions like baking. It was concluded that more water was used in the domestic category (90 %) than the non-domestic category (10 %).

Since the volume of water supplied was noted to have remained the same or declined over the years and the population had increased, it can be concluded that water consumption per head has declined. Consumption of water in 1990 was estimated to be 163 litres/head/day as compared to a figure of 227 litres/head/day in the 1960's.

Despite the volume of water per individual in Wusakile being below the national average, the water supply to domestic users was concluded to be adequate though not readily available. Measures undertaken by the residents such as such as storing, fetching water in times of disruption to supplement when not available.

Water to non-domestic users was considered inadequate. Unlike domestic users who had adopted appropriate measures to cope with disruption, non-domestic users did not and thus experienced a lot of hardships.

The problem associated with supply of water are mainly intermittent supply and low pressure. Others are leakages and few taps. The aging of the infrastructure of the water

system contributed to bursting of pipes and thus water leakages. Communal taps and toilets also contribute to water wastage.

The location of users was also noted a problem. Users located on higher grounds in relation to the pump system experienced more water problems than those on lower levels. This is due to the inability of the system to pump water uphill when pressure reduces.

Insufficient funds for maintenance contributed to problems of water distribution. Free water and low water charges contributed to this financial problem.

In Wusakile the factors that need to be addressed are technological. Proper technology can only be implemented if funds are available for rehabilitation. Once the problems have been addressed, they will be positive changes in water supplied in terms of adequacy and availability.

The projects proposed when pursued would solve the problems of intermittent supply, low pressure and broken pipes.

6.2.0 RECOMMENDATIONS

Based on the foregone research finding and discussion, the following recommendations have been suggested: The recommendations have to foster sustainable use of the water resource. Sustainable use of water in Wusakile can be achieved when both the supplier and users work together to achieve a common go of providing adequate water to all users. The following are the recommendations:

1). ZCCM, the supplier, should ensure that water supplied and consumed is measured. It should be measured from supply points where meters can be installed. Measuring the water consumed because it will reflect an average figure for the area. In situations where water used is above average, investigations should be carried out as to why there is more water. Where it is discovered that the water is being misused, some measures should be taken. These measures could include an intermittent supply or low pressure supply which should remind users or adjust their pattern of consumption.

2. The department responsible for water supply, the electrical engineering should not just concentrate on monitoring electricity run pumps but also consider aspects like amount of water extracted from the river, amount of water treated, supplied and wasted. It should take measures to control water wasted through the supply process. Such information on supply and consumption can be a base for planning purposes in terms of money allocation, for chemicals, investment and maintenance.

3). The community should be involved in water issues and educated about water affairs. Users should be made aware of the costs of supplying water and the implications of inadequate supplies. They should be made aware of the day to day affairs of water supply so that they are not taken by surprise in case of cut in supply. Such communication

with users will make them feel like partners in supply and appreciate its importance and consequently conserve it.

4). Methods of conservation which should emphasized and re-enforced are:

(a) close water taps after use. This acts as measure to minimize water wastage.

(b) to report any form of vandalism on the property and any faulty appliances which may lead to water wastage. Reporting faults at times helps reduce on resources needed when the problem is very serious. It also helps to control water wastage through burst pipes and running taps. The culprits involved in vandalizing should be charged and convicted by the law. Such an approach may discourage potential offenders not to damage or steal property.

To improve the water supply in Wusakile, the factors that needs to be urgently addressed are technological as most of the problems noted are of this nature. There is need for a complete overhaul of the water supply system. Funds must be made available for the rehabilitation of the system.

ZCCM must instal devices to measure the water supplied and consumed. This is important to determine the actual figures for Wusakile.

The community should be educated on the importance of water conservation. This could help them to minimize wastage.

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APPENDIX I

CALCULATIONS OF WATER SUPPLY AND UTILIZATION BASED ON ZCCM AND CSO DATA

SUPPLY

Pump Schedule

Time	No. of pumps running	Total hours
04:00 - 17:00	2	13
17:00 - 22:00	1	5
22:00 - 24:00	2	2
24:00 - 03:00	0	0

1. To calculate supply flow rate

(i) Water supplied by 2 pumps: 13 hrs + 2 hrs + 15 hrs

545 M^3 ---- 1 hr
X ---- 15 hr
X = 8175 M^3

2 pumps = 8175 x 2 = 16350 M^3

(i) Water supplied by 1 pump = 5 hrs

545 M^3 ---- 1 hr
X ---- 5 hr
X = 2725 M^3 where 1 litre = 1000 cm^3

(iii) total water supplied : 16350 + 2725 = 19075 M^3 = 19.1 million litres

(iv) water loss due to leakages: (25 %): 0.25 x 19075 = 4768.75 M^3

(v) water supply water loss: 19075 - 4768.75 = 14306.25 M^3

(vi) water supplied to Wusakile. 50 % of net water supply

0.5 X 14306.25 = 7153.125 M^3/day (7153125 litres) = 7.1 million litres

(ii) water distribution between domestic and non-domestic users. Domestic users account for 90 percent and non-domestic users 10 percent.

Total water supply

Domestic: 0.9 X 7153.125 = 6437.8125 M^3/day (6.4 million litres/day).

Non-domestic: 0.1 x 7153.125 = 715.3125 M^3/day (715312.5 litres/day).

2. Domestic consumption

(i) Water available for consumption: 6437.8125 M^3/day
Loss at consumption point: 40 % of 6437.8125 = 2575.125 M^3

Total water available:6437.8125- 2575.125 = 3862.6875 M^3/day

(ii) Water consumption per individual: Supply/population

3862.6875/23663 = 0.1632 M^3/day/head (163.2 litres/day/head)

APPENDIX II

UESTIONNAIRE: DOMESTIC WATER SUPPLY AND UTILISATION

roject Title: Study of Water Supply and Utilisation in Wusakile.

nstructions : Please tick against the answer of your choice or write the answer in the space provided against each question.

1. Date: .....
2. Gender : Male ..... Female .....
3. Residential Address: ..... (A,XC,D etc)
4. Period of residence ..... (Eg 4 years)
5. Size of household ..... (Eg 10)
6. Occupation: Leader of household .....
   Spouse ..... Other members .....
7. Level of education reached (number of members)
   Some Primary ..... Secondary .....
   Primary ..... Tetiary .....
   Some Secondary .....
8. What is your monthly earning? .....
9. Do you pay for the water? Yes ..... No .....
i) If the answer is(Yes) what is the mode of payment?
   - as a fixed amount. how much .....
i) - as an amount indicated on the meter .....
0. What is your opinion about the price you pay for water? it's fair ..... cheap ..... Expensive .....
1. What is the water used for?
   cooking ..... bathing ..... flushing the toilet ..
   drinking ..... washing ..... gender watering .....
   washing cars .....
   others specify .....
2. Do you manage to meet your demands with the water supplied?
   Yes ..... Partly ..... No .....
3. How is the supply of water in different seasons?

	Dry Season	Wet Season
continuous	.....	.....
intermittent	.....	.....

) When supply is intermittent how often is the supply cut?
   seasonally .....
   unpredictable .....

ii) When the supply of water is cut, what are your alternative water sources:

.....

14. Do you have an individual house connection?

Yes ..... No .....

a) If answer is yes (i) Specify number of taps inside the house

.....

(ii) number of taps outside .....

b) If the answer is No where does the water come from?

Communal tap .....

Other spcify .....

15. How is the distance to the water source?

Near ..... Far ..... Very .....

i) How long does it take to collect water? .....

ii) Why does it take this lime to collect water?

long distance ..... too many people using the tap

low pressure ....

other reasons

16. What is the extent of the problems of water supply?

a) Minor set back .....

b) Major inconvenience .....

18. If you where given an opportunity, what would you like the water supply solution to be in Wusakile?

.....

.....

APPENDIX III

QUESTIONNAIRE : Industrial/Commercial Supply and Utilisation of Water.

PROJECT TITLE : Water supply and utilisation in Wusakile Township

Instructions : Please tick against the answer of your choice or write the answer in the space provided against each question.

1. Date: .....

2. Office held by respondent .....

3. Type of organisation ..... EG Grocery School, Church)

4. Which institution supplies you with water?
ZCCM ..... Munincipal .....

5. How many litres of water are you supplied with? .....

6. Do you pay for the water you use? Yes ..... No .....

i) If(yes) what are the terms of payment.
- as a fixed amount, how much .....
- as indicated by the meter, how much .....

7. What is your opinion about the price you pay for water? it's
fair ..... cheap .....Expensive .....

8. Does this price you pay for water affect the pattern of utilisation?
Yes ..... No .....

i) How .....
.....

9. What is the water used for in your institution?
.....
.....

10. How is the supply of water during different seasons?

	Dry	Wet
continuous	.....	.....
intermittent	.....	.....

i. When the supply is intermittent, how often is ~~supply~~ it
Any time during the year .....
Seasonally .....

11. What problems can you identify of water supply?
.....

12. If you were given an opportunity what would you like to be done about the water supply solution?

.....

.....

.....

THANK YOU

APPENDIX IV

NTERVIEW : ZCCM WATER SUPPLY AUTHORITIES

ROJECT TITLE : WATER SUPPLY AND UTILISATION IN WUSAKILE

. Date --r.....
. Office held by respondent.....
. The source of water for public supply .....
. The ~~quantity~~ of water supplied .....
. Are the sources of water adequate to meet the present demand for water .
. History of the water supply system (when it was commissioned, population then).
. What is the capacity of the system and population ~~entered~~ for today.
. When were renovations/Expansion done on the supply system:
. What is the daily/monthly supply of water to Wusakile.
. What is the daily/monthly consumption of water in Wusakile.
. To whom is water supplied?
. What is the water supplied used for.
. What are the different levels of consumption for the different categories.
. What is the nature of the problems affecting supply.
. To what extent do these problems affect water supply.
...What is being done about the problem and what are your future plans.

THANK YOU