Millennium Cities Initiative
EARTH INSTITUTE | COLUMBIA UNIVERSITY

MCI SOCIAL SECTOR WORKING PAPER SERIES

N° 27/2012

WATER AND SANITATION NEEDS ASSESSMENT FOR BLANTYRE CITY, MALAWI

Prepared by:

Moumié Maoulidi, PhD

October 2012

475 Riverside Drive, Suite 253, New York, NY, 10115, United States
Phone: +1-212-870-2767; Fax: +1-212-870-2777
Website: http://mci.ei.columbia.edu

NB: This needs assessment was researched and prepared by MCI Associate Director for Research, Dr. Moumié Maoulidi, reviewed by MCI Social Sector Specialist in Blantyre, Mrs. Sophie Kalimba and edited by MCI Director, Dr. Susan M. Blaustein, and MCI Social Sector Program Associate, Ms. Lorian Wyzinski.

Figure 1. Map of Malawi Showing Blantyre City

Source: UN Cartographic Section

ACKNOWLEDGEMENTS

Blantyre City Council

Mr. Emmanuel Ted Nandolo, Chief Executive Officer, Blantyre City Council
Mr. Costly Chanza, Director of Urban Planning, Blantyre City Council
Dr. Emmanuel Kanjunjunju, Director, Health Services
Mr. Felix Khembo, Monitoring and Evaluation Officer

Blantyre Water Board
Charles A.S. Msusa, Chief Accountant
Andrew Masiye, Planning and Business Development Manager

UN-HABITAT
Mr. John Chome, UN-HABITAT, Lilongwe, Malawi.

Water For People
Mrs. Kate Harawa, Country Director
Mr. Muthi Nhlema, Grants Manager

Village Hygiene Project
Mr. Roy Khonyongwa, Executive Director

A special thank you to Mrs. Sophie Kalimba, for her indefatigable efforts and commitment to the City of Blantyre and to MCI.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

AfDB	African Development Bank
BCC	Blantyre City Council

EIB	European Investment Bank
EU-EIB	European Union - European Investment Bank
FLOW	Field Level Operations Watch
GoM	Government of Malawi
IHS	Integrated Household Survey
IWSS	Irrigation, Water and Sanitation Sector
LIA	Low-Income Areas
MCI	Millennium Cities Initiative
MDG	Millennium Development Goals
MEPD	Ministry of Economic Planning and Development
MGDS	Malawi Growth and Development Strategy
MICS	Multiple Indicator Cluster Survey
MIW	Medical and Infectious Waste
MIWD	Ministry of Irrigation and Water Development
MK	Malawi Kwacha (currency)
MoF	Ministry of Finance
NGO	Non-Governmental Organization
NRW	Non Revenue Water
NSO	National Statistics Office
NSP	National Sanitation Policy
NWDP I	First National Water Development Programme
NWDP II	Second National Water Development Programme
PPP	Public-Private Partnerships
SADC	South African Development Community
SWAp	Sector Wide Approach
THAs	Traditional Housing Areas
UFW	Unaccounted For Water
UN-HABITAT	United Nations Human Settlements Programme
UNICEF	United Nations Children's Fund
VIP	Ventilated Improved Pit Latrine
WASH	Water, Sanitation and Hygiene
W4P	Water for People
WMS	Welfare Monitoring Survey
WUA	Water Users Association

EXECUTIVE SUMMARY

Malawi is a country endowed with a large network of surface water bodies, including Lake Malawi (28,750 km^2), Lake Malombe (303 km^2), Lake Chilwa (683 km^2) and numerous rivers. Yet, the Blantyre Water Board (BWB) has been struggling to provide regular water supply to the

residents of the country's commercial capital, Blantyre, mainly because rapid population growth is outstripping supply. The city of Blantyre relies on two extraction and treatment plants for water supply, Walker's Ferry and Mudi Dam, but these two plants were designed to produce water for a much smaller population than the estimated 2012 population of 783,296 people.

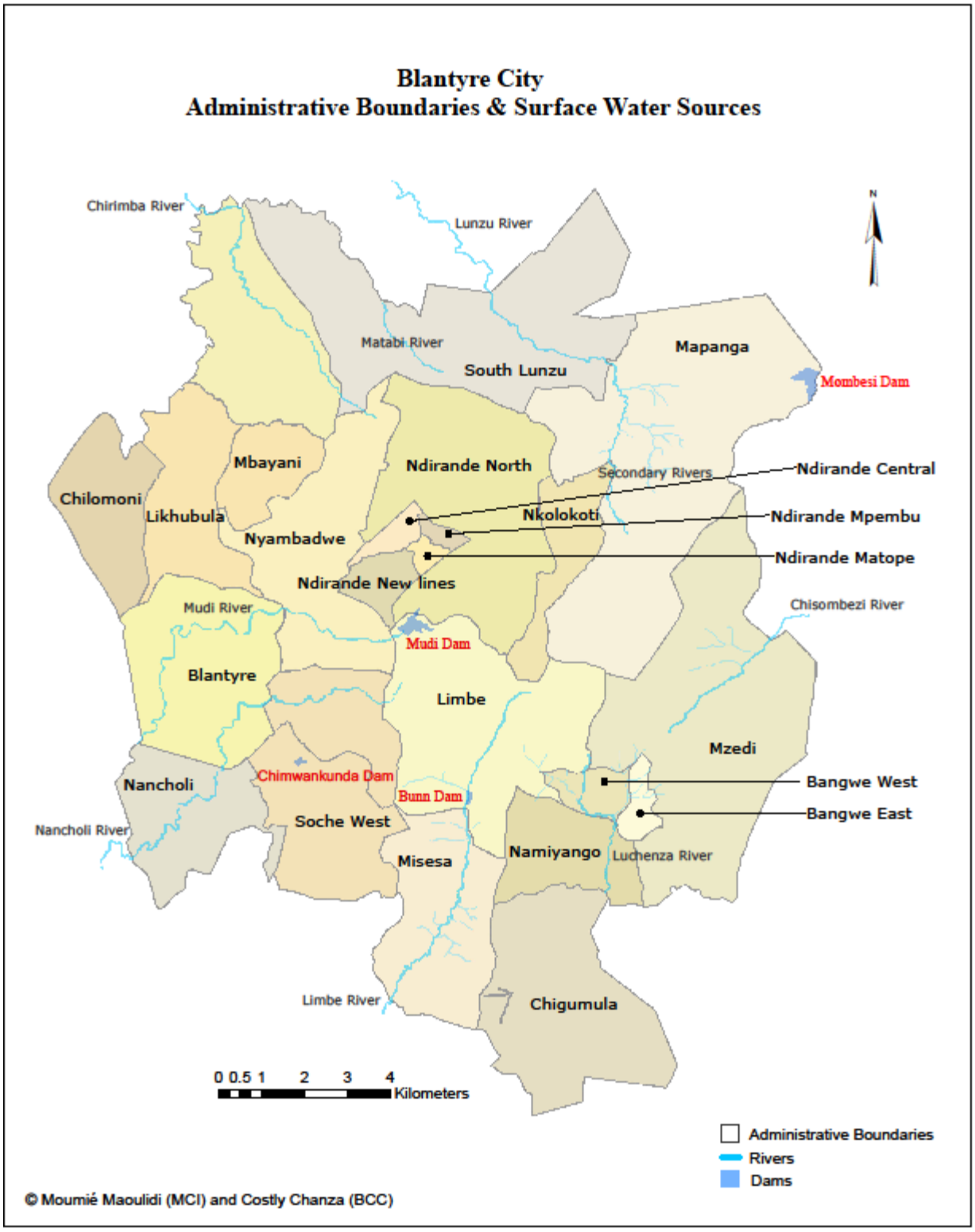
An important challenge facing the BWB is that, because of Blantyre's higher geographical location and distance from the main source of water, the Shire River, producing water is costly. Water has to be pumped vertically over a great distance and at considerable cost. Operational inefficiencies also help explain erratic water supply. BWB annual reports indicate that almost half of the produced water is lost due to leakages, illegal connections and vandalism. Dilapidated infrastructure and malfunctioning electrical/mechanical equipment are additional factors contributing to the irregular provision of water. The two water extraction and treatment plants are in need of major rehabilitation, and the costs required to repair the equipment are astronomical. The cash-strapped BWB has not been able to generate the required financial resources to overhaul and replace the water supply infrastructure. Recently, the Government of Malawi and international development partners have contributed to the rehabilitation of infrastructure by financing projects such as the Peri-Urban Water Supply Project and the Second National Water Development Programme (NWDP II).

Water supply shortages are more prevalent in high-density unplanned residential areas (where most low-income communities reside) than in low-density, high-income areas. In low-income areas, unreliable water supply is leading some residents to rely on unimproved sources of water such as shallow wells, streams and drainage ditches—with their attendant health and safety risks. There is an urgent need to ensure that these areas receive piped water, either by increasing the number of water kiosks or by extending the pipeline network.

The city also faces several acute sanitation challenges: solid waste collection is grossly inadequate, with only 30 percent of the population having access; the sewer system coverage is very limited, as only one-tenth of the population is connected to the sewer; and rivers are being polluted by effluent as well as by untreated domestic and industrial wastewater. Many people rely on pit latrines and septic tanks that fill up quickly because they are shared with extended family members and neighbors. Sanitation is particularly problematic in low-income areas where pit latrine and septic tank emptying services have until recently been irregular. The introduction of some promising new pumping technologies is alleviating this situation.

This needs assessment finds that with an annual per capita investment of $16 between 2013 and 2015, Blantyre City can achieve the Millennium Development Goal targets for water and sanitation. The report is structured as follows: the first and second sections describe the main water and sanitation challenges; the third section addresses the financing of water and sanitation in Blantyre and presents the results of the costing model, and the fourth section concludes and presents some recommendations.

Figure 2. Blantyre City Administrative Areas and Surface Water Sources



I. INTRODUCTION

Blantyre City is the second largest urban center in Malawi and is located 311 kilometers (km) southeast of the national capital, Lilongwe.[1] Situated at an altitude of approximately 1,150 meters (m) above sea level, the city covers an area of over 220 square kilometers (sq. km).[2] It is the capital of Malawi's Southern Region as well as of Blantyre District. Key water and sanitation problems facing Blantyre residents include frequent water supply disruptions, irregular solid waste collection, indiscriminate liquid waste disposal and inadequate sewerage treatment.

1.1. Objectives

The main objective of this needs assessment is to identify the main water and sanitation challenges facing the city of Blantyre in its efforts to achieve Target 7C (formerly Target 10) of Millennium Development Goal #7 – to cut in half by 2015 the proportion of people without access to safe water and basic sanitation. Moreover, it suggests specific interventions that can improve water, sanitation and hygiene conditions and estimates their associated costs, in order to enable local, regional and national governments and development partners to plan accordingly.

1.2. Methodology

The research methodology used in this study includes field research, a desk review and site visits. The field research and site visits were conducted in 2010 and 2011 by MCI's Social Sector Specialist in Blantyre and MCI's Associate Director for Research. Data and information used in this report were obtained from representatives of various agencies in Blantyre, including: the Ministry of Irrigation and Water Development (MIWD), the National Statistical Office (NSO), as well as secondary sources.

1.3. Limitations

A key challenge faced while conducting this assessment was that official government statistics relating to water and sanitation coverage are incongruous with secondary sources as well as surveys such as the demographic and health surveys (DHS) and multiple indicator cluster surveys (MICS). Some organizations, such as Water for People (W4P), argue that official government statistics overestimate the proportion of people with access to improved water sources and sanitation because they do not use the same definitions as international organizations.[3] Whenever discussing the MDGs, international definitions and indicators, rather than government definitions and statistics, are used in this study.

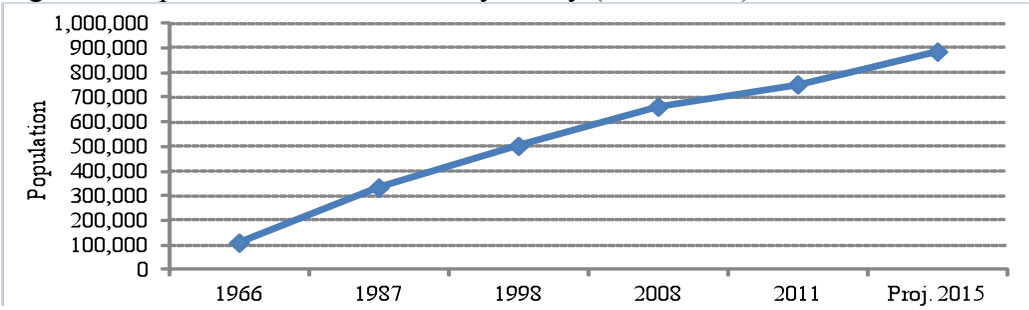
1.4. Demographics

The 2008 Census showed that Blantyre City had a population of 661,256 inhabitants (NSO, 2008). Assuming a growth rate of four percent per year, the estimated 2012 population is 783,296, and the projected 2015 population is 884,497. High fertility rates and in-migration explain this expected population increase and raise concerns about whether the existing urban

[1] Blantyre is one of four urban areas in Malawi; the others are Lilongwe, Zomba, and Mzuzu. The city was founded by Scottish Missionaries in 1870 and is named after the Scottish town where Dr. David Livingstone was born.
[2] Malawi is divided into three regions (Northern, Central and Southern) and 28 districts.
[3] http://www.waterforpeople.org/programs/africa/malawi.html.

infrastructure can sustain the rapid population growth. It should be noted, however, that the city's daytime population soars to approximately one million, because people from surrounding areas travel to the city during the day. This puts tremendous pressure on Blantyre City Council's (BCC's) ability to provide adequate water and sanitation services.

Figure 3. Population Growth in Blantyre City (1966-2015)



Source: NSO and MCI projections

Malawi is one of the most densely populated countries in Africa, with a population density of 158.3 people per square kilometer (people per sq. km); although Blantyre City is not Malawi's largest city in terms of population, it has the highest population density in the country, with 3,269 people per sq. km.[4]

About 70 percent of the city's population lives in 21 low-income areas (LIA), some of which are unplanned (Muwamba, 2010).[5] These unplanned areas are locations that have developed without following building regulations and where housing construction and selling of land is uncontrolled. There are more than a dozen such unplanned areas, with Ndirande having the highest population, and they occupy about 25 percent of the land in the city (UN-HABITAT, 2011). Table 1 shows the distribution of the city's population by administrative area and lists the names of the main low-income areas.

Table 1. Blantyre City Population by Area (left) and List of LIAs (right)

Area in Blantyre	Population
Michiru Ward	46,639
South Lunzu Ward	37,864
Mapanga Ward	23,854
Nkolokoti Ward	35,218
Ndirande Norh Ward	29,033
Ndirande South Ward	64,602
Ndirande West Ward	15,529
Nyambadwe Ward	8,304
Likhubula Ward	51,853
Chilomoni Ward	37,690
Blantyre West Ward	22,901
Blantyre Central Ward	4,808
Blantyre East Ward	5,786

Area in Blantyre	Population
Chichiri Ward	5,452
Mzedi Ward	13,333
Bangwe Ward	34,773
Namiyango Ward	18,761
Limbe East Ward	38,512
Limbe Central Ward	2,960
Limbe west Ward	13,877
Soche East Ward	14,887
Soche West Ward	50,617
Nancholi Ward	25,109
Misesa	31,212
Chigumula Ward	23,352
Msamba Ward	4,330

Low-Income Areas (LIA)	
Kameza	Manase
Machinjiri	Chatha
Mapanga	Naotcha
Chilomoni(Mulunguzi)	Soche
Mbayani/CheMussa	Chiwembe Village
Ndirande (Safarao,	Misesa
Makata, Zambia,	BCA (Mavuto Branch)
Chrimba)	Bangwe/Namiyango
Kachere,	Chigumula
Mzedi	
Manyowe	

II. BLANTYRE'S WATER AND SANITATION SYSTEM

[4] In the 1998 Census, Blantyre's population was 646,235, even as Lilongwe's was only 440,471. A decade later, in 2008, Blantyre's population was 661,256, but Lilongwe's population was 674,448.

[5] A few planned areas are also low-income.

Institutional Framework

Key policy documents defining the country's water and sanitation strategy include the First and Second Phases of Malawi Growth and Development Strategy [MGDS I & II], the 2008 National Sanitation Policy [NSP], the 2005 National Water Policy and the 1996 National Environmental Policy [NEP]. The NSP assigned local governments sanitation responsibilities, and the NEP called for better management of the environment and natural resources. The objectives of MGDS include ensuring that all people shall have access to potable water and adequate sanitation services and reducing incidences of water related diseases. To attain MGDS objectives, the Government of Malawi (GoM) initiated the first and second phases of the National Water Development Programme (NWDP I & II). Funded by the World Bank, NWDP I (1996-2003) focused on the water sub-sector and advocated for the separation of policy-making responsibilities from the service delivery function. NWDP II (2007-2012) is a sector-wide approach (SWAp) seeking to increase water production, improve operational efficiency and ensure that low-income communities have access to water supply and sanitation services. However, sanitation was initially barely mentioned in NWDP II, which is supported by the World Bank, the European Union (EU) and the African Development Bank (AfDB). This is relevant to note because, until recently, the GoM has not accorded sanitation the importance it deserves.

At the national level, the Ministry of Irrigation and Water Development (MIWD) formulates and administers water policy and standards and grants licenses for water extraction rights. A Draft National Ten Year Sanitation and Hygiene Masterplan prepared by the GoM states that the sanitation sub-sector will also be under the MIWD. At the sub-national level, local governments are responsible for planning and coordinating water and sanitation programs within their boundaries. For instance, in Blantyre, BWB, an independent entity, is charge of water supply, while on-site sanitation (pit latrines and septic tanks), the sewer system and waste management services are managed by BCC.[6] The GoM and BCC have also actively encouraged Public-Private Partnerships (PPP) in the provision of sanitation services, as well as the supply and management of water in low-income areas (Chirwa and Jungwe, 2007; UN-HABITAT, 2011).

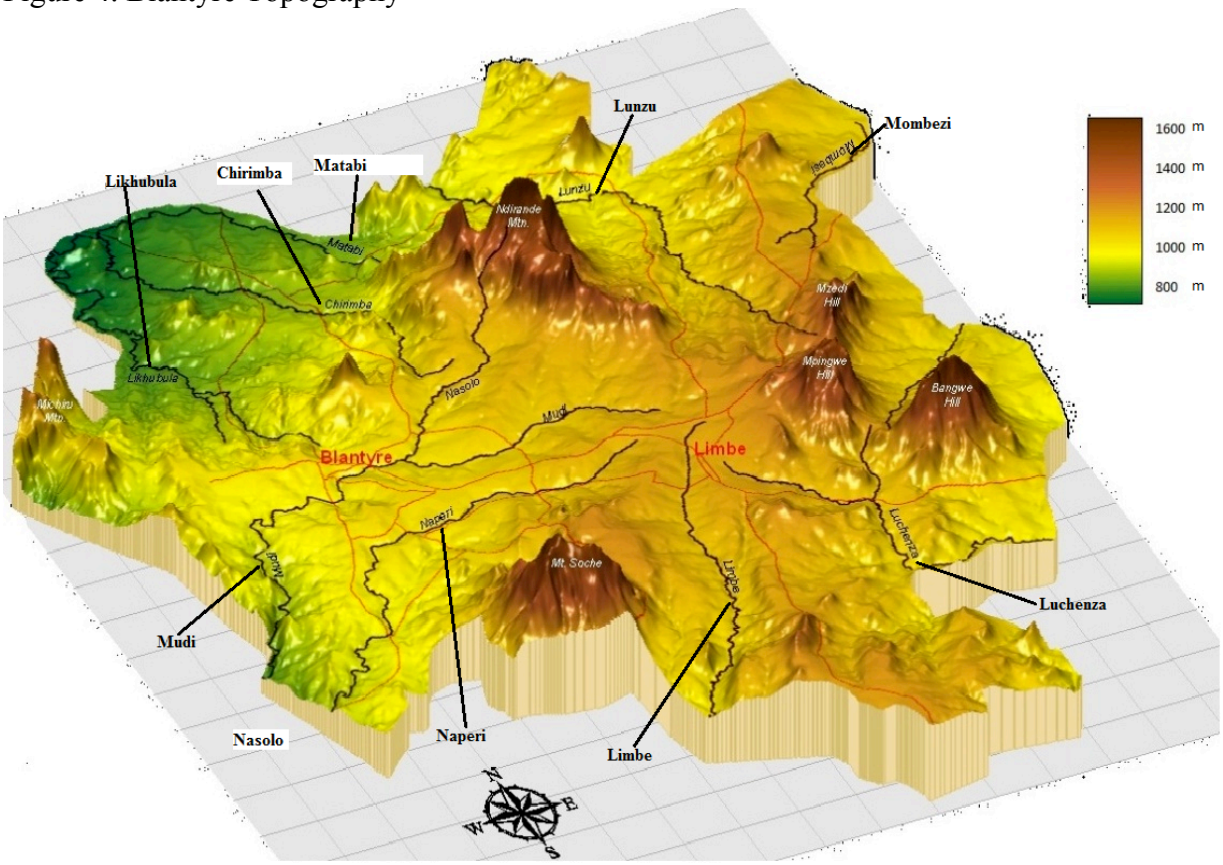
2.1. Topography

Blantyre is a city with many hills and valleys, as well as rugged terrain. The hills are between 780 and 1,612 m above sea level, and many streams originate from these hills and flow into the city. As Figure 4 shows, the topography is also varied and includes relatively flat areas. This landscape presents a unique problem because the water extraction point is situated at Walker's Ferry, 48 km from the city, and there is a 780m-altitude difference between Blantyre and Walker's Ferry. Consequently, water has to be pumped vertically over a great distance, and at considerable cost. In addition to hills and valleys, the terrain in areas such as Mbayani is rocky, making it difficult to build pit latrines deeper than three meters. Blantyre City also has three main soil types, with major implications for sanitation. Most areas in the city have dark grey or reddish brown clay loam soil, but areas near rivers and streams have soils made up of clayey

[6] The BCC comes under the Ministry of Local Government and Rural Development. As stipulated in the Local Government Act (1998), the city is managed by elected councilors and a mayor, but day-to-day operations are managed by the Blantyre Chief Executive Officer (CEO).

alluvium deposits, while hilly areas consist of sandy soils (Matope, 2000). Septic tanks are well suited to this type of soil because it is permeable.

Figure 4. Blantyre Topography



Source: Costly Chanza, BCC (2011)

There are a number of river catchment areas in Blantyre (Figure 4) that form a natural drainage system with distinct hydrological catchment areas, namely, Likhubula, Chirimba, Matabi, Lunzu and Mombezi, which drain the northern part of the city, and Mudi, Nasolo, Naperi, Limbe and Luchenza, draining the middle and southern parts. The sewerage catchment areas are Limbe, Soche, Blantyre and Chirimba (which includes Likhubula and Matabi catchment areas). In addition, there are Mudi, Limbe and Naperi sewerage catchment areas. Four of these sewerage catchment areas are operational (Chirimba, Mudi, Naperi and Limbe), and four are proposed (Luchenza, Mombezi, Chisombezi and Lunzu). Section 2.4 discusses sanitation in more detail.

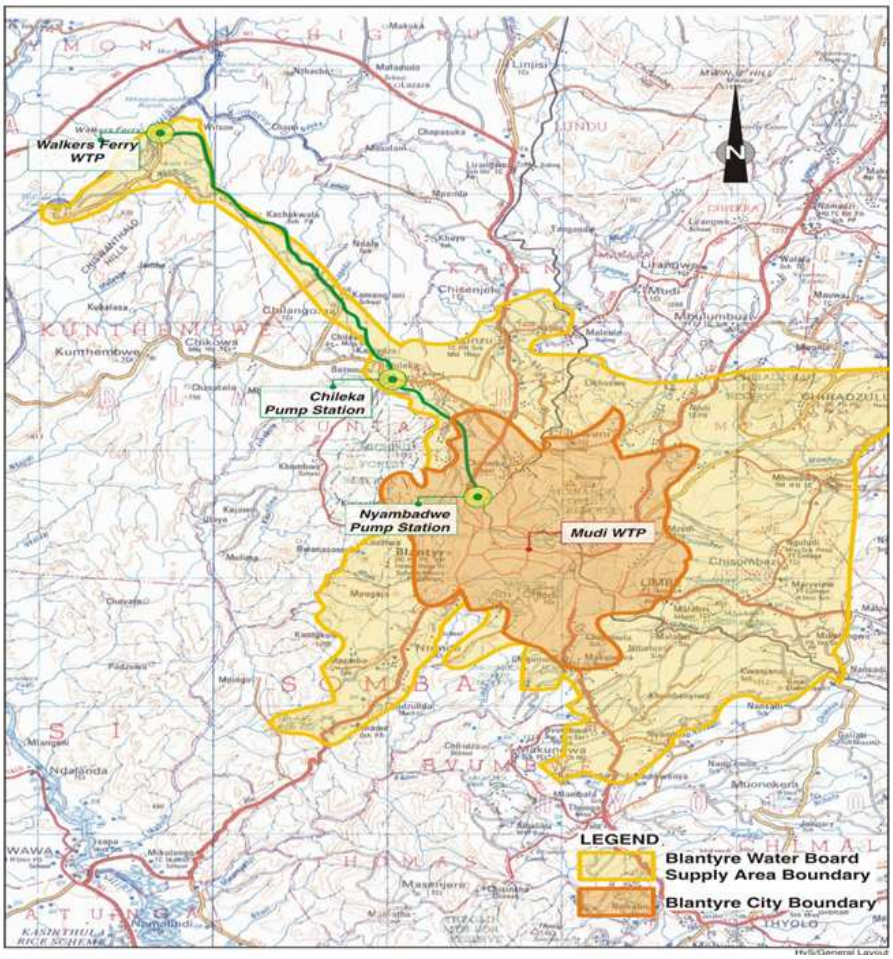
2.2. Blantyre's Water Supply System

Blantyre City derives most of its piped water supply from the Shire River (an outlet of Lake Malawi), located 48 km away. The water is abstracted and treated at a plant called Walker's Ferry, as well as at Mudi Dam, which located is within the city. The Mudi Treatment Plant was initially designed to serve the old townships of Blantyre and Limbe. As the town of Blantyre/Limbe began to grow, and the demand for water increased in the 1960s, Walker's Ferry Treatment Plant was commissioned. Built in 1963, Walker's Ferry was upgraded in 1996, but

most of the equipment is now being replaced because it is archaic. It is estimated that about 90 percent of the water currently used in Blantyre is derived from Walker's Ferry, and 10 percent is extracted from the Mudi Dam (BWB, 2011).

The BWB, a water utility organization operated by the government of Malawi, is responsible for abstracting, treating and selling potable water not only to the city, but also to surrounding peri-urban areas.[7] As a result, BWB services approximately one million people, a population much higher than the number of people living in the city (BWB, 2008). BWB extracts water from Shire River and treats it at Walker's Ferry.[8] The same water treatment process also takes place at Mudi Treatment Works, where water is extracted from an artificial dam. Figure 5 shows the locations of the water plants, some key pumping stations and the areas where BWB supplies potable water.

Figure 5. Blantyre Water Treatment Plants and Water Board Supply Area



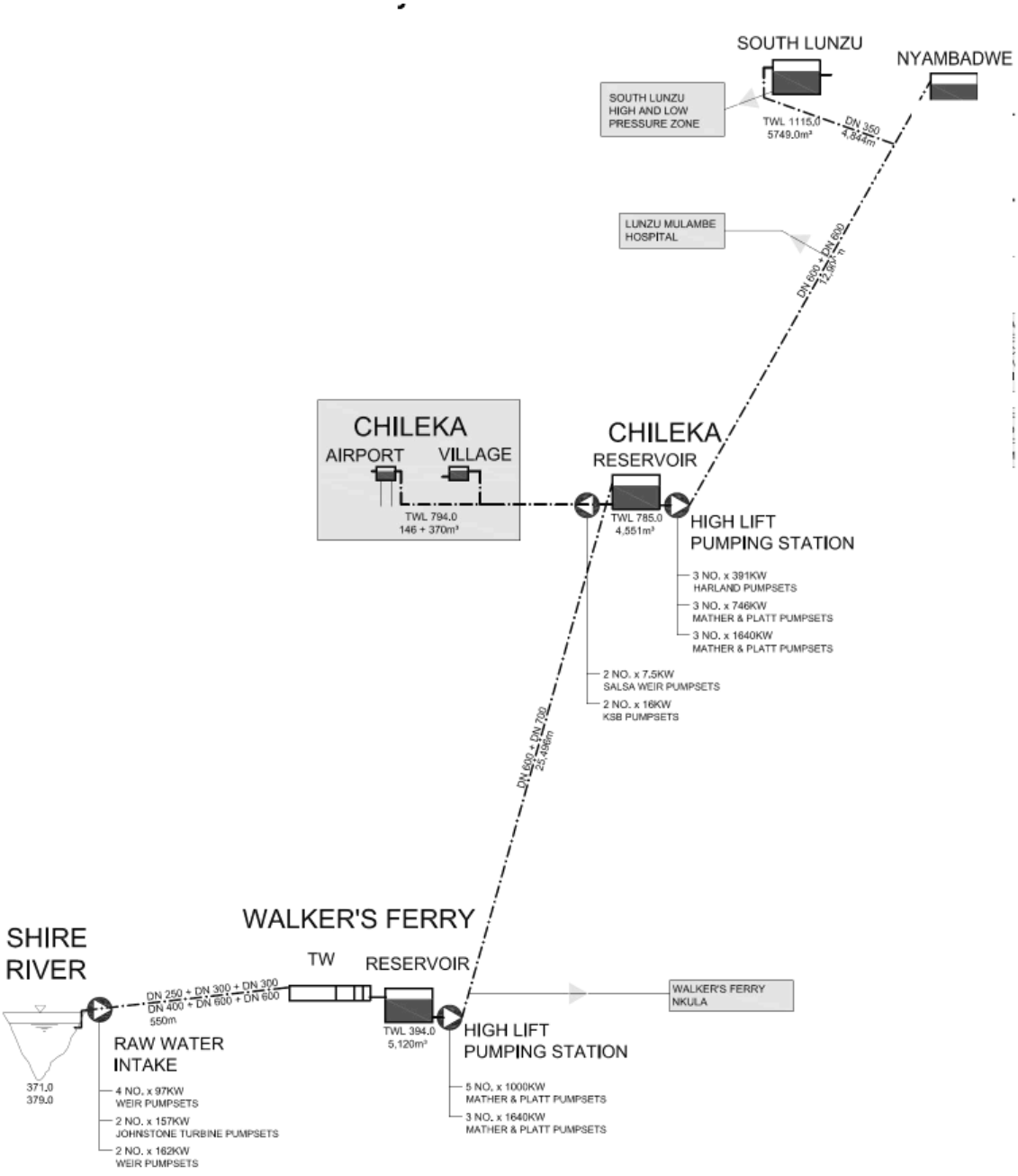
Source: (EU&EIB, 2008)

[7] BWB is a quasi-governmental organization established under the Malawi Water Works Act No. 17 of 1995 to supply water to Blantyre City and the surrounding areas of Chileka Village, Chiradzulu (part), Lumbira Estate, Lunzu and Nkula Falls.

[8] The water treatment process involves coagulation, flocculation, sedimentation, filtration and disinfection.

Figure 6 shows the water transmission system in Blantyre. As can be seen, raw water is extracted from the Shire River and treated at Walker's Ferry. It is then pumped in a first stage to the Chileka pumping station (intermediate pumping station) and in a second stage to different reservoirs in town, before being distributed.

Figure 6. Water Transmission System



Given Blantyre's hilly terrain, the distribution system includes eight booster pumping stations and 13 reservoirs (EU&EIB, 2008).

The daily production capacity of BWB is 86,000,000 liters (78,000,000 liters at Walker's Ferry and 8,000,000 liters at Mudi Dam), but the daily demand for the growing population of Blantyre and surrounding areas is at 96,000,000 liters.[9] Clearly, water production is not sufficient to meet the total consumption. Walker's Ferry has a capacity to produce 108,000,000 liters per day, and BWB expects that the total production capacity will increase to 105,000,000 liters by 2013 (BWB, 2011). Table 2 shows water production between 2004 and 2009.

Table 2. Water Production and Sales Figures (2004-2009)

	2004/05	2005/6	2006/07	2007/08	2008/09	2009/10
Average Daily Output ('000 liters)	77,000,000	79,410,000		79,556,000	82,000,000	83,100,000
Average Daily Output (m^3/day)	77,000	79,410	-	79,556	82,000	83,100
Industrial Consumption (mn m^3)	22	NA	23	26	NA	NA
Meters in Service (number)	35,000	28,388	25,744	34,101	36,009	37,174
Metered Water Charges (MK '000)	984,000	1,006,511	1,171,686	1,453,154	1,576,383	1,889,684

Source: NSO (2010)

Water shortages are widespread, particularly when pumps break down or cannot function because of electricity outages and during the dry season in Blantyre (September through November). Between 2001 and 2010, Blantyre received about 995 millimeters of rainfall every year; yet rainwater harvesting has not been widely practiced (NSO, 2010; Ng'ong'ola et al., 2010).[10] Some schools collect rainwater to supplement BWB water, improve sanitation and cultivate vegetables for commercial purposes. To encourage such activities, the Ministry of Education, the University of Malawi, the Rainwater Harvesting Association and the Malawi Industrial Research and Technology Development Center have proposed a $1.2 million (MK 342 million) project to improve rainwater harvesting in schools.[11]

2.3. Access to Water in Blantyre

Different surveys, such as the 2006 Multiple Indicator Cluster Survey (MICS), the 2005 Second Integrated Household Survey (IHS 2) and the 2009 Welfare Monitoring Survey (WMS), have used slightly different criteria to define access to improved water sources. For instance, the 2009 WMS considers boreholes, communal standpipes, protected wells and tap water (piped into dwelling unit or compound) to be "safe /improved water sources."[12] Rainwater harvesting is not included. The UN's Joint Monitoring Programme (JMP) defines access to improved water as shown in Table 3.

Table 3. UN JMP's Definition of Improved and Unimproved Water Sources

Improved Water Supply Source	**Unimproved Water Supply Source**
Individual household connection	Tanker truck provided water
Piped water from a yard tap	Vendor provided water
Piped water obtained from a neighbor	Unprotected well/spring
Protected well/spring	Bottled water
Rain water harvesting	

Source: http://www.wssinfo.org/definitions/infrastructure.html

[9] Kamanga (2009) and BWB website (http://www.bwb.mw/index.php).
[10] For a table on average rainfall per month, see Appendix 1.
[11] USD $1 = MK 280.
[12] Note: BWB does not include boreholes or protected wells as safe water sources.

Using this UN JMP definition, and results from a recent baseline survey by Ng'ong'ola et al. (2010), clean potable water is accessible to about 61 percent of the city's population. This implies that about two out of five people are using water from sources such as wells, rivers and streams. BWB, on the other hand, estimates that 75 percent of people have access to potable water, while the 2009 WMS proposes that 90 percent has access (UN-HABITAT, 2011).

It is also relevant to note that water consumption varies depending on location. According to Ng'ong'ola at al. (2010), average water consumption per person per day in Blantyre in 2010 was 152.2 liters, which is below the 160 liters per capita international consumption standard; but as Table 4 shows people living in high density areas consumed only 87 to 130 liters per day (Ibid).

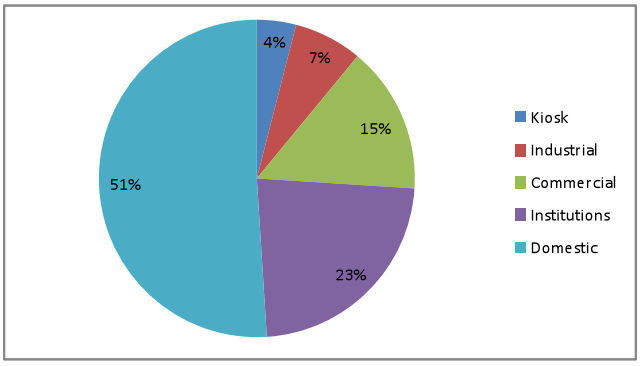
Table 4. Daily per Capita Consumption and Expenditure on Water, by Location

Per capita water consumption	High-Density Unplanned	High-Density Planned	Medium-Density	Low-Density	Overall
Mean Daily Consumption (in liters)	86.5	130.4	174.8	352.1	152.2
Max Daily Consumption (in liters)	1196.8	549.5	978.6	2446.1	3329.1
Min Daily Consumption (in liters)	1.4	18.4	2.2	18	1.4
Daily expenditure on water (MK/day)	47	87	87	156	

Source: Ng'ong'ola et al. (2010)

BWB categorizes tap water customers into four groups: domestic; industrial; institutional; and commercial customers. Figure 7 shows the distribution of consumption by customer category in 2010.

Figure 7. Distribution of Consumption by Customer Category (2010)



Source: 2010 BWB Annual Report

In 2011, BWB recorded 1,502 new connections, as compared to 1,370 new connections in 2010, an increase of 9.6 percent and an indication that more households and businesses have access to potable water.

Although some people living in informal settlements as well as in unplanned and traditional housing areas (THAs) have access to potable water, most low-income area (LIA) residents rely on improved as well as unimproved sources of water, such as rivers, streams and hand-dug wells. The 2008 Census results revealed that during the dry and wet seasons, on average, 28 percent of Blantyre City residents relied on piped water, 55 percent depended on standpipes, 11.3 percent on protected wells as boreholes and 5.7 percent on unimproved sources such as rivers. However,

almost half of slum dwellers relied on water kiosks, 13 percent acquired water from standpipes, 11 percent had piped water at home and the rest used unprotected sources (NSO, 2009). A recent community water mapping exercise conducted by Water for People (W4P) confirms that kiosks are the most common source of improved water for households in about half of the LIAs, as shown in Table 5. BWB authorities report that there are approximately 424 water kiosks in Blantyre City. However, low-income areas such as Chigumula, Chiwembe, Kameza, Manase, Mapanga, Misesa/Chensomba, Mzedi, Soche and Nancholi have fewer kiosks than boreholes and protected springs or wells. It is not uncommon to see residents in these areas washing clothes and bathing in polluted rivers.

Table 5. Distribution of Improved Water Points by Type in Low Income Areas

Name of LIA	Protected Spring	Borehole w/hand pump	Lined well w/hand pump	Kiosks	Total
Chilobwe/Chimwan/Zingwa	1 (9%)	3 (27%)		7 (64%)	**11**
Bangwe/Namiyango		8 (17%)	5 (10%)	35 (73%)	**48**
BCA		2 (15%		11 (85%)	**13**
Chigumula		13 (81%)	3 (19%)	0	**16**
Chilomoni		5 (24%)	2 (9%)	14 (67%)	**21**
Chirimba/Chileka Road		14 (50%)		14 (50%)	**28**
Chiwembe		5 (83%)		1 (17%)	**6**
Kachere/Makhe.Nkol	1 (3%)	3 (9%)	3 (9%)	28 (80%)	**35**
Kameza		3 (50%)		3 (50%)	**6**
Machinjiri	2 (6%)	25 (78%)		5 (16%)	**32**
Manase	1 (5%)	6 (38%)	3 (19%)	6 (38%)	**16**
Manyowe		2 (29%)		5 (71%)	**7**
Mapanga	1 (10%)	7 (70%)	2 (20%)	0	**10**
Misesa/Chensomba		21 (81%)	3 (11%)	2 (8%)	**26**
Mzedi	1 (4%)	17 (74%)	2 (9%)	3 (13%)	**23**
Naotcha				8 (100%)	**8**
Ndirande		4 (4%)		104 (96%)	**108**
Sigerege	1 (5%)	6 (32%)		12 (63%)	**19**
Soche	4 (17%)	4 (17%)	10 (42%)	6 (25%)	**24**
Nancholi	12 (40%)	15 (50%)	1 (3%)	14 (47%)	**30**

Source: Water for People (2009)

To improve water supply in LIAs, BWB and BCC have set up a Kiosk Management Unit (KMU), whose responsibilities include facilitating the establishment of effective and efficient kiosk management, improving revenue collection and regulating water pricing. Non-governmental organizations (NGOs) are also actively engaged in the water sector. Blantyre City Council, BWB and the NGO W4P signed a Memorandum of Understanding (MOU) in September 2007 stipulating that they will work together in establishing Water Users Associations (WUAs).[13] Under the agreement, these associations would be responsible for managing water kiosks in urban and peri-urban low-income areas of Blantyre. BWB sells subsidized water to WUA kiosks at MK 0.082 per liter, and kiosks sell it at MK 3 per 20 liter bucket, which is considerably cheaper than prices charged by other kiosk operators and illegal private sellers in low-income areas.

[13] A WUA consists of an elected board, an executive committee, a bookkeeper, water sellers, water inspectors (NO COMMA) and plumbers. It sells water to people through communal water kiosks, where people purchase by-the-bucket water from sellers.

Before the introduction of WUAs, kiosks were managed by operators that included community, religious and political party leaders and BWB. Unfortunately, many operators were pocketing substantial amounts of money collected from kiosks instead of remitting it to BWB. This resulted in BWB disconnecting water in several LIAs.

WUAs have now taken over operations, maintenance and revenue collection for kiosks in LIAs. They monitor and fix leaks and have even repaid amounts previously owed to the BWB. They are also rehabilitating old water points, reinvesting their profits in new infrastructure and employing salaried operators (mainly women). Six WUAs are now operational in 10 LIAs: Kachere-Nkolokoti; Ndirande-Matope; Michiru; Sanjika-Mitside; Namiyango-Chigumula; and Mudi. BWB and W4P plan to establish more WUAs by 2013 to be located in the following areas: Namiyango-Chigumula; Michiru; Ndirande-Matope; Mitsidi-Sanjika; Malabanda; Zingwangwa; Bangwe; Lunzu; and Chiwembe-Chensomba. One problem with the kiosks, however, is that they are only operational for about six hours a day.

To enhance service delivery, W4P has also designed a tracking system called Field Level Operations Watch (FLOW) that uses android phones equipped with Global Positioning System and Google Earth software. The FLOW system gives WUAs, BWB and community members the ability to record and share data/information on needed repairs and maintenance requirements. For instance, individuals can send SMS messages from their cell phones and request repairs.[14]

The quality of water in Blantyre has generally been considered to be acceptable, except for bacteriological load (concentrates), which are relatively easily treated. There are indications, though, that several surface water sources are affected by sewerage and industrial contamination. Sajidu et al (2007), for instance, have found that streams are polluted with lead, cadmium, nickel, manganese and phosphates and that, "wastewater treatment plants in the city do not significantly reduce heavy metals," and MIDW (2011) has noted that water quality has deteriorated in recent years. The 2011 BWB Annual Report, on the other hand, observes that water samples collected to monitor levels of toxic heavy metals such as phosphate and chromium in the Shire River do not show significant changes in the levels of heavy materials. However, the 2011 BWB report does not include any tables to substantiate these claims.

Recent surveys also indicate that the city's residents are not happy with water services, and some residents have complained that bills do not always tally with water usage, particularly during periods when water supply is disrupted (Ng'ong'ola et al., 2010).

On average, residents have to travel a mean distance of 88 meters to an improved water source in Blantyre (Ng'ong'ola et al, 2010). However, a 2008 study conducted in low-income areas observes that the average distance was 800 meters, which is more than the Malawi Government standard of 500 meters (World Water Corps, 2008). This is likely because in these locations, residents do not have household or yard connections and therefore have to travel to distant water points to collect water.

[14] SMS, or Short Message Service, is a text messaging service component of phone, web or mobile communication systems.

To improve water supply, BWB also needs to improve its operational efficiency. Vandalism, leakages and illegal taps are common, resulting in unaccounted-for-water (UFW) and great financial losses.[15] As shown in Table 6, in recent years losses as a percentage of sales have hovered around 50 percent (NSO, 2010). In 2009 the daily total water supplied was 83,100 liters, with losses of about 14,600 liters (about 49 percent). BWB would like to reduce water losses to less than 25 percent by 2013.

Table 6. Metered Water Charges and Water Losses (2004-2009)

	2004/05	2005/6	2006/07	2007/08	2008/09	2009/10
Metered Water Charges (K '000)	984,000	1,006,511	1,171,686	1,453,154	1,576,383	1,889,684
Volume of Losses ('000 m^3)	13	15	16	1.1	15.4	14.6
Losses as Percentage of Sales	50%	49%	53%	48%	49%	49%

Source: NSO (2010)

Another key issue that needs to be addressed is lack of maintenance. The BWB water distribution network has more than 1,100 km of pipelines, but many pipes are old and need to be replaced. Pumps and transformers are also not regularly serviced because of high maintenance cost. In addition, because of increased silt build-up caused by soil erosion, the Walker's Ferry and Mudi Treatment Plants are only able to produce a fraction of the total amount of water they are capable of generating (BWB, 2008).

2.4. Blantyre's Sanitation System

The sewerage system in Blantyre City consists of piped sewerage as well as non-piped and drainage systems. The Engineering Services Department of the BCC operates the sewerage system. There are five piped sewerage system networks (Mudi, Soche, Limbe, Chirimba and Maone), but only 10 percent of the city's population is connected to these networks (Matope, 2000). Moreover, the networks are aging and have fallen into disrepair. A 2006 study estimated that 80 percent of the city's sewerage flowed untreated into rivers due to breaks in the sewerage mains (MIWD, 2006).

The majority of Blantyre's residents (about 70 percent), particularly those living in informal settlements, use on-site sanitation system (mainly pit latrines) for human waste disposal. A key problem with the on-site sanitation system is that many latrines in Blantyre are only 1-3 meters deep (Ng'ong'ola et al., 2010).[16] These shallow pit latrines do not meet the government definition of 'improved sanitation facilities' (Water for People, 2008). Some of the pit latrines are also unhealthy because they lack slabs and are ideal breeding grounds for mosquitoes that transmit malaria and intestinal worms.[17] Moreover, in high-density unplanned areas, several households often share a latrine. As a result, the number of users per latrine is high, and since latrines are not very deep, they tend to fill up quickly. Typically, when a latrine becomes full, residents cap the old pit and dig another one.

[15] UFW reflects the difference between the volume of water delivered to the distribution system and the water sold. The level of UFW is considered a good proxy for the overall efficiency of operations of a water utility.
[16] The ideal depth and of pit latrines is three meters or more, with 1-1.2 meters in diameter. The other on-site sanitation technology is septic tanks.
[17] A slab is the floor of a latrine. It is commonly made of concrete and covers the pit of the latrine.

The rainy season is particularly challenging because pit latrines often overflow, contaminating groundwater in areas with high water tables and posing serious health risks. Expectedly, every year, Blantyre registers outbreaks of cholera and other waterborne diseases. For instance, during the seven-month period between December 2009 to June 2010, Blantyre recorded over 250 cholera cases (Muwamba, 2010). Organizations such as Malawi Homeless People's Federation (MHPF) have promoted the construction of EcoSan latrines or Skyloos (elevated pit latrines) in low-income areas, particularly in locations with high water tables (UN-HABITAT, 2011).

Given the preponderance of shallow pit latrines and the acute need for pit-emptying services, a promising fecal sludge management technology, called the Gulper, was recently developed. The Gulper, a simple, manual pit-emptying pump designed by Steve Sugden at the London School of Hygiene and Tropical Medicine, is easy to operate and can access hard-to-reach households in crowded areas.[18] According to Magoya (2011), this technology has "attracted a lot of interest, even owners of septic tanks are calling for Gulper service." More importantly, W4P trains local small-scale sanitation entrepreneurs to start and manage pit-emptying businesses. Pit-emptying companies charge MK 3,000 ($10) for a 200-liter drum. This is cheaper than the flat rate the BCC charges for this service, which is MK 10,000 ($35) per load. Other pit-emptying technologies that have been developed include the 'Nibbler,' which is faster and requires less pumping effort than the Gulper. However, there is also a need to ensure that there are adequate facilities for the safe transport and disposal of waste from pit latrines. In response, W4P has been developing a technology to dry fecal matter using solar energy, so as to reduce transportation costs. Without access to affordable waste dumping/drying sites, pit-emptying service providers tend to dump the septic tank/pit sludge illegally.

Solid Waste

Blantyre City's Health Department is responsible for solid waste management. More than a decade ago, Matope (2000) estimated that the total solid waste generated in the city was 0.37 kg per capita per day, which amounted to 192 tons a day, with three-quarters of it domestic waste. In 2006 BCA's Chief Environmental Officer estimated that the average solid waste amount generated each day was 540 metric tons (MIDW, 2006a). A recent document estimates that Blantyre residents produce an average of 0.9 kg of waste per capita per day (equivalent to 647 metric tons per day)—81 percent of which is organic and biodegradable (Berman, 2010). According to UN-HABITAT, only a third of the solid waste generated is actually collected (UN-HABITAT, 2011).

Solid waste collection services are available in high-income areas, but low-income areas do not have access to the same services. BCC has placed skips/containers in many residential areas and markets, but collection is irregular, particularly when there are fuel shortages or when vehicles break down. In peri-urban areas there is no regular solid waste collection system in place, partly because there are few access roads. As a result, household solid waste is often dumped into pits, drains or indiscriminately discarded in the streets. As a means of improving the waste disposal situation in the urban areas, additional skips/containers should be placed at vantage points so that people can drop waste materials in them. These skips should also be emptied regularly.

[18] For a WaterAid brochure on the Gulper, see http://www.wateraid.org/documents/thegulpertechnologyposter.pdf.

There are a number of private entities providing waste collection services, including Malawi Housing Corporation and private trash collectors, but they focus on commercial/industrial companies and houses in high-income areas, leaving poor communities underserved. The BCC charges private waste collectors fees to dispose of waste at the dumpsite, and as a result, many of these collectors dump waste in undesignated areas to avoid the fees.[19]

Table 7 shows the state of BCC's sanitation equipment in 2010. As can readily be seen, most of these vehicles are very old (over 10 years). In addition, almost half of the 14 trucks and three tractors are in poor condition and tend to break down often.

Table 7. 2010 Solid Waste Equipment List

TYPE OF EQUIPMENT	NUMBER	YEAR BOUGHT	LOADS PER WEEK
REFUSE TRUCKS	**14**		
BK 2654		1996	28
BL 913		1998	7
BL 914		1998	7
BL 915		1998	6
BL 916		1998	7
BP 2741		2008	7
BP 2742		2008	28
BN 1192		2004	6
BM 269		2000	24
BL 1005		1998	20
BL 1903		1998	20
BM 6074		2000	6
BL 6856		2000	6
BJ 4913		1993	7
TRACTORS	**3**		
BP 1532		2007	1
BP 1534		2007	1
BJ 4750		1993	Mower

Source: Blantyre City Council

Solid waste is collected on a regular basis in high-income areas, but informal settlements and Traditional Housing Areas (THAs)[20] are severely underserved. In these areas, solid waste is either not collected, or skips are emptied irregularly, leading to the accumulation of waste and the indiscriminate disposal of solid waste. Figure 8 shows an example of a dumpsite in an informal settlement. Ironically, the sign states, "Do Not Litter."

Figure 8. Informal Dumpsite in Ndirande

[19] Dumpsite fees range from MK 3,000 - MK 8,000 ($10 to $29) for 1 -10 tons of waste.
[20] THAs are areas where the urban poor can access legal and planned housing plots.

Source: BCC/S. Berman

The official site for solid waste disposal, known as Mzedi, is located along the eastern boundary of the city on the slopes of Mzedi Mountain and is nearing full capacity. The site is not a proper landfill, but rather an uncontrolled open dump without leachate or gas management systems and without a fence, so it is accessible to residents, including children. This is problematic because hazardous waste is not separated from other waste (GoM, 2009). Hazardous waste includes paints, solvents, consumer batteries, construction and demolition debris, chemical and pharmaceutical waste, medical and infectious waste (MIW), tires and sewage sludge. At times, MIW is disposed of by burning.

The Mzedi landfill is a long distance from the city center, influencing the cost involved in collecting and disposing of waste. More importantly, the landfill has also outlived its lifespan by approximately 10 years and is dilapidated. The BCC has determined that a second landfill site is needed and that it should be located closer to the city; however, it is not expected to be operational before 2015. In the interim, BCC hires a private company twice a year to "bulldoze" or cover the garbage at the landfill with earth, as a way to mitigate flies and foul odor; this is neither sustainable nor cost-effective. It is estimated that the BCC spends MK 10 million ($35,335) just to bulldoze the Mzedi landfill each year.

To reduce the volume of waste at Mzedi, recycling of inorganic materials also needs to be actively promoted. Some people living in nearby villages, including children, are already recuperating dumped items from the landfill and re-selling them, but this form of recycling/scavenging is not healthy or organized. A formal system of plastic, glass, aluminum and paper recycling needs to be introduced. The first step would be to build a recycling plant and establish a number of collection stations where households can bring their garbage.[21] Unemployed individuals could then sort recyclables from biodegradable waste and receive compensation. A public education campaign informing people about reducing waste generation and encouraging them to sort their household waste would also be needed. For instance, households could be sensitized to separate glass, plastics and aluminum cans and plastic from organic waste and encouraged to store organic and inorganic waste in separate bins.

[21] The National 2012-2022 Sanitation and Hygiene Investment Plan and Strategy calls on all Malawians to practice safe recycling of liquid and solid waste, but does not detail any specific activities.

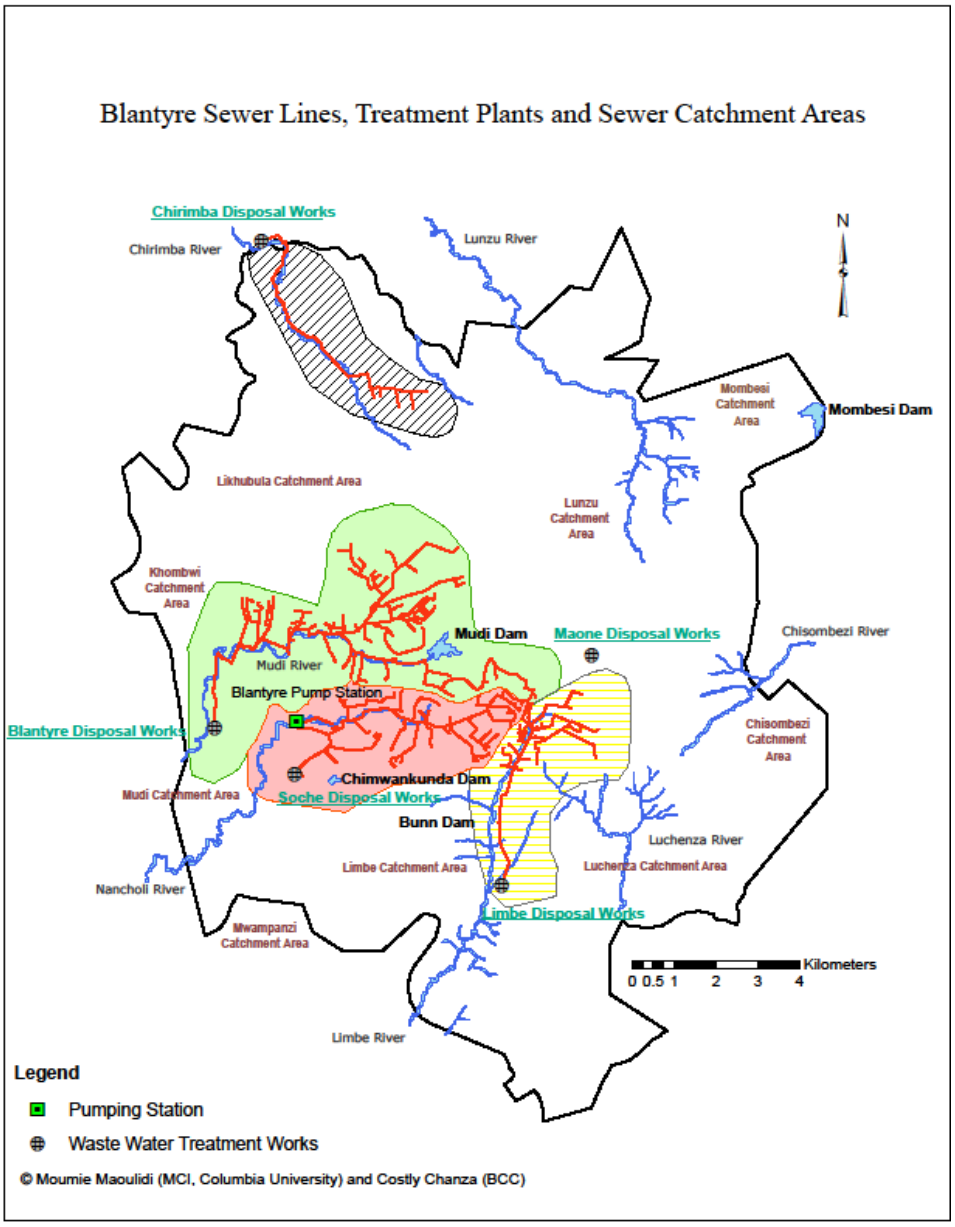
Overall, there is limited recycling and re-use of waste in Blantyre. The BCC waste management policy therefore needs to be based on the principle of "Three Rs", namely, Reducing, Reusing and Recycling. City officials also need to see organic waste as an income-generating resource that can be harnessed to produce fertilizer, or methane gas that can be used as fuel. Scholars such as Gjefle (2011) have argued that productive sanitation (also referred to as Eco-sanitation, or EcoSan) can create an engine of economic growth for African urban economies because activities such as composting can generate income and create jobs.

Finally, it is also worth noting that many roads in unplanned areas in Blantyre do not have storm drains, and the few drains that exist are often clogged by garbage, making flooding more likely. The formal areas have stormwater run-off infrastructure, but there are few drains in LIAs, with the resultant risks of flooding during the rainy season. To improve drainage in the city, BCC has proposed a $13.3m project to improve stormwater management.

Liquid Waste

Historically, Blantyre has had as many as five wastewater treatment works (WWTW)— Blantyre, Soche, Limbe, Chirimba, and Maone— but three of them (Chirimba, Limbe and Maone) are not functioning, and the others are in need of major repairs. These plants receive wastewater through the sewerage network and from tankers depositing effluent collected from pit latrines/septic tanks. Figure 9 shows the locations of WWTWs, sewer catchment areas and sewer lines.

Figure 9. Blantyre Sewer Catchment Areas and Wastewater Treatment Works



Blantyre Disposal Works is the largest WWTW and was established as a conventional biological filtration plant serving 35,000 people and industries. The Soche Sewage Treatment Plant was constructed in 1958, and the Limbe Disposal Works was built almost a decade later in 1967. However, these plants have not been properly maintained, and the capability of existing wastewater treatment plants to treat septage from growing numbers of septic tanks and latrines is limited. As a result, liquid waste that is supposed to be treated at the plants ends up flowing into rivers untreated.

The city also has treatment plants for industrial wastewater. The Blantyre plant at Manase, for instance, processes residential sewage as well as industrial effluent from companies such as Carlsberg, Dairyboard Ltd, Chibuku Breweries, the Cold Storage Company and the Mapeto David Whitehead textile company. This liquid waste is supposed to be processed through a series of settlement tanks, filters and aeration ponds, but due to poor maintenance, it often does

not go through the treatment process and flows untreated into the Mudi River. Poor wastewater management is an acute problem throughout Blantyre, but is especially so in unplanned settlements, where the lack of proper drainage and overflowing latrines result in wastewater flowing indiscriminately into open spaces or their immediate surroundings.

Figure 10. A Functioning (left) and Non-Functioning (right) Wastewater Treatment Plant

Source: Moumié Maoulidi

2.5. Access to Sanitation in Blantyre

The GoM requires that every house should have some type of sanitation facility. As a result, many surveys show that a high percentage of residents have access to some form of latrine (GoM, 2008). As Table 8 shows, flush toilets are popular in low- and medium-density areas, but four out of five households in high-density unplanned locations rely on pit and ventilated pit latrines.

Table 8. Types of Latrines Used in Blantyre

Latrine Type	High-Densisty Unplanned Areas	High-Density Planned Areas (%)	Medium-Density Areas (%)	Low-Density Areas (%)	Total
Pit latrine	80.6	48.4	29.5	31.8	62
VIP/san plat	6.6	1.1	4	5.8	5.6
Flush toilet	12.6	50.5	66.5	62.4	32.3
Other	0.2	0	0	0	0.1
Total	100	100	100	100	100
Sample (N)	653	91	176	173	1093

Source: Ng'ong'ola et al. (2010)

According to Ng'ong'ola et al. (2010), 98.1 percent of residents have access to a toilet, which suggests that Blantyre has surpassed the MDG sanitation target. The problem is that such data do not take into account that 34 percent of pit latrines are less than three meters deep, and many are open pit (without a cover); hence they cannot be considered to be improved sanitation facilities.[22] Moreover, many toilets in Blantyre are shared by several households, and it is questionable whether they conform to the JMP's definition of improved sanitation facility.

[22] The ideal depth of pit latrines is three meters, with 1-1.2 meters in diameter. These latrines have a 20-year lifespan.

According to recent documents like MIWD (2011), official statistics on the number of people with access to improved sanitation in Malawi are misleading because definitions and interpretations of what constitutes adequate sanitation have differed. For instance, the Malawi Integrated Household Surveys (IHS) use the term 'proper sanitation' and define it as having a flush toilet, VIP toilet or traditional latrine with a roof. The 2009 Welfare Monitoring Survey (WMS) uses the phrase 'safe/improved sanitation' and defines it as having a flush toilet, VIP latrine or covered pit latrine. The 2008 Census asked respondents to identify whether they have a flush toilet, VIP, traditional latrine, no toilet or other facility, but the definition of "other facility" is not clear. All the aforementioned data sources ask if the toilet facilities are shared with other households, but it is unclear whether the GoM considers shared toilets as improved sanitation facilities. Clearly, there is a need to harmonize definitions of access to improved sanitation. This report uses the UN JMP's definition of improved sanitation, as shown in Table 9. Using this definition, we estimate that 63.9 percent of Blantyre's population had access to improved sanitation in 2009.

Table 9. Definition of Improved and Unimproved Sanitation Facilities

Improved Sanitation	Unimproved Sanitation
Connection to a public sewer	Bucket latrine
Connection to a septic tank	Public or shared latrine
Pour-flush toilet	Latrines with open pit
Simple pit latrine	Flying toilets
Ventilated improved pit latrine (VIP)	

Source: http://www.wssinfo.org/definitions/infrastructure.html

2.6. Hygiene Education

Baseline survey reports, such as Ng'ong'ola et al. (2010), observe that most Blantyre residents, irrespective of socio-economic strata, wash their hands after visiting a toilet. Local hygiene teams have sensitized communities about hand-washing, and most people are aware that washing hands decreases the spread of disease-causing pathogens. The 2008 National Sanitation Policy also emphasizes that hand-washing improves personal hygiene, and the MGDS II, Malawi's reference document for development programs during the period between 2011 and 2016, underscores the importance of increased awareness of hygiene. However, due to water scarcity, most people use bowls and not running water, and soap is not always available (Water for People, 2009; Ng'ong'ola et al., 2010). In addition, according to one government official, even when soap is available, citizens do not have the "mental attitude" to use it as necessary for good hygiene.[23] To overcome such proclivities, in 2008 UNICEF and Malawi's Ministry of Health launched a nationwide "Soap Campaign" to encourage the use of soap when washing hands. The EU EIB also has a $100,000 (MK 2.8 million) hygiene education project in Blantyre that is expected to end in 2012. This type of project needs to continue.

Hygiene education should also include sensitization campaigns for solid and liquid waste disposal, given that it is equally important to change people's mindsets about how to dispose of

[23] Adrina Mchiela, Principal Secretary, Ministry of Irrigation and Water Development, quoted in *Sunday Times* newspaper, 9 November 2008.

solid and liquid waste. Such campaigns will only succeed, however, if the BCC also provides containers for the safe disposal of solid and liquid waste.

2.7. Access to Water and Sanitation in Schools and Hospitals

A 2011 BCC survey that collected data from 54 (out of 58) Blantyre City Primary Schools reveals that approximately 87 percent of the public schools have access to clean and safe water, and 13 percent relied on unimproved sources of water (BCC, 2011). In addition, about 77 percent had well-maintained toilets, but only one-third had hand-washing facilities. Moreover, only 25 percent of the schools had WASH clubs, and most schools (94 percent) did not recycle their waste (Ibid).[24] It is paramount to improve schools without working toilets or clean water because such schools are not only unhealthy, they also discourage children from attending school and completing their education.

Regarding Blantyre public health facilities, most have access to piped water and are connected to the sewer system (UN-HABITAT, 2011). The main water and sanitation challenges facing health facilities include irregular supply of water and poor management of solid waste, particularly hazardous medical waste. The Ministry of Health now has a policy that all health facilities should either have an incinerator or an arrangement to safely discard medical waste.

III. FINANCING WATER AND SANITATION IN BLANTYRE

BCC derives its income from the central government, property rates and business taxes, as well as various fees. According to UN-HABITAT (2011), the city's revenue collection rates have been low, "due to high default rates, lack of transparency and corruption."

To date, most of the funding from the central government has not been allocated to the water and sanitation sector. For instance, the Malawi Ministry of Finance (MoF) Budget estimates show that in 2009, MK 12,486 million ($88.4m) was allocated to district assemblies, but less than one percent of this amount was for the water supply or sanitation (MIWD, 2011).[25] The proportion of development partners' financial contributions to the national water and sanitation sector budget, on the other hand, has been increasing. For instance, between 2004 and 2009, contributions from development partners to the sector increased from MK 590 million ($5.4 million) to MK 4,481 million ($31.7 million) (MIWD, 2011). Table 10 shows the MoF budget estimates for 2011-2014.

Table 10. Ministry of Finance IWSS Budget Estimates 2011-2014

	2011	2012	2013	2014
Development budget local (MK Million)	422	1,656	2,289	170
Development budget foreign (MK Million)	3,863	15,644	21,777	97
Recurrent budget (MK Million)	635	730	839	965
Total budget (MK Million)	4,920	18,030	24,905	1,232

Source: MIWD (2011)

[24] WASH is an acronym for water, sanitation and hygiene.
[25] The largest sector budgets at the district level were for health (72.9 percent).

The Government of Malawi's policy is that water tariffs should be as low as possible and affordable to all, including to low-income areas dwellers. Some kiosk sellers overcharge customers, but the BWB has made it clear to water sellers that they need to abide by the following water tariff structure.

Table 11. Tariff Structure for Domestic, Commercial and Industrial Facilities (Aug. 2012)

			20 *liter* Bucket	200 *liter* Drum
		Rate Charged per Liter		
1	**Water supplied from communal water points or kiosks**			
		MK 0.082	MK 1.64	MK 16.40
2	**Water supplied for domestic purposes**			
(a)	0 to 5,000 liters	MK 0.144	MK 2.88	MK 28.80
(b)	0 to 10,000 liters	MK 0.148	MK 2.96	MK 29.60
(c)	0 to 40,000 liters	MK 0.178	MK 3.56	MK 35.60
(d)	0 to above 40,000 liters	MK 0.196	MK 3.92	MK 39.20
3	**Water supplied to institutions**			
(a)	0 to10,000 liters	MK 0.235	MK 4.70	MK 47.00
(b)	0 to 40,000 liters	MK 0.260	MK 5.20	MK 52.00
(c)	0 to above 40,000 liters	MK 0.281	MK 5.62	MK 56.20
4	**Water supplied for commercial purposes**			
(a)	0 to 10,000 liters	MK 0.254	MK 5.08	MK 50.80
(b)	0 to 40,000 liters	MK 0.280	MK 5.60	MK 56.00
(c)	0 to above 40,000 liters	MK 0.303	MK 6.06	MK 60.60
5	**Water supplied for industrial purposes**			
(a)	0 to 10,000 liters	MK 0.329	MK 6.58	MK 65.80
(b)	0 to 40,000 liters	MK 0.368	MK 7.36	MK 73.60
(c)	0 to above 40,000 liters	MK 0.407	MK 8.14	MK 81.40

Source: BWB. See http://www.bwb.mw/tariffs.php

BWB's major sources of revenue include water sales (about 97 percent), connection/reconnection fees, income from bank interest, and profits from disposal of assets (EU & EIB, 2008). User charges currently do not cover BWB's operation and maintenance costs (Ng'ong'ola et al., 2010). As previously noted, a significant portion of BWB's revenues have been used to defray electricity costs, and it is estimated that a significant portion (40 percent) of the total operating cost is still spent on electric bills for pumping treated water from Walker's Ferry and Chileka to the distribution network in Blantyre City (EU & EIB, 2008). BWB also suffers from the non-payment of water bills from a large number of government institutions, for a total of approximately $10 million.

According to the World Bank and BWB annual reports, BWB recorded net losses every year between 2002 and 2009. For instance, BWB incurred net losses of MK 234 million and MK 106 million ($835,714 and $378,571) in 2008 and 2009, respectively (BWB, 2008; BWB, 2009). The losses can be attributed to poor operating efficiency. For instance, non-revenue water (NRW)—the difference between water produced and water lost to leakages, illegal connections and unbilled consumption— increased from 34 to 49 percent between 2002 and 2005. In 2011,

BWB managed to reduce NRW from 48 to 47 percent (BWB, 2011). The high level of NRW is particularly costly since BWB has to pump up all the water that it produces, which requires a lot of electricity. The Board's Financial Statements show that the financial performance is improving: BWB recorded net profits of MK 76.8 million ($274,285) in 2010 and MK 58.9 million ($210,357) in 2011.

Table 12 shows the BWB budget between 2004 and 2009 and compares it to the total budget of Malawi's other water boards. It can be seen that the bulk of the national budget for water boards is allocated to BWB, although the proportion is decreasing.

Table 12. Budgets Blantyre Water Board Compared to Other Water Boards (2004-2009)

	2004	2005	2006	2007	2008	2009
Blantyre Water Board (MK Million)	1,175	1,148	1,140	1,433	1,799	2,086
Lilongwe + Northern Region + Central Region + Southern Region Water Boards (MK Million)	1763	2183	2626	2989	3488	3613
Total budget (MK Million)	2,938	3,331	3,766	4,422	5,287	5,699
BWB's Budget as % of Total Budget	40%	34%	30%	32%	34%	37%

Source: MIWD (2011)

Identifying the budget allocated to sanitation is challenging because on-site sanitation is managed by BCC's Health Department, while the Engineering Services Department operates the sewerage system, and the BCC's Health Department is responsible for solid waste management. Nonetheless, it was possible to obtain some data that provide an indication of the level of funding available for sanitation activities, as shown in Table 13.

Table 13. Department of Cleansing Services and Sewerage Income (2007-2010)

	2007	2008	2009	2010
Dept. of Manager of Cleansing Services (MK)	20,297,000	6,482,000	12,052,828	11,531,064
Engineering Dept: Main Sewerage - Administration (MK)	20,145,000	14,927,636	10,273,320	22,993,189
Total Income: Cleansing Service & Engineering (MK)	40,444,007	21,411,644	22,328,157	34,526,263

Source: BCC Health Department

3.1. Financing Water and Sanitation

A number of international organizations, including World Bank, Africa Development Bank (AfDB) and the European Union (EU) provide financial support to the water and sanitation sector in Blantyre. For instance, to mitigate water shortage problems, BWB is implementing a four-year project, known as the Malawi Peri-Urban Water Supply and Sanitation Project, which seeks to bring potable water and improve sanitation to people in low-income areas.[26] The project's total cost of €32 million ($40.5 million) is financed by an EU Water Facility Grant of €14.9 million ($18.8 million) and a €15.7 million ($19.9 million) European Investment Bank (EIB) loan.[27] Key goals of the project, which is part of NWDP II, include upgrading the water

[26] http://eeas.europa.eu/delegations/malawi/documents/press_corner/20100826_01_en.pdf
[27] The end-date for the project is 2013. Data are from a 26 August 2010 EU and EIB press release.

and sanitation infrastructure in Blantyre, constructing 363 water kiosks, reducing water losses to less than 25 percent and increasing production capacity by 20 percent (BWB, 2011).[28]

The World Bank initially allocated $2.5 million to improve water supply in the medium term. The funds were used to procure pumps and spare parts for the Walker's Ferry Treatment Plant and the Chileka Pumping Station and to upgrade a pipeline that runs from Walker's Ferry to Chileka. The recent EU and EIB financing supplements funding for the World Bank supported the Second National Water Development Project (NWDP II), which started in 2007. There are also plans to develop a new water source that will complement the existing water sources, at Walker's Ferry and Mudi Dam, and improve water storage capacity by building three storage reservoirs, at Kameza, Chilobwe and Chigumula. The total cost for these projects is about $21 million.

The African Water Facility (AWF), an initiative of the African Ministers Council on Water (AMCOW) managed by the African Development Bank, also has a €814 897 ($1.03 million) project to improve water and sanitation in slums surrounding Blantyre City. AFW is financing 75 percent of the project costs while the Centre for Community Organization and Development (CCODE) and the beneficiaries are incurring the remaining costs. *Inter alia*, the project seeks to facilitate access to affordable and environmentally friendly water and sanitation facilities for 1000 urban poor households through the establishment of a revolving loan fund. It is expected that the project will be completed by 2013.

3.2. Costing Model

This study uses a needs assessment tool developed by the UN Millennium Project to estimate the financial resources needed to achieve water and sanitation targets at the sub-national level. This Excel-based needs assessment tool relies on population data, coverage targets and unit costs.[29] Data on water and sanitation coverage were derived from a baseline survey submitted to MIWD by Ng'ong'ola et al. (2010) and several surveys, including the 2009 WMS.

Improved water sources or technologies identified by MCI as appropriate for Blantyre include:[30]

1. Individual household connection
2. Piped water from a yard tap
3. Kiosk/Public tap water
4. Rainwater harvesting

Technologies included in this needs assessment as representing "improved" sanitation facilities include:

1. Flush toilets connected to a septic tank or the public sewerage
2. Pit latrine
3. Ventilated improved pit latrine (VIP)
4. Skyloos/Improved Two-Pit Latrines

[28] As previously mentioned, between 2005 and 2009, water losses were 48-50 percent.
[29] The model was initially developed by the United Nations Millennium Project, now administered by the United Nations Development Programme (UNDP), and was applied here by MCI for the first time in a municipal context.
[30] This list of interventions is presented as a reference and should not be viewed as an exhaustive set of options.

Unit Costs
Units costs used in the model were derived from MIWD (2011), MCI's Social Sector Specialist in Blantyre and other sources and, when local unit costs were not available, the national Water and Sanitation costing model. Water and sanitation unit costs used in the costing model are shown in Table 14.

A plastic water storage tank with masonry supporting pillars that can store 10,000 liters costs is estimated to cost MK 150,000 ($535).[31] The unit cost for a three-meters-deep lined pit, a Two-pit improved latrine or Skyloo latrine, including cost for materials and labor, is estimated to cost MK 81,081 ($300).

Table 14. Select Unit Costs Used in the Costing Model

Water	MK	$	Source
Household Connection (Private)	25,378	93.9	BWB
Public Standpipes/Kiosks	140,811	521.0	GWCL/AVRL (Ghana)
Boreholes with Handpumps	2,150,811	7,958.0	UNICEF WASH
Rainwater Harvesting	8,108	30.0	Author
Protected dug wells	81,081	300.0	Other African WatSan model
Water Storage Facilities*	243,243	900.0	MCI Social Sector Specialist
Sanitation Facilities	MK	$	Source
Conventional Sewerage	45,405,405	168,000	GoM
Septic Tank	177,297	656	Morella, Foster, Banerjee (2008)
Flush Toilet	103,946	385	Other African WatSan model
Pit Latrine (1.5 m lined, emptiable)	36,757	136	MIWD (2011)
Ventillated Improved Latrine (VIP)	119,189	441	Morella, Foster, Banerjee (2008)
Skyloo/ Improved Latrine (Two-Pit)	81,081	300	MIWD (2011)

Note: USD units costs are converted using the July-Aug. 2012 exchange rate of USD ($) 1=MK 280

3.3. Results of the Costing Model

To identify the financial resources required to meet the water and sanitation targets, two models are presented: a Baseline scenario and an Alternative scenario.

Baseline scenario
Interventions under this scenario will be rolled out at an even pace between 2012 and 2015; hence, a linear scale-up path has been chosen. The underlying assumptions with regard to water supply and sanitation are as follows:

[31] USD $1= MK 280.

- 60.8 percent of Blantyre residents had access to piped water in 2009. The Goal is to increase coverage to 95 percent by 2015.
- Ng'ong'ola et al. (2010) note that 98.1 percent of the population had access to a toilet, but 34 percent of the pit toilets were shared. Since shared toilets are not considered by UN's JMP to be "improved" sanitation facilities, MCI assumes that only 63.9 percent of Blantyre's population had access to improved sanitation in 2009. Sanitation coverage needs to increase to 82 percent in 2015. Moreover, about a quarter of the pit latrines will be pumpable VIPs.
- Three households share a household tap water connection in a yard; a public tap serves approximately 125 households.
- Total number of households is estimated at 146,079, and in 2009, only 10 percent were connected to a sewer. However, by 2015, 15 percent of households will have access to conventional sewerage.
- 20 percent of public stand posts, boreholes, flush toilets and pit latrines were defective in 2009, but by 2015, only 10 percent are assumed to be defective.
- As recommended by Lenton and Wright (2004), the annual operating and maintenance cost for water and sanitation facilities is 7.5 percent of the capital cost, but the rehabilitation cost is 15 percent of capital cost. The cost of rehabilitating pit latrines, however, is 5 percent of the capital cost.
- 60 percent of the water and sanitation budgets are devoted to operational costs.
- The cost for primary and secondary wastewater treatment is taken into account in the baseline scenario, but the cost of tertiary treatment is assumed to be borne by the private sector. Per unit capital costs for primary treatment were taken from the Malawi National Model and are assumed to be $4,000 per unit capital costs; secondary treatment of conventional sewerage is estimated at $10,000 per unit.
- A wastewater treatment plant to recycle grey water and sewerage from households is also rehabilitated. The facility will have the following characteristics: one settling pond; two anaerobic tanks; and three bio lagoons. Total costs, including staff salaries for five engineers, five lab technicians, 10 operators, and 20 general workers, is $73,260. After the plant is rehabilitated, the annual cost for maintenance and staff salaries will be $12,900.
- The cost for teacher training and logistical support for hygiene education in primary schools is $1.50 per pupil.
- A mass media hygiene campaign will also be conducted at a cost derived from the Malawi National Model. MCI assumes that the cost for the Blantyre campaign will be a quarter of the cost of the national mass media campaign.

Based on these assumptions and proposed interventions, the average annual per-capita cost to meet the MDG water and sanitation targets between 2013 and 2015 for the Baseline scenario is $16. About 57 percent of this per capita cost is for sanitation expenses, 23.8 percent is for water and 16 percent is for human resources.

Table 15. Baseline Scenario Model Results

	2013	2014	2015	Average
Water				
Capital Cost	1,684,122	1,783,216	1,884,679	1,784,005
Operating Cost	1,230,031	1,370,620	1,521,387	1,374,013
Water Total ($)	2,914,153	3,153,835	3,406,067	3,158,018
Sanitation				
Capital Cost	3,733,375	3,949,201	4,171,336	3,951,304
Operating Cost	3,311,832	3,639,519	3,991,672	3,647,674
Sanitation Total ($)	7,045,207	7,588,720	8,163,008	7,598,979
Wastewater Treatment				
Capital Cost	13,315	14,087	14,883	14,095
Operating Cost	47,952	62,038	76,922	62,304
Total WasteWater Treatment ($)	61,267	76,125	91,805	76,399
Hygiene Education Total ($)	202,548	215,555	232,428	216,843
Hospitals Total ($)	3,285	3,519	3,753	3,519
Schools Total ($)	10,638	10,737	10,836	10,737
Human Resources Total ($)	2,249,253	2,265,174	2,281,095	2,265,174
Settling Pond/Biolagoons Total ($)	12,900	12,900	12,900	12,900
Enabling Intervention Total ($)	6,983	6,983	6,983	6,983
Grand Total ($)	**12,519,133**	**13,346,447**	**14,221,775**	**13,362,452**
Per capita cost	15	16	16	16

Alternative scenario

In the Alternative scenario, the same assumptions about operating, maintenance and rehabilitation costs outlined in the Baseline scenario apply, but the coverage inputs are different. For instance, whereas 4.3 percent of toilets were VIP in 2009, nine percent of toilets are VIP toilets, and five percent are Skyloo toilets by 2015. In other words, sewage-based systems and septic tanks are not promoted. Instead, the emphasis has repeatedly been placed on such sanitation technologies as VIP and pumpable toilets because they are low-cost, do not consume lot of water and the human excreta can be used to produce fertilizer or biogas. In addition, the cost of an additional wastewater facility is not taken into account, and only the salaries of sanitation workers, who are BCC employees, are considered. In this scenario, water employees are paid by BWB.

Baseline scenario

	2009	2015
Conventional Sewerage	10.0%	15.0%
Septic Tanks	7.6%	9.0%
Flush Toilet/Pit Latrine	42.0%	50.0%
Ventillated Improve Pit Latrine	4.3%	6.0%
Improved (Two Pit Latrine)	0.0%	2.0%
Infrastructure that is defective	20.0%	10.0%

Alternative scenario

	2009	2015
Conventional Sewerage	10.0%	10.0%
Septic Tanks	7.6%	8.0%
Flush Toilet/Pit Latrine	42.0%	50.0%
Ventillated Improve Pit Latrine	4.3%	9.0%
Improved (Two Pit Latrine)	0.0%	5.0%
Infrastructure that is defective	20.0%	10.0%

The average annual per capita costs in the Alternative scenario for the 2013-2015 period is $13 per capita, as shown in Table 16.

Table 16. Alternative Scenario Model Results

	2013	2014	2015	
Water				
Capital Cost	1,684,122	1,783,216	1,884,679	1,784,005
Operating Cost	1,230,031	1,370,620	1,521,387	1,374,013
Water Total ($)	2,914,153	3,153,835	3,406,067	3,158,018
Sanitation				
Capital Cost	3,824,547	4,049,917	4,280,535	4,051,666
Operating Cost	3,355,659	3,697,036	4,064,102	3,705,599
Sanitation Total ($)	7,180,207	7,746,953	8,344,636	7,757,265
Wastewater Treatment				
Capital Cost	4,822	4,937	5,050	4,936
Operating Cost	18,578	23,515	28,565	23,553
Total WasteWater Treatment ($)	23,400	28,452	33,615	28,489
Hygiene Education Total ($)	195,206	207,867	224,224	209,099
Hospitals Total ($)	3,285	3,519	3,753	3,519
Schools Total ($)	10,638	10,737	10,836	10,737
Human Resources Total ($)	304,695	304,695	304,695	304,695
Enabling Intervention Total ($)	6,983	6,983	6,983	6,983
Grand Total ($)	**10,638,567**	**11,463,041**	**12,334,810**	**11,478,806**
Per capita cost	13	13	14	13

IV. CONCLUSION AND RECOMMENDATIONS

Organizations such as the World Bank and reports such as Manda (2009) argue that Blantyre City and Malawi are not on track to achieving the MDG targets in water and sanitation by 2015. The World Bank website, for instance, notes that, "about one fifth of Malawians do not have access to adequate water supply, while 44 percent do not have access to adequate sanitation." Ng'ong'ola et al. (2010) corroborate this assertion by observing that only 25 percent of households in Blantyre are meeting the international water consumption standard of 60 liters per capita per day. Less than three years ago, the 2009 Welfare Monitoring Survey found that only 54 percent of Blantyre residents had access to improved sanitation.

To keep pace with higher demands for water from an increasing population, BWB needs to augment the city's water supply. This will require improving water production and operational efficiency through the rehabilitation of treatment plants, transformers, motors and pumps; improving cost recovery; developing a rapid response to vandalism; and reducing non-revenue water. Old pipes must be replaced with durable pipes to avoid frequent pipe bursts and to reduce water loss due to leakages. Some of these infrastructure rehabilitation activities are already being undertaken under the NWDP II. However, there also needs to be a re-assessment of the entire water supply network, including the possibility of replacing the current water extraction system with one that relies less on electric pumps and more on gravity.

To meet the MDG target for water, BCC needs to focus on peri-urban and informal settlements where access is lagging behind and population is growing. Extending the water pipeline to cover more areas and installing additional water kiosks and WUAs are some of the activities that can improve access to potable water in LIAs. BWB must therefore continue coordinating with NGOs and other stakeholders in the provision of safe water. Furthermore, rainwater harvesting, water conservation and the re-use of water must be given increased attention. Blantyre residents need to view water as a renewable source that can be conserved and re-treated. The private sector should be encouraged to play a leading role in water harvesting and water recycling

The MDG sanitation target of halving the population without access to sanitation facilities by the year 2015 is unlikely to be met in Blantyre City because many households share toilets with extended family members and neighbors. The sanitation situation in Blantyre City is particularly bleak in low-income areas, where a single toilet facility is often shared by several households, and pit latrines tend to be shallow— ideal breeding grounds for flies that transmit disease-inducing pathogens. Some latrines in high-density unplanned areas can hardly be considered to be improved sanitation facilities, because they are made of torn sacks and plastic wrapped on sticks and thereby do not provide privacy or safety for users.

Traditional sanitation methods (sewage-based systems, pit latrines, etc.) do not appear to be environmentally sustainable in Blantyre. Flush toilets, which are only used by a relatively small number of households, are not ideal, because, in a place with water scarcity, they consume a disproportionate amount of drinking water. The BCC therefore needs to consider using rainwater instead of drinking water to run toilets.

The fact that many people rely on pit latrines is also problematic, partly because when pits become full, residents cap the old pit and dig another one. The reliance on shallow pit latrines in informal settlements is particularly troubling because there is limited space in cities, and, in places where water tables are high, pit latrines can contaminate the water supply. Pit-emptying is an attractive option, but there is a need to ensure safe transport and disposal of waste from pit latrines. In addition, fecal sludge is often dumped into sewers and treated as waste instead of as an economic resource. This is a worrying trend, because sewage from conventional systems is increasingly going untreated into the nearest waterways and polluting rivers. BCC could build additional wastewater treatment plants, which are capital and resource-intensive, but a more viable alternative would be for BCC and/or private sector partners to invest in eco-san toilets and waste-to-energy technologies that transform fecal sludge into biogas or biodiesel fuel.

Given the situation, the population needs to be sensitized to building lined and pumpable latrines and toilets such as VIP/Skyloos. Concomitantly, the use of pit latrine/septic tank emptying technologies such as the Gulper and the Nibbler should be actively promoted, particularly since the waste can be used to produce biogas and fertilizers.

There is also a need to introduce a system that will reduce and discourage indiscriminate solid waste disposal and the emptying of raw sewage into surface water sources, particularly in low-income areas. Ideally, solid waste needs to be removed from household and skips/containers at least once a week, but BCC currently does not have the capacity to collect and dispose of all the waste produced in the city. A community-based model for solid waste collection, separation and

recycling should be considered. Finally, the BCC also need to put in place a system to separate hazardous waste from general waste.

The Government of Malawi, the BCC as well as local and international partners are committed to providing adequate water and sanitation services to Blantyre City residents. Yet, Malawi's commercial capital remains a water-stressed city, mainly due to the high levels of population growth in low-income areas, increasing demands on its water resources, aging infrastructure, the high pumping cost and erratic water supply. In low-income areas, access to potable water is limited and erratic, and most residents (about 60 percent) rely on kiosks, communal taps or resort to unimproved water sources. The provision of sanitary facilities and services, such as appropriate solid waste disposal, has also not been satisfactory. Vandalism also needs to be addressed, because it contributes to non-revenue water.

If the BCC is going to be successful, there is also a need to enforce water and sanitation laws. BCC is already working on this and has produced building regulations that are awaiting approval by the relevant government agencies. These by-laws regulations cover, inter alia, the provision of water and sanitation services to households across the city

REFERENCES

Berman, S. (2011). "Living with Garbage." http://thestar.blogs.com/africa/author-sarah-berman/

Blantyre Water Board [BWB] (2011), *Annual Report 2011.* (Blantyre: BWB)
- (2010), *Annual Report 2010.* (Blantyre: BWB)
- (2008), *Annual Report 2008.* (Blantyre: BWB)

Blantyre City Council, School Health, Nutrition and HIV/AIDS Task Team [SHNT] (2011). *Baseline Assessment of School Health, Nutrition and HIV/AIDS (SHNH) Amongst Primary Schools in Blantyre City: Draft Repor*t (Blantyre: BCC).

Chipeta, L. (2009). "The Water Crisis in Blantyre City and its impact on women: the cases of Mbayani and Ntopwa, Malawi," *Journal of International Women's Studies*, 10 (4), pp. 17-33.

Chirwa, E. and Jungwe, N. (2007). *Private Sector Participation in the Distribution and Management of Water Services: A Study of Low Income Areas in Blantyre and Lilongwe* (Lilongwe: Government of Malawi Ministry Economic Planning and Development and Ministry of Irrigation and Water Development).

European Union and European Investment Bank [EU&EIB] (2008). *Peri-Urban Water and Sanitation Project in Lilongwe and Blantyre, Malawi*. *Project Information Memorandum*. (Lilongwe: Lilongwe Water Board).

Gjefle, K. (2011). "Sanitation for all - an engine of economic growth for urban Africa," Sustainable Sanitation Design (SuSan Design) and the Association for International Water Studies (FIVAS).

Government of Malawi (2006) *Malawi Growth and Development Strategy [MGDS]: From Poverty to Prosperity* (Lilongwe: Ministry Economic Planning and Development).

Government of Malawi (2008) *National Sanitation Policy* (draft), (Lilongwe: Ministry of Irrigation and Water Development).

Government of Malawi (2010) Draft *Malawi Growth and Development Strategy 2011-2016 [MGDS]: From Poverty to Prosperity* (Lilongwe: Ministry Economic Planning and Development).

Government of Malawi, National Statistics Office and UNICEF [NSO & UNICEF] (2008). *Blantyre Multiple Indicator Cluster Survey 2006* (Zomba: Government of Malawi).

Government of Malawi (2009). *Proposed Rehabilitation of the Blantyre-Zomba (M3) Road: Environmental and Social Impact Assessment Report* (Lilongwe: Government of Malawi).

Kamanga, O. (2009). "New equipment for Blantyre Water Board to reduce water crisis."

Magoya, J. (2011) "Sanitation problems in peri-urban areas in Blantyre," *Sanitation Matters*, 2, pp.10-11. http://www.waterforpeople.org/assets/pdfs/media/sanitation-matters-2011.pdf

Manda, M. A. Z. (2009). "Water and sanitation in urban Malawi: Can the Millennium Development Goals be met? A study of informal settlements in three cities." *Human Settlements Working Paper Series.* (London: Human Settlements Group International Institute for Environment and Development)

Matope, J. (2000). *Blantyre City Environmental Profile*. UNDP, UN-HABITAT.

Ministry of Irrigation and Water Development [MIWD] (2011). Malawi Irrigation, Water and Sanitation: 2010 Sector Performance Report (Lilongwe: Government of Malawi).

Ministry of Irrigation and Water Development [MIWD] (2005). *National Water Policy* (Lilongwe: Government of Malawi).

Misunje, M. (2008). "Malawi beats MDGs targets on water," *Nation* newspaper, 29 May.

Mkwambisi, D. (2007). "Urban agriculture and waste management in Malawi," (Leeds: University of Leeds).

Muwamba, E. (2010). "Blantyre Water Board Fights Blantyre's Sanitation Woes," *The Nation* December 10, 2010.

National Statistics Office [NSO] (2010). *Statistical Yearbook* (Zomba: Government of Malawi).

National Statistics Office [NSO] (2009). 2008 *Population and Housing Census: Final Report* (Zomba: Government of Malawi).

Ng'ong'ola, D. H., Wiyo, K. A.; Jumbe, C.B.L. and Kalowekamo, F. (2010). "Residential Urban Water use Study in Lilongwe and Blantyre; A Baseline Survey," (Lilongwe: Ministry of Irrigation and Water Development).

Sajidu, S.M.I., Masamba, W.R.L., Henry, E.M.T., and Kuyeli, S.M. (2007). "Water quality assessment in streams and wastewater treatment plants of Blantyre, Malawi," *Physics and Chemistry of the Earth*, 32 (15-18), pp.1391–1398.

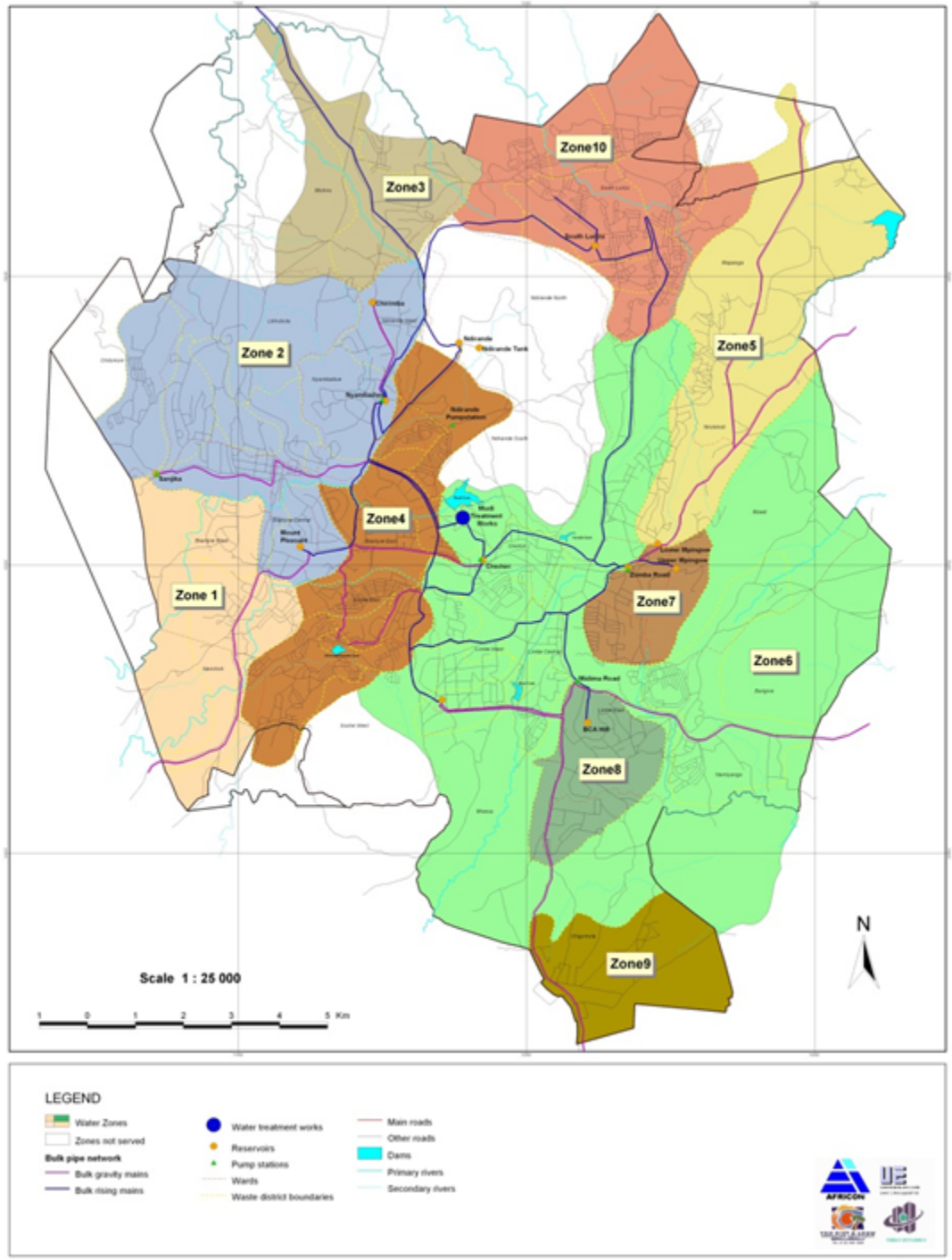
UN-HABITAT (2011). Malawi: *Blantyre Urban Profile* (Nairobi: UN-HABITAT).

World Bank (2007). *Project Appraisal Document for a Second National Water Development* (Washington. DC: World Bank).

World Bank (2008). *Africa Catalytic Growth Fund (ACGF) Grant. Report No. 42385-MW* (Washington. DC: World Bank).

APPENDIX

Appendix 1. BWB Water Supply Zones



Source: Costly Chanza (BCC)

BWB has defined 10 water supply zones within the boundaries of Blantyre City and a further two zones outside these boundaries for the Walker's Ferry settlement and the Chileka Village area. They are:
Nyambadwe supply zone; Chirimba supply zone; UNICEF tank supply area; Ndirande supply area; Mount Pleasant supply area; Mudi clear water tank; Chichiri supply zone; Zomba supply zone; Upper Mpingwe supply zone; Lower Mpingwe supply zone; Kanjedza supply zone; and BCA supply zone.

Appendix 2. Annual Rainfall (mm)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average 2001-2010
Blantyre (Chileka Airport)	1,107	857	795	606	521	1,082	974	912	837	839	853
Blantyre (Chichiri Met.)	1,257	1,130	1,182	852	871	1,316	1,261	1,069	1,124	1,293	1,136
Average	1455	1330	1327	1154	1132	1468	1414	1330	1323	1381	995

Source: NSO (2010) Statistical Yearbook using Department of Climate Change and Meteorological Services

Appendix 3. Water Kiosks in Blantyre- Source: Water for People

Ratio of water kiosks to population in the LIA- Source: Water for People

Name of LIA	Total Number of Water Kiosks	Kiosks to Population Ratio	Kiosks to Household ratio
Chilobwe/Chimwan/Zingwa	9	1:2107	1: 219
Bangwe/Namiyango	37	1: 1076	1: 112
BCA	14	1: 1606	1:167
Chigumula	NA	NA	NA
Chilomoni	14	1: 2292	1: 413
Chirimba/Chileka Road	22	1: 1537	1: 160
Chiwembe	2	1: 6670	1:694
Kachere	29	1: 538	1: 56
Kameza	3	1: 1712	1: 297
Machinjiri	5	1: 7793	1: 1231
Manase	6	1: 1100	1: 114
Manyowe	5	1:1699	1: 177
Misesa/Chensomba	1	1: 39,321	1: 4,064
Mzedi	3	1: 5160	1: 950
Naotcha	8	1: 1, 855	1:193
Ndirande	103	1: 1150	1: 120
Sigerege	12	1: 609	1: 63
Soche	8	1: 6559	1: 682
Nancholi	14	1: 653	1: 68

Most Low-Income Areas in Blantyre City have higher populations compared to the number of kiosks available. Note that Mapanga/Njuli and Chigumula have no kiosks at all. The situation is made worse in areas with more broken-down kiosks.

Functionality of Water Kiosks in Blantyre's LIA

	Frequency	Percentage
Functional and in good condition	86	31
Functional but need repairs	130	47
Broken down	62	22
Total	**278**	**100**

22 percent of all kiosks across all LIAs are completely broken down. Only 31 percent of kiosks can be said to be working properly at all times.

Distribution of Water Kiosks in Blantyre's LIA According to their Functionality

Name of LIA	Works well and in good condition	Works but needs repair	Broken down	Total Water Kiosks
Chilobwe/Chimwan/Zingwa	1 (14%)	4 (57%)	2 (29%)	7
Bangwe/Namiyango	7 (20%)	17 (49%)	11 (31%)	35
BCA	5 (45%)	6 (55%)		11
Chigumula	0	0	0	0
Chilomoni	9 (65%)	3 (21%)	2 (14%)	14
Chirimba/Chileka Road	4 (27%)	7 (50%)	3 (21%)	14
Chiwembe		1 (100%)		1
Kachere/Makhe.Nkol	10 (36%)	16 (57%)	2 (7%)	28
Kameza	1 (33%)		2 (67%)	3
Machinjiri	3 (60%)	1 (20%)	1 (20%)	5
Manase	2 (33%)	4 (67%)		6
Manyowe	3 (60%)	2 (40%)		5
Mapanga/Njuli				0
Misesa/Chensomba	1 (100%)			2
Mzedi		1 (33%)	2 (67%)	3
Naotcha		6 (75%)	2 (25%)	8
Ndirande	23 (22%)	49 (47%)	32 (31%)	104
Sigerege	8 (67%)	3 (25%)	1 (8%)	12
Soche	4 (66%)	1 (17%)	1 (17%)	6
Nancholi	5 (36%)	8 (57%)	1 (7%)	14

Ndirande and Bangwe have the highest number of broken-down kiosks in the Blantyre LIAs.

Availability of Water at Water Kiosks, every day of the year

Name of LIA	Water available every day	Water not available every day
Chilobwe/Chimwan/Zingwa	1 (33%)	2 (67%)
Bangwe/Namiyango	3 (9%)	32 (91%)
BCA	2 (14%)	12 (86%)
Chigumula	NA	NA
Chilomoni	4 (31%)	9 (69%)
Chirimba/Chileka Road	2 (9%)	20 (91%)
Chiwembe	0(%)	2 (100%)
Kachere/Makhe.Nkol	3 (11%)	25 (89%)
Kameza	1 (33%)	2 (67%)
Machinjiri	2 (40%)	3 (60%)
Manase	1 (17%)	5 (83%)
Manyowe	0 (0%)	5 (100%)
Mapanga/Njuli	NA	NA
Misesa/Chensomba	0(0%)	1 (100%)
Mzedi	0(0%)	3 (100%)
Naotcha	0(%)	8 (100%)
Ndirande	5 (7%)	97 (93%)
Sigerege	4 (33%)	8 (67%)
Soche	1 (14%)	6 (86%)
Nancholi	1 (7%)	13 (93%)

Appendix 4: Summary of production and sales figures for 2000/01 to 2010/11 period

Year	Treated water produced (Mill m^3)	Increase as % of previous year	Source		Water sold (Mill m^3)	Increase as % of previous year
			W.Ferry	Mudi		
2000/01	25.66	2.89	23.25	2.41	16.64	1.90
2001/02	26.56	3.51	23.53	3.03	17.58	5.65
*2002/03	33.86	**2.05	30.61	3.25	18.81	**-14.35
2003/04	28.77	5.72	26.52	2.25	15.74	- 4.63
2004/05	30.60	6.33	27.03	3.57	15.11	- 4.17
2005/06	28.99	-5.16	26.90	2.09	13.96	-7.61
2006/07	29.38	0.39	25.48	3.90	13.77	-1.36
2007/08	28.64	-2.52	26.64	1.99	15.75	14.38
2008/09	29.87	4.3	27.47	2.40	15.32	2.7
2009/10	30.04	0.6	28.07	1.97	15:45	0.8
2010/11	30.91	2.8	28.68	2.23	15.21	-1.6

Notes: * 15 months (April 2002 - June 2003) ** Daily average figures used in the comparison.

Appendix 5: Water and Sanitation Technologies

Standpipe

Source: W4P

Concrete Kiosk

Source: W4P

Protected Spring

Source: W4P

Rainwater Harvesting at a School

Source: BCC

Below: A Gulper Being Cleaned

Photo by Moumié Maoulidi

Additional Information on the Gulper is Available at the Following Websites:

Water Aid
http://www.wateraid.org/uk/what_we_do/sustainable_technologies/technologies/9505.asp
http://www.unwater.org/statistics_urb.html

You Tube
http://www.youtube.com/watch?v=IUoX96WFass

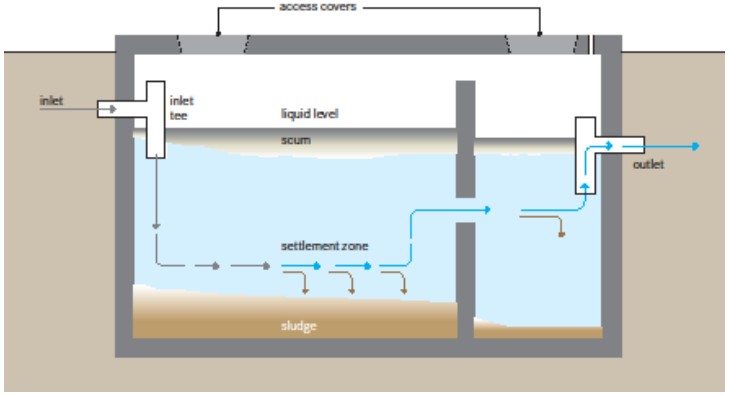
Pit Latrine

Flush Toilet

Ventillated Improved Latrine (VIP)

EcoSan or Skyloo Toilet

Septic Tank



A Septic Tank is a watertight chamber made of concrete, fiberglass or plastic, for the storage and treatment of black water and grey water.

It should typically have at least two chambers. The first chamber should be at least half of the total length, and when there are only two chambers, it should be 2/3 of the total length.