LUSAKA WATER AND SEWERAGE COMPANY LIMITED

E1376

ZAMBIA

Water Sector Performance Improvement Project

ESMF - Environmental and Social Management Framework

FINAL REPORT

April 2006

Norconsult
EXECUTIVE SUMMARY

Project Outline
The project is funded by the World Bank and its main focus is to support improved performance and increase water and sanitation services in the City of Lusaka, Zambia. The project is designed as an Adaptable Program Lending (APL) instrument in two phases.

Phase I (2006-2009) supports Lusaka Water and Sewerage Company (LWSC) with an estimated US$ 20 m: This component aims to introduce performance improvements and commercial management methods for LWSC to become a financially sustainable utility with the ability to finance new investments from its own cash flows in the longer term. The majority of the works and goods under this component are aimed at rehabilitation. This includes funds for Emergency Works, goods, works and working capital to support a Development Financing Agreement, a Human Resources Strategy and Implementation, Design and Tenders and EIA for Phase II.

Phase II of the APL (due to start in 2010). The estimated cost of Phase II for LWSC is around US$ 20 m. The achievement of the key objectives in Phase I would permit the move to Phase II which would include the scale up of infrastructure investments in urban areas, mainly Lusaka.

Study Framework
This Environmental Study is provided as an Environmental and Social Management Framework (ESMF) covering the items as defined below:

i. Engineering works for rehabilitation, networks extensions and other works in the medium phase for the implementation of the Performance Agreement
ii. Working capital for operational costs in the Performance Agreement

Project Works
It is important to understand the scope of the works, in order to also understand the Consultant’s approach in dealing with both the evaluation of the environmental impacts, and the subsequent reporting.

The summarised works items are shown in Table A below.

Table A: Components of the LWSC Rehabilitation Project, Lusaka

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Policy, Legal and Administrative Framework

The World Bank Governing policy is OP 4.01. At present this project is categorized as “B”. This means all components of the Project with the exception of capacity building will be subject to environmental assessment (EA).

The Environmental Council of Zambia (ECZ) has two formats for environmental assessment:

- The first is an Environmental Project Brief (EPB), which covers small projects, and/or projects that undertake works in already disturbed areas.
- The second is a full Environmental Impact Assessment, which covers projects where impacts will occur to natural areas and/or to natural resources, as a result of new activities.

The regulations covering environmental assessment are covered principally by the Environment and Pollution Control Act (1990), and for purposes of ESMF, are covered by the 1997 Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations.

In terms of this project, the works are covered under the EPB Requirements of the ECZ as described under the First Schedule of the 1997 regulations.

The consultant also examined the need for possible compensation as a result of the works associated with the project in light of World Bank OP and BP 4.12. OP 4.12 may be triggered under WSPIP (Phase I). Precise locations of works have not yet been established and therefore a Resettlement Policy Framework (RPF) needs to be in place to cater for all possibilities. OP4.12 may be triggered in the project by:

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1. Note: OP and BP 4.01 together replace OMS 2.36, Environmental Aspects of Bank Work; OD 4.00, Annex A, Environmental Assessment; OD 4.01, Environmental Assessment.

• Encroachments - The social-economic analysis undertaken in the process of preparing the ESMF reported numerous cases where it is expected that pipes and other water and sewerage infrastructure belonging to LWSC has been built over. Houses, buildings and other assets (including gardens) have encroached on rights of ways. To access this infrastructure, LWSC may be required to destroy or damage assets (for instance, walls and fences) to undertake rehabilitation works.

• Unforeseen events, accidents, and by minor changes in project specifications that may cause damage to or loss of assets. In some areas, dwellings, fences, etc. are close to proposed infrastructure rehabilitation and access is very confined, for example during pipe laying.

Public Consultation
The public consultation and awareness programme has involved a 3 tier process:

1. Informal meetings held at community level in the proposed areas of works
2. *Ad hoc* discussions with key Government agencies and NGOs as appropriate
3. A formal workshop for key stakeholders held to present the draft report findings

Informal meetings with community leaders in affected areas have ensured that people who will be affected by the works programme are both aware of the impending project and are aware of the probable effects. Any comments or concerns raised by the community at this stage have been incorporated into the environmental management plan (EMP) where they are relevant.

In addition to the site inspections and consultations within the LWSC, extensive consultations were carried out with people from different departments within Government Ministries and Departments, and with representatives of communities that will be affected by the rehabilitation works programme.

Additional communications were held with the ECZ regarding the expected levels of impacts and proposals to cover the likely approach of the ESMF, mainly through an EMP.

Environmental Impacts
Overall, once the works are completed, there will be a significant net positive social and environmental benefit to the citizens of Lusaka.

However, limited negative environmental and social impacts will occur for short periods during the works. By careful pre-planning by the organisation contracted to undertake the rehabilitation works all the negative impacts can be addressed through an EMP. Compensation issues if any arising from damage or destruction to assets will be addressed through the RPF.

The bulk of the impacts fall under Construction phase works, mainly trenching and excavation works. There are two categories of trenching works, firstly water supply lines, and secondly sewer pipelines.

The water supply lines are mainly small diameter, especially in the peri-urban settlements, where the longest sections of pipeline are to be installed. The trenches will mostly be up to 1.5 m depth and approximately 0.5m wide.

Most of the sewer trench works will occur in urban areas, and most of the trenches will be of depths to a maximum of 2m and widths to a maximum of 1.5m. There is one 200m section, however, that will be as deep as 4m for a length of 500m.
The secondary or indirect impacts of the trenching works will be disruptions to traffic, pedestrians, and safety issues where trenches are located along pedestrian pathways and where they may block access to private and/or public property in both residential and commercial areas in Lusaka.

These impacts can be minimised, in terms of severity and duration, by ensuring that the excavation and construction works are limited to short working sections, and that works are carried out rapidly and efficiently.

The remainder of the impacts will be site specific, and generally within the LWSC operating sites. The EMP for the project has been drawn up according to the anticipated impacts from the rehabilitation works and subsequent operating phases.

**Conclusions**
The representative works as identified are unlikely to call for any permanent land take or destruction of houses and not necessitate any movement or resettlement of people. If assets are damaged or people's lives disrupted, the RPF has been prepared to compensate for these actions.

From the impact assessment carried out the environmental acceptability of the project may be summarised thus:

- **Terrestrial Ecology.** Very minor negative impacts; all capable of being reduced to an acceptable level through environmental management planning.

- **Aquatic Ecology.** No significant negative impacts on the Kafue River or on water courses in and around Lusaka.

- **Water Quality:** No negative impacts.

- **Air and Noise Quality:** Minor negative impacts associated with dust, fumes and noise from construction works and rock blasting.

- **Landscape:** Very small-scale and largely temporary negative impacts associated with works areas.

- **Socio-Economic and Cultural Environment:** Minor short-duration socio-economic impacts associated with construction works. Mitigation possible through an effective environmental management plan and resettlement policy framework.
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ACRONYMS AND ABBREVIATIONS

CSO  Central Statistics Office
DISS  Department of Infrastructure Support Services
DWA  Department of Water Affairs
EA  Environmental Assessment
ECZ  Environmental Council of Zambia
EFR  Environmental Flow Requirement
EIA  Environmental Impact Assessment
EMP  Environmental Management Plan
EPB  Environmental Planning Brief
ESMF  Environmental and Social Management Framework
GIS  Geographical Information System
GRZ  Government of Republic of Zambia
IDA  International Development Association
JICA  Japanese International Cooperation Agency
LCC  Lusaka City Council
LWSC  Lusaka Water and Sewerage Company Ltd
LUAs  Large Urban Areas
MEWD  Ministry of Energy and Water Development
MI/d  Million litres per day
MTENR  Ministry of Tourism, Environment and Natural Resources
NWASCO  National Water and Sanitation Council
NECZ  National Environmental Council of Zambia (Website)
NGO  Non-Governmental Organisation
RPF  Resettlement Policy Framework
SUTs  Small Urban Towns
SWRP  Support to the Water Sector Reforms Project
USD  United States Dollar
WRAP  Water Resources Assessment Programme
WSS  Water Supply and Sanitation
ZESCO  Zambia Electricity Supply Corporation
ZNFU  Zambian National Farmers Union

ACKNOWLEDGEMENTS

The Consultant would like to acknowledge the extremely useful help and co-operation from Lusaka Water and Sewerage Company in the preparation of this report.
1 PROJECT BACKGROUND & OBJECTIVES

This project is focused on increasing access and improving reliability to safe water and sanitation services to the residents of Lusaka city, Zambia. The project will:

i. promote equity in service provision, increase financial self-sufficiency of the WSS sector and therefore decrease GRZ subsidies to the sector; and

ii. support economic growth, by assuring the Lusaka Water and Sewerage Company (LWSC) service provision achieves economies and efficiencies to deliver services to current and future consumers (domestic and industrial) in a reliable and cost-effective manner.

The current situation regarding water supply and sewerage management within Lusaka is that many areas are working efficiently, while some areas are experiencing problems. These problems are listed as follows:

- Inadequate water supplies in some new residential areas and informal settlements
- Broken water supply lines
- Absence of water pressure in upper storeys or urban flats and office blocks due to small diameter pipelines with related pressure drops,
- Inadequate facilities to draw off sewerage
- Broken sewer lines and inadequate facilities to move sewerage to treatment works sites
- Inadequate facilities to treat sewerage in some suburbs/districts

The proposed objective of the project is to ensure that water sector resources are effectively and efficiently used to contribute to poverty reduction. Specifically, the Project will:

i. Provide increased access to improved water and sanitation services in Lusaka in a more efficient and sustainable manner, and

ii. Initiate design studies for further upgrading and rehabilitation under the same funding package

1.1 Components Requiring Environmental Impact Assessment

The project is funded by the World Bank and its main focus is to support improved performance and increase water and sanitation services in the City of Lusaka. The project is designed as an Adaptable Program Lending (APL) instrument in two phases.

This Environmental Study concerns Component A in Phase 1 of the overall study as defined below:

iii. Engineering works for rehabilitation, networks extensions and other works in the medium phase for the implementation of the Development Financing Agreement for Performance Enhancement (DFA)

iv. Working capital for operational costs in the DFA.
2 BIO-PHYSICAL CONTEXT

Lusaka is the capital city of Zambia with its climate which is typical of a sub-tropical environment and characterized by three distinct seasons: the cool dry season experienced from May to August: the hot dry season from August to November and the rainy season from November to April. The mean annual temperature ranges between 18°C and 20°C. The highest annual average temperature is 32°C and the lowest temperature averages 4°C.

Lusaka is situated on the high plateau of Central Africa, with an average altitude of 1,200 meters above sea level. The topography is flat to undulating with ridges and drainage basins, the latter which feed the Kafue River. The majority of the drainage in Lusaka flows in a northerly direction before turning to the southwest into the Kafue River. The Kafue then flows south-westwards before turning to the south east to join the Zambezi River.

The soils of Lusaka are primarily determined by their position on the landscape. 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 limestones and laterites derived from these beneath the greater Lusaka area. These areas where shallow groundwater is found in the city of Lusaka.

The prominent vegetation type is the Miombo savanna woodland (dominated by species such as Brachystegia, Baikiaea, Pterocarpus, Azanza, Acacia, Albizia and Ficus in particular), with a canopy density varying from closed in heavily wooded areas located on hills and hill foot-slope areas, to open on the lower lying floodplain margins. The next in prominence is the grasslands, which are located on the low-lying Dambo areas. These are predominantly areas prone to seasonal flooding as they receive rainfall runoff from the adjacent hilly areas. Scattered throughout the area are bush aggregations / clumps that are associated with termite mounds.

2.1 Rainfall and Hydrology

The project area falls within the Kafue catchment. Rainfall is primarily determined by the north south movement inter-tropical convergence zone over Zambia. Early rains however are caused by the Congo air boundary resulting from the convergence of westerly winds from the Atlantic ocean with the south-east trade winds.

The mean annual rainfall in the Lusaka area and representative of the central drier parts of the country is 836 mm, 90% of which falls in the rainy season between November and March. The coefficient of variability of the rainfall is 20% while the distribution and pattern of rainfall during the season is variable and the number of rain days is approximately half the total number of days in the season. There is a tendency for the rain days to be grouped in rainy spells. In Lusaka, usually the rain season begins with isolated showers from thunder storms. These may be intense and follow narrow paths. As the season progresses, these storms become less isolated with broader storm paths, but much of the total rainfall still
occurs as heavy showers. Wide spread and steady rains may often follow these initial showers and link successive storms to produce rainy spells sometimes lasting several days. Intense rain during such spells may cause water logging, very high runoff and aquifer recharge. Intensities of individual storms frequently exceed 25 mm/hour and can exceed 75 mm/hour thereby causing drainage problems to the city’s storm water system.

Although there are no major rivers within the city, the variations in the rainfall cause related variations in stream flows and changes in the groundwater recharge storage and discharge. It has also been observed that dolomite aquifers can receive most of the annual recharge in one or two rainfall events, while huge stream flow a major concern to the city’s excessive load on sewerage disposal to the natural environment.

2.2 Groundwater Hydrogeology

Groundwater resources in the Greater Lusaka area is a function of recoverable volume of water in storage in the identified aquifers and the periodic changes in this storage caused by recharge, discharge and abstraction. LWSC maintains and monitors the water quality in order to dictate its use for public, industrial and domestic supplies.

The limestones and dolomites which underlie the Lusaka area, are within the current understanding of the regional hydrogeology, the only viable aquifers for large scale developments. The limestones and dolomites display strong karstic features resulting from the solution of carbonate matrix by circulating groundwater in accordance with established karstic geomorphological processes (i.e. propagation of permeability and groundwater flow is favoured along fractures/ faults and contacts with less permeable rocks).

The action of karst processes has divided each limestone and dolomite outcrop into a number of discrete groundwater catchments. Groundwater development within one of these discrete catchments may not markedly deplete the resources available from neighbouring catchments. In addition it is important to note that the total catchment area is considerably larger than the aerial extents of the relevant aquifers. Thus, significant recharge may occur through the lateral migration of groundwater from adjacent formations. This should be taken into account when evaluating the groundwater resources and planning development for Lusaka.

Considerable information is available for the Lusaka aquifers including long-term groundwater levels and reasonable assessments of well yield and abstraction. Recharge rates have been reasonably established at 8 to 20% of rainfall.

Catchment Hydro-environment

There is no systematic water quality monitoring of the Kafue River and its tributaries to indicate background hydrochemistry. The sporadic water quality sampling that has been undertaken to date has been done without reference to simultaneous discharge data and does not provide a basis for definitive hydrochemical analysis.

LWSC is, however, monitoring bacterial and nutrient contents at selected points including production bore holes throughout Lusaka. Additional information on water quality in this report is described in greater detail in Appendix 6.
3 PROJECT WORKS

It is important to understand the scope of the works, in order to also understand the Consultant’s approach in dealing with both the evaluation of the Environmental Impacts, and the subsequent reporting.

As a water supplies and sanitation project, there are a variety of components, and these are briefly described below. Reference is also made to the lists of maps in Appendix 3 showing an outline of the city and selection aerial images with existing and planned improvement to water services infrastructure superimposed.

3.1 Water Supply System

The water supply system has two components, a pump intake on the Kafue river with water treatment works, piping and booster pump stations into Lusaka and numerous boreholes scattered throughout the city. Before entering the secondary supply network and subsequently the end users, water from surface and ground sources collects and mixes in storage and treatment facilities. These are located on various high points throughout the city.

The connecting supply pipelines have diameters ranging from 750mm for the main Kafue supply line into Lusaka, and grading down to 550mm to 450mm for the main reticulation lines form the main storage reservoirs to the local suburban water supply tanks.

Local water supply lines start at 300mm and then subsidiary branches decrease, to terminal lines at 75mm.

As the pipes become smaller in diameter, they are buried in smaller and narrower trenches. The largest pipes require trenches up to 2m deep and 1.5m wide, while the smallest pipes require only 0.75m depth and up to 0.3m width.

Since the water supply is pressurised to ensure it will reach facilities located in tall buildings, the pipes can be buried to standard depths, but the lines can also follow contours (unlike sewerage outfall pipelines).

3.2 Sewerage Reticulation and Treatment Works

The sewerage reticulation system starts at the offtake from individual properties, including private houses, business premises and from larger institutions (e.g. Government Office Blocks, Prisons, Hospitals, and Hotels etc). From there the primary sewers lead into larger and larger pipelines, located at increasing depths.

In some parts of the city, the sewerage cannot continuously move down the various pipelines to the terminal treatment works areas. Where this occurs, the sewerage is collected in a tank and pumped under pressure to the treatment works.

Sewer outfall lines follow specified gradients, and as a result, the largest diameter pipes are often buried at depths of about 3-4m below the ground. As a result any excavation work will require trenching to depths of 3-4m and widths of up to 1.5m.

The Sewerage Treatment Works consist of primary ponds where solid sewerage is decomposed through bacterial action under anaerobic conditions, then the sewerage water flows into maturation ponds, where organic and inorganic compounds are subject to further
bacterial action under aerobic conditions. At this stage the water is filtered to remove suspended solids, before allowing it to enter into a local river, or stream.

### 3.3 Rehabilitation and Upgrading

The scope of works for this project covers a variety of elements, located at various points around the city of Lusaka. The rehabilitation and upgrading works have different components and these fall under 6 main categories, as follows:

1. Replacement of non-working parts – mechanical, electrical and instrumentation (e.g. water flow meters, automated chlorination equipment)
2. Replacement, or refurbishment of faulty or damaged equipment, especially pumps, pressure release valves and surge protection tanks, and broken water supply pipelines
3. Repairs to leaking water storage tanks
4. Replacement of decayed and broken sewage supply pipelines and associated pumping equipment, and installation of new sewage lines in urban and peri-urban areas
5. Repairs to non-working equipment, and to treatment pond infrastructure and embankments in the sewage treatment works
6. Removal and disposal of residual waste water and sludge from pipes and trenches
7. Identification of new water supply boreholes in available open space around the city and in the peri-urban areas

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<td>Sludge Removal, repair embankments, wave protection, works to banks and</td>
</tr>
<tr>
<td>treatment works</td>
<td>sewage treatment plants</td>
<td>installation of flow meters</td>
</tr>
<tr>
<td>Rehabilitation of existing</td>
<td>Emergency Works</td>
<td></td>
</tr>
<tr>
<td>maturation ponds</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For the purpose of this ESMF, the project elements have been assessed individually, however as representative works, according to location and the extent and duration of environmental impacts that are likely to occur.

Justification for this approach is provided later in this report, but it is important to be aware that the expected (negative) environmental impacts will only be experienced during the period when excavation works take place when the majority of the water and sewerage infrastructure repairs are underway.
4 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

4.1 World Bank

The World Bank Governing policy is OP 4.01. Considering that project activities will be largely confined along existing infrastructure and road alignments, conflicts with natural habitats and sites of cultural/historical value are extremely unlikely. As a result it is assumed that additional policies such as Natural Habitats (OP4.04) and Cultural Property (OPN 11.03) are not triggered by the project activities. However, upon using the screening checklist if it is found that any of these policies are triggered by a subproject, then a subproject specific EMP will be prepared and implemented, that will comply with the policy that is triggered.

Conflicts may, however, arise where residents/ businesses will have to be temporarily moved to allow access to buried pipes, especially in the peri-urban areas where many settlements are situated on top of water supply pipes. The applicable policy concerning compensation and resettlement in these cases are World Bank OP and BP 4.12. The applicable policy and procedures are set forth in the Resettlement Policy Framework (RPF) included in Appendix 5 of this report. This document is disclosed separately by the World Bank.

At present this project is categorized as “B”. This means all components of the Project with the exception of capacity building will be subject to environmental assessment (EA). An explanation of category B requirements follows.

Category B: A proposed project is classified as Category B if its potential adverse environmental impacts on human populations or environmentally important areas — including wetlands, forests, grasslands, and other natural habitats — are less adverse than those of Category A projects. These impacts are site-specific; few if any of them are irreversible; and in most cases mitigatory measures can be designed more readily than for Category A projects.

The scope of EA for a Category B project may vary from project to project, but it is narrower than that of Category A EA. Like Category A EA, it examines the project's potential negative and positive environmental impacts and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance.

The civil works components of the Project will be the main focus of the EA and concerns mainly rehabilitation. These works have been described in the above sections.

4.2 Environmental Council of Zambia (ECZ)

The Environmental Council of Zambia has two formats for environmental assessment.

- The first is an Environmental Project Brief (EPB), which covers small projects, and/or projects that undertake works in already disturbed areas.

3 Note: OP and BP 4.01 together replace OMS 2.36, Environmental Aspects of Bank Work; OD 4.00, Annex A, Environmental Assessment; OD 4.01, Environmental Assessment.

4 World Bank OP and BP 4.12 together replace OD 4.30, Involuntary Resettlement
The second is a full Environmental Impact Assessment, which covers projects where impacts will occur to natural areas and/or to natural resources, as a result of new activities.

The regulations covering the environmental assessment are covered principally by the Environment and Pollution Control Act (1990), and for purposes of ESMF, are covered by the 1997 Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations.

Under the terms of the 1997 Regulations, the onus is on the Lusaka Water & Sewerage Company to submit a Project Brief to the ECZ outlining the activities. Thereafter, ECZ will take up to 20 days to review the project outline and determine whether an EPB or a full EIA will be required. In either case, Terms of Reference for the environmental report are developed under the ECZ guidelines.

In terms of this project, the works are covered under the EPB Requirements as described under the First Schedule of the 1997 regulations. The works schedules (as given in Table 1) are covered as indicated in Box 1.

**Box 1**

<table>
<thead>
<tr>
<th>PROJECTS THAT REQUIRE PROJECT BRIEFS</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Projects</td>
</tr>
<tr>
<td>(a) Urban area rehabilitation.</td>
</tr>
<tr>
<td>(n) Pumped storage schemes</td>
</tr>
<tr>
<td>12. Others</td>
</tr>
<tr>
<td>(f) Projects located in or near environmental sensitive areas such as:-</td>
</tr>
<tr>
<td>(ix) areas prone to flooding and natural hazards;</td>
</tr>
<tr>
<td>(x) water catchments containing major sources for public, industrial or agricultural uses; and</td>
</tr>
<tr>
<td>(xi) areas of human settlements (particularly those with schools and hospitals).</td>
</tr>
</tbody>
</table>

The project works are expected to be covered to the largest extent through an Environmental Management Plan (EMP). This document will be guided by the ECZ 1997 Regulations, in addition to regulations covering Waste Management, Noise, Air Pollution, Water Pollution, Disposal of Hazardous Wastes (in this instance, sewerage effluent), and Control of Pesticides and Toxic Substances.
5 THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

5.1 Consultant's Approach to the ESMF Process

The ESMF falls under World Bank Category B, and is confined to the Lusaka service area. Under National regulations the work proposed falls under the category requiring an Environmental Project Brief.

The Consultant also examined the possible need for compensation as a result of works associated with the project in the light of World Bank OP and BP 4.12. In case the latter is triggered reference is made to the Resettlement Planning Framework (RPF) for more detailed description of the guidelines to be adhered to. These policy guidelines are essentially those in place currently at LWSC and based on the Water and Sanitation Act of 1997 as well as other Acts. The RPF is a separate document and is disclosed with the ESMF.

The ESMF was conducted with an initial scoping study to review the type of work that will be conducted under the rehabilitation and extension works undertaken. Essentially, the Environmental scoping study assessed all the elements as described by the Lusaka Water and Sewerage Company.

Following the scoping study, further investigations were conducted at the representative sites where the works are required. In addition to site inspections, consultations were carried out with the LWSC Engineering Section about the proposed methodology for construction and/or rehabilitation and with the Area and Site Managers.

Fieldwork undertaken consisted of visits to representative sites accompanied by LWSC field staff, to assess the extent of probable impacts at each representative rehabilitation site. Digital photos were taken of the areas to indicate the typical conditions in the works areas, and GPS readings were taken, to verify the locations as shown on the LWSC GIS System (see Appendix 3 for works locations).

5.2 Environmental Management Plan

The project is intended to result in a net positive environmental impact on the residents of the City of Lusaka. Where negative environmental impacts are expected within the scope of the works they will be experienced during the rehabilitation/construction phase.

To help offset any potential negative impacts the main focus of this study will be on the project environmental management plan. Box 2 sets out the framework for an EMP.

Within the Environmental Management Planning process, the Consultant has identified the need for increased effort and cost to mitigate the impacts, and an increased effort to ensure that the EMP is fully implemented by the organisation contracted to undertake the civil and mechanical works (the Contractor) - see Appendix 4.

---

5 World Bank OP and BP 4.12 together replace OD 4.30, Involuntary Resettlement
Box 2

**The environmental management plan (EMP)**

Reducing potential negative impacts to a tolerable level during the construction phase especially is the purpose of having an environmental management plan (EMP). The EMP sets out what should be done (and what should not be done) and how those actions should be performed to avert environmental harm or to keep it to an acceptable minimum.

The main responsibility for producing the EMP falls on the project proponent. This responsibility is fulfilled:-

- by ensuring that social and environmental aspects are integrated with project planning and design;
- through regulation and supervision of the contractors during the tender and construction; and;
- by observing approved measures throughout the operational period.

The EMP enables environmental mitigation measures to be effectively integrated into project planning and implementation. As compliance with provisions of the EMP is ultimately the responsibility of the proponent of the project he must extend this to bind contractors and sub-contractors.

5.3 Monitoring Schedule and Guidelines for Contractors

To ensure that the EMP is adhered to a monitoring schedule has been provided, with recommendations included for identifying the person(s) responsible for checking on the Contractor that the EMP is implemented (Appendix 4).

To ensure that the Contractor is able to comply with the EMP effectively it should become part of the special conditions of contract and the Contractor must include adherence to the specifications in their bid (the cost of mitigation is therefore assumed under the contractor’s price proposal).

To assist this process, the EMP is written in a format that will provide guidelines to be included with the tender documents.

5.4 Public Consultation

The public consultation and awareness programme has involved a 3 tier process:

4. Informal meetings held at community level in the areas of works
5. *Ad hoc* discussions with key Government agencies and NGOs as appropriate
6. A formal workshop for key stakeholders held to present the draft report findings

Informal meetings with community leaders in affected areas have ensured that people who will be affected by the works programme are both aware of the impending project and are aware of the probable effects. Any comments or concerns raised by the community at this stage have been incorporated into the EMP where they are relevant.
During the ESMF process, public consultations have been held during meetings and representative site visits together with LWSC. These meetings and site visits helped to determine the proposed scope of works and the LWSC’s intended work methodology. These were used to determine the probable impacts on the physical and social environment.

In addition to the representative site inspections and consultations within the LWSC, extensive consultations were carried out with people from different departments within Government Ministries and Departments, and with representatives of communities that may be affected by the rehabilitation works programme. These were conducted by the Consultant's Sociologist and Community Health and Safety Specialist (results are included in Appendix 2).

Additional communications were held with the Environmental Council of Zambia regarding the expected levels of impacts and proposals to cover the likely approach of the ESMF, mainly through an EMP.

**Key Institutional Stakeholders**

A list of key institutional stakeholders consulted has been drawn-up mainly from the statutory entities that will directly and/or indirectly have some interest in the Works Programme These are listed in Table 2 below.

**Table 2: Key Institutional Stakeholders**

<table>
<thead>
<tr>
<th>Stakeholder Institutions</th>
<th>Affiliate Contact Agency or Department</th>
<th>Contact Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government Ministries and Departments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ministry of Tourism, Environment and Natural Resources</td>
<td>Director, Environment</td>
<td>Director, Environment</td>
</tr>
<tr>
<td>Ministry of Local Government and Housing</td>
<td>Director, Department of Infrastructure Support Services DISS</td>
<td>Director, Department of Infrastructure Support Services DISS</td>
</tr>
<tr>
<td>Lusaka City Council</td>
<td>Director, Town and Country Planning</td>
<td>Director, Town and Country Planning</td>
</tr>
<tr>
<td>Ministry of Agriculture and Cooperatives</td>
<td>The Director, Department of Agriculture</td>
<td>The Director, Department of Agriculture</td>
</tr>
<tr>
<td>Ministry of Energy and Water Development</td>
<td>Department of Water Affairs Board</td>
<td>Director of Water Affairs</td>
</tr>
<tr>
<td>Ministry of Energy and Water Development</td>
<td>Water Resources Action Programme</td>
<td>The Secretary of the Board</td>
</tr>
<tr>
<td>Ministry of Health</td>
<td>Lusaka Urban Health Management Board</td>
<td>Environmental Health Expert</td>
</tr>
<tr>
<td>Ministry of Lands</td>
<td>Lands Department</td>
<td>Commissioner of Lands</td>
</tr>
<tr>
<td>Statutory Bodies and parastatals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ministry of Lands</td>
<td>Lands Department</td>
<td>Surveyor General</td>
</tr>
<tr>
<td>National Water and Sanitation Corporation NWASCO</td>
<td></td>
<td>The Director</td>
</tr>
<tr>
<td>Zambia Electricity Supply Corporation ZESCO</td>
<td>Environment Section, Construction Department</td>
<td></td>
</tr>
<tr>
<td>Environmental Council of Zambia ECZ</td>
<td>Inspector EIA</td>
<td></td>
</tr>
</tbody>
</table>

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5.5 GIS Data and Mapping

The GIS data held by LWSC and utilised in this study covers background information (i.e. the baseline conditions) on the general environment plus the layouts for the entire City of Lusaka water supply and sewerage reticulation systems. The relevant data available on the GIS has been presented in Appendix 3, and used for diagnostic analysis and for presentation of findings. This approach has been used in preference to conventional maps as it provides information on the baseline context in addition to geographical location.

6 ASSESSMENT OF ENVIRONMENTAL IMPACTS

Overall, once the works are completed, there will be a significant net positive social and environmental benefit to the people of Lusaka.

However, limited negative environmental and social impacts will occur for short periods. By careful pre-planning by the organisation contracted to undertake the rehabilitation works all the negative impacts can be addressed through an Environmental Management Plan (Appendix 4).

The bulk of the impacts fall under Construction phase works, mainly trenching and excavation works. There are two categories of trenching works, firstly water supply lines, and secondly sewer pipelines.

The water supply lines are mainly small diameter, especially in the peri-urban settlements, where the longest sections of pipeline are to be installed. The trenches will mostly be up to 1.5m depth and approximately 0.5m wide.

Most of the sewer trench works will occur in urban areas, and most of the trenches will be of depths to a maximum of 2m and widths to a maximum of 1.5m. There is one 200m section, however, that will be as deep as 4m for a length of 500m.

The secondary or indirect impacts of the trenching works will be disruptions to traffic, pedestrians, and safety issues where trenches are located along pedestrian pathways and where they may block access to private and/or public property in both residential and commercial areas in Lusaka.

These impacts can be minimised, in terms of severity and duration, by ensuring that the excavation and construction works are limited to short working sections, and that works are carried out rapidly and efficiently.

The remainder of the impacts will be site specific, and generally within the LWSC operating sites. The Environmental Management Plan for the project has been drawn up according to the anticipated impacts from the rehabilitation works and subsequent operating phases.
6.1 Impacts Anticipated During the Works

There are a number of impacts that should be expected during the rehabilitation works programme. These are listed below:

**Trenching and other Excavation Works:**
- Noise, damage to property, danger to traffic due to rock blasting and dust created during excavation
- Disruption to traffic – mainly detours and hold-ups where trenches cross major routes and residential area access
- Destruction of property, e.g. walls, buildings, gardens, property access driveways, churches, markets, informal settlements
- Destruction of vegetation - trees, woodlands, gardens landscapes, parks, etc
- Disruption to pedestrian walkways
- Danger of people, traffic falling into trenches
- Storm-water entrainment in trenches on steep slopes and ponding on level ground
- Damage to adjacent services e.g. to sewer lines where water pipelines are being excavated
- Odours released where sewer lines are excavated, plus potential hazard of raw sewerage being released – particularly in urban and peri-urban areas, soil contamination and spread of diseases e.g. cholera, dysentery, typhoid
- Disruption to other services in narrow servitudes, e.g. power supplies, telephone lines, storm-water drains blocked by soil stockpiles, etc.
- Soils replacement methodologies to ensure rapid rehabilitation of works areas – including road and storm-water drainage repairs
- Landscape rehabilitation works to be completed as rapidly as possible

**Rehabilitation of Site-Specific Works, Such as Reservoirs, Sewerage Maturation Ponds, Lift-Pump Stations Etc:**
- Noise and dust created during excavation
- Additional land requirements where existing facilities cannot contain the extension works
- Disposal of sewerage sludge
- Inadequate storage for sewerage treatment during and/or immediately after high rainfall storms
- Contamination of surrounding drainage lines and major rivers
- Potential contamination of ground water supplies
- Spread of diseases
- Hazards associated with working in these places
- Soil and landscape rehabilitation after works are completed

**Operating Phase Activities**
- Pipeline monitoring, localised repairs
- Demarcation of pipelines
- Water supplies operation
- Borehole testing for groundwater contamination
- Sewerage ponds inflow and outflow quality testing
- Extent of areas impacted by discharge of sewerage into river catchments during high rainfall runoff periods

Tables 3 to 6 in the following pages reflect the types of impacts and how these will be dealt with. The tables have been presented according to the works items with the lowest impacts...
first. This order has been selected to highlight the limited extent of the majority of works items.

**Impacts on Hydrology**
Most of the impacts on surface water will be short term during the construction phase and of negligible significance. However, there will be some rehabilitation works at the water intake on Kafue River; specifically:

- Treatment Works: Up-rating of WTW from 95 Ml/d to 140 Ml/d and replacement of intake and high lift pumping plant.

In view of the importance of maintaining environmental flows in the River the Consultant has analysed the impact on the hydrology of additional abstraction of 45 Ml/d from the River. A simple model has been established to indicate environmental flow (EFR) requirements and then the current and predicted flows have been superimposed upon that.

Figure 1 illustrates the results of the hydrological analysis and as can be seen the additional abstraction has a negligible effect on the River hydrograph (the graph line for existing flow downstream almost indistinguishable from the line showing flow after rehabilitation).

**Figure 1: Hydrological Analysis of Rehabilitation Works on Kafue River (from Source)**

6.2 **Screening checklist**

Note: LWSC currently has an abstraction right of 105 Ml/d from the Kafue River; a new permit will need to be applied for to cover the additional abstraction.
An overview of the work items/sub-projects that require an EMP is presented in Table 3 following a checklist for screening of Site Specific issues below.

The screening checklist will be used before implementing the subprojects. Its purpose is to identify if there are environmental/social issues/safeguards at a particular location that will trigger preparation of an Environmental Assessment and Management Plan (EA/EMP) for the specific works in question.

It is to be noted that a “Yes” or “Don Not Know” response to any of the questions below warrants an investigation by the Environmental Management Officer (EMO, see Appendix 4).

<table>
<thead>
<tr>
<th>#</th>
<th>ISSUES</th>
<th>Yes</th>
<th>No</th>
<th>Do Not Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Is the area zoned for the intended land use?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Will the project involve any involuntary land acquisition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Will there be any private land donation?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Will the project use any vacant public land?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Is the project located in an area with cultural properties such as archaeological, historical sites/monuments, religious structures, sacred groves and or cemeteries?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Is the project located in an area with endangered or conservation-worthy ecosystems, or an area with endemic fauna or flora?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Is the project located within or in an area close to a national park, a protected area, wilderness area, wetlands and or critical habitats?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Is the project located close to a springs, groundwater sources, surface water bodies, water courses or wetlands?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Is the groundwater table close to the surface, i.e. 0.5m or less?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Is the project in a polluted or contaminated area and or close to a waste dump?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Is the project located in an area of steep slope and or susceptible to landslides or erosion?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Is the project located on prime agricultural land?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Is the project located in an area of tourist importance?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Is the project area prone to flooding?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Signed by Project Officer: __________________________
Name: __________________________
Date: __________________________

Signed by Community Representative: ________________
Name: ________________
Date: ________________

Approved by EMO: ________________  ECZ Environmental Permit Required: Yes/ NO
Name: ________________
### Table 3: Works Items That Require a Very Limited EMP

<table>
<thead>
<tr>
<th>Component</th>
<th>Works Programme</th>
<th>Works Item</th>
<th>Expected Impact(s)</th>
<th>Typical Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Boreholes</td>
<td>Phase 1 – Rehabilitation and additional chlorination equipment</td>
<td>Pump and motor refurbishment</td>
<td>Drilling – noise and dust creation</td>
<td>Work during daylight working hours only</td>
</tr>
<tr>
<td>District Metering</td>
<td>Bulk water meters, data loggers, and telemetry</td>
<td>119 No. sizes 2” to 8”</td>
<td>Localised disturbances within existing works areas</td>
<td>Inclusive in pipeline installation works</td>
</tr>
<tr>
<td>Customer metering</td>
<td>Existing properties/new 5,000 new customers, scattered throughout Lusaka</td>
<td>44,000 current customers and over 5,000 new customers, scattered gardens</td>
<td>Localised disturbances within peoples’ gardens</td>
<td>Inclusive in pipeline installation works – letter of notification from LWSC</td>
</tr>
<tr>
<td>Treatment Works</td>
<td>Up-rating of the Kafue Water Treatment Works from 95 ML/d to 140 ML/d</td>
<td>Replacement of intake and high lift pumping plant</td>
<td>Localised, installation of machinery and other equipment within the WTW site</td>
<td>Health and Safety requirements within the EMP</td>
</tr>
<tr>
<td>Rehabilitation of existing treatment works</td>
<td>Rehabilitation of conventional sewage treatment plants</td>
<td>New Manchinchi, Old Manchinchi, and Chunga</td>
<td>Localised disturbances, mainly noise and additional large vehicles bringing in replacement equipment</td>
<td>Topsoil, subsoil stockpiling, avoid excavations during the rainy season, Assess for land owner and possible need for compensation</td>
</tr>
<tr>
<td>Rehabilitation of Sewage Pumping Station</td>
<td>Phase 1</td>
<td>Replacement of pumps and undersized pipes</td>
<td>Localised, soil disturbances, within the works area</td>
<td>Topsoil, subsoil stockpiling, avoid excavations during the rainy season</td>
</tr>
</tbody>
</table>

### Table 4: Highly Localised Works Items That Require Some EMP

<table>
<thead>
<tr>
<th>Component</th>
<th>Works Programme</th>
<th>Works Item</th>
<th>Expected Impact(s)</th>
<th>Typical Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service reservoir storage</td>
<td>Rehabilitation of existing reservoirs within Lusaka, Replacement of leaking valves</td>
<td>Reservoir rehabilitation emptying of reservoirs to repair leaks, localised excavations to replace valves (water taps)</td>
<td>Localised, very minor soils disturbances</td>
<td>Topsoil, subsoil stockpiling, avoid excavations during the rainy season</td>
</tr>
<tr>
<td>Transmission</td>
<td>Strengthening of existing</td>
<td>Surge equipment, air valves,</td>
<td>Localised, soil disturbances</td>
<td>As above¹</td>
</tr>
</tbody>
</table>

¹ Please refer to Resettlement Policy Framework (Appendix 5)

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Main transmission main washouts, thrust blocks, etc.

As above: Refers to the description in the corresponding column in preceding row

Table 5: Localised Works Items That Require an EMP

<table>
<thead>
<tr>
<th>Component</th>
<th>Works Programme</th>
<th>Works Item</th>
<th>Expected Impact(s)</th>
<th>Typical Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mains renewal &amp; rehabilitation</td>
<td>Strategic transmission mains throughout the city &gt; 200 mm for 200m along Lumumba Road</td>
<td>Upgrading and replacement of degenerated ac pipes and corroded galvanized iron and steel pipes</td>
<td>Localised excavations, soil disturbances, disruptions to traffic, possible flooding from burst mains</td>
<td>Topsoil, subsoil stockpiling, avoid excavations during the rainy season Access ways required to private properties Carefully demarcate trenches in traffic and pedestrian areas Only work on short sections of trenching in sloping areas (Kabulonga Rd) Notify public, in advance of temporary water supply cuts</td>
</tr>
<tr>
<td>Mains renewal &amp; rehabilitation</td>
<td>Distribution mains refurbishment /replacement</td>
<td>Mains renewal and rehabilitation, in conjunction with network modelling and leakage investigations – short sections on Kabulonga Rd and Zambezi Drive</td>
<td>Danger to pedestrians and traffic where trenches coincide with roads, paths and walkways Problems on sloping ground due to storm water entrainment in trenches</td>
<td>As above¹, and Demarcate trenches Only work during the dry season</td>
</tr>
<tr>
<td>New Development Areas</td>
<td>Mains and services to priority development areas</td>
<td>Over 5,000 but scattered in locations of up to 600 units</td>
<td>Extensive, medium to long-term disturbances (several weeks to a few months)¹ Traffic redirection, trenching noises, soil stockpiling in narrow service-ways, dust in dry season, mud in rainy season Danger to pedestrians and traffic Noise, danger to public, damage to trees</td>
<td>Do main trenching in areas where disruptions will be minimal, do very short sections of 'link' trenches where disruptions will occur – especially to traffic – to reduce period of traffic disruption Dry season work, wherever possible Dampen down soil stockpiles Avoid extensive damage to trees by careful pipeline alignment and work in</td>
</tr>
</tbody>
</table>

¹ Please refer to the Resettlement Policy Framework (Appendix 5)
² Please refer to the Resettlement Policy Framework (Appendix 5)
<table>
<thead>
<tr>
<th>Component</th>
<th>Works Programme</th>
<th>Works Item</th>
<th>Expected Impact(s)</th>
<th>Typical Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peri-urban extensions</td>
<td>Mains and services to new development areas and upgrading of undersize water mains.</td>
<td>Total properties – not known To be derived from the proposed investment plans to be finalised in January 2006</td>
<td>Infrastructure due to rock blasting</td>
<td>narrow servitude areas</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Demarcate trenches very clearly</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>As above¹</td>
</tr>
<tr>
<td>Sanitation to Peri-urban areas</td>
<td>Programme to Improve on-site disposal</td>
<td>Design and construction of on site sanitation using appropriate technology including extension of sewer lines (primary, offtake and linking to the existing mains network)</td>
<td>Mixing of sewerage and Council Water Supplies if sewers and water supplies pipes are located in the same servitude</td>
<td>Topsoil, subsoil stockpiling, avoid excavations during the rainy season</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Plan works through the EMP to avoid problems, and include emergency mitigation measures to be taken by Contractor where problems do occur</td>
</tr>
</tbody>
</table>

¹As above: Refers to the description in the corresponding column in preceding row

Table 6: Site Specific Works Items That Require a Comprehensive EMP

<table>
<thead>
<tr>
<th>Component</th>
<th>Works Programme</th>
<th>Works Item</th>
<th>Expected Impact(s)</th>
<th>Typical Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Boreholes</td>
<td>Investigation and development of existing Lusaka aquifer</td>
<td>Drilling, pumps, control, associated pipe work and chlorination</td>
<td>Drilling – noise and dust creation, potential to draw-down on nearby boreholes</td>
<td>As above¹</td>
</tr>
<tr>
<td>Rehabilitation of existing Sewerage Network</td>
<td>Phase I</td>
<td>Upgrading and replacement of degenerated ac pipes and corroded galvanized iron and steel pipes</td>
<td>Large-scale excavations, soil disturbances, disruptions to traffic, excavations on private property, possible flooding from burst mains, odours and localised/general contamination Damage to woodlands, trees and tree-lined</td>
<td>Topsoil, subsoil stockpiling, avoid excavations during the rainy season Assess for land owner and possible need for compensation Use labour intensive methods and/or</td>
</tr>
<tr>
<td>Rehabilitation of existing maturation ponds</td>
<td>Emergency Works</td>
<td>Sludge Removal, repair embankments, wave protection, works to banks and installation of flow meters</td>
<td>avenues Danger to pedestrians and traffic where trenches coincide with roads, paths and walkways(^{10})</td>
<td>very small machinery in narrow confines Carefully demarcate trenches in traffic and pedestrian areas Diversion of sewer</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Sludge Removal, repair embankments, wave protection, works to banks and installation of flow meters</td>
<td>Localised, soil disturbances, disruption to sewerage off-take Possible extension into adjacent land Disposal of sludge</td>
<td>Topsoil, subsoil stockpiling, avoid excavations during the rainy season Preferable use and approved landfill site for sewerage sludge disposal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^{10}\) Please refer to the Resettlement Policy Framework (Appendix 5)
7 SUMMARY FINDINGS FROM THE SOCIAL AWARENESS AND PUBLIC HEALTH & SAFETY MEETINGS

Table 7 below summarises the issues and concerns raised by communities in the proposed areas of works. Full report-backs are provided in Appendix 2.

Table 7: Summary of Major Issues Raised at Community Meetings

<table>
<thead>
<tr>
<th>Major Issue</th>
<th>Community Location</th>
<th>Works Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disturbance of water supply (threat to disease out breaks from either drinking water from un safe sources, no water for flush toilets)</td>
<td>Chilenje, Kabwata, Chawama and Kanyama</td>
<td>At construction stage</td>
</tr>
<tr>
<td>Disturbance of sewer network (threat to disease outbreaks, exposure to bad smell)</td>
<td>Kaunda square stage 1 and 2, Lilanda, Matero and Chunga</td>
<td>In the initial stage</td>
</tr>
<tr>
<td>Loss of business</td>
<td>Comesa, Kabwata market, along streets with tutemba (make shifts/vendors) i.e. where rehabilitation works will take place (Kaunda Square Stage 1 and 2, Matero, Chilenje)</td>
<td>Construction stage</td>
</tr>
<tr>
<td>Uncovered trenches/holes for too long, standing water, threat of diseases e.g. Cholera and Typhoid, mosquitoes and other pests can breed here, accidents to children, people walking at night, murder, dumping of babies, becoming rubbish pits.</td>
<td>Kanyama, Chawama, Kaunda Square Stages 1 and 2, Chilenje, Matero</td>
<td>Construction stage</td>
</tr>
<tr>
<td>Work taking too long</td>
<td>All</td>
<td>Construction stage</td>
</tr>
<tr>
<td>Demolishing/breaking up of peoples wall fences and extensions.</td>
<td>Kaunda square stage 1 and 2, Matero, Chilenje</td>
<td>Construction stage</td>
</tr>
<tr>
<td>Inconvenience to motorists and pedestrians (uncovered trenches).</td>
<td>Kabwata Estates, Kabwata Clinic (from Burma Road)</td>
<td>Construction stage</td>
</tr>
<tr>
<td>Compensation of affected people</td>
<td>Chilenje, Matero, Kaunda square stage 1 and 2</td>
<td>After demolishing and reconstruction.</td>
</tr>
<tr>
<td>Employment opportunities for local people (positive)</td>
<td>All</td>
<td>During construction</td>
</tr>
<tr>
<td>Improved quality of life from improved sewer network and water supply (no more threat of diseases, no more bad smell from blocked sewer pipes and man holes, access to safe drinking water continuously etc.)</td>
<td>All</td>
<td>After rehabilitation is completed.</td>
</tr>
</tbody>
</table>

7.1 Community Concerns

The issue of risk of damage and/or destruction of property was raised during the public meetings. The locations where this is likely to occur most are in very narrow confines where pipelines need to be excavated, and where new pipelines are to be installed. The period when most problems will be encountered is when excavation works are taking place.
To deal with this problem, the Contractor must be made aware of locations where damage to property is most likely to occur, and should adjust the working method to minimise/avoid damage to property. Where damage cannot be avoided, the first course of action will be to follow guidance set forth in the Resettlement Policy Framework (disclosed separately) in compensating damages.

The Consultant discussed the procedure for assessment of compensation with LWSC, Lusaka City Council, the Ministry of Local Government and Housing and the Ministry of Works and Supplies, Buildings Department. As no standard schedule of compensation rates exists any compensation claims will need to be handled on a case by case basis according to the policy set out in the Resettlement Policy Framework (disclosed separately).

8 CONCLUSIONS

The project works will benefit the citizens of Lusaka. The aim of the ESMF has been to identify any unintended impacts associated with development and then to suggest how they can be minimised through effective environmental management.

The physical consequences of the type of works identified so far on private property are likely to be limited to the dismantling of some wall fences during the period of works. However not all areas of work have been defined. Should damage occur to assets or should people's livelihoods be disrupted, the process for establishing compensation is set out in the RPF.

From the impact assessment carried out the environmental acceptability of the project may be summarised thus:

**Biological Environment**

*Terrestrial Ecology.* Very minor negative impacts; all capable of being reduced to an acceptable level through environmental management planning.

*Aquatic Ecology.* No significant negative impacts on the Kafue River or on water courses in and around Lusaka.

**Physical Environment**

*Water Quality:* No negative impacts.

*Air Quality:* Minor negative impacts associated with dust and machine fumes from construction works.

*Landscape:* Very small-scale and largely temporary negative impacts associated with works areas.

**Socio-Economic and Cultural Environment**

- Minor short-duration socio-economic impacts associated with construction works.
- Mitigation possible through an effective environmental management plan and the resettlement policy framework.
## Appendix 1

### List of Persons Met During Preparation of the Environmental Assessment Report

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mr. Henry Mtine</td>
<td>Director of Engineering</td>
</tr>
<tr>
<td>2</td>
<td>Mr. Daniel Sichombo</td>
<td>Director of Admin. &amp; Secretarial Services</td>
</tr>
<tr>
<td>3</td>
<td>Mr. George Ndongwe</td>
<td>Director of Marketing &amp; Customer Services</td>
</tr>
<tr>
<td>4</td>
<td>Mr. Hebert Chinokoro</td>
<td>Projects Manager</td>
</tr>
<tr>
<td>5</td>
<td>Mr. Carinous Mizinga</td>
<td>Acting Sewerage Services Manager</td>
</tr>
<tr>
<td>6</td>
<td>Ms. Tafuna Mumba</td>
<td>Legal Counsel</td>
</tr>
<tr>
<td>7</td>
<td>Mr. Simon Mwale</td>
<td>Communications Officer</td>
</tr>
<tr>
<td>8</td>
<td>Mr. Henry Manzi</td>
<td>Acting Project Manager</td>
</tr>
<tr>
<td>9</td>
<td>Mr. Malambo</td>
<td>Area Engineer, Water Distribution</td>
</tr>
<tr>
<td>10</td>
<td>Mr. Muwowo</td>
<td>Senior Engineer, Water Distribution</td>
</tr>
<tr>
<td>11</td>
<td>Mr. Mubita Mubita</td>
<td>Acting Area Engineer, Water Distribution</td>
</tr>
<tr>
<td>12</td>
<td>Mr. Michael Chileshe</td>
<td>Area Engineer, Water Distribution</td>
</tr>
<tr>
<td>13</td>
<td>Mr. Akapelwa</td>
<td>Senior Engineer, Production</td>
</tr>
<tr>
<td>14</td>
<td>Mr. Jilly Chiyombwe</td>
<td>Sewer Engineer, Sewer Maintenance</td>
</tr>
<tr>
<td>15</td>
<td>Mr. Aubrey Mulenga</td>
<td>Acting Senior Engineer GIS LWSC</td>
</tr>
<tr>
<td>16</td>
<td>Mr. Gabriel Chikama</td>
<td>Manager, Water Quality Assurance</td>
</tr>
<tr>
<td>17</td>
<td>Ms. Nancy M. Mushota</td>
<td>Inspector EIA</td>
</tr>
<tr>
<td>18</td>
<td>Mr. Augustine Lupenga</td>
<td>Inspector EIA</td>
</tr>
<tr>
<td>19</td>
<td>Mr. Christopher Chileshe</td>
<td>Acting Director, DWA</td>
</tr>
<tr>
<td>20</td>
<td>Mr. Andrew Mondoka</td>
<td>Programme Manager, WRAP</td>
</tr>
<tr>
<td>21</td>
<td>Mr. William Ndhlovu</td>
<td>Assistant Director, Public Health and Social Services</td>
</tr>
</tbody>
</table>

Additional lists of people met during interviews is supplied in Appendix 2, which includes the report-back from the Sociologist and the Health & Safety specialist.

### EIA Team

- **Mr. K C Burton**: Project Co-ordinator
- **Mr. J N Burgess**: Team Leader, Environmental Specialist/Ecologist
- **Dr. J B Knudsen**: Hydrogeologist
- **Dr. L Mbumwae**: Environment and Water Specialist
- **Mrs. Harriet Ntalasha**: Sociologist
- **Ms. Constance Mulenga**: Environmental Health & Safety Specialist

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1. Note: list of persons consulted in the communities appears in Appendix 2
General References

World Bank Operational Directive 4.01: Environmental Assessment

Zambia: Environmental Protection and Pollution Control Act (1990) and subsidiary regulations covering hazardous waste, pesticides and toxic substances, water pollution, noise and air pollution

Zambia: 1997 Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations

Specific References


Appendix 2

Socio-Economic Issues Concerning The Rehabilitation Of Water/Sewer Installations By The Lusaka Water And Sewerage Company

INTRODUCTION
A total of ten group meetings and individuals interviews were held in ten affected communities. The purpose was to sensitize the affected communities/create awareness and also collect their views, comments on the proposed rehabilitation work to be carried out by LWSC. The communities covered include Chawama, Chunga/George, Lilanda, Kanyama, Kabwata, Kaunda Square Stage 1 and 2, Comesa Market, Matero and Chilenje. The details of the meeting are as follows.

DATE: 1st February, 2006

NAME OF COMMUNITY: COMESA

NUMBER OF PARTICIPANTS: 10: 7 Male, 3 Female

LIST OF PARTICIPANTS:
1. Mrs Alice N Phiri
2. Mr Lebon Kanda
3. Brenda Malambo
4. Abraham Maseba
5. Irene Mukena (Mrs)
6. Faindani Phiri
7. Joseph Lungu
8. Robert Chigika
9. Patrick Malipo
10. Kasongo Bernard

ISSUES RAISED:

- Period of rehabilitation likely to cause loss of business for marketers because construction work may affect City market bus stop which is used by most of the clients who come to the market, open pipeline trenches may also be an inconvenience to the clientele
- Water supply disturbance- maintenance of hygiene and cleanliness in toilets will be a problem leading to diseases such as cholera, and the bad smell from toilets will be worse and will repel customers more
- Drawing water for the toilets when work will be ongoing will be a problem
- Dangers of trenches especially if left open for too long
- Concerns over who will do the work i.e where the workers will be recruited from
- Accidents will be many, as people will try to fetch water from the other side of the road
- Noise pollution not a serious problem as compared to their need for water
- Air pollution can be endured for a short period
SUGGESTIONS TO REDUCE IMPACT

- Suggested time frame; the period has to be short – though not in a position to decide, they suggested 4 days because 1 week would be too long.
- People need to be notified early before construction work commences.
- There should be detours in advance before rehabilitation work starts.
- Need for alternative source of water and suggested that Lusaka Water and Sewerage should provide water using tanks to prevent outbreaks of diseases and accidents which can be caused by people crossing over to the other side of the road to access water.
- They should work on one lane and let traffic flow on the other lane.
- Need for signposts to clearly guide the public on what will be happening and how to get into the market to avoid loss of business.
- Work should be done at the end of the rainy season just before the dry season.
- Reason being that business is at its highest during the dry season, during the rainy season it would be difficult for the constructors to do their work effectively because of the rains.
- People to do the work should be recruited from within COMESA because the majority of the marketers have dependants who are not working.

CURRENT SITUATION

- The market is comprised of cross-border traders.
- Erratic water supply leading to smelly toilets repelling customers and a threat to people’s health.
- Sewer system not connected to main line.
- Drainage system is non-existent.

POSITIVE IMPACTS AFTER REHABILITATION

- With rehabilitation these problems will be dealt with and will positively affect people’s businesses, more customers will visit the market as smelly toilets will be no more and an improvement in the drainage system.
- The risk of disease outbreaks will be reduced.
- More toilets will be functional.
- Safe drinking water will be provided continuously.
DATE: 2nd February, 2006

NAME OF COMMUNITY: KABWATA

NUMBER OF PARTICIPANTS: 16: Males 9, Females 7

LIST OF PARTICIPANTS:
1. Agness Mulenga
2. Feston Banda
3. Nixon Nkhoma
4. Martha Vumo
5. Beatrice Siwila
6. Regina Daka
7. Elida Tembo
8. G. Ng'uni
9. V. Soko
10. Beaty Petu
11. A. Zulu
12. Kelly Koji Chipumbu
13. Dorothy Yamba
14. Anna Mulenga
15. Bertha Simasiku
16. George Mwanza

ISSUES RAISED

- Disturbance of water supply – worsening the situation since the water supply is already erratic
- Disturbance of some sources of livelihood especially at the market and the small shops (Tuntemba) along Burma road
- Motorists and pedestrians will be affected especially going into Kabwata Estate flats – access routes from Burma road will be affected
- Trenches will be a danger to the community especially children if left open for a long time. If trenches will be dug during the rainy season they will be a source of breeding mosquitoes leading to malaria and it will also source for other diseases like cholera
- Accidents for motor vehicle drivers who may not know that the place has been dug up
- Air pollution will be a danger to the people digging the trenches

SUGGESTIONS TO REDUCE IMPACT

- Work to be done early – one (1) month so that the work can be done properly. A period longer than that will affect their businesses
- Should connect a temporal pipe when construction is ongoing
- Should provide tanks of water at central places like the ones in George and Matero Compounds
- People to do the work should come from the local community because there are a lot of dependants who can do the work as most of them are not in formal employment
- Information on recruitment of casual workers should be given to the community leaders in good time before commencement of rehabilitation of work so that they can be able to get reliable people
Covering of trenches should be done as soon as possible to reduce accidents.
Laying of pipes should be done in stages
Time frame should be short as a longer period will affect some businesses

CURRENT SITUATION

The water problem in the area is big
Residents especially marketers buy water from nearby homes because most parts have no running water
Drainage system is very poor
Flush toilets are not functioning well due to lack of continuous running water

POSITIVE IMPACTS AFTER REHABILITATION

When rehabilitation work is done and completed water situation will improve
Sanitation will improve
In general people’s lives will improve
Some residents will get income from casual work
Residents will have more access to safe drinking water

ISSUES RAISED

Risks of injury and disease with uncovered trenches/holes
Hope this project will be a reality and not a campaign for elections.
People’s homes may be affected especially those who have made extensions without consulting the council. Some people who bought houses from former tenants are not even aware that there are pipes under their structures. Such structures will need to be demolished and there will be need to compensate those affected
Concrete arrangements should be made in advance for those who will need compensation because in the past such agreements were entered into but people were never compensated
Most people are unemployed and depend on informal businesses, so if disturbed their livelihoods will be affected
Spreading of STDs and HIV from migrant and casual workers
Risks of subsidence and cracks on existing structures due blasting and operation of heavy machinery

SUGGESTIONS TO REDUCE IMPACT

If possible breaking of wall fences and buildings should be avoided and instead divert the pipes
For people to work on the project, Lusaka Water and Sewerage should engage local people from the community (This was strongly emphasized)
Digging of trenches should be done in phases to reduce the inconvenience on the public
This exercise should not be made a political gimmick – the job should be completed before elections
The project should start just after the rainy season e.g April – March
There is need to put reflectors, signposts
There is need to do the job quickly

FINAL 05/04/2006
Trenches should not be left uncovered for a long time, they should be covered as the work progresses.

Work should be completed instead of starting and leaving it on the way.

Work should be done in sections instead of drawing water for the whole area.

During construction, there will be need for water tanks to be brought to the points under construction.

Compensation should be done in advance for those who need to be compensated.

CURRENT SITUATION

The drainage system for Chilenje is very poor, people fall, and they have to walk in dirty rainy water whenever it rains. This causes skin diseases.

Water supply is a serious problem in Chilenje, characterized by low pressure and inconsistency.

Use of flush toilets is a big problem.

POSITIVE IMPACTS AFTER REHABILITATION:

People working on the road will benefit from employment opportunities.

There will be no more begging of water.

Employment opportunities for local people.

Residents will have more access to safe drinking water.
DATE: 6th February, 2006

NAME OF COMMUNITY: KANYAMA

NUMBER OF PARTICIPANTS: 17: Males 12, Females 5

LIST OF PARTICIPANTS:
1. David Kasanga
2. Joseph Mpande
3. Nichodimas Mwamulimba
4. Nebel Phiri
5. Geofrey Sichilima
6. Mululu Mulonda
7. Gabriel Phiri
8. Michael Chumya
9. Geofrey Kaoma
10. Grace Muyembe
11. Ezekiel Kayange
12. Rev Fackson Peter Tembo
13. Mary Mutale
14. Veronica Mapiye
15. David Banda
16. Flyvia Bwalya
17. Hellen Kanyemba

ISSUES RAISED:

- Water disturbance in some parts of new Kanyama, without water supply people will be forced to drink water from shallow unprotected wells, which is a health risk. In some parts of site and service there is no water so there will be no water disturbance.
- Increasing road accidents as more affected residents by water disturbance will try to cross over to Chibolya in search of water (especially women and children).
- Dangers of demolition of houses/wall fences where there is no room for diversion but site and service will not be affected because the place has been properly demarcated by the council and more space in between houses/roads unlike new Kanyama where houses are squeezed to each other; but people would not mind to have their walls broken into because they are desperate for water.
- Demotion of houses, especially those approved by the council will need compensation so as to enable the affected residents rebuild their houses. Most of the residents are unemployed and so may not have the money to rebuild their structures once demolished, even those with illegal structures could be compensated also if there is a way because poverty levels in the area are very high.
- Concerned about period of the rehabilitation work, hope it won’t take so long both to start and to complete once started.
- Dangers of trenches if left open for too long—drunk people and children falling into them, some people will turn them into rubbish pits.
- Concerned about where the casual workers will be recruited from, local people are willing to provide labour.
- Rehabilitation work may negatively impact on people’s livelihoods especially those selling along the street, including marketers who have moved to the road sides.
o Trenches may be a breeding place for mosquitoes especially if the work will be done during the rainy season and the trenches are left open for a long time
o Too many delaying tactics make people lose confidence. Emphasized that a project like this is very cardinal in a peri-urban like Kanyama because this is where real problems are
o If contract workers are employed from outside the community and come to camp in Kanyama, they will be exposed to local prostitutes because prostitution is as a result of poverty

SUGGESTIONS TO REDUCE IMPACT

o Local people should do the job. Both men and women should be considered
o Modalities of recruiting people to work on the project should be through the local leadership because as community leaders as they know most of the residents – some people are drunkards and may not be able to do the work
o The project should also think of poverty alleviation, even if it is community work People contracted to do the work should be paid since poverty levels are very high in Kanyama. some payment would motivate the people. Residents are willing to cooperate and they always cooperate
o Best time to commence rehabilitation work would be just at the end of the rainy season say March/April because then digging will be easier
o The project should be finished quickly – people are not interested in dragging projects. In Chibolya water tanks were put up in 80 days so even this one if people are serious work can be completed in the shortest possible time
o Lusaka Water and Sewerage should put up some measures to prevent vandalism once work is completed, working through RDC office would help a lot. Even sensitization on water conservation can be done hand in hand with RDC office
o Provide tape reflectors – for trenches to avoid accidents at night
o Put up some protection of the trenches so that children do not go to play there
o Compensation should not be delayed
o Continuous sensitization of contract workers and the local community on the dangers of promiscuity and HIV/AIDS

CURRENT SITUATION

o Water supply especially for site and service is bad, residents feel they are the worst hit in terms of water, Lusaka Water and Sewerage is aware of the water situation in the area
o Currently water sources are taps for LWSC for New Kanyama, Old Kanyama uses Care International sources while there is completely no water in some parts of Site and Service. People have to cross into Chibolya for water leading to accidents as people try to cross the road with buckets of water on their heads

POSITIVE IMPACTS AFTER REHABILITATION

o Poverty alleviation for the community as casual workers will earn an income from rehabilitation work
o Kanyama Site and Service will have water and residents will no longer need to cross into Chibolya to access water
o People will have access to clean and safe drinking water.
DATE: 3rd February, 2006

NAME OF COMMUNITY: CHUNGA

NUMBER OF PARTICIPANTS: 13: Males 4, Females 9

NAMES OF PARTICIPANTS:
1. Mrs Violet Chinukwe
2. Mrs Luisa Leo
3. Mr. Boniface Kambita
4. Mrs Christine Kapela
5. Mrs Monica Nkumbula
6. Mr Katakala Katambo
7. Mr Clement Manzila
8. Mr Mulenga Mushikamgimbo
9. Mrs Masumbo
10. Mrs Majory Mushikalima
11. Mrs Elika Nkhata
12. Mrs Tasila Sichanga
13. Mrs Rister Mwiimbi

ISSUES RAISED

- Rehabilitation of sewer point will cause inconvenience to people depending on flush toilets
- For those who depend on pit latrines, this won't be a problem
- Concerned about the alternative measures to be put in place during rehabilitation period
- Employment of casual workers locally

SUGGESTIONS TO REDUCE IMPACT

- LWSC should work hand in hand with RDCs and other locally based organizations in identifying the workers
- Affected people to be notified in advance through the press so that they can be aware of the proposed rehabilitation works
- Need for those with flush toilets to be given alternative means for relieving themselves
- The job should be done in the shortest period. Proposed time frame: 2 – 3 months to start around March this year
- Sewer system should be worked on, roads should be replaced for drainage improvement
- Need to sensitize the community on what to use in toilets to avoid blockages – need to use toilet paper as opposed to hard stuffs like newspapers, remains of maize cobs
- Release of funds to do the rehabilitation work should be released quickly so that work can start immediately, and once the work starts, there should be continuous flow of funds so that there is no work stoppage
- Need for the community to be sensitized and also to be disciplined to avoid vandals

FINAL 05/04/2006
There will be need to spray the sewer trenches once opened up to avoid the bad smell, avoid the risk of disease outbreak; and also to avoid breeding of mosquitoes.

PVC which was put by KAJIMA (Yellow plastic) is a problem and asbestos has also given problems, so there is need to put strong ones – iron ones especially at road crossings.

Casual workers should be got locally so that local people can also benefit in terms of income.

Need to sensitize casual workers on HIV/AIDS.

**CURRENT SITUATION**

- Mainly depend on boreholes
- Sewer system is blocked and needs to be pumped out
- Houses are stinking of sewer water (faeces)
- Children falling into pit latrines
- Sewerage not treated and a breeding place for mosquitoes
- Water and sewer situation in Chunga is a big issue, people are tired of drinking water mixed with faeces, too much smell from blocked sewers, cholera outbreaks are the order of the day
- Toilets are blocked due to lack of water
- 75% of Chingwele clinic cholera cases are from Chunga
- Livelihoods – most informal business i.e. selling at the market, along the street, unemployment rates are very high

**POSITIVE IMPACTS AFTER REHABILITATION**

- Once rehabilitation is completed all problems associated with blocked sewer system will be over, no more threats of malaria and cholera outbreaks will be greatly minimized or if possible eradicated
- Employment opportunities for the local community
- Improved business for street vendors – selling food to casual workers
- No more bad smell from blocked sewer, manholes, no more flies from toilets hovering on food.
DATE: 7th February, 2006

NAME OF COMMUNITY: KAUNDA SQUARE STAGE 1

NUMBER OF PARTICIPANTS: 24, Male 12, Female 12

LIST OF PARTICIPANTS:
1. Mrs Chola Kaoma Chanda
2. Mulumbwa Lubemba
3. Abraha Musa K.
4. Tresford Mulenga
5. Mulenga Emmanuel
6. Royda Mumba
7. Mrs T. Mwanza
8. Sarah Soko
9. Charity Zimba Tembo
10. Mr Kunda
11. Reuben Mukwazo
12. Dorothy Mwale
13. Elizabeth Juma
14. G. Chombela
15. G. Kalonga
16. Mr Paul Kaluba
17. Mr Daniel Mwanza
18. Mrs Nancy Mwanza
19. L. Simfukwe
20. Eunice Kabwe
21. J. Bwalya
22. Esther Nsofwa
23. J. Kabunda
24. J. Bwendo

ISSUES RAISED:

- Residents mostly unemployed, most of them marketers, landlords, tavern owners, tutembas or small shop sellers - livelihood could be negatively impacted on by rehabilitation work because some of these structures may be demolished where diversion is not possible
- Extensions and wall fences may be affected. A number of people extended their houses after buying them from the council, some people have built fences on top of the sewer and water pipes
- Open trenches can be a problem – children falling into them, rainy water collecting in them and hence mosquitoes breeding causing malaria and other diseases such as cholera
- Concerned with demolishing of illegal structures, may lose out as they may not be compensated
- People will be inconvenienced in terms of toilets, alternative places to go to may be a problem – people may resort going to the bush
- Some buildings are sitting on water and sewer pipes and so there will be need to demolish such structures
- Some wall fences sitting on sewer pipes
Digging of trenches will disturb business of those who sell along the street for most of the people this is their major source of livelihood – most people are in informal businesses.

Coughs from dust as a result of air pollution both for the local community in general and especially the people digging up trenches.

There will be too much smell from opened up sewer pipes and manholes, flies increasing the risk of disease outbreaks. (These problems are there even now but will be worse with rehabilitation work)

Employment of workers i.e. both casual workers and some professionals like plumbing can be done by retirees and many of them can be found within Kaunda Square.

**SUGGESTIONS TO REDUCE IMPACT**

- In case of demolishing structures, there will be need for refund/compensation, or if need be, to move them to another place. People will be supportive because what they want is improved water supply.
- If possible, water tanks should be provided during the rehabilitation period.
- The earlier the work is started the better. Proposed time frame: 6 months and work to start at the end of March to August
- Modality for employing the people should be through RDC office.
- Need to spray the sewer trenches once opened up to avoid the bad smell, avoid the risk of disease outbreak; and also to avoid breeding of mosquitoes.
- Need to sensitize the community on the issue of vandalism. There is also need to caution the residents that vandalism is illegal and tantamount to imprisonment.
- Need to sensitize casual workers on the issue of HIV/AIDS.
- Population has grown, so need for bigger pipes to be put to avoid blocking.
- Need to do work in parts to avoid too much inconvenience.
- Need to ask/sensitize people to help those affected at a time eg allowing those affected to use the toilets for that period.
- Not to remove the old sewer line before putting in place the new one.
- Health inspectors should come and see the situation in Kaunda Square Stage 1.
- Need to spray the sewerage with disinfectants.
- Drainages need to be worked on.

**CURRENT SITUATION**

- Pipes are too old and rusty and hence contaminate water.
- In some parts of Kaunda Square Stage 1 taps have been dry for the past 7 years.
- Some parts have communal taps.
- Pipes are small and this leads to blocking of sewerage system.
- In Zone 3 there is completely no water.
- Sewerage situation is bad. During rainy season they flood and faeces flood people’s yards and houses especially in Zone 3.
- Children are unable to play safely in their yards because of cholera scare.
- LWSC has closed most taps but bring bills.
- Available sewer pipes are small and overloaded.
- Smelly surroundings because of blocked and overflowing manholes especially during the rainy season.
- Residents don’t feel encouraged to pay bills because the water supply is pathetic.
- Some people have put booster pumps, worsening the water situation.
POSITIVE IMPACTS AFTER REHABILITATION

- Once the sewer system is rehabilitated, residents will enjoy a clean environment because blocked pipes and manholes will be the talk of the past, no more worry of disease outbreaks.
- Children will be able to play freely in yards unlike now when some parents have to lock up their children to avoid them from playing outside in the dirty yards contaminated with faeces from blocked manholes.
- The smell from blocked manholes will go.
- Employment for local community members as casual workers and other professionals like plumbers.
- Residents will be motivated to pay the bills and LWSC will be able to make more money.

DATE: 3rd February, 2006

NAME OF COMMUNITY: MATERO

NUMBER OF PARTICIPANTS: 15: Male 9, Female 6

LIST OF PARTICIPANTS:
1. Getrude Musonda
2. Elizabeth Chisamba
3. Loutia Banda
4. Enala Manase
5. Gladys Shatewa
6. Naomi Kapembwa
7. Benjamin Luswili
8. Muntele Kamanga
9. Nyirenda Chitembeya
10. Shonga Oscar
11. Francis Maganda
12. Thompson Banda
13. Lupupa Goodwell
14. Raphael Phiri
15. Mark Mwanga

ISSUES RAISED:
- Unemployment is very high and most of the people depend on informal businesses, selling at markets along the road (these are street vendors and small shops (tuntemba) lines up along most streets. These will be negatively impacted i.e loss of business when work is going on.
- Small backyard gardens may be affected.
- Threat of disease from dug out sewer lines.
- Concerned with how long the rehabilitation work will take.
- Because of extensions, wall fences, some breaking up of structures may take place to pave way for rehabilitation work.
Compensation will be required for those affected, will need advance payment to avoid being given a raw deal.

- Open trenches will pose a danger to the community, children will falling into them, cars falling into trenches.
- If trenches are left open for too long during the rainy season will pose a danger in terms of diseases such as malaria, cholera, dysentery etc.
- Trenches can also be used for dumping solid waste and for murder activities including dumping of newly born babies.
- Bad smell from dug out sewer lines.

**SUGGESTIONS TO REDUCE IMPACT**

- They should do the work according to sections so that people can relieve themselves in the neighborhood i.e. digging and connecting pipes should be in phases to reduce the inconvenience.
- Divert pipes to avoid demolishing of structures and compensation.
- The work should be done quickly to avoid prolonged inconvenience for the local community.
- Should employ a lot of manpower so that work does not take long.
- Most youths are not working and can be empowered financially by doing casual work, but experts can come from LWSC.
- On period of work – no time frame was given. This was based on the fact they expected a good job done at the end of the project.
- There will be need for the project to be evaluated to confirm that their views have been addressed.

**CURRENT SITUATION**

- Water supply is not good, pressure is low.
- Payments are made through bills, especially in Matero, in Old Matero people do not pay.
- People with individual taps are willing to pay.
- People depend on tap water but pressure is low.
- Toilets – pour flush toilets are there, but water is a problem, majority use pit latrines.
- One soaker way has many pipes leading to blockages from time to time.
- Smell and diseases from blocked sewer pipes, drainages.

**POSITIVE IMPACTS AFTER REHABILITATION**

- Improved sewer system.
- Reduced risk of disease outbreaks.
- No more bad smell from blocked drainages.
DATE: 9th February, 2006

NAME OF COMMUNITY: KAUNDA SQUARE STATE 2

NUMBER OF PARTICIPANTS: 14: Male 10, Female 4

LIST OF PARTICIPANTS:
1. Benson Sapato
2. James Mbambi
3. Peter Chipeta
4. Peter Mwanza
5. Micheal Hankuba
6. Joseph Nkhoma
7. Victor Chilambu
8. S. N. Chiyesu
9. Stella Chiwombozi
10. Kabuswe Cecilia
11. Isaac M. Chisamba
12. John Chirwa
13. Mrs L. Ngulube
14. Catherine Chipeta

ISSUES RAISED:

- When rehabilitation work starts there will be a problem in toilets and this would result in a disease outbreak like cholera. Most toilets if not all in Stage 2 are flush
- Dangers from open trenches - accidents would occur involving motorists or children falling into the trenches
- Bad smell from dug out sewer lines
- The open trenches could also lead to diseases like malaria as a result of stagnant water
- Garbage would also be thrown into the trenches resulting in outbreaks of diseases such as cholera
- Since those coming to work in the area are likely to have a lot of money, this will attract young ladies and it could result in the spread of HIV/AIDS
- Most of the people suggested that the water bills should be cancelled to give them a fresh start
- Threat of disease from dug out sewer lines

SUGGESTIONS TO REDUCE IMPACT

- During installation of new pipes the alternative source of water would be Zambia Air force (ZAF) in adjacent Chamba Valley
- Dig out pipes on one side at a time. This will allow those from the affected part to use toilets from the neighboring section
- Those whose structures/buildings will be affected during rehabilitation should be compensated as long as they have documents that show their building was permitted by the right authorities (LCC) but those who will be found to have built or extended their structures without the consent of the local authorities should have their structures demolished
For those with legal papers they have to be relocated to a new area given by the council before the project commences

- Others were of the view that diversions should be considered where possible
- There is need to sensitize people on the dangers of thefts of taps and sewer pipes in Kaunda Square Stage 2

**CURRENT SITUATION**

- Most houses have been disconnected due to lack of funds to settle the huge water bills
- People complain of the unfair billing by LWSC - even when they have been disconnected the bill keeps growing and unmanageable. This has in fact forced to make illegal connections because of this lack of reasoning on the part of LWSC
- Water pressure is very low especially with the coming of the PHI houses, which were also tapped, to the Kaunda Square line
- Drainage is also bad on most roads. This has also been compounded by the building of PHI houses where there are big drainages which though they accommodate the water quite all right these became a problem as all this water is drained down into Kaunda Square where there is no proper drainage
- Sewer PHI was also connected to the Kaunda Square sewer line. This has overwhelmed the capacity of the pipes hence the frequent blockages
- Flushed toilets being the common toilet facility sewer blockage is a problem. This problem has been partly caused by the small pipes people put in houses being built at the moment. LWSC has also stopped monitoring the sewerage situation in the area. Furthermore, because of the high sewer line connection fee, a number of people are making illegal connections
DATE: 6th February, 2006

NAME OF COMMUNITY: CHAWAMA

NUMBER OF PARTICIPANTS: 6: Male 3, Female 3

LIST OF PARTICIPANTS: CHAWAMA

1. M. Mpumila Phiri
2. Isaac. I. Shumba
3. Grace M. Phiri
4. Brian Chibamba
5. Doreen Miti
6. Mr R Njovu

ISSUES RAISED

- If rehabilitation of pipes is considered in future, problems are expected because no plan was followed in building a good number of houses. Councilors have been giving out land anyhow; hence some houses are built on water and sewer pipes.
- Concerns over period of time to be taken rehabilitating the reservoir because prolonged period will cause prolonged inconvenience for the residents.
- Water disturbances from rehabilitation of the reservoir.
- Wondered who would be in charge of recruiting the workers for the rehabilitation.
- Dangers likely to arise should the hole be left open for long period of time.
- People may start throwing garbage in the hole and this could lead to disease outbreaks e.g. cholera. The uncovered hole would also be breeding ground for mosquitoes.
- Accidents for people who may use the footpath near the reservoir and children drowning if the hole is left for too long.
- Concerned about the recruitment of casual workers.

SUGGESTIONS TO REDUCE IMPACT

- On time frame: people felt it would be better for LWSC to propose first. Their expectations however is that the work should be properly done and the water problems be a thing of the past but work should not take long.
- The community would need to be informed before hand so that they can prepare themselves.
- The pressure of water should be increased given the rising population in the area.
- Need to construct communal water borne toilets (KOSHU toilets).
- Provide communal taps like those in George Compound strong recommended.

CURRENT SITUATION

- Water is a big problem in the area.
- There are a lot of illegal connections.
- The method of tapping water in these connections has health hazards resulting from contamination because of illegal connections.
Most households have almost exhausted the space available around their houses for digging pit latrines. Most pit latrines are full. People do not have money to buy chemicals to make the waste subside.

**POSITIVE IMPACTS AFTER REHABILITATION**

- The community would benefit from rehabilitation work
- Employment opportunities for the local community

**DATE:** 30th January 2006

**NAME OF COMMUNITY:** KANYAMA

**INTERVIEW WITH MR DAVID KASANDA - RDC CHAIRMAN**

**ISSUES RAISED**

- In both New Kanyama and Site and Service, there would be no threat of disturbance to any buildings or wall fences because they were both well planned and are well established, they have roads which are well planned
- Even if disturbances were to be there, people of Kanyama are very desperate for water improvement, water has to do with the lives of people and a project that has to do with uplifting of people’s lives needs to be supported
- In fact it is time such projects concentrated on peri-urban area because we are the people with real problems, for example cases of cholera
- Employment of local casual workers

**SUGGESTIONS TO REDUCE IMPACT**

- Work should be done quickly by employing adequate manpower
- Involvement of local community in the rehabilitation work – women should also be involved in digging of trenches, they have done so under PA (Food for work program)

**CURRENT SITUATION**

- Kanyama is divided into 3 parts i.e Old Kanyama, New Kanyama and Site and Service. In Old Kanyama, water provided is provided by Care International, in new Kanyama and Site and Service the main provider is Lusaka Water and Sewerage
- For Site and Service water pipes only go up to certain points – so it needs extension and also enlargement of the source so it can match the requirements of the people
- Residents of Kanyama have been waiting for water improvement for a long time, and they can’t wait for this rehabilitation work to start
- People in Site and Service have to cross over into Chibolya in search of water – accidents on the road
- Women and children have to wake up even as early as 0200 hours – risk of being attacked or raped
POSITIVE IMPACTS AFTER REHABILITATION

- Once the rehabilitation work is successfully completed, then all these problems will be no more
- No more need to cross over into Chibolya for water – reduced accidents
- Women will spend less time queuing for water
- Women and children will not have to wake up at 02:00 hours in search of water and hence reduced risk of being attached by thugs or raped at night

DATE: 30th January, 2006

LOCATION: KABWATA MARKET

INTERVIEW WITH MR WHITE BANDA – CHAIRMAN OF ZAMBIA HUMANISM MARKET COOPERATIVE SOCIETY LTD

ISSUES RAISED

- The rehabilitation work along Burma road will have an impact on access way to the Kabwata Clinic because there is no other way into the clinic, but for the market the impact will not be so much because there are other smaller entrances into the market
- Interpretation of water supply to the clinic, Kabwata market, the prison, Kabwata estates and Kabwata residential area
- Access to Kabwata estate will be affected i.e. from Burma road especially for motorists
- Kabwata estates has a big population of children who are always playing outside the flats and may start playing in trenches if left open for a long time, these places can also be breeding places for all sorts of diseases i.e. cholera, malaria, dysentery etc.
- Concerned about where manpower to do the rehabilitation is going to come from because they would not want them to come from outside
- Limit access to Kabwata Cultural village and hence cause an impact on the livelihoods of the number of people who live by selling crafts to tourists
- Flush toilets will be a problem – need for alternatives

SUGGESTIONS TO REDUCE IMPACT

- The work should not take too long once it starts to avoid too much inconvenience to residents.
- Public notices should be put up, even adverts on the radio and television to notify the public of the ongoing work in the area so that they can be able to find alternative routes.
- LWSC to provide alternative water supply.
- The residents also need to be notified so that they can make necessary arrangements for water storage.
- The work should be done in parts and not dig up the whole pipe at the same time to reduce problems of access to the clinic.
CURRENT SITUATION

- Kabwata area is usually characterized by inadequate supply of water, the water pressure is low and erratic especially during the dry season. The water situation for the market is even worse yet it has over 670 traders

POSITIVE IMPACTS AFTER REHABILITATION

- The water supply for Kabwata market, Kabwata estates and Kabwata residential area will improve
- Sanitation situation will also improve

DATE: 30th January, 2006
LOCATION: CHILENJE MARKET

INTERVIEW WITH MR LUFEYO BANDA (MARKET CHAIRMAN) AND MR NYASULU – MMD BRANCH CHAIRMAN AND MEMBER OF CHILENJE WATER SUB-COMMITTEE

ISSUES RAISED

- Water supply will be disturbed during rehabilitation work
- Flush toilets will be a problem and hygiene will be compromised
- Threat of water borne diseases e.g. cholera and other diarrhea diseases
- People owning small businesses like restaurants, saloons etc will be affected due to disturbance of water supply
- Some extensions and wall fences will be affected; this will be a big problem because most of the people who bought the small former council houses have made fences. These may need compensation, especially those who had approved plans by the council
- In some places people’s small gardens and small farm plots may be affected
- Tuntemba (small business) owners will also be affected temporarily when work is ongoing – people depend on these as a source of livelihood
- Trenches might be a problem for both pedestrians and motorists leading to accidents
- If left uncovered for a long time, children may also fall into these trenches, may start playing in any stagnant water collecting there
- Trenches can also be a breeding place for mosquitoes, the streets are not light up and so people walking at night may end up there
- Trenches have been a source of hiding place for murderers in the past and if left for a long time murderers and thieves may find it conducive to hide there, rape people from there and through dead bodies in them

SUGGESTIONS TO REDUCE IMPACT

- When rehabilitation starts, workers including plumbers should be recruited locally since there are a lot of retired plumbers who used to work for the council who have knowledge of the location for the “Welensky” pipes
They should not replace the old pipes because they are made out of very durable material unlike the ones Lusaka Water currently uses; may be the only problem will be the size because there is need to put bigger sized pipes, the old ones are smaller and can’t match with the population increase of Chilenje.

CURRENT SITUATION

- Most of the people of Chilenje are in informal business, like most residential areas, unemployment rate is very high
- Water supply is quite erratic in some places and for new Chilenje i.e. the area behind the clinic on Malabo road, Chilumbulu road up to Woodlands there is no water completely but pipes are there
- Lusaka Water did not know that the pipes were there but we told them to dig and they did find the pipes
- “We are able to know about the location of these pipes because we have so many retired plumbers who used to work for the council, even the closed valves – we know where they are. As members of the Water Committee we have been waiting for LWSC to start work but from the time they came to check on the pipes, they have never come back”
- Residents of new Chilenje have to get water from Chilenje South but even there water is timed, erratic and with low pressure
- Residents of Chilenje are ready to start work, even as voluntary workers because all they want is water

POSITIVE IMPACTS AFTER REHABILITATION

- When the water rehabilitation is finally completed there will be improved water supply, people especially women and children will no longer have to spend so many hours searching for water; and the saved time will be used for other more productive activities
- Employment opportunities for the local people
- Reduced risks of disease outbreaks
- Residents will have an improvement in the quality of life
- More people will be paying bills and hence more revenue for the water company

DATE: 31st January, 2006
LOCATION: KAUNDA SQUARE STAGE 1 RDC OFFICE
INTERVIEW WITH MR KUNDA – RDC CHAIRMAN

ISSUES RAISED

- Inconveniencing of residents during rehabilitation
- Disturbance of water supply
- Digging of trenches
- Problems with toilets
- The problem of working space is a big one, so some structures may be affected by the rehabilitation work
- Unplanned buildings may be affected by rehabilitation work
SUGGESTIONS TO REDUCE IMPACT

- Inconvenience of residents can be reduced if the work can be done in Zones
- Need for Lusaka Water and Sewerage to work hand in hand with RDC office

CURRENT SITUATION

- Water pipes are too small, they were meant for a small population but now the population has grown
- Water and sanitation situation for Kaunda Square I is very poor, in some places people are now thinking of digging wells so as to deal with the water situation
- People with no water supply for 5 years but continue receiving bills
- Toilets and manholes are blocked because of no running water, a lot of mosquitoes breeding in stagnant dirty water mixed with faeces
- Blocked toilets, manholes flowing into people’s yards – health hazards

POSITIVE IMPACTS AFTER REHABILITATION

- Improved sewer network (no more blocked toilets, manholes, no more places for breeding mosquitoes causing malaria)
- Because there will be no more overflowing of faeces in yards, yards will be safe places for children to play
- No more bad smell from overflowing blocked sewer pipes and manholes
- More people will be willing to come and rent houses in Kaunda Square – good income for landlords who depend on rentals as a source of livelihoods
- Employment opportunities for local youths

DATE: 9th February, 2006
LOCATION: KAUNDA SQUARE STAGE 2
INTERVIEW WITH MR R MUKWAZO – RDC CHAIRMAN

ISSUES RAISED:

- Alternative places for people to go for relieving themselves will be a problem
- Trenches will be a big problem especially for children if they take long to be covered, people can even start using them as rubbish pits
- When pipes are laid before the soil is not yet hard enough, they should be guaranteed to avoid vandalism
- Danger of spillage and bad smell from opened up sewer pipes, disease outbreaks may be a problem
- Wall fences and extensions done with approval of Lusaka City Council will need compensation if disturbed
- Space for diversion is there
- Some houses may be affected especially with extensions especially Mikonfwa section

FINAL 05/04/2006
SUGGESTIONS TO REDUCE IMPACT

- Bigger pipes should therefore be installed.
- At joints sewer pipes should be compacted with cement so that they are not uprooted.
- Period to do the rehabilitation is difficult to determine but work should start immediately after the rainy season when the ground is still soft for easy digging and fast work.
- If there is room for diversion, pipes should be diverted instead of demolishing to avoid compensation, but were buildings have been tempered with compensation is the only way out.
- Lusaka Water also causes pipe blocking because they cut off water supply whenever someone fails to clear the water bill, some of the bills were found by current occupants, so there is need for Lusaka water to start afresh, forget the old bills and start at zero.
- When they start rehabilitation work, LWSC should continue working hand in hand with the local leadership e.g. RDC.

CURRENT SITUATION

- Main problem is that the sewer system is always blocked, the problem that the population has grown compared to the past years.
- Council not controlling buildings e.g. extensions and wall fences, people build anywhere and anyhow; even on top of the water and sewer lines.
- ¾ of the homes have no water.
- Lusaka Water workers sometimes bypass blocked sewer pipes without doing anything unless they are paid, work culture is very bad, they just want money.
- Some people bought houses without knowing that they were sitting on sewer and water pipes so it is not their problem and these should also be compensated.
- Most of the toilets are flush toilets but blocked due to lack of awareness among community member e.g. use remains of maize cobs instead of toilet papers, but poverty is also a problem because some people cannot afford buying toilet papers.

DATE: 9th January, 2006
LOCATION: KABWATA BP FILLING STATION
INTERVIEW WITH MR ADAM – MANAGER
ISSUES RAISED

- The filling station would be negatively impacted on rehabilitation work because business will be affected if the trench is dug and left for a long time because vehicles coming from off would have to use alternative routes to come into the filling station. In the past Lusaka Water and Sewerage dug up the reservoir by the filling station but left it for a long period without covering it and had to use own labour, other wise I am ready to support them.
- Access to the flats by both car owners and pedestrians may also be a problem if trenches are not covered for a long time.
SUGGESTIONS TO REDUCE IMPACT

- The work should be done in sections instead of digging up the whole line at once

POSITIVE IMPACTS AFTER REHABILITATION

- Water situation for the filling station, market and the nearby shopping complex, Kabwata residential area, the prison will improve

DATE: 31st January, 2006
LOCATION: COMESA MARKET
INTERVIEW WITH MR GREENWELL SHIMUKONKA (MARKET CHAIRPERSON) AND MR MWANAKISI (VICE-CHAIRPERSON)

ISSUES RAISED

- The market is not connected to the main sewer line and septic tanks, with adequate supply of water, some toilets had to be closed – so need to be connected to the main sewer line
- Rehabilitation work likely to affect traffic – so need to do as the work lane by lane but business may not be so much affected because most of the traders walk or use wheelbarrows but may have problems with crossing of trenches if left open. The majority will have problems to jump over
- Most of the traders and clients use city market bus stop and this may be a problem with businesses because the bus stop is likely to be affected

SUGGESTIONS TO REDUCE IMPACT

- When rehabilitation is in progress, there will be need to put up sign posts to inform people of what is happening otherwise clients may think the market is closed
- Work should not take too long

CURRENT SITUATION

- The people’s source of livelihood is trading either owners of business or employed by business owners as an attendant
- COMESA market has people coming from all parts of the region and countries represented include Zambia, Malawi, Zimbabwe, Rwanda, Uganda, Kenya, Botswana, Congo DRC, Burundi and Mozambique
- Total traders in the market is approximately 2860, most of the traders – 70% are women
DATE: 10th February, 2006  
LOCATION: CHAWAMA RDC OFFICE  

INTERVIEW WITH MR PAUL NJOVU (RDC CHAIRMAN) AND MR ISAAC SHUMBA (VICE-CHAIRMAN)  

ISSUES RAISED  
- The rehabilitation work is long overdue  
- We have been providing the information being asked for since 2004 but nothing is moving  
- Need for local manpower to instill a sense of ownership for the local community, skilled labour e.g. Engineers or Sewerages can be allowed to come from outside  
- Type of machinery to be used, hope there will be no blasting that weaken structures of some private buildings  
- Disturbance of water supply and so need to put measures in place to avoid the inconvenience  
- If rehabilitations will also include putting pipes – business houses especially those near the road will be affected. For structures along the way, diversion is better to avoid compensation, that money can be used in other areas  
- Can’t suggest on the number of days for the project because we do not know the magnitude of the job to be done, but LWSC should be aware that people will be inconvenienced by the rehabilitation work, but work should start in March  
- Dangers of trenches will be there for children falling into them, last week a child fell and died in a soak way  

SUGGESTIONS TO REDUCE IMPACT  
- Trenches should not be left open for long periods, they should be backfilled as quickly as possible  
- Residents should be given notice on what will be happening so that they can start preparing for say - how to store water for longer periods  
- Even for recruitment of workers, ample time should be given to RDC so that they can be able to find responsible people who can sustain the project  
- If trench is not covered need to put up protective measures e.g. wire fence around the pit  
- If water provided to every yard, people can be able to pay, e.g. overspill but for old Chawama this may not be possible because of lack of space, there are communal taps for 20-50 households would be best; at the moment people wake up at 0200 hours to fetch water  
- LWSC should learn from how ZESCO does its work by thinking ahead at the time of laying pipes so that they do not have to carry out replacing of pipes every after one year, they should look at a five year period  
- Also materials should be of good quality so as to reduce of replacing every after 2 years  
- To avoid vandalism of new installations after rehabilitation is completed, need for LWSC to work hand in hand with RDC to set up Sub-committee, these also ensure instant attendance of any water problem instead of waiting for a long time  
- Local people should also be the ones to do the repairs – LWSC has plumbers and a Community Development Officers but they have no tools to use. In addition, their
attitude towards work is not good, always take too long to attend to reports, it can even take 5 years but come very fast when paid for illegal connections
- If the water company has problems, it is better it hands over the company back to Lusaka City Council

CURRENT SITUATION
- The current reservoir is very small, it was built for a smaller population then but now the population has grown
- Unemployment levels are very high, most of the people are in informal business but will be very willing to pay for water if made available
- Most of the water pass near toilets and so the water quality is affected
- No prompt attendance to reports by LWSC, leakages are allowed to take months
- Sanitation: people are not in employment so many cant afford to put up good toilets and ask from neighbors, 4 families could be using one toilet – cleanliness becomes a problem – risk diseases
- Lack of continuous supply of water also makes cleaning of pit latrines very difficult
- Paying for water, K3000 per month, every household has a card
- The water company is losing a lot of water through the unattended to leakages
- Tired of singing the same song of water for such a long time, who knows this could be a campaigning gimmick

POSITIVE IMPACTS AFTER REHABILITATION
- If water supply improves for Chawama, people will be very willing to pay for the service and the water company can make money which it can use for its expansion. In this way other parts of Lusaka could also benefit
DATE: 24th January, 2006

LOCATION CHUNGA

INTERVIEW WITH MR. MATAKALA KATAMBO (RDC CHAIRMAN) AND MRS LISTER MWIMBI (RDC TREASURER)

ISSUES RAISED

- Disturbance of sewer system.
- Inconvenience to residents.
- Worried that the rehabilitation may take too long to complete.
- Concerned about employment of casual workers.
- Use of flush toilets will be a problem during rehabilitation.

SUGGESTIONS

- People should be informed of intended rehabilitation work either through the media or put notices/letters
- The work should not take too long to complete so as to reduce inconvenience to the people
- People to do work should be recruited locally and if outsiders are brought they will be chased
- Need for alternative measures for flush toilet users

CURRENT SITUATION

- Pipes have rust and they get blocked
- Very few people are registered and receive bills
- Difficult to convince people to pay due to escalating bills
- Types of water supply; communal taps, bore holes
- Sewer lines are always blocked
- People drink water feaces and this has led to a lot of diseases such as dysentery and cholera
- The Council had promised people free water service but when the water was brought they charged arrears, the Council breached the contact

LOCATION LILANDA/GEORGE COMPLEX

INTERVIEW WITH MR BONIFACE MUNALULA RDC CHARMAN ZONE 22

ISSUES RAISED

- Disturbance to sewer network.
- Bad smell from opened up sewer pipes.
- Threats of disease outbreaks from opened up sewer pipes.
- People with flush toilets will be affected.

SUGGESTIONS TO REDUCE IMPACT

- The work should not take too long.
- Need to disinfect opened up sewer pipes.

CURRENT SITUATION

- George Complex consists of George proper, Lilanda, Chikolokoso, Paradise, Lilanda site and service, Soweto, Twikatane
- The water situation in George complex is very bad. There are 2 types of water sources, communal taps and individual connections.
- People pay K5000 per month for 10-20 liters of water
- Individual taps have no meters
- Most of the residents are unemployed, they depend on informal businesses
- Alternative water sources-shallow wells
- During dry season water supply is very bad
## SUMMARY OF MAJOR ISSUES

<table>
<thead>
<tr>
<th>MAJOR ISSUE</th>
<th>WHERE IT IS LIKELY TO OCCUR</th>
<th>AT WHAT STAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disturbance of water supply (threat to disease out breaks from either drinking water from unsafe sources, no water for flush toilets)</td>
<td>Chilenje, Kabwata, Chawama and Kanyama</td>
<td>At construction stage</td>
</tr>
<tr>
<td>Disturbance of sewer network (threat to disease outbreaks, exposure to bad smell)</td>
<td>Kaunda square stage I and 2, Lilanda, Matero and Chunga</td>
<td>In the initial stage</td>
</tr>
<tr>
<td>Loss of business</td>
<td>Comesa, Kabwata market, along streets with tuntemba (small shops) i.e. where rehabilitation works will take place (Kaunda Square Stage 1 and 2, Matero, Chilenje)</td>
<td>Construction stage</td>
</tr>
<tr>
<td>Uncovered trenches/holes for too long (threat to diseases, accidents to children, people walking at night, murder, dumping of babies, becoming rubbish pits)</td>
<td>Kanyama, Chawama, Kaunda square stage 1 and 2, Chilenje, Matero</td>
<td>Construction stage</td>
</tr>
<tr>
<td>Work taking too long</td>
<td>All</td>
<td>Construction stage</td>
</tr>
<tr>
<td>Demolishing/breaking up of peoples wall fences and extensions.</td>
<td>Kaunda square stage 1 and 2, Matero, Chilenje</td>
<td>Construction stage</td>
</tr>
<tr>
<td>Inconvenience motorists pedestrians (uncovered trenches).</td>
<td>Kabwata Estates, Kabwata Clinic (from Burma Road)</td>
<td>Construction stage</td>
</tr>
<tr>
<td>Compensation of affected people</td>
<td>Chilenje, Matero, Kaunda square stage 1 and 2</td>
<td>After demolishing and construction.</td>
</tr>
<tr>
<td>Employment opportunities for local people (positive) – especially those involved in original pipeline installations</td>
<td>All</td>
<td>During construction</td>
</tr>
<tr>
<td>Improved quality of life from improved sewer network and water supply (no more threat to diseases, no more bad smell from blocked sewer pipes and man holes, access to safe drinking water continuously)</td>
<td>All</td>
<td>After rehabilitation is completed.</td>
</tr>
<tr>
<td>Boost of business for landlords, as more people will want to come and rent houses. Boosting of business</td>
<td>Kaunda square stage 1, COMESA as more will visit the market (with improved water supply and drainages worked on)</td>
<td>After rehabilitation is completed.</td>
</tr>
<tr>
<td>Employment procedure for casual workers</td>
<td>All</td>
<td>During construction</td>
</tr>
</tbody>
</table>
PUBLIC HEALTH & SAFETY AND OTHER ENVIRONMENTAL IMPACTS

The following are the findings for the places visited and meetings held. This report includes places visited, specific issues raised in each of the places, impacts observed/discussed, mitigation measures and finally the overall benefits of this rehabilitation project.

<table>
<thead>
<tr>
<th>Place</th>
<th>Issues raised</th>
<th>Impacts</th>
<th>Mitigation measures</th>
<th>Benefits</th>
</tr>
</thead>
</table>
| Kabulonga Road | Replacement of 200mm UPVC pipe along main road    | • Water interruptions if done for an extended period of time will bring about water borne as well as water washed disease e.g. cholera, skin infections, typhoid etc.  
• Trenches will allow water to stagnant i.e. if the works are done in rainy season, hence acting as breeding ground for disease vector such as mosquitoes which will promote the spread of malaria.  
• In places where the road will be cut across the road, there is going to be traffic diversion, which if not well publicised could bring about accidents. | • Timely public notification of water supply interruption and traffic diversion, as well as entry to houses.  
• To ensure the time spent on rehabilitation works is limited bearing in mind the impacts it will cause if prolonged. | • Improvement in water supply and sanitation i.e. safe water will be accessed and used by residents hence reducing on out breaks of water related diseases  
• Improvement in the quantity of water being supplied to the residents therefore reducing on the use of unsafe sources of water which will also help in the reduction of diseases. |
<table>
<thead>
<tr>
<th>Place</th>
<th>Issues raised</th>
<th>Impacts</th>
<th>Mitigation measures</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woodlands, Kamwala &amp; Kabwata sewage</td>
<td>Most impacts are in-house; confined to LWSC premises. Along public lee ways;</td>
<td>• Interruption in the flow of sewage from households, hence causing blockages which will lead to bad smell, contamination of soil and surrounding environments, causing a public nuisance in accordance with the Section 67 of the Public Health Act Cap 295 of the Laws of Zambia.</td>
<td>• Time spent on removing and replacing the pumps and valves should be as short as possible to reduce the risk of an outbreak in the area draining into the pump station.</td>
<td>• Reduction in sewer line blockage from households due to less pumping, hence reducing on the Public nuisance of backflows of sewage.</td>
</tr>
<tr>
<td>pumping stations</td>
<td>Caution to other service infrastructure e.g. ZESCO, AMTEL etc.</td>
<td></td>
<td>• Changing of pumps and valves should be done in an alternating manner.</td>
<td></td>
</tr>
<tr>
<td>Chilenje</td>
<td>Some fences are very close to the area where the water or sewage lines pass.</td>
<td>• Impacting on accessibility to the road</td>
<td>• Timely public notification of road diversion</td>
<td>Improvement in the flow of both water and sanitation</td>
</tr>
<tr>
<td></td>
<td>Caution to other service infrastructure such as ZESCO, ZAMTEL etc.</td>
<td>• Traffic diversion</td>
<td>• Ensure that works are done in the dry season &amp; limited time is spent on the works.</td>
<td>Improvements in the water quantities supplied to the residents</td>
</tr>
<tr>
<td>Libala South</td>
<td>This is a new development area. Trenching has already been done in some places, if not all parts and there was evidence of stagnant water.</td>
<td>• Trenches will pose as a breeding ground for disease vector such as mosquitoes and will also pose as a danger to the public in terms of accidents; children &amp; drunken adults falling into these trenches.</td>
<td>• The trenches should not be left open for a long period of time.</td>
<td>Residents will have access to water since the area is new development area.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Noise in areas were blasting of rocks is done during excavation.</td>
<td>• Ensure that watering of the area is done to reduce dust.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Dust during excavation.</td>
<td>• Noise should be minimised</td>
<td></td>
</tr>
<tr>
<td>Place</td>
<td>Issues raised</td>
<td>Impacts</td>
<td>Mitigation measures</td>
<td>Benefits</td>
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</tbody>
</table>
| Burma road          | Work already under progress. No immediate disruptions to public infrastructure. | • Disturbance to people trying to gain access to and from the road  
• Dust during excavation  
• Noise                                                                 | • Timely notification to the public and ensuring that work is done in the shortest possible time.  
• Watering to reduce dust  
• Minimising noise                                                                 | • Improvement in water pressure to the area and specifically flats along this road. |
| Lumumba road        | Major works                                                                    | • Traffic diversion causing serious traffic congestion in town  
• Interruption of water supply to areas supplied through these lines  
• Dust during excavation  
• Noise during excavation and blasting of stones, where necessary                                                                 | • Timely notification to the general public (Motorists) and ensuring that work is done in the shortest possible time.  
• Watering to reduce dust  
• Minimisation of noise                                                                 | • Improved water supply in terms of pressure, to town area |
| Lumumba Booster Station | Impacts will mostly be in house                                                 | • Water interruptions will bring about the problem of shortage of water which would breed both water washed and water borne diseases.  
• When there is a shortage of water people will be forced to use unsafe sources of water                                                                 | • The public should be given enough notice so as to enable them store enough water or find alternative water sources. |
|                     |                                                                               |                                                                                              |                                                                                                         | • Increase in water pressure supplied to town area, Matero area etc. |

**FINAL 05/04/2006**
<table>
<thead>
<tr>
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<th>Benefits</th>
</tr>
</thead>
</table>
| Matero (Salima Rd) | • Fear to walk long distances & standing for a long time on queues to fetch water during rehabilitation  
• In the case of demolishing property or disturbing activities, compensation or diverting the system should be considered.  
• Need to engage local labour.  
• In terms of HIV/Aids, sensitisation to be done to both the skilled labour as well as local labour  
• Old pipes should only be removed when new pipes are ready to be placed, such that the time between removal & installation is shortened. | • Demolition of property encroaching in the LWSC line  
• Trenches posing a danger of accidents as well as breeding ground for disease vector such as mosquitoes  
• Trenches, if left open for a long period act as dumping sites for solid waste and “flying toilets” hence breeding other diseases such as cholera and other diarrhoea diseases.  
• Water interruption which will bring the danger of water related diseases  
• Blockages, smells due to the sewage interruption hence contaminating the environment  
• Odours, where sewer lines are excavated  
• Diseases emanating from contact with raw sewage being released to the environment during rehabilitation.  
• Workers getting exposed to sewage | • Compensation  
• Covering of trenches after rehabilitation works  
• Work to be done a shortest time possible in order to reduce the mentioned impacts  
• Enough notice should be given to the general public or people affected in order to let them find alternatives during rehabilitation.  
• Provision of protective clothing for the workers who will be handling sewage | • Safe/clean water will be supplied to the residents  
• A reduction in water related diseases after rehabilitation |

**FINAL 05/04/2006**
<table>
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<tr>
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<th>Benefits</th>
</tr>
</thead>
</table>
| Kanyama compound | - In Kanyama site & service, there is a big problem of encroachment on LWSC pipes  
- If rehabilitation is done in the rainy season, contamination of water pipes is likely to occur due to water-logging because drainage is very poor or non-existent.  
- Local labour must be used in order to promote ownership of project.  
- Need for communal water borne toilets e.g. the JICA, KOSHU toilets  
- Proposed rehabilitation period – April to May 06 | - Trenches- dumping of solid waste as well as flying toilets  
- Children and drunken adults falling in trenches  
- Breeding of disease vector such as mosquitoes, hence promoting malaria.  
- Contamination of water during rehabilitation due to poor drainage. | - Trenches to be covered immediately the works are finished  
- Providing reflector tapes on the sides of trenches to avoid accidents.  
- Drainage system should also be worked on at the same time as the rehabilitation process.  
- To give people enough notice in cases were demolition orders are to be served | - Clean water will be supplied to the residents  
- Contamination of water will be reduced  
- Reduction in water related diseases. |
<table>
<thead>
<tr>
<th>Place</th>
<th>Issues raised</th>
<th>Impacts</th>
<th>Mitigation measures</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaunda</td>
<td>Sewage flooding in households &amp; contaminating surrounding environment</td>
<td>Demolition of wall fences &amp; extension to houses that are built on LWSC lines</td>
<td>Enough notice to be given to the public, and verification of papers in cases that will warrant demolition.</td>
<td>A reduction in sewage blockages and floods</td>
</tr>
<tr>
<td>Square</td>
<td>Lack of toilets to use during rehabilitation</td>
<td>Interruption of both water and sewage will breed a lot of problems such as bad odours, fly breeding, water related diseases.</td>
<td>Compensation to affected residents in cases of demolition.</td>
<td>Reduction in cockroach infestation.</td>
</tr>
<tr>
<td>Stage 1</td>
<td>There is high cockroach infestation due to presence of sewage effluent in the environment.</td>
<td>Smell from opened sewer lines and impact of workers getting exposed to sewage</td>
<td>The rehabilitation project should be done in phases so as not to interrupt the entire settlement at the same time, so as not to risk having an outbreak of water related diseases.</td>
<td>Reduction in disease burden; in terms of water related diseases</td>
</tr>
<tr>
<td></td>
<td>No impact of smell or dust will be felt because residents are already living in a dusty &amp; smelly environment.</td>
<td>When drains (sewer) drains are opened, there is also an impact of cockroaches leaving these drains to the households, hence transmitting diseases such as cholera &amp; other diarrhoea diseases etc.</td>
<td>Providing protective clothing for workers involved in rehabilitation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LWSC to disinfect the area in Zone 3 which is contaminated with sewage.</td>
<td>Impacts of children &amp; drunken people falling in dug out trenches left for a long time.</td>
<td>To find a way of eradicating cockroaches in order to lessen the likelihood of contamination by movement of cockroaches.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Local labour should be used to assist in rehabilitation for the sake of ownership in order to lessen vandalism.</td>
<td>Trenches being breeding ground for mosquitoes</td>
<td>Rehabilitation should be done most preferably in dry season.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Impact of HIV/AIDS infection due to interaction between the workers &amp; residents.</td>
<td>Sensitisation on HIV/AIDS.</td>
<td></td>
</tr>
<tr>
<td>Place</td>
<td>Issues raised</td>
<td>Impacts</td>
<td>Mitigation measures</td>
<td>Benefits</td>
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</tbody>
</table>
| Chawama  | • During illegal connections, pipes are punctured posing a risk of water contamination<br>• Pipes are very old. Leakages are experienced giving way to contamination since the area is not well drained.<br>• Population is higher than capacity of water & sanitation<br>• Problem of encroachments on water pipes e.g. a pipe burst in a bedroom & water pipe burst in the toilet in Old Chawama<br>• LWSC to ignore the old pipes & lay new pipes<br>• Local labour should be used during this exercise<br>• The JICA Koshu toilets are highly recommended | • Interruption of water for the rehabilitation period<br>• Impact of water (line) contamination because some water pipes pass through latrines & some are very closed to latrines<br>• Children and drunken people falling into trenches<br>• Trenches acting as dumping sites for solid waste as well as flying toilets hence breeding disease<br>• Water stagnation in trenches breeding mosquitoes, hence promoting the spread of malaria.<br>• Noise, in cases where stone blasting is done.<br>• Impact of HIV/AIDS due to interactions between the workers & residents. | • Timely public notification<br>• To disconnect all illegal connections.<br>• Time taken to do this work should be short enough to prevent the said impacts to occur.<br>• A way of minimising or avoiding noise which is likely to arise from these activities should be sought<br>• A sensitisation workshop should be organised for the workers who are going to be deployed in the settlement, on HIV/AIDS and other Occupational Health Hazards likely to occur during rehabilitation. | • Contamination of water due to punctured pipes during illegal connections will reduce or stop, if possible.<br>• New pipes will reduce on leakages<br>• Improved water and sanitation facilities<br>• Reduction in water related diseases such as cholera, dysentery, typhoid, skin infections etc.
<table>
<thead>
<tr>
<th>Place</th>
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<th>Impacts</th>
<th>Mitigation measures</th>
<th>Benefits</th>
</tr>
</thead>
</table>
| Kaunda Square Stage II| • Most residents are disconnected  
• Problem with irregular bills and billing people even after they are disconnected  
• Cancellation of old bills to start afresh after rehabilitation.  
• Risk of accidents due to regular crossing of a busy Great East Road to fetch water.  
• Rehabilitation to be done zone by zone  
• Providing water in the water tankers during rehabilitation.  
• Increasing capacity on both water and sanitation  
• Servicing of sewer lines is not done  
• Connection fees are very high and so people resort to illegal connections  
• Drainage problem  
• During rehabilitation billing should be fixed  
• Use of plastic taps to prevent vandalism  
• Placing of cement covers on manholes | • Trenches harbouring disease vector, solid waste as well as liquid waste  
• Trenches posing a danger of accidents  
• HIV/Aids risk for the people deployed during rehabilitation as well as the residents  
• Dust and noise; though people feel they are already living in dusty and noisy environment and so wouldn’t be much of an impact | • Covering of trenches soon after laying the pipes. The time between digging of trenches, laying the pipes and covering the trenches should be as short as possible. The Resettlement Policy Framework lays out the mitigation measures in such cases.  
• A workshop to be organised for the workers who will be doing work in the rehabilitation sites on HIV/AIDS and other Occupational Health Hazards. | • Access to both water and sanitation will improve  
• Reduction in water related diseases  
• Improvement in the general health of the people due to the installation of new water and sewage facilities and improved access to both water and sanitation. |
<table>
<thead>
<tr>
<th>Date</th>
<th>Place</th>
<th>Person(s) talked to</th>
</tr>
</thead>
<tbody>
<tr>
<td>18/01/06</td>
<td>Kafue Road (Transmission line)</td>
<td>Local LWSC Site Staff</td>
</tr>
<tr>
<td>18/01/06</td>
<td>Railway Clinic</td>
<td>Mrs Precious Kalubula - EHT</td>
</tr>
<tr>
<td>21/01/06</td>
<td>Chawama Clinic/Kanyama Clinic</td>
<td>Ms Clevina Simutele - EHT</td>
</tr>
<tr>
<td>24/01/06</td>
<td>Kabulonga Road</td>
<td>Site survey</td>
</tr>
<tr>
<td>24/01/06</td>
<td>Woodlands Sewage pumping station</td>
<td>Mr Gift Dula – Pump Attendent</td>
</tr>
<tr>
<td>24/01/06</td>
<td>Kabwata Sewage pumping station</td>
<td>Mr Wamulume Alvin – Pump Attendent</td>
</tr>
<tr>
<td>24/01/06</td>
<td>Kamwala Sewage pumping station</td>
<td>Site survey</td>
</tr>
<tr>
<td>24/01/06</td>
<td>Chilenje</td>
<td>Site survey</td>
</tr>
<tr>
<td>24/01/06</td>
<td>Libala South</td>
<td>Site survey</td>
</tr>
<tr>
<td>24/01/06</td>
<td>Burma Road</td>
<td>Site survey</td>
</tr>
<tr>
<td>24/01/06</td>
<td>Lumumba Road</td>
<td>Site survey</td>
</tr>
<tr>
<td>24/01/06</td>
<td>Lumumba Booster Station</td>
<td>Mr J. Zulu – Plant Operator</td>
</tr>
<tr>
<td>27/01/06</td>
<td>JICA PHC/DHMT</td>
<td>Mrs Marvis Kalumba</td>
</tr>
<tr>
<td>30/01/06</td>
<td>LWSC Peri Urban Department</td>
<td>Ms Yvonne Sieni – CDO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mr Victor Mujelemani - CDO</td>
</tr>
<tr>
<td>31/01/06</td>
<td>LCC Peri Urban section</td>
<td>Mr Matawe – Ass. Director Public</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Health/Peri urban</td>
</tr>
<tr>
<td>02/02/06</td>
<td>LWSC Peri Urban Department</td>
<td>Ms Yvonne Sieni – CDO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mr Victor Mujelemani - CDO</td>
</tr>
<tr>
<td>07/02/06</td>
<td>Matero</td>
<td>15 residents</td>
</tr>
<tr>
<td>07/02/06</td>
<td>Kanyama</td>
<td>18 residents</td>
</tr>
<tr>
<td>08/02/06</td>
<td>Kaunda Square Stage I</td>
<td>24 residents</td>
</tr>
<tr>
<td>09/02/06</td>
<td>Chawama</td>
<td>11 residents</td>
</tr>
<tr>
<td>09/02/06</td>
<td>Kaunda Square Stage II</td>
<td>16 residents</td>
</tr>
</tbody>
</table>
Appendix 3

Description of Works Site Locations

This document contains photographs and GIS satellite imagery to show the site locations and to indicate the extent of the impacts of the different works components.

The Consultant wishes to indicate the locations and extent of impacts of the different works components in order of increasing impact, and associated requirements for inclusion of the works items into site-specific Environmental Management Plans. This has been done to focus the attention of the Client and ECZ on the types of works that will require the greatest attention, and to enable the Client to obtain rapid planning approval from ECZ for works elements that will incur no, or very limited environmental impacts.

Works with Minimal Environmental Impacts

The works activities with minimal environmental impacts are indicated on the map of the City of Lusaka, and described by location as follows:

Water Supply Borehole rehabilitation
There are approximately 73 existing production boreholes for LWSC located within the city. Out of these boreholes 36 have been earmarked and selected for rehabilitation involving deepening, cleaning and development in order to improve their yields. A list of these boreholes with their yields other characteristics is attached. A typical borehole site is located in LWSC premises for security of electrical fitting and other ancillary equipment, (for example Lumumba Road, and Lusaka International School) that will need refurbishment, replacement of old equipment and installation of new equipment, repairs to leaking pipe joints.

Water Supply Treatment Works
The water treatment plant known as Lolanda Water and Treatment Works are located within the LWSC Kafue Waterworks premises, which is situated near the Kafue River approximately 3 km downstream of the Kafue road bridge.

The work will involve rehabilitation and/or replacement of the works components, mainly mechanical and electrical parts.

In addition, the intake pumps located on the north bank of the river will also require replacement equipment.

Environment
There are two different land types at the Kafue Treatment Works and at the Intake. The treatment works site is on a hill in a disturbed open, Miombo woodland Savanna. The Kafue Intake Site is located on an river embankment (or river terrace) on the same hillside as the Treatment Works, with a separate structure that has been constructed out over the riverbank and the fringing wetland, to the intake tower.

Topography
The land is characterised by an undulating plateau surface with subdued hills and slopes with shallow, wide drainage patterns. The Kafue river lies on a natural drainage system.
Soils
The soils around the Treatment Works site comprise shallow to moderately deep brown gravelly loams overlying laterite and rock.

The soils at the Kafue Water Intake site comprise thick layers of clayey to loamy soils (alluvium)

Vegetation
Miombo woodland comprising an open stand of trees and a field layer dominated by grass and other shrubs

Hydrology
High rainfall area with over 1,200 mm per annum and giving rise to a dendritic system of perennial streams and rivers.

Existing Land Use
Predominantly agricultural and farming land for commercial, small scale and traditional farmers.

Water Distribution
For the purpose of management, the Lusaka service area is divided into four Water Supply District areas while customer metering locations are scattered throughout Lusaka Urban and Peri-Urban areas. The work will involve installation of bulk water meters and/or removal of old equipment and installation of new water meters at individual properties. There should be limited Environmental Impacts associated with this activity.

The storage reservoirs on Lumumba Road and at Stuart Park, Woodlands will be emptied for repairs to leaking tanks in addition to replacement of old gate valves and other piping within the storage tank enclosures. There should be limited Environmental Impacts associated with this activity.

Environment
The local environment comprises residential and commercial developments within relic upland Miombo savanna woodland (see vegetation below).

Topography
Generally flat to gently sloping

Soils
The soils comprise moderately deep to deep, brown to dark brown clay loams to gravelly loams

Vegetation
The vegetation has been cleared from the sites, but surrounding vegetation is dominated by a close canopy, tall upland Miombo savanna woodland. It has been modified within the residential and commercial areas following the introduction of exotic trees and shrubs

Hydrology
Shedding, with an urban hydrology consisting of stormwater drainage system of culverts, trenches and furrows
Existing Land Use
Within the LWSC Water Storage Reservoir site.

In addition there will be repairs to leaking valves at the Addis Ababa Roundabout, the High Court Roundabout, within the Stuart Park water storage tanks site and at the International School LWSC water supply boreholes area.

The environmental descriptions for these are the same as for the works described above.

Sewerage Treatment Works
The rehabilitation of non-functioning mechanical and transmission works will take place at Manchinchi and Chunga Sewerage Treatment Works. This will result in the recommissioning of a portion of the existing works, to increase the working capacity of the existing treatment works site. There should be limited Environmental Impacts associated with this activity.

Environment
These are located on upland drainage areas

Topography
The ground within the Treatment Works sites is generally flat to gently sloping in low-lying (receiving) areas

Soils
Dark grey loamy clays to clayey loams

Vegetation
Modified Miombo woodland at both Manchinchi and Chunga

Hydrology
The WTW sites are located on existing drainage lines, where treated water is returned to the natural stream flow

Existing Land Use
Sewerage Treatment Works Site

Works with Limited Environmental Impacts to be covered by an EMP
The works with limited, mainly site specific impacts that will occur during construction or rehabilitation excavation stages are described as follows:

Water Supply - Transmission Mains
The transmission mains rehabilitation works will take place along the supply pipeline from the Kafue Treatment Works site to the Lumumba Road storage tanks. Much of the work will involve replacement of non-functioning parts such as gate valves, pressure release valves, and leaking pipe connections on specific locations along the pipe line.

Site Access
The pipeline is approximately 50km long and covers a varying topography, but site access is directly off the main Lusaka-Kafue road for most of the alignment, with a
short ~3km section routing through agricultural from the Kafue Treatment Works to the main road

Environment
The environment along the Kafue pipeline is variable, but is predominantly located in land disturbed for agriculture and settlements. There are sections within Miombo savanna woodland, and other sections within villages, adjacent to agricultural lands, and within Lusaka city. The pipeline is situated on a servitude that has an access track that is used by local people as a footpath and bicycle track.

Topography
The topography along the pipeline varies from the lowland plain along the Kafue, with few scattered hills, to the hilly region as the alignment rises up the escarpment from Kafue to Lusaka. There are flat to undulating areas on the upper escarpment, and then the land form changes to flat to gently undulating approximately 20km out of Lusaka.

Soils
The soils vary from clayey loams and loamy clays on the Kafue floodplain, to shallow gravelly soils on the Kafue escarpment. The soils become deeper grading to dark brown loams to clayey loams on the upland areas approaching Lusaka.

Vegetation
The vegetation is dominated by Miombo woodland, with open areas where the land has been developed for agriculture or urban use, while the sections on the Kafue escarpment comprise a close canopy Miombo woodland.

Hydrology
The hydrology on the floodplain is both shedding and receiving, with rainfall runoff entering the major and minor drainage lines leading into the Kafue River. On the escarpment, the pipeline is located on a watershed, with small ephemeral streams and occasional perennial streams on the escarpment. On the upland sections the pipeline passes over areas both shedding and receiving, while the flatter areas within Lusaka tend to have standing water.

Existing Land Use
Existing land use varies from agriculture on most of the sections to the edge of Lusaka, where it becomes urban commercial and residential land. The section on the Kafue escarpment is natural Miombo woodland forest.
Three photos showing the roadside in Matero showing drainage lines and available space for pipe alignments, plus an existing pipeline passing under a culvert.
Three photos showing the roadside in Matero showing drainage lines and available space for pipe alignments, plus an existing pipeline passing under a culvert.
The valve cover is in the foreground – repairs are needed here, and at the edge of the roundabout, as shown in the photo below

Ground subsidence along Kabulonga Road where the pipeline must be reinstalled
The valve cover is in the foreground – repairs are needed here, and at the edge of the roundabout, as shown in the photo below.

Ground subsidence along Kabulonga Road where the pipeline must be reinstalled.
Lumumba road south, where the pipeline will cross the road to supply the business area on the left hand (western) side

Side road off Lumumba with adequate space for water pipeline rehabilitation

Impact of storm water on the roadsides in Lusaka

The construction works must be restricted during the rainy season to local works only and long pipelines should not be excavated during this period
Lumumba road south, where the pipeline will cross the road to supply the business area on the left hand (western) side.

Side road off Lumumba with adequate space for water pipeline rehabilitation.

Impact of storm water on the roadsides in Lusaka.

The construction works must be restricted during the rainy season to local works only and long pipelines should not be excavated during this period.
Valve to be replaced – the hole is approximately 3x3m across and 1.5m deep
04. **Valve to be replaced** — the hole is approximately 3x3m across and 1.5m deep.
Woodlands sewerage pumping station – to be refurbished and additional pumps to be installed

Burma road – the pipeline is to be rehabilitated, plus extensions to be installed around the blocks of flats

The wayleave corridor is located close to the power line and the line of trees

An additional pipeline will run to the left of the tar road
Woodlands sewerage pumping station – to be refurbished and additional pumps to be installed.

Burma road – the pipeline is to be rehabilitated, plus extensions to be installed around the blocks of flats.

The wayleave corridor is located close to the power line and the line of trees.

An additional pipeline will run to the left of the tar road.
Water flocculation tank where chemicals are added to remove sediment at the initial water clarification stage

Water flowing into the settling tanks

Beneath the settling tanks

Settling tank
Water flocculation tank where chemicals are added to remove sediment at the initial water clarification stage.

Water flowing into the settling tanks.

Beneath the settling tanks.

Settling tank.
Water flocculation tank where chemicals are added to remove sediment at the initial water clarification stage.

Water flowing into the settling tanks.

Beneath the settling tanks.
Local children harvesting treated water from a pressure release valve near Shimabala

View along the pipeline from Kafue up the escarpment

Water harvesting from another pressure release valve on the pipeline

View along the pipeline from Kafue on the upper plateau
Local children harvesting treated water from a pressure release valve near Shimabala.

View along the pipeline from Kafue up the escarpment.

Water harvesting from another pressure release valve on the pipeline.

View along the pipeline from Kafue on the upper plateau.
Appendix 4

Environmental Management Plan

*Environmental issues identified to be dealt with under the Scoping Exercise in the Inception Report*

This EMP is designed according to the scope of works and expected impacts as determined during the scoping and main phases of the assessment of environmental impacts, according to the scheduled plan of works supplied by the LWSC.

Under the initial assessment program, lists of potential environmental impacts that should be dealt with and mitigated during the construction phase of the project. The mitigation of these impacts should take place under the Environmental Management Plan (EMP).

The EMP is intended to provide a basis on which a Contractor can firstly be advised about the expected environmental impacts generated by the works, and then a guideline so that the Contractor can factor in the costs of the mitigation measures to be taken during the construction works. By including the costs of remedial works and mitigation, the Contractor can ensure fair payment for environmental mitigation works carried out.

The EMP also provides guidance as to procedures that should be undertaken during the works to ensure that the general public are confident that the eventual benefits from the work will far surpass the inconveniences experienced during the works period of the project.

For ease of reference, the potential environmental impacts are listed in italics against the required mitigation procedure.

Following the presentation of the findings of the EIA at a workshop in Lusaka on 16th February 2006, it became clear that it is very important for the LWSC that their representative Engineer, and the Contractor, should work closely with the public during the works period. Although the net result of the works will be highly beneficial to the people of Lusaka, there should be adequate advanced warning of the project, with information on how the works will be mitigated to minimise the negative impacts on the people who will be affected by the works.

**Potential Impacts**

*Destruction of property, e.g. walls, buildings, gardens, property access driveways, churches, markets, informal settlements*

*Destruction of vegetation - trees, woodlands, gardens landscapes, parks, etc*

*Disruption to pedestrian walkways*

*Danger of people, traffic falling into trenches*

*Storm-water entrainment in trenches on steep slopes and ponding on level ground*

*Spillage and accumulation of residual waste water and sludge during excavation of old sewer lines*

*Damage/disruption to adjacent services e.g., e.g. power supplies, telephone lines, storm-water drains blocked by soil stockpiles, etc.*

*Soils replacement methodologies to ensure rapid rehabilitation of works areas – including road and storm-water drainage repairs*
Mitigation Measures

Preliminary Ground Survey
The Contractor should undertake an initial site survey to assess the alignment and/or location of the works. The site survey should also be used to take note of any property that may be damaged during the works phase of the project.

Where the Contractor is aware that damage may occur to property, he should notify the property owner, and advise the owner about the works program and the method used to reinstate the damage.

Damage may be incurred to garden walls, buildings (temporary, or permanent) to trees and woodlands. Wherever possible, the Contractor should attempt to route pipeline trenches and vehicle access to works areas, so as to minimise damage to people, property and natural (or planted) vegetation. This also applies to other services such as water supplies, telephones and power supplies.

The Contractor should also note drainage lines, storm water drainage channels etc, to ensure that these are not blocked when seasonal thunder storms occur.

The Contractor should also obtain up-to-date information on the locations of services and supplies located within the works area (power, telephones, water, sewerage) that are not relevant to the works program, and ensure that these are not damaged or disrupted. Where this cannot be avoided, the relevant authorities should be notified, so they can, in turn, notify their customers.

Where there is probable cause for compensation, the formal compensation procedures are provided at the end of this document.

Excavation works and land preparation
Where the Contractor is required to undertake ground excavations for trenching and other disturbances such as clearing and grubbing, a set procedure should be followed, in order to make environmental rehabilitation easier, once the works have been completed.

Firstly, a works area should be established, according to the amount of soil to be excavated, and the types of materials (sand rock, clay, vegetation) to be moved. Space should also be left to ensure access for vehicles bringing in materials (pipes, valves etc) and heavy equipment for installing the materials. Space should also be left to ensure safe access by pedestrians and vehicular traffic, unless the site is to be closed off for the period of the works (this is possible mainly in the LWSC enclosed sites targeted for rehabilitation, e.g. sewer pump stations, boreholes, water tanks and reservoirs, and sewerage works areas).

For clearing and grubbing, only very little surface soil should be cleared (to 50mm depth or less, wherever possible), along with any vegetation that is to be removed for access to a works area. The grubbed material should be placed in either spoil heap, or spoil line on one side, but furthest from the excavation, within the prescribed works area.

Topsoil excavations are then placed in a separate spoil heap, or line adjacent to, but closer than the grubbed materials. Finally, the subsoil excavations should be placed closest to the excavations, also in a spoil heap, or line, depending upon the extent of the works.

It may be necessary to water down the spoil heaps from time to time, to reduce the amount of dust blowing around the works area and onto adjacent areas, particularly in densely populated areas.

Any blasting should be conducted according to the Blasting Regulations and only after acquiring appropriate blasting permits.

All open trenches should be clearly demarcated, and where they have to be open for extended periods, they may require fencing to prevent people from entering the works site.

Where open trenches block access to businesses (e.g. the BP Petrol Station on Burma Road), access should be ensured by the Contractor, by providing adequate and safe crossing points for vehicles.
and people to gain access to the business locations. Failure to comply will trigger compensation proceedings, and where the Contractor has been found negligent, costs may be extracted from the contractors bond.

**Timing of works**

Disruption to traffic – mainly detours and hold-ups where trenches cross major routes and residential area access

Storm-water entrainment in trenches on steep slopes and ponding on level ground

Disruption to other services in narrow servitudes, e.g. power supplies, telephone lines, storm-water drains blocked by soil stockpiles, etc.

Soil and landscape rehabilitation works to be completed as rapidly as possible after works are completed

Any works that will require open trenching works should not take place during the rainy season. The Contractor must ensure that trenching works are scheduled for the dry season. If it is not possible to work on trench sections during the dry season, e.g. under emergency works, trenches should have a protection berm around them, to prevent them from filling up due to storm water runoff into them, and they should also be pumped out regularly, to ensure that there is no standing water left in the trenches.

One of the major public and environmental concerns is when trenches are left open for long periods, as they are dangerous, when left open. They also become accident traps and repositories for rubbish disposal.

For these reasons, long sections of pipeline should be installed in manageable sections, so that no trench is left open for a period of more than 2 weeks, in areas where there are few people and very little traffic (e.g. Kabulonga Rd and Zambezi Drive). In areas where there are many people and traffic is busy, trenches should only be opened for as short a period as possible, as little as half a day in some instances, particularly where the pipelines pass under major roads (e.g. Lumumba Rd).

**Raw Materials to be Used**

The raw materials to be used for the rehabilitation works will include small amounts of river sand for bedding pipelines and concrete works. The major part of the works will involve the replacement of old machinery, electrical and mechanical parts and communications equipment used to monitor the performance of the water and sewerage systems managed by the LWSC.

**Waste Management**

All construction waste must be cleared away regularly, and disposed of in a designated landfill site.

All materials such as broken machinery and non-functional LWSC works parts may either be sold as scrap, or consigned to an approved landfill site.

Where the Contractor removes mineral oils and other chemicals during the servicing of LWSC machinery, or the Contractor’s own machinery, these should be stored in sealable containers, and either removed by a designated sub-contractor for recycling, or disposed of in an approved landfill site that is designated for hazardous waste.

**Sewerage Management**

Inadequate storage for sewerage treatment during and/or immediately after high rainfall storms is likely to result in the following impacts:

1. Contamination of surrounding drainage lines and major rivers
2. Potential contamination of ground water supplies
3. Spread of diseases
iv. Hazards associated with working in these places

The Contractor must ensure that raw sewerage does not run outside of the trenches where old sewer pipelines are being replaced. It is also critical to ensure that sewer trenches under rehabilitation do not fill with rainwater/ storm water runoff or that people and animals can fall into open holes. Trenches must thus be clearly marked and fenced in.

To ensure that sewerage is properly disposed of, a septic tanker will need to be available during the pipe excavation and removal. The septic tanker must have the necessary equipment to pump sewerage into the tank from pipeline trenches. Sewerage collected should then be disposed of at the nearest operational sewerage treatment works site.

In addition the emptying and rehabilitation of sewage ponds to increase storage volume and prevent leaching will require temporary on-site storage and or treatment. Depending on the volumes and nature of the sludge (i.e. liquid/ solid and composting stage) there are several methods that may be used. Relevant examples include release/ treatment of the supernatant wastewater with the solid fraction being dried, incinerated or spread onto appropriate lands (i.e. non-cultivated). The choice of methods should be based on international best practice as described in the EPA guidelines on disposal and treatment of sludge.

All works staff should be provided with appropriate safety equipment when working with raw sewerage (i.e. gloves, masks, rubber boots and protective overalls). They should also be checked to ensure that they are using the equipment when working with raw sewerage.

Air Quality and Environmental Health

Odours released where sewer lines are excavated, plus potential hazard of raw sewerage being released – particularly in urban and peri-urban areas, soil contamination and spread of diseases e.g. cholera, dysentery, typhoid

Air quality problems can occur where trench excavations are taking place (e.g. Matero and Lilanda residential areas), and where sewerage ponds are emptied for rehabilitation works.

Odours should be kept to a minimum, by ensuring that any open, or exposed sewers are closed off at night, after work has stopped on the site.

Any accidental, or intentional releases of sewerage should be pumped into a sewerage tanker and disposed of at the nearest operating Sewerage Treatment Woks Site.

Noise and Air Quality Management

Noise, damage to property, danger to traffic due to rock blasting and dust created during excavation

Trenching excavation works will create dust (and noise), and these can be mitigated by watering down trench spoil to prevent dust blowing around, and reducing noise by working during daylight hours only.

Traffic Redirection

Disruption to traffic – mainly detours and hold-ups where trenches cross major routes and residential area access

Where the pipeline trench is to be excavated under major roads, traffic detour routes must be pre-arranged with the City Council and the Traffic Department. In the case of dual carriageways, one side of a carriageway may be closed and single lanes used as temporary detours, while a pipeline section is installed and the road is properly reinstated, and then the other side can be closed in a similar fashion.

Where it is not possible to redirect traffic around works locations, the sections under repair / construction should be closed off and traffic rerouted according to a schedule drawn up by the Contractor in cooperation with the City Council Engineer.
Access at entry and exit points to works sites should be controlled and heavy trucks should be assisted by traffic controllers as they enter and leave works sites (e.g. water treatment works, sewerage treatment works sites, enclosures for reservoirs, boreholes, and other all other point locations where heavy trucks are required to bring in, or remove heavy goods required for the works).

**Post-Works Rehabilitation**

Landscape rehabilitation works to be completed as rapidly as possible

The post-works rehabilitation comprises reinstatement of soils in trenches pipelines and the disturbed areas surrounding all works undertaken by the Contractor.

Trench soils should be replaced and compacted to the same compaction level as surrounding soils, in reverse order to which they have been removed. It is also important to ensure that soils will not erode rapidly following heavy thunder storms that regularly occur around Lusaka. For this reason, it may be suitable (but assessed on a site-by-site basis) to replace grubbed vegetative material, or to plant vegetation over the completed trench-works.

In urban areas, the trench soils should be compacted and original, or replacement materials reinstated as soon as possible after the works have been tested and commissioned.

When the works have been completed at a site, the site should be fully rehabilitated as rapidly as possible. The timetable of this rehabilitation will have to be agreed upon between the Contractor and the Engineer’s Representative, and will depend upon the period following which the works are tested. Once the installation/rehabilitation works have been completed, the Contractor should conduct environmental rehabilitation of the site within a period of two (2) weeks.

**Management & Monitoring**

It is important that the environmental works should be supervised and monitored at all times, in order to ensure that the greatest possible benefits are gained from the Environmental Management process. General guidelines are provided below, as to how the EMP can be managed and monitored.

**Site Management**

Within/on each works site, there should be a works manager to supervise the operations. This person should be hired by the Contractor, and the work should also be checked on a regular basis (daily for all small works) by the Engineer’s Representative, to ensure that all aspects of environmental health and safety are adhered to.

The site should also be inspected by a person designated to ensure that the EMP is being adhered to (normally under the authority of the Client). This aspect of the EMP is dealt with in a later section.

The site manager should ensure that heavy vehicles entering and leaving the works area are assisted at all times by a person/persons responsible for ensuring the safety of pedestrians and vehicular traffic moving past the entry and exit points to each site.

There should always be enough people on site to assist in moving heavy equipment, where this is to be done manually.

A daily schedule of work progress and adherence to the EMP should be logged with the Site Engineer. This log should contain a brief summary of the day’s events, and should record any site accidents and other problems that need to be addressed by the Engineer on behalf of the Client.

**Environmental Management**

The Consultant recommends that a person responsible for Environmental management at all works sites, should be seconded to the works program.
This person should have adequate experience in environmental management, and in dealing with construction works. The person could be hired by the LWSC for the specific purpose of monitoring progress and adherence to the EMP, or could be someone allocated part-time from an existing post within LWSC. A third alternative, is for the person to be seconded through the World Bank’s project assistance program.

**Estimated Costs of Mitigation Works**

It is very difficult to estimate costs for the mitigation works, and this should be left to the Contractor to quote for, on a site by site basis.

The EMP should be included in the Terms of Reference for Contractors, so that they can assess each works site and bid not only for the costs of the installations and rehabilitation works, but also for the rehabilitation works, as a separate item. This process also enables the Engineer to assess the rehabilitation according to the Contractor’s works program and each item can be audited accordingly. The contractor can then receive full payment for the works when each site has been fully rehabilitated / reinstated under the EMP requirements.

**Support measures for mitigation works**

The Contractor may require assistance for the mitigation works, particularly in identifying methods to reinstate soils and prevent erosion, and also in dealing with the general public in areas where works operations create inconveniences for local residents and traffic.

People who will be affected by works in any area should be notified of the proposed works, including the measures that will be taken to ensure that negative impacts are mitigated to the greatest possible extent.

**Compensation &/or Relocation Issues**

**Additional land requirements where existing facilities cannot contain the extension works**

Compensation for temporary acquisition of land during the works period

Under the current scope of works as supplied by the LWSC, there should be no need for relocation or compulsory acquisition of land.

In cases where compensation may be required, such as loss of assets or impact on livelihood, procedures must be followed as set out in the Resettlement Policy Framework. People will be informed by LWSC, or their representative engineer, in informing people of the works procedure, the compensation process, and beginning the consultation process. All compensation claims will be addressed through the RPF process. Where property owners are still aggrieved, they should follow grievance measures set out in the RPF, or the set legal procedures of Zambia (see App. 5).

Where additional land is required, for example when installing new boreholes, the standard land acquisition procedures should be triggered. The onus rests with the LWSC to ensure that land required for extension of their service provision is acquired under the standard City Council bye-laws.

**Institutional Strengthening**

Institutional strengthening will assist the LWSC in the long term, as it will speed up future development and rehabilitation works projects, once there are designated staff within LWSC who have ready information for environmental planning and implementation.

**Identification of Institutional Needs to Implement the EA**

There are two parallel approaches required to assist in Institutional Strengthening. The first is to employ people within LWSC to undertake environmental management, and the second is to hire in a
specialist. The latter option does have a drawback, though, which is that the expertise is not bound to remain with the LWSC on completion of the Project.

**Monitoring**

**Arrangements required for Monitoring during the Construction Phase**

*EMP Operation*

The proponent will appoint an environmental management officer (EMO) while the construction contractor will nominate and environmental site officer (ESO).

The ESO will be the CC’s focal point for all environmental matters and is routinely on-site for the duration of the construction works.

ESOs are appropriately briefed technical officers (often the CC site engineer). The ESO carries out regular inspections of the CC activities in relation to environmental issues, and provides day-to-day advice to Contractor personnel about environmental issues.

**EMO Roles & Responsibilities**

The EMO should be responsible for monitoring, reviewing and verifying compliance with the EMP by the Construction Contractor. The ESO should also ensure compliance (as per the construction contract). The EMO's duties in this regard, and working with the CE who will have day-to-day interaction through supervisory staff, should include the following:

Checking CC equipment complies with the contract specifications regarding environmental standards;

Issuing or refusing the final Environmental Compliance Certificate (post construction-audit) to the Construction Contractor;

Taking decisions in case of severe non-compliances to the EMP are detected;

Providing input for ongoing internal review of the EMP;

Stopping works in case of emergency or if significant environmental impacts are apparent or imminent.

The EMO ensures the CC has all plans, procedures, approvals, and documentation in place to ensure EMP compliance prior to commencement of any work. The EMO's duties here include the following:

i. Supervising preparation and maintenance of the EMP;

ii. Monitoring and verifying that the EMP is adhered to at all times and taking action if the specifications are not followed;

iii. Monitoring and verifying that environmental impacts are kept to a minimum;

iv. Sampling sites and surrounding areas regularly with regard to compliance with the EMP;

v. Reporting on the environmental issues;

vi. Recommending the issuing of penalties (via the proponent and CE) for contraventions of the EMP;

vii. Recommending to stop work in emergencies or if significant environmental impacts are apparent or imminent;

viii. Completing post-construction audit;
ix. Participating, upon request in meetings with interested or affected parties as requested by the proponent.

**ESO Roles & Responsibilities**

The ESO(s) has the responsibility of observing construction activities and ensuring that those activities are in compliance with the EMP requirements from the CCs side. To accomplish this, each ESO should be familiar with the EMP and contract specifications.

The specific responsibilities of the ESO are to:

i. Monitor implementation of environmental measures by CC construction staff against contractual obligations by:

ii. detecting non-conformance and approving corrective action (with advice from EMO if necessary); and

iii. identifying circumstances requiring management decisions to evaluate variance or compliance issues.

iv. Interface with EMO to assist in field interpretation of environmental requirements, provide advice regarding corrective actions and resolving non-compliance situations, and issue specific formal instructions to the CC workforce;

v. Interface with CC manager to help communicate requirements, obtain a hands-on view of special problems so that implementation difficulties can be communicated to the EMO to aid in problem resolution especially in situations where adjustment of compliance requirements may be necessary;

vi. Regular communicate to EMO by monthly reports:

**Arrangements required for Monitoring during the Operational Phase**

Monitoring during the operational phase of the project is through standard LWSC operational procedures. These have been standardised and are being strengthened through the World Bank Institutional Strengthening Support program for LWSC.

**Reporting Relationships**

These are through Area and Site Managers, who report to LWSC Head Office managers responsible for different sections of LWSC (Engineering, Sanitation, Water Supplies, Water Treatment Works, etc).

Adaptation of Monitoring to ensure it is effective at all times

A monitoring schedule has been included in the tables below, to assist in performance monitoring of adherence to environmental and health and safety procedures by the Contractor.

<table>
<thead>
<tr>
<th>Pt</th>
<th>Factor</th>
<th>Approach, Data Type, Assets Impacted</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Soil</td>
<td>Types, areas of disturbance</td>
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<tr>
<td>2</td>
<td>Water Resources Supply</td>
<td>Well logs, stream flow records, geology records</td>
</tr>
<tr>
<td>3</td>
<td>Water Quality</td>
<td>Well logs, physical–chemical and biotic records and surveys</td>
</tr>
<tr>
<td>4</td>
<td>Biota</td>
<td>Harvest reports, population statistics, abundance and diversity records, vegetation densities, animal-vehicle traffic accident records, road kill counts</td>
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FINAL 05/04/2006
<table>
<thead>
<tr>
<th>Pt</th>
<th>Factor</th>
<th>Approach, Data Type, Assets Impacted</th>
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<tbody>
<tr>
<td>5</td>
<td>Development Economics</td>
<td>Dichroic comparisons, commodity trade and price records, Household income and distribution surveys, Infrastructure inventories</td>
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<tr>
<td>6</td>
<td>Land Use and Tenure</td>
<td>Land use areas from remote sensing images, property records, maps, cadastral surveys</td>
</tr>
<tr>
<td>7</td>
<td>Accessibility</td>
<td>Proximities, travel time and mode surveys</td>
</tr>
<tr>
<td>8</td>
<td>Attractions and Displacement</td>
<td>Structure counts, parks, green belts, pathways, streams/dambos, other land areas, displacement-resettlement records, employment statistics, Census reports</td>
</tr>
<tr>
<td>9</td>
<td>Community Cohesion Surveys</td>
<td>Construction and operation patterns, socio-economic residential Activity trends</td>
</tr>
<tr>
<td>10</td>
<td>Health reports and statistics</td>
<td>Construction and operations aspects, clinic records, medical</td>
</tr>
<tr>
<td>11</td>
<td>Safety</td>
<td>Accident / injury records, traffic counts, safety inventory</td>
</tr>
<tr>
<td>12</td>
<td>Vandalism and Theft</td>
<td>Camp security records, local police reports</td>
</tr>
<tr>
<td>13</td>
<td>Aesthetics</td>
<td>Proximities, view line areas, rating sales, opinion surveys</td>
</tr>
<tr>
<td>14</td>
<td>Historical, Archaeological</td>
<td>Officials and residents consultation, government listings, and Spiritual Resources tourism reports, site maintenance records</td>
</tr>
<tr>
<td>15</td>
<td>Air Quality</td>
<td>Traffic counts and O-D surveys, ambient air quality, traffic records, projections, meteorological records, vehicle tests and emission reports</td>
</tr>
<tr>
<td>16</td>
<td>Noise Pollution</td>
<td>Loudness survey records, traffic counts and projections terrain parameters</td>
</tr>
<tr>
<td>17</td>
<td>Road Maintenance</td>
<td>Drain maintenance reports, supplies inventory records, monitoring / rehabilitation records and reports</td>
</tr>
<tr>
<td>18</td>
<td>Environmental Protection Measures</td>
<td>No. Planned / Done</td>
</tr>
<tr>
<td>19</td>
<td>Contractor / Consultant Training</td>
<td>No. of materials prepared, No. of Participants</td>
</tr>
<tr>
<td>20</td>
<td>Mitigation / Enhancement</td>
<td>No. Planned / Done, contracts record</td>
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<td>21</td>
<td>Development Projects</td>
<td>Advisory group feedback, ratio of tasks</td>
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<td>Environmental Management</td>
<td>Planned / Done, effectiveness ratings</td>
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<td>23</td>
<td>Contractor Requirements</td>
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<td>24</td>
<td>Local Employment and Supplies</td>
<td>No. / sex employees, amount of supplies</td>
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<td>25</td>
<td>Borrow Pit Rehabilitation / Protection</td>
<td>No. sites involved / Done</td>
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<tr>
<td>26</td>
<td>Landscape Re-</td>
<td>No. sites involved / Done</td>
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</tbody>
</table>
### Estimates of costs for Monitoring (Indicative)

Estimates for monitoring are difficult to identify accurately. They will also vary according to the pay rate of either a dedicated environmental specialist, or a partial pay rate for someone allocated on a part-time basis, to Environmental Monitoring.

The costs will also vary according to the level of experience of the person(s) responsible and additional requirements such as office space, equipment and transport.

### Institutional Training & Strengthening Requirements for Monitoring

At present there is no environmental officer or environmental unit at LWSC. It is recommended that LWSC appoint a person(s) to receive training to enable LWSC to carry out environmental monitoring. Alternatively persons within the existing staff should be allocated for the purpose of Environmental Training, to ensure long-term continuity with regard to environmental inspections, monitoring and adherence both by Contractors and by LWSC.

### Arrangements for Post-Construction Works Environmental and Social Audit

Once the works are completed, there should be a full audit of environmental and social impacts to ensure compliance by the Contractor under the signed agreement, where the agreement has included the costs of environmental mitigation.

In order to ensure compliance with the EMP, it is recommended that the Contractor’s bond should not be released until the EMP audit has been completed and signed of by the Environmental Management Officer (EMO) representing the LWSC.

### Summary of Activities

An overview of project monitoring activities, their impacts and proposed mitigation measures including responsible entities is presented in the table below. In designating institutional responsibilities the following abbreviations have been used:

- **ESO:** Environmental Site Officer (appointed by the Contractor)
- **EMO:** Environmental Management Officer (appointed by the Client, LWSC)
- **ECZ:** Environmental Council of Zambia
- **LWSC:** Lusaka Water and Sewerage Company
- **LCC:** Lusaka City Council

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<tr>
<th>Pt</th>
<th>Factor</th>
<th>Approach, Data Type, Assets Impacted</th>
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<tbody>
<tr>
<td>27</td>
<td>Wastes Management Reports</td>
<td>No. facilities, No. trainees, Pollution Records, Disposal</td>
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<tr>
<td>28</td>
<td>Resource Protection</td>
<td>No. Sites Available / Used, Areas Involved</td>
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<td>29</td>
<td>Archaeological Protection</td>
<td>No. training Sessions, No. Artefacts, Frequency Activities of archaeologist involvement</td>
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<tr>
<td>30</td>
<td>Consultations with Local Officials</td>
<td>No. types, Contacts / Decisions Made Records</td>
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<tr>
<td>31</td>
<td>Co-operation on Environmental Program</td>
<td>Contracts record, evaluation scale</td>
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</table>
Emphasis is initially placed on the entity dictating policy and operational procedures. However, the proponent (LWSC) will in all cases need to take charge during the implementation (liaising with the relevant entity in the areas outside its own institutional realm).

Costs have been estimated as no additional if the activity is a natural part of the works (i.e. proper storage and disposal of materials and equipment, demarcation/management of construction sites and access routes) and otherwise as a percentage of the relevant works item (erosion control, special construction methods etc). Costs that are not directly related to the construction works will need to be costed separately for the relevant impacts. These costs concern compensation and possibly resettlement where the proposed extension works will encroach on existing settlements/property boundaries as well as various capacity building, awareness creation and communication initiatives required for cooperation and sustainability of the operation (WSPIP).
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<tbody>
<tr>
<td>1</td>
<td>Soil (management of excavated and exposed sites)</td>
<td>Construction</td>
<td>Prevent accessibility, increased erosion potential in exposed areas, aesthetics, habitat for insects/ disease vectors</td>
<td>ESO (Site-specific), EMO (overall)</td>
<td>Stockpiling in designated areas, demarcation of sites, covering to prevent water accumulation</td>
<td>No additional</td>
<td>LWSC (urban aesthetics, access etc) ECZ (natural resources, soil integrity)</td>
</tr>
<tr>
<td>2</td>
<td>Water Resources Supply (water supply delivery and abstraction rights for ground and surface water)</td>
<td>Construction</td>
<td>Lack of water supply to consumers, periodic over-abstraction during low flow season leading to user conflicts</td>
<td>EMO</td>
<td>Water tankering for surplus emergency supply, increase groundwater pumping if river flows become too low</td>
<td>No additional</td>
<td>LWSC</td>
</tr>
<tr>
<td>3</td>
<td>Water Quality</td>
<td>Construction</td>
<td>Discharge of waste water and contamination of water supply and groundwater</td>
<td>ESO (Site-specific), EMO (overall)</td>
<td>Sewerage to precede water supply where both are to be replaced, immediate removal of any spills (availability of septic tanker at short notice)</td>
<td>No additional</td>
<td>LWSC</td>
</tr>
<tr>
<td>4</td>
<td>Biota</td>
<td>Construction</td>
<td>Loss of vegetation and increased erosion potential, refuge for animals in construction pits, open trenches and materials stockpiles</td>
<td>ESO (site specific) EMO (overall)</td>
<td>Diversion of pipes around vegetation of particular value, selective cutting, removal and proper disposal of all cuttings, monitoring of materials stockpiles</td>
<td>No additional</td>
<td>LWSC (urban aesthetics, accessibility) ECZ (natural resources, soil and ecosystem integrity)</td>
</tr>
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</table>

Operation | None anticipated

Operation | None anticipated

Operation | None anticipated

Operation | None anticipated

Operation | None anticipated
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<tbody>
<tr>
<td>5</td>
<td>Development Economics</td>
<td>Construction</td>
<td>Reduced/ loss of business potential for street vendors/ markets in construction corridor/sites, increased employment opportunities</td>
<td>ESO (site specific) EMO (overall)</td>
<td>Designate alternative market areas and facilitate access to infrastructure that temporarily is lost (i.e. public toilets, water taps etc)</td>
<td>5% of site specific works item</td>
<td>LCC (overall framework) LWSC (implementation)</td>
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<tr>
<td></td>
<td></td>
<td>Operation</td>
<td>Increased business potential with improved infrastructure</td>
<td>LCC</td>
<td>Designate market areas to avoid future land-use conflicts</td>
<td>Costed separately</td>
<td>LCC (overall framework) LWSC (implementation)</td>
</tr>
<tr>
<td>6</td>
<td>Land Use and Tenure</td>
<td>Construction</td>
<td>Removal of houses/ businesses, reconstruction and resettlement along extensions (peri-urban mainly)</td>
<td>LCC</td>
<td>Early notification, designate alternative land and issue compensation as specified in Resettlement Policy Framework</td>
<td>Limited, (costed separately)</td>
<td>LCC (overall framework) LWSC (implementation)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operation</td>
<td>Continued informal settlement along servitude/ extensions</td>
<td>LCC/ LWSC</td>
<td>Formalizing of settlements, community development, issuing of penalties for breach of land rights</td>
<td>Costed separately</td>
<td>LCC (overall framework) LWSC (implementation)</td>
</tr>
<tr>
<td>7</td>
<td>Accessibility</td>
<td>Construction</td>
<td>Obstructions to traffic, increased potential for accidents</td>
<td>ESO (site) EMO (overall)</td>
<td>Demarcation of works/obstacles and detours, traffic control, removal of surplus soils, covering of holes</td>
<td>No additional</td>
<td>LCC (overall framework) LWSC (implementation)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operation</td>
<td>Likely improvement where existing uncovered pits and trenches are filled and covered</td>
<td>EMO</td>
<td>No mitigation necessary</td>
<td>No additional</td>
<td>LCC (overall framework) LWSC (implementation)</td>
</tr>
<tr>
<td>8</td>
<td>Attractions and Displacement</td>
<td>Construction</td>
<td>Reduced/ loss of access along servitude/ extensions</td>
<td>LCC</td>
<td>(see pt. 5 Land Use and Tenure)</td>
<td>Limited, (costed separately)</td>
<td>LCC (overall framework) LWSC (implementation)</td>
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<tr>
<td>9</td>
<td>Community Cohesion Surveys</td>
<td>Construction</td>
<td>Noise and disturbance and increased risk of traffic accidents along access routes</td>
<td>ESO (site)/ EMO (overall)</td>
<td>Demarcation of routes, enforcing traffic regulations</td>
<td>No additional</td>
<td>LCC (overall framework) LWSC (implementation)</td>
</tr>
<tr>
<td></td>
<td>Operation</td>
<td>None anticipated</td>
<td></td>
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<tr>
<td>10</td>
<td>Health Reports and Statistics</td>
<td>Construction</td>
<td>Disease and injuries during the during the proposed works</td>
<td>ESO/ Contractor EMO (overall)</td>
<td>HSE (Health, Safety and Environment guidelines for construction and operations aspects, medical screening and follow-up)</td>
<td>No additional</td>
<td>LWSC</td>
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<tr>
<td></td>
<td>Operation</td>
<td>Possible disease outbreaks</td>
<td>EMO</td>
<td>Source protection zones, water quality monitoring</td>
<td>Costed separately</td>
<td>LCC (overall framework) LWSC (implementation)</td>
<td></td>
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<tr>
<td>11</td>
<td>Safety</td>
<td>Construction</td>
<td>Construction related accidents (on site, traffic, interaction w/materials and equipment)</td>
<td></td>
<td>Demarcation of sites, posting of signs, traffic control (accident / injury records, traffic counts, safety inventory)</td>
<td>5% relevant works item</td>
<td>LCC (overall framework) LWSC (implementation)</td>
</tr>
<tr>
<td></td>
<td>Operation</td>
<td>None anticipated</td>
<td></td>
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<tr>
<td>12</td>
<td>Vandalism and Theft</td>
<td>Construction</td>
<td>Damage/ loss of construction materials</td>
<td>ESO/ Contractor</td>
<td>Guarding of depots, community awareness</td>
<td>No additional</td>
<td>Contractor</td>
</tr>
<tr>
<td></td>
<td>Operation</td>
<td>Damage/loss of equipment, illegal connections</td>
<td>EMO</td>
<td>Community awareness, incentives</td>
<td>Costed separately</td>
<td>LWSC</td>
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<tr>
<td>13</td>
<td>Aesthetics</td>
<td>Construction</td>
<td>Spill/ dumping, lack of removal and disposal of left over materials (sand, soil), littering (wind-blown waste)</td>
<td>ESO (site)/ EMO (overall)</td>
<td>Community awareness, penalties</td>
<td>No additional</td>
<td>LCC (overall framework) LWSC (implementation)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operation</td>
<td>Improved, none anticipated</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>14</td>
<td>Historical, Archaeological</td>
<td>Construction</td>
<td>Conflicts along existing servitude unlikely, potential conflicts in peri-urban areas (e.g. grave-yards, churches)</td>
<td>ESO (site)/ EMO (overall)</td>
<td>Early notification, community awareness of rights (resettlement compensation policy, see pt. 5 Land Use and Tenure),</td>
<td>Limited, (costed separately)</td>
<td>LCC (overall framework) LWSC (implementation)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operation</td>
<td>(e.g. Land Use and Tenure)</td>
<td>LCC</td>
<td>See pt. 5 Land Use and Tenure</td>
<td>Costed separately</td>
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<tr>
<td>15</td>
<td>Air Quality</td>
<td>Construction</td>
<td>Spreading of dust, reduced visibility at construction sites, potential noxious smells w/ sewerage replacement</td>
<td>ESO (site)/ EMO (overall)</td>
<td>Watering of access routes to reduce dust, avoid/ limit access routes through areas with existing heavy traffic/ markets/ population centres</td>
<td>No additional</td>
<td>ECZ (overall framework) LWSC (implementation)</td>
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<tr>
<td></td>
<td></td>
<td>Operation</td>
<td>None anticipated</td>
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<tr>
<td>16</td>
<td>Noise Pollution</td>
<td>Construction</td>
<td>Construction/ blasting noise</td>
<td>ESO (site)/ EMO (overall)</td>
<td>Work during day only, best practice (e.g. established guidelines for blasting)</td>
<td>No additional</td>
<td>ECZ (overall framework) LWSC (implementation)</td>
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<td></td>
<td></td>
<td>Operation</td>
<td>None anticipated</td>
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<tr>
<td>17</td>
<td>Road Maintenance</td>
<td>Construction</td>
<td>Increased wear and tear on existing roads, reduced access</td>
<td>ESO (site)/ EMO (overall)</td>
<td>Traffic control, adherence to speed limits and recommended loads for construction vehicles</td>
<td>No additional</td>
<td>ECZ (overall framework) LWSC (implementation)</td>
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<tr>
<td>18</td>
<td>Environmental Protection Measures</td>
<td>Construction</td>
<td>None planned, no likely conflicts</td>
<td>ECZ/EMO</td>
<td>Community awareness, communication</td>
<td>No additional</td>
<td>ECZ (overall framework) LWSC (implementation)</td>
</tr>
<tr>
<td></td>
<td>Operation</td>
<td>None anticipated</td>
<td></td>
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<tr>
<td>19</td>
<td>Contractor / Consultant Training</td>
<td>Construction</td>
<td>Improve mitigation/ enhancement and compliance monitoring</td>
<td>EMO/ Consultant</td>
<td>Prepare and conduct training program (no. of materials prepared, no. of participants)</td>
<td>5% of relevant, works item</td>
<td>LWSC</td>
</tr>
<tr>
<td>Operation</td>
<td>As above</td>
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<tr>
<td>20</td>
<td>Mitigation / Enhancement</td>
<td>Construction</td>
<td>Avoid negative impacts (e.g. pollution degradation of resource base, improve development potential)</td>
<td>EMO</td>
<td>To be facilitated and emphasised as part of training and compliance monitoring/post construction audit (no. planned / done, contracts record)</td>
<td>No additional</td>
<td>LWSC</td>
</tr>
<tr>
<td>Operation</td>
<td>None anticipated</td>
<td></td>
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<tr>
<td>21</td>
<td>Development Projects</td>
<td>Construction</td>
<td>Accessibility to sites, availability of personnel</td>
<td>LCC’ EM0</td>
<td>Advisory group feedback, ratio of tasks</td>
<td>No additional</td>
<td>LCC (overall framework) LWSC (implementation)</td>
</tr>
<tr>
<td>Operation</td>
<td>None anticipated</td>
<td></td>
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<tr>
<td>22</td>
<td>Environmental Management</td>
<td>Construction</td>
<td>Inefficiencies in implementation, confusion of tasks and responsibilities, and risk of delays and exceeding of costs</td>
<td>ESO/ Contractor EM0 (overall)</td>
<td>Evaluations, careful planning of /, effectiveness ratings</td>
<td>No additional</td>
<td>LWSC</td>
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<td>23</td>
<td>Contractor Requirements</td>
<td></td>
<td>Risk of unnecessary costs with lack of specificity and negligence of EMP for items not costed</td>
<td>ESO (site)/EMO (overall)</td>
<td>Proper construction supervision, compliance monitoring</td>
<td>No additional</td>
<td>LWSC</td>
</tr>
<tr>
<td>24</td>
<td>Local Employment and Supplies</td>
<td></td>
<td>Risk of increased number of sex workers and spreading of STDs with temporary/ migrant labour</td>
<td>ESO/ Contractor EMO</td>
<td>Community awareness, promotion of condoms, health screening</td>
<td>No additional</td>
<td>LCC (overall framework) LWSC (implementation)</td>
</tr>
<tr>
<td>25</td>
<td>Borrow Pit Rehabilitation / Protection</td>
<td></td>
<td>Erosion and risk of accidents with open pits and exposed soil (see also pt. 1 soils)</td>
<td>ESO (site)/EMO (overall)</td>
<td>Demarcation of sites, work during the dry season</td>
<td>No additional</td>
<td>LCC/ ECZ (overall framework) LWSC (implementation)</td>
</tr>
<tr>
<td>26</td>
<td>Landscape Re-vegetation</td>
<td></td>
<td>Loss of cover/ shade and soil support, increased erosion risk</td>
<td>ESO (site)/EMO (overall)</td>
<td>Selective cutting and rapid replanting / slope stabilization where applicable</td>
<td>5% of relevant works item</td>
<td>ECZ (overall framework) LWSC (implementation)</td>
</tr>
<tr>
<td>27</td>
<td>Wastes Management Reports</td>
<td></td>
<td>Pollution risk with unaccounted for waste/ improper disposal</td>
<td>ESO (site)/EMO (overall)</td>
<td>Establish and conduct training program (No. facilities, No. trainees, Pollution Records, Disposal)</td>
<td>No additional</td>
<td>LCC (overall framework) LWSC (implementation)</td>
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<td>28</td>
<td>Resource Protection</td>
<td>Construction</td>
<td>Risk of loss/ degradation of land/ soils, vegetation with uncoordinated implementation of proposed works</td>
<td>ESO (site)/ EMO (overall)</td>
<td>Designate/ prioritize conservation sites, formalize land use</td>
<td>No additional</td>
<td>LCC (overall framework) LWSC (implementation)</td>
</tr>
<tr>
<td>29</td>
<td>Archaeological Protection</td>
<td>Construction</td>
<td>Potential conflicts along extensions (mainly peri-urban areas), lack of awareness of conservation worthy sites</td>
<td>ESO (site)/ EMO / Specialist (overall)</td>
<td>Prepare and conduct training program (No. training Sessions, No. Artefacts, Frequency, Activities of archaeologist involvement)</td>
<td>Limited, (costed separately)</td>
<td>LCC (overall framework) LWSC (implementation)</td>
</tr>
<tr>
<td>30</td>
<td>Consultations with Local Officials</td>
<td>Construction</td>
<td>Lack of information/ communication, negative perceptions of impacts/ benefits</td>
<td>EMO/ LWSC spokes person</td>
<td>Record keeping, awareness reaction ( eg. no. types, contacts / decisions made records)</td>
<td>No additional</td>
<td>LWSC</td>
</tr>
<tr>
<td>31</td>
<td>Co-operation on Environmental Program</td>
<td>Construction</td>
<td>Increased risk of pollution and accidents without co-operation</td>
<td>ESO, Contractor EMO, LWSC</td>
<td>Establish contracts, awareness creation communication (record, evaluation scale)</td>
<td>No additional</td>
<td>LWSC</td>
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Appendix 5

Compensation/ Resettlement Framework Policy

With regards to the above reference is made to the Resettlement Framework Policy Document, which is disclosed separately.
Appendix 6

Review of Hydrogeological Data

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ACKNOWLEDGEMENTS

We greatly appreciate the fruitful discussions and eagerness of LWSC staff in providing background knowledge and information to carry out this assignment.
1 INTRODUCTION

1.1 Context and Aims

The present study titled Groundwater Review forms part of the larger project on Environmental Assessment and Management of planned remediation works to upgrade water supply and sewerage infrastructure in Lusaka. A brief summary of the motivating context follows below.

At present the city of Lusaka presently obtains the bulk of its water supply from the Kafue river and the remainder about 15% from the limestone/dolomite aquifers which stretch from the north west to the south east of the city.

It is estimated that 55% of Lusaka's water is unaccounted for, which translates into a daily loss in revenue of US$ 45,000. Such unaccounted for losses is just one factor, which seriously complicates cost-effective and sustainable delivery of water services, i.e. with other contributing causes being outdated infrastructure, weak institutional framework and lack of adequately trained personnel. Currently only 230 million litres per day (mld) of the 350 million litres needed to supply the population of 2 million is pumped due to limited funds.

In addition to lack of service capacity water pollution has become a major problem for Lusaka over the past few years. Pollution originates from industries, uncollected solid waste and inadequate disposal as well as inadequate sanitary facilities in large informal settlements, where 60% of Lusaka's population live.

The aquifer in Lusaka has been exploited since the 1950’s where it represented the only supply source through 90’s where groundwater abstraction reached a peak of 100 mld (about 40% of total supply). Notwithstanding this high potential, the aquifer is very vulnerable to pollution. A number of high density areas (informal settlements or peri-urban areas) sit on the relatively high and porous aquifer making the ground water supply from these areas vulnerable to pollution. The sources of pollution are mainly solid waste dumps and the shallow pit latrines.

While the remediation works will address the city’s urgent need to augment existing service capacity and reduce unaccounted for losses, the overall aim of this review is to outline the status and contribution groundwater can make to Lusaka’s water supply including recommendations for more detailed study.

1.2 Scope of Works

More specifically the scope of work undertaken comprises the following:

1. Collation and review of available data gathered from LWSC and the Department of Water Affairs (DWA)
2. Present overview of groundwater use and development
3. Examine groundwater potential with respect to both quantity and quality
4. Present recommendations for more detailed study including required resources to develop and manage groundwater resources
1.3 Availability of Data

Data was gathered through consultation with LWSC staff and visits to the Department of Water Affairs in Lusaka


In addition the following data was gathered from the database of LWSC:

- Hydrogeological map with boreholes and city plan
- Spreadsheet files on boreholes, their locations and operation. 2005
2 WATER SUPPLY IN LUSAKA

2.1 Historical Perspective

The summary below is based on source (1) for the period up to 1980. Source (2) and data obtained from LWSC as well as information found on the internet is used to document the situation through the 80's, 90's and today. To assess water demands the increase in supply is compared with population growth. Furthermore, to gain greater understanding of the current status with regards to existing and planned water supply developments, a brief outline of recommendations in the above studies are subsequently presented.

1950's

Lusaka originally derived its water supply from relatively small diameter boreholes. Between the years of 1954 and 1959 two large diameter boreholes were drilled and the supply was increased to approximately 22.8 mld. These boreholes are situated inside the water works pumping plant in the Libala area in the Southern part of the city.

1960's

As the rate of consumption increased in subsequent years the first augmentation scheme was implemented in 1964 to increase the supply by another 11.4 mld. This was achieved by the construction of a 3 m diameter and 61 m deep shaft (Shaft No. 5).

Based on further hydrogeological study which suggested that the potential for additional expansion of groundwater supply was limited (Jordan, 1963 and Tague, 1965), plans were initiated for the design of a surface water scheme from the Kafue river. Construction commenced in 1968.

As the rapidly increasing demand exceeded available capacity, it became evident that additional water would be needed before commissioning the Kafue scheme. An emergency programme was therefore initiated for drilling additional boreholes and utilising surplus water from quarries. By the end of 1968 groundwater supply amounted to 78.2 mld.

1970's

The Kafue stage I was commissioned in 1971 with construction of stage 2 and 2a commencing the following year.

The raw water production in 1977 was assessed as 164.5 mld with approximately 60% supplied from the Kafue river and the remaining 40% (45.5 mld) from groundwater. With peak consumption reaching up to 210 mld at the height of the dry season in September and October 1978, substantial amount of groundwater is also abstracted from shallow wells and boreholes (private and public) not connected to the distribution network. Thus, groundwater probably accounted for up to 55% of total water consumed (about 60 mld).

After completion of the Kafue stage 2a in 1978 total yield from all sources is reported as 225 mld with 60% supplied from the Kafue river and the remaining 40% (i.e. about 90 mld) from groundwater. The additional yield from groundwater probably reflects increased pumping rates from existing sources.

1980's and 1990's

After the Germans completed their study in 1979, there is little documented information on the status of water abstractions until the mid 90's when JICA initiated their national water resources master plan study.
In the above study total water production is reported as 190 mld of which 90 mld is supplied from groundwater (JICA, 1995). Current data obtained from LWSC gives total groundwater abstraction of about 27 mld. With current pumping amounting to 230 mld, it is clear that groundwater supply has decreased significantly over the last decade.

**Population and Water Demand**

Table 2.1 below gives an overview of total population. On average the proportion of low income poor people is about 30% of the total. Compared with reported water yields (i.e. amount of water produced and pumped into the distribution network), yield is significantly larger than demand. The case study by WUP in 2001 reported that leakages in 1997 had been reduced to about 30%. This implies that other types of losses such as illegal connections account for the remainder and that actual water demand is higher than that which is calculated from population estimates. Noting the current unaccounted for losses of 55% it is clear that Lusaka is experiencing water shortages.

**Table 2.1. Population and water demands**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban population</td>
<td>535830</td>
<td>769353</td>
<td>1084703</td>
<td>1225000</td>
<td>1530000</td>
</tr>
<tr>
<td>High/ middle income 70% (160 l/cap/day)</td>
<td>60</td>
<td>86.2</td>
<td>121.5</td>
<td>137.2</td>
<td>171.1</td>
</tr>
<tr>
<td>Low income poor 30% (60 l/cap/day)</td>
<td>1</td>
<td>1.4</td>
<td>2</td>
<td>2.21</td>
<td>2.75</td>
</tr>
<tr>
<td>Water produced</td>
<td>137</td>
<td>190</td>
<td>230</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Only 10% of low income areas are served by the LWSC distribution network, 80% served and *Projected from 1997 estimate using a 2.8% population growth rate

**Recommendations**

The above study was undertaken to assess the potential to exploit groundwater resources for additional water supply to the city of Lusaka.

Detailed geological and hydrogeological surveys including extensive electrical resistivity mapping to locate suitable borehole sites followed by numerous drillings, pumping tests and model calculations to quantify aquifer yields were conducted.

Based on the results obtained the study concluded that about twice as much groundwater about 120 mld in comparison with the then abstracted rate of 60 mld could be pumped without adversely affecting groundwater levels and that this water could be economically extracted from high yielding boreholes. Preliminary cost estimates suggested that the associated production costs probably would be lower than of Kafue water.

More specifically the study emphasised the karstified Lusaka Dolomite as the aquifer with the greatest potential. Occupying a surface area of 680 km² the dolomite forms a low ridge running in a northwest - southeast direction. The central part of the aquifer is situated just south of Lusaka. The water is moderately hard, but besides chlorination requires no further treatment. The schists of the Cheta formation which surround the aquifer are reported to have poor groundwater potential and are consequently ruled as a potential future water source. It is, however, noted that the limestone and dolomites of the Cheta formation could be of interest for water supply with further northward expansion of the city.

Groundwater potential depends on recharge and was calculated from an average annual rainfall of 820 mm as 160, 180 and 200 mm for forest, open bush and cultivated grassland.
respectively. Little or no recharge was considered to occur in dry years with rainfall less than 700 mm as most of the percolating rain is intercepted by vegetation.

The study recommends 6 areas for further groundwater expansion with drilling of about 20 additional boreholes.

To protect against downward infiltration of contaminants (i.e. noting that soil cover in the Lusaka area is thin), groundwater protection zones and an extension of the groundwater monitoring activities are proposed.

The Water Resources Master Plan Study of Zambia, JICA:

The study considers that the yield of the Lusaka dolomite/limestone aquifer is nearly reached and consequently recommends that future groundwater development focus on exploitation of the Cheta Limestone formation North of Lusaka with drilling on some 50 boreholes to augment supply by 20 to 30 mld. In addition the JICA study recommends that a groundwater training facility be developed in Lusaka. Inherent principles include the training of provincial staff in hydrogeology, operation and maintenance of drilling equipment, boreholes and groundwater management.

For the future the study suggests that a dam and reservoir be constructed on the Chongwe river (100-150,000 m$^3$/day) and that the existing intake and pipeline on the Kafue be upgraded to increase capacity to 300-600 mld. This they point out will require re-allocation of water rights from hydropower. In the case that 400,000 m$^3$/day is converted to water supply this will result in about 1.4 million USD annually, which is about 10% operating cost of water supply facilities.

In the JICA study little or no mention is made about groundwater quality. The study mainly focuses on determination of groundwater potential through water balance analyses using rainfall run off and groundwater level data to determine aquifer recharge. Water quality and potential for contamination from both point (industry, landfills, toxic waste sites) and diffuse (sanitary drainage) sources are hardly mentioned.

2.2 This Review

Despite some inconsistencies with regards to water demands and the amount produced the conducted studies show that both groundwater abstraction and conveyance of Kafue water has increased in line with the population growth.

Additionally both studies document the existence of significant quantities of groundwater that can be economically developed for water supply, as well as the need to protect this vulnerable resource from contamination. However, the studies suggest different areas for groundwater development. While the earlier German study favours the southern Lusaka dolomite/limestone aquifer, the Japanese consider this resource to be fully exploited. Instead they recommend that further groundwater development should concentrate on the dolomite/limestone formations north of the city. This despite the fact that there is little or no difference in reported groundwater abstraction rates between the two studies. The Japanese also go further in proposing an ambitious groundwater management and development strategy with the establishment of a national centre of expertise and significant capacity building of inherent staff.

In the face of increasing need to increase capacity to meet both current and future water demands LWSC is considering several options for augmenting its water supply, one of these options being upgrading of the existing pipeline from the Kafue Water Works. However, considering the abundance of economically viable groundwater resources and the fact that
these are grossly under utilized (i.e. with current abstraction rates less than 30% of historic levels), the importance of a holistic strategy is highlighted.

In the sections to follow this review will therefore concentrate on outlining (1) the current plans to improve service delivery and the existing water supply set-up within the different areas of Lusaka and (2) comparing this with the inherent geological and hydrological factors determining groundwater occurrence and recharge. Opportunities and constraints for future groundwater development is then discussed taking into account the distributions of favourable hydrogeological conditions, available sources and contaminant loadings.

2.3 Existing and Planned Development

In addition to the planned rehabilitation and upgrade of water services infrastructure, the city of Lusaka is currently faced with a formidable challenge to reduce unaccounted for losses and to increase revenue collection to enable economic sustainability in the long term. LWSC has consequently initiated an ambitious action plan to upgrade performance at all levels.

The main goals can be summarized as follows:

- Reduction of unaccounted for losses in the urban areas to 40% by carrying out water audits of production facilities, leak detection to reduce transmission and distribution losses and demand management to control leaks and project demands.

- Reduction of unaccounted for losses in the peri-urban areas to 40% by capturing unregistered consumers with emphasis on demand management, review of policy for provision of water supply and sanitation and development of schedule for installation of new water points.

- Upgrade of sewerage capacity and treatment by installing new pumps and biological filters

- Reduce water treatments costs by optimising use and dosing of chemicals

- Increase groundwater supply by commissioning of Malo Farm and Avondale boreholes currently under development.

- Improve institutional capacity in the areas of corporate finance, governance, human resources development and internal accountability

For more detailed information on management and configuration of water services in the urban served parts of Lusaka reference is made to the EA report as well as the GIS department of LWSC, which has detailed and comprehensive overview of all characteristics of water related infrastructure. With regards to peri-urban water supply LWSC is in the process of taken over responsibility from several donor organisations. An overview of peri-urban areas and supply characteristics is shown in Table 2.2.
### Table 2.2. Peri-urban areas with service providers and supply type

<table>
<thead>
<tr>
<th>Area</th>
<th>Water Supply Provider</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chunga</td>
<td>LWSC</td>
<td>Boreholes</td>
</tr>
<tr>
<td>Matero</td>
<td>LWSC</td>
<td>Piped</td>
</tr>
<tr>
<td>Lilanda</td>
<td>LWSC</td>
<td>Boreholes</td>
</tr>
<tr>
<td>George</td>
<td>LWSC and JICA</td>
<td>Boreholes and piped</td>
</tr>
<tr>
<td>Marrapodi</td>
<td>LWSC</td>
<td>-</td>
</tr>
<tr>
<td>Chipata</td>
<td>Care Int.</td>
<td>-</td>
</tr>
<tr>
<td>Kabanana</td>
<td>LWSC</td>
<td>Piped</td>
</tr>
<tr>
<td>Ngombe</td>
<td>JICA</td>
<td>-</td>
</tr>
<tr>
<td>Kamanga</td>
<td>LWSC</td>
<td>Boreholes</td>
</tr>
<tr>
<td>Chaisa</td>
<td>CARE</td>
<td>-</td>
</tr>
<tr>
<td>Garden</td>
<td>Care Int. and LWSC</td>
<td>Boreholes and piped</td>
</tr>
<tr>
<td>Kalingalinga</td>
<td>LWSC</td>
<td>-</td>
</tr>
<tr>
<td>Mtendere</td>
<td>LWSC</td>
<td>-</td>
</tr>
<tr>
<td>Kalikiliki</td>
<td>JICA</td>
<td>Boreholes</td>
</tr>
<tr>
<td>Chainda</td>
<td>LWSC and World Vision</td>
<td>Boreholes</td>
</tr>
<tr>
<td>Kanyama</td>
<td>LWSC</td>
<td>-</td>
</tr>
<tr>
<td>John Laing</td>
<td>LWSC</td>
<td>Boreholes</td>
</tr>
<tr>
<td>Chibolya</td>
<td>Care International</td>
<td>Boreholes</td>
</tr>
<tr>
<td>Misisi</td>
<td>LWSC</td>
<td>-</td>
</tr>
<tr>
<td>Chawama/Kuomboka</td>
<td>LWSC</td>
<td>Piped</td>
</tr>
<tr>
<td>John Howard</td>
<td>LWSC</td>
<td>-</td>
</tr>
<tr>
<td>Jack Compound</td>
<td>LWSC</td>
<td>Boreholes</td>
</tr>
<tr>
<td>Bauleni</td>
<td>Irish Aid</td>
<td>Boreholes</td>
</tr>
</tbody>
</table>

*Type: Boreholes are individual water points not connected to the LWSC network while Piped refer to supply from the LWSC distribution network. - no data*
3 GROUNDWATER POTENTIAL

3.1 Geology of Groundwater Occurrence

Geomorphology

The map in Figure 3.1 overleaf shows the general outline of the city of Lusaka and borehole locations with geological background. In brief the map shows the thick grey-bluish band of Lusaka dolomite (Lusdol) formation stretching in a northwest to southeast direction. To the south the Lusaka Dolomite is bounded by schists (light green) and to the north by dolomite of the Cheta formation interbedded with schists and quartzites of the Cheta and the older Chunga formation. Moving further north alluvium (light red) is encountered.

The area south of Lusaka has been described as forming part of the Mid-Tertiary peneplain of central Africa, whereas the flat topped hills to the north are thought to be remnants of a younger peneplain of Cretaceous age (Dixey, 1945 and 1955). Dolomites and limestones forming typical karst topography outcrop as flat lying areas, whereas schists and quartzites underlie more broken and hilly ground. Schist-dolomite boundaries are normally indicated by steep downward slopes from schists to dolomite.

Due their karstic nature with water infiltrating in solution cavites, surface streams are rare on the Lusaka Dolomite. Instead these tend to reappear as springs along carbonate-schists junctions; (i.e. as can be seen along the southern border of the Lusaka Dolomite).

Typical solution features of the Lusaka dolomite are pinnacle karst and sinkholes. The former usually develop as ridges along the direction of preferred drainage where this coincides with bedding. Sinkholes on the other hand represent areas where underlying rock has collapsed. Mostly they are grassy depressions with gentle slopes, oval or circular shaped, ranging in diameter from a few meters to about 100 meters and in depth from 1 meter to a maximum of 10 meters. Sinkholes can easily be overlooked in the field, but can clearly be distinguished on aerial photographs.
Figure 3.1. Groundwater sources with geological background
Geology

To appreciate the groundwater potential of the various rock units in the Lusaka area it is helpful to first consider the underlying geology and inherent structural features (i.e. faults, joints and lineaments).

The various rock units depicted in the above references map belong to the Katanga system. In the Lusaka area the transition between the Katanga system and the underlying basement is marked by a pronounced unconformity (exposure and erosion of strata before continued deposition). The whole system of Katanga rocks has, however, gone through multiple phases of tectonic deformation (i.e. being part of one of the primary pieces (craton) of today's continents). This has resulted in destruction of all primary features, thus complicating establishment of the stratigraphic sequence and regional correlation.

For example it is uncertain whether the two calcareous (limestone/dolomite) and schist units of the Cheta formation represent a true stratigraphic sequence (that is originated from separate depositional events) or duplication by recumbent (overturned folding of the same unit) (Simpson et al., 1963, Cairney 1967 and Garrard, 1968 in FIG, 1978). Another theory is that the current positioning of strata has resulted from an extensional fault regime where units of the Cheta formation have moved downward in relation to adjacent blocks of the Lusaka Dolomite and basement complex rocks. This is illustrated in Figures 3.2 and 3.3. Here faults have largely been interpreted to coincide with stratigraphic boundaries as shown in Figure 3.1. The locations of boundaries interpreted from lineaments in satellite and aerial photos (JICA, 1995).

Noting that extensional dip-slip faulting tends to open fractures, hence increasing permeability the JICA study have indicated 3 preferred zones for siting of boreholes. These zones are located along the boundaries between Cheta limestone and lower Chunga Schist (e.g. see Figure 3.2). However, a word of caution in karst terrains is that dissolution features commonly also appear as lineaments on aerial imagery, particularly in areas with contrasting geologic properties (Simpson et al., 1963 in FIG, 1978). These may or may not yield promising potential at depth. In addition to sinkholes, dissolution cavities and springs, a karst feature which is thought to indicate favourable groundwater potential are the breccias running along the strike (orientation of bedding) in the limestone/dolomite rocks (Simpson et al. 1963 in FIG, 1978). Proposed borehole sites and interpreted geologic properties therefore need to be examined in greater detail as part of future groundwater exploration, and will be discussed in greater detail in Ch 4.

Aquifer Characteristics

The groundwater features of the various lithologic units can be summarized as follows

Lusaka Dolomite:  
The limestones, dolomitic limestones and dolomites are karstified. Primary porosity is low and permeability is mainly developed through dissolution enlargement of joints and fissures. A pinnacle karst surface is developed and partly buried under laterite cover. As already described features like sinkholes, karstic waterlosses, depressions are indicators of underground solution activities.

Cheta Formation:  
This include the schist and limestones bordering the Lusaka Dolomite to the north. Intergranular porosity and fissures exist in unaltered schist, but less so in areas of deformation where schistosity has smeared granules creating impermeable sheets. Within the schists highly fractured quartz veins produce localized zones of high porosity and permeability. Highest porosity and permeability is developed in the transition zone between weathered and unaltered schist. Specific capacities (yield in m³/hr per meter of drawdown)
and boreholes yields average at about 0.3-1 m³/hr/m and 0.9-18 m³/hr respectively (FIG, 1978). Corresponding values in the Lusaka Dolomite are 24.5 m³/hr/m and 45 m³/hr (JICA, 1995). Due to their low groundwater potential the schists are not considered sufficient for future large scale water supply.

Unfortunately the limestones and dolomite of the Cheta formation are less soluble than the Lusaka Dolomite. Outcrops are usually large pavements devoid of karstic surface features. Their groundwater potential is therefore much lower with a probability of suitable borehole sites of 1:2 to 1:4 (Lambert, 1963 in FIG, 1978).

With the planned northward expansion of the city these limestones could be of interest to the most northerly suburbs, provided well yields and lengths of pipelines are in economical relation (FIG, 1978).

Figure 3.2. Inferred position of faults and suggested sites for boreholes (JICA, 1995)
Figure 3.3. Inferred geological cross section along the profiles A-A' and B-B'.

Explanation of Symbols:
- Alluvium
- Lusaka Dolomite
- Senosi
- Chota Formation
- Limestone
- Kasanga system
- Chonga Formation
- Quarries
- Gischa
- Basement Complex
- Faults
3.2 Recharge/Discharge Considerations

Groundwater circulation

Groundwater circulation and subsequent karstification is controlled by contact with the less pervious schists surrounding the carbonate rocks. As a result the outcropping contact dolomite schist is the controlling discharge level for the karst aquifer.

The karstic water is under free water table conditions. As water containing fractures are intercepted at depth (at distance from the point of recharge), an apparent artesian head is usually encountered when drilling. Drilling depths are seldom more than 150 meters and most water strikes with highest permeability usually occur in the section from 25 - 50 meters. Resulting groundwater levels range from 20 m to a few meters below ground level (i.e. in the areas affected by pumping).

The groundwater surface closely follows the topography and following the general inclination of the low ridge formed by the Lusaka Dolomite the main groundwater flow is directed towards the northwest. No seasonal changes in flow directions have been detected. Natural discharge from the aquifer occurs in certain sections along the schist-dolomite contact through intermittent springs.

To explain the presence of dissolution cavities at depths exceeding 60 meters, the presence of a deeper circulating groundwater system has been postulated. The Chunga valley to the north of the Lusaka Dolomite and stream beds along its south western boundary act as drains for the deep karstic water (FIG, 1978).

Recharge

Recharge occurs over the whole area of the aquifer as a result of downward percolation of rainwater. However, as the surrounding rocks (schists and limestones) are partially permeable water may also enter laterally through these formations. Thus the groundwater catchment probably extend well beyond the boundaries of the Lusaka Dolomite. No recharge estimates have, however, quantified the amounts of such lateral migration of groundwater. An overview of recharge estimates for the Lusaka Dolomite and the Cheta limestone is shown in Table 3.1 below.

Table 3.1. Recharge estimates.

<table>
<thead>
<tr>
<th>Study</th>
<th>Rainfall/year (mm)</th>
<th>Infiltration rate (%)</th>
<th>Surface Area (km²)</th>
<th>Recharge m³/year (mid)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lusaka D. (FIG, 1978)</td>
<td>820 mm</td>
<td>20</td>
<td>680</td>
<td>111*10⁶</td>
</tr>
<tr>
<td>Lusaka D. (JICA, 1995)</td>
<td>840 mm</td>
<td>8</td>
<td>680</td>
<td>45.7*10⁶</td>
</tr>
<tr>
<td>Cheta L. (FIG, 1978)</td>
<td>820 mm</td>
<td>20</td>
<td>220</td>
<td>36.8*10⁶</td>
</tr>
<tr>
<td>Cheta L. (JICA, 1995)</td>
<td>840 mm</td>
<td>8</td>
<td>220</td>
<td>14.1*10⁶</td>
</tr>
</tbody>
</table>

Available storage can be calculated by multiplying the storage coefficient (1.8%) with the thickness of the most permeable part of the aquifer (20 meters) and the surface area (680 km²). This gives 245*10⁶ m³. Available storage should therefore not be limiting factor for retention of recharge.
3.3 Opportunities and Constraints

Potential for augmenting supply

Based on records received from the GIS Department of LWSC there are currently 21 boreholes operating out of a total of 74 installed. With current pumping rates amounting to about 27 mld, it is evident from comparison with the above recharge estimates, that there is significant potential for increasing groundwater supply from existing boreholes. However, from the more conservative estimate in Table 3.1, is likely that groundwater can only serve as an additional water source, up to 50% of present demand with current rate of unaccounted for losses, i.e without securing additional recharge through lateral migration of groundwater from adjacent formations. Thus, to meet long term water demand steps must also be taken to secure flows from the existing intake and treatment works on the Kafue river.

Increasing groundwater pumping will, however, be the only economically viable alternative for securing additional water supply for the short term. The reason being both the higher costs and time required to increase the capacity of the existing transmission main from the Kafue river. As a first priority steps should therefore be taken to rehabilitate and upgrade existing boreholes.

The decreasing pumping rate over the last decade have caused a general rise of the water table (e.g. see Figure 3.4). In groundwater discharge areas this rise may cause water logging and consequently offer favourable sites for breeding of mosquites and transmission of water borne diseases.

![Groundwater Levels](image)

*Figure 3.4. Groundwater levels averaged over all observation points from 1995-2000*

Potential with respect to water quality

Apart from undertaking groundwater exploration to find suitable locations for siting boreholes, it is likely that the increasing potential for diffuse contamination from waste water will represent a development constraint. To assess pollution impact water quality data containing information on mainly total bacterial and faecal coliforms was compiled. Based on records from 2003 - 2005 average concentrations of bacterial coliforms were calculated and plotted for each location. This is shown in Figure 3.5. Peri-urban areas are shaded in light red. Concentrations vary from bright blue nil to red 20 per 100 ml sample. Concentrations greater than 0 are considered unacceptable.

The overview shows that there are only a few points, mainly located around the periphery of the city and or areas close to peri-urban settlements that are affected. Most groundwater points appear to be relatively free from organic pollution. Diffuse contamination from waste
water should therefore not pose serious obstacle to groundwater development. To protect groundwater abstraction from points from further deterioration of water quality from diffuse pollution of waste water protection zones as well as continued monitoring to ensure acceptable quality before and after disinfection are needed.

Figure 3.5. Urban layout with concentrations of bacterial coliforms
4 CONCLUSIONS - POTENTIAL FOR AUGMENTING WATER SUPPLY

The key features and conclusions resulting from the review can be summarized as follows:

- Water supply to Lusaka was originally based on groundwater and groundwater utilisation peaked in the early 90's where abstraction rates amounted to 100 million litres per day (mld) representing about 40% of total supply capacity.

- Over the last decade abstraction of groundwater has decreased steadily. Currently only 21 of 74 installed production boreholes are operating with about 27 mld abstracted.

- For the main Lusaka dolomite aquifer underlying the central and southern parts of Lusaka groundwater potential as annual renewable recharge from precipitation is estimated at approximately 120 - 300 mld. Similarly groundwater potential in the Cheta limestone formation along the northern periphery of the city is estimated at 38 - 100 mld.

- From the above is evident that there is significant potential for augmenting groundwater supply. However, without securing additional recharge from adjacent formations, it is clear as previous studies have noted, that groundwater can only serve as an additional water source (i.e. up to 50% of present demand from the more conservative recharge estimate).

- In evaluating the future groundwater potential the Lusaka dolomite is regarded as the preferred choice. This is due its vicinity to the main population centres and more favourable hydrogeologic properties compared to the Cheta formation. The latter can prove interesting with further northwards expansion of the city.

- Despite widespread diffuse pollution from sanitary drainage, groundwater quality is generally good. Plotting of bacterial water quality from all surveyed boreholes indicated that waste water contamination was mainly confined to the boreholes located within or close to areas not served with septic tanks or sewerage. To protect groundwater sources and avoid deterioration of water quality groundwater protection zones and continued monitoring is needed.
5 RECOMMENDATIONS FOR FUTURE INVESTIGATIONS

5.1 Approach to groundwater development and management

Noting the number of existing boreholes and groundwater infrastructure future activities within the groundwater sector should as a first priority focus on rehabilitating and managing existing sources rather than finding new ones. In particular this concerns the following key tasks:

- Ascertaining the operational status and yield of existing boreholes
- Establishment of groundwater model as an integral step of groundwater management, protection and in guiding future exploration and development.
- Training of personnel in hydrogeology and water resources management

The suggested focus can also be seen as being in line with uncertainty regarding additional potential as indicated by annual recharge beyond the full operating capacity of existing sources; an aspect that needs to be determined in greater detail before embarking on an ambitious groundwater exploration and development program.

Further description of the above presented points follows below.

5.2 Operational status and yield

Existing boreholes need to be examined with regards to working conditions of installed equipment (pumps, electrical control equipment, pressure pipes, valves etc) and borehole integrity concerning the condition of casing, screen and sanitary seals).

Having ascertained which boreholes are working and which are not including the condition status and nature of all remedial works required, a yield assessment of all boreholes should be conducted. The yield assessment should as far as possible be based on existing data from previous studies. This information should then be used to for the planning and undertaking of borehole rehabilitation and pumping tests.

Based on the above tender documents with bill of quantities for all civil works should be prepared.

Estimated resources: 20 person days

5.3 Groundwater modeling

Introduction:

To effectively manage and develop groundwater resources it is necessary to have a holistic and comprehensive picture of the distribution of biophysical ecological, flow and geologic properties determining the nature of recharge, propagation of permeability and concomitant groundwater flow and contaminant transport and behaviour. The following tasks and principles should guide model development.

Model development:

Determination and definition of the 3-D configuration of lithologies and permeability characterisitics and land cover based on,
- Review of existing data and previous models
- Analyses of satellite and aerial imagery

Model calibration:
- Placement of pumping and observation boreholes
- Establish records on pumping rates and water level fluctuations
- Establish recharge rates both spatially and temporally.

Model should incorporate alternative boundary conditions and assumptions concerning the aerial extent of the aquifer to examine the nature of recharge (i.e. in particular lateral recharge from adjacent formations).

The groundwater model will also be a useful tool to determine optimum pumping rates, well field configuration, management and protection of groundwater resources.

Estimated resources: 50 person days

5.4 Groundwater protection and monitoring

In order ensure that Lusaka's groundwater resources are sustainable in the long-term, the resource needs to be protected from pollution and over-abstraction. Integral elements of a protection and monitoring system include the following:

Establishment of protection zones around production boreholes prohibiting activities that can lead to pollutant leaching (informal settlements, dumping of solid waste, discharge of industrial effluents)

Determination of protection zones should be based on internationally accepted methods that are applicable in karst terrains where preferential pathways control groundwater flow.

Similarly, current monitoring activities should be continued and expanded to conform to international standards (WHO, EU-Water Framework Directive). In addition to analyzing more species, this task should include the establishment of a GIS for groundwater resources.

Whether such a GIS should be integrated within the present GIS of LWSC, or be developed as a separate unit should be considered, and the most efficient and easy to use system should be chosen. To be able to draw on the powerful data presentation and processing capabilities, the groundwater modelling software needs to be compatible with the chosen GIS.

Lastly, to manage groundwater development and abstracted amounts a groundwater licence and register should be established and integrated with the groundwater GIS

Required resources: 20 person days

5.5 Groundwater exploration

The siting of suitable locations for high yielding production boreholes have in the past been based on ground surveying and analyses of aerial imagery followed by electrical resistivity surveys refine mapping of geological properties on the surface and at depth.

It is recommended that future groundwater exploration use similar techniques. Over the last decade the increasing availability of satellite imagery and data processing capability have contributed to tremendous advances in the acquisition and processing of geophysical data.
At present, rapid identification of buried coarse sand lenses, weathering zones and dissolution cavities has become routine. Using electrical resistivity imaging contrasts in geological properties can accurately be identified within a 3-400m profile in a period of a few hours.

However, in order to target resources most efficiently, it is recommended that future groundwater exploration start with a review and plotting of existing data. The objective of the review will be to re-evaluate earlier proposed drilling locations and to prepare a plan for additional exploration activities including bidding documents for geophysical surveying and drilling works.

Estimated resources: 20 person days

5.6 Capacity building and training of personnel

To achieve lasting improvements in groundwater supply rehabilitation of existing and construction of new infrastructure will not suffice alone. Training of personnel within all aspects of groundwater development and management will also be necessary. Such a training program needs to be formulated including the institutional framework and capacity for its management and coordination.

A natural starting point should be a review of the existing situation and preparation of a training and capacity building program. The latter should be developed and formalized within LWSC prior to undertaking the groundwater rehabilitation and upgrading. This to ensure that training is integrated as a key element of the latter being conducted both in the form of preparatory course/problem solving work and on the job.

Critical elements of capacity building and training will include but not necessarily limited to the following:

- General training in hydrogeology and principles of groundwater construction and design (e.g. geology of groundwater occurrence, construction of boreholes, logging of geological data, test-pumping and analyses of test-pumping results)
- Training in groundwater exploration (e.g. geological mapping, identification of lineaments using remote sensing, geophysical methods)
- Training in development and use of the groundwater model including GIS for pre/post processing of input data and results generated
- Training in groundwater management (e.g. principles of integrated watershed management and regulatory controls/standards, setting and monitoring of environmental objectives (i.e. water quality)

Estimated resources: 30-50% of total time resource
### 5.7 Required resources

A summary of the main tasks and required resources is described in the following table:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Time (person days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational status and yield</td>
<td>Review of existing sources and preparation of plan for rehabilitation and future development with tender documents for civil works</td>
<td>20</td>
</tr>
<tr>
<td>Modeling</td>
<td>Development and calibration of groundwater model</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Simulations to examine hypothesis on the nature of recharge, yield and development strategy</td>
<td>20</td>
</tr>
<tr>
<td>Protection and monitoring</td>
<td>Preparation of monitoring programme and strategy</td>
<td>20</td>
</tr>
<tr>
<td>Exploration</td>
<td>Preparation of groundwater exploration plan including review of existing data and preparation of tender documents for geophysical surveys and test drilling</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Total (person days)</td>
<td>110 (5.5 man months)</td>
</tr>
<tr>
<td>Training</td>
<td>Preparation and implementation of a capacity building and training plan including review of existing human resources and institutional set-up (50 % of total estimated resources)</td>
<td>50 (2.5 man months)</td>
</tr>
<tr>
<td></td>
<td>Total for future groundwater studies</td>
<td>160 (8 man months)</td>
</tr>
</tbody>
</table>
Annex A

List of Persons Met During Preparation of the Groundwater Review

<table>
<thead>
<tr>
<th>Item</th>
<th>Name</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LWSC</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Mr. Henry Manzi</td>
<td>Acting Project Manager</td>
</tr>
<tr>
<td>2</td>
<td>Mr. Dennis D. Mwanza</td>
<td>Managing Director</td>
</tr>
<tr>
<td>3</td>
<td>Mr. Akapelwa</td>
<td>Senior Engineer, Production</td>
</tr>
<tr>
<td>4</td>
<td>Mr. Aubrey Mulenga</td>
<td>Acting Senior Engineer GIS LWSC</td>
</tr>
<tr>
<td>5</td>
<td>Mr. Victor Mujelmani</td>
<td>Engineer Peri-urban department</td>
</tr>
<tr>
<td></td>
<td>ECZ</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Ms. Nancy M. Mushota</td>
<td>Inspector EIA</td>
</tr>
<tr>
<td>7</td>
<td>Mr. Augustine Lupenga</td>
<td>Inspector EIA</td>
</tr>
<tr>
<td></td>
<td>DWA</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Library</td>
<td>Copying of reports</td>
</tr>
<tr>
<td></td>
<td>FAO</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Library</td>
<td>Copying of reports</td>
</tr>
</tbody>
</table>