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A WATER AND SANITATION NEEDS ASSESSMENT FOR KUMASI, GHANA

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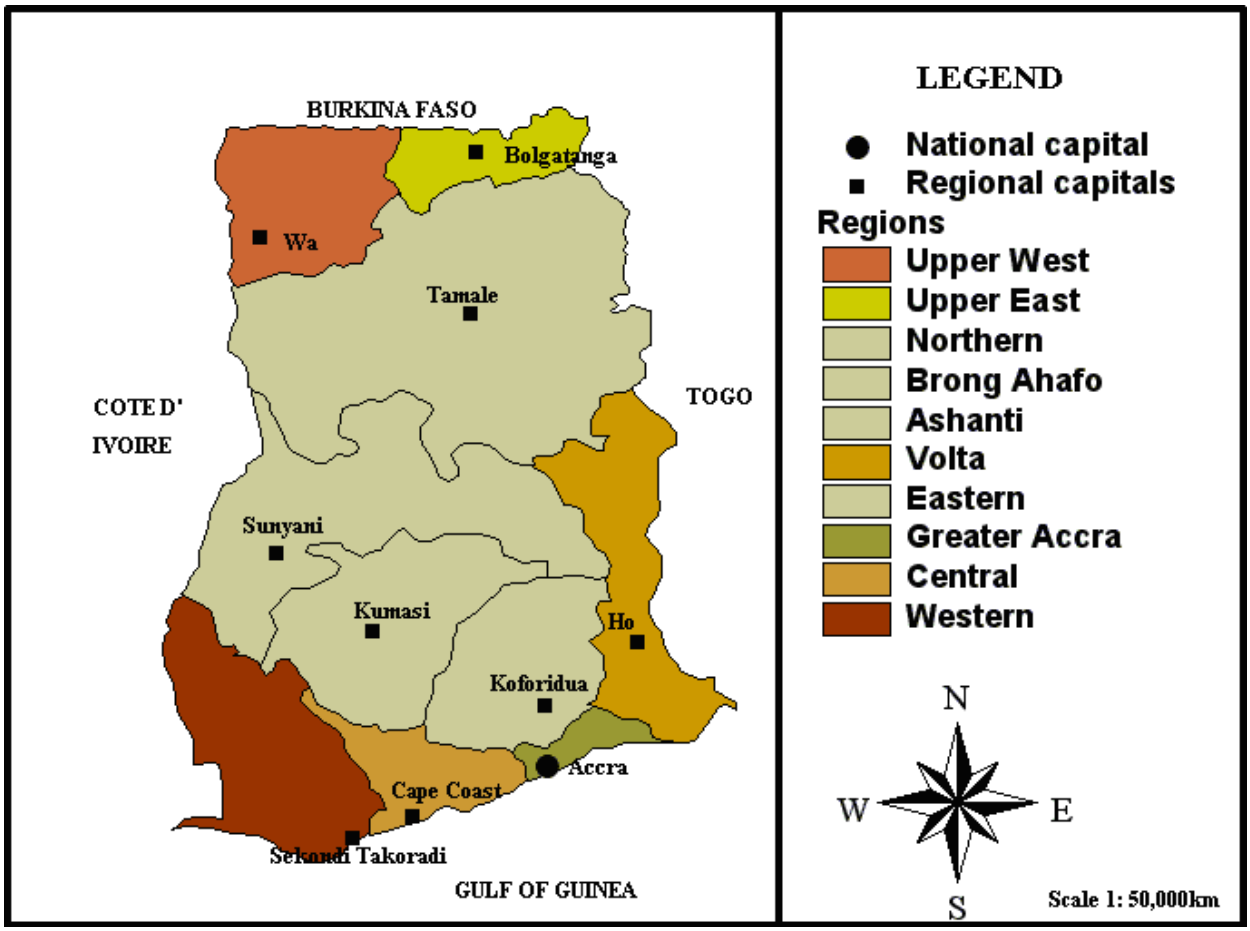
Figure 1. Map of Ghana Showing Kumasi



Source: UN-HABITAT (2009)

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AVRL	Aqua Vitens Rand Limited
DACF	District Assemblies Common Fund
EPA	Environmental Protection Agency
GOG	Government of Ghana
GWCL	Ghana Water Company Limited
IDA	International Development Association
IWMI	International Water and Management Institute
KMA	Kumasi Metropolitan Assembly
KNUST	Kwame Nkrumah University of Science and Technology
KVIP	Kumasi Ventilated Improved Pit Latrine
MSW	Municipal Solid Waste
NGO	Non-Governmental Organization
SANDEC	Department of Water and Sanitation in Developing Countries at the Swiss Federal Institute of Aquatic Science and Technology (Eawag)
SSP	Strategic Sanitation Plan
UESP	Urban Environmental Sanitation Project
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
WB	World Bank
WHO	World Health Organization
WMD	Waste Management Department

EXECUTIVE SUMMARY

Kumasi, Ghana's second largest city, is located in south-central Ghana and is a commercial, industrial and cultural center with a rapidly increasing population.[1] The city is making progress towards Target 7C of the Millennium Development Goals, which mandates that the number of people without sustainable access to water and sanitation be reduced by half by 2015. However, while access to piped water in Kumasi has increased from 66.2 percent in 2000 to 80 percent in 2008, and solid waste collection is improving, about 40 percent of the city's residents still rely on public and shared toilets. Since public and shared toilets are not considered to be "improved sanitation facilities" by the WHO/UNICEF Joint Monitoring Programme (JMP), the city today, with little more than four years to go, remains far from attaining the sanitation target.[2]

Water production in Kumasi has been expanding in recent years, with an increase from 21 to 27 million gallons per day between 2005 and 2010 (Blokhuis et al., 2005; GWCL, 2010). However, average per capita daily consumption has been declining, due largely to Kumasi's fast-growing population, in light of which, both water production and the water supply network need to be expanded soon and significantly. Additional water supply challenges include the irregular water supply and leakages from pipes. Irregular, and hence, unreliable water supply is mainly the result of frequent power outages, a chronic problem afflicting all of Ghana in recent years. Water loss from leakages, though, is expected to decline, given the ongoing effort of Ghana Water Company Limited (GWCL), to replace the old pipes and extend the water main.

The Kumasi Metropolitan Assembly's Waste Management Department (WMD) has also made significant progress in improving sanitation in the city. Public toilets are being rehabilitated, and the city has introduced both a house-to-house refuse collection scheme and a "pay-as-you-dump" system to deal with its solid waste collection challenges. As a result, open defecation is not a major problem, and heaps of uncollected solid waste are no longer a common sight, as they were a decade ago. The city is also committed to ensuring that schoolchildren and the population at large are well informed about good hygiene practices. Nevertheless, major sanitation problems remain. "A worrying trend is that about 40 percent of the city's population uses public toilets, and only about half of all residents have toilet facilities at home." Another persistent problem facing the WMD is inadequate revenue mobilization to finance sanitation services.

The findings of this needs assessment indicate that with an average annual investment of $13 per capita, Kumasi has the opportunity to attain the MDG targets related to water and sanitation.

The structure of the report is as follows: Section I presents an overview of the city, as well as the objectives, methodology and limitations of the study. Section II discusses key problems faced by residents, namely the availability, affordability and suitability of water and sanitation services. Section III focuses on the financing for water and sanitation in Kumasi City and outlines the results of the costing model. Section IV summarizes the needs assessment's findings and offers some recommendations.

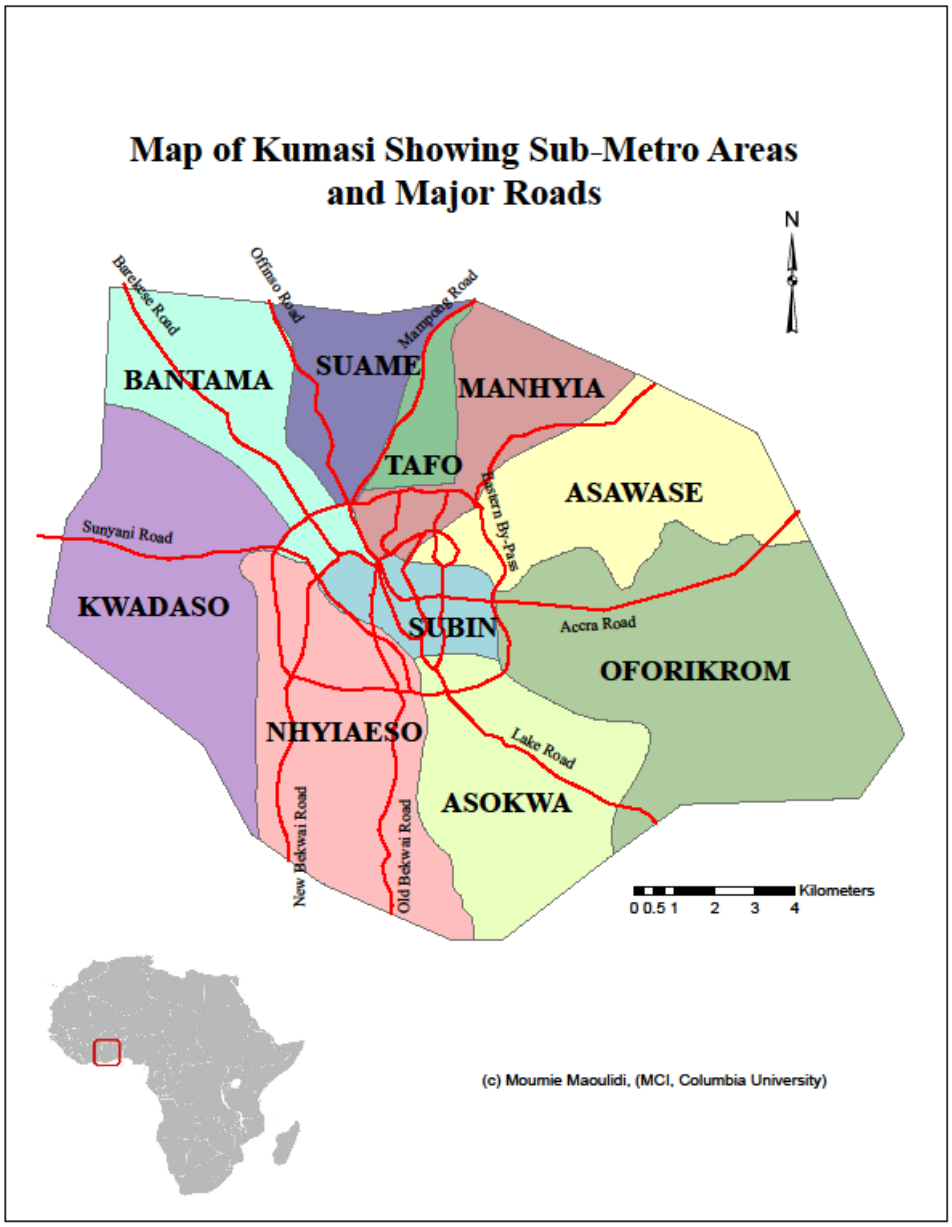
[1] MCI estimates the 2010 population at 1.6 million, with a daytime population estimated at roughly 2 million.

[2] The JMP defines an improved sanitation facility as any of the following: a pit latrine; a ventilated improved pit latrine; a pit latrine with slab; a composting toilet; and/or a flush toilet piped to a sewerage system or septic tank.

I. INTRODUCTION

Kumasi is strategically positioned as the capital of Ghana's Ashanti Region, one of the most heavily populated parts of the country. Located 300 km north-west of Accra, the national capital, Kumasi has been the crossroads between the northern and southern sections of Ghana since its establishment as the heart of the Ashanti Empire, around the turn of the eighteenth century. The city is easily accessible by road and has a large transient and immigrant population from all parts of the country, as well as from neighboring West African countries. Figure 2 shows the city's 10 sub-metropolitan areas and its major roads.

Figure 2. Map of Kumasi Showing Sub-Metropolitan Areas and Major Roads



1.1. Objectives

This paper aims to identify the main water and sanitation challenges facing the city of Kumasi 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 drinking water and basic sanitation. Going further, this study suggests specific interventions to improve that access and estimates their costs, enabling local, regional and national government and the development partners to plan accordingly.

1.2. Methodology

The research methodology used in this needs assessment includes field research, a desk review and site visits. The field research was initially conducted in between February and April 2008 by a researcher who travelled to Kumasi to gather preliminary information, work then followed up by MCI's Social Sector Research Manager and Program Manager in Ghana in July 2010.

Data and information were obtained from representatives of various agencies in Kumasi, including: Ghana Water Company Limited (GWCL) and Aqua Vitens Rand Limited (AVRL); The Kumasi Metropolitan Assembly (KMA) Waste Management Department (WMD); the International Water Management Institute; KMA Metropolitan Health Directorate (MHD); the Metropolitan Education Directorate and the School Health Education Program (SHEP); the KMA Town and Country Planning Department; and the wastewater treatment lagoons at Asafo and Ahensan Housing Estates.[3] Personal contact with WMD and AVRL employees, the KMA Statistical Office and staff at the IWMI office also provided unique opportunities for discussing water and sanitation issues.

1.3. Limitations

A key challenge in conducting this assessment was that data regarding the number of people with access to improved water and sanitation sources differed in different documents, partly because different population projections were used. Another limitation was that Kumasi has a significant immigrant and transient population. People migrate to the city from different parts of Ghana and West Africa, and some Ashanti residents travel to Kumasi to work or trade during the day and then return home at night, making it difficult to estimate the water supply and sanitation resources and facilities needed to achieve the MDG water and sanitation targets.

1.4. Demographics

Kumasi is the most populous district in the Ashanti region. As of the 2000 census, the city had a population of 1,170,270. MCI projects that the 2010 population is 1,634,899.[4] Data collection

[3] Ahensan is also spelled Ahinsan.

[4] MCI's population projections are based on the 2000 census and rely on an exponential growth function and a growth rate of 3.34 percent. Using this growth rate, the MCI population projection for 2007 (1,478,869) is the same as that in the Kumasi Metropolitan Assembly's reports. However, other KMA documents, such as the "Development Plan for Kumasi Metropolitan Area (2006-2009)," use a different population growth rate (5.4 percent) and show divergent population figures.

for the 2010 Ghana census is expected to begin in September 2010. Table 1 shows Kumasi City's population by location, both at the time of the 2000 census and, as projected, in 2010.

Table 1. Kumasi City Population, by Area

Sub-Metropolitan Area	Census population 2000	Projected population 2010	Area (sq.km)
Oforikrom	124,869	174,445	54.1
Asawase	131,418	183,595	29.5
Bantama	101,409	141,671	30.6
Nhyiaeso	64,505	90,115	30
Kwadaso	118,039	164,904	34.2
Subin	100,979	141,070	8.5
Manhyia	163,986	229,093	17.1
Suame	114,751	160,310	14.6
Old Tafo	128,022	178,850	6
Asokwa	122,292	170,845	29.3
Total	1,170,270	1,634,899	253.9

Source: Ghana Statistical Services (2005); MCI projections

II. WATER AND SANITATION IN KUMASI

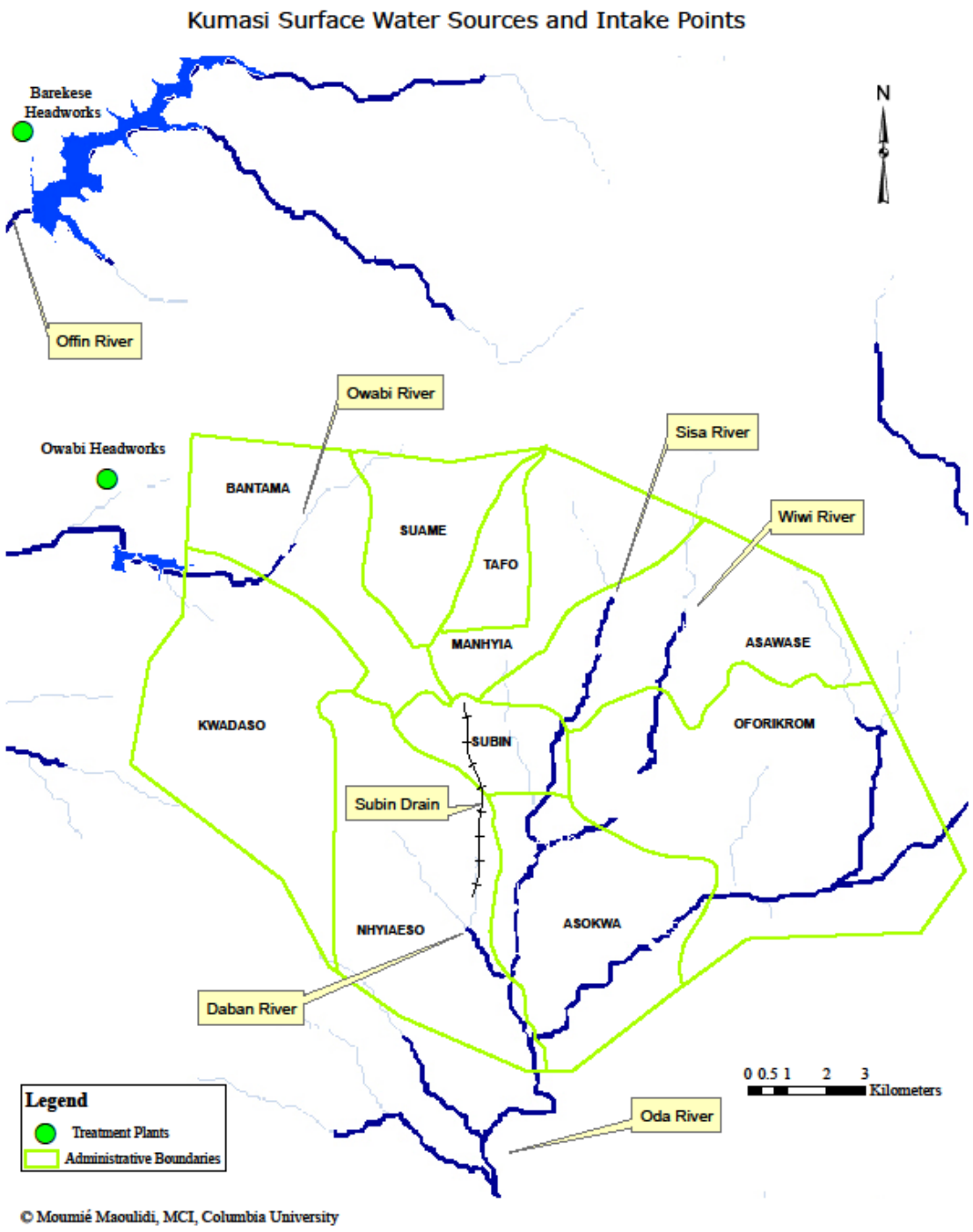
2.1. Background

The Government of Ghana's key water and sanitation policy objectives are to accelerate the provision of safe water and adequate sanitation facilities and to ensure the sustainable management of those facilities. Strategies for achieving these objectives include: the development of District Water and Sanitation Plans (DWSPs); improving community-owned and -managed water supply systems; and strengthening public-private partnerships. The government is also interested in integrating hygiene education into water and sanitation delivery.

The Ghana Water Company Limited (GWCL) is a state-owned company responsible for producing and distributing potable water to the urban population nationwide. In Kumasi, GWCL provides water and manages household connections and public stand posts, as well as boreholes in peri-urban areas. The Ashanti Regional Office of Aqua Vitens Rand Limited is the company managing the water systems on behalf of GWCL. Sanitation services are provided by the Waste Management Department (WMD) of the Kumasi Metropolitan Authority (KMA). WMD supervises the design and construction of public sanitation facilities and oversees the activities of the companies sub-contracted to collect household waste in the metropolis.

Kumasi is located in a wet semi-equatorial zone and receives substantial amounts of rain each year. The major rainfall season is from April to July, and the minor season occurs between September and mid-November. Average yearly maximum rainfall is 214.3 mm in June and 165 mm in September (KMA WMD, 2010). Figure 3 shows some of the open water sources, and the two water intake points in Kumasi.

Figure 3. Map of Kumasi Showing Surface Water Sources and Intake Points



2.2. Kumasi's Water System

Most of the water in Kumasi is obtained from rivers, such as the Offin and Owabi. These surface water sources are fed by several tributary streams, as shown in Figure 3. GWCL does not rely on boreholes for the city's water supply. Rainwater harvesting used to be widely practiced in Kumasi, but urbanization and pollution have made it impractical. Emissions from a growing number of industries and vehicular fumes have increased the range and levels of pollutants in the city, including such toxic chemicals as platinum, palladium and lead.

There are two water intake points: one at Owabi (located 10 km from the city); the other at Barekese (located 19 km from the city).[5] The abstracted water is treated at the Owabi and Barekese Water Treatment Plants.[6] The water is stored at the Owabi reservoir, a stone masonry gravity dam constructed in 1928 that is 135 meters long and 11 meters high, and at the Barekese reservoir, a 15 meters high and 600 meters long earth-filled dam built between 1967 and 1971 and rehabilitated in 1998.

Average water production at Owabi and Bakerese headworks is 122,638 m^3/day, or 27 million gallons per day[7] (GWCL, 2010). This is an improvement from five years ago, when the average daily output was 95,000 m^3/day (Blokhuis et al., 2005). However, given that the design capacity of Bakerese is about 220,000 m^3/day and that of Owabi is 13,600 m^3/day, the total water produced by the two waterworks amounts to just over half the design capacity. Low electrical power voltage is a factor contributing to this deficit in water production. For instance, in 2006, Mr. Timothy Nettey, then Project Manager for Kumasi Water and Rehabilitation Expansion, noted that the dams required 415 volts to run the pumps but were receiving fewer than 390 volts.[8]

There are four pumps at Bakerese and Owabi, with a capacity to pump 4,500 cubic meters (m^3) per hour, which has improved the flow of water to residences and businesses (GWCL personal communication). After water is abstracted and processed at the treatment plants, it is pumped to a surface reservoir in Suame, for distribution to different parts of the city. Suame has an elevated tank and ground level tanks, with a total storage capacity of 19,090 m^3 (4.2 million gallons), as shown in Table 2.

Table 2. Storage Capacity and Condition of Water Tanks at Suame

	Capacity	Condition
Tank # 1	10,000 m^3	Functional
Tank #2	4,545 m^3	Good
Tank # 3	4,545 m^3	Good
Total	19,090 m^3	

Source: GWCL/AVRL

[5] Note that Owabi and Barekese are outside the Kumasi district boundaries. These plants are also known as Owabi and Barekese Headworks. According to the KMA 2006-2009 Development Plan, Barekese is 16 km from the city.

[6] The treatment process involves chemical dosing, clarification, and filtration.

[7] 1 cubic meter (m^3) is equal to 220.16 UK gallons.

[8] http://www.ghanaweb.com/GhanaHomePage/NewsArchive/artikel.php?ID=177728

While water production has been increasing, the average per-capita daily water consumption in Kumasi has been decreasing, mainly because the population growth has outstripped supply. Kuma et al (2010) estimate that, in 1996, daily per capita water consumption was 24.2 m^3/year (0.066 m^3/day or 66 liters/day) and argue that in 2009, it should have been 0.094 m^3/day or 94 liters/day. GWCL, on the other hand, notes that current per capita daily water consumption varies depending on socio-economic status. Low-income residents, for example, consume 0.025-0.035 m^3/day, while middle-income residents consume 0.060-0.075 m^3/day and upper-income residents consume over 0.120 m^3/day.[9] Average water consumption also varies, depending on the number of people per household and each household's location.

Kumasi's water production clearly needs to increase to meet demand, as shown in Table 3.

Table 3. Water Demand Forecast (m^3/day) for Kumasi

Year	Demand in Liters per day	Production in Liters per day	Coverage, %
1990	69,678,000	68,200,000	98%
2010	242,735,348	122,727,273	51%
2011	256,382,827	150,021,032	59%
2012	270,797,618	177,297,600	65%
2013	286,022,863	204,574,100	72%
2014	302,104,126	231,818,182	77%
2015	319,089,538	231,818,182	73%

Source: GWCL/AVRL

The catchment area of Barekese has been under intense human pressure in recent years, which has reduced the yield from the dam. For instance, encroachment by private land developers, farming and logging have contributed to high sediment levels entering the dam, which has detrimentally affected recent initiatives to expand water production at Bakerese. Water production at Owabi has not been adversely affected by encroachment, because the catchment area is the Owabi Forest Reserve which is restricted from human activity. However, Owabi only produces one sixth of the water produced at Barekese.

Additional problems affecting the operations of the GWCL include leakages, illegal connections and non-payment of customers' bills.[10]

2.3. Access to Water in Kumasi

Table 4 lists the improved and unimproved sources of water as defined by the WHO/UNICEF Joint Monitoring Programme (JMP).[11]

[9] One liter per day (l/day) is equivalent to 0.001 m^3/day; hence, 0.025 m^3/day =25 liters per day, 0.075 m^3/day =75 liters per day and 0.120 m^3/day =120 liters per day.

[10] In 2005 the Ashanti Regional Minister noted that consumers owed the GWCL 33.6 billion cedis ($3.5 million); (http://www.modernghana.com/news/74315/1/kumasi-water-consumers-owe-33-billion-cedis.html; the exchange rate used is $1 = 9607 old Ghana cedis and was derived from www.oada.com.)

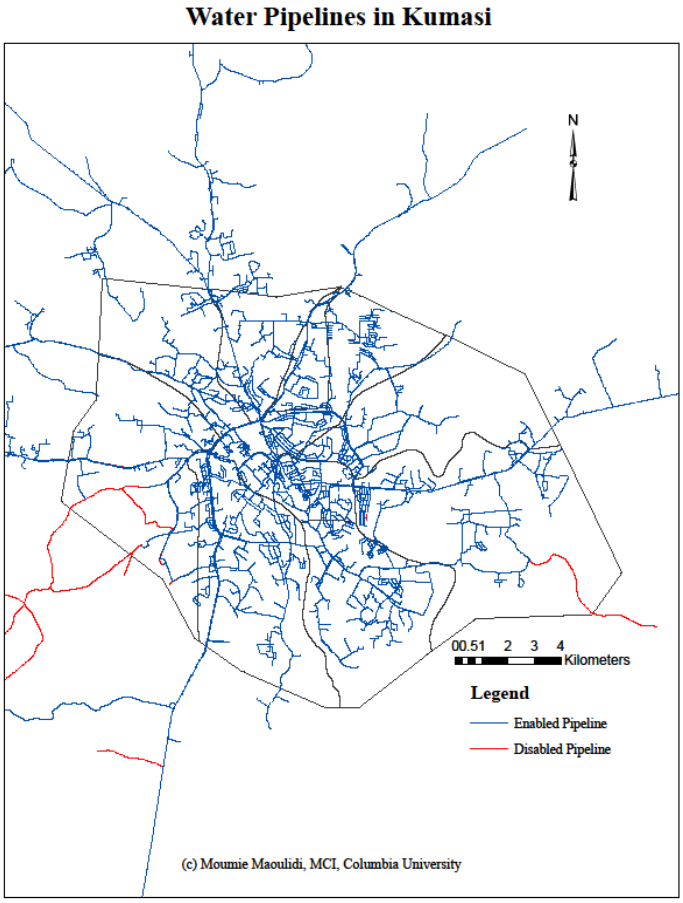
Table 4. Definition of Improved and Unimproved Water Sources

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

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

The Kumasi Water Supply System (WSS) currently has 1,005 km of pipeline, with diameters ranging between 13 and 600 mm. Pipes between 13 and 32 mm are being phased out and replaced with 25 mm pipes, because the former are prone to breakage (Kuma et al., 2010). Figure 4 shows the functioning and non-functioning water pipelines in Kumasi.

Figure 4. Water Pipelines in Kumasi

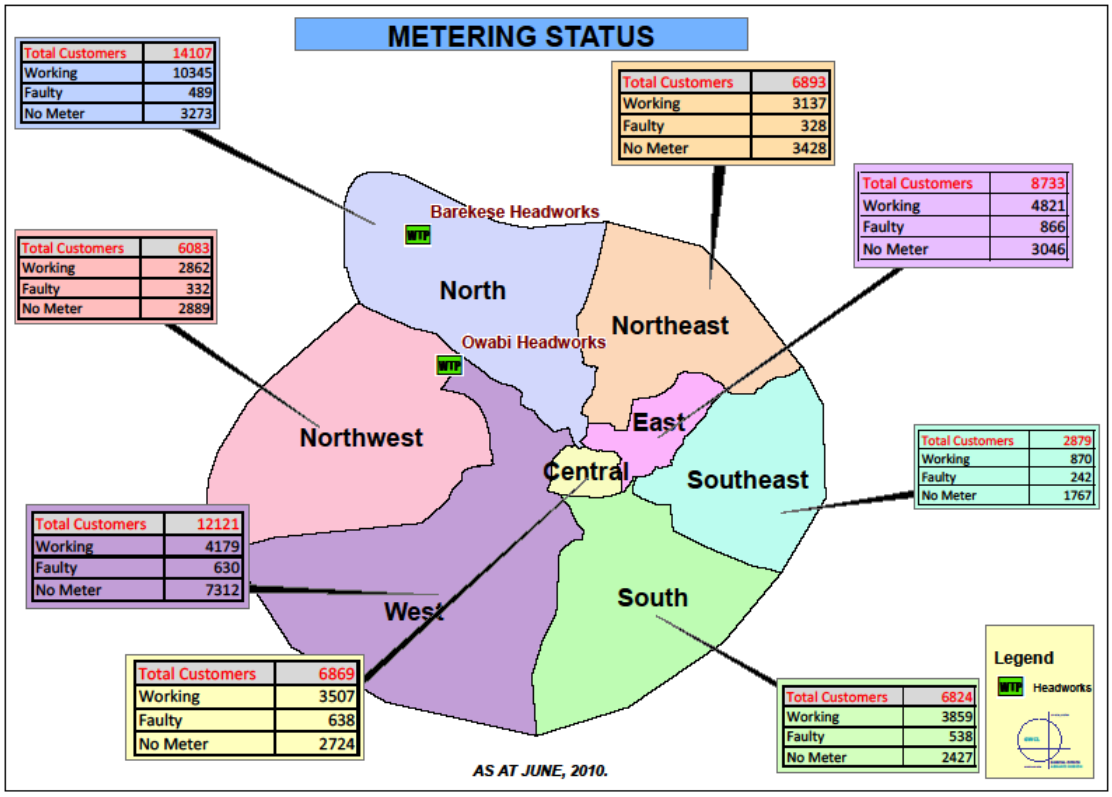


[11] Tanker truck-provided and vendor-provided water are not considered improved sources because there is no quality control to ensure that the water is safe to drink. Bottled water is not considered improved because of concern for the quantity, rather than the quality, of supplied water. Using this JPM definition, it is estimated that approximately 80 percent of Kumasi residents had access to an improved water source in 2008.

GWCL/AVRL recently upgraded and extended Kumasi's water transmission mains, under the World Bank/GoG Urban Water Project.[12] The main objectives of this project were to increase the supply of water in the city by replacing worn-out water distribution networks and extending the water transmission mains by 45.9 km.[13] According to former Managing Director of the Ghana Water Company Limited (GWCL), Mr. Kwaku Botchway, the upgrade and extension were necessary because the lines were faulty, resulting in significant wastage of treated water.[14]

To reduce the number of unbilled customers, GWCL/AVRL has also been installing 20,000 new meters and replacing 1,776 existing ones, as part of the Kumasi Water Supply Rehabilitation Project. This initiative will ensure that households with access to piped water pay, which is important because many Kumasi houses are built as rows of rooms around a central courtyard, where the water taps tend to be located. Figure 5 shows the metering status in 2010 in the Kumasi metropolis and the surrounding peri-urban areas. As can readily be seen, each area includes a substantial number of customers still without meters.

Figure 5. Metering Status in Kumasi Metropolis and Peri-urban Areas.



Source: GWCL/AVRL

[12] This project focused not only on water supply in Kumasi but also in Obuasi, Accra and Mampong.

[13] The 61.8-kilometer length of the water transmission mains, comprised of 45.9 km in Kumasi and 15.9 km in Obuasi, was added at a cost of GH¢400,600 ($276,275), with funding from the World Bank and the GoG.

[14] Areas benefitting from the extension include: the airport roundabout to Kenyase; Santase to Atasemanso; Kwadaso to Edwenase, and Edwenase to the Police Depot; Buokrom through Asabi to Aboabo junction; Tafo through Pankrono to Mampong road; Santase to Brofoyedu; Fankyenebra through Apere to Edwenase; and the Santase roundabout through Sofoline to Abrepo junction.

Water Quality
Water produced in Kumasi is generally of acceptable quality, but the use of chemicals near river bodies is threatening the quality of the water supply. According to the KMA, chemicals used by farmers and fishermen have been polluting streamlets that feed streams, which, in turn, supply water to the Bakerese and Owabi dams. The discharge of liquid waste from sewers and drains into rivers also threatens water quality.

According to the GWCL, another issue has been the infestation of bloodworms in the Owabi River, which dramatically diminishes the quality of the water from that source. These organisms contaminate the water by invading the filtration system and breeding in distribution tanks.

2.4. Kumasi's Sanitation System

The KMA Waste Management Department (WMD) is the institution responsible for environmental sanitation services in the city. It supervises the design, construction and management of public sanitation facilities and provides financial and technical assistance for their establishment and maintenance (KNUST, 2007).

In 1999, KMA produced a Strategic Sanitation Plan for Kumasi (SSP-Kumasi), under the UNDP Water and Sanitation Program. The first SSP-Kumasi was for the 1999-2000 period, but it was then updated and another strategic plan was adopted for the period between 1996 and 2005. The plans recommended different sanitation systems for different areas of the city.[15] Simplified sewerage was recommended for high-population density areas, Kumasi Ventilated-Improved Pits (KVIP)s for medium-density areas and WCs with septic systems for low-density areas. In addition, unhygienic bucket latrines were to be phased out, and an eight-kilometer simplified sewerage scheme, serving a population of 20,000, was installed in the Asafo tenement.

Kumasi residents rely on five different sanitation technologies: the water closet (WC); the KVIP; the Enviro-Loo; the aqua privy; and the bucket/pan latrine.[16] Water closets (flush toilets) are either linked to septic tanks or sewers. Unfortunately, many septic tanks lack properly functioning drain fields and tend to overflow, causing a risk of ground and surface water pollution (Owusu-Addo, 2006). Enviro-Loos and aqua privy toilets are generally found at public facilities in Kumasi; bucket or pan latrines are mostly used by low-income individuals and are unhygienic because they have to be emptied by laborers who collect the buckets several times per week. The contents of bucket latrines are deposited into tanks located at various sanitary sites.

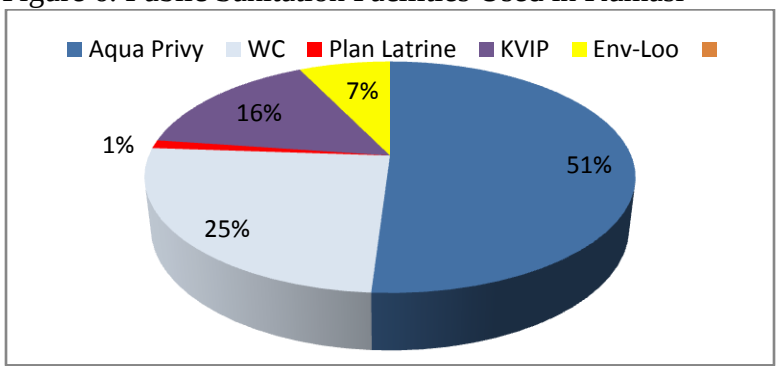
Most WCs in Kumasi are connected to septic tanks, as a result there are only a few small sewer networks. For instance, there are estate sewers managed by associations whose responsibilities include their day-to-day operations, maintenance and revenue collection. The associations engage private contractors to undertake management and maintenance. In addition, the city has

[15] According to the plans, houses in Kumai could be categorized into four groups: high-population density (also known as tenement areas); medium density (indigenous areas); low density (new government and high-cost areas).
[16] An Enviro-Loo is an on-site, dry sanitation toilet system that functions without water, while an aqua privy is a pit toilet with a tank under the latrine floor.

three small-scale sewerage systems, one serving the university, one serving the hospital and the other serving central parts of the 4BN army barracks.

Many Kumasi residents also rely on public latrines scattered throughout the city. Figure 6 shows public sanitation facilities in Kumasi, by type. It can be seen that, in 2008, about half of the public toilets were aqua privy toilets and a quarter were water closet (flush) toilets.

Figure 6. Public Sanitation Facilities Used in Kumasi



Source: KMA WMD (2009)

The cost of using a public toilet is between GH¢ 0.05 and 0.20 ($0.03-0.14). Table 6 shows the number of public toilets in the city by sub-metro location in 2008.

Table 5. Types and Numbers of Public Toilets in Kumasi Metropolis (2008)

	Type of Toilet					
Sub-Metro Area	**Aqua Privy**	**WC**	**Plan Latrine**	**KVIP**	**Env-Loo**	**Total**
Asawase	19	5	0	4	3	31
Asokwa	20	7	0	9	2	38
Bantama	27	6	2	2	0	37
Kwadaso	10	3	0	4	1	18
Manhyia	26	22	0	6	5	59
Nhyiaeso	8	6	0	8	2	24
Oforikrom	18	2	0	7	7	34
Suame	20	7	0	7	2	36
Subin	17	24	2	4	2	49
Tafo	12	5	0	3	1	21
Total:	**177**	**87**	**4**	**54**	**25**	**347**

Source: KMA WMD (2010)

After a public toilet is built, the maintenance and management become the responsibility of the Unit Committee[17] (UC) in the community where the toilet is located. However, UCs face several challenges, including the inability to generate sufficient funds, and the indiscriminate disposal by

[17] Unit Committees are supposed to be the main channels of communication between the KMA and local communities.

inhabitants of their solid waste. In addition, public WC toilets have to be de-sludged once every six weeks, and the cost, GH¢50 ($34) per de-sludge, is prohibitive to some UCs (KNUST, 2007). Public toilets are also costly to maintain, because they require electricity and water to function, and they often break down, resulting in the poor maintenance of some public toilets. The WMD nonetheless estimates that 62 percent of public toilets are in good condition, with the rest in satisfactory condition.

The WMD has embarked on a project to improve the public latrines. It is worth noting, however, that the UNICEF/WHO Joint Monitoring Program (JMP) does not consider public toilets to be improved sanitation facilities. KMA's 2006-2009 Development Plan states that the long-tem plan is to reduce the dependence on public toilets in favor of household toilets (KMA & MLGRD, 2009). Given that almost 40 percent of Kumasi residents rely on public toilets, it is unlikely that the city will achieve the MDG sanitation target if the focus remains on providing one toilet per household and shared toilets are not considered to be improved sanitation facilities. This suggests that communal toilets (one used by 5-6 households) could be a preferable alternative to public toilets.

Solid Waste

In 1995, the rate of domestic waste generation in Kumasi was estimated at 600 tons per day (Post, 1999). By 2005, 1000 tons of solid waste was generated each day in the city; three years later, the WMD was collecting 1,200 tons a day, and a 2010 WMD document shows that 1,500 metric tons of waste is now generated in Kumasi each day. Most of the waste is generated in the Subin sub-metro area, largely because there are two markets there. Table 6 shows the total domestic, commercial and industrial (non-toxic and non-hazardous), as well as the market and restaurant waste generated during the 2006-2009 period.

Table 6. Waste Generation in Kumasi, by Sub-Metropolitan Area, 2006-2009

	2006 Estimated Waste Generation	2008 Estimated Waste Generation	2009 Estimated Waste Generation/Day
Metric tons/day	1000	1200	1500

Source: KMA & MLGRD (2006); KMA WMD (2010)

The main site for the disposal of collected solid waste is the Dompoase sanitary landfill. Prior to the construction of the landfill, uncollected waste was routinely dumped in open spaces, in drains or was burned. A 1999 study estimated that two-thirds of residential waste was dumped in open lots or on the banks of natural streams (Post, 1999). The uncollected waste posed a serious health hazard and contaminated surface water sources.

To deal with solid waste collection challenges, the city has introduced a house-to-house refuse collection scheme and has assigned solid waste collection to the private sector. Kumasi has been divided into seven zones, each with its own private contractor, who is responsible for the house-to-house refuse collection in that zone.[18]

[18] As of July 2010, the private contractors operating in Kumasi are: Anthoco, Aryetey Brother Company Limited (ABC), Kumasi Waste Management Limited (KWLM), Meskworld, Sak-M Company Limited, Waste Group Ghana Limited (WGG) and Zoomlion Ghana Ltd.

Households pay monthly fees for house-to-house waste collection. The rates are on a sliding scale, determined according to income: the wealthiest households pay about GH¢ 5 per month ($3.50), while middle-income households pay GH¢ 4 per month ($2.75). In 2009, 55,000 households participated in the house-to-house waste collection scheme (KMA WMD, 2010). Poor households generally rely on the pay-as-you-dump system, whereby communal metal containers/skips are placed at designated sites, and households pay between GH¢ 0.10 and 0.20 ($0.07-0.14) per load. Typically, about five households share a communal small container; in 2009 there were 540 such containers. Residents also use 12,000 bins, with storage capacities of 120 or 240 liters. One problem with the containers is that they are too high for small children, who then sometimes leave or throw the waste on the ground. Strategically placed ladders can resolve this problem. KMA, the Department of Parks and Gardens and the Forestry Services Division also plan to plant trees around skips, to improve the appearance and reduce the odors emitted by these facilities.

Solid waste is collected at least twice a week by 20 refuse trucks and three tractors, all in satisfactory condition (KMA WMD, 2010).

Although most household waste generated in Kumasi is organic, recycling and composting are not widely practiced in Kumasi. Some residents and a few enterprises salvage such materials as plastic bottles, metals and bags, and some people re-use items like plastic bottles to store different types of liquids, but recycling is still not officially part of solid waste disposal management. Nor do the private contractors engaged by KMA to collect and haul solid waste engage in recycling. The WMD estimates that paper, plastics, metals and rubber constitute about eight percent of total household waste (KMA WMD, 2010), and the KMA is currently in the process of identifying land on which to build a material recovery facility plant. Table 7 shows the estimated composition of municipal solid waste (MSW) in 2009.

Table 7. Composition of Municipal Solid Waste (MSW) in 2009.

Material	Percentage of Municipal Solid Waste
Biodegradable	47%
Paper	3.1%
Plastic	3.5%
Glass	0.6%
Metal	0.6%
Inert, ash, debris	44.6%
Total	100%

Source: KMA WMD (2010)

Recycling clearly needs to be given heightened consideration as a means of reducing the volume of waste sent to landfill sites. A 2007 KNUST study notes that in order for recycling to be a viable option for household waste treatment, the waste must be separated at the source (KNUST, 2007). The KMA will, therefore, have to educate residents to separate waste at the source, i.e., before it is deposited into containers or trash cans.

Liquid Waste

The main sewage treatment plant(s) in Kumasi is the Dompoase Septage Treatment Facility Treatment Plant (STW), built in 1958. However, even though a number of industries generate significant amounts of effluent, leachate and spillage, there is little wastewater treatment in Kumasi. Industrial wastewater, domestic grey water and storm water flow through open sewers and discharge into rivers like Subin, Abaoba and Sissai, without being treated.[19]

According to the KMA's 2006-2009 Metro Development Plan, most of the industrial wastewater in Kumasi is generated by two breweries, Guinness Ghana and Coca Cola Bottling Company, and the Kumasi Abattoir. Together they generate more than 1,510 m^3 of effluent daily, all of which ends up in the city's drains (KMA & MLGRD, 2006). Enterprises such as the Suame Magazine Complex and the sawmills also generate significant amount of waste oil and leachate, respectively, adding to environmental degradation. As industrial production increases, wastewater production is more than likely to increase.

Less than 10 percent of Kumasi's households are connected to a sewer.[20] Sewage treatment lagoons are located in three residential areas: Asafo, Ahensan, and Kyirapatre Housing Estates, [21] as well as the Kumasi National University of Science and Technology (KNUST). Figure 7 shows the treatment plant at Asafo (left) and an overloaded anaerobic pond at Ahesan.

Figure 7. Treatment Plant at Asafo and Overloaded Anaerobic Pond at Ahesan

Source: IWMI

Wastewater treatment plants in Kumasi need to be rehabilitated, and the maintenance of these facilities needs to improve. The treatment plant on the KNUST campus, installed in the 1950s, was out of order for about 20 years, until pumps and pipes were replaced and/or restored in 2007 (Erni, 2007). Waste stabilization ponds[22] are another alternative that have been proposed as an

[19] KMA Metro Development Plan, 2006-2009, p. 115.

[20] Waste Management Department. Action Plan for the Improvement of Waste Management in the Kumasi Metropolis.

[21] Also spelled Chirapatre,

[22] Waste stabilization ponds are also referred to as oxidation ponds, or lagoons.

appropriate wastewater treatment technology for developing countries (Ramadan and Ponce, 2008). In 2004, the KMA built a series of waste stabilization ponds for faecal sludge treatment at Dompoase, in the south of Kumasi. However, improper management and inefficient treatment have resulted in the pollution of surface water sources by effluents (Buama Ackon, 2006).

2.5. Access to Sanitation in Kumasi

According to the WHO/UNICEF JMP, a household is considered to have adequate access to sanitation if it has a flush toilet that is connected to a public sewer or septic tank, a ventilated improved pit latrine (VIP) or a pit latrine. As Table 8 shows, public and shared toilets and open pit latrines are all considered to be unimproved sanitation.

Table 8. 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

Using the JPM definition, MCI estimates that in 2008, only 43 percent of Kumasi residents had access to improved sanitation (Ghana DHS, 2008).

2.6. Hygiene Education

The KMA has an Environmental Health and Sanitation Department (EHMD) that engages in a wide range of hygiene education and health-related activities. For instance, EHMD educates Unit Committees, Town Councils and schoolchildren about hygiene; encourages the Unit Committees to educate communities about waste management; and ensures that dumpsites are sprayed with chemicals, to reduce mosquito-related diseases.

An important sanitation-related problem, according to the EHMD, is that although residents are encouraged to wash their hands, facilities sometimes do not provide soap. Schools and public toilet facilities, therefore, need to provide sufficient water and soap for regular hand-washing after toilet visits.

The WMD also houses a health education unit, which is in charge of administering the School Health Education Programme (SHEP). One of the objectives is to provide Ghana Education Service (GES) schools with access to relevant quality education on hygiene education. SHEP also works on de-worming and school feeding issues and organizes debates and panel discussions in the schools.

Environmental health officers also engage in hygiene education by conducting house-to-house inspections to identify sanitation issues that can have adverse health effects. Community fora are

also convened, print and electronic media campaigns are conducted and traditional leaders are engaged to mobilize people.[23]

III. FINANCING WATER AND SANITATION IN KUMASI

As a result of Ghana's successful decentralization, the provision of social services such as water and sanitation is the responsibility of local governments. However, district assemblies such as the KMA do not have the financial and human resources needed to ensure effective service delivery.

The rapid increase in Kumasi's population has put pressure on the KMA to improve the water supply and sewer infrastructure. To meet the rising demands of urbanization, the KMA needs additional revenue to pay for both the services and the infrastructure.

3.1. Financing Water and Sanitation

The main sources of revenue for the KMA include transfers from the central governmental, internally generated funds (IGF) and funds from international sources. IGF is derived from property taxes, user fees and consumption taxes, such as value-added taxes (VAT), as well as from water and sanitation tariffs.

Transfers from the central government are the KMA's most important source of revenue. For instance, it is constitutionally mandated that at least 7.5 percent of total Government of Ghana (GoG) revenues will be provided to metropolitan, municipal and district assemblies via the District Assemblies Common Fund (DACF). One problem affecting the financing of water and sanitation activities at the local level is that the GoG often fails to release funds from the DACF to the assemblies in a timely fashion (Amu-Mensah et al, 2008).[24] Given that the assemblies were created to implement government policy at the local level, delays in the transfers of funds impede the KMA's capacity to provide adequate social services to its residents, thereby hindering the development of Kumasi's water and sanitation systems.[25]

3.2. Water and Sanitation Projects in Kumasi

In recent years, several projects have been initiated to improve the water supply and sanitation in Kumasi City.

Between 1996 and 2002, the World Bank and GoG implemented the Urban Environmental Sanitation Project (UESP) with an IDA credit of $71 million.[26] The five main components of

[23] 10 sub-chiefs are paid a GH¢ 100 ($69) honorarium to participate in three-day training sessions on malaria and HIV.

[24] The DACF distribution to assemblies is based on a formula and funds have to be approved by Parliament.

[25] This phenomenon, in part a cash-flow problem at the national level, is not unique to water and sanitation, adversely affecting the delivery on KMA budgetary commitments in numerous other social sectors.

[26] The project covered Ghana's five major cities: Accra, Kumasi, Sekondi-Takoradi, Tema and Tamale. The $71 million was for the 5 cities, to which the Ministry of Local Government and Rural Development and municipal assemblies also contributed funds.

this project were: storm drainage; sanitation; solid waste; upgrading of low-income urban areas; and capacity-building (World Bank, 1996). In Kumasi, the USEP storm drain component consisted of rehabilitating the primary channel from the Zoo through Kejetia to the Asafo Market, and building four new secondary drains to reduce flooding in the Central Market, the Asafo Market and the Kejetia Lorry Park neighborhoods. The sanitation component supported the construction or rehabilitation of public sanitation facilities at markets. The solid waste component provided for the construction of the Dompoase landfill. The landfill was finalized in 2003, and although publications such as Post (1999) claim that the Dompoase landfill has an expected lifetime of 25 years, the KMA's WMD informs that the expected lifetime is 15 years, hence the remaining lifetime is nine years, rather than 18. USEP also financed construction of sanitation facilities at primary and junior secondary schools.

In 2004, the World Bank Board approved an IDA credit of $62 million to support the Second Urban Environmental Sanitation Project in Ghana (UESP II).[27] The objectives of UESP II are to further improve storm drainage, as well as household and public sanitation facilities and solid waste management. Community infrastructure upgrades, and institutional strengthening for environmental sanitation, are also included in UESP II.

In 2006, to alleviate problems affecting water supply, such as low power voltage, the Dutch Government contributed €37 million ($50 million)[28] to expand water production in Kumasi. The total amount consisted of a grant from the Dutch government and loans contracted by the Ghana government from commercial banks in the Netherlands. The project involved the rehabilitation and expansion of the Barekese and Owabi head-works as well as the construction of an additional 90 kilometers of distribution lines in Kumasi metropolis and its peri-urban areas. The funds were used to purchase filters, lift pumps and clarifiers and to build booster stations.[29]

In 2007, the Oforikrom Water and Sanitation (OWAS) project targeted five low-income urban and peri-urban communities in Southeast Kumasi.[30] The objectives of the projects were to improve sanitation and hygiene education and to provide piped water to 108,000 inhabitants. Prior to the OWAS project, residents relied on distant community toilets and water vendors. The project reduced by 200 meters the distance community members had to travel to community toilets and lowered by five percent the monthly expenditures on water.

3.3. Costing Model

This study uses a needs assessment tool developed by the UN Millennium to estimate financial resources needed to achieve water and sanitation targets at the sub-national level. This Excel-based needs assessment tool relies on coverage targets and unit costs.[31] Data on water and sanitation coverage in 2000 are derived from the Population and Housing Census, while 2008 baseline data is derived from Ghana Water Company Limited/Aqua Vitens Rand Limited (GWCL/AVRL) and

[27] http://allafrica.com/stories/201007230662.html
[28] Using $1= €1.35 exchange rate.
[29] http://www.ghanaweb.com/GhanaHomePage/NewsArchive/artikel.php?ID=177728
[30] The communities included Oforikrom, Adukrom, Akorem, Kotei and Gyenyase.
[31] The model was initially developed by the United Nations Millennium Project, now administered by the United Nations Development Programme (UNDP), and applied here for the first time in a municipal context

the KMA Waste Management Department (WMD). Water unit costs were obtained from GWCL/AVRL and sanitation unit costs were obtained from the KMA WMD and a 2004 water and sanitation MDGs country assessment compiled by the World Bank and the African Development Bank.

Improved water sources or technologies identified by MCI as appropriate for Kumasi include:[32]

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

It should be noted that the policy of the Government of Ghana is to phase out public taps. However, given that some people still rely on this water source, it is included in the scenarios presented in this needs assessment.

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

1. Water closet (flush toilet) connected to a septic tank or the public sewerage.
2. Kumasi Ventilated improved pit latrine (KVIP).
3. Communal latrine.

Table 9. Sanitation Coverage in Kumasi (2000 & 2008)

	2000	2008
KVIP, Pit Latrine	21.3	10
WC (septic tank)	27.3	25
WC (simplified sewerage)	0.8	8
Public latrines	36.8	38
Communal (Shared) latrines	5.6	1
Pan latrines/bucket	5.3	12
Other (no access)	2.9	6
Total	100	100

Source: Ghana Statistical Service (2005); KMA (2008)

Unit Costs

The water unit costs were obtained from GWCL/AVRL officials. Sanitation unit costs were derived from KMA WMD officials as well as a 2004 World Bank/Africa Development Bank (WB/AFD) country assessment report. According to the KMA WMD, the unit cost for a two-seater pour flush toilet is GH¢ 4,000 ($2,759). This cost includes the super structure, the water closet and the cost of labor. MCI proposes that half the cost of this type of toilet should be financed by a grant and half by households. Moreover, we use the cost of a two-seater, three pit KVIP as a proxy unit cost for a communal toilet serving approximately 10 households. This includes cost for materials and labor.

Water and sanitation unit costs used in the costing model are shown in Table 10.

[32] This list of interventions is presented as a reference and should not be viewed as an exhaustive set of options.

Table 10. Select Unit Costs Used in the Costing Model

Water	GH¢	$	Source
Household Connection (Private)	200	138	GWCL/AVRL
Household Connection (Yard)	210	145	GWCL/AVRL
Public Tap	755	521	GWCL/AVRL
Rainwater Harvesting	43.5	30	Author
Sanitation Facilities			
Kumasi Ventilated Improved Pit Latrine (KVIP)- one seater	2500	1724	KMA WMD
Water Closet	4000	2759	KMA WMD
Septic Tank	4000	2759	KMA WMD
Public Toilet	5800	4000	WB/ADB (2004)
Communal Toilet (two seater, 3 pit KVIP)	3500	2414	KMA WMD
Sewer Connection	145	100	WB/ADB (2004)

Source: GWCL/AVRL and KMA WMD

3.4. Results of the Costing Model

To identify the financial resources required to meet 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 2010 and 2015; hence, a linear scale-up path has been chosen. The underlying assumptions with regard to water supply and sanitation are as follows:

- 66.2 percent of Kumasi residents had access to piped water in 2000, and 80 percent had access in 2008. The goal is to increase coverage to 90 percent by 2015.
- Public toilets are not considered as "improved" sanitation facilities, but we assume that communal toilets are improved sanitation facilities. As a result, 49 percent of Kumasi's population had access to sanitation in 2000 and 44 percent had access in 2008. Sanitation coverage needs to increase from 44 percent in 2008 to 75 percent in 2015.
- Three households share a household tap water connection in a yard and a public tap serves approximately 13 households.
- Public latrines are designed for an average of 50 households per latrine,[33] while each communal latrine serves about 10 households.
- 10 percent of WC and KVIP toilets, and 30 percent of public toilets, are defective. The cost of rehabilitating WC and KVIP is 5 percent of the capital cost.
- As recommended by Lenton and Wright (2004), the annual operating and maintenance cost for water and sanitation facilities is 5 percent of the capital cost, but the rehabilitation cost is 15 percent of capital cost.
- 60 percent of the water and sanitation budgets is devoted to operational costs.
- The cost for primary and secondary wastewater treatment is taken into account, but the cost of tertiary treatment is assumed to be borne by the private sector.

[33] Amu-Mensah et al (2008).

Based on these assumptions, the average annual per capita cost to meet the MDG water and sanitation targets between 2010 and 2015 is $13. This is mainly due to the high capital costs for sanitation. The supplementary intervention is the cost for three Lexmark T650dn printer which can be purchased locally at GH¢ 2,900 ($2,000) each. GWCL/AVRL needs these printers to improve billing.

Table 11. Baseline Model

Baseline Scenario Costs (USD)							
	2010	2011	2012	2013	2014	2015	Average
Water	2,711,209	2,906,874	3,114,804	3,335,677	3,570,206	3,819,142	3,242,985
Sanitation	14,395,005	15,056,564	15,749,133	16,419,668	17,153,203	17,990,429	16,127,334
Hygiene Education	50,285	56,791	63,808	68,164	72,069	76,370	64,581
Hospitals	17,620	17,620	17,620	17,620	17,620	17,620	17,620
Human Resources	3,880,345	3,880,345	3,880,345	3,880,345	3,880,345	3,880,345	3,880,345
Supplementary Intervention		6,000					
Total	21,167,384	22,053,538	22,972,465	23,886,672	24,878,171	25,989,301	23,491,255
Per capita	13	13	13	13	13	13	13

Alternative scenario

In the Alternative scenario, public toilets are considered to be improved sanitation facilities. In addition to the assumptions about O&M and rehabilitation costs outlined in the Baseline scenario, the underlying assumptions in the Alternative scenario are as follows:

- The 2015 sanitation coverage target is 88 percent, and 44 percent of the toilets are public or shared toilets. Furthermore, whereas 25 percent of toilets are water closets in 2008, by 2015 only 18 percent of toilets are water closets.
- The unit costs of public and shared toilets goes down because of economies of scale.

The average annual per capita costs in the Alternative scenario for the 2010-2015 period is $11 per capita, as shown in Table 12.

Table 12. Alternative scenario

Alternative Scenario Costs (USD)							
	2010	2011	2012	2013	2014	2015	Average
Water	2,711,209	2,906,874	3,114,804	3,335,677	3,570,206	3,819,142	3,242,985
Sanitation	14,226,833	14,831,041	15,453,296	16,093,901	16,753,155	17,431,344	15,798,262
Wastewater Treatment	112,921	129,345	146,755	165,200	184,729	205,395	157,391
Hygiene Education	21,720	22,396	23,093	23,811	24,552	25,316	23,481
Hospitals	2,556	4,416	3,519	3,519	3,519	3,519	3,508
Human Resources	3,880,345	3,880,345	3,880,345	3,880,345	3,880,345	3,880,345	3,880,345
Supplementary Intervention		6,000					
Total	17,072,682	17,889,656	18,737,947	19,618,589	20,532,642	21,481,196	19,222,119
Per capita	10	11	11	11	11	11	11

IV. CONCLUSION AND RECOMMENDATIONS

For Kumasi 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 drinking water and basic sanitation—the water supply and sanitation infrastructure must be rehabilitated and/or expanded. For Kumasi, this will entail a significant, but not insurmountable estimated cost, of $11-13, depending on the scenario chosen. However, while the internationally agreed JMP definition of access to improved sanitation is a basis for comparing and measuring progress made among countries and regions, if Kumasi abides by this definition, the city cannot meet this target by 2015. An overwhelming number of Kumasi residents still rely on public toilets and although WMD has taken steps to improve public toilets, communal latrines should also be promoted. If the definition is modified to include communal toilets, Kumasi can meet the target within time.

The KMA WMD has significantly improved solid waste collection and successfully conducted a wide range of hygiene education activities. However, since most flush toilets in Kumasi are connected to septic tanks, faecal sludge composting must also be accorded priority. A pilot project recently initiated by WMD and groups like IWMI and SANDEC can serve as a model.

GWCL/AVRL has successfully increased the number of new water connections and expanded delivery. It has also replaced obsolete equipment, repaired leaking pipes and introduced measures to reduce illegal connections and unpaid bills. However, GWCL/AVRL must continue expanding water production to meet the needs of a growing population. With increased urbanization in and surrounding the Kumasi metropolitan area and the concomitant growing threats to water quality, there is a need for a shift in thinking towards improving the efficiency of water use by better managing wastewater. Water re-use is a cost-effective option for increasing the city's water supply. For instance, treated wastewater, as well as collected rainwater could be used to flush toilets.

Access to safe water and adequate sanitation is clearly essential to good health; it is also critical for the attainment of the MDGs in education and gender, MDGs 2 and 3, respectively. Providing piped water to Kumasi residents, for instance, has the potential to reduce the time spent on such household chores as collecting water, particularly for women, who might otherwise be engaged in other income-generating or family-related activities, and for girls, whose fulfillment of such obligations is frequently given as a reason for their not being in school. Building safe sanitation facilities and ensuring adequate solid waste management can reduce the number of water-borne illnesses and unnecessary deaths. A significant number of under-five deaths can be attributed to diarrhea and other water-borne illnesses, including trachoma, cholera, typhoid, hookworm and roundworm, all of which can be prevented by providing clean water and scaling up hygiene education. The socio-economic costs of not investing in sanitation and water, according to the international NGO WaterAid, are significant, particularly factoring in the lost work days and missed school (WaterAid, 2008).

Moreover, the KMA should consider creating sanitation courts capable of speedily adjudicating those who pollute surface water sources. This would entail hiring judges as well as sanitation monitors and inspectors to enforce existing laws and ordinances.

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APPENDIX 1. MONTHLY WATER PRODUCTION IN 2006 & 2009

		2006		2009	
		Owabi	**Barekese**	**Owabi**	**Barekese**
Month		Production (m^3)	Production (m^3)	Production (m^3)	Production (m^3)
Jan	Raw Water Total	350,771	2,359,698	347,356	1,605,278
	Treated Water Total	339,830	2,174,000	331,070	1,502,000
Feb	Raw Water Total	340,132	1,876,962	284,216	1,460,614
	Treated Water Total	315,870	1,686,000	270,960	1,360,000
Mar	Raw Water Total	365,106	2,029,845	281,736	1,636,382
	Treated Water Total	353,870	1,841,000	269,880	1,530,000
Apr	Raw Water Total	329,183	1,947,898	269,038	1,482,550
	Treated Water Total	312,710	1,758,000	258,660	1,390,000
May	Raw Water Total	364,616	2,076,947	218,951	1,543,628
	Treated Water Total	347,330	1,949,000	209,420	1,447,168
Jun	Raw Water Total	357,368	1,895,797	290,055	1,489,913
	Treated Water Total	332,560	1,706,000	279,150	1,393,184
Jul	Raw Water Total	360,620	1,982,737	318,968	1,447,368
	Treated Water Total	341,720	1,877,000	305,490	1,343,112
Aug	Raw Water Total	366,716	2,247,913	348,059	1,451,120
	Treated Water Total	360,310	2,072,000	335,870	1,349,528
Sep	Raw Water Total	295,404	2,194,509	365,105	1,604,144
	Treated Water Total	288,100	2,019,000	353,880	1,498,808
Oct	Raw Water Total	264,166	2,209,835	323,088	1,710,947
	Treated Water Total	258,090	2,067,000	313,570	1,602,864
Nov	Raw Water Total	289,942	2,196,206	357,440	1,899,472
	Treated Water Total	283,390	2,056,000	346,200	1,798,000
Dec	Raw Water Total	313,315	2,308,589	391,376	2,046,334
	Treated Water Total	306,300	2,176,000	381,500	1,937,000
Annual	**Raw Water Total**	**3,997,338**	**25,326,936**	**3,795,388**	**19,377,750**
	Treated Water Total	**3,840,080**	**23,381,000**	**3,655,650**	**18,151,664**

Source: GWCL/AVRL

Note: the production shortfall in 2009 at Barekese and Owabi was mainly due to power failures

APPENDIX 2. SANITATION BUDGET FOR 2008

Sanitation Budget for 2008				
Category	**Number**	**Salary/Month (GH¢)**	**Total/Annum (GH¢)**	**Total/Annum ($)**
Labourers	80	80	76,800	52,966
Mechanics	30	100	36,000	24,828
Supervisors	30	300	108,000	74,483
Engineers	10	500	60,000	41,379
Total Salaries/Annum			**280,800**	**193,655**
Tools requirement/Annum			30,000	20,690
Equipment maintenance/annum			10,000	6,897
Total of salaries, equipment. Maintenance and tools			320,000	220,690
MANAGING WASTE				
Collection: 1,200 tons a day @GHc9.00 per ton *365 days			3,942,000	2,718,621
Disposal: 900 tons a day @ GHc7.20 per ton *365 days			2,365,200	1,631,172
Total:			6,628,000	4,571,034
10% contingency			662,800	457,103
Grand Total:			**7,290,800**	**5,028,138**

Source: KMA WMD