CHAPTER 4 EXISTING CONDITION OF LUSAKA CITY

4.1 NATURAL CONDITIONS

4.1.1 GEOGRAPHICAL CONDITION

Lusaka City is located on the top of the Lusaka Plateau bout 1,250 to 1,300m in elevation. The plateau is one of the highest places around Lusaka District and the City is located in a Chunga River Catchment Area. The Ngwerere and Chalimbana streams drain most of the northeast part of the city into the Chongwe River, a tributary of the Zambezi River. Other surface water of the City are drained to the Kafue River by the Chunga River in the northwest and a series of small streams (Muchito, Funswe River) to the south of the City (refer to Figure 4.1.1).

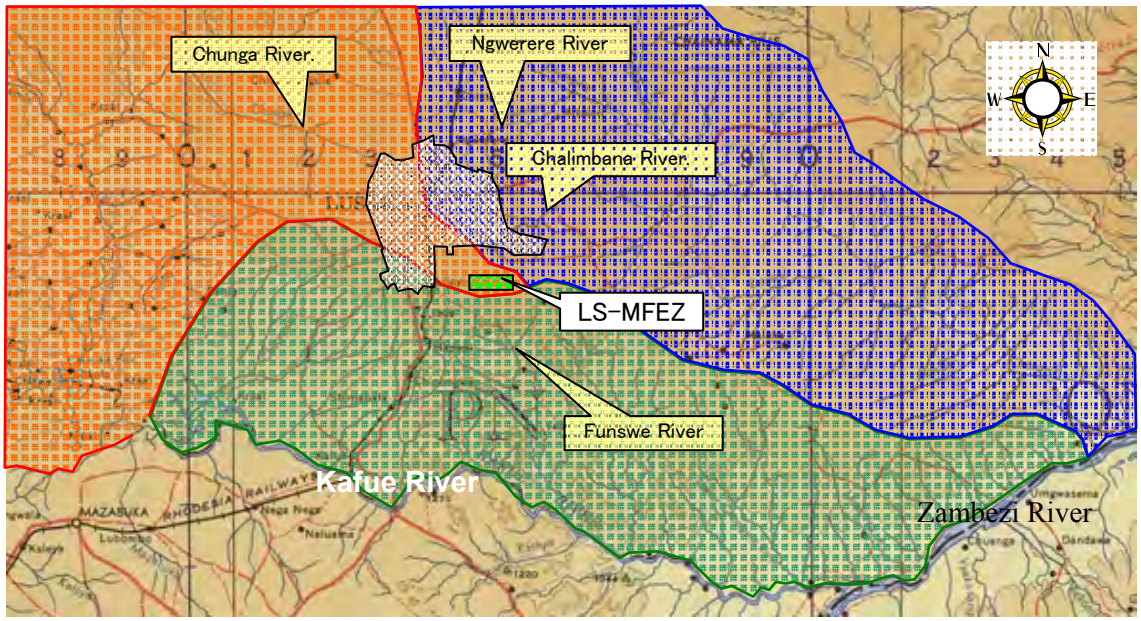


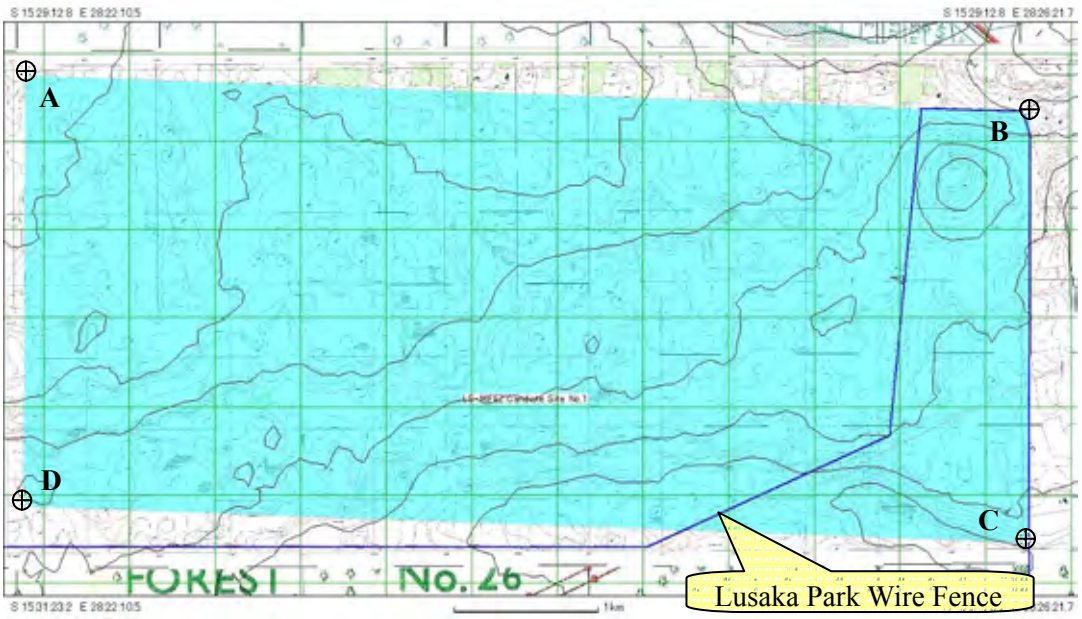
Figure 4.1.1 Catchment and River Condition

Lusaka Plateau slopes gently from the southeast to the northwest, and the highest area is occupied by the LS-MFEZ.

Micro topography of the LS-MFEZ area is shown in Appendix C. It was created by the study based on satellite image and Digital Elevation Model (DEM) data produced by United States Geological Survey (USGS). According to the topographical map, a gradual sloping ridge in the east-west direction lies in the southern part and shallow valley which begins in the southeast area and extends to the north-west part. Average gradient of the valley is approximately 0.4%. A small hill is located at the northeast corner, and the whole area of the LS-MFEZ site can be viewed from the top of the hill.

The boundary of the LS-MFEZ area was determined by the survey taken in June 2008 (Survey Department of Ministry of Land). Coordinates of the corners are shown in Table 4.1.1.

Table 4.1.1 Coordinates of the LS-MFEZ

Point	Geographic Coordinates		UTM Coordinates	
	Latitude	Longitude	X m	Y m
A	**-15:29:25.008**	**28:22:15.591**	**647063.37**	**8286975.50**
B	**-15:29.33.307**	**28:26:10.276**	**654055.71**	**8286674.63**
C	**-15:31:10.904**	**28:26:09.953**	**654025.97**	**8283675.23**
D	**-15:31:02.603**	**28:22:15.237**	**647033.64**	**8283976.21**
Out line				

Datum : WGS84

Many depressions are shown in the map (shown by small green arrows in Appendix C). Some of them may be sinkholes. Those places shall be surveyed in the Study. Also topographical survey will be undertaken by the Zambian counterparts to the LS-MFEZ project. A typical huge sinkhole located near by the LS-MFEZ area is shown in Photo 4.1.1 and Photo 4.1.2.

Location:

Latitude: 15:30.460 S
Longitude: 28:22.028 E

Groundwater level:

Approximately BGL-5m

Photo 4.1.1
Typical Sinkhole 1

Location:

Latitude: 15:32.756 S
Longitude: 28:23.577 E
(Southern part of BH-J3)

Photo 4.1.2
Typical Sinkhole 2

(There are deep holes between the rocks)

4.1.2 CLIMATE CONDITION

Lusaka's climate is typical of a sub-tropical environment, and characterised by three distinct seasons: the cool dry season experienced from April to August; hot dry season experienced from August to November; the hot rainy season experienced from November to April. Average temperature in the 30 years from 1976/77 to 2005/06 is 20.7°C. Monthly average temperature in September and October is highest at 23°C and that in June is lowest at 16°C. Monthly average of daily maximum temperature in October is highest at 30°C and that in June and July is lowest at 23°C. Monthly average of daily minimum temperature in November is highest at 18°C, and that in June and July is lowest at 10°C. The average annual rainfall in the past 30 years is 802mm. In Lusaka, there is much rainfall in December, January and February and there is almost no rain from May to September.

Monthly rainfall and temperatures are shown in Table 4.1.2 and Figure 4.1.2. More than 96% of rainfall is concentrated in the rainy season from November to March. Average annual rainfall is 782mm.

Table 4.1.2 Rainfall and Temperature in Lusaka City

Year	Month												Annual Total
	1	2	3	4	5	6	7	8	9	10	11	12	
Rainfall (mm)	219	194	98	18	1	1	0	0	0	7	70	196	782
Temperature (°C)	23.5	23.0	23.7	22.7	21.0	17..3	18.3	21.5	24.9	27.8	26.7	23.0	22.8

Station: Lusaka City Airport (1995-2006)

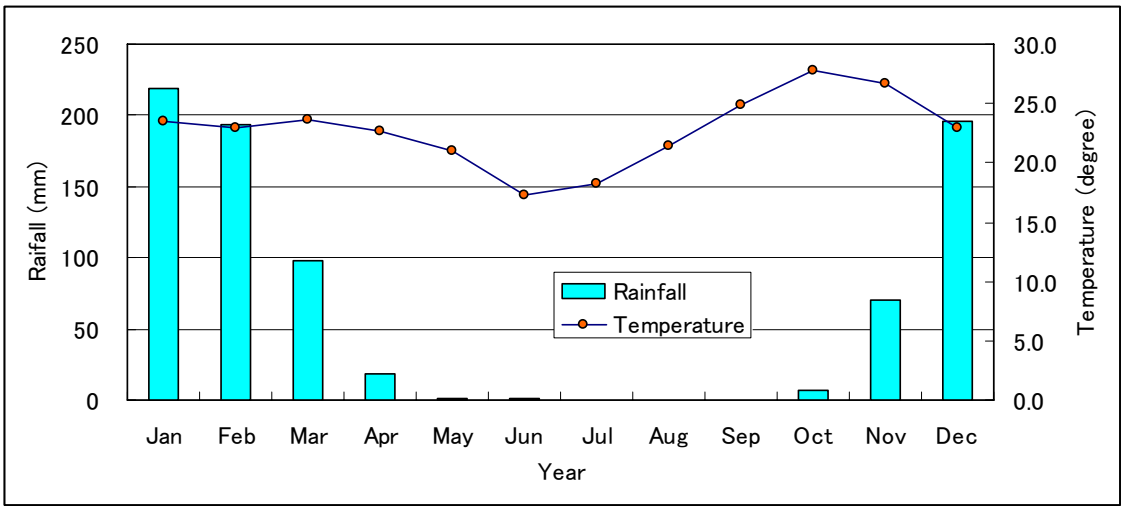


Figure 4.1.2 Rainfall and Temperatures

4.1.3 GEOLOGICAL CONDITION

The carbonate rock/dolomite and schist are mainly distributed in Lusaka City. In Lusaka City, the flat areas consist of carbonate rocks and the slope areas consist of schist rocks. Alluvial deposit is distributed around the Lusaka International Airport area (refer to Figure 4.1.3).

As mentioned above, karst exists in the carbonate rock area with some variation. The western area of the Lusaka Plateau dolomite which has few cracks and melted roundly. On the other hand, south-eastern area of the Lusaka Plateau dolomite which has many cracks and melted sharply (refer to Photo 4.1.3 and 4.1.4).

Photo 4.1.3 Dolomite in Western Area

Photo 4.1.4 Dolomite in South-eastern area

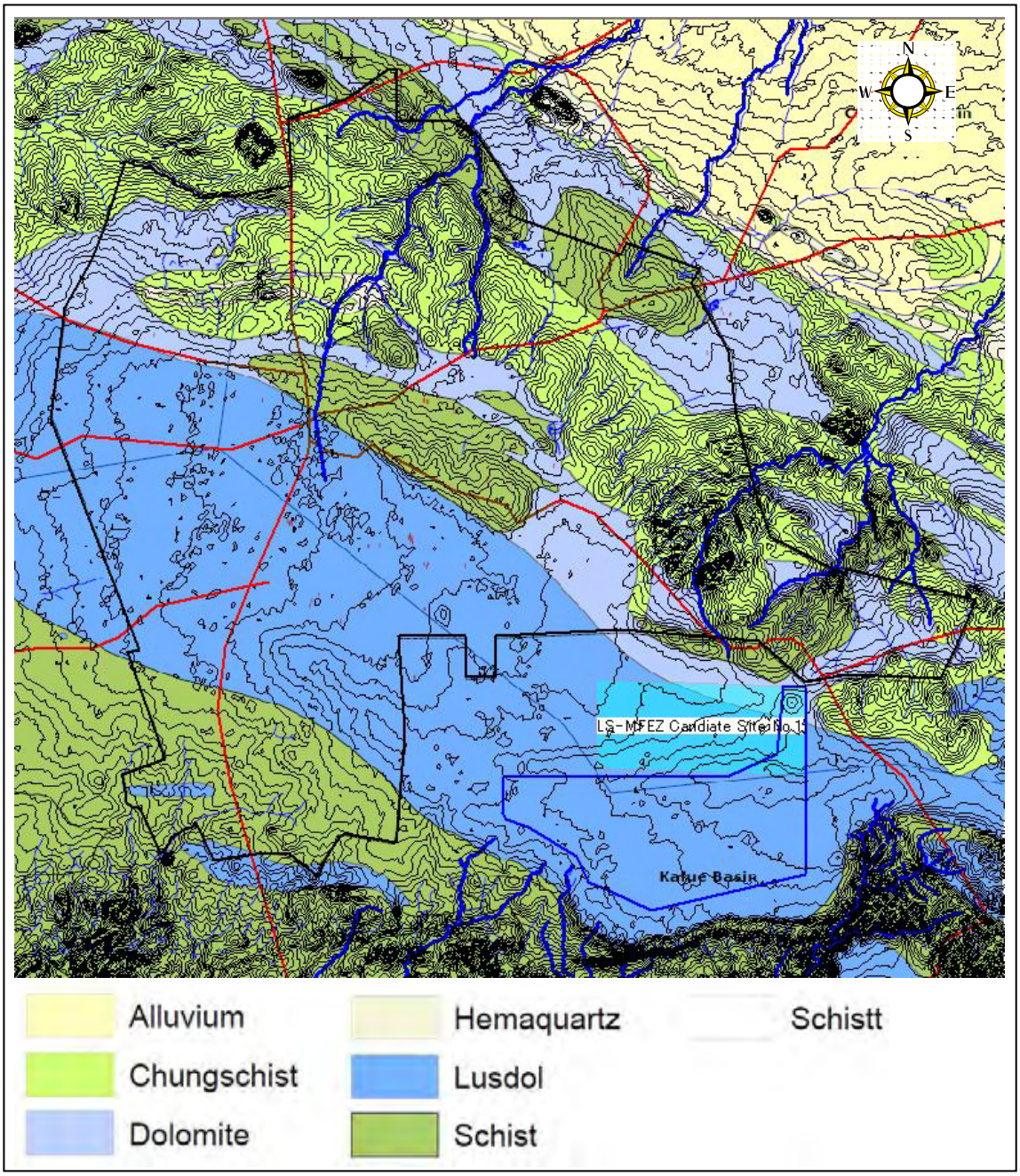
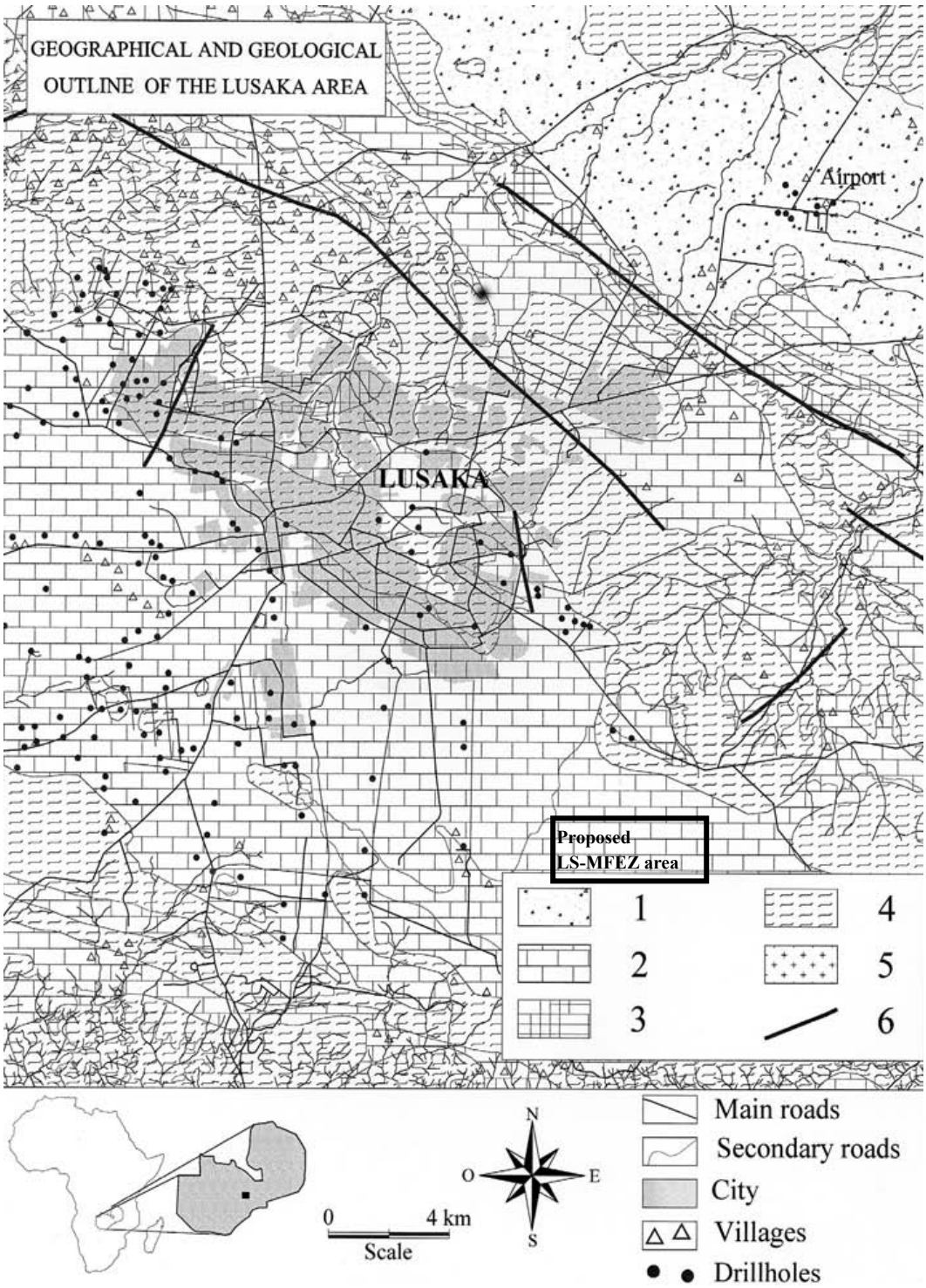


Figure 4.1.3 Geological and Topographical Condition of Lusaka City

In most areas, karst is covered by surface soil. In a few places where it is connected to an underground channel, surface soil has flowed into the ground causing sinkhole.

Urban areas of Lusaka are built on schist ground. Previously, villages are also developed on schist ground as shown in Figure 4.1.4. However, development has begun on dolomite ground with the expansion of the city.



Source: Human impact on Karst: the example of Lusaka (Zambia), Jo DE Waele and Roberto Follesa (University of Cagliari, Geology Department, Italy), Int. J. Speleol., 32 (1/4), 71-83, 2003

Note: 1: Quaternary Alluvial Deposits, 2: Lusaka Dolomite, 3: Matero Quartzite, 4: Ridgeway, Schist, 5: Granite, 6: Fault

Figure 4.1.4 Geographical and Geological Outline of the Study Area

Construction in areas underlain by carbonate rocks has sometimes proved environmentally risky and economically unfeasible. Since water permeability of carbonate rocks is high, there are few rivers on carbonate rocks. The proposed candidate site of the LS-MFEZ is on such dolomite ground.

4.1.4 GROUNDWATER CONDITION

(1) Issues of the Water Usage of Lusaka City

There is no mountain which can recharge and store groundwater around Lusaka City, which is located on the Lusaka Plateau and which is gently sloping to the northwest. Groundwater recharge area for Lusaka City water supply is limited to the surface of Lusaka Plateau accordingly (refer to Figure 4.1.5).

Candidate site of the LS-MFEZ is located in the southeast area of Lusaka City where there is the most upstream of catchment including Lusaka City. Therefore, stakeholders fear about 1) groundwater shortage and, 2) groundwater contamination for Lusaka City which may occur by developing the LS-MFEZ.

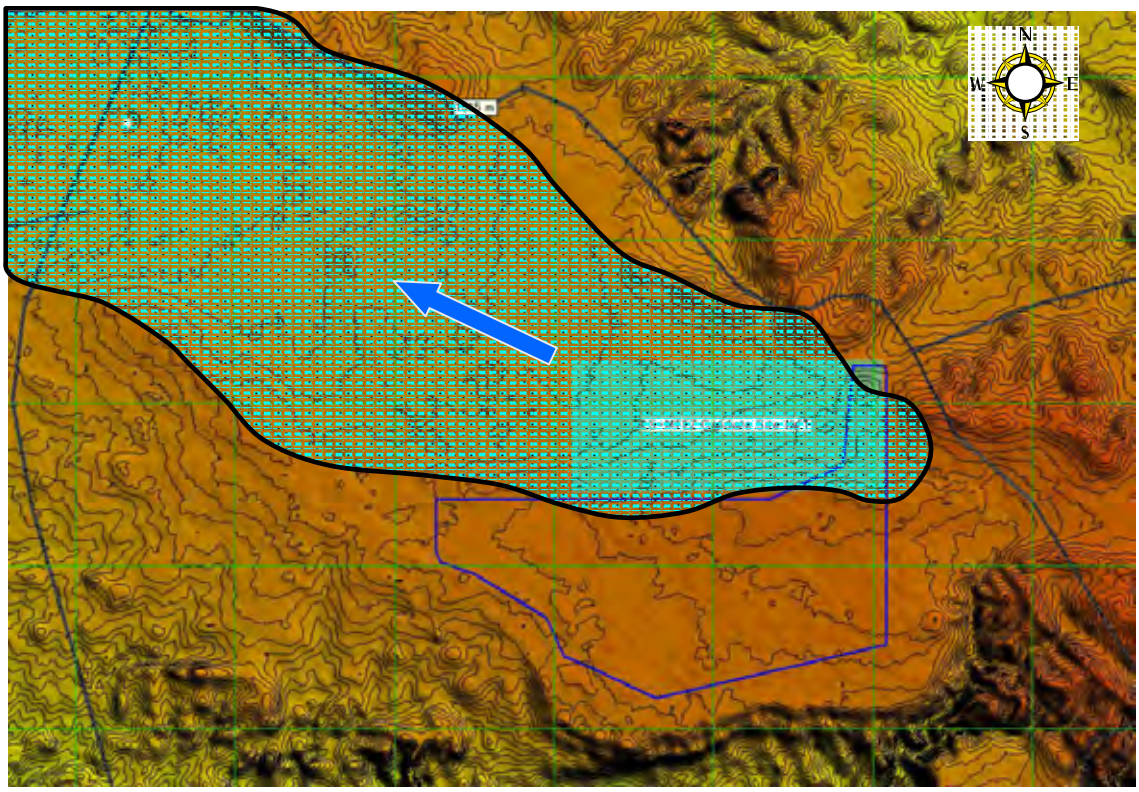


Figure 4.1.5 Geographical Catchment Area Related with the LS-MFEZ Site

(2) Balance of the Water Usage

The catchment area including the groundwater consumption (pumping) area is approximately 300km^2 (Figure4.1.6). The average annual rainfall is approximately 800mm. Assuming that a coefficient of permeability is 60%, the rough annual recharge amount is calculated as follows:

Estimated annual recharge amount : 300,000,000m^2 × 0.8 m × 0.6=144 MCM/year

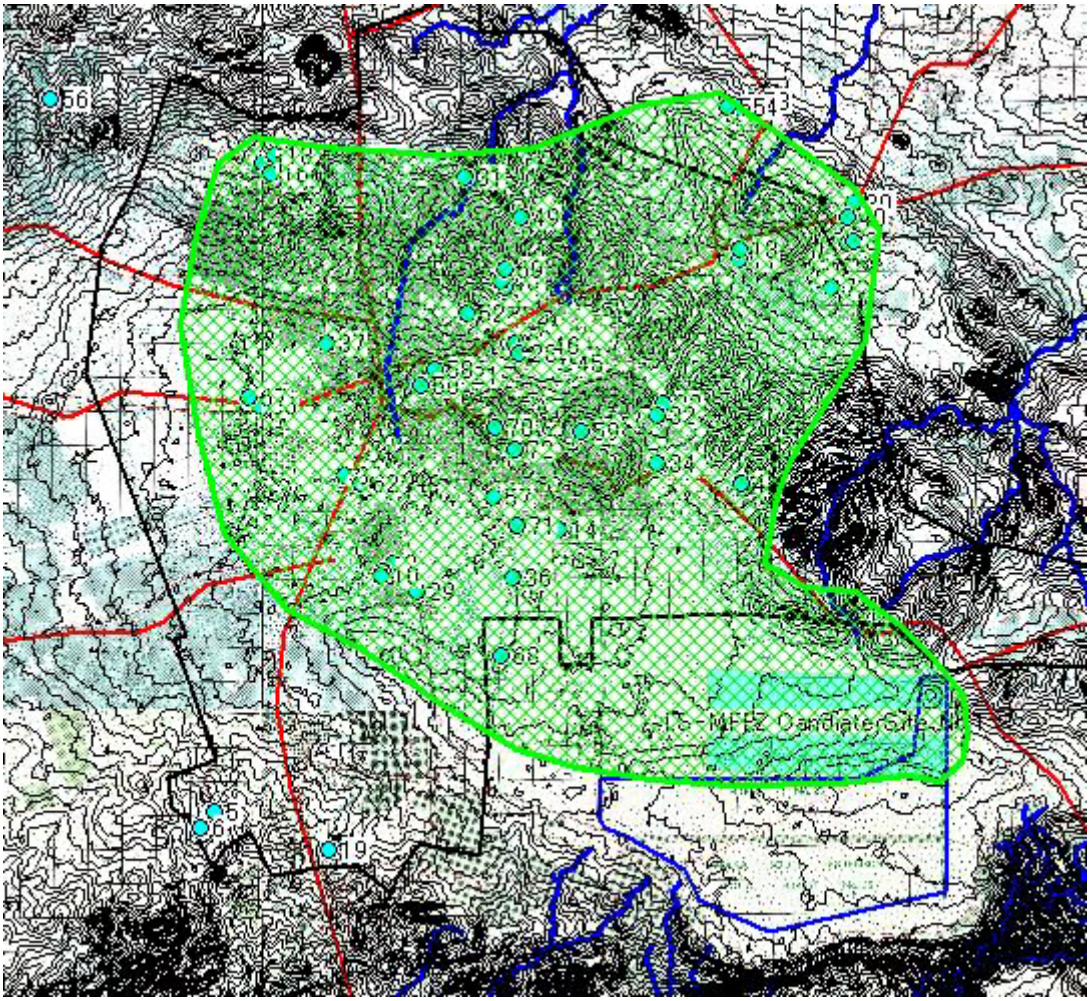


Figure 4.1.6 Recharge Area for Groundwater

The annual consumption of groundwater can be estimated below based on the data aforementioned, which means that the amount of daily consumption is 110,000 m^3/day by LWSC and is 80,000m^3/day by private wells respectively.

Estimated amount of annual consumption: (110,000 + 80,000) x 365=69.35 MCM/year

Meanwhile, it is reported that an estimated quantity of 90,000 m^3/day from 40 production wells and a quantity of 260,000 m^3/day from 3000-4000 private boreholes are pumped, and therefore a minimum amount of 350,000 m^3/day in total is drawn from the aquifer (Nyambe & Maseka, 2000; Nkhuwa, 2000).

However, if consumption rate is 350,000 m^3/day, annual consumption amount would be estimated as 128 MCM/year, which is almost equivalent to the recharge amount. The possibility of the groundwater utilization in the LS-MFEZ is considered by the analysis of the aquifer structure and groundwater flow using the results obtained from hydrological survey (see Appendix D).

4.1.5 OTHER NATURAL CONDITIONS

The LS-MFEZ area is located in the area extending outside of Lusaka City. The natural environment of Lusaka including the extended area is discussed in this section.

(1) Air

Air pollution in Lusaka City is not more serious as than in the Copperbelt. However, the recent increase in the number of vehicles is contributing to air pollution.

The air quality survey results for the LS-MFEZ are shown in Appendix E. It is evident from the air quality results that all the concentration levels of pollutants were within the prescribed Zambian guideline limits. The observed pollution load of total suspended particles (TSP) and the respirable particles less than 10 micro-m (PM_{10}) could be attributed to the wind movements as well as the vehicles that were coming to site during the survey.

(2) Groundwater

The results of the groundwater quality survey for the LS-MFEZ are shown in Appendix D. The concentration level of each surveyed pollutant was less than the guideline value of the WHO drinking water guidelines.

(3) Soil

Soils of hills and uplands are generally shallow to moderately deep, brown to red-brown, gravelly loams to skeletic soils overlying laterite on rocky outcrops.

Soils of the mid-slopes are generally the same as those on the upper slopes, but tend to be deeper and more fertile.

Soils of the low-lying areas are generally deep to very deep, dark brown to black, loamy clays to sandy clay loams. These soils are prone to seasonal water-logging leading to the development of dambos.

The soil substrate varies from granitic parent material in the south of the city, to dolomitic limestone and laterites derived from these beneath the greater Lusaka area.

The soil quality survey results for the LS-MFEZ area are shown in Appendix F. Observed concentration of arsenic in the LS-MFEZ area is within the natural background level, but is within the boundary level of critical soil concentration. However, the arsenic concentration of the groundwater in the LS-MFEZ area is below the detection limit (0.001 mg/L).

(4) Flora and Vegetation

The open deciduous woodland, “Miombo” consists of the most forest areas. In most areas, the natural vegetation has been cleared and cultivated.

There are three gazetted forest reserves in/around Lusaka City: namely the Lusaka East Forest Reserve No.27, Lusaka North Forest Reserve No.28 and the Lusaka South Forest Reserve including No.26 and No.55.

Lusaka South Forest Reserve which consists of Forest No.26 and No.55 has 2,698 ha and 1,982 ha respectively or 4,680 ha in total. The South Forest Reserve was established to prevent soil erosion and to protect the groundwater in the Lusaka City as well as to provide wood. However, the site has been deforested and disturbed by human activities. At present the natural vegetation is almost devoid of full-grown trees and mainly consists of a regeneration of trees, shrubs and grasses.

Flora and vegetation survey results for the LS-MFEZ area are shown in Appendix G. One of 6 national tree species which the forest Act protects, *Pterocarpus angolensis*, was found in the LS-MFEZ area.

(5) Fauna

It is generally believed that all large animals have been wiped out of the Lusaka South Forest Reserve No.26. General management plan for the Lusaka Park described that Signs of existence of small animals such as Common Duikers and Rabbits were visible in the Lusaka South Forest Reserve No.26. Fauna survey results for the LS-MFEZ area are shown in Appendix H.

4.2 SOCIAL CONDITIONS

4.2.1 LUSAKA CITY

This section is discussed mainly based on the "Lusaka City State of Environment Outlook Report, February, 2008".

(1) Land Use

Rapid population growth in Lusaka has led to increased competition for land acquisition. For instance, there is an increase in the conversion of agricultural land to residential land. Currently 70% of the population in Lusaka live in peri-urban areas occupying about 30% of the land.

Overcrowding, spontaneous construction and lack of financial resources have made it difficult to provide services such as proper roads, street lighting, sanitations and drainage systems in peri-urban areas. This problem is compounded by the inadequate capacity of the local authority to provide these services. In most cases, these areas are either squatter settlements or are settlements that have unregistered households and as such, little or no revenue is raised from them. On the other hand, provision and maintenance of services to low density areas is costly as services are provided to few households spread out over large areas.

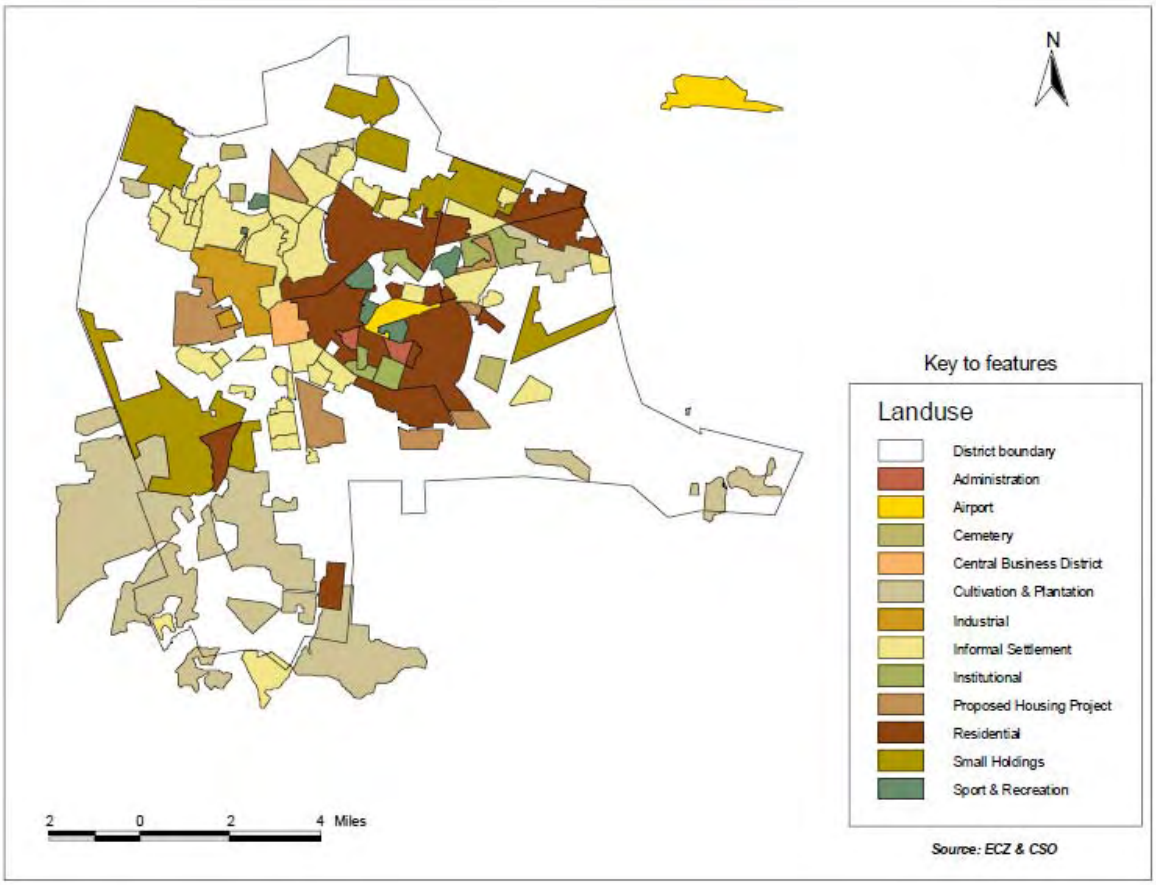
The Local authority has constantly found it difficult to provide adequately serviced land for residential, industrial, commercial and community development due to lack of financial resources. In most cases, development takes place before services are provided. The general land use categories include:

- Industrial Area
- University and R&D Institute Area
- Business Area (Central business district, Satellite business centres)
- Residential Area (High density, Medium, Low density)
- Public Administration Area
- Public Park and Recreational Park
- Agricultural Land
- Conservation Forestry

Lusaka Land Use Map indicates that most of the unplanned settlements are spreading towards the north, northwest and south from the City centre, whereas most of the formal residential area is developing to the east of the CBD (refer to Figure 4.2.1).

Lusaka was established as an administrative centre. Manufacturing sector is the minor activity in the City. The closure of a number of mines on the Copperbelt in the early 1990s and declining economical activity, resulted in a number of business and light industries are relocating to Lusaka. This resulted in increased industrial activities located predominantly in the western part of the city. However, service provision in this area has not been commensurate with the developments there

resulting in increased instances of industrial effluent being discharged within the properties in septic tanks and soak-aways.



Source: Lusaka City State of Environment Outlook Report, 2008

Figure 4.2.1 Land Use Types in Lusaka City

The major commercial activities in Lusaka are concentrated along three major streets in the CBD (Cairo, Chachacha, and Freedom Way), and in the Kamwala Trading Area. However traffic congestion, lack of parking spaces and limited expansion space has resulted in business enterprises relocating to residential areas. This has resulted in a remarkable change of land use character in residential areas around the CBD from general residential to business use such as office use and other service industry activities.

Urban agriculture has been an important part of economical activities in Lusaka. However the importance of agriculture has waned over the years as agricultural land gave way to residential development. There has, however, been an increase of informal agricultural activities within residential areas and road reserves in form of maize cultivation, vegetable gardens and even poultry rearing. It must be mentioned that the local authority in accordance with the Public Health Act regards this type of agriculture as a nuisance. As Lusaka is a built up urban area and more and more agricultural productive land is being taken up for urban purposes, there is little scope for long-term growth in this sector.

(2) Population

The population of Lusaka in 2005 was estimated to be about 1.3 million and the city is growing rapidly. Lusaka has steadily developed into a vibrant metropolis with a population increase of about 6.0% per annum. About 10% of the total area is occupied by informal settlements or compounds, and the majority of the people live in peri-urban areas.

(3) Economic Development

Lusaka provides among other services, administrative functions to Zambia as a whole. It also plays a significant role in the country's manufacturing. Although the economy of the city is more diversified than that of the country, it is quite weak, as most of the sectors are underdeveloped. The basic manufacturing activities, such as food processing and beverages, textiles and leather goods, dominate the manufacturing activities.

The economy of the Lusaka City provides formal employment to a small proportion of labour market. The Integrated Development Plan (IDP) targeted to address the key economic challenges for Lusaka, for example, put the number of people in formal employment in Lusaka at 120,233 or 35% of the labour force (source: LCC 2000). About 65% of the city's labour force, therefore, earns its livelihood from informal economic activities, which predominantly consist of unregistered and unregulated small-scale non-agricultural economic activities ranging from petty trading to metal fabrication and wood processing. The bulk of the informal economic activities are, however, essentially in trading.

(4) Education

The literacy rate at 81.1% of working age in Lusaka City is higher than the country's average at 67.2% and the enrollment ratio is one of the highest in the country at 75.1% (source: CSO 2000).

(5) Employment

There are currently 120,233 people in formal employment in Lusaka City. This represents 9.02% of the total population, or 16.85% of the economically active of working population of Lusaka City. In other words, the unemployment rate is about 83% (source: LCC 2000).

Out of 223,828 jobs available in Lusaka, only 65,585 were females representing 29%. This gap between male and female employment could be due to the fact that there are more skilled males than females.

The unemployment rate in Lusaka City is increasing at 13.7% in 1990 to 27.0% in 2000 (source: CSO 2004) as a result the bulk of the residents of Lusaka work mainly in the informal sector. The unemployment rate for females is higher than that for males represented by 30.0% and 24%, respectively. Those without any practical skills generally engage in piecework and small-scale trading activities.

(6) Poverty

The poverty level has been steadily increasing over the last two to three decades mainly due to the

high levels of population growth, which are not matched by economic growth. Other causes of poverty include the social exclusion of a vast majority of the people.

At the personal level, poverty is more as a result of not having the means of production or inability to secure decent regular employment. Decent employment here is understood to mean a job that pays a wage above the poverty line, that is to say, one that enables a person to meet the basic requirements of shelter, food, clothing, heating and lighting, and costs of social services such as education and healthcare.

4.2.2 LS-MFEZ AREA

The LS-MFEZ area is shown in Figure 4.2.2. The existing conditions of the LS-MFEZ area are described below.

The LS-MFEZ area is located in the southeast 15 km from the central part of Lusaka City. In the north side of the LS-MFEZ, the land along the Leopard Hill Road is dotted with dwellings. Settlements crowded with people are Chilenje, Chilenje South, Bauleni, etc. The west and south sides of the LS-MFEZ are the Lusaka South Forest Reserve No.26 and No.55; the south side will be utilised as the Lusaka Park.

(1) Actual Situation of the LS-MFEZ Area

The LS-MFEZ area is on government land. However because the LS-MFEZ area has not been sufficiently managed, informal farming, charcoal production, quarrying and sand mining have been carried out, which supports the life of people in informal employment.

The LS-MFEZ area used to be part of the Lusaka South Reserve Forest No.26, and was degazetted for the LS-MFEZ area in October 2007. Many forest reserves in Zambia are facing a crisis of deforestation, as people encroach the forest reserves to live, cultivate, mine quarry stones or sand, cut the trees for charcoal production and so on for their lives. The increasing number of population and demand for land and means for livelihood has caused this problem. Encroachers were evicted in some reserved forests. On the other hand, some reserved forests were degazetted and pieces of land were allocated to squatters in the form of farmlands or residential lands.

The Lusaka South Forest Reserve No.26 has also been facing this problem and consequently deforested. A person calling himself as coordinator, who said had been living in the Lusaka South Reserve Forest No.26 for 15 years, has produced a list of farmers living in the whole area of the Lusaka South Reserve Forest No.26. There are over 1,300 names in the list. He also said that seasonal farmers are issued an identity card. This list does not tell the location of each farmland or house, thus, the number of farmers in the LS-MFEZ area is uncertain.

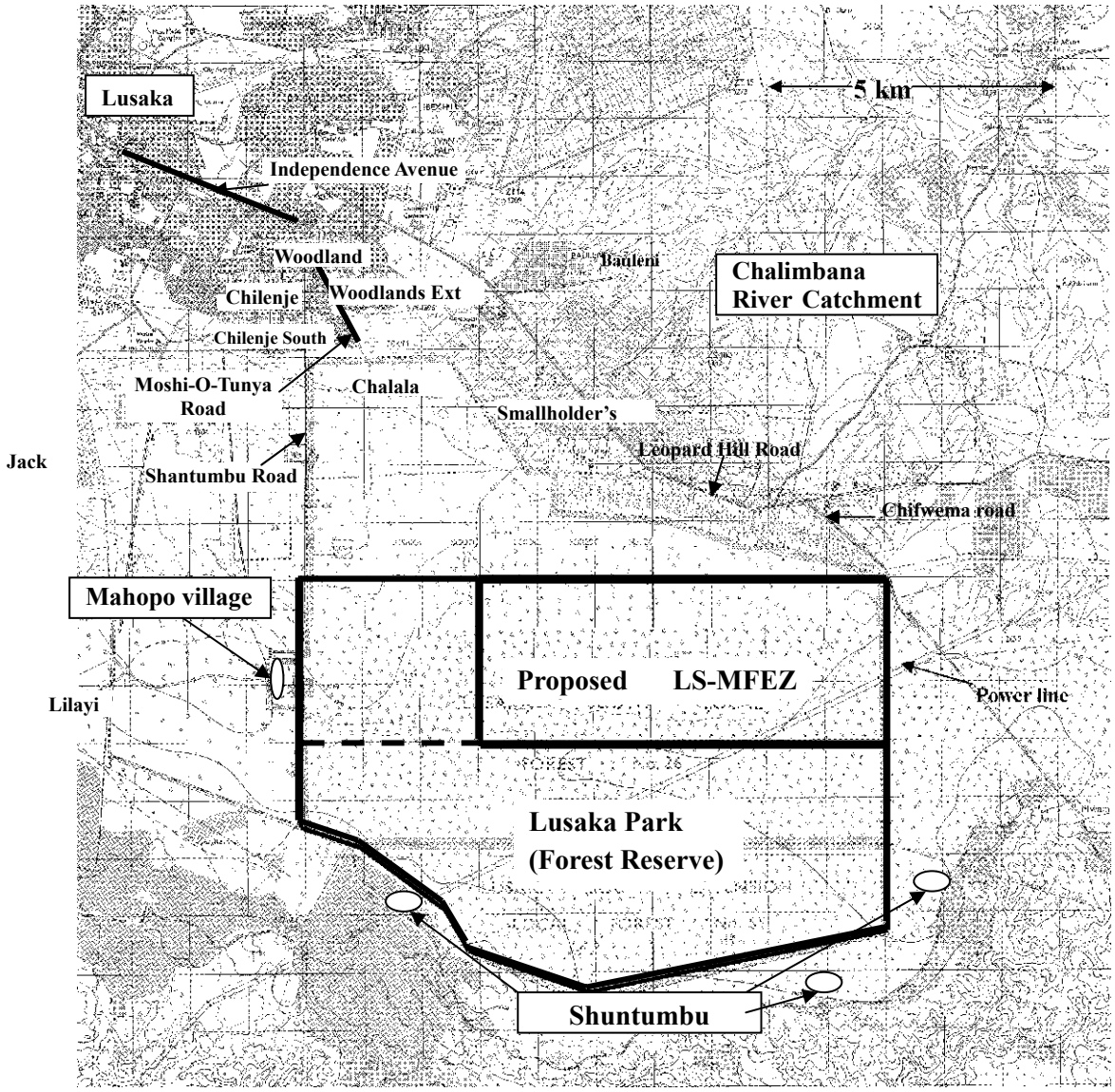


Figure 4.2.2 LS-MFEZ Area by the Government of Zambia and Its Surrounding

The LS-MFEZ area has also been deforested. We can find only farmlands, grass or rocky fields. People have been cultivating in particular in the west side of the LS-MFEZ area for the past years. They cultivate mainly maize by practicing slash and burn cultivation. Most of them do not live in the site but come from neighboring villages or compounds to cultivate seasonally, during the rainy season. The Department of Forest had expelled them from the site several times on the grounds that they were illegal and committed an offence under the Forest Act[1], but they always returned and continued their cultivation.

The LS-MFEZ area has been state land. Therefore, the people in the LS-MFEZ area do not have legal title to the land. As they are not legal land title holders and they cultivate only seasonally, it is difficult to know exactly who cultivates where. From the site surveys, it was confirmed that there are many farmlands in the west side of the site, and along the road which runs through from west to east in the southern part of the LS-MFEZ. It seems that some cultivate solely for self consumption, and some are hired by well to do city dwellers. Although the number is small, some farmers claim they have been living in the LS-MFEZ site for some years. There are a number of small huts, too. It is also said that quarrying stones and cutting trees for charcoal production have been often practiced in the LS- MFEZ site.

There was a disagreement between JST and the Local Expert Team (LET) as to how to treat these informal farmers and informal settlers living in the LS-MFEZ site before the first local stakeholder meeting in Mahopo village on 11th December, 2008. LET claimed that they were illegal settlers or illegal seasonal farmers. LET understood that under the laws of Zambia, they were all illegal and could be evicted, and there was no need to compensate or support them.

The Lusaka Park, which is in the south of the LS-MFEZ area, was enclosed with a fence in May 2008 when the harvest of maize had almost finished. The Department of Forest and the Zambia Wildlife Authority (ZAWA) said that it was not necessary to consider specifically those illegal settlers.

On the other hand, JST claims that even informal farmers and settlers are entitled to compensation in cash or kind and other support to restore their lives after they leave the site. It is required in an Master Plan study to evaluate potential impacts caused by resettlement. To do so, it is necessary, as

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[1] According to the Forest Act, 1999, to enter reserved forest without license, or to cut tress or to do any without license is considered committing an offence.

Restrictions in National Forest

16(1) Subject to subsection(2), no person shall without a license issued by the Commission enter any National Forest

(3) Any person who contravenes subsection (1) shall commit an offence.

Restriction on cutting etc, forest produce

42. Except as otherwise provided in this Act, any person who cuts, or takes or otherwise deals with any forest produce or does any other act the doing of which requires a license, without a license, commits an offence.

Power of arrest

76.(1) When any person is found committing any offence or is reasonably suspected of having committed an offence under this Act, a forest officer or law enforcement officer may demand the person's name and address, and if such person refuses to furnish such information to the satisfaction of the forest officer or law enforcement officer, or if the forest officer or law enforcement officer has reasonable grounds to believe that unless arrested the person will escape or cause an unreasonable amount of delay, trouble or expense in being made answerable to justice, that officer may arrest such person without an warrant and keep that person in custody.

a first step, to know the number and socio-economic conditions of affected people. A clear understanding of how the affected people's lives depend on the LS-MFEZ area is necessary.

JST has stopped any social survey on this matter upon request from LET. Thus, the planed socio-economic survey targeting the affected informal farmers and settlers has not been conducted and the current situation described here is uncertain. As of middle of August 2008, JST has been waiting a response from LET on how LET would deal with this problem by applying the JICA Guideline for Environmental and Social Considerations.

Since the informal activities in the LS-MFEZ project may be relevant to the poverty level of people, the actual situation needs to be appreciated and mitigation measures need to be considered.

(2) Surrounding Communities

Lusaka Park is located in the south of the LS-MFEZ area and the Zambia Air Force is located in the west of the LS-MFEZ area.

High population density areas near the LS-MFEZ area are listed below with average income levels and their location is shown in Figure 4.2.2:

- Bauleni (average monthly household income: ZMK 345,000 (equivalent US$ 91));
- Chilenje, Chilenje South (average monthly household income: ZMK 925,000 (US$ 243));
- Woodlands Ext., Nyumba Yanga (average monthly household income: ZMK 3,583,000 (US$ 943));
- Woodlands (average monthly household income: ZMK 2,461,000 (US$ 648));
- Jack (average monthly household income: ZMK 904,000 (US$ 238));
- John Howard and Chawama (average monthly household income: ZMK 376,000 (US$ 99)); and
- Lilayi (average monthly household income: ZMK 393,000 (US$ 104)).

(Source: Progress Report of the study on Comprehensive Urban Development Plan for the City of Lusaka in the Republic of Zambia, February 2008)

Chalala: Chalala is one part of the area degazetted from the Lusaka South Forest Reserve No.26 in 1996. The planed new access road to the LS-MFEZ site from the Independence Avenue passes a real estate development site in Chalala. Several staff from the Lusaka City Council and JST conducted a joint survey for setting up the access road arraignment.

Thus, construction of most of houses has not been completed and many plots still remain vacant and undeveloped. In a couple of hundred meters along the main road from the entrance of the site, there are 24 houses. There is a need to expand this main road as a part of the access road. This means that the land would have to be seized and affected people need to be resettled. The number of houses to be demolished and the size of land to be seized would vary in accordance with how the road would be expanded. It depends on whether to expand only on the west side, only on the east side or on both sides. Also the width of the road would influence the decision. There are 15 houses on the east

side of the main road, and nine on the west side. People are already living in about 10 houses, and the rest are still under construction. Another five houses, further inside the site after the end of the main road, might need to be demolished. Again, the number will be changed to align the road.

LCC will decide the alignment of the road and stop the further development of the houses on the road.

This housing area was planed and developed by the LCC. The land of LCC and Ministry of Land (MOL) are mixed in the site. Over 1,000 plots were sold and the owners gained formal land title to the plots they have bought. The size of a plot is approximately 20m times 40m. The price of each plot was decided on basis of the cost of infrastructure development, that is, "service charges" like water supply, electricity, and road.

Shantumbu village, a typical rural area, is located in the south of the Lusaka Park. The area is characterised by seasonal and ephemeral streams, which are only active during the rainy season. Shantumbu is comprised of 11 villages, with a total of 500 households and an average family size is about seven persons. The total population is about 3,500 people. Subsistence farming and charcoal burning are the most important economic activities of the community (source: Joseph Mbinji, Zambia Alliance of Women, the experience of desertification in Shantumbu community in Making a Difference, Secretariat of the United Nations Convention to Combat Desertification (2002)).

Mahopo village is located, approximately 7km from Chilenje South along the Shantumbu Road in Kafue District. The village started as a camp site for the Forestry officers manning the adjacent Lusaka South Forest Reserve No.26. The village has grown over the years and now has a population of approximately 300 people. The agricultural small holdings in the area were created by the Lusaka Province Planning Authority in 1998 and were allocated on recommendation by the Kafue District Council in the same year. In this regard, on 13th December, 2005, a request was made to the Ministry of Tourism, Environment and Natural Resources (MTENR) to have the forest de-gazetted in order to settle the 300 people, but this request was not accepted.

Smallholding area along the Leopard Hill Road is in the north part of the LS-MFEZ area. It is a rural low density area.

The Chalimbana River catchment is located in the north of the LS-MFEZ area as shown in Figure 4.2.2. The Chalimbana River rises outside of Lusaka and drains into the Chongwe, itself feeding the Zambezi River. Water resources have been captured in a typical pattern of urban headstreams, plantation agriculture in mid-stream, and smallholder, peasant agriculture at the downstream end. A series of dams exist to service the large farms. These dams are often the cause of friction between settler large agricultural farmers and downstream local peasants, particularly during periods of low flow.

4.3 TRANSPORT CONDITIONS

Lusaka City has Road, Railway and Civil Aviation Networks. Because Lusaka is located at the centre of Zambia, those transport networks provide both intercity and international transport services.

Since the LS-MFEZ will connect to major markets and other domestic and international industrial/economic centres, the LS-MFEZ's connection to the transport facilities is a crucial issue.

4.3.1 ROAD

(1) National Road

The national roads are constructed, maintained and operated by Road Development Agency (RDA).

National road names connecting neighboring nations are shown in Table 4.3.1. T1, T2, T4 which connect to other National roads are present in Lusaka. International road traffic has to pass on these roads. Therefore, the LS-MFEZ should have access roads to the National Roads.

Table 4.3.1 National Road Network in Zambia

Nation	Road Name
Democratic Republic of the Congo	T3
Republic of Angola	No direct access national road
Namibia	M10(T1)
Republic of Botswana	M10(T1)
Republic of Zimbabwe	T1, T2
Republic of Mozambique	T6
Republic of Malawi	T6(T4), M12(T4)
United Republic of Tanzania	T2, M1(T2)

Source: JICA Study Team

Source: RDA

Figure 4.3.1 National Road Network in Zambia

Distance, average travel speed and travel time between Lusaka and national borders are shown in Table 4.3.2.

National road surface condition inside and on the outskirts of Lusaka is good. Most of national 2- lane carriage way width is typically about 6.6 m (some are less). Therefore Large vehicles such as truck and trailers have to slow down in case of passing each other on a 2-lane carriage way.

All the following routes can support international road traffic.

a) Lusaka - Chililabomwe

This route's road condition is the best among the routes. The total road surface condition is good. Most of this route is 2-lane carriageway, but dual carriageway (4-lane carriageway with median) connects between Ndola and Kitwe. Traffic volume between Ndola and Chingola is clearly higher than other routes to national borders, and there are many large trucks/trailers. Therefore, even with good road condition, drivers have to slow down in some areas which have high traffic volume and low-speed trucks.

b) Lusaka – Nakonde

Road condition is good between Lusaka and Serenje. There are some bad surface conditions in pockets between Serenje and Nakonde although not so many. Therefore, any adverse impact to travel time is limited. Average speed is the highest among routes to borders. About 3km of a part between Isoka and Nakonde is under surface improvement by a Chinese Contractor.

c) Lusaka – Chipata

Bad road surface in pockets are located in some places between Nyimba and Petauke. Traffic condition in this section is bad so travel speed is less than other sections. However, most of this route condition is good, and traffic volume is low. Therefore travel speed is still high even there is bad surface condition in some sections.

d) Lusaka – Chirundu

Chirundu and surrounding area are mountain area. The area's road surface condition is good but in some parts it is steep, therefore drivers can't maintain high speed and average travel speed is lower than other sections. Roads in the mountain area have a climbing lane. Heavy loaded vehicles speed is much decreased in these areas.

e) Lusaka - Livingstone

Road condition between Zimba and Livingstone is not good. RDA plans to improve this section with EU funds. Most of this route condition is good, and traffic volume is low. Therefore travel speed is still high speed, even though there are bad surface conditions in some sections.

Table 4.3.2 Distance and Average Travel Speed between Lusaka and National Borders

	Distance (km)	Average travel speed (km/h)	Travel Time (hour)
Chililabomwe (Democratic Republic of Congo Border)	439	79	5.5
Nakonde (Tanzania Border)	1,027	96	10.75
Chipata (Malawi Border)	602	72	8.3
Chirundu (Zimbabwe Border)	126	62	2.0
Livingstone (Zimbabwe Border)	469	73	6.5

Source: JICA Study Team
Note: Survey period = weekday and daytime. Vehicle type = Passenger car (4WD). Distance is the car travel distance.

Traffic volumes on the national road near national borders are shown in Table 4.3.3. The traffic volume of Livingston and Chirundu are higher than others. Chirundu traffic volume drastically increased in 2007. One reason may be the road improvement (ref: World Bank Fund).

On the other hand, according to the one-stop project data, vehicles passing volume at Chirundu border consisted of 150 commercial vehicle/day and 250 vehicle/day of all other types in 2006. Road improved project has been completed and one-stop customs clearance system will be introduced at Chirundu border. (Note: JICA is supporting the system introduction).

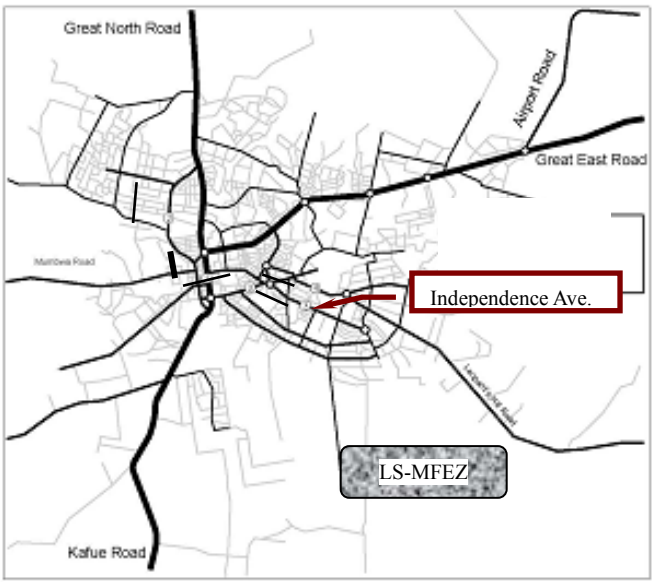
Table 4.3.3 Daily Traffic Volume near National Border

District	Road Name	Year	Light Vehicles	Buses	Semi-Unit Trucks	Trailer/Semi Trailer	Average Annual Daily Traffic
Livingstone (Mozambique Border)	T1	2006	2,504	358	60	5	2,927
		2007	2,139	308	80	89	2,616
Chirundu (Zimbabwe Border)	T2	2006	654	19	22	22	717
		2007	754	311	593	772	2,430
Chipata (Malawi Border)	T4 (T6)	2006	n.a.	n.a.	n.a.	n.a.	n.a.
		2007	958	85	67	32	1,142
Nakonde (Tanzania Border)	T2	2006	783	148	31	126	1,088
		2007	n.a.	n.a.	n.a.	n.a.	n.a.
Chililabomwe(Congo Border)	T3	2006	n.a.	n.a.	n.a.	n.a.	n.a.
		2007	n.a.	n.a.	n.a.	n.a.	n.a.

Source: RDA

(2) Lusaka City Road

Lusaka City Council operates and maintains the roads in Lusaka. Lusaka Road Network is shown in Figure 4.3.2. Arterial road surface conditions are good in Lusaka, but some minor road conditions are not good. Sink holes are found in Lusaka.

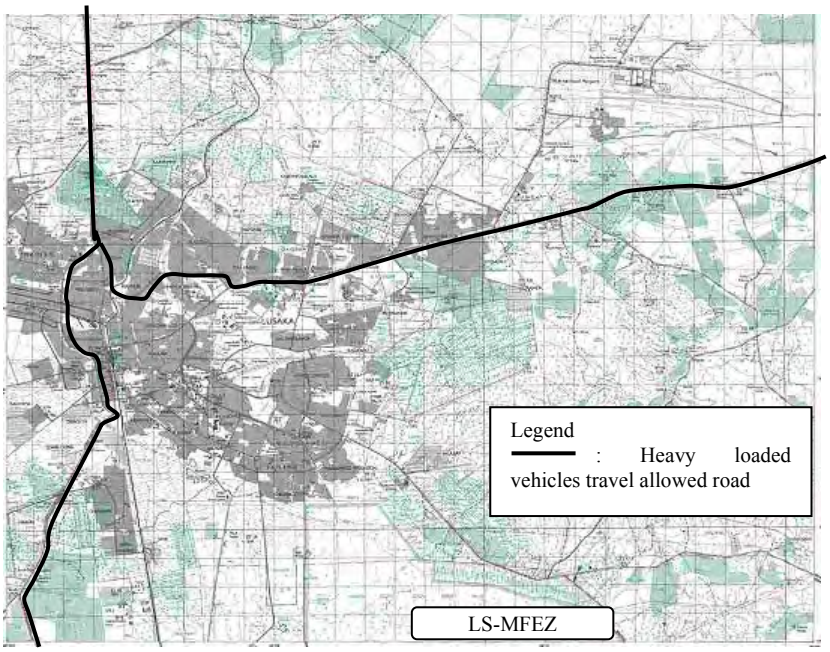


Source: Progress Report of LUSEED

Figure 4.3.2 Present Road Network in Lusaka

(3) Heavy Loaded Vehicle Travel Allowed Route

Passing route for Heavy Loaded Vehicle such as large trailer is regulated by LCC. The network is shown in Figure 4.3.3. Leopards Hill Road is not included in the network.



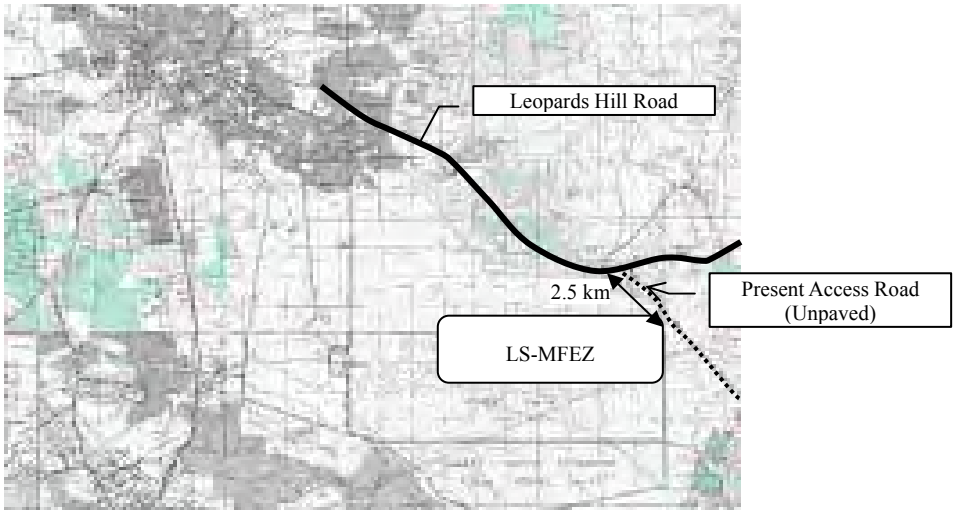
Source: JICA Study Team

Figure 4.3.3 Heavy Loaded Vehicle Travel Allowed Road in Lusaka

(4) Access Road to the LS-MFEZ

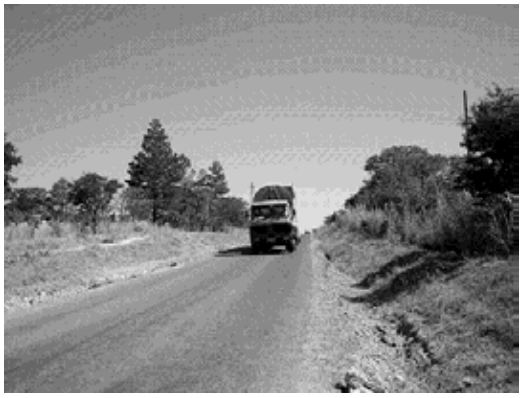
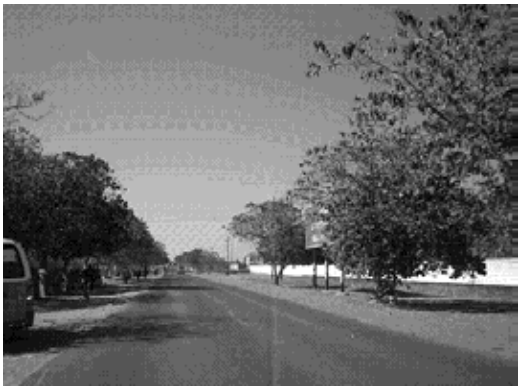
Leopards Hill Road is the only paved road (Bituminous Surface Treatment) going to the LS-MFEZ. Connection road between Leopards Hill Road and the LS-MFEZ is dirt road (Refer to Photo 4.3.1). The distance between Leopards Road and the LS-MFEZ is about 2.5km.

Leopards Hill Road is a two-lane paved road, but the thickness of asphalt pavement near the LS-MFEZ is small. If it is used by heavy loaded vehicles, it should be improved by overlay and widening.



Source: JICA Study Team

Figure 4.3.4 Present Access Road to the LS-MFEZ

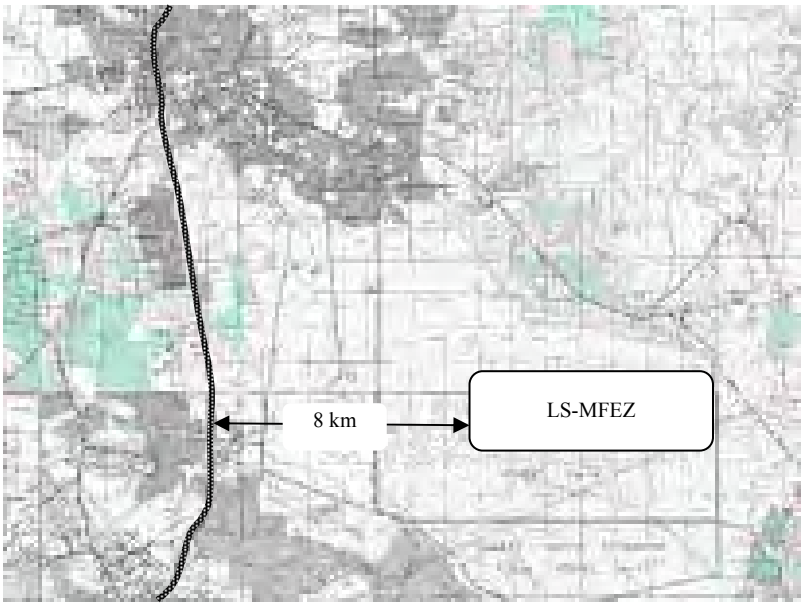
Chifwema Road (width: 4.6 m)	Surface Condition of Leopards Hill Road
	
Leopards Hill Road near the LS-MFEZ (Carriageway width : 5.6 m)	Leopards Hill Road in Lusaka Developed area (Carriageway width : 6.3 m)

Source: JICA Study Team

Photo 4.3.1 Present Access Road and Leopard Hill Road Conditions to the LS-MFEZ

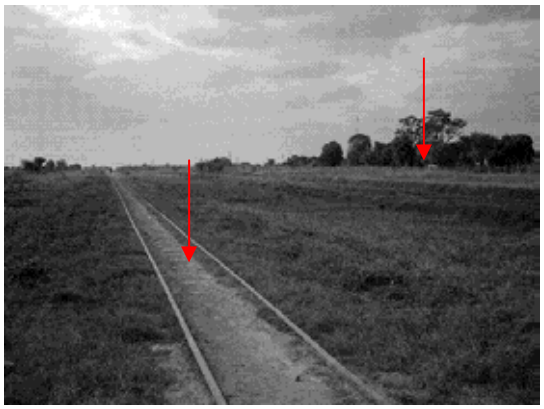
4.3.2 RAILWAY

The railway passes at about 8 km from west edge of the LS-MFEZ. There is no access railway toward the LS-MFEZ at present. Railway in the South area of Lusaka is double track. MOCT and LUSEED have no extension plan to the LS-MFEZ.



Source: JICA Study Team

Figure 4.3.5 Present Railway in Lusaka



Double Track

Source: JICA Study Team

Photo 4.3.2 Present Railway Condition

Lusaka has north-south railway, but the activity is low. Three passenger trains for each direction between Kitwe and Livingstone are operated on a weekly basis. Two or three freight trains for each direction between Copperbelt Province and Livingstone are operated per day. Railway System of Zambia Ltd. (RSZ) as a private company operates these trains at present.

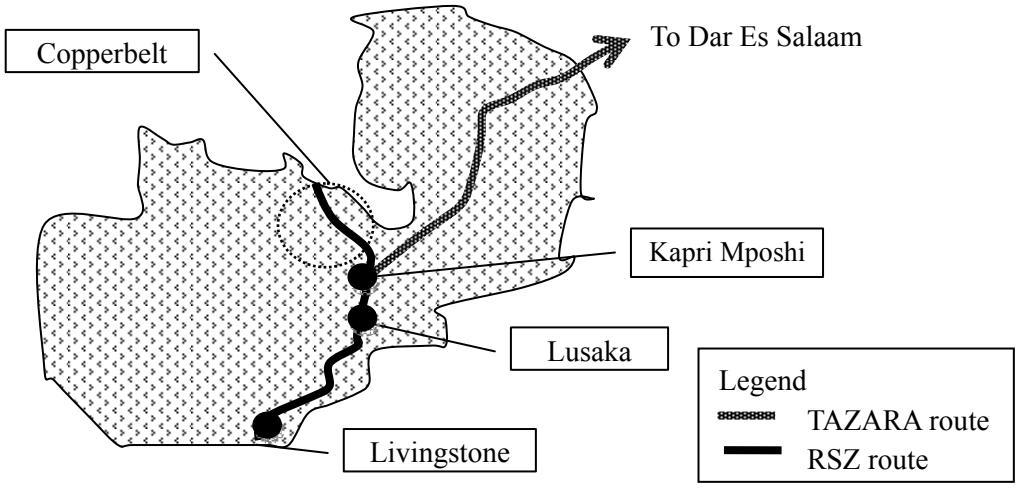
On the other hand, International train between Dar Es Salaam (Tanzania) and Kapiri Mposhi (Zambia) is operated by Tanzania Zambia Railway Authority (TZR, national company). International train operation is also limited, and the trains don't come into Lusaka directly from Tanzania. The terminal station is in Kapiri Mposhi in Zambia. The Kapri Mposhi station is the connection point of two railway routes. One domestic passenger train for each direction between Kapri Mposhi and Nakonde

is operated per week by TZR in Zambia. TZR operates freight trains between Kapri Mposhi and Dar Es Salaam. According to interview with TZR, there are still a small number of locomotives, and therefore TZR can't operate freight trains matching demand.

Table 4.3.4 Train Routes and Frequency of Travel to Lusaka

Train Route	Frequency	Operation Company
Passenger Train		
1) Domestic		
Between Kitwe and Livingstone (Via Lusaka)	3 trains each direction per week	RSD
Between Kapri Mposhi and Nakonde (Local Train)	One train each direction per week	TZR
2) International		
Between Kapri Mposhi and Dar Es Salaam (Express train)	2 trains each direction per week	TZR
Freight Train		
1) Domestic		
Between Libingstone and Copperbelt Prov. (Via Lusaka)	2-3 trains each direction per day.	RSD
Between Kapri Mposhi and Nakonde	Na	TZR
2) International		
Between Kapri Mposhi and Dar es Salaam	Na	TZR

Source: TZR and RSD



Source: JICA Study Team

Figure 4.3.6 Present Railway Routes in Zambia

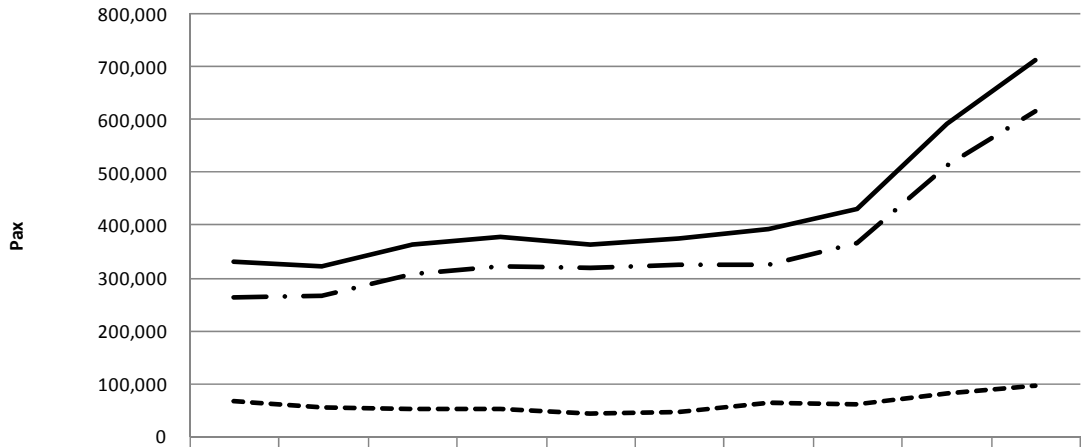
4.3.3 AIRPORT AND CIVIL AVIATION

Lusaka International Airport is the only airport that is operated for regular civil aviation services in Lusaka. The airport is operated by National Airport Corporation Limited (NACL). NACL operates among four International Airport (Lusaka, Livingstone, Ndola and Mfuwa) in Zambia.

Lusaka International Airport is located in the north area of Lusaka. Travel time by car takes about 40 minutes between the airport and the LS-MFEZ.

The airport annual handling passenger volume trend is shown in Figure 4.3.7.

From 2006, both domestic and international passenger volumes increased. International passenger volume growth is especially high, and growth rates exceeded 20% in 2006 and 2007.



	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Domestic	65,947	54,257	52,769	51,176	43,551	45,307	62,918	61,620	79,539	94,754
International	264,112	266,600	309,063	324,203	319,779	327,042	327,332	367,928	512,953	617,101
TOTAL	330,059	320,857	361,832	375,379	363,330	372,349	390,250	429,548	592,492	711,855

Source: NACL

Figure 4.3.7 Annual Air Passenger Volume of Lusaka International Airport

Lusaka international airport has 9 direct flight routes to 9 nations (9 cities). Johannesburg (South Africa) and Nairobi (Kenya) are higher frequency. For domestic, Ndola and Livingstone record higher frequencies.

Flight routes and frequencies are shown in Table 4.3.5.

Table 4.3.5 Flight Routes and Frequencies for Lusaka International Airport

	Flight Route	Frequency (per week)
International		
South Africa	Lusaka - Johannesburg	34
Kenya	Lusaka - Nairobi	14
Tanzania	Lusaka – Dar-es-Salaam	3
Democratic Republic of the Congo	Lusaka - Lubumbashi	3
Malawi	Lusaka - Lilongwe	4
Zimbabwe	Lusaka - Harare	7
Ethiopia	Lusaka - Addis Ababa	7
Angola	Lusaka - Luanda	4
United Kingdom	Lusaka - London	3
Domestic		
	Lusaka - Ndola	29
	Lusaka - Mfuwe	14
	Lusaka - Livingstone	21
	Lusaka - Chipata	4
	Lusaka - Mfuwe	14
	Lusaka - Solwezi	5

Source: NACL

According to NACL, an Airport master plan was developed by JICA in 1984 which unfortunately was never implemented due to the downward trend in the country's economy during the 1980's stretching into the 1990's. With recent changes in Aviation security and safety, there is a need to update these plans to conform to the new requirements. The US Trade and Development Agency (USTDA) plans to prepare a detailed plan for future development.

4.3.4 INTERNATIONAL SEA PORT

Zambia has no sea port since it is a landlocked country. Major international sea ports connecting with Zambia by road are the following;

1) Dar Es Salaam (Tanzania)
2) Nacala (Mozambique)
3) Beila (Mozambique)
4) Mapto (Mozambique)
5) Durban (South Africa)
6) Walvis Bay (Namibia)

According to Ministry of Communications and Transport, Dar Es Salaam, Durban and Walvis Bay are main sea port for Zambia. Trade volume of Zambia at Mapto port is low at present.

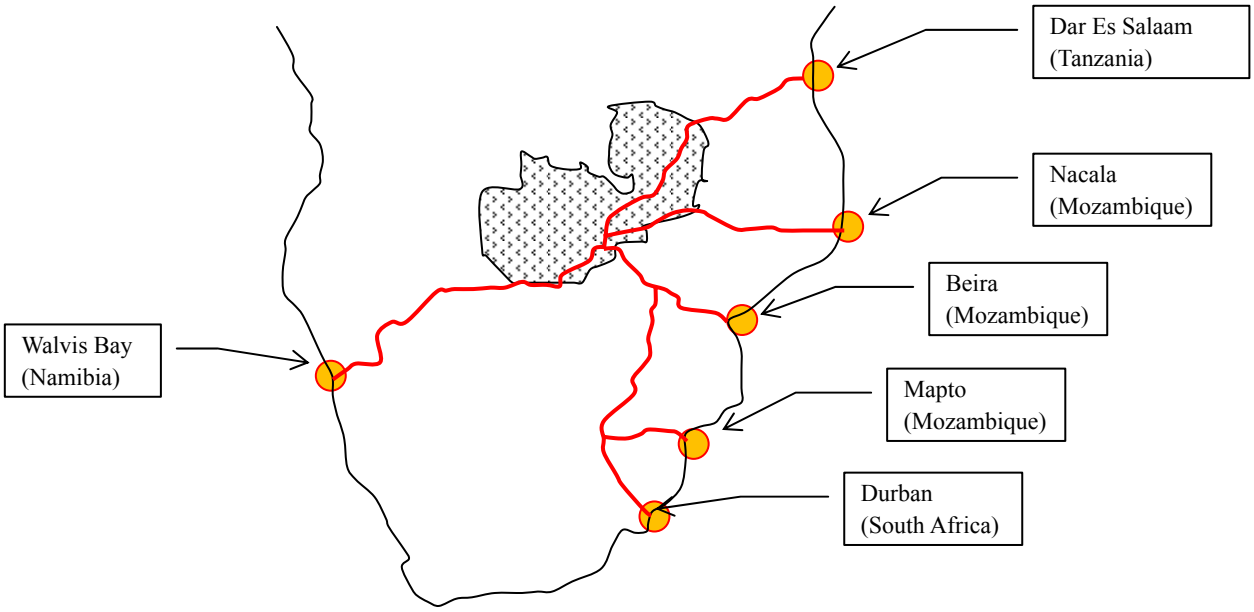
Distances between Lusaka and International Sea Ports are shown in Table 4.3.6. Beira Port is closest international sea port to Lusaka.

Walvis Bay faces the Atlantic Ocean (west side of Africa), the port may be suitable for trade to/from European and American countries. Other ports face the Indian Ocean (east side of Africa), and Dar Es Salaam, Nacala and Beira ports may be suitable for trade to/from Asian countries.

Table 4.3.6 Distance between Lusaka and International Ports

International Sea Port	Distance (km)
Dar Es Salaam (Tanzania)	1,892
Nacala (Mozambique)	1,499
Beila (Mozambique)	983
Mapto (Mozambique)	1,984
Durban (South Africa) via HARARE (Zimbabwe)	2,092
WalvisS Bay (Namibia)	2,143

Source: JICA Study Team calculated distance with Southern Africa Map, 2nd edition (Map Studio)



Source: JICA Study Team

Figure 4.3.8 Major Road Routes between Lusaka and International Sea Ports

4.3.5 PUBLIC TRANSPORTATION (BUS)

Intra-city Public Bus types operating in Lusaka are mini bus (12 seats) and medium size bus (24 seats). Large size buses are operated for inter-city travel. Five bus terminals are located in Lusaka City centre. The bus routes are mainly radial to/from Lusaka City centre. Circular pattern routes are lacking. Therefore, if a passenger wants to transit to another radial route, he must go to the central bus terminal for transfer. Public bus is not operated to the LS-MFEZ at present.

Bus operation license is issued by Road Transport and Safety Agency under Ministry of Transport.

Mini bus	Medium size bus

Source: JICA Study Team

Photo 4.3.3 Bus Types for Intra-City Bus Service

Source: Progress Report of LUSEED

Figure 4.3.9 Intra-City Bus Routes

4.4 WATER SUPPLY AND SEWERAGE MANAGEMENT CONDITIONS

4.4.1 WATER SUPPLY

(1) Water Resources

LWSC (Lusaka Water Service Public Corporation) is responsible for water supply for Lusaka City. Water resources of the water supply system are surface water from Kafue River and groundwater from production wells which is located in the Lusaka City. The General water supply facilities of LWSC are shown below.

1) Surface Water from Kafue River

Surface water supply system consists of Iolanda intake facility, Iolanda water treatment plant, Chilanga transfer pumping station, and Stuart Park reservoir in the Lusaka City as shown in Figure 4.4.1.

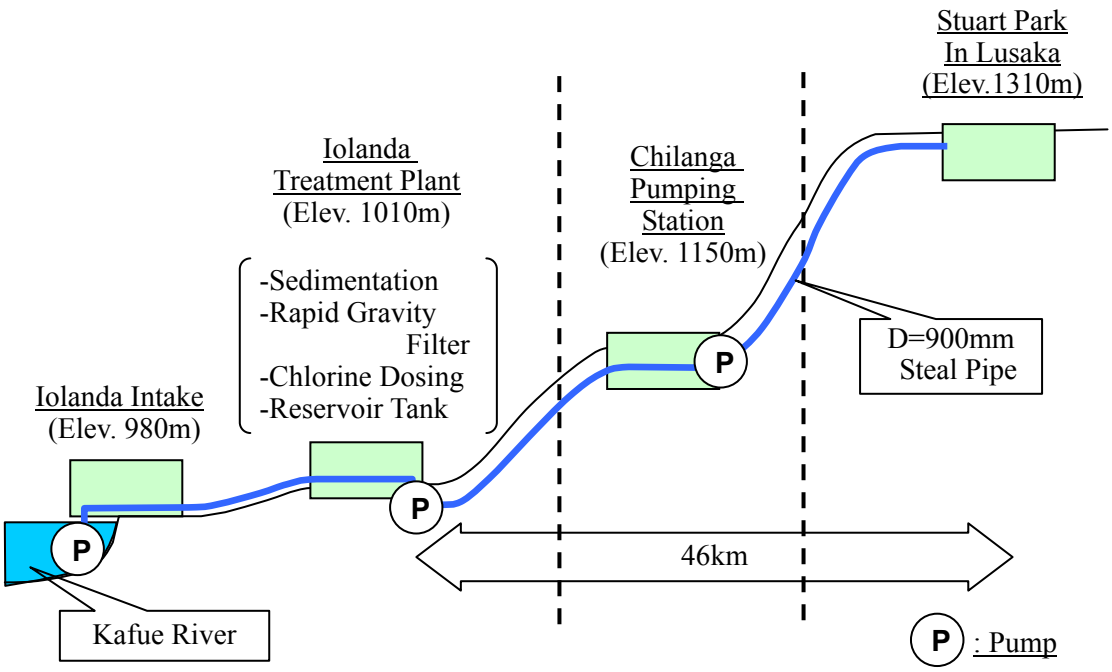


Figure 4.4.1 Surface Water Supply System from Kafue River

Initial design capacity of the system is 110,000 m^3/day. According to the flow meter in Iolanda treatment plant, it showed approximately 4,050 m^3/h (97,200 m^3/day) which is 88% of design capacity. It is considered that the decreasing of the capacity originated in power instability condition and aging of the facility.

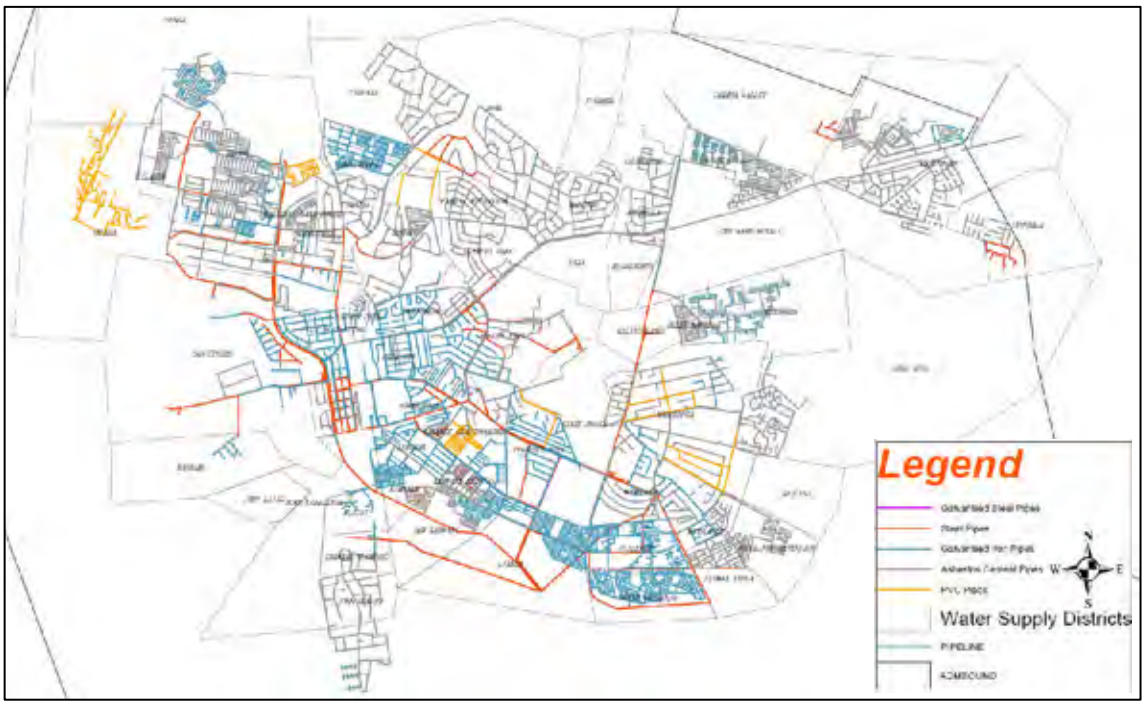
2) Groundwater

LWSC has 73 production wells for the Lusaka City water supply. Those boreholes were constructed from 1954 to 2003 with 90% constructed before 1999. Some are not in operation. A description of operating conditions and capacity are shown in Appendix I.

(2) Water Supply Condition

The water is supplied from two sources: water of 97,000 m^3/day comes from Kafue River by pipeline and 110,000 m^3/day comes from groundwater by production wells. In total, approximately 210,000 m^3/day is currently supplied to Lusaka City (LWSC, January, 2008).

Distribution network of water supply is shown in Figure 4.4.2.



March 2001 (LWSC)

Figure 4.4.2 Water Supply Network by Lusaka Waste and Sewerage Company

The current amount of water supply has been recognized as insufficient for a population of 1.25 million in 2005. Estimated demand of the Lusaka City is 340,000 m^3/day (source: Progress Report of "The Study on Comprehensive Urban Development Plan for the City of Lusaka in the Republic of Zambia" 2008). Thus shortage of 130,000 m^3/day is estimated. Other water sources such as satellite systems and private boreholes are groundwater, that supplies approximately 80,000 m^3/day. (source: Lusaka City State of Environment Outlook Report, 2007 LCC, ECZ)

Other than the above water sources, 80,000 m^3/day of groundwater which is supplied from satellite systems and private boreholes, can be estimated.

4.4.2 Sewerage Management

(1) General

Existing wastewater management services in Lusaka City are carried out by an off-site system and an on-site system. With the off-site system, wastewater is collected and transferred to a wastewater treatment plant away from the generated site, and is applied to an urbanized area. The on-site system

is applied to rural areas, and wastewater is treated mainly with septic tanks and soakaways / leaching systems installed at households.

A separate system is applied to wastewater and drainage system, so wastewater of off-site systems and storm water are separately collected.

(2) Off-Site System

There are six (6) Wastewater Treatment Plants (WWTP) working in Lusaka, they are Manchichi, Chunga, Matero, Ngwerere, K/Square, and Chlstone. Four (4) of the Wastewater treatment systems; Matero, Ngwerere, K/Square, Chelstone utilize the stabilization pond system. The treatment system of the Manchichi WWTP is a combination of a tricking filter and a stabilization pond. The stabilization pond called Garden is located away from the tricking filter treatment plant. The treatment system of the Chunga WWTP is a tricking filter. The Manchichi WWTP and Chunga WWTP have sludge drying beds, and the dried sludge is sold for agriculture use. The treated wastewater is discharged to nearby drainages or rivers from each WWTP. Lusaka Water and Sewerage Company (LWSC) is operating and maintaining the wastewater treatment plants and the sewers.

The stabilization pond system is easy to operate and major maintenance work is removing solid waste every day at the screen. It is necessary to remove accumulated sludge at the bottom of the ponds; the interval is about every 5-10years. Based on the site visits, it was observed that solid waste is removed well, but sludge removal has not been carried out and sludge is coming out over the water level around the inlet at some stabilization ponds. Some of the systems have been operating for more than about 30 years, so the pond's effective volume is reduced and it is expected the treatment function is also reduced. Although sludge is accumulated at the ponds, it was observed that treatment is generally good as BOD_5 of the treated wastewater is about less than 50 mg/L and the BOD_5 of two WWTP is less than 20 mg/L as shown in Table 4.4.1.

On the other hand, the tricking filter, that is one kind of mechanical treatment system has not been working well as some mechanical parts have been damaged. About 50% of the tricking filter is not working at both Manchichi and Chunga WWTP. In addition, a power failure occurs frequently, and the system reliability is not high enough.

Chunga WWTP receives industrial wastewater from the industrial area. There is a "Quality Policy Statement" established by LWSC to regulate quality of influent wastewater into sewers. LWSC requested industries not to discharge the high polluted wastewater into the sewers based on the Statement, but it has not been satisfactorily realized. As a result of this condition, high polluted wastewater inflow with toxic matters deduces malfunction of the treatment with biological reactions, and the quality of the treated wastewater is bad as over 250 mg/L in BOD_5.

The flow and quality of raw wastewater and treated wastewater is shown in Table 4.4.1.

Table 4.4.1(A) Flow and Quality of the Wastewater Treatment Plant in Lusaka

LUSAKA WATER AND SEWERAGE COMPANY LIMITED
SEWAGE TREATMENT PLANTS SECTION
SUMMARY OF 2006 FLOWS

		MANCHICHI	CHUNGA	MATERO	NGWERERE	K/SQUARE	CHELSTONE
January		40832	9655.36	1252.09	10417.6		7371.93
February		37164.1	12471.2	1179.74	23893.7		8844.03
March		43949.19	9655.36	1252.09	26582.7		8950.95
April		29873.6	12290.2	329.022			2693.6
May		24481	9655.36	1252.09	10417.6		7571.93
June		27021.5	12762.3	1656.87	14407.8		1548.71
July		27832.3	13179	2051.35	13952		1634.96
August		25974.3	13179	2051.35	1395.2		1408.595
September		24644.1	10361.2	611.895	116.895		1273.05
October		25974.1	8759.07	577.36			1246.81
November							
December							
Av. M3/d		**30,775**	**11,197**	**1,221**	**12,648**	**3,105**	**4,254**
m3/hr		**1,282**	**467**	**51**	**527**	**129**	**177**
m3/year		**11,232,736**	**4,086,834**	**445,806**	**4,616,497**	**1,133,325**	**1,552,877**
Instrument of measurement		Parshal Flume	Parshal Flume	Parshal Flume	Parshal Flume		Parshal Flume
Av. M3/d	**Design Capacity**	**36,000**	**9,100**	**6,300**	**5,424**		

Quality of Effluent (Treated water quality) in 2006

			MANCHICHI +Garden	CHUNGA	MATERO	NGWERERE	K/SQUARE	CHELSTONE
PARAMETER	**Unit of measure**	**ECZ Standard**	**Average Jan-Dec**	**Average Jan-Dec**	**Average Jan-Dec**	**Average Jan-Dec**	**Average Jan-Dec**	**Average Jan-Dec**
pH		**6 -- 9**	**7.9**	**7.1**	**7.9**	**8.9**	**7.4**	**6.47**
Settleability	ml/L	**0.5**	**0**	**0.2**	**0**	**0**	**0**	**0**
Turbidity	NTU	**15**	**34.5***	**82.3***	**56.2***	**211***	**51***	**26.9***
TSS	mg/L	**100**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**
BOD	**mg/L**	**50**	**30**	**266***	**55***	**18**	**48**	**8.9**
COD	mg/L	**90**	**178***	**1455***	**238***	**95***	**184***	**55**
TC	Count/100ml	**25000**	**485 455***	**69 x 10^6***	**501 133***	**2 800**	**2.6 x10^6***	**4 710**
FC	Count/100ml	**5000**	**44 636***	**25 x10^6***	**78 000***	**364**	**1 x10^6***	**520**
Treatment system			**Tricking filter + Pond**	**Tricking filter + Pond**	**Pond**	**Pond**	**Pond**	**Pond**

KEY
* Unsatisfactory
ND :Not done
10^6 : number raised to power six
TSS: Total Suspended Solids
BOD: Biochemical Oxygen Demand
COD: Chemical Oxygen Demand

May-06

BOD Inflow	**mg/L**	**-**	**56**	**544**	**333**	**30**	**213**	**74**
BOD Outflow	**mg/L**	**50**	**35**	**333**	**87**	**19**	**51**	**7**

May-06

FC Inflow	**mg/L**	**-**	**4 x 10^6**	**-**	**15 x 10^6**	**1.6 x 10^5**	**6.5 x 10^6**	**2.1 x 10^6**
FC Outflow	**mg/L**	**5,000**	**50,000**	**-**	**64,000**	**400**	**300,000**	**300**

Table 4.4.1(B) BOD_5 of the Wastewater Treatment Plant in Lusaka

		Garden		K/square		Chelstone		Ngwerere		Matero		Chunga	
Year	Month	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT
2006	Jan.	62	24	81	26	25	2	3	9	141	8	900	365
	Feb.	60	18	145	35	48	5	-	-	247	57	243	201
	Mar.	-	-	-	-	-	-	-	-	-	-	220	174
	Apr.	90	25	189	34	63	6	24	21	243	74	283	261
	May	56	31	213	46	74	7	30	19	333		544	333
	Jun.	86	31	210	54	84	6	52	23	151	49	384	244
	Jul.	85	29	245	56	84	6	35	19	90	55	647	225
	Aug.	81	30	247	62	104	9	46	23	146	58	478	286
	Sep.	73	18	111	48	76	12	17	22	92	38	704	182
	Oct.	59	40	128	64	87	11	32	9	340	-	397	138
	Nov.	104	44	196	61	149	15	36	ND	490	ND	1744	647
	Dec.	52	37	196	62	123	18	25	ND	490	ND	1578	298
2007	Jan.	44	19	129	49	116	7	9	ND	257	153	508	448
	Feb.	80	15	125	23	43	17	29	23	89	110	309	108
	Mar.	32	18	154	29	88	9	74	27	184	120	420	322
	Apr.	106	26	243	53	74	7	48	30	101	101	691	206
	May	84	33	256	61	128	8	46	33	132	48	733	284
	Jun.	92	32	207	54	96	16	75	29	164	42	642	319
	Jul.	98	37	285	58	110	18	75	25	133	52	540	507
	Aug.	101	34	289	57	129	15	85	26	445	44	703	518
	Sep.	-	40	-	90	-	-	-	60	-	-	502	123
	Oct.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-
	Nov.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-
	Dec.	96	32	110	67	116	29	75	29	107	35	387	199
2008	Jan.	75	22	98	34	43	9	34	13	141	66	278	229
	Feb.	141	31	241	35	53	13	48	18	301	67	994	405
	Mar.	160	29	153	39	59	13	28	18	286	22	295	214
	Apr.	46	36	209	36	79	14	48	22	144	42	632	287
	May	113	40	327	51	99	21	20	30	1097	54	-	-
	Jun.	187	41	289	53	119	30	104	28	180	65	-	-
	Jul.	135	29	106	40	92	20	64	23	136	41	-	-

Source: Observation data produced by LWSC

4.5 SOLID WASTE MANAGEMENT

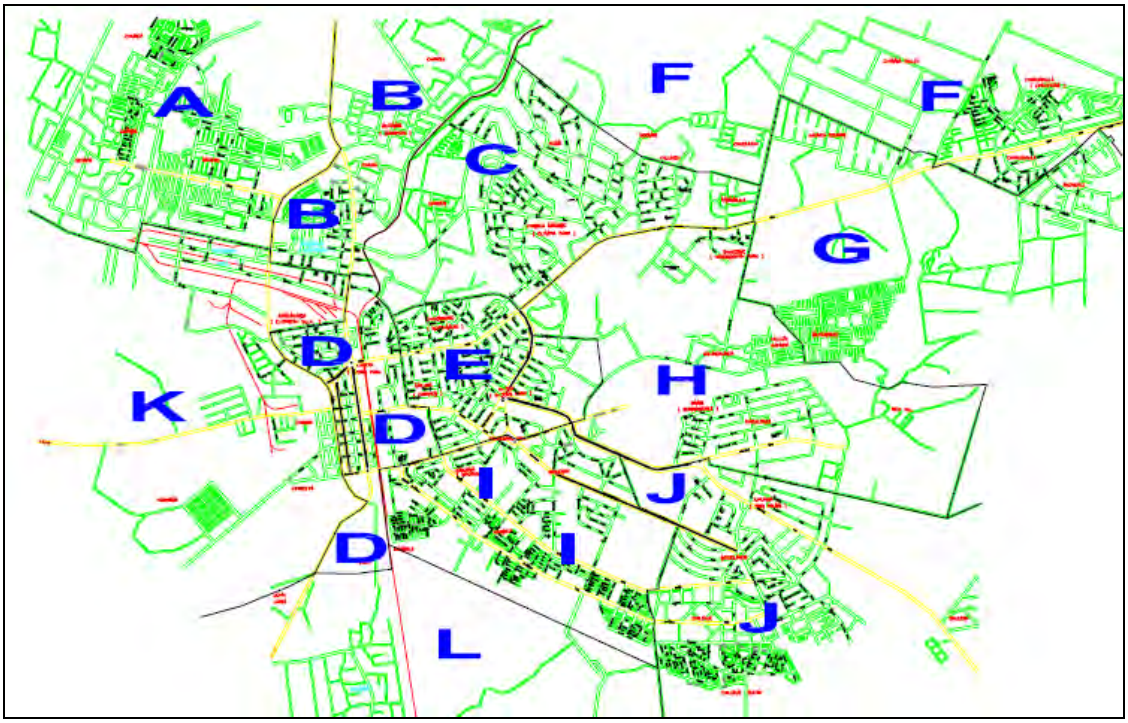
4.5.1 GENERAL

In charge of solid waste management of Lusaka City such as collecting and disposal is West Management Unit (WMU) which belongs to Lusaka City Council. WMU carries out solid waste collection, transfer and disposal for domestic waste. It has collection parties and disposal facility (landfill). Previously, it had a landfill in Kamwala South (south part of Lusaka City), however, since it is a type of open dump site without any protection for groundwater, it was closed. Lusaka City Council (LCC) has a newly constructed landfill which was established in 2007 located in Chunga (7 km north-west from city centre) supported by DANIDA . It will be fully utilised by 2020.

WMU does not manage industrial waste including medical waste. This is managed by each business unit within its responsibility.

4.5.2 COLLECTION SYSTEM

LCC has set up the waste management districts as shown in Figure 4.5.1.



Source: LCC WMU

Figure 4.5.1 Waste Management District

District [D], [K] waste and waste which is generated from compound area are collected by its collecting party. Other areas are collected by private companies which have contracts with LCC. Solid waste is piled up in front of houses, offices and complexes using plastic bags, waste bin or container. Collection period is decided based upon the amount of emergence. Rate of collection was 45% in 2007. It is expected to cover 80% until 2013. Separate collection is not supported.

4.5.3 FORECASTED WASTE AMOUNT

Forecast of the solid waste amount is estimated by WMU as Table 4.5.1. Actual waste collection amount in 2007 was 45% which is 20% behind of the initial target. Current target of collection rate will be 80% in 2013. Total waste amount of the period from 2007 to 2020 when Chunga landfill will be operating is shown in the bottom field of Table 4.5.1.

Table 4.5.1 Forecasts of the Solid Waste Generation

Year	Amount of Waste (t/year)	Assumed Collection Rate (%)	Assumed Collection Waste (t/year)
Increase Rate	4%/year		
2002	224,312	10	22431
2003	233,285	12.5	29161
2004	242,616	15	36392
2005	252,321	25	63080
2006	262,413	50	131207
2007	272,910	65	177391
2008	283,826	70	198678
2009	295,179	75	221385
2010	306,987	80	245589
2011	319,266	85	271376
2012	332,037	85	282231
2013	345,318	85	293520
2014	359,131	85	305261
2015	373,496	85	317472
2016	388,436	85	330170
2017	403,973	85	343377
2018	420,132	85	357112
2019	436,936	85	371397
2020	454,415	85	386253
Total (2007-2020)	4,992,043	-	4,101,213

Source: WMU (modified by the LS-MFEZ JST)
* 4% of Increase Rate is highest assumption by WMU

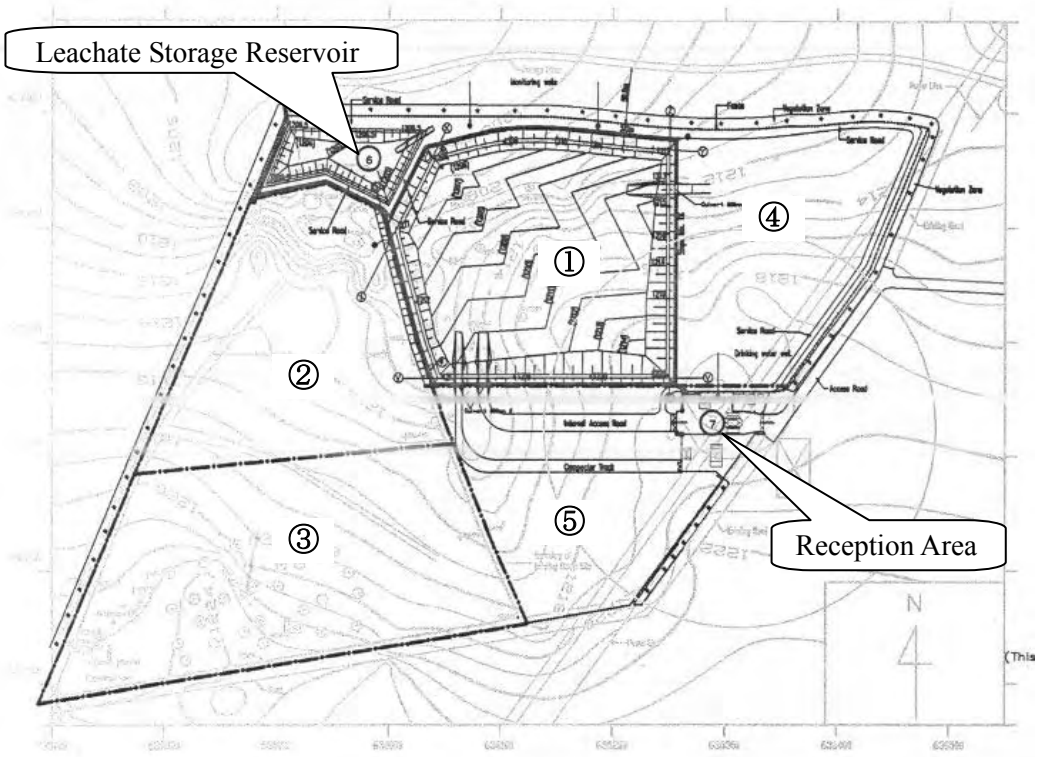
4.5.4 LANDFILL

Chunga landfill site started operation in 2007. It has a leachate collection system with HDPE liner sheet for groundwater protection. Leachate from landfill is collected into the leachate storage reservoir. There is no treatment system and no outlet. In flow and evaporation is balanced. Capacity of landfill and extension plan is shown in Table 4.5.2.

Currently 4.7ha of stage 1 is under operation. The capacity of the landfill in meeting with the assumption of solid waste amount is described in Table 4.5.1.

Table 4.5.2 Capacity of the Chunga Landfill Site

Section (stage)		Year of Construction	Landfill Area (ha)	Landfill Capacity (m^3)	Disposal Period
①	1	2005	4.7	620,000	2006 - 2008
②	2	2008	4.2	715,000	2009 – 2011
③	3a	2011	4.3	694,000	2012 – 2013
④	3b	2013	5	1,507,000	2013 – 2017
⑤	5	2017	4	688,000	2018 – 2020
Total			22.2	4,224,000	



4.5.5 INDUSTRIAL WASTE

Industrial waste shall be managed by generators themselves. Unfortunately, the actual condition of hazardous waste management is not clear since Lusaka City does not have hazardous waste disposal facility. Incineration is one of the disposal methods of hazardous waste. University Teaching Hospital (UTH) has three incinerators whose capacities are 150kg/h, 300kg/h and 500kg/h. UTH accepts to incinerate not only medical waste but also hazardous waste and confidential document from enterprises.

4.6 POWER SUPPLY CONDITIONS

4.6.1 PRESENT STATE OF POWER SECTOR

(1) Organizations

The overall responsibility for energy administration and policy formulation lies with the Ministry of Energy and Water Development (MEWD). Under the supervision of MEWD, the ZESCO is a vertically integrated public power utility, with generation, transmission, and distribution. ZESCO owns most of the power stations including small hydro and diesel power, transmission lines, and distribution facilities in Zambia. ZESCO is undergoing commercialization to improve its performance although the Government still retains 100% in the company.

(2) Power Demand and Supply

Table 4.6.1 shows the details of the major hydropower stations. According to ZESCO, the maximum power demand is 1,400MW in 2008, already exceeding the present supply capacity of 1,008MW. The majority of large consumers have self-generating facilities to provide for load shedding in Zambia. ZESCO owns three large hydropower stations, and all of their major works fall under a Power Rehabilitation Project (PRP). Therefore, ZESCO plans to expand the power generating capacity to 1,880MW by completing the PRP to mitigate this situation.

Table 4.6.1 Three Major Hydropower Stations

Name of Power Station	[Unit]	Kariba North	Kafue Gorge	Victoria Falls	Total
Number Units	Set	4	6	14	—
Original Installed Capacity	MW	600	900	108	1,608
Available Capacity (present)	MW	300	600	108	1,008
Expected Capacity after Rehabilitation	MW	720	990	108	1,818

Source: ZESCO

(3) Future Planning

In the future, as the domestic electricity consumption starts increasing rapidly, the supply-demand balance will become tighter. The ZESCO Generation Development Plan, shown in Table 4.6.2, plans expansion of the power generating capacity to 1,230MW through the projects. However, if demand continues to grow at the current pace, the supply-demand balance could become even tighter.

Table 4.6.2 Major Generation Development Plan of ZESCO

Name of Power Station	[Unit]	Itezhi-Tezhi	Kariba North	Kafue Gorge Lower	Total
Number Units	Set	1	5	1	—
Installed Capacity	MW	120	360	750	1,230

Source: ZESCO

4.6.2 EXISTING SYSTEM

(1) Transmission System

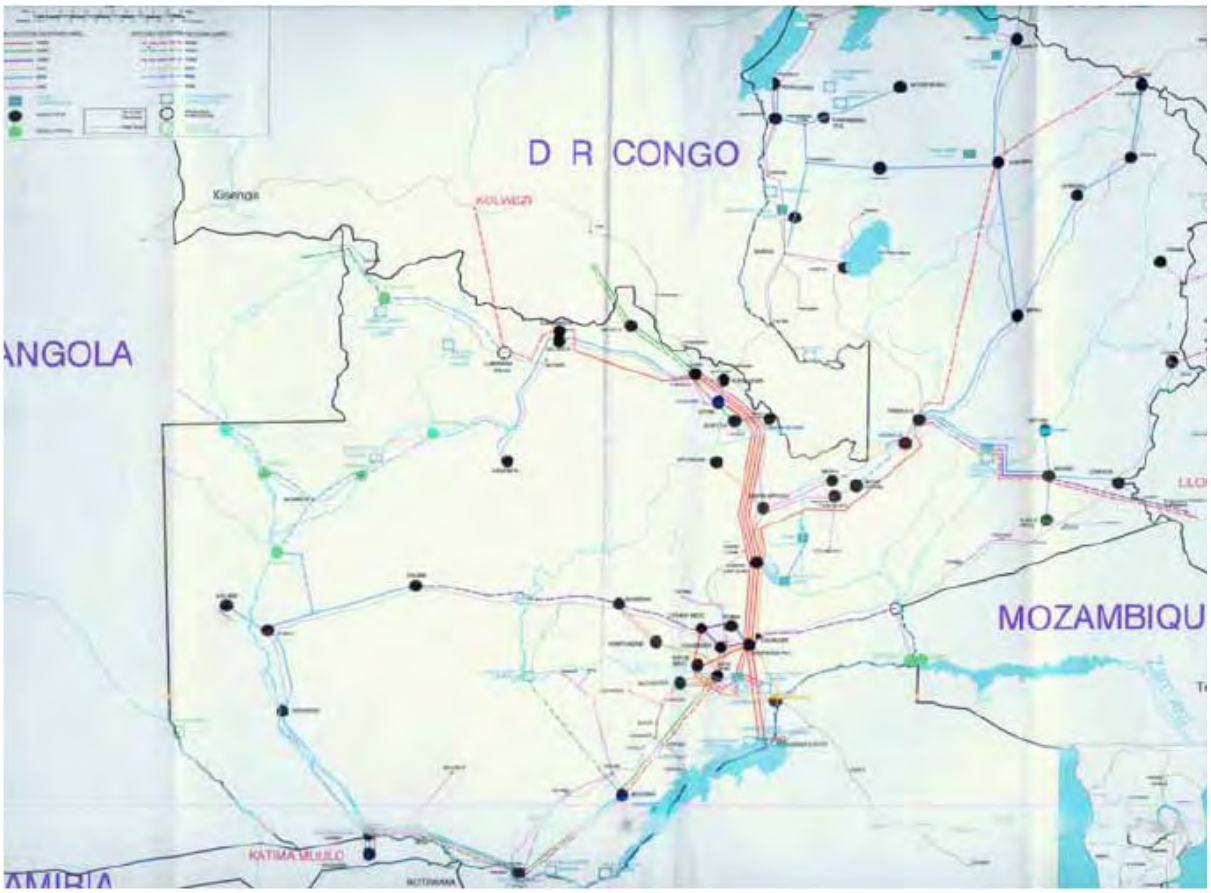
Power transmission systems are as follows.

- ZESCO's transmission system has various voltage levels, 330kV, 220kV, 132kV, 88kV and 66kV. These voltage levels are stepped-down to 33kV and 11kV for distribution at substations.
- ZESCO's power system is interconnected to that of neighboring countries as part of the Southern African Power Pool (SAPP). SAPP consists of power systems in southern African countries, namely Angola, Botswana, Democratic Republic of Congo, Lesotho, Malawi, Mozambique, Namibia, Republic of South Africa, Swaziland, Tanzania, Zambia and Zimbabwe, though actually some of these countries are not interconnected yet.

Figure 4.6.1 and 4.6.2 are the system diagrams in Zambia as of 2007. Most of the system is owned and operated by ZESCO. According to ZESCO statistical data, total circuit length of 330kV transmission lines is 2,241km, total 220kV lines 348km, total 132kV lines 202km, total 88kV lines 754km, and total 66kV lines 3,033km as at the end of March 2006. In addition, Copperbelt Energy Corporation also has transmission lines whose total length is 808km. The ZESCO transmission system, as part of SAPP, has interconnection with DR Congo, Zimbabwe and Namibia in the south, and is also used for international power trade.

4.6.3 DISTRIBUTION SYSTEM

The distribution network is operated at 33kV and 11kV middle voltage and 400/230V low voltage. Total length of 33kV and 11kV lines is 2,245 km and 7,000 km respectively, but detailed facility data and operation data is not maintained. In addition, the statistics of 400/230V lines are not available. Almost all the distribution lines are overhead wires, except for underground cables installed in some parts of town centres.



Source: ZESCO

Figure 4.6.1 ZESCO Grid 33KV to 330KV and Regional Transmission Line Interconnectors

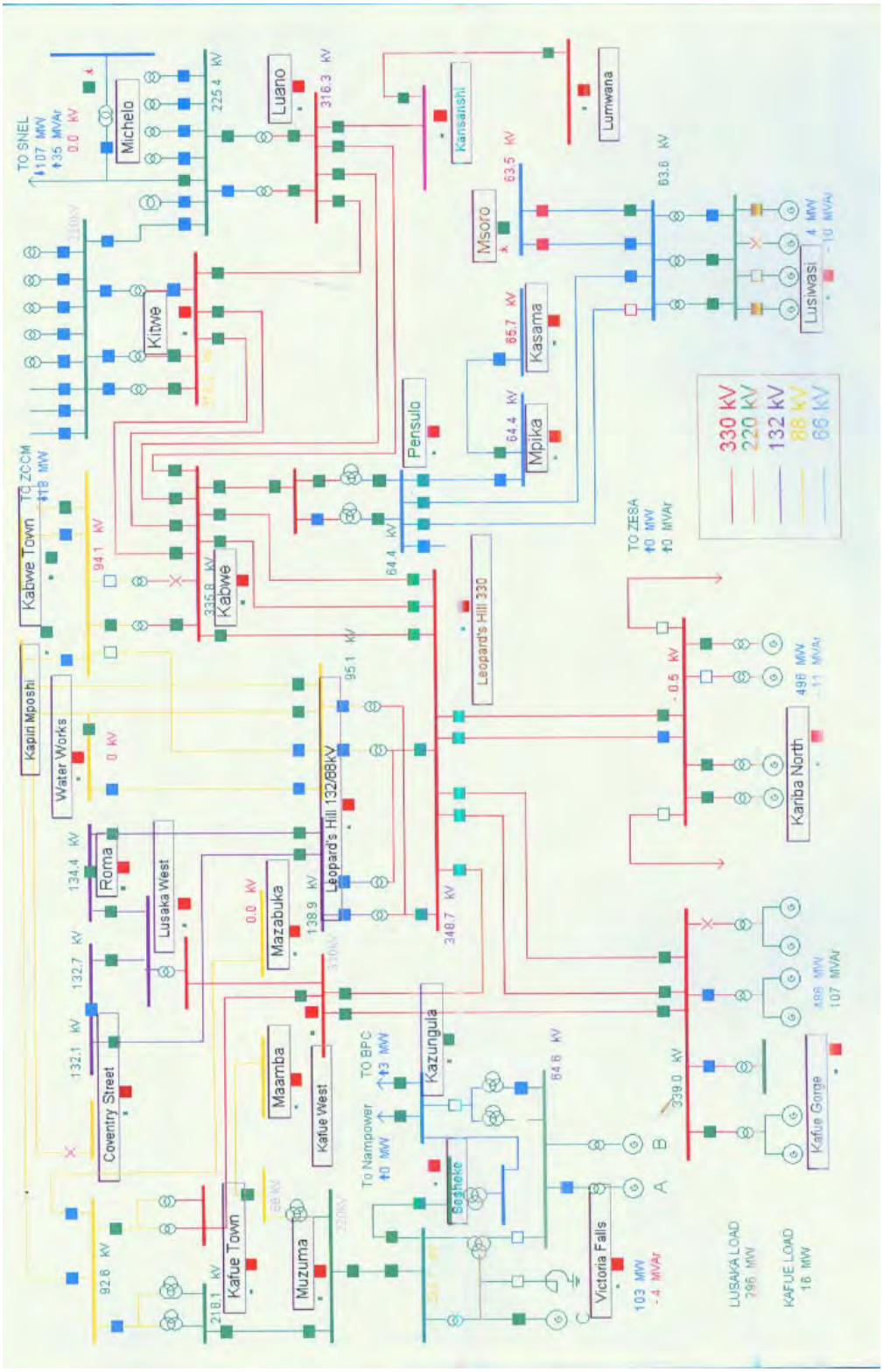


Figure 4.6.2 Zambia Transmission System Diagram

4.7 TELECOMMUNICATIONS SYSTEM

4.7.1 ORGANIZATIONS

In July 1994 the Government of Zambia passed a Telecommunications Act that led to the splitting up of the Post and Telecommunications Corporation (PTC) into two (2) separate companies, named Zambia Postal Service Corporation, and Zambia Telecommunications Company Ltd (Zamtel).

The public telecommunication services in the republic of Zambia are provided by the Zamtel a, state owned company under the Ministry of Transport and Communications. Zamtel is a market leader in the information communications technology (ICT) industry.

4.7.2 DEVELOPMENT PROJECT

The Telecommunication system has been converted from analogue to digital systems and now to the Next Generation Network soft switches.

The following projects are carried out in a telecommunication sector.

- Lusaka New Generation Network (Metropolitan Fiber Network) Project
- Optical Fiber National Backbone Project

According to Zamtel, when those projects are completed, telecommunication services of high quality would be provided at inexpensive rate schedules.