SWITCH

SIXTH FRAMEWORK PROGRAMME

Towards integrated urban water management in the Greater Accra Metropolitan Area

Current status and strategic directions for the future

Marieke Adank, Bertha Darteh, Patrick Moriarty
Henrietta Osei - Tutu, David Assan, Daan van Rooijen

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IWMI International Water Management Institute

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Executive summary

Accra is the administrative, political and commercial capital of Ghana. Providing water and sanitation services to all in a fast growing, largely unplanned city like Accra and managing water in an efficient and integrated way, is a huge challenge. This document presents the results of the contribution of the SWITCH project to the development of a strategic plan for integrated urban water management for the city of Accra to address this challenge. This takes the form of the definition of a vision for water management and water related services in the city of Accra of the future, a comprehensive situational analysis, and strategic directions for going from the current situation towards the vision.

The city of Accra and its population

The city of Accra, the capital city of Ghana, used to be synonymous with the Accra Metropolitan Area. However, in the last two decades, the city has sprawled beyond these boundaries. Today, the city of Accra covers an area generally referred to as the Greater Accra Metropolitan Area (GAMA), consisting of the Accra Metropolitan Area (AMA); the Ledzekuku-Krowor Municipal Area; the Tema Metropolitan Area (TMA) ; the Ashaiman Municipal Area; the Adenta Municipal Area; the Ga East Municipal Area; the Ga West Municipal Area; and the Ga South Municipal Area.

In the year 2000, the population of this area was 2.7 million inhabitants. Taking into consideration different growth rate scenarios, the 2007 population of the Greater Accra Metropolitan Area (GAMA) can be estimated to be between 3.4 million and 3.9 million people. Considering these different growth scenarios, estimates for the 2030 population of GAMA range between 7.3 million and 16.3 million inhabitants. Infrastructural development within the city has to a large extent taken place in an unplanned way. Within Accra, a number of different types of social-economic zones can be identified. High density indigenous areas are mainly located along the coast, while high density low class areas are more scattered over the Greater Accra Metropolitan area. Middle density indigenous areas can mainly be found in the older residential areas within the AMA area, middle density middle class areas in central Accra and in the Ga and TMA areas and low density high class areas can mainly be found in eastern AMA, but also in some Ga areas and TMA. The majority of the population (54 percent) of GAMA lives in compound houses and many households rent (46 percent) rather than own the house they live in.

Vision and scenarios

Accra City Stakeholders, brought together in the Accra Learning Alliance, have defined an integrated urban water management vision for Accra 2030 as follows:

- There will be 100 percent access to uninterrupted water supply
- Water quality will meet Ghana Standard Board criteria
- Non revenue water (due to physical and commercial losses) in the GWCL system will amount to 20-25 percent
- There will be improved productive uses of water for livelihoods (micro enterprises and agriculture)
- 80 percent of Accra's citizens will practise good sanitation behaviours and willingly pay for waste management. This will have led to a 70 percent reduction in water and sanitation diseases
- At least 80 percent of Accra's citizens will have access to an acceptable level of sanitation facilities

- Integrated solid waste management (collection, transport treatment and final disposal) of solid waste in a sustainable way. Collection of solid waste will be 90 percent. Accra will separate its solid waste
- Accra will be a cleaner city with good drainage systems

To aid in the identification of robust strategies to achieve this vision, a number of narrative scenarios of possible future trends in water resource availability, population growth and demand and governance have been developed.

The scenarios have been defined as follows:

Worst case scenario
Accra in 2030 is a depressing, chaotic and crisis prone town, with a population of more than four times its 2007 level and a water demands almost six times higher than the actual capacity of the water supply system in 2007. Lack of effective political leadership, coupled with poor economic performance and severe poverty mean a lack of ability to tackle deep-seated problems of under-investment and poor management of water supply and sanitation infrastructure. These problems are made worse by lack of raw water resources due to increased competition and a reduction in river flows.

Medium case scenario:
Accra has grown to almost three times the population in 2007, fueled in part by strong economic performance based on oil wealth. This has led to sharply increased demand for water. This demand is augmented by the rapid growth in the tourism and manufacturing sectors. However, while rapid, this growth has not been chaotic – due in large part to the marked improvement in political culture and related enforcement of planning laws and other regulations. Climate change (and competition for water from outside the city) has led to a modest reduction in overall water resource availability, which together with the strong growth in demand (four times what it was in 2007), presents major challenges. These are compounded by lack of access to finances and land for new infrastructure. However, improved management and capacities within both the utility (GWCL) and local government, new technological options and engaged and empowered citizens inspire confidence that solutions will be found.

Best case scenario:
Accra in 2030 is in many ways a blessed city. Contrary to the fears of many in the early 2000s, the city's population growth, while large, has been manageable (2.2 times 2007 levels). The frequent power shortages of the early 2000s are only a distant memory. A sharply improved political culture has led to improvements in enforcement of planning laws, whilst policy is seen as progressive. This, coupled with strong economic growth (partly driven by increasing oil wealth), has led to marked improvements in citizens willingness and ability to pay for water and sanitation services. Water demands have increased because of steady population growth and economic growth (three times as high as the capacity of the system in 2007). Challenges do exist. Overall water resource availability is reduced. It continues to be difficult to source the necessary financing to upgrade the city's infrastructure and access to land for waste processing facilities and new networks is a constant problem. Nevertheless, there is guarded optimism about the ability of the city to deal with these problems.

Water resources
Water resources in and for Accra include rainwater (average annual rainfall is about 756 mm with the main rainy period from March to July and a smaller rainy period from September to October), ground

water resources (with an estimated total recharge of about 0.038 km^3/year) and surface water resources.

The population of Accra is to a large extent dependent on surface water for its water supply, which is imported from sources that lie outside the boundaries of the city: the Weija Lake on the Densu River and the Volta Lake on the Volta River, further afield from the city. The optimal safe yield from the Weija Lake is about 0.10 km^3/year. With an average annual discharge of about 43 km^3/year, the potential yield from the Volta is determined by the capacity of the intake and treatment infrastructure, rather than by the availability of water resources, even when considering a potential drop in river flow caused by climate change and increased use of water upstream in the basin.

Ground water is to a large extent too saline to be used for consumption, especially near the coast. The water quality of rivers and lagoons within the GAMA is below WHO and Ghana EPA standards, especially in the Odaw and the Korle lagoon.

Water supply services

A variety of water service delivery models can be identified in the Greater Accra Metropolitan Area with different sources of water providing different levels of water services. These include utility water supply services, private (intermediary and independent) water supply services and community managed water supply services. Households can rely on a mix of different service delivery models for their water supply.

The main source of water for AMA and TMA is the utility system, which produces almost 365,000 m^3 per day, about 99 percent of all water produced in GAMA. Although the utility, the Ghana Water Company Limited (GWCL) produces most of the water that is used in the Greater Accra Metropolitan Area, only about 51 percent of the population has direct access to utility water supply services. The rest depend on private and community service providers, many of whom get their water from the GWCL system, either directly (through a connection to the network) or indirectly (e.g. through tanker services). There is a variety of alternative service providers. Each provides different services in different areas at different costs per unit water, which are considerably higher than the costs per unit water charged for water supplied through household connections. A number of communities on the fringes of Accra are being served by systems independent from the utility system, including community-managed small town piped water supply systems implemented by the Community Water and Sanitation Agency (CWSA), and privately-operated and managed water supply kiosks, like the WaterHealth Centres which can be found in the northwest of Accra.

Challenges related to water supply in Accra are:

- The water demand is higher than the supply:
  The amount of water produced was between 71 percent and 81 percent of the water demand in 2007, which was estimated to be between 450,000 and 500,000 m^3 per day. The GWCL head works are working under their capacity (for the Kpong system, production was 88 percent of the capacity in 2007, while this was 83 percent for the Weija system). In the longer term, water demand is projected to increase considerably due to population and economic growth to somewhere between almost one million and 2,400,000 m^3 per day. Therefore, the capacity of the system(s) supplying water to GAMA will have to be substantially increased.
- The amount of non-revenue water in the GWCL system is very high:
  Non-revenue water amounted in 2007 to about 60 percent of the amount of water produced. This was both due to physical losses (27 percent of the amount of water produced), as well as economic losses (33 percent of the amount of water produced). Physical losses in the system are

caused by the bad state of the distribution infrastructure, aggravated by the limited leakage detection system. The bad state of the distribution infrastructure can be attributed to lack of maintenance, replacement and rehabilitation. This is likely to be (partly) caused by lack of financial resources available to GWCL because of high commercial losses, uneconomical tariffs and lack of investment by government and external donors in maintenance, replacement and rehabilitation. Causes of the commercial losses include inaccurate recording of customer meters, inaccurate data recording, estimation and use of flat rate water rates, ineffective revenue collection procedures and illegal consumption and connections. Illegal connections and consumption are influenced by a number of underlying factors. People struggle to get connected due to complicated procedures and legal boundaries. In order to get connected, proof of ownership has to be submitted to the utility. People living in rented houses, which is the majority of the GAMA population, are unable to do so and are therefore unable to connect. In addition, the connection costs are relatively high.

- The reliability of the GWCL system is very low:
  This is caused by unreliable electricity supply, lack of storage capacity in the distribution system and the fact that demand is higher than supply, resulting in rationing of the water supply. Reasons for the low supply are diverse. They include low system capacity, high physical losses in the distribution system, the stealing of water and the presence of in-line booster pumps which, according to GWCL/AVRL, disrupt the distribution of water in the system.
- A large part of the GAMA population depend on expensive alternative service providers:
  Because of the legal and financial barriers faced by the poor, it is mostly the wealthier strata of the population that is connected to the GWCL network, which enables them to profit from the considerably lower rates per unit of water than people who are not able to connect. The majority of people in the Greater Accra Metropolitan Area, especially the poor, depend on alternative water service providers. Rates charged by these alternative water providers are higher than the GWCL tariff. This is (partly) due to the extra costs the alternative service providers have to make in order to provide the service. Prices and quality of water provided by the alternative service providers is not regulated, as alternative providers are not formally recognised, registered and regulated.

In order to overcome these challenges, the following strategic directions have been explored by the Accra Learning Alliance:

- Decreasing demand though education, incentives, by-laws and possibly through tariff adjustments
- Improving GWCL water supply services:
  - Creating addition system capacity by expanding the treatment capacity of the GWCL system and exploring additional sources of raw water
  - Decreasing physical losses through rehabilitation of the distribution system, better operation and maintenance and active leakage detection, including bulk metering
  - Increasing GWCL revenues, through decreasing commercial losses (by further investments in customer meters and their ongoing maintenance, improvement of the billing management system, community awareness raising and education and active monitoring of the distribution system) and possibly through increasing the tariff
  - Improving access to GWCL system through innovative approaches for connecting the poor and acknowledging alternative approaches to providing water to people who are not able to connect to the GWCL directly, like standpipes and community-managed bulk water supply

- Lowering water prices for low income households, through special consideration in the water tariff for compound housing and recognition, registration and regulation of alternative service providers
- Improving access to water services for communities and households outside the reach of the GWCL network, though independent privately managed systems, community managed systems and self-supply (e.g. rainwater harvesting)

Excreta and wastewater services

Different sanitation service delivery models can be identified in the Greater Accra Metropolitan Area. Sanitation service providers can be broadly grouped into three categories: municipal service providers, private service providers and self-supply. The municipal providers include septic emptiers, servicing both private WCs as well as public facilities; the sewer system, with household and institutional connected WCs; and human waste transfer stations where human waste from pan and bucket latrines is collected. There are also private sector septic emptiers, servicing the same target group as the municipal septic emptiers. Finally, a number of people and institutions provide their own sanitation services. These include institutional sewer systems and on-site treatment sanitation facilities like pit latrines and KVIPs.

The main challenges related to sanitation in Accra can be summarised as:

- The vast majority of the waste treatment plants are not working:
  The two central sewer systems are not operational and of the 35 institutional treatment plants, only four are functioning. Most wastewater is disposed of in soak-away storm drains and by throwing it into the street or compound. Part of this water infiltrates and joins the groundwater resources and part flows to the sea through the storm drainage system. Most of this flows untreated into the ocean.
- There is a lack of treatment capacity:
  Even if fully functional, the current (2007) capacity for liquid waste treatment is far below the estimated wastewater production - only about 17 percent of the estimated amount of wastewater produced. As more water is supplied to the city, the production of wastewater will rise as well, increasing the need for safe collection, treatment and disposal of wastewater.
- The lack of use of safe and hygienic sanitation facilities:
  Although according to official statistics the percentage of people who practice open defecation or use unhygienic bucket or pan latrines is very low (4.3 percent), the presence of rubber bags containing human excreta, especially in the densely populated areas, seems to suggest that there still is a problem in this area. An important reason for people not using hygienic sanitation facilities is the fact that these facilities are not available in the house, because of lack of space, lack of willingness of landlords to provide sanitation facilities and /or lack of awareness and urgency. Public facilities are often not used because these are too far away, too filthy and/ or too time consuming to use, because of long queues.
- Many people depend on public sanitation facilities, paying more for access to lower level services than people with access to private sanitation services:
  Low income households generally do not have the space and resources to install a septic tank or (K)VIP. The level of sanitation services provided by the public latrines service varies but is generally low. The number of public latrines is too small to serve the estimated 1.5 million people depending on these facilities, leading to long queues during the early morning and evening rush hours. The abolishment of pan and bucket latrines will increase the pressure on the public latrines. In addition to the problem of long queues to access the facilities, the sanitary

condition of public toilets is generally poor. As with water supply, people connected to the central system pay less than people who are not connected. However, the number of people connected to the sewer system is extremely small.

To overcome these challenges, the Accra Learning Alliance explored the following strategic directions:

- Improving access to private sanitation facilities, which can be done through the enforcement of by-laws for the construction of household latrines, the facilitation of appropriate technology choice and awareness creation and education
- Improving public latrine services by increasing the number of public latrines, ensuring adequate water supply to public latrines and improving the management of public latrines
- Increasing the treatment capacity. Under the Accra sewerage improvement project, there are plans to extend the sewer system. However, even when fully successful, the impact of this intervention will be relatively small. Therefore, additional strategies are needed like securing, acquiring and maintaining sludge treatment sites; rehabilitating existing ones; and using natural systems
- Improving the use of existing treatment capacity by increasing the number of connections to the sewer system and by building the capacity of the sewerage unit staff.

Storm water drainage

Most of the drainage of storm water takes place though natural drains. In addition to the storm water, the storm drains handle a large part of the (grey) wastewater. The current capacity of these drains is not sufficient to handle the storm water, which leads to frequent flooding of certain areas within GAMA. Discharge through the storm drains is limited due to erosion, siltation and the collection of solid waste in drains. None of the drains in the Densu and Mokwe basin are lined and in the other basins, only part of the drains are lined or otherwise improved, like the Odaw drain.

The Greater Accra Metropolitan Area is developing and expanding. This development will result in increased 'sealing' of the soils in the upstream parts of the urban catchments. The loss of permeability will result in an increase in storm water flows in the southern part of the city, which is likely to increase the flooding frequency and the subsequent damage to infrastructure, the economy and will endanger human lives. The development of new urbanised areas in the northern part of the city in the coming years is likely to also result in an increase in grey and black wastewater generation. As large areas of the Greater Metropolitan Area become urbanised, urban farmers will find it more and more difficult to find land in the city to satisfy the city's demand for fresh vegetables.

The Accra Learning Alliance explored the following strategic directions to address these challanges:

- Improving storm water discharge by improving and maintaining the storm water drainage system and by ensuring drains do not become clogged by solid waste
- Reducing surface water run-off by applying Sustainable Urban Drainage Systems, developing and maintaining a green belt around the current built up area, where urban agriculture can be practiced and by promoting rainwater harvesting

Institutional coordination and planning

Institutionally the sector is fragmented, with overlapping areas of responsibility. There is poor-to-no enforcement of existing (planning) regulations and lack of frameworks for integrated planning.

In order to improve this situation, the Accra Learning Alliance suggested the following:

- Facilitation of a ‘Greater Accra Metropolitan Area (GAMA) Integrated Urban Water Management Planning and Coordination Platform’ for city wide planning alignment and development of water and sanitation services
- Resolution of ambiguities regarding the respective roles of the municipalities and Ghana Water Company Limited in providing water services
- Resolution of ambiguities on responsibilities for drainage
- Resolution of ambiguities regarding responsibilities for wastewater management at the local authority (Metro/Municipal Authority) level

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List of abbreviations

ADB	African Development Bank
AFD	Agence Française de Développement
AMA	Accra Metropolitan Assembly
ASIP	Accra Sewerage Improvement Project
ATMA	Accra Tema Metropolitan Area
AVRL	Aqua Vitens Rand Limited
AWP	Accra Waste Plant
CWSA	Community Water and Sanitation Agency
DRWH	Domestic Rainwater Harvesting
EPA	Environmental Protection Agency
ET	Evapotranspiration
GAMA	Greater Accra Metropolitan Area
GH¢	Ghana cedi
GSS	Ghana Statistical Services
GWCL	Ghana Water Company Limited
HSD	Hydrological Services Department
IRC	International Water and Sanitation Centre
IUWM	Integrated Urban Water Management
IWMI	International Water Management Institute
KNUST	Kwame Nkrumah University of Science and Technology
lpcd	Litre per capita per day
masl	Metre above sea level
MDG	Millennium Development Goals
PURC	Public Utility Regulatory Committee

RIDA	Resources, Infrastructure, Demand and Access
RCN	Resource Centre Network Ghana
SIP	Strategic Investment Plan
STP	Sewage Treatment Plant
SWITCH	Sustainable Water Improves Tomorrow's cities' Health
USD	United States Dollar
WHO	World Health Organisation
WMD	Waste Management Department
WD-MWRWH	Water Directorate of the Ministry of Water Resources, Works and Housing of Ghana

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1 Introduction

Accra is the administrative, political and commercial capital of Ghana. It is the largest and fastest growing metropolis in Ghana. In addition to its residential population, Accra has a large fluctuating migrant population who come to trade or work for part of the year.

The city has been struggling to keep up with the booming population growth. Providing water and sanitation services to all in a fast growing, largely unplanned city like Accra is a huge challenge. A large part of the population is not connected the central water supply network and only a very small part is connected to the city central sewerage system. Also, many areas in Accra are prone to frequent floods, partially caused by the blockage of storm water drains by solid waste. The institutional framework is fragmented and ill-equipped to deal with the ever increasing complexity of managing urban water in Accra. While there are various plans and planning processes relating to different aspects of water management and sanitation within Accra, responsibilities are fragmented. The action of the various agencies responsible are not well coordinated, and often planners and operators are hampered by limited access to accurate data on key aspects to inform their planning, decision making and the monitoring of progress towards objectives.

In view of this, the SWITCH Project, through research and with the support of its Learning Alliance, explores options that will contribute to addressing these challenges to Integrated Urban Water Management and the provision of sustainable and affordable water and sanitation services to all in Accra. SWITCH is a large-scale EU research project that aims to promote a paradigm shift to achieve integrated urban water management - away from existing ad hoc solutions and towards a more coherent and integrated approach. The SWITCH project is made up of 33 partners from 15 countries. The project seeks to develop innovative and sustainable urban water management approaches, technologies and financing mechanisms. This is being implemented by the various partners through a combination of Research & Technological Development, Training and Demonstration activities within a Learning Alliance framework[1]. Accra is the only sub-Saharan African city among the SWITCH demonstration cities around the world.

Within this framework, SWITCH supports the development of a strategic plan for better and more integrated water management and service delivery in the city of Accra. Since different elements of the urban water cycle are closely interlinked, as illustrated by the figure below, this strategic plan should cover all elements of the urban water cycle, rather than focussing on a specific part of the urban water cycle. This document presents the results of the contribution of the SWITCH project to the development of a strategic plan, in the form of the definition of a vision for water management and services in the city of Accra of the future; a comprehensive situational analysis and analysis of future scenarios; and strategic directions for achieving this vision, taking into account the current situation.

1.1 Methodology: The Accra Learning Alliance and the strategic planning process

The support of the SWITCH Project to the development of an integrated strategic plan for water management and service delivery in the city of Accra followed the visioning, scenario building and strategy development methodology, as developed under the EMPOWERS Project (www.empowers.info)

[1] A learning alliance is a multi-stakeholder platform made up of individuals or organisations with a shared interest in innovation aimed at breaking down barriers to information sharing, speeding up the process of uptake of innovation and scaling up of research outputs.

and further developed for urban water management under the SWITCH project (www.switchurbanwater.eu). The first steps towards an integrated strategic plan for water management in the city of Accra were taken during the First Multi-Stakeholder Forum, held in March 2007, when stakeholders developed a draft vision for urban water management in Accra in 2030. The workshop brought together key stakeholders in urban water management such as: policy makers, regulatory agencies, researchers, consumer groups and representatives from local assemblies. Participants included the then mayor of Accra and the Minister of Water Resources, Works and Housing. This formed the basis of the Accra Learning Alliance.

This was followed by a visioning and scenario building workshop in August 2008 at which the vision was refined, the different scenarios of developments outside our sphere of influence were developed and broad strategic directions were proposed.

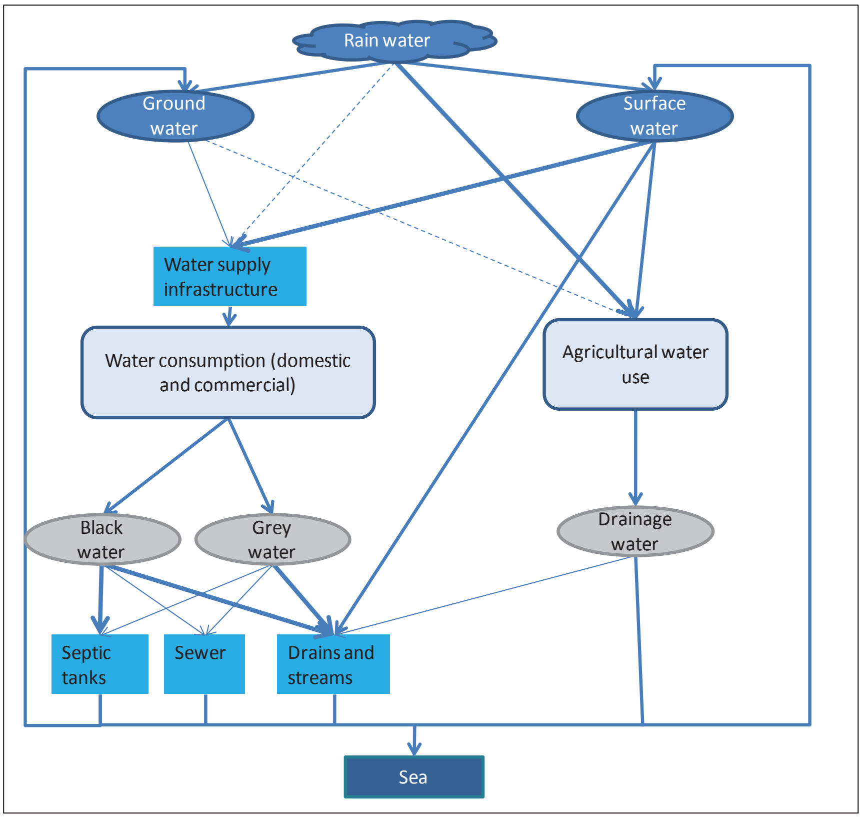


Figure 1: The urban water cycle

During the workshop, lack of information was identified by city-level stakeholders as one of the bottlenecks for the development of an integrated plan for water management in the city of Accra. Therefore, the SWITCH project facilitated a data collection and analysis exercise in between the different workshops. The objective of this exercise was to improve access to data and information and improve communication between and within stakeholder groups. The exercise used a RIDA (Resources, Infrastructure, Demand, and Access) framework for the collection and analysis of data and information. It provided background information for a data and information based strategic planning process for the city of Accra, by collecting, structuring and analysing information on water resources, water related infrastructure, demand for water supply, sanitation and storm water drainage services as well as the actual access to these services in Accra. Data and information were collected though a review of literature, including grey literature, and a number of key stakeholder interviews.

A good start in compiling information was made by the development of the Accra Starter kit, a CD Rom containing data and information about key aspects related to integrated urban water management in Accra, compiled by IWMI and KNUST, under the SWITCH project. The data from the Accra Starter Kit and additional secondary information and data collected from, and with the help of, Accra Learning Alliance members was used to get a comprehensive picture of the current status of water management in the city of Accra and to build realistic scenarios of external factors the city will have to deal with in the years to come. An overview of the sources of data and information used can be found in Annex 1.

In addition to the RIDA analysis, an institutional mapping was done on urban water management in the city of Accra. Both the tentative RIDA and the institutional analysis were presented and discussed at the Accra Learning Alliance workshop in June 2009 and served as input for further discussions on strategic directions during the workshop. The strategic directions were taken further in the November 2009 Accra Learning Alliance meeting and were presented to the National Level Learning Alliance Platform. The strategic directions were finalised during the Accra Learning Alliance workshop on strategy building in January 2010, in which working groups worked on finalising the strategic directions around water supply; excreta and wastewater management; storm water drainage and flood control; and institutional coordination and planning.

This document presents the RIDA analysis with relevant parts of the Institutional Mapping report (Darteh, forthcoming) and the vision, scenarios and strategic directions for improving integrated urban water management and service delivery in the city of Accra, as developed by the Accra Learning Alliance. It intends to stimulate and serve as an input to the further development of an integrated plan for the management of water and the delivery of water related services in the city of Accra.

1.2 Outline of Report

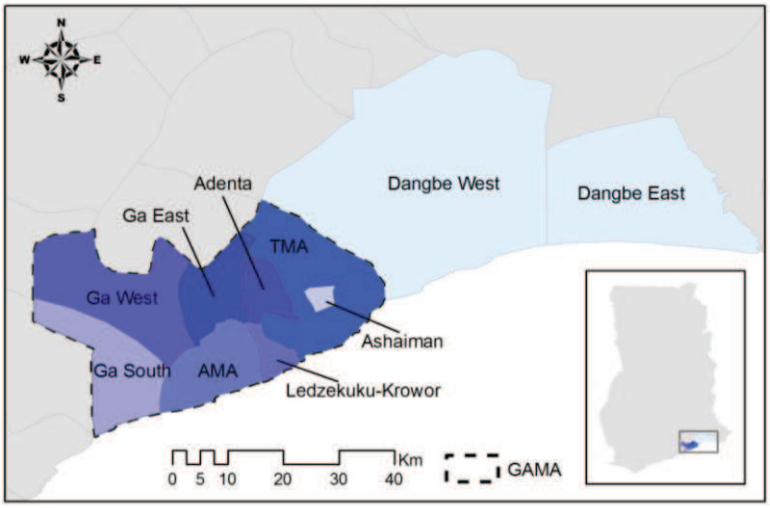
This report contains nine chapters. This first chapter has given the background and purpose of this document and its development. In the chapter that follows, the city of Accra, its institutional set-up and its population are presented. It includes a discussion on how to delineate the Accra urban area to define “the city of Accra” and how this will be used in this document. This is followed by chapter three, in which the vision for the city of Accra, as defined by the Accra Learning Alliance, is presented. This chapter also presents the scenarios which will have to be considered when looking for strategic directions towards achieving the vision. Chapters four, five, six and seven each deal with a specific part of the urban water cycle: water resources (chapter four), water supply (chapter five), excreta and wastewater management (chapter six) and storm water drainage and flood control (chapter seven). Each of these chapters describes the current situation regarding infrastructure, demand for water related services and actual access to these services and the barriers that people, especially the poor, face in accessing these services, including the costs of accessing these services. In addition, these chapters describe the current and future challenges and proposed strategic directions for reaching the vision, addressing the challenges. Chapter eight focuses on planning and coordination of water management in the city of Accra. Finally, chapter nine presents the main conclusions.

2 The city of Accra and its population

This chapter gives an introduction to the city of Accra, the capital of Ghana. In section 2.1, the city of Accra and its development are described. Section 2.2 presents the administrative set-up and in section 2.3 an introduction is given to Accra's population, both in terms of size as well as composition. A summary of the chapter is given in section 2.4.

2.1 Accra and the Greater Accra Metropolitan Area

The city of Accra is located in the Greater Accra Region, which is with 3,245 km^2 (GSS, 2005) the smallest region in Ghana. About 88 percent of the population of the Greater Accra region lives in localities defined as urban (settlements with a population of 5,000 or more) and only 12 percent lives in small rural communities. The region used to be divided into six administrative districts: Accra Metropolis (AMA), Ga West, Ga East, Tema Municipality, Dangme East and Dangme West. Currently, however, as shown in
Figure 2, the Greater Accra Region consists of the following:



- Accra Metropolitan Area (AMA)
- Ledzekuku-Krowor municipality (formerly under AMA)
- Tema Metropolitan Area (TMA)
- Ashaiman municipality (formerly under TMA)
- Adenta municipality (formerly under TMA)
- Ga East municipality
- Ga West municipality
- Ga South municipality (formerly under Ga West)
- Dangme West
- Dangme East

Figure 2: Greater Accra Region, Greater Accra Metropolitan Area (GAMA), and Accra Metropolitan Area (AMA)[2]

Originally, the "City of Accra" covered only the area under the Accra Metropolitan Assembly (AMA), covering an area of about 200 km^2. However, in the last two decades, the city has sprawled beyond these boundaries, as illustrated in Figure 3.It displays the extent of the urbanised areas of Accra in 1985, 1991 and 2002 as well as the extent of the area that is under conversion to urban use in 2002. The maps are based on texture-based classification of Landsat (E)TM satellite images (Yankson et al 2004). As show in the maps, the city of Accra actually covers AMA, as well as parts of Ga West, Ga South, Ga East, Tema Metropolitan Area (TMA), Ashaiman and Adenda.

The report of the fifth round of the Ghana Living Standards Survey (GSS, 2008), defines the Accra Metropolitan Area (AMA), Tema Municipal Area (TMA) (which at that time also covered Ashaiman and

[2] As the boundaries of the newly established districts have not yet been defined officially, the boundaries shown on this map should be considered as approximate boundaries.

Adenta municipality), and the urban areas in Ga East and Ga West (which at that time included Ga South) Districts as the **Greater Accra Metropolitan Area (GAMA)**. Other terms which can be found in reports and literature to describe the same urban area, include “Mega Accra” and “Accra Tema Metropolitan Area” (ATMA).

This document will as much as possible focus on the GAMA area. This area covers a total area of about 1,261 km^2 (Twum, 2002).

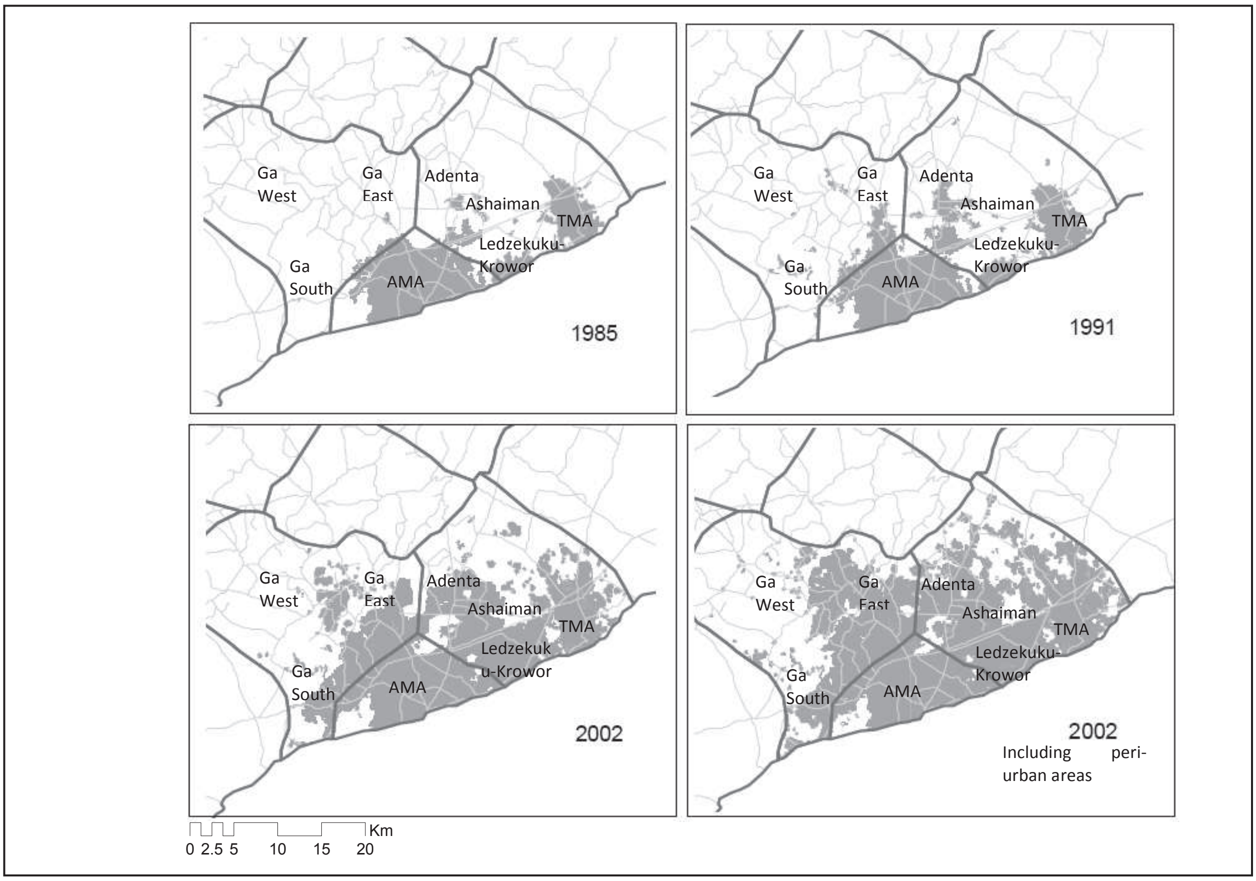


Figure 3: Growth of Accra from 1985 – 2002
Source: Yankson et al, 2004

2.2 Administrative structure

The eight metropolitan and municipal areas that constitute the Greater Accra Metropolitan Area are managed by Assemblies. The Metropolitan and Municipal Assemblies derive their mandate from the Local Government Act of 1993 (Act 462).The structure of these assemblies is also spelt out in the act. By this act, the Assemblies are the highest political authorities mandated to govern a municipality or metropolitan area and to provide basic infrastructure and services to support the social and economic development of the area. The area under the assemblies is sub-divided into sub-metros, which are in turn further divided into town or areas councils and unit committees.

Representatives from the sub-metro structures form the General Assembly. Members of the Assembly are voted from Assembly elections which are held every four years. The general assembly is responsible for making decisions and passing by-laws. This Assembly is chaired by a presiding member while the day-to-day administration is handled by the chief executive (mayor or metropolitan/municipal chief executive), who is also a member of the Assembly.

The Accra Metropolitan Assembly (AMA) was up to mid 2004 divided into six sub-metros. In 2004, the number of sub-metros was increased to 13 by further sub-dividing the original six (Ghana Health Services 2008). In February 2008, two sub-metros, Teshie and Nungua, were split off from AMA and joined to form the Ledzekuku-Krowor municipal (with Teshie-Nungua as the district capital). Currently, AMA consists of 11 sub-metros: Ablekuma Central, Ablekuma North, Ablekuma South, Ashiedu Keteke, Ayawaso Central, Ayawaso East, Ayawaso West-Wuogon, La, Okaikoi North, Okaikoi South, and Osu Klottey.

2.3 Accra's population

The population of the Greater Accra Metropolitan Area was estimated to amount to about 2.7 million inhabitants in the year 2000 on about 1261 km^2 land (Twum-Baah, 2002), which gives a population density of about 2,154 people per km^2.

The projection for population growth of GAMA/ATMA done under the Review and Updating of the Strategic Investment Plan (SIP) of the Ghana Water Company Ltd (GWCL) (TAHAL Group, 2008), does not use administrative boundaries, but areas grouped together into three main groups: Accra, Tema and Accra Rurals. This projection is based on the 2000 population according to the 2000 census (GSS, 2002) and a population growth rates as used by the 1998 GWCL SIP (3.5 percent). As shown in the figure below, this prediction assumes that the main growth will take place in the urban areas of Accra, rather than the more rural areas and the Tema and Ga districts.

However, as illustrated in Figure 3, the population growth of AMA is constrained by its administrative boundary and seems to be concentrated in the more rural Ga and Tema districts. This is confirmed by the GSS 1984-2000 growth rates of these areas, which were estimated to amount to 6.4 percent and 9.2 percent in the Ga and Tema districts respectively, while only 3.4 percent in AMA.

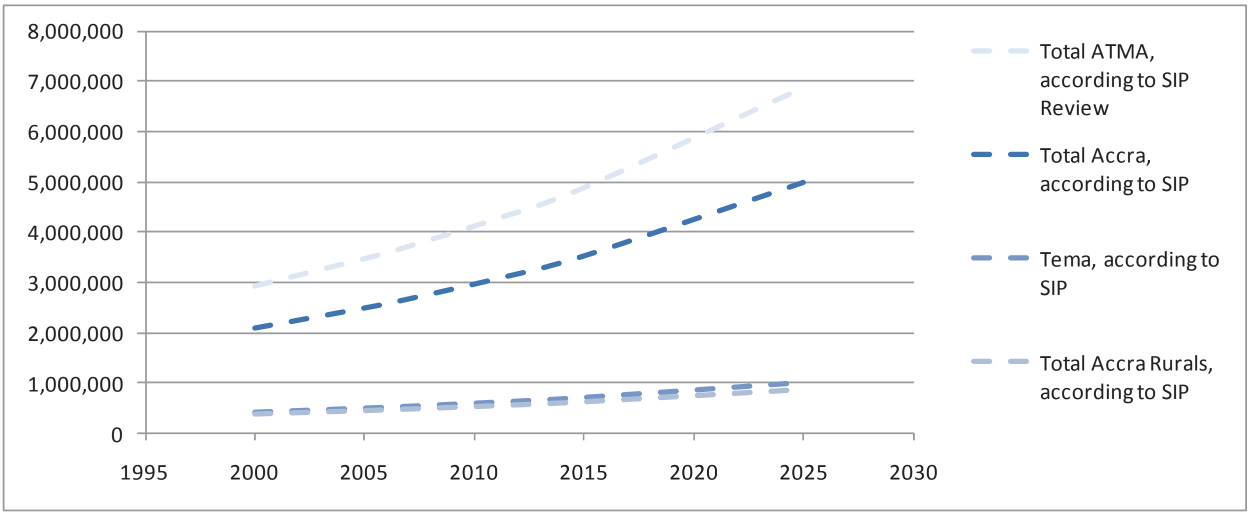


Figure 4: Population growth according to SIP

In order to project population growth from 2000-2030, this document will consider three population growth scenarios in addition to the projection as presented in the 2008 SIP. These scenarios are:

- High growth rate scenario: population growth according to the 1984-2000 growth rates per district[3].
- Medium growth rate scenario: population growth of 4.4 percent per year (based on the 1984-2000 growth rate of Greater Accra)
- Low growth rate scenario: population growth of 3.4 percent per year (based on the 1984-2000 growth rate of AMA)

The figure below shows the projected population growth from 2000 to 2030 according to these different scenarios and according to the 2008 SIP. Details can be found in annex 2.

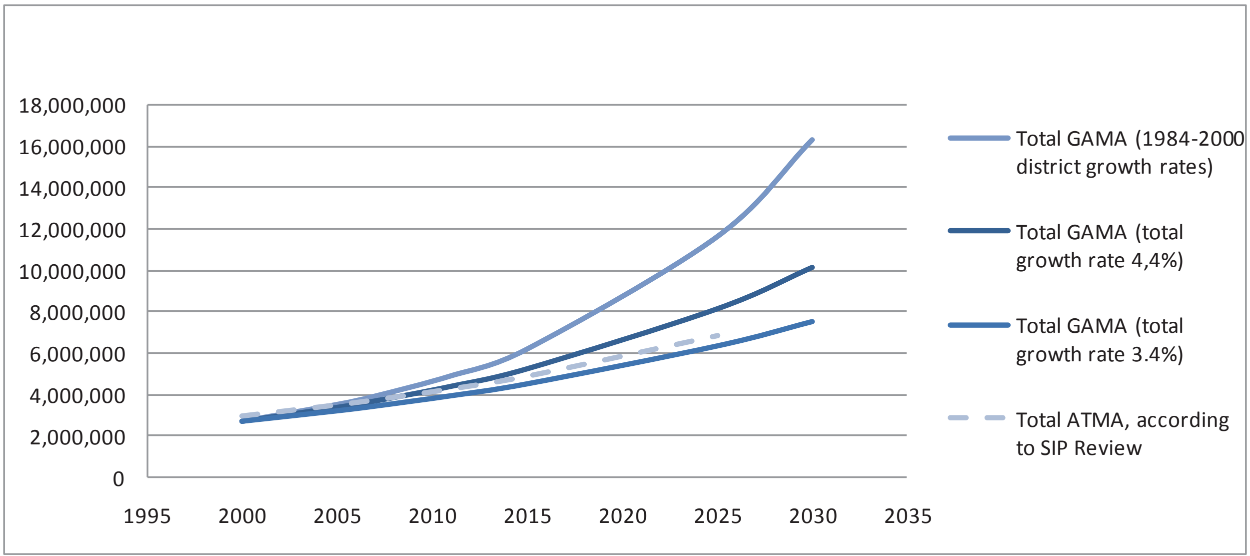


Figure 5: Population of GAMA

According to the high growth rate scenario, the total population of GAMA would be slightly more than 3.9 million people in 2007. Assuming a low growth rate scenario, the population of GAMA would amount to more than 3.4 million people, while it would be almost 3.7 million people, assuming a medium growth rate scenario. The graphs show a wide variation of population size of the GAMA area in 2030, ranging from over about 7.5 million to over 16 million inhabitants. The population of the Greater Accra Metropolitan Area (GAMA) in 2030 might have increased to about 4.2 times the size of the population in 2007 in the high growth rate scenario (16,356,315 inhabitants), to about 2.8 times (10,166,402 inhabitants) in a medium growth rate scenario and to about 2.2 times (7,531,456 inhabitants) in the low case scenario.

With a fertility rate in the region of only 2.9 percent, the high population growth rate in the Greater Accra Region is a mixture of natural increase and rapid migration into the urban parts of the region from all over the country. Many of these migrants are unskilled, moving from rural areas into the city to look for non-existent jobs and ending up in the pool of urban poor (GSS, 2005). In addition to its residential

[3] At the time of writing, the 2010 census was underway way, but results had not yet been published. Therefore, the population data from the 2000 census (GSS 2002) was used for the population projection as presented in this document.

population, Accra has large fluctuating migrant population who come to Accra to trade or work for part of the year.

Within Accra, different types of social-economic zones can be identified, as shown in Figure 6. The map, based on Songsore et al (2005)[4], shows that the main high density indigenous areas are located along the coast. These are mainly traditional fishing villages, like Teshi and James town. The areas classified as high density, low class areas are more scattered over the Greater Accra Metropolitan area. These areas mostly consist of so-called *zongo* areas, like Nima, Sabon Zongo and Madina, where many newcomers, mainly from the northern regions, have settled in their search for a better life in the big city. Obuobie et al, (2006) estimate that up to 60 percent of the population of the city (which they considered as AMA) live in slums and informal settlements. Middle density indigenous areas can mainly be found in the older residential areas within the AMA area, like Adabraka, Mamprobi and Kokomlemle. Middle density middle class areas can mainly be found in central Accra and in the Ga and TMA areas. These include areas like Kaneshie, North Teshie, Dzorwulu and Ashaiman West. The low density, high class areas can mainly be found in Eastern AMA (like cantonments, airport residential area, Kanda), but also in some Ga areas (Macarthy Hill and North Legon) and TMA (Community 12 and Motorway North Estate). It should be noted that the map shows the 'official' qualification of areas. It does not show informal settlement areas such as Old Fadama (also known as Sodom and Gomorrah). As the city is expanding, there is a trend of more and more middle and high income households moving to the peri-urban areas. This has resulted in communities in these areas with a mix of poor and rich households (Sarpong Manu and Abrampah, 2006).

Income levels are relatively high in Accra, with an annual per capita income of almost GH¢564, compared to a national average of almost GH¢400 (GSS, 2008). However, expenditure levels are also high, at GH¢1,106 per capita per year, against a national average of GH¢644.00 (GSS, 2008). The table below presents the absolute and relative number of non-poor, poor and hard core poor people in the Accra Metropolitan Area (AMA). The Ghana Living Standards Survey (GLSS) found that the number of Accra households in poverty increased from 9 percent to 23 percent between 1988 and 1992.

Table 1: Poverty levels by income in AMA

	Population	% of population
Non-poor	1,182,822	73%
Poor (between 25 and 66% of national income)	369,943	23%
Hard core poor (<25% of national income)	61,380	4%
Total population	1,614,145	

Source: based on GoG, 2003

About 82 percent of the population of GAMA is Christian, while about 12 percent is Muslim and 0.8 percent follows other religions. The remaining 6 percent does not follow a specific religion (GSS, 2008).

In AMA, there were 131,355 houses in 2000, according to the 2000 Population and Housing Census (GSS, 2000). The average number of people per house was thus about 12.The majority of the population of GAMA lives in compound houses, with multiple households per dwelling, as can be seen in the Table 2. Table 2 shows that most households rent rather than own their houses.

[4] It should be noted that this is based on data from 2001.

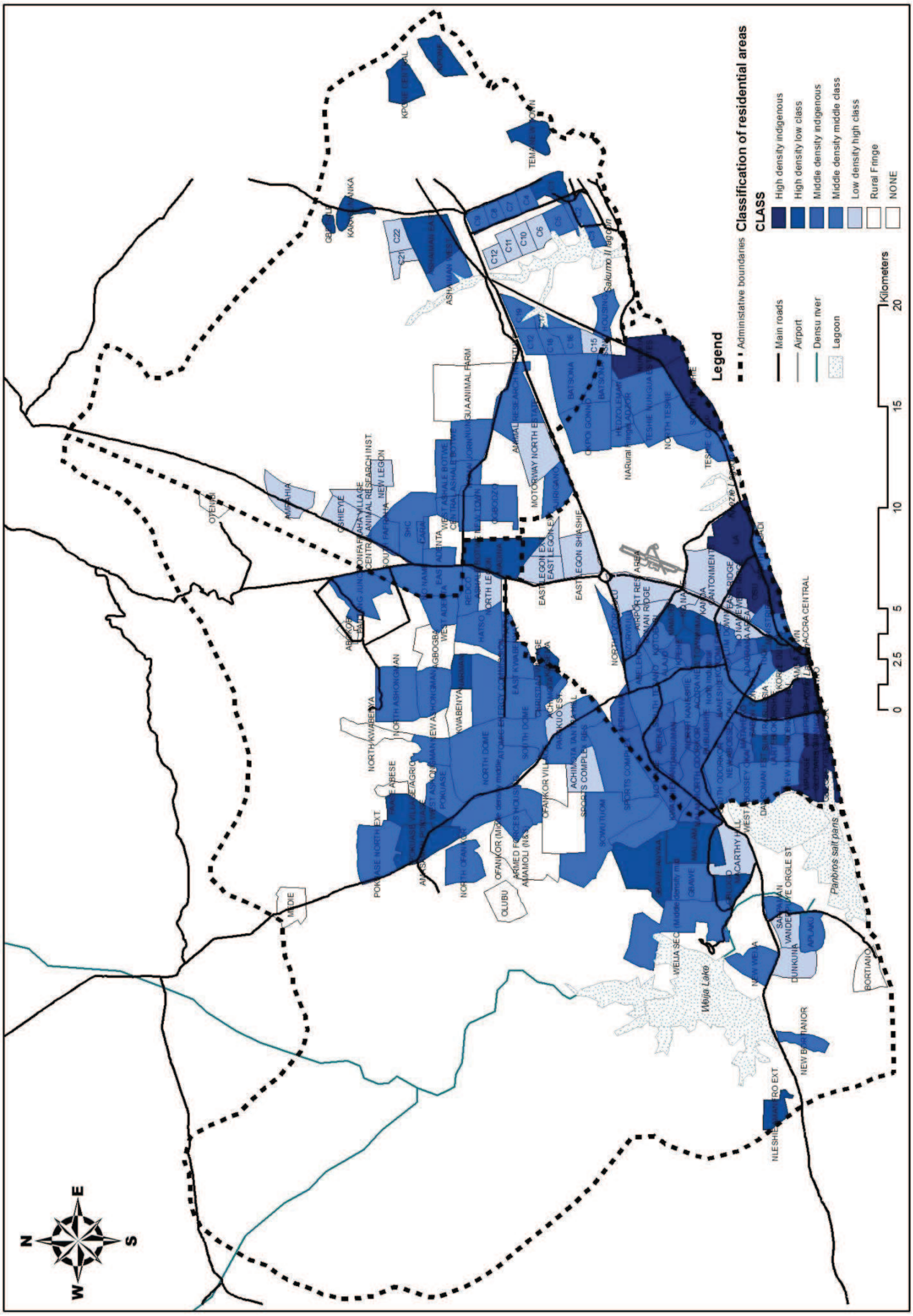


Figure 6: Classification of residential areas in the Greater Accra Metropolitan Area
Source: Songsore et al, 2005

Table 2: Type of dwelling

Type of dwelling	GAMA
Separate house (Bungalow)	8.5
Semi-detached house	6.8
Flat / apartment	8.9
Room(s) (compound house)	53.9
Room(s) (other type)	15.6
Several huts / buildings (same compound)	2.6
Tents / improvised home	2.3
Other	1.4

Source: GSS, 2008

Table 3: Occupancy status

Occupancy status	GAMA
Owning	26.6
Renting	45.9
Rent-free	24.8
Perching	2.7

Source: GSS, 2008

2.4 A summary overview of the city of Accra and its population

The above has shown that the city of Accra is a growing and expanding city, covering no less than eight metropolitan and municipal areas, each with their own assembly and administrative set-up. This area is referred to as the Greater Accra Metropolitan Area (GAMA).

Within this area, different areas with different socio-economical characteristics can be identified:

- High density indigenous areas are mainly located along the coast.
- High density low class areas are more scattered over the Greater Accra Metropolitan area.
- Middle density indigenous areas can mainly be found in the older residential areas within the AMA area.
- Middle density middle class areas can mainly be found in central Accra and in the Ga and TMA areas.
- Low density high class areas can mainly be found in Eastern AMA but also in some Ga areas and TMA.
- Rural fringes can be found on the outskirts of Accra, in all areas except for the Accra Metropolitan Area (AMA)

About four percent of the population is considered hard core poor, with an income lower than 25 percent of the national income. The poor, with an income of 25 percent and 66 percent of the national income, constitute about 23 percent of the population. The portion of non poor is about 73 percent of the population. The majority of the population (54 percent) of GAMA lives in compound houses. Many households rent (46 percent) rather than own their house.

3 A vision for the city of Accra

A vision for integrated urban water management for the city of Accra in 2030, scenarios of external factors and strategies for achieving the vision, given the different scenarios, were developed by the Accra Learning Alliance over the course of a number of workshops. This chapter presents the vision (3.1) and the scenarios (3.2) as discussed and developed by the Accra Learning Alliance.

3.1 The vision for Accra in 2030

Stakeholders involved in water management in the Greater Accra Metropolitan Area, bought together in the Accra Learning Alliance, have defined the integrated urban water management vision for Accra 2030 as follows:

In 2030, everyone in the city of Accra (the Greater Accra Metropolitan Area), regardless of economic and social status, will have access to uninterrupted water supply, at an affordable price within a reasonable distance from the house. The water quality of the supplied water will meet Ghana Standard Board criteria. Non revenue water in the GWCL system, caused by physical and commercial losses, will have decreased to 25 percent.

In 2030, at least 80 percent of Accra's citizens have access to an acceptable level of sanitation facilities, including flush toilets, KVIPs or good public toilets. Pan and bucket latrines will be phased out. Good sanitation behaviours will be practiced by at least 80 percent of Accra's citizens. There will be no more open defecation and littering, and hand-washing after toilet use will be common practice. People will willingly pay for waste management. This will have led to a 70 percent reduction in water and sanitation diseases.

In 2030, Accra will be a cleaner city with a well-functioning drainage system. There will be integrated solid waste management (collection, transport, treatment and final disposal) of solid waste in a sustainable way. At least 90 percent of the solid waste will be collected. The improved collection of solid waste will have eradicated the dumping of solid waste into small and larger drains. The drains will be free from solid waste, and pollution of the surface waters and the risk of flooding will have reduced. There will be improved productive uses of water for livelihood (micro enterprises and agriculture), especially through the reuse of storm water and/or wastewater in urban agriculture.

3.2 Scenarios

To aid in the identification of robust strategies to achieve the vision, a number of narrative scenarios of possible future trends have been developed, taking into account the external factors that have a great impact (importance) on the strategic plans and which are unpredictable (uncertain). During the SWITCH Accra visioning workshop in August 2007 (Darteh et al, 2007) stakeholders determined that the following factors are the most important and uncertain factors, which need to be taken into account when building the scenarios:

- City population
- Economic growth
- Climate change
- Power/energy supply
- Political commitment and interference
- Public awareness and attitude

Population and economic growth have direct impact on the water demand, while climate change can have direct impact on the availability of water resources. Population growth, economic growth and the resulting demands on water supply and sanitation services were discussed in chapters two, four and five, while climate change and its potential effect of water resources was discussed in chapter three. Based on this, the following narrative scenarios have been defined:

Worst case scenario:
Accra in 2030 is a depressing, chaotic and crisis prone town. The population has exploded to more than four times its 2007 level. Water demands are almost six times higher than the actual capacity of the water supply system in 2007. Lack of effective political leadership, coupled with poor economic performance and severe poverty mean a lack of ability to tackle deep-seated problems of under-investment and poor management of water supply and sanitation infrastructure. These problems are made worse by lack of raw water resources due to increased competition and a reduction in river flows.

Medium case scenario:
Accra has grown to almost three times the population in 2007, fueled in part by strong economic performance based on oil wealth. This has led to sharply increased demand for water. This demand is augmented by the rapid growth in the tourism and manufacturing sectors. However, while rapid, this growth has not been chaotic – due in large part to the marked improvement in political culture and related enforcement of planning laws and other regulations. Climate change (and competition for water from outside the city) has led to a modest reduction in overall water resource availability, which together with the strong growth in demand (four times what it was in 2007), presents major challenges. These are compounded by lack of access to finances and land for new infrastructure. However, improved management and capacities within the utility (GWCL) and local government, new technological options and engaged and empowered citizens inspire confidence that solutions will be found.

Best case scenario:
Accra in 2030 is in many ways a blessed city. Contrary to the fears of many in the early 2000s, the city's population growth, while large, has been manageable (2.2 times 2007 levels). The frequent power shortages of the early 2000s are only a distant memory. A sharply improved political culture has led to improvements in enforcement of planning laws, whilst policy is seen as progressive. This, coupled with strong economic growth (partly driven by increasing oil wealth), has led to marked improvements in citizens willingness and ability to pay for water and sanitation services. Water demands have increased because of steady population growth and economic growth (three times as high as the capacity of the system in 2007). Challenges do exist. Overall water resource availability is reduced. It continues to be difficult to source the necessary financing to upgrade the city's infrastructure and access to land for waste processing facilities and new networks is a constant problem. Nevertheless, there is guarded optimism about the ability of the city to deal with these problems.

In order to develop strategic directions towards the achievements of the above presented vision under the given scenarios, there is a need to take into cognisance the current status of water-related services in Accra in terms of infrastructure, current and future demand and access to services. Before exploring the present situation, current and future challenges and strategic directions for overcoming these challenges in order to achieve the vision in chapter five, six and seven, chapter five will focus on the first element of the RIDA analysis framework - water resources.

4 Water Resources

This chapter presents the current and foreseen future situation regarding the quality and quantity of available water resources in and for the Greater Accra Metropolitan Area (GAMA). These water resources include rainwater (section 4.1), groundwater (section 4.2) and surface water (section 4.3) resources. The box below gives an overview of the institutional arrangements around the management and regulation of these water resources. An overview of available water resources in GAMA is presented in section 4.4.

Box 1: Management and regulation of water resources

The WRC (Act 522, 1997) is responsible for the regulation and management of the use of water resources and for the co-ordination of any policy related to its functions. The act empowers the WRC to carry out the following functions:
propose comprehensive plans for the use, conservation, development and improvement of water resources;
initiate, control and co-ordinate activities connected with the development and use of water resources

Under the act, the ownership and control of all water resources is vested in the president on behalf of and in trust for the people of Ghana. No person shall divert, store, abstract or use water resources, or construct or maintain any works for the use of water resources,[5] except with the prior grant of a right by the commission. The WRC may through regulations levy charges under the act and it has in fact proposed water abstraction fees to be paid by users. The requirement to obtain a license for water abstraction beyond domestic use means that independent small-scale providers, supplying water from source to end-user, have to take steps to regularise their operations.

The EPA was established by parliament in 1994 (Act 490, 1994) following reforms aimed at protection of water and the general environment. Act 490 conferred regulatory and enforcement powers on the EPA. Currently the EPA provides guidelines for developments that affect the environment and set standards for emissions and discharges into the environment.

The agency has also developed an environmental impact assessment procedure backed by appropriate regulations that must be followed for approval of development projects. These reforms are aimed at ensuring a sustained development and management of resources and the environment to avoid exploitation of resources in a manner that might cause irreparable damage to the environment. The EPA works in close collaboration with the Water Resources Commission (WRC) on all water related issues.

4.1 Rainfall

The figure below shows an overview of the annual rainfall from 1970-2008. (see Annex 3 for details)
The graph shows that the annual rainfall is highly variable. The average annual rainfall over the period 1970 – 2008 is 756 mm. With a total land area of 1,261 km^2, the average total amount of rain that falls in GAMA within one year is about 0.954 km^3/year.

When the departure and cumulative departure from mean rainfall are analysed based on the data presented above, it seems to show a trend of a declining cumulative departure from mean rainfall since 1985, as illustrated in the figure below. However, it would be speculative to conclude from this that there is a trend of decreasing water resources. In order to be able to make a more conclusive statements about current trend, bigger data sets going back longer would have to be used, as this might be part of a rainfall cycle, rather than a pattern of decreasing rainfall.

[5] Water resources means all water flowing over the surface of the ground or contained in or flowing from any river, spring, stream or natural lake or part of a swamp or in or beneath a water course and all underground water but excluding any stagnant pan or swamp wholly contained within the boundaries of any private land.

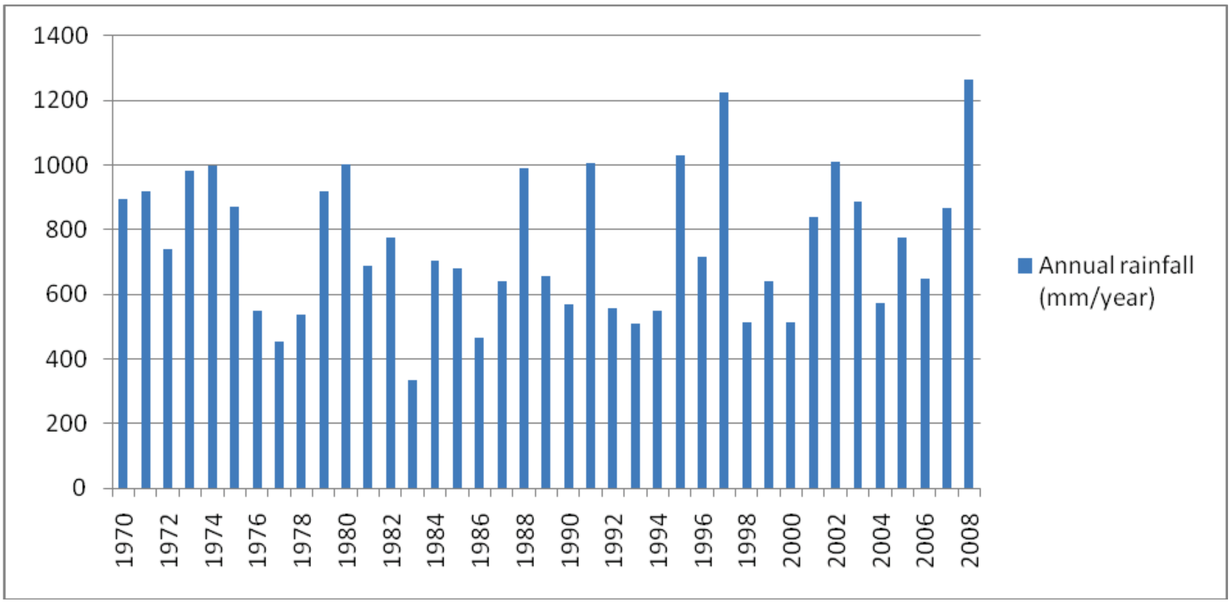


Figure 7: Annual rainfall and ET
Source: Based on daily rainfall data, from the Meteorological Services Department, station 23016ACC Accra (airport station)

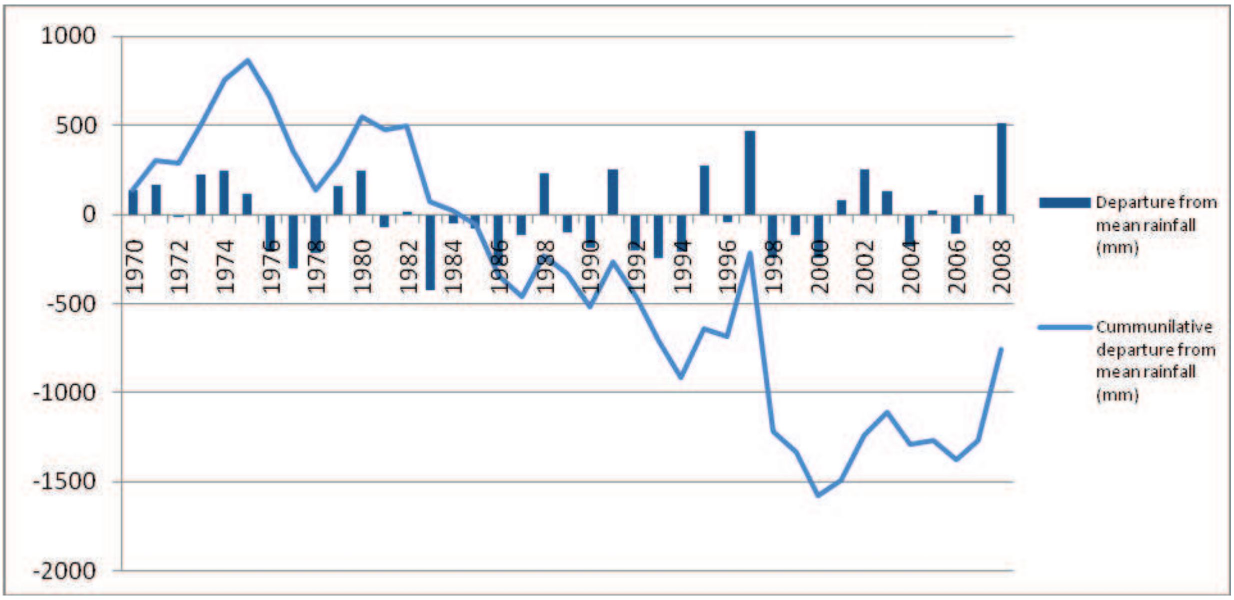


Figure 8: Departure from mean rainfall
Source: Based on daily rainfall data (mm) from the Meteorological Services Department

There is great variation in rainfall within the year. The main rainy period is from March to July, and a smaller rainy period runs from September to October, as can be seen in the figure below. The dry season spans thus about five months: from November to February and August. This is illustrated in the figure below.

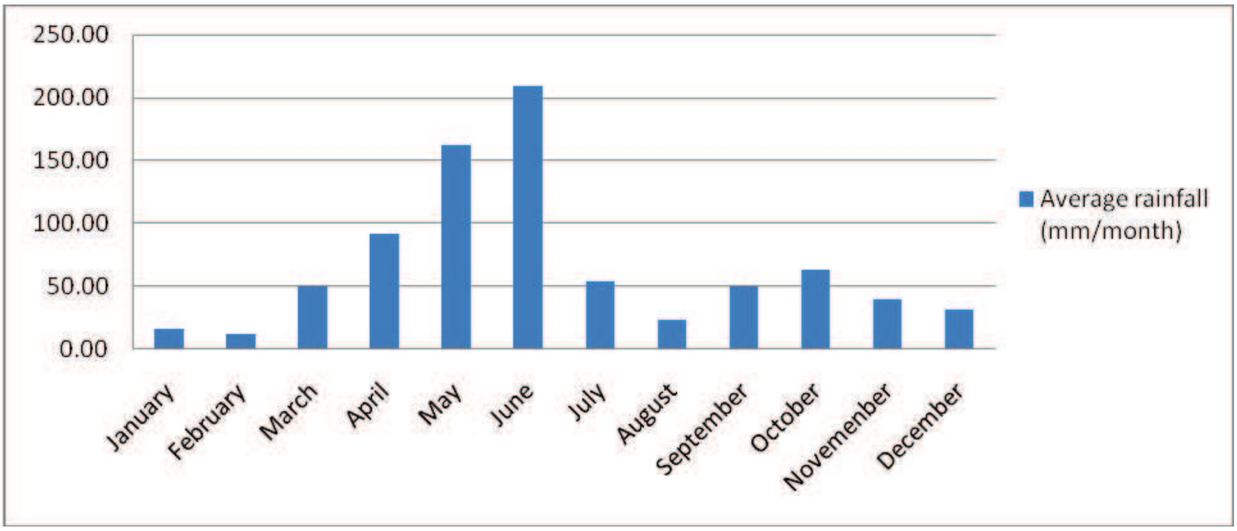


Figure 9: Monthly rainfall
Source: Based on daily rainfall data (mm) from the Meteorological Services Department (1999-2008)

Variations in intensity of rainfall are considerable and rates of 203 mm/h may be reached and even exceeded for short periods (Ghana Metrological Services Department, 2002, in Lundgren and Åkerberg, (2006). In his assessment of run-off in the GAMA area, Nyarko (2002) considered a rainfall intensity of 140.2 mm/h.

4.2 Groundwater

The geology of the Greater Accra Region is predominantly that of the crystalline basement rocks (Kesse 1985). The geological formations are the Dahomeyan system, the Togo series and Accraian. The Dahomeyan series covers the greater part of GAMA, as can be seen in the figure below. It occurs as alternating belts of acidic and basic gneisses. Accraian formations are sedimentary rocks found mainly in the Accra Metropolitan Area. The Togo series can be found at the foothills of the Togo-Akwapim ranges.

The water table varies between 4.8 and 70m (Nyarko, 2002). The mean yield of boreholes in the Dahomeyan series with a mean depth of 39m, have a mean yield of 3 m^3/hour, ranging from 0.54 to 12 m^3/hour. The yield of boreholes in the Togo series with a mean depth of 44m ranges between 0.42 and 31.5 m^3/hour, with a mean value of 5.6 m^3/hour. (WRI,1999). Boreholes in the Accraian Series have an average yield of 3,9 m^3/hour (Ghana Mining Portal). According to Darko (2005), the probable yield in zones with negative transmissivity anomalies would be 0.36 m^3/hour in the Dahomeyan and 0.6 m^3/hour in the Togo Series formation. In areas of positive anomalies, the expected yield would amount to 2.1 m^3/hour and 7.2 m^3/hour in the Dahomeyan and Togo Series formations respectively.

It is difficult to give an estimate of the volume of suitable groundwater that could be extracted in a sustainable way. Taking a conservative estimate for ground water recharge of four percent of the rainfall, and using an annual rainfall of 756 mm, the recharge can be estimated to amount to about 30mm. Over the entire Greater Accra Metropolitan Area, this would mean a total recharge of about 0.0381 km^3/year. In that case, a total of 1,116 boreholes with an average yield of 3,9 m^3/hour (93,6 m^3/day) could in theory abstract ground water, without deflating the groundwater resources.

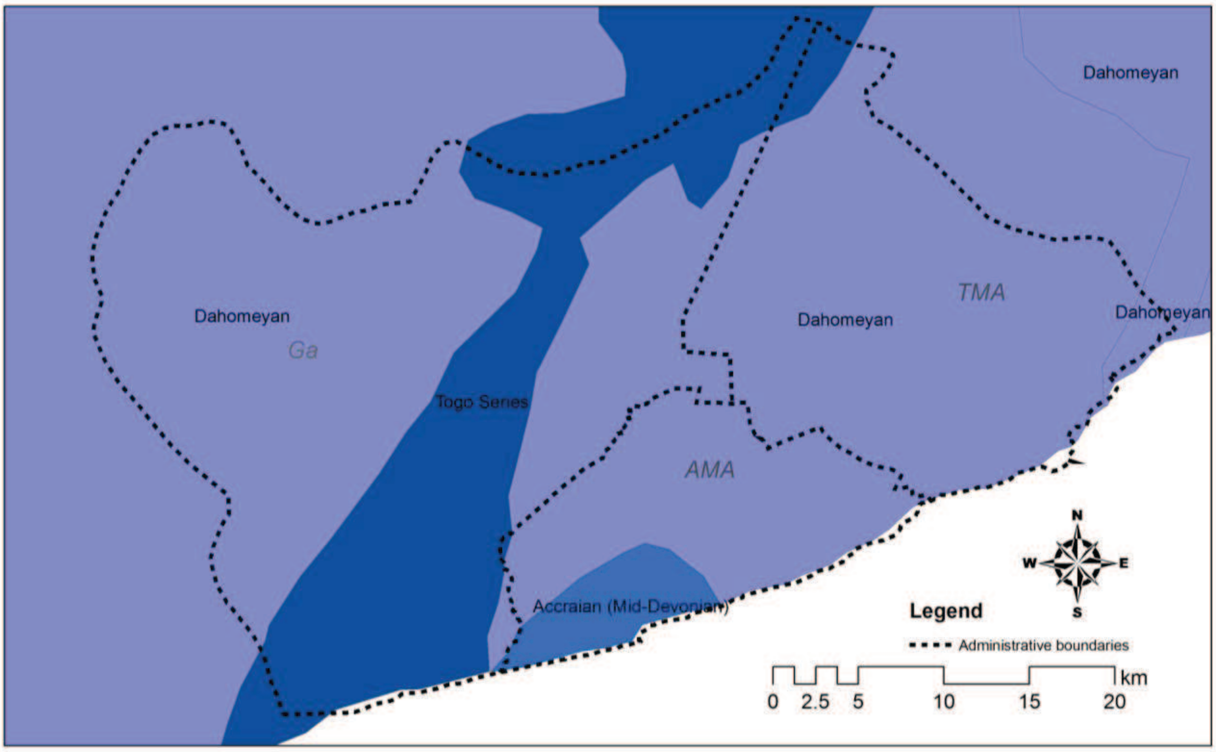


Figure 10: Geology of the Greater Accra Metropolitan Area

The classification of the groundwater using the Durov diagram, indicates NACl waters as the dominant water type, with minor $MgCl_2$ and $CaCl_2$ waters. Ground water salinity increases from north to south, going towards the coast. The origin of the high salinity levels of the groundwater can be attributed to several probable causes. Halite dissolution from the soil zone as a result of aerosol deposition seems to be the main cause of groundwater salinity, according to Kortatsi and Jørgensen (2001). They identify saline water intrusion as the main cause for salinity of the groundwater close to the cause. They do not mention possible causes of this sea water intrusion. Evaporative concentration of surface waters contributes to salinisation on a small scale, according to Kortatsi and Jørgensen (2001).

4.3 Surface water

There are a number of river basins partly or fully located in GAMA , as can be seen in Figure 1. This section gives an overview of these basins. As the population of the Greater Accra Metropolitan area depends to a large extent on water from the Volta Basin, located outside the boundaries of GAMA, this catchment is considered here as well.

4.3.1 Surface water in Accra

Only part of the Densu Basin can be found in GAMA. The total drainage area of the Densu Basin is about 2,500 km^2 (WRC, 2008). It is divided into two sections: above and below the Weija dam. The northern section of the basin, which extends 100 km inland along the Densu River and its tributaries, is hilly. The southern section of the basin consists of low-lying land which is largely urbanised now. The Densu River runs from its source in the Atiwa Range near Kibi to the Weija Reservoir, before entering the Sakumo 1 lagoon and Panbros salt pans and finally the Gulf of Guinea (WRC, 2008).

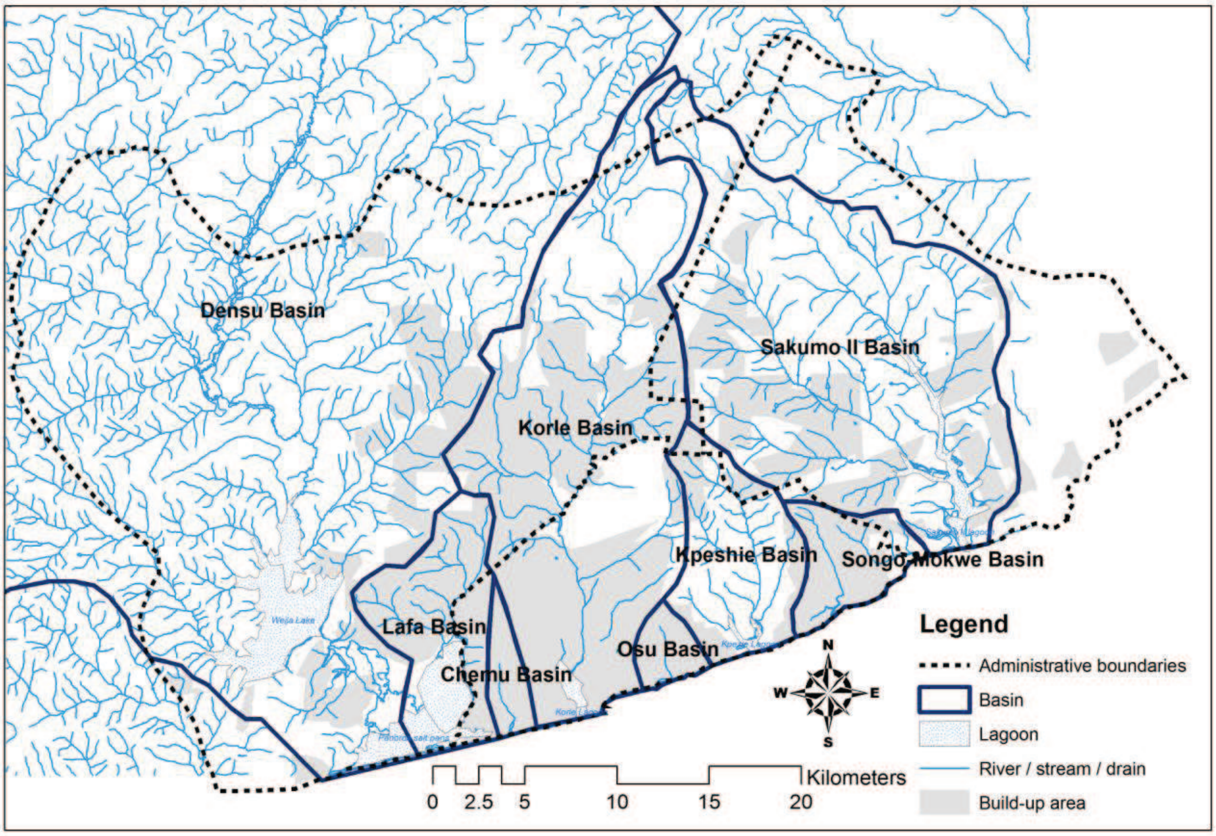


Figure 11: Basins in the Greater Accra Metropolitan Area

The population density in the Densu Basin is, with 240 persons per km^2, considerably higher than the national average of about 100 persons per km^2. The main occupation of inhabitants of the basin is agriculture. Due to uncontrolled human activities that generate waste, untreated sewage, fertiliser and pesticide run-off in the Densu Basin, very high colour, turbidity and nutrient levels have been identified in the Densu river (WRI 2003). Raw water at the Weija dam has been reported to have a biological oxygen demand of 10 mg/l (which is high considering that moderately polluted rivers generally have a BOD of 2-8 mg/l) and a chemical oxygen demand of 49 mg/l (Lundéhn and Morrison, 2007). A general trend of water quality deterioration in the Weija lake has been observed (Ansa-Asare and Asante, 2005, and Asante et al, 2008).

The Lafa stream flows into the lagoon and drains much of the western area of Accra including Dansoman, Kwashieman, McCarthy Hill and Awoshie.

The Korle-Chemu Catchment covers an area of about 291 km^2 (Nyarko, 2002)[6]. The principal streams that drain the catchment are the Odaw River and its tributaries, the Nima, Onyasia, Dakobi and Ado (AMA, 2006).

[6] 250 km^2 according to AMA (2006)

The Odaw river drains Dome, Legon, Achimota, Ring Road Industrial Area and the high density, low income areas of Nima, Maamobi and Accra Newtown. The catchment area of the Odaw river is densely populated and has a large concentration of industries including Ghana Breweries Limited, several textile factories and vehicle repair workshops. The eastern channel drains the eastern and central parts of Accra, including areas around Accra Brewery Limited. Several light industries are situated in this area. The western channel drains the western parts of Accra including Kaneshie and Korle-Bu Hospital. These areas are mainly residential, with an array of vehicle repair shops. The major channels are interconnected by a network of medium and smaller-sized drains, which are mostly uncovered and are often used for the disposal of untreated domestic and industrial effluents, which are ultimately flushed into the lagoon by flood waters.

The water of the Odaw is highly polluted. The BOD has been measured to be 240 mg/l and the COD 2560 mg/l (Awuah and Fiakuma, 2007), which is far in access of the EPA and WHO norms, as presented in the table below.

Table 4: Water quality standards

	EPA Standards for Inland Watercourse (EPA 2000)	WHO Standards for Coastal Water:
Biological Oxygen Demand (BOD) (ppm)	< 50	< 2
Chemical Oxygen Demand (COD) (mg/l)	< 250	
Total Suspended Solids (ppm)	< 50	< 5
Total Fecal Coliform Count (FC/100ml)	< 400	< 500
E. Coli Count (MPN/100ml)	< 10	
N-NH4		< 0.5

The Odaw discharges into the Korle Lagoon. In addition, there is a minor outfall at Chemu. The Korle Lagoon empties into the sea near Korle Gonno. This southern-most section is tidal. The lagoon, with a surface of about 0.6 km^2, was dredged between 1961 and 1963. In addition, inadequate attempts to deepen the tidal sections were made in 1976. Its capacity has been seriously reduced by siltation and also by the proliferation of mangrove vegetation of the species Rhizophora (deGraft-Johnson, 1991; Amoah et al, 1998). Siltation of the lagoon is, to a large extent, caused by flood waters which erode the commonly unpaved areas in the catchment and transport the silt into the lagoon (Karikari, Asante and Biney, 2006).

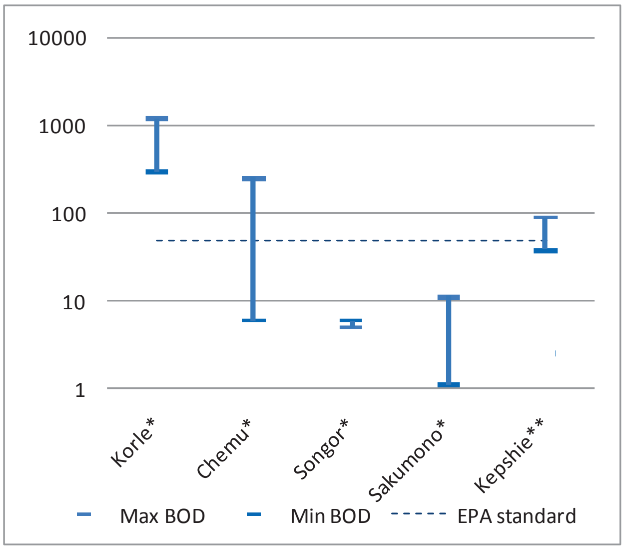
A survey conducted in April 1997 indicated that the entrance of the Korle lagoon, in which the Odaw discharges, is moderately to grossly polluted as evidenced by the physical, chemical and bacteriological characteristics (Karikari, Asante and Biney, 2006). The Korle Lagoon has been mentioned as one of the most polluted water bodies on earth (Bourgoing, 1996; Boadi and Kuitunen, 2002). Causes for this include discharge of domestic and industrial effluents from inland and the operations of the sewage outfall in the vicinity of the lagoon entrance. At high tide, the effluents from the outfall are back-washed into the lagoon. The extremely high levels of BOD, SS, coliforms and ammonia-nitrogen of the raw sewage are an indication of the extent of organic pollutants introduced into the sea. However, according to Karikari, Asante and Biney (2006), samples collected 500m offshore showed good water quality, which can be primarily attributed to dilution. So although the outlet of the lagoon and immediate environment are moderately to grossly polluted because of discharges from the sewage outfall and from inland, this negative impact is significantly reduced less than one km offshore as a result of the dilution effect of the open ocean. This process is important for artisanal fisheries, such as beach seining, which take place within the zone less than one km from the beach.

The Kpeshie drainage basin covers a relatively small catchment area of about 62.6 km^2 (Nyarko, 2002)[7]. Streams in the catchment empty directly into the principal outlet to the sea at Kpeshie Lagoon or the small Korle Lagoon at Osu.

The Songo-Mokwe Catchment is the smallest drainage basin in the Accra Metropolitan Area. It covers about 31 km^2 (Nyarko, 2002)[8], draining the area of Teshie. Two main streams drain the area flowing into the Mokwe and Songo Lagoons. Much of this catchment is undergoing residential development. (AMA, 2006).

Finally, the Sakumo II catchment mainly drains the Tema Municipal Area and discharges most of the drained water in the Sakumo II lagoon. It covers an area of about 280 km^2 (Nyarko, 2002).

The figures below give an overview of water quality characteristics for some lagoons in the GAMA area.



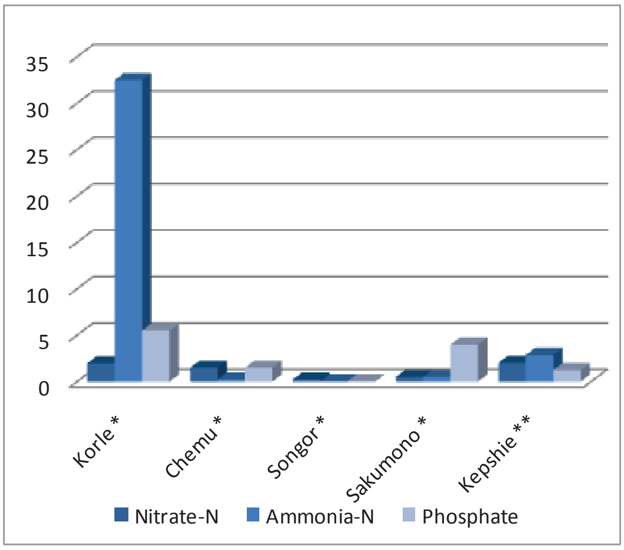


Figure 12 (left): Maximum and minimum BOD (ppm)
Figure 13 (right): Nitrate, ammonia and phosphate concentrations in lagoons (mg/l)
Source: * Kankam-Yeboah, 2007; ** Awuah, Ansah and Ackerson,2009

4.3.2 Surface water for Accra

The **Weija dam on the Densu river** is located some 20 km from the centre of the Accra and is one of the main sources of water supply for the Greater Accra Metropolitan Area. The dam was initially realised in 1952 to supply potable water for Accra and was reconstructed in 1978. According to the station manager of the Weija GWCL treatment plant (personal communication Mr. Micheal Amuakwa, 2007), the maximum surface area at 15.24m of the impoundment is 33.59 km^2. The optimal safe yield from the system is 272,765m^3/day (about 0.10 km^3/year) and a volume of impoundment of 212,546 m^3. The

[7] 110 km^2, according to AMA (2006)
[8] 50 km^2, according to AMA (2006)

mean inflow is 54.2 m^3/s at the peak of the rainy season. The mean annual run-off is 0.5 million km^3 (about 16 m^3/s).

The other main source of water for Accra is the **River Volta**. The Volta Basin is located entirely outside the Greater Accra Metropolitan Area, as can be seen in the figure below. It covers six countries: Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali, Togo and has a total area of 400,000 km^2. The three main rivers, the Black Volta, the White Volta and the Oti discharge into the world's largest artificial lake: the Akosombo Reservoir - more commonly named Volta Lake.

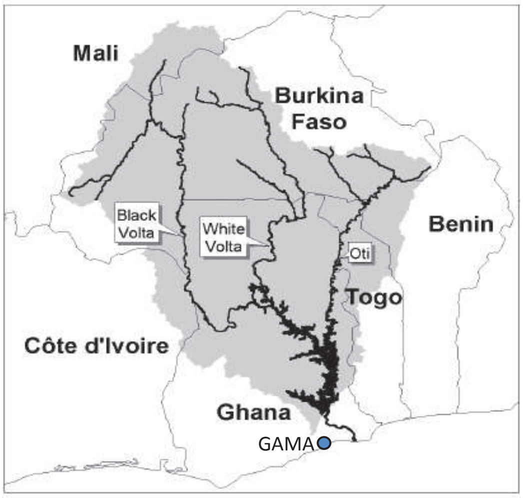


Figure 14: The Volta Basin

The Volta Lake was created by the construction of the Akosombo Dam (1961-1964). The main reason for the construction of the dam was hydro-electricity generation. As demand for electricity increases, there is a temptation to generate power at higher rates despite drought or storage deficits (Andreini et al, 2000). The lake has a storage capacity of about 148 km^3. However, according to Andreini et al (2000), the mean volume stored in the reservoir in the 1970s was only 132 km^3. In the 1980s and 1990s, the mean volume stored decreased to 102 km^3. The amount of water flowing through the Akosombo Dam increased from 28 km^3/yr to 35 km^3/yr in the 1990s (Andreini et al, 2000).

Friezen et al (2005) estimate the coefficient of variation for rainfall in the Volta Basin to be only 0.08 (1931-1995), with an average of 400 km^3 /year. The coefficient of variation in run-off is however estimated to be far higher: 0.38, with an average discharge of 43 km^3/year[9] (1931-1995) (Friezen et al, 2005). The level of inflow was considerably below this average in 1983 (about 7.6 km^3), in 1997 (26.5 km^3) and in 2006 (23.8 km^3), which resulted in lower water levels at Akosombo and the electricity crises of 1984, 1998 and 2007 (Ameko, 2007). The minimum level needed for hydro-power generation is 73.15m. The figure below shows that this level was approached in 1984 and again around 1998, 2002 and 2003.

There is some concern that climate change will have a negative effect on the availability of water for the city of Accra. WRI (2000) simulated the change in river flow in the Volta Basin, based on different General Circulation Model (GCM)-based global climate change scenarios. According to this, the stream flow will have decreased by the year 2020 with 8.5 percent in case of low sensitivity, with 15.8 percent in case of medium sensitivity and with 22.9 percent in case of high sensitivity. In the worst case scenario, the flow of the Volta would thus decrease to 33 km^3/year.

[9] 37 km^3/year, according to Rodier (1964)

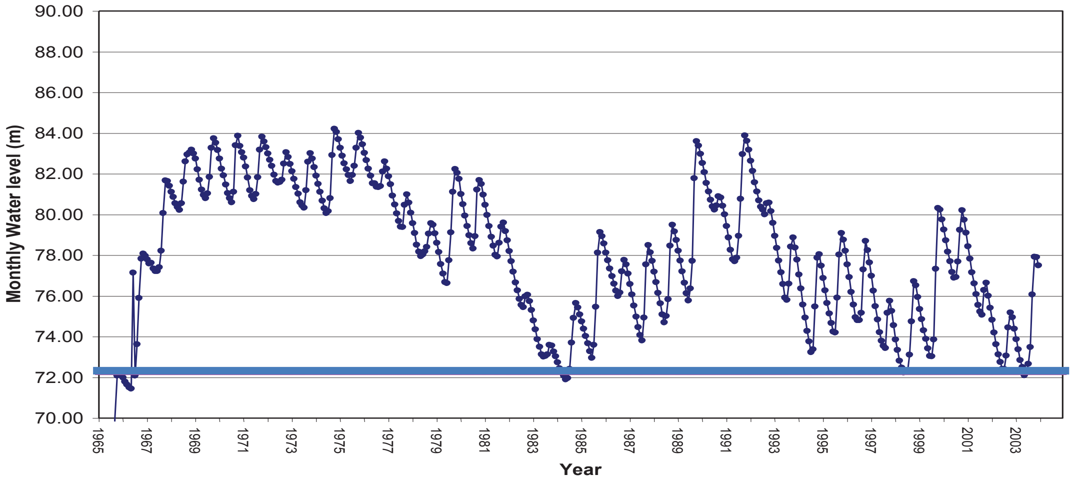


Figure 15: Water level at Akosombo 1965-2003
Source: Ameko, 2007

In addition, there is concern that upstream increased water use will lead to downstream water shortages. Based on a synthesis of country reports, Andah (2005) projects the demand on water from the Volta river, as indicated in the table below (for details per country, see annex 4). This shows a big increase in water demand, especially from the irrigation sector. The projected total water demand for 2025 is almost 20 percent of the average discharge of 43 km^3/year (1931-1995). Taking into account the worst case scenario of a decreased flow of 22.9 percent, the water demand of 2025 would amount to about 25 percent of the average discharge, which seems to suggest there is little reason for concern for the availability of water for the city of Accra. Decreased water flow caused by climate change and increased upstream water use can however have serious consequences on the water levels in the dam, which can have serious consequences on electricity generation from the dam.

Table 5: Water demand in the Volta Basin

	2000	2010	2020	2025
Projected domestic and industrial water demand (km^3)	0.360	0.604	0.891	1.058
Projected irrigation water demand (km^3)	1.169	3.170	5.974	6.730
Projected livestock water demand (km^3)	0.166	0.294	0.430	0.511
Total	1.695	4.068	7.295	8.299

Source: Andah,2005

The quality of raw water from the Volta is better than that of the Densu due to two large dams that serve as sedimentation basins for the raw water. However, as the population in the surrounding villages continue to grow, the situation is likely to worsen both at Weija (Densu) and Kpong (Volta) in the near future. (Uusitalo, 2002;Salifu and Mumumi,2000)

4.4 Overview of water resources within and for Ghana

Figure 16 gives a schematic overview of the water resources present in (within the dashed line) and available for (in blue) the Greater Accra Metropolitan Area. Water resources available for water supply are limited within the boundaries of the Greater Accra Metropolitan Area (GAMA), both in terms of quantity, as well as in terms of quality. The water quality of several rivers and lagoons within the city of Accra is below WHO and EPA standards, especially in the Odaw and the Korle lagoon. Groundwater is too saline in large parts of the greater Accra Metropolitan area, especially near the coast.

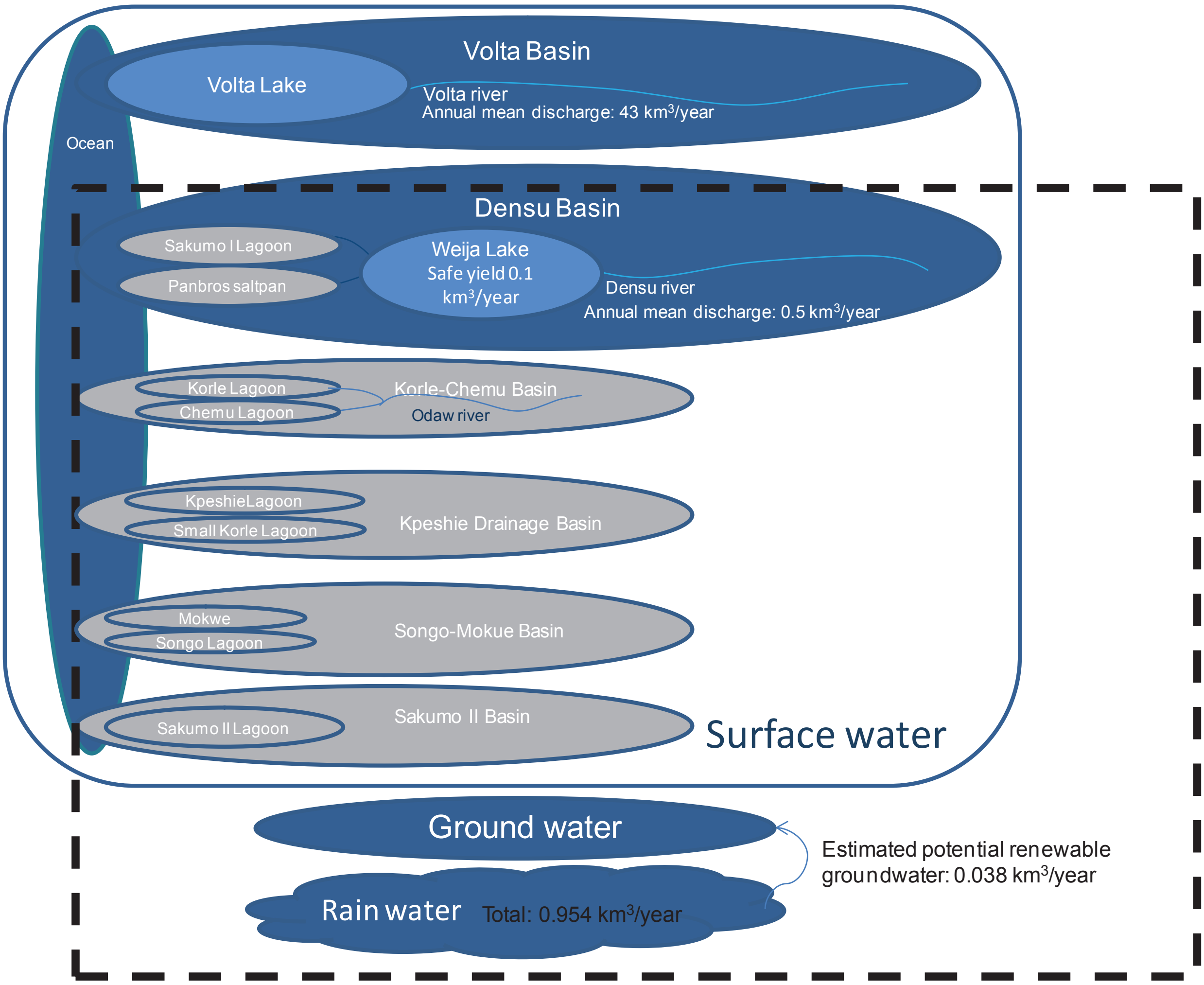


Figure 16: Overview of water resources

However, the Greater Accra Metropolitan Area is located at the downstream end of the Volta and the Densu basin, from where large amounts of water can be abstracted. The optimal safe yield from the Weija lake is about 0.10 km^3/year. With an average annual discharge of about 43 km^3/year, the potential yield from the Volta is determined by the capacity of the intake and treatment infrastructure, rather than by the availability of water resources, even when considering a potential drop in river flow caused by climate change and increased use of water upstream in the basin.

The next chapter will take a closer look at the abstraction of water for water supply for the Greater Accra Metropolitan Area.

5 Water supply services

Within the Greater Accra Metropolitan Area, four main models for the delivery of water services can be found: utility managed water supply, managed by Ghana Water Company Limited (GWCL); privately managed water supply; community managed water supply; and self supply. Private managed water supply can either depend on the GWCL network (intermediary private providers) or on own sources of water (independent private providers). A schematic overview of these service providers is given in the figure below. Households can rely on different service providers for their water supply.

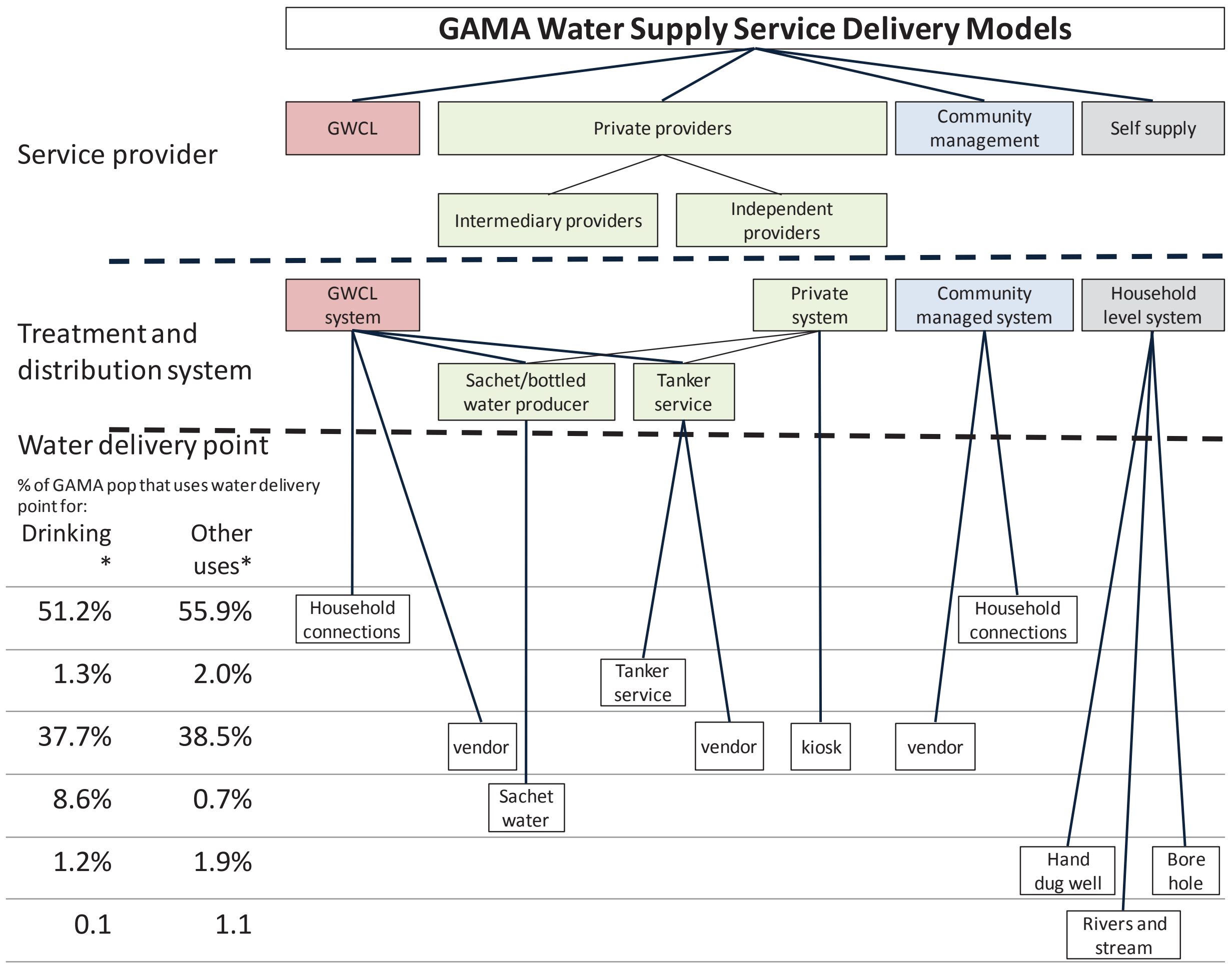


Figure 17: Water service delivery models in GAMA
Source *: GSS, 2008

Besides giving an overview of the different service delivery models, the figure above gives an indication of the percentage of people in the Greater Accra Metropolitan Area with access to different types of water delivery points as their main source of water supply for drinking and for other uses, based on the findings from the fifth round of the Ghana Living Standards Survey (GSS, 2008) (see annex 5 for details). Access to these water delivery points and the barriers people face, will be discussed in more detail in section 5.3. Before going into access to water services, the main water supply infrastructure serving the Greater Accra Metropolitan Area is described in section 5.1. This is followed by an overview of the current and projected future demand for water supply services in section 5.2. Section 5.4 discusses the main current and foreseen future challenges related to water supply. Finally, section 5.5 presents suggested strategic directions, in order to overcome these challenges and achieve the vision of Accra as a city where everyone, regardless of economic and social status, will have access to uninterrupted water supply at an affordable price within a reasonable distance from home.

5.1 Water supply infrastructure

The main source of piped water for the Greater Accra Metropolitan Area is the GWCL system. As shown in the map below, a number of communities on the fringes of Accra are being served by other systems, like community-managed small town piped water supply systems, implemented by CWSA, and Small Scale Independent Producers (SSIPs) operating and managing water supply kiosks independently from the GWCL system. This section describes the utility-managed system, private service providers' infrastructure and community-managed infrastructure.

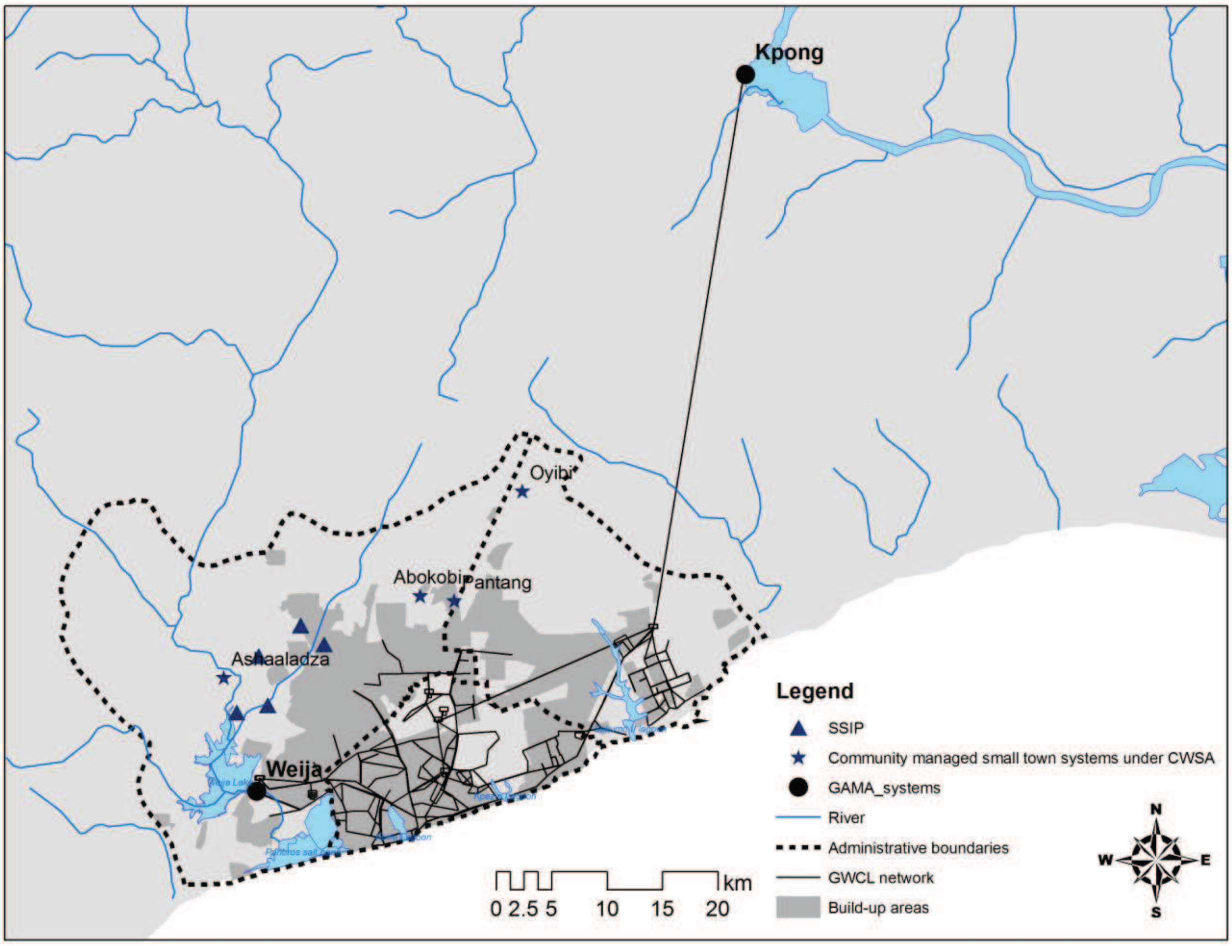


Figure 18: Water systems in the Greater Accra Metropolitan Area

5.1.1 The GWCL managed system

This section presents the capacity of the different water supply systems that supply GAMA, managed by the utility, the Ghana Water Company Limited (and operator Aqua Vitens Rand Limited), and gives a description of the distribution network and delivery points. The box below gives a description of the history and institutional set-up of utility water supply in Ghana.

Box 2: The Ghana Water Company Limited (GWCL)

The formal responsibility for urban water supply lies with the utility company **Ghana Water Company Limited** (GWCL) which is under that Ministry of Water Resources, Works and Housing. GWCL has since 1999 been operating as a limited liability company following the enactment of the *Statutory Corporations (Conversion to Companies) Act 1993* (Act 461, 1993). Its name changed from Ghana Water and Sewerage Corporation to Ghana Water Company Limited. The main objects of GWCL are to provide, distribute and conserve water for domestic, public and industrial purposes. Following the establishment of Water Resource Committee (see Box 1), the Public Utility Regulatory Committee (see Box 3), and the enactment of the *Local Government Act* (Act 462, 1992), certain functions that GWCL previously performed, have been reallocated to these regulatory agencies. Examples include the setting of standards for water supply and the monitoring of drinking water quality, which are now performed by PURC. The sewerage functions of the water company have been transferred to the MMDAs/local government (see Box 4). Therefore the GWCL is no longer required to establish, operate and control sewerage systems in Ghana. GWCL is responsible for its customers and until one is connected to the formal utility one is not considered a customer even though one consumes water.

As part of urban water sector reforms, GWCL entered into a five-year management contract with Aqua Vitens Rand Limited (AVRL), a Dutch-South African joint venture in 2006. This management contract was met with a lot of public agitation. This was due to the perception that all asset of the utility company were going to be handed over to a private person. Despite this outcry, the management contract was made with the justification that it will help to improve the water supply (especially to the poor). Under the current management contract, GWCL (grantor) is responsible for planning and investments in capital projects. AVRL is responsible only for operation and management of the systems and for replacements that are not considered as major capital expenditures. This means that having investments made to improve the water supply system is the responsibility of GWCL. GWCL draws up its own strategic investment plan and decides on the future expansion and direction of water supply in the country.

AVRL operates a total of 86 systems spread out over the 10 regions of Ghana. In the Greater Accra Metropolitan Area (or ATMA, as commonly referred to by GWCL/AVRL), GWCL/AVRL has defined three regions which are subdivided in a total of 13 districts. The boundaries of these regions and districts do not match the administrative boundaries, as show in the figure below.

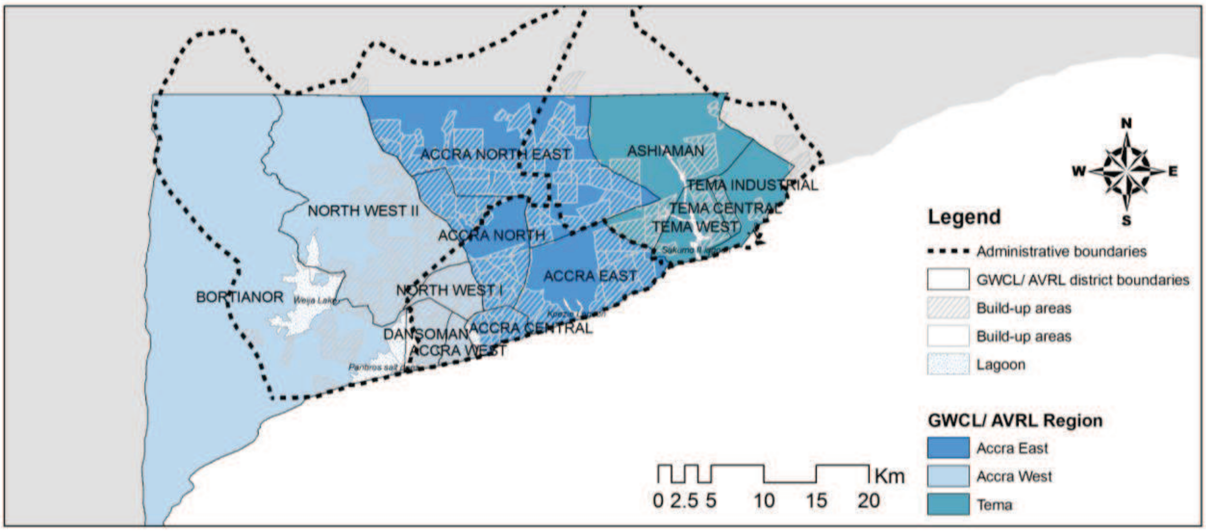


Figure 19: GWCL/AVRL regions and districts

Currently, almost at the end of the five-year management contract, there are mixed feelings about the benefits that the country has gained. Many civil society organisations are of the view that consumers, especially the urban poor, did not benefit. AVRL argues, however, that they have improved on the existing system, reduced losses through illegal connections and increased revenue to the water company. They, however, note the challenges they have to go through with the national procurement system and also the fact that they do not own the asset and cannot make the needed capital investment required. This means that they have to rely on GWCL and it is challenging for them to receive some of the needed inputs for the system. From the PURC side, AVRL has not performed badly since they have approved a number of tariff increases based on performance of the provider. They also indicate that the private operator has been consistent with providing reports as required by their contract.

Treatment capacity of the GWCL system

The GWCL system in the Greater Accra Metropolitan Area is supplied by two main systems: the Kpong system on the Volta river and the Weija system on the Densu river. The table below shows the capacity of these systems and the actual production in 2007.

Table 6: Capacity of water supply systems

System name	Production of raw water (m^3/year)	Production of treated water (m^3/year)	Plant capacity, design (m^3/day)	Average plant capacity actual (m^3/day)	% Average plant capacity of design capacity
Kpong New	61,369,489	58,136,665	181,818	159,280	88%
Kpong Old	13,131,091	12,464,845	38,636	34,150	88%
Total Kpong	74,500,580	70,601,510	220,454	193,430	88%
Weija -Adam Clark	48,117,071	44,746,911	134,000	122,580	91%
Weija Candy	6,926,738	8,598,451	39,440	23,555	60%
Weija–Bamag	12,330,064	8,650,654	30,240	23,852	79%
Total Weija	67,373,873	61,996,016	203,680	169,987	83%
Total	141,874,453	132,597,526	424,134	363,417	86%

Source: AVRL, 2008 (Data from 2007)

As shown in the figure below, the amount of treated water produced seems to be fairly constant over the year. The figure also shows a big different between the amount of water produced and the amount of water sold. This is discussed in more detail in Section 5.3.1.

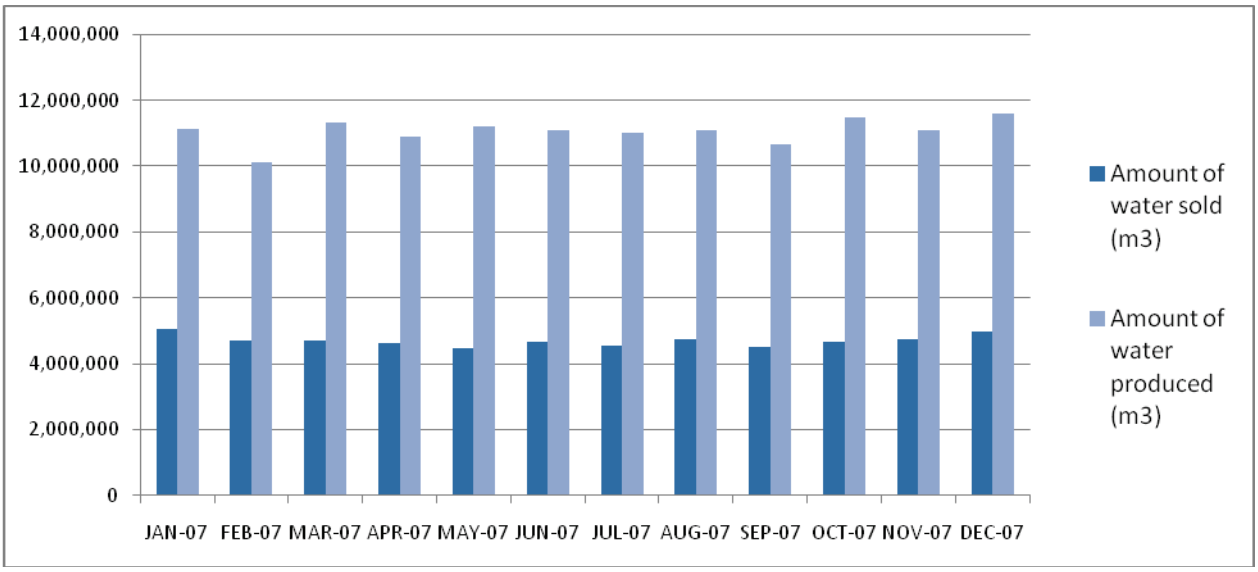


Figure 20: Variation of water sold and treated and water produced over the year
Source: AVRL, 2008(Data from 2007)

From the Weija Waterworks on the Densu River, the water is pumped to treatment facilities composed of three plants: Pintsh-Bamag and Candy (old plants) and the Adam Clark or Canadian plant (new plant). In 2007, the combined output of these three plants was 169,987 m^3/day, which is about 83 per cent of the plant capacity of 203,680 m^3/day (AVRL, 2008). The water is transported by gravity to Accra and communities on the western side of the city.

The Kpong waterworks on the Volta River is located downstream from the Akosombo Dam, 54 km north of Tema. The water is pumped from the intake to the adjacent treatment facilities consisting of two plants: the 'new' Kpong plant which mainly supplies the urban areas, and the 'old' Kpong plant which supplies mainly the rural areas (Columbia University, 2003). The design plant production is 220,454 m^3/day. In 2007, the actual average capacity was 193,430 m^3/day (AVRL, 2008), which is about 88 percent of the design capacity.

The consumption of chemicals to treat the raw water is higher at Weija (7,540 tonnes in 2004), where water quality is poorer, than in Kpong (where only 428 tonnes were used in 2004). The high chemical costs are regarded a barrier to the production of high quality drinking water, as all chemicals are imported. The total cost for chemicals in 2004 was 20,400 USD per million m^3 produced drinking water. (Lundéhn and Morrison, 2007).

Distribution network

The Accra distribution system is divided into three pressure zones:

- The Low Pressure Zone covers areas with ground elevations generally between 0 and 30.5 m. It covers the largest supply area of Accra and covers the main commercial, administrative and industrial areas and some of the largest residential areas. The LPZ is controlled by the water levels in the Weija works storage facilities to the west, in the Accra terminal reservoir (altitude 73 m) to the north and in the mile four reservoir (altitude 57 m) in the centre. It is the largest and most extensive distribution zone in the Accra Supply System.
- The Medium Pressure Zone covers areas with elevations generally between 30.5 and 61 m. The MPZ is theoretically controlled by the MPZ reservoir (altitude 97 m). When this reservoir is not in service the MPZ is supplied directly from the HPZ booster station.
- The High Pressure Zone, generally covering areas above 61 m in elevation, is controlled by the HPZ Reservoir (altitude 137 m). (Sarpong and Abrampah, 2006; Columbia University, 2003)

From the new Kpong plant, a high-lift pumping station delivers treated water via a 54 km long pipeline (1,050 mm diameter) to the Tema terminal reservoir, a storage tank in the north of Tema. The maximum output of this station is about 172,800 m^3/day. From the Tema terminal reservoir, the water is pumped by the Tema booster station through a 22.6 km long steel pipeline (800 mm diameter) to the Accra reservoir. The maximum output of the Tema booster is about 99,600 m^3/day. The Tema terminal reservoir also supplies the following, directly by gravity via a series of pipes: the town of Tema (via a 1,050 mm diameter line), the central area (via a 400 mm diameter line passing through the Old Tema reservoir of a capacity of 11,365 m m^3), and the east of Tema and eastern areas.

The Accra terminal reservoir supplies the Accra Low Pressure Zone by gravity via an 800 mm diameter main pipe and also feeds the Okponglo booster station. This station has two different sets of pumps that supply, respectively, the Medium Pressure Zone with its balancing tank at Okponglo and the High Pressure Zone via the Legon University service reservoir. The supply mains between Kpong and the Tema and Accra terminal reservoirs were highly corroded both externally and internally in 2003, compromising their reliability. (Columbia University, 2003)

Getting water from Kpong poses a challenge because of the distance and flat topography between the Volta lake and Accra. The cost of production is raised by the energy cost to pump the water in several points to maintain a pressure in the pipes. Energy consumption is higher from Kpong than from Weija, due to the long pumping distance to Accra whereas distribution from Weija is based on gravity. The total energy consumption for water production and distribution in 2004 was 101,900 MWh (842 Wh/m^3) (Uusitalo, 2002). The all inclusive costs of water production, including the use of chemicals and pumping, is much lower at Weija (0.10 GHC/m^3) compared to water from Kpong (0.22 GHC/m^3) (personal communication Michael Amuaka, 2008).

Water delivery

GWCL/AVRL provides direct services to people with a domestic connection. In addition, it provides piped water to private service providers like water vendors (standpipes), tanker services and sachet and bottled water producers. It also provides water to industries and private and governmental institutions. The table below gives an overview of the number of main water supply clients for each of the three GWCL-AVRL regions in the Greater Accra Metropolitan Area (for the full overview of clients and water use, please see annex 6).

Table 7: Average number of AVRL clients in 2007

Area	Tanker services	Metered household connections	P'stand unmtd	Standpipe mtd	Sachet water producer	Bottled water producer	Commercial sales	Industrial sales	Institution (private)	Institution (gov't)
Accra East	1	57,342	1	73	0	1	11,869	58	453	1,057
Accra West	9	56,329	1	40	0	0	6,515	65	653	336
Tema	4	40,647	0	201	218	3	7,513	95	258	488
Total GAMA	14	154,318	2	313	218	4	25,897	218	1,364	1,880

Source: AVRL, 2008 (data 2007)

The preferred water delivery option under this model is the household connection, supplying eight to 15 people per connection. The (design) amount of water to be delivered by GWCL/AVRL to household connections differs over the different income groups, as can be seen in the table below.

Table 8: GWCL design parameters

Income Group	Per Capita consumption (lpcd)	Average Resident population	Household size	Average monthly consumption (m^3 / month)
High Income	120	8	1	28.8
Middle Income	90	12	2	32.4
Low Income	60	15	>3	27

Source: GWCL, 2006 (GWCL Planning and Development Unit, (2006). Design parameters. Planning and development document for GWCL, Accra)

Many upper and middle income households have installed private water storage tanks in order to better cope with irregular water supply. In addition, according to GWCL/AVRL, hotels and households have installed inline booster pumps to increase the pressure from their taps. GWCL/AVRL claim that this contributes to reduced pressure in parts of the system. These pumps have been forbidden by GWCL. GWCL and AVRL have been seriously trying to track down the location of inline boosters and confiscate them.

5.1.2 Private independent systems

Besides private service providers using the GWCL as the source of water, either directly or indirectly, a limited number of Small Scale Independent Producers (SSIP**)** operate in GAMA, capturing, treating and distributing water from alternative sources. An example of this is a number of water kiosks, implemented by the NGO WaterHealth Ghana. These systems have either a capacity of 65,000 litres serving 3,000 people with 21 lpcd, or a capacity of 21,000 litres serving a population of 1,000 people (Puplampu, 2009).

5.1.3 Community managed water supply systems

There are four community managed piped water supply systems within the GAMA area, implemented under the Community Water and Sanitation Agency (CWSA): Abokobi, Pantang, Oyibi and Azhaaladza (see Figure 18). These are generally relatively small piped systems, supplied by a borehole with a yield of 45-50 m^3/hour (Pantang and Abokobi respectively) and an actual production of about 100,000 m^3 per year. The boreholes that supply these systems are thus generally not used to their full capacity (in Pantang the water produced was 24 percent of the borehole capacity, while this was 27 percent in the case of Abokobi) (Ampadu, forthcoming). An overview of the technical details and the performance of the Abokobi and Pantang system can be found in Annex 7.

For community managed small town systems, the recommended amount of water use per capita, per day is 60 lpcd for people with access to household connections and 20 lpcd for people getting water from standpipes. In addition, industrial and commercial demand is assumed to be 10-20 percent of the domestic demand and physical losses are assumed to be 8-10 percent (10-15 percent in case of rehabilitated pipelines) (CWSA, 2004). The number of people per standpipe should not exceed 300 persons per spout and the maximum walking distance should be 500 meters (CWSA, 2007).

Through the community managed system, water is generally provided to a number of standpipes and household connections. In Abokobi, water is supplied to 21 public standpipes and 374 household connections. There are 22 public standpipes and 267 household connections in Pantang.

5.2 Current and future demand for water supply services

Various estimates on water demand can be found in different documents. The different estimates use different amounts of water requirements per person per day and different population sizes as a basis, as can be seen in the table below.

Table 9: Water demand estimates for the GAMA area from various sources

Source	Year	Demand (m^3/day)	Based on
TAHAL, 2008	2007	474,465	Population of 3,705,136 @average 54 lpcd in the rural areas and 139 lpcd in the urban areas (see annex 8 for complete overview)
Kessie, 2007	2007	456,000	Population of 3,050,000 @ 150 lpcd
Awuah, 2007	2007	408,727	Personal communication GWCL 2007
Smit, 2007	2005	364,384	Domestic demand: 191,781 (pop 3,000,000, @ 64 lpcd), commercial and industrial demand: 82,192 (23%) and 25% leakages)

The reviewed and updated SIP (TAHAL Group, 2008) estimates the water demands for ATMA by extrapolation of the values adopted by the SIP 1998, which were based on data on water production, water consumption by domestic, institutional, commercial and industrial consumers. See table below.

Table 10: Per capita water demand adopted in the SIP Review

Year	2005	2011	2015	2020	2025
lpcd	138	141	143	144	145

Source: TAHAL Group, 2008

Based on the per capita demand and the population forecast as used by the SIP Review, the reviewed and updated SIP (TAHAL Group 2008) came up with the water demand projection as displayed in Table 12.

This table also gives the projected water demand using three additional scenarios, based on three population growth scenarios as presented in chapter 2, and based on different projections of economic growth. These scenarios are:

- A "high water demand" scenario with maximal population growth and higher water demands caused by economic growth
- A "medium water demand" scenario with medium population growth and economic growth, resulting in an increase of in water demand
- A "low water demand" scenario with minimum population growth and no economic growth

For the scenario without economic growth, we assume a steady total water demand of the equivalent of 130 lpcd (based on a well-off population of 73 percent of the total population with a demand of 150 lpcd, and a poor population of 27 percent poor, with a demand of 75 lpcd[10]). For the cases with economic growth, we estimate an increase in the proportion of the population with a higher daily water demand rate. The table below gives an overview of the estimated equivalent per capita water demand in the three scenarios.

Table 11: Per capita water demand adopted for this study

	2007	2011	2015	2025	2030
Without economic growth	130	130	130	130	130
With economic growth	130	133	135	142	145

This does not mean, however, that this is the amount of water that households will receive, as this amount includes physical losses in the system and water use for industrial and commercial use. Estimating physical losses to be 20 percent, and estimating the industrial and institutional used to be about 25 percent, the amount of water available for households will be about 41 lpcd for poor and 83 lpcd for rich households. Increases in per capita water demand can thus both be due to increased water use at the household level because of increased wealth, but also to rise in industrial and commercial water demands.

The projected water demands according to these three scenarios and according to the revised SIP are presented in the table and graph below.

[10] According to Sarpong Manu and Abrampah (2006), water requirement rates that should be used in the design of urban systems are 75 to 150 lcpd.

Table 12: Water demand estimation for GAMA (m^3/day)

	2007	2011	2015	2025	2030
High water demand scenario (max pop growth, economic growth)	510,967	652,094	840,127	1,652,499	2,371,666
Medium water demand scenario (medium pop growth, economic growth)	480,402	584,345	710,502	1,156,411	1,474,128
Low water demand scenario (min pop growth, no economic growth)	447,924	513,178	587,939	826,023	979,089
Scenario from SIP review	474,465	554,988	647,363	931,746	

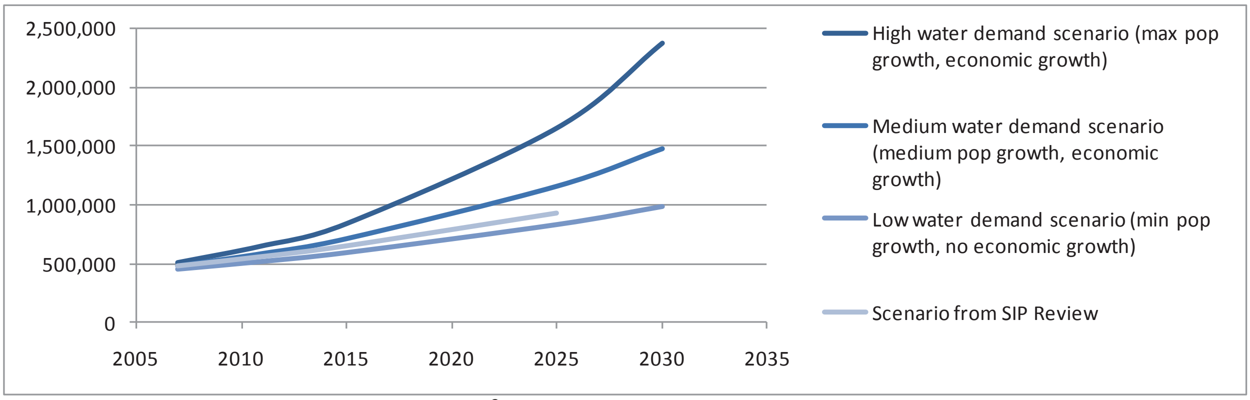


Figure 21: Projected water demand (in m^3/day)

Taking into account economic growth, the water demand will grow more than the population growth. The table below shows that in the high water demand scenario, the demand will increase to 4.6 times the estimated 2007 water demand, or more that 6.5 times the amount of treated water that was actually produced in 2007. In the low water demand scenario, demand will increase by a factor of 2.2 and by a factor of 2.7 related to the 2007 water demand and the amount of treated water produced respectively.

Table 13: Projected 2030 water demand increase

Water demand (m^3/day)	% of 2007 demand	% of 2007 production
High water demand scenario (max pop growth, economic growth)	464%	652%
Medium water demand scenario (medium pop growth, economic growth)	307%	406%
Low water demand scenario (min pop growth, no economic growth)	219%	269%

5.3 Access to water supply services

This section describes access to different water supply services and the barriers that people face. The services provided by GWCL, intermediate providers, small scale independent providers and community managed service providers are described in terms of quantity and quality of the supplied water and accessibility and reliability of the services. Furthermore, actual consumption and user costs for the different water services are analysed and presented.

5.3.1 Access to the GWCL system

Water use from the GWCL water services

The total amount of GWCL water sold[11] in GAMA in 2007 was 53,718,987 m^3 (147,175 m^3/day). Divided over the projected number of GAMA inhabitants in 2007, this amounts to an average of 37 to 43 litres per capita, per day. Of this, a bit more than half was sold from domestic metered taps, as visualised in the graph below. The rest was mainly sold for commercial (including tanker operators), industrial and institutional use. Minor qualities were sold to bottled water producers, sachet water producers and metered and unmetered standpipes.

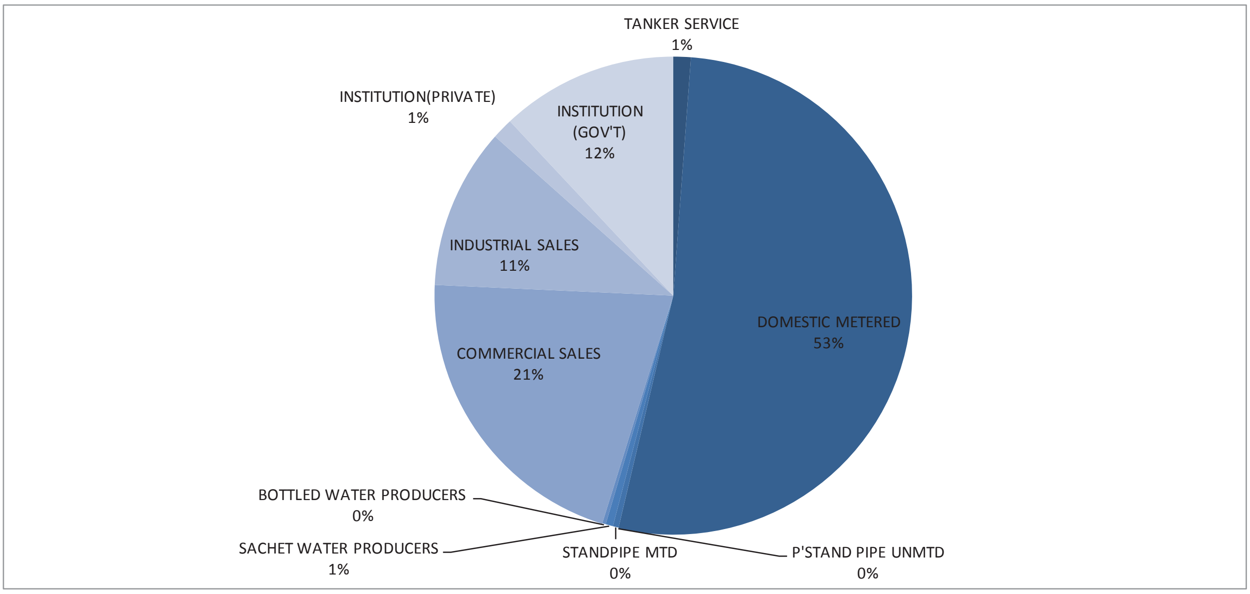


Figure 22: Water use from GWCL/AVRL
Source: AVRL 2008, data from 2007

The amount of water sold was about 40.5 percent of the amount of water actually produced in 2007, which means a non revenue water rate of 59.5 percent. Non revenue water is caused by both physical losses, estimated by Lievers and Barendregt (2009)[12] to be 45 percent of the total non revenue water, as well as economic losses, estimated to be 55 percent of the total non revenue water. Commercial losses are thus estimated to amount to about 33 percent of the actual produced water and the physical losses to about 27 percent.

Subtracting the physical losses from the amount of water produced gives an indication of the amount of water actually used in the city, whether officially sold or not. In 2007, this was 97,152,814 m^3 (266,172 m^3/day), or an equivalent of about 68-77 litres per GAMA inhabitant, per day. Part of this water was sold for industrial and commercial uses. Subtracting the amount used for commercial and industrial uses, leaves 80,065,198 m^3 (219,357 m^3/day), or the equivalent of 56-64 litres per GAMA inhabitant, per day. This is the estimated average amount of GWCL supplied water used per person for domestic uses. The table below gives an overview of these figures[13].

[11] See annex 6 for details

[12] based on unpublished 2009 AVRL data

[13] It should, however, be mentioned that the accuracy of the estimation of the amount of water sold is low because of a lack of working domestic meters. About 55 percent of the billed customers are billed on flat rate, rather than on actual amount of water consumed. (Lievers and Barendregt, 2009)

Table 14: Water production, sale and use in GAMA (2007)

	Amount of water (m^3)	Amount of water (m^3/day)	Lpcd, according to max pop growth scenario	lpcd, according to min pop growth scenario	% of amount of water produced
Produced	132,689,581	363,533	92	106	
Sold	53,718,987	147,175	37	43	40%
Non Revenue Water (= produced - sold)	78,970,594	216,358	55	63	60%
Commercial losses (= 55% of NRW)	43,433,827	118,997	30	35	33%
Physical losses (= 45% of NRW)	35,536,767	97,361	25	28	27%
Delivered (=produced - physical losses)	97,152,814	266,172	68	77	73%
Domestic use (=delivered – amount sold for commercial use - amount sold for industrial use)	80,065,198	219,357	56	64	60%

Source: Based on data from AVRL, 2007 database

The table below presents the water use per connection for household connections and metered and unmetered standpipes, showing an average water use of 501 litres per household connection. Assuming an average number of people per household connection of 10, average consumption would be 50.1 lpcd. However, as mentioned in chapter two, many people in GAMA live in compound housing, often sharing a single household connection with 20-50 people. The amount of water sold per unmetered standpipe indicated in the table below, is enough to provide 20 lpcd to 58 people, while the amount of water sold per metered standpipe is sufficient to provide 91 people with 20lpcd. As this seems very low, it could be questioned how reliable this data on standpipes is, which suggests more research is needed.

Table 15: Average water use per connection (litre per day)

GWCL/AVRL region	Domestic metered	Unmetered stand pipe	Metered stand pipe
Accra East	425	1793	317
Accra West	566	0	2090
Tema	518	0	2332
ATMA (GAMA)	501	1,160	1,832

Source: AVRL, 2007 database (based on average 2007 monthly water use per connection)

There are big differences in the amount of water used between households from different wealth classes. Based on customers' consumption information from 2004 – 2008[14], Lamptey (2010) analysed domestic water consumption for households from different wealth classes, with household connection to the GWCL system with different flow conditions, ranging from continuous flow to intermitted poor flow in Accra East. The table below presents his findings. It shows a wide range in actual water consumption, ranging from 138 lpcd for high income households with continuous flow conditions, to 43 lpcd for poor households with poor intermitted flow conditions.

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[14] Based on 800 service accounts, randomly selected from 11,000 domestic customers. Source: Processing Unit of Accra East Region of GWCL/AVRL.

Table 16: Per capita consumption in income groups under different flow conditions

Income group	Flow condition		
	Continuous	Intermittent Good	Intermittent Poor
High Income	138 l/c/d	110 l/c/d	75 l/c/d
Middle Income	90 l/c/d	83 l/c/d	54 l/c/d
Low Income	66 l/c/d	56 l/c/d	43 l/c/d

Source: Lamptey, 2010

Households using water for small enterprises use more water than people using water for domestic uses only. Based on a number of interviews with small entrepreneurs, Abraham et al *(*2007) estimate that depending on the size of the enterprise, households may use 30-400 litres per day of additional water for productive uses. The table below gives an overview of a variety of productive uses of water.

Table 17: Productive uses of water in Accra

Description of enterprise	Water use (litres/day)
Tea and beverage	34 – 140
Chop bar	170 – 370
Restaurant	1000
Beauty salon	200 – 400
Livestock	220 – 350

Source: Abraham et al, 2007

Water quality of the GWCL water services

The quality of water supplied by GWCL can generally be considered good. However, Lulani et al (2008) identified a number of incidents in both the treatment and distribution systems that have a negative effect on the water quality. At the treatment plant level, these incidences include power outages, algae clogging filters, inadequate disinfestations, filter backwashing problems and no coagulation. In addition, contamination in the distribution system and pollution entering part of the system without pressure were identified as having a negative effect on water quality.

Reliability of the GWCL water services

Water supply from GWCL is irregular and unreliable in a big part of GAMA. According to Yepes et al (2000), GWCL has been rationing water on a trial-and-error base since 1996. The rationing programme is executed by the distribution officer, who operates valves to direct water to communities during the rationing. However, Lamptey (2010) notes there are circumstances where the officer forgets to re-direct the supply to certain areas. According to GWCL/AVRL management, the rationing programme is disrupted as well by private water filling points in the distribution areas, as they disturb the service pressure during the rationing period.

The figure below shows the current (2008) areas with good, intermediate, rationed and no or poor water supply from GWCL in GAMA. The figure shows that areas closer to the pipelines have generally better access to good water supply from the utility. The areas on the fringes of Accra are worst off, having little reticulation and no-to-poor water supply. The Teshi Nungua area is located at the end of both the pipes coming from Weija, as well as the one coming from Kpong. As illustrated in this figure below, this area is affected by no-to-poor water supply as well.

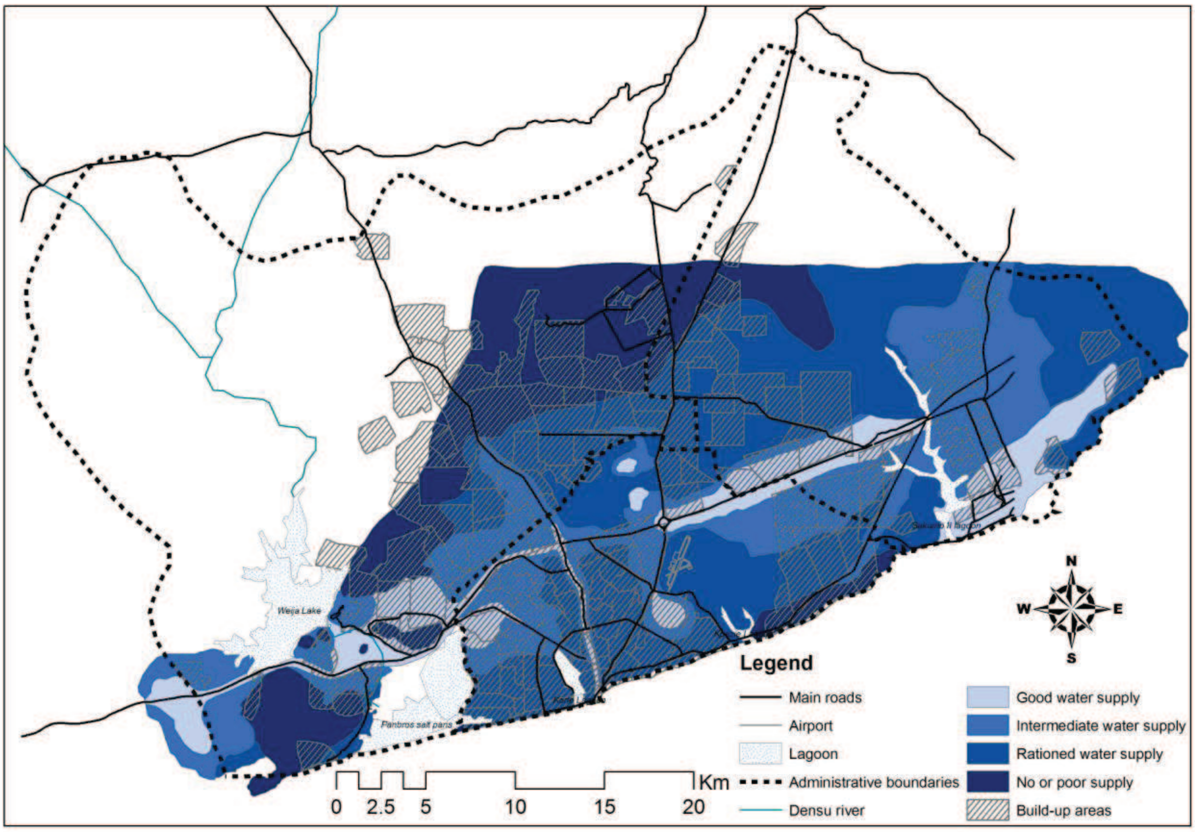


Figure 23: GWCL/AVRL water supply services in GAMA
Source: AVRL GIS unit, 2008

A number of studies have been done on the reliability of water supply from GWCL. The table below gives an overview of the results of some of these studies.

Table 18: Availability of water supply from GWCL

<table>
<tr><th></th><th colspan="4">% of population</th></tr>
<tr><th>Source: / Frequency of availability of water</th><th>Nii Consult (2003)</th><th>WaterAid (2005)</th><th>Lundéhn and Morrison (2007)</th><th>Nyarko, Odai, Owusu and Quartey (2007)</th></tr>
<tr><td>Every day</td><td>30</td><td>25</td><td>9.4</td><td>17</td></tr>
<tr><td>5-6 days per week</td><td>30</td><td rowspan="5">75</td><td rowspan="5">90.6</td><td>6</td></tr>
<tr><td>3-4 days per week</td><td></td><td>16</td></tr>
<tr><td>2 days per week</td><td>25</td><td rowspan="2">33</td></tr>
<tr><td>1 day per week</td><td rowspan="2">15</td></tr>
<tr><td>No water</td><td>7</td></tr>
</table>

Lamptey (2010) presents data on planned and actual water supply in seven high income, seven middle income and seven low income areas in Accra East with rationed water supply, as summarised in the table below. This suggests that although high income areas are scheduled to receive water over longer periods than the low income areas, in reality they received water for slightly shorter periods than the low income areas.

Table 19: Reliability of GWCL water supply (in East Accra)

	Planned supply		Actual supply		
Type of area	Hours/month	% of month with planned water supply	Hours/month	% of month with actual water supply	% of planned
High income area	507	69%	145	20%	29%
Middle income area	398	54%	171	23%	43%
Low income area	233	32%	211	29%	91%

Source: Lamptey, 2010

It could be concluded that high and low income areas experience almost the same level of unreliability of GWCL water supply. However, households in high and middle income areas are likely to cope better with the unreliability of water supply, as they often have storage tanks in which they capture and store water to be used in times of rationing.
In order to be connected to the GWCL-AVRL network, consumers have to pay connection costs. These amount to GH¢80-100 (Eguavoen and Spalthoff, 2008) per connection (which amounts to GH¢8-¢10 per person, assuming an average number of people per connection to be 10). Other investment costs can include the installation of a water tank, starting from GH¢120 for an 800-litre tank (MIME Consult, 2004), and / or a booster pump which amounts to about GH¢300-800. The connection procedure requires that that the client is able to provide proof of ownership of the property to be connected, which makes it difficult for tenants to get connected.

Users connected to the GWCL network pay a water tariff according to the amount of water used. Consumers either pay a flat rate or according to an increasing block tariff, displayed in the table below as determined by PURC (see Box 3). A compound house connected to the piped network with 12 people, each using 60 lpcd, will use more than 20 m^3 per month and will thus have to pay according to the higher tariff.

Table 20: Water tariffs 2008

	Monthly charges (in GH¢ per 1 m^3)
Domestic (metered)	0-20 m^3 (lifeline tariff) = 0.66 >20 m^3 = 0.91
Metered public standpipes	0.66
Commercial/industrial/private/public institutions	1.10
Special commercial rate	2.04

Source: PURC, 2009

The special commercial rate is applicable to industries that use a lot of water, like water bottling companies, coca cola etc. Tanker operators pay the commercial rate at the filling points. Sachet water producers are supposed to pay a commercial rate as well.

Box 3: Regulation of water service providers

The Public Utilities Regulatory Commission (PURC) is responsible for the economic and drinking water quality regulation for GWCL water supply services. It is also responsible for the approval of rates chargeable for the provision of utility services, including electricity and gas. The commission was established by the Public Utilities Regulatory Commission Act, 1997, Act 538. It is an independent body (section 4 of the Act 538) and is not subjected to direction or control of any authority in the performance of its functions. For administrative purposes, however, PURC falls under the Office of the President. Members of the PURC include civil society representatives, including representatives of the Trades Union Congress (TUC) and the Consumer Association in Ghana. This brings up the question of how much strength do consumers have and whether they are aware of what the influence they have as members of the PURC.

The key functions of the PURC include:

- the provision of guidelines on, and the examination and approval of rates chargeable for, provision of utility services
- the protection of the interest of consumers and providers of utility services
- the promotion of fair competition among public utilities
- the initiation and conduct of investigations into standards of quality of services given to consumers
- monitoring the standards of performance for provision of services

By its mandate, the PURC is responsible for tariff setting and regulation of services provided by GWCL, but in practice GWCL proposes the tariff for the PURC to endorse. GWCL regulates its own standards for the quality of service and PURC only conduct investigations based on complaints. This is to ensure accountability of the utility to the consumer. This is supported by regulations known as the Public Utilities (Complaints Procedure) Regulations, 2000, LI 1665, which came into force in January 2000 after the due parliamentary process. The regulations give the opportunity to any person with a complaint against GWCL to complain to the PURC. The PURC, however, encourages complainants to first deal with GWCL themselves. Rather than filing a complaint with the PURC, it seems that most consumers choose to air the grievances through the media.

Even though the PURC is aware of the existence of secondary and tertiary providers, they are neither formally recognised nor registered. They are also not well organised. Recently, however, tanker guidelines (2008) have been developed for members of the tanker associations to regulate the quality of water supplied.

In areas not supplied by GWCL but by systems under community management, Water and Sanitation Development Boards, set their own tariffs, which are then approved by the respective district or municipal assembly.

5.3.2 Private intermediary (secondary and tertiary) service providers

As mentioned above, a large part of people living in GAMA depend on alternative service providers as they lack direct access to the GWCL system. The majority of these alternative service providers depend on GWCL as their source of water, either directly, or indirectly. Here, we will have a closer look at these intermediary service providers and the services they provide.

Domestic vendors sell water from storage tanks built either underground or on overhead polythene tanks. The storage volume ranges from 1,000 gallons to 5,000 gallons (3.8-18.9 m^3). Water is bought from tankers and sold directly to households, who collect water in 18 or 20 litre containers. The vendors are mostly women and are often low income earners who rely on this as a main source of livelihood (Sarpong Manu and Abrampah, 2006). Domestic vendors can mostly be found in densely populated, low class and indigenous areas, within the reach of the tanker services. Unlike domestic vendors, neighbourhood sellers do not rely on tanker services, but sell water from the GWCL mains directly. Neighbourhood sellers can mostly be found in densely populated, low class and indigenous areas, within the reach of the GWCL system. GWCL does not recognise domestic vendors and neighbourhood sellers, as they consider these vendors to be partly to blame for the inability of some residents to get their supply. (Sarpong, Manu and Abrampah, 2006)

The reliability depends on the reliability of the tanker or GWCL supply and the storage capacity of the vendor or seller.

People depending on domestic vendors and neighbourhood sellers generally use less water than people connected to the GWCL system. Abraham et al (2007) estimate water use for these people to be 25-60 lpcd. Field data from a study done by Sarpong Manu and Abrampah (2006) suggests a poor household uses about 180 litres per day, which would only be about 18 lpcd, assuming a household size of 10 persons.

Sarpong and Abrampah (2006) mention there are quality concerns related to the fact that water is handed over at various points (network – tanker- vendor-client), which all pose potential points of contamination.

The vending points are only accessible during opening hours when people often have to queue for long periods of time. The costs of fetching water from neighbourhood vendors vary depending on the area. Van Rooijen et al (2008) found water fees per m^3 in Sukura and Old Fadama to be about 3 and 6 GH¢/m^3 respectively (which is 4-9 times the price of piped water supply). This difference in price is influenced by the fact that Sukura is a formal low income settlement with some water supply infrastructure, while Old Fadama is an informal settlement where connections to the utility are officially not permitted. There is a monopoly amongst private vendors and prices are agreed upon. In times of scarcity, especially during the dry season, the price in Old Fadama goes up to about 11.5 GH¢/m^3 (18 times the official price for domestic users). (Van Rooijen et al, 2008)

In order to lower the prices from domestic vendors supplied by tanker services, AVRL piloted tanker service supply in a number of areas in Accra with poor water supply. These areas included Osu, La Central, Dome, Taifa and Kwabenya. Water was sold to the AVRL tankers at the subsidised rate of 1.14 GH¢/m^3, while other tankers buy at 2.03 GH¢/m^3. At the vending points supplied by the AVRL water tankers, water was sold to consumers at 0.05 GH¢ per 20 litres (2.50 GH¢/m^3), as opposed to the fees of 0.10 to 0.20 GH¢ per 20 litres (5 to 10 GH¢/m^3) charged by other vendors in the area (Tuffuor, 2009). However, the desired effect of lowering vendor prices was not achieved. People continued to patronise the more expensive water vendors if they were located closer to the house. Distance and convenience seemed to play a more important role than price in deciding from where to buy. (Tuffuor, 2009)

Tanker services supply water to households directly and to other intermediary service providers. The size of the tanker trucks range from 1,200 to 3,500 gallons (4.5 to 13.3 m^3) and in very exceptional cases 4,000 and 4,500 gallons (15.1-17.0 m^3). The tankers are owned by individuals who for operational purposes have formed associations (see annex 9 for an overview of tanker associations). In 2006, there were seven major associations operating, serving the areas indicated in the figure below. Tanker associations have a formal relationship with GWCL (Sarpong Manu and Abrampah, 2006). Some tankers operate independently and some take water illegally from sources of disputable quality, creating a health risk for the people that they serve. In 2008, PURC launched its 'Tanker services guidelines' in order to provide guidelines for the safe and affordable supply of water by water tankers.

Tanker services deliver water to the storage facilities of individual households. The amount of water supplied depends on the storage capacity of the household. Owusu Kanin (2010) found that high income households mostly buy water in quantities of 3,000 gallons to 4,500 gallons, while middle income households generally buy 2,000 gallons and 3,000 gallons. According to his calculations based on user data, high income households supplied by tanker trucks use on average 149 lpcd, middle income households 101 lpcd and the low income 51 lpcd.

The quality of the water depends on quality of water at the source and on operation and maintenance of the tanker and household tanks. (Sarpong and Abrampah, 2006)

Tariffs charged by tanker operators are supposed to be determined through consultations between PURC and the Tanker Associations and should be based on distance and bear reference to bulk haulage rates provided by the State Transport Corporation or Ghana Private Road Transport Union. Tariffs should be published by the associations at filling points and in the media for the benefit of consumers. Owusu Kanin (2010) found that prices paid for tanker services differed between high and low income households, with high income households paying about 5.17 GH¢/m^3, middle income households paying about 5.3 GH¢/m^3 and low income households paying about 7.2 GH¢/m^3. He attributes this difference to the fact that high income households are able to buy water in larger quantities than poor households.

Sachet water is a popular source of drinking water and abundantly available for sale in shops and on the street throughout GAMA. It is produced by a large number of sachet water producers, many of whom can be found in Tema. They obtain water either from the tanker trucks or directly from the utility mains. Water is filtered, sealed in 0.5 litre polythene plastic sachets, and sold to retailers who resell them either individually or in 30 piece packages. The popularity of sachet water can be seen as an indication of the lack of public confidence in the quality of the water supplied by GWCL (Sarpong Manu and Abrampah, 2006). The quality of sachet water is generally considered to be good, even though there is evidence that some sachet water produced actually delivers water of lower quality than that of the utility. Kwakye-Nuako et al (2007) mention a study on 27 different sachet brands that found the presence of pathogenic parasitic organisms in 77 percent of the cases. Sachet water is sold at 0.05 GH¢ per 0.5 litre bag (100 GHC/m^3) or at 1 GH¢ per 30 bags (67 GH¢/m^3).

5.3.3 Independent private producers

Water Health Centres can be considered independent private producers (managed in partnership by WaterHealth and the community), not connected to the GWCL network. Four of these Water Health Centres can be found in the North Western part of GAMA (see Figure 18). The centres are designed to supply 20 lpcd. The quality of water produced by these centres is high. The centres are accessible during operation hours when water can be fetched from these centres by bucket or basin. Based on the data from the Pukuase Health Centre, as presented by Puplampu (2009), the average amount of water used was only about 3 lpcd in during the first half of 2009. As this amount is insufficient for all (domestic) uses, the service was probably only used for a limited number of (domestic) uses, mostly drinking. Other sources are used for activities like washing and doing laundry.

The costs of fetching water from a Water Health Centres is 0.10 GH¢ per 20 litre (5 GH¢/m^3) (Puplampu, 2010), which is significantly more than water provided though the utility or community managed systems under CWSA (see below).

5.3.4 Independent community managed water supply

In the community managed systems in the peri-urban communities of Abokobi and Pantang the average capita water use was found to be about 15 lpcd and 11 lpcd respectively (Ampadu, forthcoming). However, the amount of water used seems to differ greatly between people with access to standpipes and people with household connections. The average amount of water sold from the standpipes was 4-6 lpcd (in Pantang and Abokobi respectively). This would mean that the vast majority of households depend on alternative sources for their water supply, like nearby streams and dugouts. The average amount of water consumed from each household connection was estimated to be about 307 and 374 l/day for Abokobi and Pantang respectively, which would roughly be 31 and 37 lpcd, assuming an average household size of 10 people (for details see annex 7). The non revenue water rate in the small community managed systems Abokobi and Pantang amounts to about 42 percent and 40 percent respectively, which is lower than the non revenue rate of the utility managed system. (Ampadu, forthcoming)

The tariff in the community managed systems of Abokobi and Pantang has been set at 0.03 GH¢ per 18-litre bucket (1.66 GH¢/m^3). In addition to the water fees, the community had to contribute five percent of the total capital investment costs before the implementation of the system, in accordance with the National Community Water and Sanitation Programme, under which the systems have been implemented. Bismark (2009) found capital investment costs of community managed systems in the Greater Accra Region to range between 58 to 150 Ghana cedis per served capita (using 2008 as the common base year), which, assuming five percent community contribution, would amount 2.9 to 7.5 GH¢ per capita. However, as indicated by Nyarko et al (2007), the community contribution was reduced to 2.5 percent due to concerns about the ability to pay by small towns and seems to have been abolished since.

5.3.5 Overview of costs of water services

As illustrated in the figure below, consumers who rely on alternative providers generally pay much more per unit of water fetched than people connected to the utility.

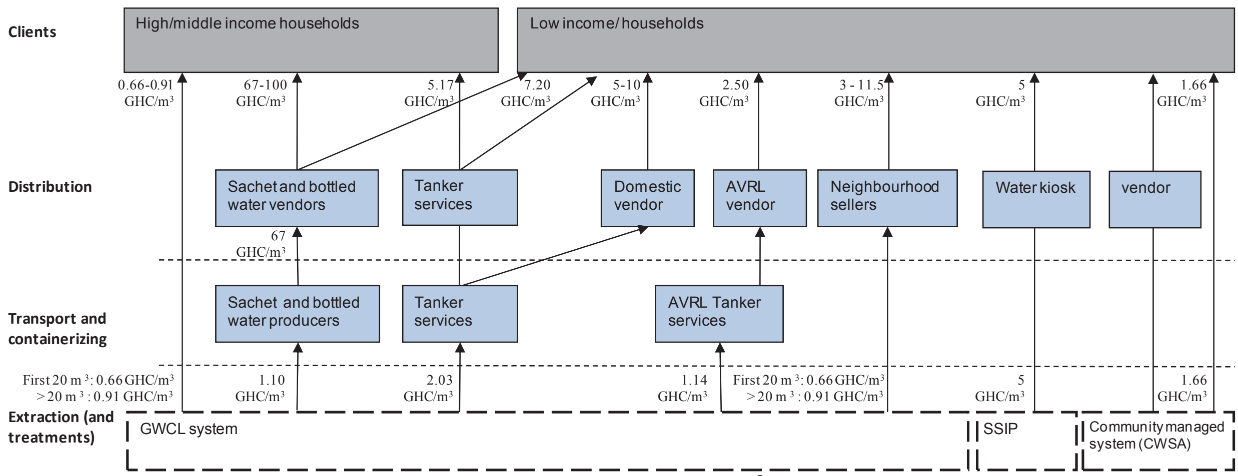


Figure 24: Urban water supply chain and water tariffs (in GH¢/m^3)

The table below gives a summary of the different service providers. It shows the quantity of water used per capita, per day, the tariff and the average monthly expenditure on the services of high and low income households receiving water from the different service providers. This is visualised on the figure below.

The table shows that low income households tend to spend more on water supply than high income households. For example, a high income household with a GWCL household connection, using between 75 and 138 lpcd, paying 0.66 GH¢ per m^3, spends between 1.49 and 2.73 GH¢ per capita per month (providing the total amount of water used is less than 20 m^3 per month). A low income household depending on a water vendor, using only 25 to 60 lpcd, paying between 3 and 11,5 GH¢ per m3 of water, will spend between 2.25 and20.70 GH¢ per capita, per month.

It also shows that people with household connections or using tanker services consume a considerably higher amount of water than people who depend on other service providers. Water use from community managed standpipes and independent water kiosks is not sufficient to cater for all (domestic) uses, which means households depending on these service providers also have to use other sources of water to satisfy their daily water demands. The table also shows that in many cases low income households pay more for less water, especially when they depend on vendors or neighbourhood vendors.

What is not reflected in this table is the fact that people in compound houses tend to share one connection, using a total amount of water exceeding 20 m^3 per month, thereby paying a higher tariff.

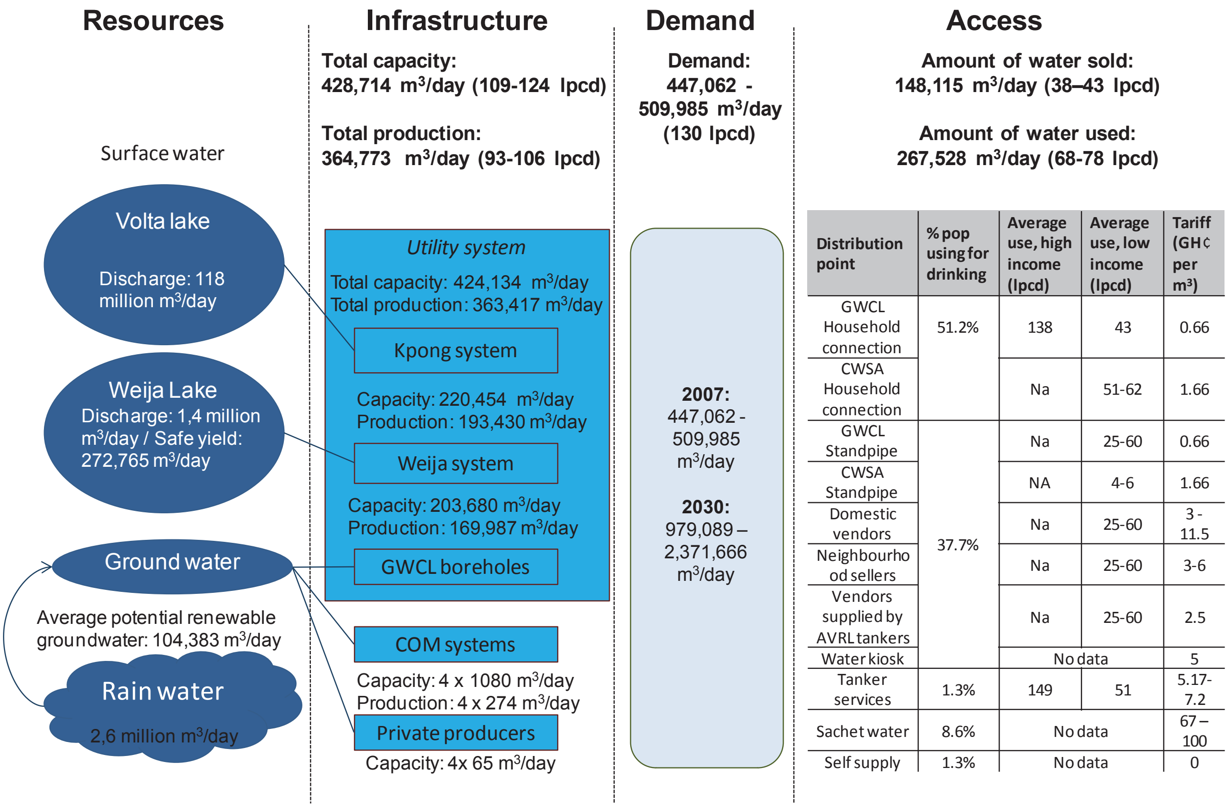
Table 21: Overview of access to distribution points

Type of distribution point	% Pop with access (source: GSS 2008)	Distribution point	Quantity of water used, high income, min (lpcd)	Quantity of water used, low income, max (lpcd)	Tariff (GH¢/m^3)	Average monthly expenditure, high income (GH¢ / capita)	Average monthly expenditure, low income (GH¢/capita)
Household connection	51.2%	GWCL household connection	75 - 138	43 - 66	0.66	1.49-2.73	0.85 - 1.31
		Household connection community managed system	-	51-62	1.66	Na	2.54 - 3.09
Vendor	37.7%	GWCL standpipe	-	25-60	?	Na	?
		standpipe community managed system	-	4 - 6	1.66	Na	0.2 - 0.3
		Domestic vendors	-	25 - 60	3-11.5	Na	2.25 - 20.70
		Neighbourhood sellers	-	25 - 60	3-6	Na	2.25 - 10.8
		Vendors supplied by AVRL tankers	-	25 - 60	2.5	Na	1.88 - 4.50
		Independent water kiosk (Water Health)	-	3	5	Na	0.3
Tanker service	1.3%	Tanker services	149	51	5.17-7.20	23.11	11.02
Sachet water	8.6%	Sachet water	No data	No data	67 - 100	No data	No data
Self supply	1.3%	Self supply	No data	No data	No data	No data	No data

5.4 Current and future water supply challenges

The figure below gives an overview of the water Resources and water supply Infrastructure, Demand and Access (RIDA). It shows that at the moment the availability of water resources for the supply of water to the city of Accra is not a major issue. In the future, availability of water resources is not likely to be a major issue either. Even in the worst case scenario, with maximum decreased flow levels in the Volta and maximum upstream water demand, the average discharge of the Volta would be almost 25 km^3/year in 2025. Comparing this with the maximum 2030 GAMA water demand of about 0.866 km^3/year (2,371,666 m^3/day), this means that the maximum demand will only be 3.5 percent of the Volta discharge. However, the future lowering of water levels caused by climate change and the increase in upstream water use, could have a negative impact on the functioning of the current intake and treatment infrastructure at Kpong and on the costs involved in acquiring and transporting water from Kpong to the city of Accra.

The figure also shows that the vast majority of water produced to serve the Greater Accra Metropolitan Area (99.2 percent) is produced by the GWCL system.



Distribution point	% pop using for drinking	Average use, high income (lpcd)	Average use, low income (lpcd)	Tariff (GH¢ per m³)
GWCL Household connection	51.2%	138	43	0.66
CWSA Household connection		Na	51-62	1.66
GWCL Standpipe	37.7%	Na	25-60	0.66
CWSA Standpipe		NA	4-6	1.66
Domestic vendors		Na	25-60	3 - 11.5
Neighbourhood sellers		Na	25-60	3-6
Vendors supplied by AVRL tankers		Na	25-60	2.5
Water kiosk		No data		5
Tanker services	1.3%	149	51	5.17-7.2
Sachet water	8.6%	No data		67 – 100
Self supply	1.3%	No data		0

Figure 25: Overview of the 2007 water supply situation in the Greater Accra Metropolitan Area.

Looking at this figure, a number of challenges become apparent:

- The water demand is higher than the capacity of the systems providing services to GAMA (the design capacity was 84-96 percent of the 2007 demand, while the 2007 production was 72-82 percent of 2007 demand)
- The systems are not used to their full (design) capacity (production is 85 percent of design capacity)
- The amount of non-revenue water is very high (59 percent)

- Low income households use less water than high income households but pay more per unit water

In addition, a major challenge as identified above is the reliability of the GWCL system. Below we will have a closer look at these challenges and their root causes.

5.4.1 Water demand is higher than the capacity of the system(s)

From the above, it is clear that in 2007 the estimated optimal water demand was slightly higher than the amount of treated water produced in the Greater Accra Metropolitan Area, which is estimated to be between 71 and 81 percent (depending on the population growth scenario) of the water demand in that year. The low supply is to some degree caused by the fact that the GWCL head-works are working under their capacity (for the Kpong system, production was 88 percent of the capacity in 2007, while this was 83 percent for the Weija system). Even when working at full capacity, the demand would slightly outweigh system capacity. However, the fact that the difference between water demand and production is relatively small, seems to suggest that on the short term, production capacity is not a major challenge. In the longer term, however, water demand is expected to increase considerably, due to population and economic growth (to between 2.7 and 6.5 times the 2007 amount of water produced by 2030 in the best and worst case scenario respectively). Therefore, the capacity of the system(s) supplying water to GAMA will have to be increased and / or the demand will have to be decreased.

5.4.2 High rates of non revenue water in GWCL system

More so than the discrepancy between water supply and water demand, the considerably larger difference between the amount of water produced and the amount sold in 2007 is cause for concern and short term action. As presented above, non revenue water was estimated to amount to about 59 percent of the amount of water produced. This was both due to physical losses, to which about 27 percent of the actual produced water was lost, as well as economic losses, which were estimated to be 33 percent of the water produced.

Physical losses in the system are to a large extent caused by the bad state of the distribution infrastructure. This is aggravated by the limited leakage detection system and a lack of bulk water metering within the system. The bad state of the distribution infrastructure can be attributed to lack of maintenance, replacement and rehabilitation. This is likely to be (partly) caused by the lack of financial resources available to GWCL, because of high commercial losses, uneconomical tariffs and the lack of investment by government and external donors in maintenance, replacement and rehabilitation (CapManEx).

Causes of the commercial losses include inaccurate recording of customer meters, inaccurate data recording, estimation and use of flat rate water rates, ineffective revenue collection procedures and illegal consumption and connections. The occurrence of illegal connections and consumption has a number of underlying causes. People struggle to get connected due to complicated procedures and legal boundaries. In order to get connected, proof of ownership has to be submitted to the utility. People living in rented houses, which was shown in chapter two to be almost 46 percent of the GAMA population, are unable to do so and are therefore unable to connect. In addition to this, the connection costs are relatively high.

5.4.3 Low reliability of GWCL water services

As presented above, reliability of the GWCL water supply is a big issue for the population of Accra connected to the GWCL system. The low reliability is to a large extent caused by the fact that demand is higher than the supply, resulting in rationing of the water supply. Reasons for the low supply are diverse. These include low system capacity, high physical losses in the distribution system, stealing of water and the presence of in-line booster pumps which, according to GWCL/AVRL, disrupt the distribution of water in the system. Ironically, one of the reasons people and businesses put in an in-line booster is because of the unreliability of the GWCL system.

5.4.4 Low income households depend on expensive alternative service providers

The GWCL system is the source of water in GAMA. The GWCL system contributes to 98.6 percent of the total capacity of water supply systems in GAMA and to 99.2 percent of the amount of water produced. However, only part (about 50 percent) of the population has direct access to the GWCL water supply services. Because of the legal and financial barriers the poor face, it is mostly the wealthier strata of the population that is connected to the GWCL network, which enables them to profit from the considerably lower rates per unit of water than people who are not able to connect.

The majority of people in the Greater Accra Metropolitan Area, especially the poor, depend on alternative water service providers. As was shown above, there are a variety of service providers, all providing different services in different areas at different rates. Rates charged by these alternative water providers are higher than the GWCL tariff. This is (partly) due to the extra costs the alternative service providers have to make in order to provide the service. This includes the costs of the water, the transport (e.g. fuel, tanker truck) and labour to sell the water to customers. Prices and quality of water provided by the alternative service providers is not regulated, as alternative providers are not formally recognised, registered and regulated.

5.5 Strategic directions

The Accra Learning Alliance defined the vision that by 2030 everyone in the City of Accra (the Greater Accra Metropolitan Area), regardless of their economic and social status, will have access to uninterrupted water supply at an affordable price within a reasonable distance from their house. Going from the current situation towards this vision, taking into account the different scenarios related to external factors (population growth, economic growth, raw water situation), will require a solid strategic plan.

This section presents strategic directions, which could form the building block of such a strategic plan. These strategic directions are:

- Decreasing demand for water
- Improving GWCL water supply services, by:
    - Increasing GWCL system capacity
    - Decreasing physical losses
    - Increasing GWCL revenues
    - Improving access to the GWCL system
- Ensuring lower water prices for low income households
- Ensuring services for people outside the reach of the GWCL network

5.5.1 Strategic directions for decreasing demand

Decreasing water demand can lessen the need for increasing system capacity, which can have a positive impact on the supply / demand ratio and the reliability of the supply. Several tools and techniques for reducing water demand by households, commercial enterprises such as hotels, and public institutions are discussed below.

In order to stimulate water saving and decreasing demand on the GWCL system, **education and awareness raising campaigns** could be implemented with targeted messages prepared for different target groups such as school children, residents, hotel owners etc. These campaigns aim to bring about voluntary behavioural changes. Although technically and politically not difficult to implement, the impact of these campaigns on people's behaviour are difficult to predict, while the costs are considerable. **Incentives**, like subsidies and tax reductions, can have a positive impact on people's choices related to the implementation of water-saving technologies at the household level. Examples of these water saving devices include rainwater harvesting, flushing toilets, showers, sink taps etc. This would, however, require good administrative systems and procedures and substantial financial resources.

By-laws that prescribe the use of water saving technologies in newly-built residential, commercial and public properties could have a positive influence on water saving. However, without enforcement, these by-laws are not likely to be enacted. The impact of this is thus expected to be limited, as is political interest and willingness to support this.

In theory, **increasing the water tariff** could lower demand for water. However the impact of this, especially on the high water consuming, high income households is questionable, especially when taking into account the fact that high income households supplied by tanker trucks, which deliver water at far higher rates than the GWCL rate, consume a more than average amount of water. Furthermore, this would be a politically unpopular measure, also discussed further below (under 'installing an economic tariff'). The table below gives a summary of the options discussed above.

Table 22: Summary of options for decreasing water demand

Option	Impact (m^3/day saved)	Costs	Time frame	Challenges	Feasible under scenario		
					WCS	MCS	BCS
Education and awareness raising campaigns	Unknown (estimate: low to medium)	Unknown (estimate: medium)	Medium to long term	Availability of human and financial resources	yes	yes	yes
Incentives for household level water saving technologies	Unknown (estimate: low to medium)	Unknown (estimate: medium- high)	Short to medium term	Availability of human and financial resources and administrative systems	no	yes	yes
Enforcement of by-laws to stimulate water saving technologies in new residential, public and commercial properties	Unknown (estimate: low to medium)	Unknown (estimate: low)	Medium to long term	Availability of human and financial resources	no	yes	yes
Increasing the water tariff	Unknown (estimate: low)	Unknown (estimate: low)	Medium to long term	Lack of political willingness	no	yes	yes

WCS = worst case scenario; MCS = Medium case scenario; BCS = Best case scenario

5.5.2 Strategic directions for increasing GWCL system capacity

To satisfy the future water demand and ensure reliable water supply, there is a need for additional system capacity. Additional treatment and system capacity for GAMA can be achieved by enhancing the capacity of the GWCL system, by linking alternative sources of water to the GWCL system, and by implementing decentralised systems, independent from the GWCL system. Here, we will have a closer look at increasing the capacity of the GWCL system, while the implementation of independent systems will be discussed in section 5.5.7.

The revised Strategic Investment Plan (SIP) of GWCL (TAHAL Group, 2008) suggests **increasing the treatment capacity of the GWCL system** to 917,990 m^3/day by 2025, by rehabilitating the current treatment systems to function at design capacity and by expanding the treatment capacity of the systems, as shown in the table below. Since capacity expansion of the Weija system is constrained by the availability of water resources, expansion will mainly have to take place through expansion of the Kpong system.

Table 23: System capacity after rehabilitation and expansion (2025), according to the SIP

System	Capacity (m3/day)
Existing (Kpong New and Weija)	386,362
Weija expansion	68,190
New WTP at Kpong	300,000
New Kpong works	127,038
Total Kpong New and Weija	881,590
Kpong old	36,400
Total	917,990

When implemented fully, it would result in a GWCL system capacity of 917,990 m^3/day, which is considered sufficient for serving a total population of 6,857,285. However, this increase in capacity would only be sufficient to satisfy the water demands in 2025 in the minimum water demand scenario. It will not be sufficient in the medium and high water demand scenario for 2025 or any scenario for 2030. In the low water demand scenario, the treatment capacity will be about 94 percent of the projected demand. In the high water demand case scenario, however, the treatment capacity will only be 40 percent of the projected demand for 2030. This needs to be addressed, either from the supply or from the demand side, or from both.

The costs of the execution of the Strategic Investment Plan are high. They are estimated to amount to 844,495,422 USD (TAHAL, 2008), which amounts to about 123 USD per person served. In addition to increasing the capacity of the GWCL system, the SIP includes activities to: improve performance of existing treatment plants; expand treatment facilities, rehabilitate and extend the distribution system; and, the construction of a number of additional standpipes. The planned rehabilitation and extension of the distribution system is intended to decrease leakages in the systems and improve system reliability. Accessibility to the system would be improved by the extended distribution network and the construction of a total of 5,880 standpipes. These activities will be discussed in more detail below.

Political support to the Strategic Investment Plan is high, but political interference in the execution of the plan is a risk. Changes in political leadership may delay the progress of the execution of the plan.

In addition to use of surface water, alternative ways of increasing the capacity of the GWCL could be explored. One such alternative option is **desalinisation of saline water**. In 2008, GWCL signed a Water Purchase Agreement with Aqualyng Ghana Limited (AGL),which is a company specialised in designing, manufacturing, installing and financing desalination plants for the production of drinking water. The Water Purchase Agreement was for the provision of 20,000 m^3/day of desalinated water to be produced in Nungua, Accra on a Build Own Operate basis (BOO) for a contracted period of 25 years (aqualyng, 2009). The plant is supposed to serve Teshie, Nungua and Lashibi. The additional capacity could serve about 153,846 people with 130 lpcd, which is about 4 percent of the current population and one to two percent of the 2030 population. The disadvantage of this option is high demands on management capacity for operation and maintenance and the high production costs of the water, which will have to be recovered from the clients.

Besides desalination of saline water, the **use of groundwater to supplement the GWCL water supply** to Accra is being explored. GWCL has drilled 13 boreholes in various parts of Accra. In the area north of Accra, groundwater is being abstracted in the Dodowa well fields to supplement the water supply in the system. These boreholes contribute an extra 1,531 m^3 per day of water (Lievers and Barendregt, 2009). Work on six of these boreholes at Tantra Hill, Dome and Ashongman is in progress. Other high yielding boreholes are to be mechanised, notably those in Fafraha and Dodowa to boost supply to Adenta and its surrounding areas. Groundwater is available and of adequate quality in the northern fringes of GAMA. Technically and financially this could be a realistic option but would require further research and analysis on feasibility and impact if seriously considered in the future.

The table below gives a summary of the options discussed above.

Table 24: Summary of options for increasing system capacity

Option	Impact (m^3/day)	Investment costs (USD / cap)	Recurrent costs	Timeframe	Challenges	Feasible under scenario		
						WCS	MCS	BCS
Expansion of the existing treatment capacity of the GWCL system (as suggested in SIP)	High (917,990)	High (123)	Unknown (estimate: low, based on production costs of 0.10 - 0.22 GHC/m^3)	Long term	Availability of financial resources	no	yes	yes
Increasing GWCL system capacity through desalinisation of saline water	Low (20,000)	Unknown (estimated: high)	Unknown (Estimate: high)	Short to medium term	High requirements on management capacity	no	no	yes
Increasing GWCL system capacity through the use of ground water	Low (e.g. Dodowa boreholes: 1,531)	Unknown (estimated: medium)	Unknown (Estimate: low)	Short to medium term	Availability of ground water resources Intrusion of saline water in groundwater	yes	yes	yes

WCS = worst case scenario; MCS = Medium case scenario; BCS = Best case scenario

However, it should be noted that increasing system capacity is only effective if it goes hand in hand with improving management and decreasing physical and commercial losses.

5.5.3 Strategic directions for decreasing physical losses in the GWCL system

Decreasing physical losses would increase the availability of water from the system, which could have a positive impact on access to reliable water services for people connected to the GWCL system or depending on secondary service providers connected to the system.

Rehabilitation of the distribution system is taken up in the GWCL Strategic Investment Plan. This would decrease leakages in the systems and improve system reliability. In addition to rehabilitation of the distribution system, the following **leakage detection** options could play an important role in the fight against physical losses in the system:

- Improve system monitoring by creating District Meter Areas (DMAs)
- Improve leakage detection by investing in leakage detection systems, equipment and staff training

Efficient detection and repair of physical losses will require a change in mentality from relying on reactive leakage management to active leakage management.

The table below gives a summary of the options discussed above.

Table 25: Summary of options for decreasing physical losses

Option	Impact	Costs (USD/cap)	Time frame	Challenges	Feasible under scenario		
					WCS	MCS	BCS
Rehabilitation of the distribution system (as suggested in SIP)	Medium (physical losses brought back from 27% to less than 20%)	High (123)	Long term	Technical difficulties	yes	yes	yes
Improve system monitoring by creating District Meter Areas (DMAs)		Unknown (estimate: medium)	Medium term	Lack of interest from investors / donors	no	yes	Yes
Improve leakage detection by investing in leakage detection systems, equipment and staff training		Unknown (estimate: medium)	Medium term	Lack of interest from investors / donors	no	yes	yes

WCS = worst case scenario; MCS = Medium case scenario; BCS = Best case scenario

5.5.4 Strategic directions for increasing GWCL revenues

An increase in availability of financial resources to the GWCL could contribute to better maintenance and hence decreased physical losses. Below, some options of increasing financial resources available to GWCL are discussed.

A first logical and necessary step towards improving GWCL's financial situation is **reducing commercial losses**. Lievers and Barendregt (2009) suggest that reduction of commercial losses will require:

- further investments in customer meters and their ongoing maintenance
- improvement of the billing management system
- community awareness raising and education in order to stimulate communities to deal with water stealing themselves
- active monitoring of the distribution system with the help of sensitised members of the community

GWCL/AVRL has ongoing programmes to reduce the commercial losses, including the visualisation and professionalisation of the rationing programme and an audit of the customer data (Lievers and Barendregt, 2009). In addition, there are plans to improve metering, both at the system and household connection levels.

The **implementation of an economic tariff** could enable GWCL/AVRL to have access to sufficient financial resources for maintaining the system. Political will to support this, however, is very low, as raising prices of basic services like water, is not very popular with the public[15], although, as shown above, it is mainly the higher income part of the population that benefits from low tariffs.

The table below gives a summary of the options discussed above.

Table 26: Summary of options for increasing GWCL revenues

Option	Impact	Costs	Time frame	Challenges	Feasible under scenario		
					WCS	MCS	BCS
Increasing tariffs	Unknown (estimate: low to medium)	Not relevant	Short to medium term	Lack of political willingness	no	yes	yes
Further investments in customer meters and their ongoing maintenance	High (commercial losses brought back from 33% to 0%)	Unknown (estimate: medium to high)	Medium to long term	Lack of political willingness Lack of willingness of investor / donor to finance	no	no	yes
Improvement of the billing management system			Medium to long term	Lack of political willingness Lack of willingness of investor / donor to finance	no	no	yes
Community awareness raising and education in order to stimulate communities to deal with water stealing themselves			Short term		yes	yes	yes
Active monitoring of the distribution system, with the help of sensitised members of the community			Short term		yes	yes	yes

WCS = worst case scenario; MCS = Medium case scenario; BCS = Best case scenario

[15] Recently (2010) there has been an upward revision of the utility water tariffs. This has led to a public outcry.

5.5.5 Strategic directions for improving access to the GWCL system

Improving access to the GWCL system will ensure people will not have to depend on expensive alternative service providers. Here, some options of increasing accessibility of the GWCL are discussed.

Expansion of the distribution system as planned under the GWCL SIP will have a positive effect on accessibility to the GWCL system. However, as mentioned above, many people, especially the lower income households, struggle to get connected to the GWCL system. The complicated procedure people have to go through to connect to the GWCL system is for many a barrier to connecting to the system. In addition, as many people in GAMA are not the owner of the house they live in, legal barriers also prevent them from connecting. **Facilitating connection procedures and putting in place measures that would enable tenants to connect** would enable new clients to connect to the system. To overcome the barrier of high connection costs, innovative financing mechanisms could be explored that enable people to connect to the GWCL system. These could include micro finance mechanisms or cross-subsidies.

However, supplying water service solely through household connections is not a realistic option for ensuring access to water supply to all in the short- and medium term, and may not be one even in the long term. Key constraints are the high population density and the unplanned nature of many part of the city, making it difficult to lay tertiary mains and service connections to the individual households. Furthermore, providing a 'formal' service to an 'informal' settlement is not a realistic option. Improved water service delivery has to go hand in hand with, not run in advance of, housing stock improvement.

In addition to the extension of the distribution system, the construction of a total of 5,880 additional **standpipes** has been proposed under the SIP. The implementation of standpipes managed by the GWCL, with fixed tariffs, could have a positive effect on the accessibility of the GWCL system for people without household connections, so they would have better access to affordable and good quality water. Technically, the implementation of standpipes is feasible in the short term, even in more densely-populated, unplanned areas. The investment costs associated with implementing standpipes are low. Politically, however, this option might run into resistance as GWCL tends to prefer household connections over standpipes.

Bulk water supply could be provided to communities which are difficult to connect because of physical (e.g. densely populated areas) and legal (e.g. informal and illegal areas) constraints. Under a bulk water supply arrangement, water is supplied to the community in bulk, either through the GWCL mains or tanker services. The community manages the distribution from the bulk water supply point onwards. This is done in the same way community-managed small town systems are managed in Ghana: through Water and Sanitation Development Boards (WSDB) consisting of representatives of the community. The WSDB is responsible for the management of the distribution system from the bulk water meter to the community standpipes. In small town systems, the WSDB proposes an appropriate water tariff, facilitated by the Community Water and Sanitation Agency (CWSA). This tariff has to be approved by the local government (municipal or district assembly). Who should set and who should approve the tariff in the case of urban water supply, and the role of the WSDB, GWCL, PURC and local government, in this is unclear at this moment. Bulk water supply could be a technically and financially attractive solution, especially for reaching the poor in densely populated unplanned areas, which are impossible to serve through the conventional system.

Table 27 summarises the options discussed above.

Table 27: Summary of options for improving access to water services

Option	Impact	Costs (USD/cap)	Time frame	Challenges	Feasible under scenario		
					WCS	MCS	BCS
Expansion of the GWCL distribution system in accordance with SIP	Unknown (estimated to be high for high and medium income areas, but low for high density, low income areas)	High (123)	Medium to long	Technical difficulties to reach densely populated areas and legal difficulties to reach informal areas.	no	yes	yes
Facilitation connection procedures for GWCL household connection	Unknown (Estimate: medium to high)	Unknown (estimate: low)	Short to medium	Political willingness and good administrative systems and procedures are needed.	no	yes	yes
Implementing GWCL standpipe	Unknown (Estimate: medium to high)	Unknown (estimate: low)	Short to medium	Resistance from GWCL and policy makers, as household connections are the preferred option	yes	yes	yes
Community managed bulk water supply from GWCL	Unknown (Estimate: medium to high)	Unknown (estimate: low)	Short to medium	Resistance from GWCL and policy makers, as household connections are the preferred option. Institutional roles and responsibilities need to be clarified.	yes	yes	yes

CapEx = capital expenditure (investment costs); Opex = Operations and minor maintenance expenditure; WCS = worst case scenario; MCS = Medium case scenario; BCS = Best case scenario

5.5.6 Strategic directions for ensuring lower water prices for low income households

As demonstrated above, the price of water services provided by alternative service providers is higher than that of the GWCL. Here, a number of interventions for lowering the prices of private service providers are discussed.

There is a need for the implementation of a **special GWCL tariff for compound houses**. The majority of the population of the Greater Accra Metropolitan Area, especially the poorer segment of the population, lives in compound housing. Compound houses with a single connection generally consume more that 20m^3/month, putting them in the higher block tariff.

In order to lower the prices of alternative service providers, there is a need for **recognition, registration and regulation of alternative service providers**. As there is no regulation of water tariffs from private water service providers, prices are generally set by the service providers themselves, based on the costs of providing the service plus a profit margin. The role of the GWCL, PURC and local government in this is unclear. There is thus a high need for clarifying roles and responsibilities related to registration and regulation of these water service providers, especially related to the setting of tariffs. This will first and foremost require political will. Furthermore, it will require investment in systems and procedures for regulation and enforcement. This will imply closed cooperation and coordination between local government, GWCL and PURC.

In order to lower the price of water charged by intermediate service providers (water vendors, tanker operators etc), GWCL could set up a registration system for these intermediate service providers and sell water to them at special, **subsidised tariffs**. However, as the costs of water from the GWCL system are only part of the costs intermediate service providers make (19-25 percent for tanker operators and about 18 percent for water vendors and neighbourhood sellers, (Sarpong and Abrampah, 2006), the impact of this is likely to be limited. Furthermore, this would only be effective if intermediate service providers would indeed lower their prices. This would require good regulation of prices set by intermediate service providers and enforcement.

The table below gives a summary of the options discussed above.

Table 28: Summary of options for ensuring lower water prices for low income households

Option	Impact	Costs	Time frame	Challenges	Feasible under scenario		
					WCS	MCS	BCS
Implementing a special GWCL tariff for compound houses	Unknown (estimate: high)	Unknown (estimate: low to medium)	Short to medium	Requires good administrative system of connections	No	yes	yes
Recognising, regularising and regulating alternative water providers	Unknown (estimate: high)	Unknown (estimate: low)	Short to medium	Requires good administrative system of alternative service providers	No	yes	yes
Installation of a special, subsidised tariff for intermediate service providers	Unknown (estimate: low)	Unknown (estimate: low)	Short to medium	Requires good administrative system of intermediate service providers	Yes	yes	yes

WCS = worst case scenario; MCS = Medium case scenario; BCS = Best case scenario

5.5.7 Strategic directions for serving people outside the reach of the GWCL system

As presented in this chapter, most people in the Greater Accra Metropolitan Area depend on the GWCL system, either directly or indirectly. The strategic directions presented above have therefore focussed on the GWCL system. However, the above has shown that taking into account the population growth of the expanding city, there is a need to look at service delivery options beyond the utility model. Below a number of options for service provision independent of the GWCL are discussed.

Under the Community Water and Sanitation Agency (CWSA), a number of **community managed systems** have been implemented in the outskirts of the Greater Accra Metropolitan Area. These systems serve between 6,651 (Oyibi) and 12,758 (Pantang) people (Bismark, 2009). The implementation of additional independent community-managed systems is technically feasible and could have a positive impact on the water supply situation in the peri-urban areas on the fringes of Accra not (yet) served by GWCL. Investment costs are relatively low at about 58-150 Ghana cedis per served capita (using 2008 as the common base year) (Bismark, 2009).

However, as presented in section 5.3, the level of service and costs differ considerably between community managed water supply and GWCL water supply. The GWCL system focuses on household connections, providing 60-120 lpcd, while in the community managed systems there is a bigger focus on public standpipes, providing a minimum of 20 lpcd (60 lpcd in the case of household connections), and the water tariffs of the community managed systems are considerably higher than the utility tariffs set by PURC. Therefore, if given the choice, communities would probably rather be supplied by the GWCL than by a community managed system. However, for communities for which good water supply from GWCL is no more than a distant dream, community managed systems could be a good short-to-medium term solution. Politically, the implementation of these systems might be difficult though because of perceived 'competition' between GWCL and community managed systems, commonly implemented with support from CWSA.

A small number of Water Health Centres have been implemented in GAMA, which provide **independent, privately-run water services** in collaboration with community members. These systems have the potential of servicing a small number of people (1,000-3,000 depending on the capacity of the centre). Investment costs amount to 55,000 USD for a system serving 3,000 people (so about 18 USD per capita). Because of the elaborate treatment process, the operational costs are rather high, resulting in a high water tariff, especially compared to the tariff of the GWCL water services. Such independent private producers are not regularised or regulated.

Interest in **rainwater harvesting** is high. The national water policy notes that with appropriate technology and incentives, rainwater harvesting could provide a reasonable amount of water for household and institutional water needs thereby reducing demand on the pipe-borne system and the resource. Even though the policy indicates that appropriate legislation will be passed to support rainwater harvesting, no new laws have been passed in this direction. There, however, exists provision in the National Building Code to encourage rainwater harvesting.

Assuming that one percent of the rainwater that falls in GAMA can be captured through roof-top rainwater harvesting, gives a maximum harvestable amount of 0.00936 km^3/year. If this water could be captured and stored for use throughout the year, rooftop rainwater harvesting would have the potential to provide a total amount of water of 25,635 m^3/day. This could bring the average 2030 per capita water demand from the GWCL system down with 2-3 lpcd.

Technically and financially, the storage capacity of the rainwater harvesting system is the main barrier. For a dry period lasting three months, a household of five with a demand of 20 lpcd will require 9,000 litres of storage, which is more than one large poly tank, which costs almost 1,000 GHc (200 GHc per person). Beyond the question of affordability is also the question of space to put the tank and the catchment area for harvesting the rain. Question marks can therefore be placed at the viability of rainwater harvesting as an alternative to piped water supply. It could, however, be a mechanism to cut back demand on the GWCL system, especially from high income households which could use harvested water instead of GWCL water for watering the garden, washing the car etc. This would decrease demand on the GWCL system. It can also play an important role in preventing storm water run-off, causing stagnant water and soil erosion.

The options discussed above are summarised in the table below.

Table 29: Summary of options for serving people outside the reach of the GWCL system

Option	Impact	Service provider costs	User costs		Time frame	Challenges	Feasible under scenario		
		CapEx (USD/cap)	CapEx (GH¢/cap)	Tarif (GH¢/m^3)			WCS	MCS	BCS
Independent community managed system	Medium (5,000 - 13,000 people per system)	Medium (83)	Medium – high (2.9 - 7.5)	Medium (1.66)	Short to medium	Resistance from GWCL/AVRL	yes	yes	yes
Independent private provider (Water Health)	Low (1000 - 3000 people per system)	Low (18)	None	High (5)	Short to medium	Presence and willingness of investor / donor	no	yes	yes
Rainwater harvesting	Low - medium	Not applicable	High (200)	Low	Short to medium term	Availability of space and financial resources at household level	yes	yes	yes

WCS = worst case scenario; MCS = Medium case scenario; BCS = Best case scenario

5.5.8 Summing up

This section has presented a number of strategic directions and options for addressing the current and future challenges the city of Accra is facing related to water supply. However, in order to develop a comprehensive strategic plan to improve water supply in the city of Accra, there is a need for more data collection and analysis. Based on that, a mix of options should be selected, which have the potential to contribute to achieving the vision under each scenario.

Based on the available data and analysis as presented above, promising approaches for the short to medium term could include:

- The use of rainwater harvesting to complement water availability to people (especially for medium and high income households, with available space) and bring down demand on the GWCL system
- The use of ground water to complement GWCL system capacity
- Improve metering, administration and management of the GWCL system to decrease physical and commercial losses
- The implementation of more GWCL standpipes, to improve accessibility
- The introduction of community-managed bulk water supply in densely populated urban areas, which are difficult to reach with the utility system directly
- The introduction of community-managed systems in the fringes of Accra, which will not be connected to the GWCL in the next 20 years, to increase access to safe water supply
- The recognition, regularisation and regulation of alternative water providers to ensure affordable water supply for all

For the medium to long term, expansion and rehabilitation of the GWCL system will be needed as well.

6 Excreta and wastewater services

This chapter focuses on how the city of Accra deals with the collection, treatment and disposal of human excreta, including the management of 'black water[16]'. Furthermore, the chapter will touch briefly on the management of 'grey water'[17]. The management of storm water and grey water will be discussed in more detail in chapter seven.

The figure below gives an overview of the different Sanitation Service Delivery Models in GAMA, including collection, treatment and disposal of human excreta, municipal service provision, private service provision and self supply. The figure also shows the percentage of people in GAMA with access to different sanitary facilities.

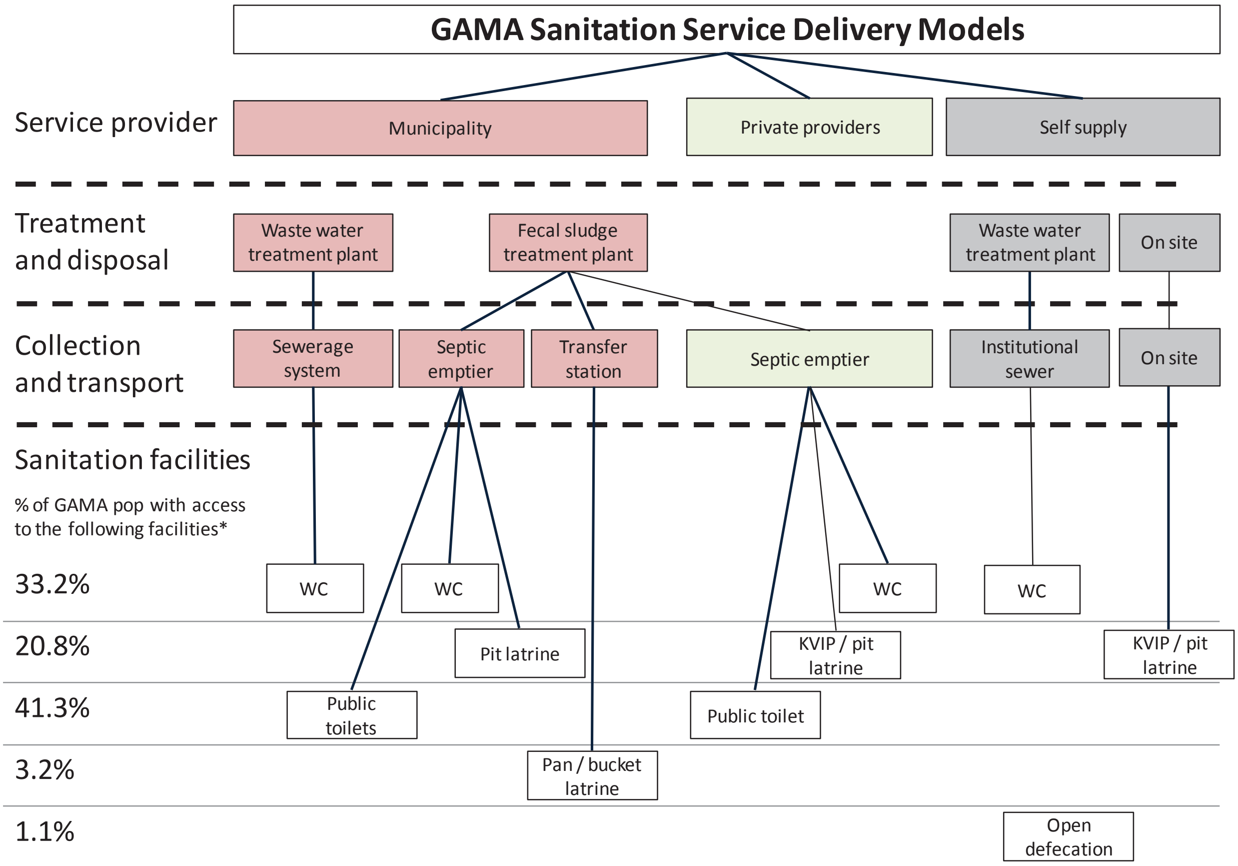


Figure 26: Sanitation service delivery models
Source *: GSS, 2008

The central sewerage system falls under municipal service provision, as do the municipal public latrines, municipal septic emptiers, transfer stations, where excreta from pan and bucket latrines are collected, and faecal sludge treatment plants, where both municipal as well as private septic emptiers can dump septic waste. Private public latrines and septic emptiers fall under private sector service provision. In

[16] Residential wastewater that contains faecal matter and/or urine
[17] Water drained from sinks, showers, kitchens and laundry. Unlike black water, grey water does not contain water drained from sinks, showers, kitchens and laundry. Unlike black water, grey water contains no faecal matter and/or urine.

addition to municipal and private services, a number of communities, commercial enterprises and institutions are served by their own independent systems (self supply). These include institutional and commercial sewerage systems and private on-site treatment sanitation facilities, like pit latrines and KVIPs, which do not require emptying.

This chapter gives an overview of sanitation infrastructure related to the different service delivery models (section 6.1), the demand for sanitation services (section 6.2) and the current situation regarding access to these services in GAMA (section 6.3). An overview of the present and future challenges is given in section 6.4, after which a number of strategic directions are presented in section 6.5.

6.1 Sanitation infrastructure

The municipal central sewerage systems as well as institutional and commercial sewerage systems present in GAMA are described in this section. Furthermore, this section describes non-sewered infrastructure related to containment, collection, treatment and disposal of human excreta.

6.1.1 Municipally managed sewerage system

The sewerage system in GAMA is very limited. The Accra Central Sewerage System was built in 1972 with support from the World Bank. It covers mostly the area of the ministries and the Makola Market (Columbia University, 2003). The system has the capacity to accommodate 1,500 houses, offices and public institution connections and has the capacity to be extended to include the central business district within the ring road and the industrial and intensively developed areas in the vicinity of the Accra north post office.

The flows from the metropolitan sewered areas are discharged from an intercepting sewer into a wet well at the Central Accra Pumping Station. The sewage is then pumped to the headwork of the UASB (Up-flow Anaerobic Sludge-Blanket) sewage treatment plant at James Town / Korle Lagoon, some 50 m from the pumping station. This plant is the largest wastewater treatment plan in the Greater Accra Metropolitan Area. It was designed by Lettinga Associates Foundation (the Netherlands) and constructed by Taylor Woodrow Construction LTD (UK) and started operations in 2000 (Obuobie et al, 2006; Agodzo et al, 2003). Until 2002, the facility was operated by its construction firm, after which the plant was handed over to the municipality. It broke down partially in 2003/4, as the municipality lacked the expertise to operate the plant. The sewage was consequently directed into the ocean and the Korle Lagoon (Obuobie et al, 2006; Murray and Drechsel, 2009.

The treatment plant is designed to treat a total hydraulic flow of 16,080 m^3/day:

- 1,000 m^3/day from Korle-Bu
- 500 m^3/day from State House
- 1,200 m^3/day from Ministries Beach
- 1,000 m^3/day from High Street
- 10,380 m^3/day from Osu-Labone
- 2,000 m^3/day from Accra Brewery

However, in 2003 only about 5,000 m^3 was being treated per day, which is only about 31 percent of its capacity (OCIN, 2005). In 2009, the wastewater treatment plant was not functioning at all.

Tema has a comprehensive waterborne sewerage system, which connects about 60 percent of the total housing stock to the sewer network (OCIN, 2005). Collected wastewater from the Tema Sewage System is supposed to be treated in the connected oxidation pond treatment plant. The system was rehabilitated under the World Bank funded Urban II project in the early 1990s, under which a new sea outfall (1.6 km), three pumping stations and the oxidation pond treatment plant with surface aerators were constructed and parts of the network were rehabilitated. The system has a capacity of 20,000 m^3/day. However, the volume of liquid waste generated in 2001(personal communication with K. Benjamin in Agodzo et al, 2003) was about 1,525 m^3/day and is currently not functioning at all.

Box 4: Organisational arrangements around wastewater management

The responsibility for implementing projects and programmes in wastewater management lies with the Metropolitan and Municipal Assemblies. The MMDAs are expected to promote the construction and use of domestic and institutional latrines, treatment and disposal of waste, law enforcement and improved management of urban sewerage systems. They are also to build their capacity to better manage environmental sanitation.

Previously, the management of wastewater was the responsibility of the then Ghana Water and Sewerage Corporation (now GWCL) under the Ministry of Water Resources, Works and Housing. Currently, the Metropolitan and Municipal Assemblies are responsible for solid and liquid waste collection and disposal and storm water drainage systems. In line with the decentralisation process, the urban sewerage responsibility of the former GWSC was devolved to the assemblies, through their Waste Management Departments (WMDs). In AMA, however, a separate sewerage unit, which does not fall directly under the WMD, has been set up. The sewerage unit is responsible for the implementation of the Accra Sewerage Improvement Project (ASIP) and the operation and maintenance of the sewer infrastructure in Accra. Though the unit reports directly to the Mayor, the oversight for the project falls directly under the Ministry of Local Government and Rural Development, while oversight for disbursement of funds falls under the Ministry of Finance and Economic Planning. It is worth noting that sewerage charges are still part of the water bill that is paid. GWCL is expected to periodically transfer these funds to the sewerage unit.

A challenge for the MMDAs is the capacity in terms of resources and personnel to effectively provide sanitation services. For example, in AMA, out of a staff of more than 2000, less than three percent are at management/ appreciable technical level and about 50 percent are unskilled staff. In the waste management department alone more than 60 percent of the staff consists of unskilled labourers.

The regulation of wastewater discharge is the responsibility of the Environmental Protection Agency which was established by Act 490, 1994. The duties of the EPA include ensuring wastewater disposal is in accordance with LI 1652 -environmental assessment regulations of 1999. The EPA is also responsible for ensuring that all projects that have adverse effects on the environment have duly conducted EIAs and acquired the necessary license.

6.1.2 Institutional and commercial sewerage systems

In addition to the municipally managed Accra and Tema central sewerage systems, Murray and Dreichsel (2009) identified about 35 independent community, institutional and commercial sewerage systems within the Greater Accra Metropolitan Area. They found that out of these 35 treatment plants, only four were fully functioning (the plants at Kotoko airport, La Palm Royal Hotel, Labadi Beach Hotel and Golden Tulip Hotel), 30 were not, or only partially functioning, and of one the status was unknown. In addition, one commercial treatment plant was under construction. (Nestle WWTP) (Murray and Dreichsel, 2009)

The above has thus shown that neither the municipal, nor the institutional sewerage systems have been very successful. The vast majority of the wastewater treatment plants connected to these sewer systems are not functioning.

6.1.3 Private facilities not connected to the sewer system

In most newly-established low-density residential areas, private WCs connected to septic tanks can be found. In many of the high-density, poor areas, rooms initially intended as toilets have been converted to shops and bedrooms, which are rented out because of the high demand for accommodation within the city.

Kumasi Ventilated Improved Pit latrines have been installed throughout the Accra Metropolitan Area. Most KVIPs have been installed as public and private toilets, pre-financed through a revolving fund set up by the German Technical Co-operation Unit (GTZ) to support the phasing out of pan latrines. KVIPs are supposed to be built in areas with porous soil allowing for liquids can be absorbed by the soil, leaving the scum to be scooped out for use as manure in gardening and agriculture. Unfortunately, however, the soil in Accra is clay and does not absorb the liquid from the latrine. Most latrines are therefore always wet and need emptying by septic emptiers. (Van der Geest and Obirih-Opareh, 2006)

Although the phasing-out of pan and bucket latrines is ongoing in Accra (see box below), these types of latrines can still be found in the city. According to Lukman Salifu, Consultant to Ghana's Technical Committee on Sanitation and Water for All Global Partnership (SWA), some 5,200 pan latrines are still being used in Accra.

Box 5: Phasing out pan and bucket latrines

In February 2008, Accra-based legal practitioner, Nana Adjei Ampofo, initiated a legal action against the AMA for the continued use of people to carry human excrement from bucket and pan latrines. In July that year, the Supreme Court ordered Accra Metropolitan Assembly (AMA) to phase out the use of pan latrines in the metropolis within five years. The Supreme Court instructed the Accra Metropolitan Assembly (AMA) to construct 1,500 water closets and KVIPs under the Urban Environmental Sanitation Project 11 by 2010, as well as arrange subsidies fro those who will convert their pan latrine. The court also directed the AMA to stop granting permits to building plans that do not have adequate provision for WC or KVIP and asked the Assembly to prosecute anyone who engages people to carry human excreta after the period. (AMA, 2008)

6.1.4 Public facilities

Public toilets can be found in virtually all densely populated areas in the city. Most public toilets have septic tanks to collect black water. Initially these public facilities were intended to serve the floating population. It has never been the policy of the assembly to encourage the construction of public toilets in residential areas. However, nowadays, public toilets are allowed in the densely populated areas where other options are not available (Tettey-Lowor, 2009).

The management of public toilets has been privatised since 1997. Facilities are either built by the assembly or by private entrepreneurs. In cases where the facility is built by the assembly, tenders are invited from the general public to bid for the operation and management of the facility. Operators of these facilities are required to pay a percentage of their net earnings to the assembly. There are also cases of franchising and Build, Operate and Transfer (BOT) agreements. Under these arrangements, the private entrepreneur constructs the facility and is allowed to keep 60 percent of the net earnings to enable him to pay back his investment. The remaining 40 percent of the net income is supposed to go to the assembly. After payment period of recovering the capital investment costs, the arrangement is changed to 40 percent for the entrepreneur and 60 percent for AMA (Tettey-Lowor, 2009).

6.1.5 Infrastructure for the collection, transport and disposal of faecal sludge

Night soil collectors, referred to as 'Kruni', empty the bucket or pan latrines during the night. The Waste Management Department provides surface and underground storage facilities and collection vehicles to empty the tanks (Van der Geest and Obirih-Opareh, 2006).

Septic waste is either collected by private or municipal septic emptiers. There are three faecal sludge treatment plants: the Achimota plant, the Marine Disposal Site, also called Lavender Hill at Korle Gonno, and the plant at Teshie-Nungua. Reports on dumping rates at these sites vary widely. According to 2000

AMA records, as presented by Murray and Dreichsel (2009), total amount of septic waste dumped that year was 90,000 m^3 of sludge (which gives an average daily dumping rate of almost 250 m^3/day, while an additional 70,000 m^3 could not be absorbed. Obuobie et al (2006) estimate the dumping rate to amount to about 250 m^3/day at Achimota, 50 m^3/day at Korle Gonno and 80 m^3/day at Teshie-Nungua, giving a total dumping rate of 380 m^3/day. According to Lundéhn and Morrison (2007), about 550 m^3/day is collected and dumped by sanitation tankers and according to Awuah and Yeboah (unpublished), the amount of faecal sludge dumped at Korle Gonno (Lavender Hill) alone amounts to 760 m^3/day.

None of the three faecal sludge treatment plants is functional. Untreated faecal sludge ends up being disposed of in nearby streams (Achimota, Teshie) or on the seashore, as is the case at Korle Gonno (Obuobie et al 2006; Murray and Dreichsel, 2009). For an artist's impression of this site, please see Figure 27.

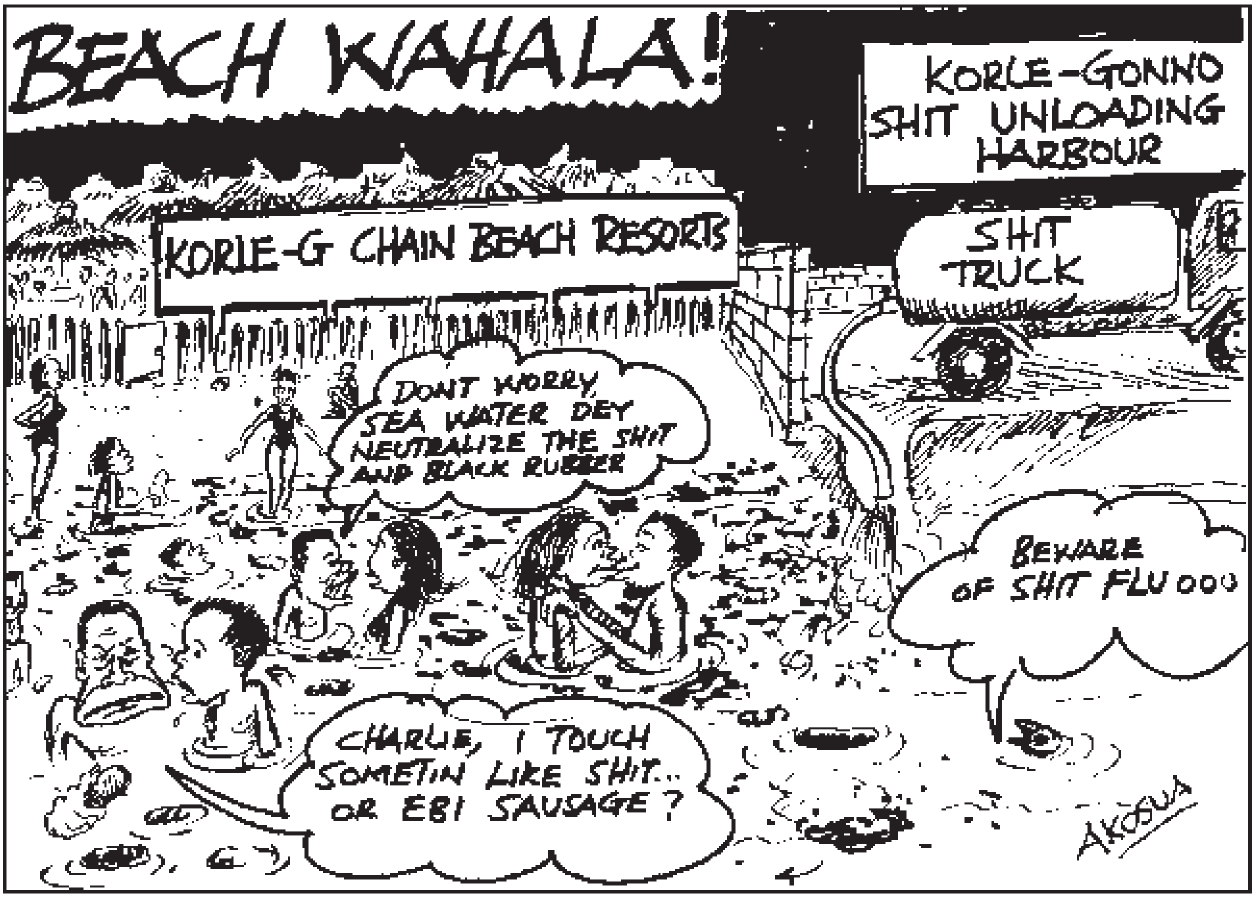


Figure 27: Lavender Hill according to Akosua
Source: Akosua

6.2 Demand for wastewater management services: the production of black and grey water

The amount of wastewater produced (black and grey) depends on the amount of water supplied and the amount of water returned, indicated by the return factor. The return factor is usually 0.8-0.9. It is lower in rich areas where water is used for car washing and garden watering (Mara, 2003) and can be as high as 0.95 in areas where supply is based on public standpipes (Mara et al, 2001). To estimate the wastewater production in Ghana, Agodzo et al (2003) and Cofie and Awuah (2008) use a return factor of 0.8. Here, we will estimate the wastewater production based on the water supplied to the Greater Accra Metropolitan area (= produced amount of water – physical losses), as presented in section 4.5.2, using a return ratio of 0.8.

In 2007, the quantity of water supplied to the Greater Accra Metropolitan Area in 2007 was about 266,172 m^3/day. Based on this, and using a return factor of 0.8, the actual wastewater production in 2007 would have been about 212,938 m^3/day. The amount of wastewater produced would have been bigger, if water had been supplied according to the optimal water demand, as presented in chapter five. The table below presents the estimated projected wastewater production, in case the optimal water supply demands are met, taking into account 25 percent physical losses and using a return factor of 0.8.

Table 30: Projected wastewater production (m^3/day)

	2007	2011	2015	2025	2030
High water use scenario (max pop growth, economic growth)	306,580	391,257	504,076	991,500	1,422,999
Medium water use scenario (medium pop growth, economic growth)	288,241	350,607	426,301	693,847	884,477
Low water use scenario (min pop growth, no economic growth)	268,754	307,907	352,763	495,614	587,454

Part of this water will be evacuated through the infrastructure as described above (sewerage system and, septic tank emptiers etc), but part of this, especially grey water from domestic uses other than sanitation, is disposed of through soak aways, gutters or by simply throwing it into the street or compounds, to evaporate, infiltrate or run-off through the gutter and storm drain system.

6.3 Access to sanitation services

As illustrated in Figure 26, according to the Ghana Living Standards Survey, Round Five (GSS, 2008) about 41.3 percent of the GAMA population access public latrines for the disposal of excreta. An estimated 33.2 percent make use of private WCs, while about 20.8 percent use private latrines. Furthermore, about 3.2 percent of the GAMA population still use bucket and pan latrines. The percentage of people not using sanitation facilities and resorting to open defecation is very low (1.1 percent), although the number of rubber bags containing human excreta commonly found on the ground in densely populated areas seems to suggest a different reality. The remaining 0.4 percent uses facilities of neighbouring households.

Grey water is disposed of though the sewerage system, septic tanks, soak aways, gutters and by throwing it outside in the street or compound, as presented in the table below.

Table 31: Liquid waste disposal

	GAMA
Sewerage system	15.3%
Gutter	41.1%
Street / outside	18.3%
Compound	24.8%
Other	0.6%

Source: GSS, 2002

The part of this water that is not disposed of through the sewerage system[18] and does not evaporate or infiltrate will eventually join the storm water drains, which will be discussed in chapter seven. This section focuses on how people in GAMA access facilities for excreta disposal, the barriers they face and the costs of use of these facilities.

6.3.1 Private facilities connected to the sewer system

About 33.2% of the GAMA population has access to WCs (GSS, 2008). The majority of WCs in GAMA are connected to septic tanks, rather than to the sewer system, as the number of domestic sewer connections is very low. According to the appraisal report of the Accra Sewerage Improvement Project (ASIP), approximately 15% of the city area, mainly the central area, is served by a piped waterborne sewerage network. Though the basis of this figure is not clear, it does seem rather high, when considering only 537 households were officially connected to the sewerage system in 2007 according to customer data from GWCL/AVRL, as indicated in the table below.

Table 32: Sewerage clients

	Domestic sewer	Commercial sewer	Industrial sewer	Institutional sewer	Municipal sewer	Gov't sewer
Accra East	537	529	1	1	6	59

Source: AVRL, 2008, data from 2007

Households with WCs connected to the sewerage system have to pay a connection fee of 20 GH¢, while commercial enterprises have to pay a connection fee of 50 GH¢. Upon payment of the connection fee, an estimation of the installation costs is made based on the site plan. Installation costs are about 200 GH¢ for household connections and can be as high as 7,000 GH¢ for a connection of a building like a bank (personal communication ASIP staff, 2009). A requirement for the connection is that the person requesting the connection can hand over proof of ownership of the property to be connected, which excludes tenants and people living in informal settlements from connecting to the sewerage system.

A surcharge of 35 percent is added to the water charges for those with sewer connections, as indicated in the table below. A household connected to the sewerage system, using a maximum amount of 20 m^3/month of water, would thus be charged 4.60 GH¢. In Tema, each household connected to the sewerage network is charged a flat sewerage tariff of 6 GH¢ per year (OCIN, 2005).

Table 33: Sewerage charges

Category	Monthly charges (per 1 m^3 water consumed)
Domestic (metered) 0-20 m^3 >20 m^3	 0.23 GH¢ 0.35 GH¢
Commercial/industrial/private/public institutions	0.39 GH¢

[18] Considering the high percentage of people disposing their liquid waste into the "sewerage system" and the low coverage of the actual central sewer system, it might be safe to assume that this percentage includes people disposing liquid waste through household plumbing, connected to septic tanks.

6.3.2 Private facilities not connected to the sewer system

As mentioned above, the majority of WCs in GAMA are connected to sceptic tanks rather than to the sewer system. Households with private WCs connected to septic tanks pay a fee for collection of septic waste. This fee amounts to about 52 GH¢ per go (about 7,000 litres of waste) (Waste Management Department, 2007, quoted in Scott and Boot, 2008). A properly designed tank has to be emptied every five to 10 years. A household with a septic tank that would have to be cleaned every five years, would have to pay 52 GH¢ every five years, which is the equivalent of about 0.87 GH¢ per month. However, in order to be able to install a septic tank, there is a need for financial resources and sufficient land, which is often not available to the poor who live in high density areas.

About 20.8 percent of the GAMA population use private on-site sanitation facilities like KVIPs (15.8 percent) and pit latrines (five percent) (GSS, 2008). Pit emptiers charge about 45 GH¢ per go (about 7,000 litres of waste) (Waste Management Department, 2007, quoted in Scott and Boot, 2008), which implies average monthly costs of about 0.75 GH¢, assuming the pit is emptied every five years.

The percentage of people using pan and bucket latrines is about 3.2 percent according to GSS (2008). The Metropolitan Public Health Department of the AMA indicated to journalists from Peace FM that that in 2009 a total of 5,002 residences, three industrial and 243 hospitality joints, as well as 46 schools in various parts of the city were still using the pan latrines (PeaceFM, 2010). Households depending on pan and bucket latrines pay about 12 GH¢ per week (about 7,000 litres of waste) (Waste Management Department, 2007, quoted in Scott and Boot, 2008) for their excreta disposal.

6.3.3 Public facilities

About 41.3 percent of the GAMA population does not have access to sanitation facilities in their homes but use public facilities (GSS, 2008). In absolute terms this means that in 2007 about 1.5 million people in GAMA depended on public sanitation facilities. It is mostly the poorer segment of the population that makes use of these facilities, as they lack the space and financial resources to install a septic tank or latrine. According to Boadi (2004), 44.6 percent of poor households use public latrines, whereas only 1.9 percent of medium and 1.7 percent of high income households use these public facilities.

Van der Geest and Obirih-Opareh (2006) estimate that public latrines are visited by 1,000 people per day on the average, while OCIN (2005) estimates the number of visitors per facility to be 1,500. Whatever the exact number, it is not surprising that long queues can be observed early in the mornings and evenings in front of these facilities, especially near the unplanned densely populated areas. Facilities tend to close between 9pm and 5am.

The quality of public sanitation facilities is generally low. As Solomon Davids writes in a featured article on the website GhanaWeb: *"what we call public toilets are not places of convenience as we all know. They are rather places of inconvenience. I can say without any fear of being challenged that over ninety percent of the public toilets in Accra are not fit for human use. They are a major source of diseases in the country; anyone who disagrees can carry out a study on that to prove me* wrong." (http://www.ghanaweb.com/GhanaHomePage/features/artikel.php?ID=183943)

The costs of the use of a public latrine in different areas of Accra, range from 0.05 to 0.15 GH¢ per use (AMA, 2009). User fees are collected by attendants prior to use of the facilities. A household of five people, each using a public latrine once a day, would spend about 7-21 GH¢ per month on visiting the public latrine.

The costs of emptying the public latrines range from 50 GH¢ to 80 GH¢ per go for emptying services provided by AMA and from 60 to 150 GH¢ for services provided by private contractors (AMA, 2009). As public latrines generally do not have to be emptied more that once every two years, this amounts to a maximum of about six GH¢ per month, which suggests that managing a public latrine is quite profitable.

6.3.4 Overview of costs of access to sanitation facilities

The table below gives an overview of access to and the costs involved in using different sanitation facilities in the Greater Accra Metropolitan Area. It clearly shows that the costs of using facilities commonly used by low income households, like public latrines and bucket/pan latrines, are higher than those commonly used by high income households (WC with septic tank).

Table 34: Overview of access to sanitation facilities

Type of sanitation facility	% Pop with access (source: GSS 2008)	Excreta transport	Average monthly expenditure to access the sanitation facilities (GH¢)	Method of payment	Connection costs (GH¢)
WC	33.2%	Sewerage system	4.6-6	Monthly bills	20+200
		Septic tank emptier	0.87	Per emptying go (once every 5 years)	-
KVIP / VIP	20.8%	Pit emptier	0.75	Per emptying go (once every 5 years)	-
Public latrine	41.3%	Septic tank emptier	7.50-22.50	Per visit	-
Pan/ bucket latrine	3.2%	Manual	48	Per week	-
Open defecation	1.1%	none	-	none	-

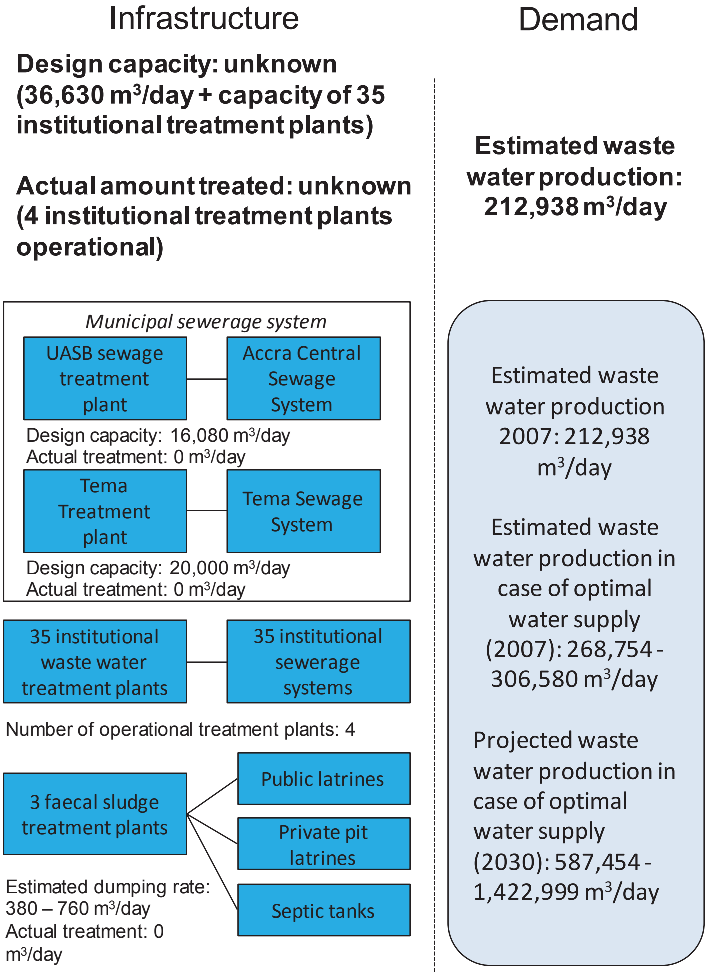
6.4 Current and future wastewater management challenges

Figure 28 gives an overview of the excreta and wastewater management situation in 2007.

This overview illustrates a number of challenges related to excreta management in the Greater Accra Metropolitan Area:

- There is a lack of treatment capacity to deal with the amount of faecal sludge and wastewater generated
- Existing excreta collection and treatment facilities are not functional
- There are still people in Accra (4.3 percent of the population, according to GSS, 2008), who practices open defecation or uses unhygienic bucket or pan latrines
- Low income households depend on public latrines, providing lower services levels against higher prices

Below, the root causes of these challenges are analysed.



Access

Type of sanitation facility	% Pop with access (source: GSS 2008)	Human excreta transport	Average (equivalent) monthly expenditure (GH¢)
WC	33.2%	Sewer	4.60 - 6.00
		Septic tank emptier	0.87
KVIP / VIP	20.8%	Pit emptier	0.75
Public latrine	41.3%	Septic tank emptier	
Pan/ bucket Latrine	3.2%	Manual	48
Open defecation	1.1%	None	None

Figure 28: Overview of the current (2007) wastewater management situation

6.4.1 Lack of wastewater treatment capacity

The current (2007) capacity for liquid waste treatment is far below the estimated wastewater production: only about 17 percent of the estimated amount of wastewater produced. As more water is supplied to the city with improvements in the water supply system over years to come, the production of wastewater will rise as well, increasing the need for safe collection, treatment and disposal of wastewater. The current capacity is only about three to six percent of the estimated 2030 wastewater production of 1,422,999 m/day in the high population growth scenario and 587,454 in the low population growth scenario.

As mentioned above, a large part of wastewater is disposed of in soak-away, storm drains and by simply throwing it into the street or compound[19]. Part of this water will infiltrate and join the groundwater resources, and part will flow to the sea through the storm drainage system. The collected septage that remains in the septic tanks is collected and transported by septic emptiers and disposed of at the faecal

[19] According to the 2000 census, people in GAMA mainly disposed of their liquid waste by throwing it in gutters and storm drains (41.1 percent), on the ground within the compound (24.8 percent) or into the street (18.3%) (GSS, 2002)

sludge treatment sites. However, the dumping rate far exceeds the capacity of the treatment sites, resulting in septic waste flowing untreated into the lagoons and ocean.

6.4.2 Under-utilisation and non functionality of wastewater treatment infrastructure

As displayed in Figure 28, the vast majority of the excising treatment plants are not functional. The main cause of this sub-optimal functioning of the treatment plant UASB reactor of the Accra Central Sewerage System, which was operating at about 31 percent of its capacity in 2007, is believed to be the low volume of influent flow, (OCIN, 2005) (Awuah and Abrokwa, 2008) (Obuobie et al, 2006), caused by a lack of sewer connections and network. According to OCIN (2005), the low number of connections can be attributed to the high cost of installation and the low level of services. In addition to the low number of connections, efficient and effective management of the treatment plant, lack of funds available for maintenance and lack of human capacity to operate and maintain the plant are major problems. The lack of human resources is mainly addressed by hiring (expatriate) consultants. The lack of financial resources is interesting, as the collected sewer charges should in theory be more than sufficient to run and maintain the treatment plan. The non functionality of the oxidation pond treatment plant at Tema is believed to be caused by high operation and maintenance costs, mainly electricity consumption costs are mentioned as reasons for this. In addition, excessive bureaucracy is mentioned to often delay procurement processes, compromising the efficient delivery of services by the sewerage sub unit (OCIN, 2005).

6.4.3 Part of the population does not use safe and hygienic sanitation facilities

According to GSS (2008) only 4.3 percent of the GAMA population practices open defecation or uses unhygienic bucket or pan latrines. The reality of the presence of flying toilets and observation of open defecation on beaches seems to suggest though, that this figure might be underestimated. An important reason for people not using hygienic sanitation facilities is the fact that these facilities are not available in the house and public facilities are far away, filthy and time consuming to use, because of long queues. Root causes for people not having improved facilities in or near the house include the lack of space, lack of willingness of landlords to provide sanitation facilities and lack of awareness and urgency.

6.4.4 Low income households depend on public latrines, providing low service levels at high costs

As shown above, low income households tend to depend on public latrines, as they generally don't have the space and resources to install a septic tank or (K)VIP. The level of services provided by the public latrines service differs but is generally low. The number of public latrines is too small to serve the estimated 1.5 million people depending on these facilities, leading to long queues during the early morning and evening rush hours. The abolishment of pan and bucket latrines will increase the pressure on the public latrines. In addition to the problem of long queues to access the facilities, the sanitary condition of public toilets is generally poor. Reasons for this include the lack of reliable water supply available to the facility and bad maintenance and management.

6.5 Strategic directions for excreta and wastewater management

The vision for Accra, as defined by the Accra Learning Alliance, is that by 2030, at least 80 percent of Accra's citizens have access to an acceptable level of sanitation facilities, including flush toilets, KVIPs or good public toilets. The ALA says that pan and bucket latrines should be phased out and that there should be no more open defecation. Good sanitation behaviours should be practiced by at least 80 percent of Accra's citizens and hand-washing after toilet use should be common practice.

This vision is very far removed from the current reality as presented above, especially when considering acceptable sanitation to cover the full sanitation chain, including treatment. In order to achieve the visions, there is a need for a comprehensive long term strategic plan for addressing the above mentioned challenges. In addition to the current challenges, bringing more water into GAMA and improving water supply will result in the production of more wastewater. This means an even bigger challenge for a city which has proven unable to deal with providing excreta management services to its population as it is. This section presents the strategic directions discussed by the Accra Learning Alliance, which could form the building block of such a strategic plan. These strategic directions are:

- Improving access to and use of sanitation facilities
- Improving public latrine service
- Increasing the treatment capacity
- Improving the use of the excising treatment capacity

6.5.1 Strategic directions for improving access to private sanitation facilities

In order to ensure that at least 80 percent of Accra's citizens have access to an acceptable level of sanitation facilities, access to private sanitation facilities needs to be improved. This will also decrease the dependency on public sanitation facilities, decreasing crowding at public latrines and overuse.

Under the **Accra Sewerage Improvement Project (ASIP)**, there are plans to increase the sewered area of the Accra Metropolitan Area by providing three independent sewerage schemes at Densu Delta, Legon and Burma Camp areas with new Sewage Treatment Plants (STPs) to replace the existing institutional small treatment plants scattered across the Accra Metropolitan Area[20]. The Accra Waste Plant (AWP) will continue to serve the Accra central area. However, only a small part of AMA will be connected to the sewer system. The table below presents the projected population served and total population of the project areas. It shows that the projected population connected to the sewerage network after project completion would be 410,742, which would be about 18 percent of the total population in the areas served and only nine percent of the total projected AMA population in 2030. Table 35 shows the projected sewerage coverage by 2030, in case of a 100% successful Accra Sewage Improvement Project.

Table 35: Projected contributory population to principle treatment plants in 2030

	Sewered population	Sewered + non-sewered population	Percentage of population sewered
Densu Delta	107,731	1,299,163	8%
Legon	40,000	92,325	43%
Burma Camp	95,654	494,918	19%
AWP	167,357	424,982	39%
Total	410,742	2,311,388	18%

Source: OCIN, 2005 (see annex 10 for details)

The total cost of the Accra Sewer Improvement Project, net of taxes and customs, was estimated to be 77.57 million USD. This includes the provision of public latrines and septic tanks, as will be discussed below. Taking out the capital investment costs of the public toilets and septic tanks leaves a total amount of 67.65 million USD, which amounts to about 165 USD per 2030 beneficiary.

[20] As at the time of going to print, it had been decided that the Densu Delta plant and sea outfall will not be constructed anymore but rather changes will be made to the AWP to accommodate the wastewater flow from those areas.

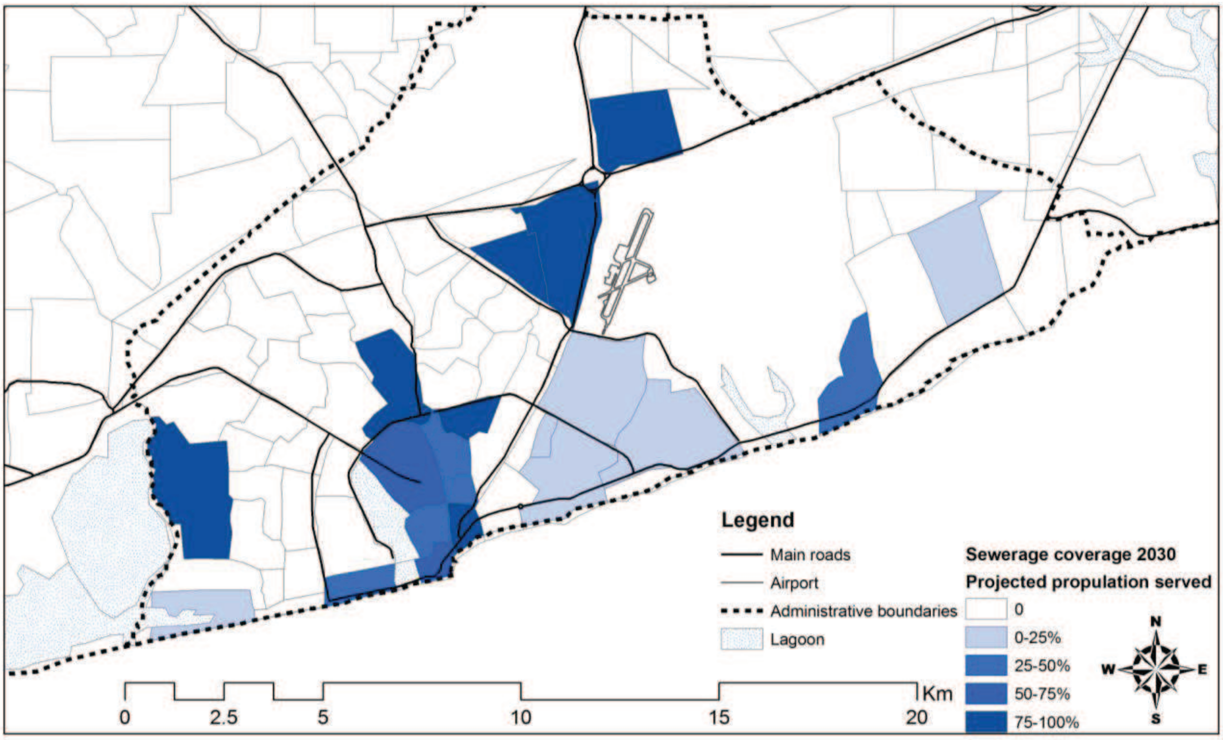


Figure 29: Sewage coverage in 2030 in case of successful ASIP
Source: based on OCIN, 2005

As connections to the sewerage system will only be a very small part of the solution, there is an urgent need to think about additional and alternative sustainable and affordable private sanitary facilities. A whole range of appropriate affordable and sustainable sanitation technologies exists. Table 36 gives an assessment of a number of private sanitation facilities.

The sustainability of sanitation technology is determined by its physical and institutional environment, and therefore a one-size-fits-all strategy is unlikely to work. A **standard procedure for technology selection** could be developed, such that expertise will accumulate in the Ghanaian sanitation sector about which technologies are most sustainable in the various environments of Accra. Such a standard procedure for technology selection would also prevent ad-hoc decisions being made or various district assemblies needing 'to re-invent the wheel' again and again. This procedure would also allow people to make well-based decisions on the sanitation option suitable for them.

There are by-laws in place that prescribe the presence of sanitary toilet facilities in every house. However, **regulation and enforcement of by-laws** is very low. Better enforcement could potentially have high impact on ensuring people's access to sanitary facilities. However, there are big institutional challenges related to this. Enforcement of the by-laws stating that there should be sanitation facilities in every house would require a good, well-staffed enforcement apparatus, which is currently not there. Furthermore, the largely unplanned and informal nature of large parts of Accra makes it next to impossible to enforce these by-laws. Enforcement could therefore be focused on the newly-constructed planned housing projects. Enforcement of by-laws will not involve very high additional costs. For the period 2006-2009, the AMA took up a budget of 10,000 GH¢ for enforcement of environmental by-laws, which should have resulted in stringent regulations.

Table 36: Assessment of sanitation options

Option	Investment costs	Operation and maintenance costs	Applicability	Potential to provide access to the poor	Potential for health improvement	Risk of failure
Sewerage connection	High	High (35% of water bill)	In areas within the sewered area	Low to Medium	Medium – High	High. Only possible if there is reliable water supply
WC with septic tank	High	Medium to low (about 52 GH¢ every 5 year)	In areas with sufficient space	Low	High	Very high. Only possible if there is reliable water supply
Ecosan toilet / Dry Urine Diversion Toilet	Medium to High	Low	In areas with potential to use the sanitation products	Medium	Medium-High	Medium-High. Only possible if there is willingness to use and maintain these facilities and a market for the sanitation products
KVIP	Medium	Low (about 45 GH¢ every 5 year)	In areas with appropriate soil conditions	Medium to High	Medium – High	Medium. Only possible when there is a good system of sullage collection, treatment and disposal
Pit latrines	Low	Low (about 45 GH¢ every 5 year)	In areas with sufficient space	Medium to High	Medium	Medium. Need to be well constructed and maintained in order to be hygienic

Source: Based on Accra LA, 2010

In order to facilitate household connections to the sewer system, the connection and construction costs for connecting to the sewer network could be **subsidised** for low income household, for example, by cross-subsiding from high income households by surcharging them slightly. However, the impact of this kind of subsidy would probably not be very large, as the number of low income households within the reach of the sewer system is small. Subsidising the construction of private sanitation facilities not connected to the sewer system could enhance the construction of these facilities. However, as was shown above, in densely populated areas, people tend to convert private sanitation facilities into rooms or storage facilities. It can thus be questionable how much impact subsidising construction of latrines would have on the use of these facilities, especially if it does not go hand in hand with awareness raising and hygiene education. Furthermore, great care should be taken in order to ensure the subsidies benefit low income households rather than the rich.

Awareness creation and hygiene education can to some extent contribute to raising demand for sanitation services and can stimulate the sustainable use of sanitation facilities and hygienic behaviour like hand washing. There are many methods for urban hygiene promotion and awareness creation, ranging from urban variants of community-led total sanitation to media campaigns. As awareness creation and hygiene education intend to bring about voluntary behavioural change, the impact of it is uncertain.

The table below gives an overview of the different options for improving access to private sanitation facilities, as discussed above.

Table 37: summary of options for improving access to private sanitation facilities

	Impact	Costs	Timeframe	Challenges	Feasible under scenario		
					WCS	MCS	BCS
The application of a standard procedure for technology selection	Unknown (estimate: medium to high)	Unknown (estimate: low to medium)	Short - medium	good, well-staffed sanitation promotion apparatus needs to be in place	no	yes	yes
Regulation and enforcement of bye-laws	Unknown (estimate: medium to high)	Unknown (estimate: low to medium)	Medium - long	Need for political willingness and good, well-staffed enforcement apparatus needs to be in place	no	yes	yes
Subsidising private sanitation facilities	Unknown (estimate: low)	Unknown (estimate: medium to high)	Short - medium	Impact is uncertain	no	yes	yes
Awareness creation and hygiene education	Unknown (estimate: medium to high)	Unknown (estimate: medium)	Short - medium	Impact is uncertain	yes	yes	yes

WCS = worst case scenario; MCS = Medium case scenario; BCS = Best case scenario

6.5.2 Strategic directions for improving public latrine services

Especially in the unplanned densely populated low income areas, private facilities might not be an option, at least not in the short term. Improving the quality of services provided by public latrines can thus be an important strategic direction for achieving the vision of providing good and affordable sanitation services to at least 80 percent of the population by 2030.

In order to reduce the queues during rush hours, **more public toilets** will need to be implemented. Under the Accra Sewer Improvement Project (ASIP), 147 public toilets were originally planned to be constructed and 37 septic/night soil reception tanks were planned to be provided (OCIN, 2005). However, by 2009, the number of public toilets to be constructed was brought down to 101, while the provision of the septic / night soil reception tanks was abandoned, and the money was reallocated to other activities (personal communication with WMD-AMA, 2009).

However, it should be noted that politically, the issue of public toilets is a difficult one. Public toilets are not counted as improved sanitary facilities and are therefore not incorporated in the joint monitoring programme of WHO and UNICEF. A number of organisations, including the Water and Sanitation Monitoring Platform, have therefore been advocating the abolishment of public latrines in Ghana.

In order to improve the sanitary conditions of public latrines, **reliable water supply** is essential. Reliable water supply can be provided through a connection to the GWCL network, access to an alternative service provider, or an own source of water (e.g. rainwater harvesting with sufficient storage). Strategic directions for improving access to water were discussed in chapter five.

The amount of water required will depend on the type of sanitation technology used. WCs will require a large amount of water, while pit latrines or dry (ecosan) toilets will only require water for hand washing and cleaning of the facilities.

The **management of public latrines** needs to be addressed. According to Ayee and Crook (2003), there is some evidence that privately managed facilities are better maintained than those being run by the sub-metro and their sub-contractors. Also tri-partite management models, in which there is a role for both the public sector as well as the private and civil society sector, could be an option for improving the management of public toilets and thereby improving the level of service of these facilities.

The table below gives a summary of the options discussed above.

Table 38: summary of options for improving public sanitation facilities

Option	Impact	Costs	Timeframe	Challenges	Feasible under scenario		
					WCS	MCS	BCS
Implementing addition public latrine facilities	High	Medium	Short - medium	Not considered improved sanitation and hence (political) resistance towards this option	no	yes	yes
Ensure reliable water supply to public latrines	High	Low – medium	Medium - long		no	yes	yes
Improve management of public latrines through regulation	High	Low	Short - medium	Lack of clarity on who should be responsible for regulating public sanitation facilities	no	yes	yes

WCS = worst case scenario; MCS = Medium case scenario; BCS = Best case scenario

6.5.3 Strategic directions for increasing treatment capacity

In order to ensure that collected excreta and wastewater is treated before it is disposed of, there is a need to increase the treatment capacity of water and faecal sludge treatment plants. As mentioned above, under the **Accra Sewerage Improvement Project (ASIP)**, there are plans to implement new Sewage Treatment Plants (STPs) and improve existing sewage treatment capacity. The table below gives an overview of the projected sewage flows to the four principle treatment plants, as envisaged under the ASIP.

Table 39: Projected sewage flows to principle treatment plants in 2030

	Average daily flow, including infiltration (m^3/day)
Densu Delta	12,673
Legon	8,558
Burma Camp	25,724
AWP	16,110
Total	63,065

Source: OCIN, 2005 (see annex 10 for details)

However, when considering the estimated amount of wastewater production as presented in section 6.2, the treatment capacity will only amount to about four to 11 percent of the total amount of wastewater produced, even if the project is fully successful. As the ASIP will only address part of the required increase in treatment capacity, there is an urgent need for identifying appropriate means for collecting, treating and disposing of urban liquid waste collected from septic tanks and pit latrines.

As the majority of excreta management takes place through faecal sludge collection and disposal, there is a need to address **faecal sludge treatment and disposal**. This could be addressed by securing and acquiring new faecal sludge treatment sites and by rehabilitating and improving the maintenance of existing treatment sites.

An alternative option which could be explored further is the use of **natural systems for wastewater treatment**. Studies carried out in Kumasi and Accra on the potential of natural systems to treat wastewater shows that if solid waste and human excreta are not dumped into rivers and drains receiving grey water, natural wetland can act as treatment sinks for treating grey water in the cities of the future in Ghana (Ansah et al, 2009; Awuah et al, 2007a; Awuah et al, 2007b). As it is now, most of the natural wetlands have been encroached upon. It is important that in future, wetland areas are preserved by the formulation of a policy on urban wetlands. An educational campaign on the need to protect wetlands and also elimination of defecation in open drains and the avoidance on the use of open drains as solid waste disposal sites will be needed. Waste stabilisation ponds should be used as treatment systems for wastewater generated in the city. The effluent should be channelled into the Weija Dam, especially during the dry season. Those that cannot be rechanneled must be used for irrigation purposes for example the stabilisation ponds to be constructed in the University of Ghana, Legon. A receiving pond can be constructed and used for fish farming and the effluent can be used for horticultural purposes on the university campus and to irrigate the Achimota Golf Park nearby.

The mangroves around the Kpeshie Lagoon, and the Korle Lagoon should be preserved as they are seriously under threat. Discharge of wastewater from industries and institutions near the Odaw River must be regulated. The African Lake near the Kpeshie Lagoon should be protected and the area round it developed for recreation purposes.

The table below gives a summary of the options discussed above.

Table 40: Summary of options for increasing treatment capacity

Option	Impact (increased treatment capacity in m^3/day)	Costs (USD/cap)	Timeframe	Challenge	Feasible under scenario		
					WCS	MCS	BCS
Construction of central sewer treatment plants, as planned under ASIP	Low (63,065)	High (165)	Long	Requires good management which has proven a big challenge considering Ghana's bad track record in this field	no	yes	yes
Rehabilitation of sludge disposal facilities	Unknown (estimate: Medium to high)	Unknown (estimate: medium to high)	Short – medium	Politically unpopular option	no	yes	yes
The use of natural systems	Unknown (estimate: low)	Unknown (estimate: low)	Short-medium	Land availability	no	no	yes

WCS = Worst case scenario; MCS = Medium case scenario; BCS = Best case scenario

6.5.4 Strategic directions for improving the use of the available treatment facilities

In order to ensure that the currently available wastewater treatment facilities in GAMA do not become 'white elephants', action will have to be taken to ensure the effective and efficient functioning of these facilities. In this way, these facilities can contribute to the collection, treatment and disposal of human excrement.

In order to increase the inflow of wastewater for the optimal functioning of the wastewater treatment plant, the **number of households connected to the sewer network** will have to be increased. Under the Accra Sewerage Improvement Project (ASIP), there are plans for the rehabilitation and extension of 63.1 km of sewers and the implementation of 4,184 house connections (OCIN, 2005). Households and companies in the areas where the sewer system will be extended will be obligated to connect to the sewer system (personal communication ASIP staff, 2009). However, whether or not these households will be willing to do this in reality, is not sure.

In order to improve the operation and maintenance of the treatment plants, there is a need to **develop the capacity of the Sewerage Unit staff**, both in terms of quantity (the number of people) and quality (in terms of skills and experience). This is supposed to be catered for under the ASIP project. However, so far, contracting consultants seems to have been given preference above the development of local capacity.

The table below gives a summary of the options discussed above.

Table 41: Summary of options for improving the use of the available treatment facilities

Option	Impact	Costs (USD/cap)	Timeframe	Challenges	Feasible under scenario		
					WCS	MCS	BCS
Increasing the number of connections to the sewer system in accordance with ASIP	Low - medium (4,184 additional household connections)	High (165)	Medium-long	Unwillingness to connect to the sewerage system because of financial and administrative barriers	no	yes	Yes
Capacity building of the Sewerage Unit staff	Medium	Unknown (estimate: medium)	Medium term		yes	yes	yes

WCS = Worst case scenario; MCS = Medium case scenario; BCS = Best case scenario

6.5.5 Summing-up

Above, a number of strategic directions and options for addressing excreta and wastewater management in the Greater Accra Metropolitan Area have been presented. In order to develop a comprehensive strategic plan to improve excreta and wastewater management in the city of Accra, there will be a need for more data collection and analysis. Based on that, a mix of options should be selected, which have the potential to contribute to achieving the vision under each scenario.

Based on the available data and analysis as presented above, promising approaches could include:

- Facilitating technology choice for the implementation of private facilities
- Enforcement of bye-laws related to the presence of sanitation facilities in every house
- Increase the number of public latrines and improve the management of existing ones
- Rehabilitation of sludge disposal facilities to improve treatment of collected faecal sludge

- Building the capacity of the Sewerage unit, to properly operate and maintain excising treatment plants

7 Storm water drainage and flood control

This chapter takes a closer look at storm water drainage and flood control in the Greater Accra Metropolitan Area. It gives a description of the main storm water drainage infrastructure (section 7.1). Furthermore, it gives an indication of the requirements for storm water drainage by giving an estimation of peak runoff in the different catchment areas in the Greater Accra Metropolitan Area (Section 7.2). The reality of flood occurrences is presented in section 7.3, as is the re-use of storm and wastewater in urban agriculture. This is followed by a description of the main current and future challenges related to storm water drainage (section 7.4) and a presentation of suggested strategic directions for addressing these challenges (section 7.5).

7.1 Storm water drainage infrastructure

There is no comprehensive storm drainage network in most of the urban areas in the country. In Accra, most of the drainage of storm water takes place though natural drains. None of the drains in the Densu (including Lafa) and Mokwe basin are lined and in the other basins only part of the drains are lined or otherwise improved. A more detailed overview of these drains and their current condition can be found in Annex 11. For the design of major drains, the maximum rainfall occurring once in 25 years is used.

Figure 30: Secondary drain in Accra (Dzorwulu Drain which leads to the Odaw River)

Even though recent road projects and other urban developments have made substantial investments in tertiary drains, little or no attention has been paid to primary and secondary drains. The institutional framework related to storm water drainage is weak, as presented in the box below.

Box 6: Institutional arrangements for storm water drainage

Even though the National Water Policy (MWRWH, 2007) is strong on water supply (rural and urban) and integrated water resources management, it does not give a clear direction for the management of storm water. Brief mention is made of the Hydrological Services Division as being part of the Water Resources Information Services (WRIS) institutions. In the National Water Policy, storm water management is only mentioned under Focal Area 10 which looks at extreme events such as flooding. Even then it mainly refers to emergency water supplies during extreme events to mitigate the effects.

The ministries with responsibilities for drainage are the Ministries of Water Resources, Works and Housing and the Ministry of Roads and Transport. Having the NESP give the policy direction on flooding and drainage also brings the Ministry of Local Government and Rural Development (and MMDAs) into the picture while the HSD remain a sector agency under the Ministry of Water Resources, Works and Housing. The responsibility for primary drains lies with the Hydrological Services Department of the Ministry of Water Resources Works and Housing. The responsibility for constructing secondary and tertiary drains lies with the Department of Urban Roads of the Ministry of Roads and Transport, as drains are usually installed as part of road construction. This activity falls under the Urban Roads Department (metro roads unit) which is under the Metro and Municipal Assemblies. They also have a secondary responsibility of maintaining the drains. Funds are available for those activities, which are commonly undertaken by contractors.

The Metropolitan and Municipal Assemblies within GAMA are responsible for maintaining (in this case mainly cleaning and de-silting) tertiary drains. Under the Urban Environmental Sanitation Project UESP II, assistance was given to AMA to take over the management of storm water drainage from the Hydrological Services Department of the MWRWH. Under this new arrangement, the AMA is expected to create a Drainage (Maintenance) Unit, which is expected to handle issues with storm water management in Accra (ASIP Appraisal Report, 2005). This Drainage Maintenance Unit, which should be under the Waste Management Department (WMD), is expected to be equipped to undertake this activity on a regular basis(personal communication shows that the DMU has been created but it is not well resourced to carry out the functions envisaged for it adequately).

7.2 Demand for storm water drainage

The peak storm water run-off in the basins in the Greater Accra Metropolitan Area can be calculated based on the size of the basins, the run-off coefficient, storage coefficient and the rainfall intensity. The run-off coefficient of urban areas ranges between 0.7 and 0.95. With increased urbanisation of the drainage basins, the run-off coefficient will go up, as will the peak run-off. The peak run-off as determined by Nyarko (2002) is presented in the table below.

Table 42: Peak run-off

	Area (km^2)	Peak run-off (m^3/s)
Densu catchment (downstream of Weija)	122	1432
Korle basin	291	2432
Kpeshie catchment	62.6	341
Mokwe-Songo catchment	31	218
Sakumo II Catchment:		3230

Source: Adapted from Nyarko (2002) (see annex 12 for details)

As mentioned in chapter 6, in addition to the storm water, the storm drains handle a large part of the (grey and to some degree black) wastewater. The amount of grey and black water transported through the storm drains is however difficult to determine.

With the introduction of more water in the city and with the increased proportion of the city that is paved, storm water run-off is likely to increase in the years to come. Possibly more erratic rainfall caused by climate change will only aggravate this.

7.3 Storm water drainage reality

Many areas in the Greater Accra Metropolitan Area are affected by the lack of proper storm water management, causing flooding and water logging, especially in the rainy season. On the other hand, storm water serves as a resource for the production of agricultural products in several areas in Accra, when urban agriculture is practiced. Both flooding and urban agriculture are described below.

7.3.1 Flood risks and flood occurrences

The Greater Accra Metropolitan Area faces serious flooding problems during the rainy season which causes damage to life and property. The situation is especially bad in the low-lying flood prone areas, where many the urban poor live in unplanned and often informal settlements. The figure below shows a map of flood risks as determined by Nyarko (2002)[21].

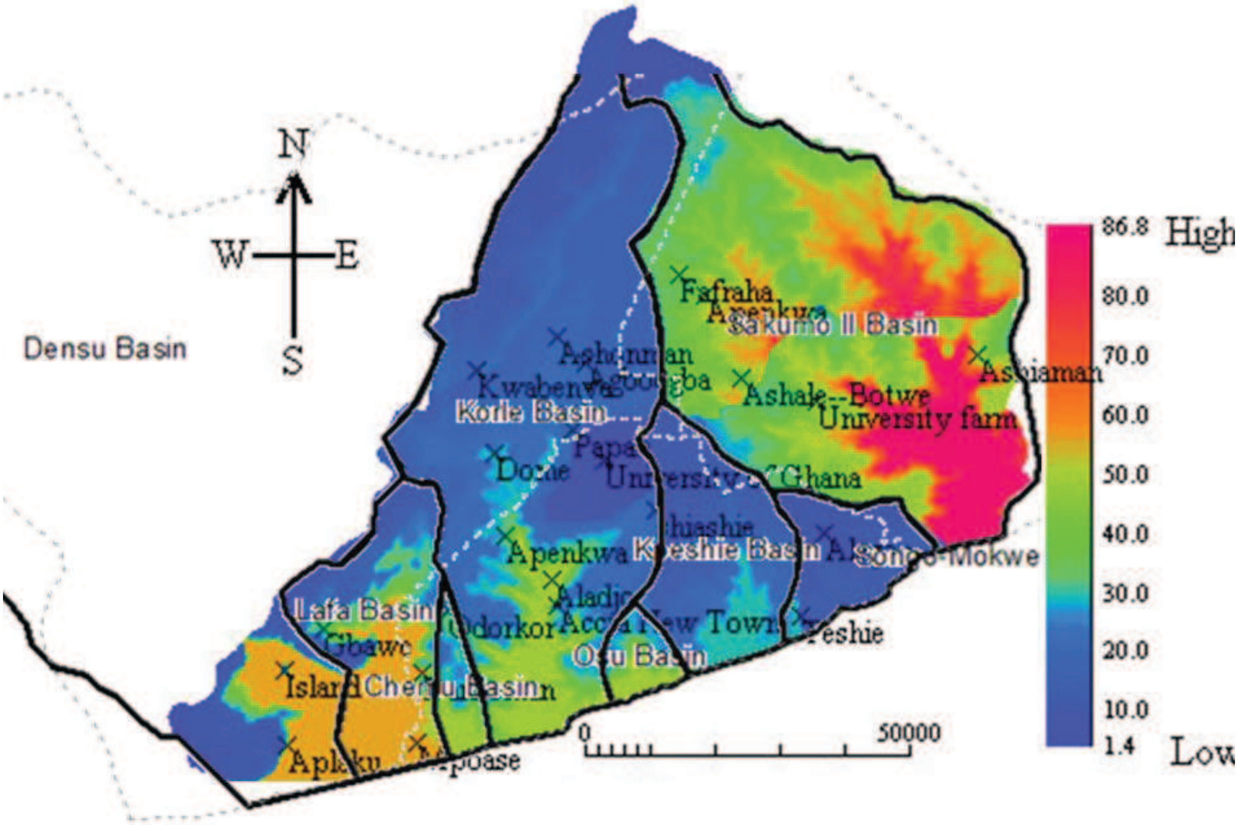


Figure 31: Flood risk areas
Source: Adapted from Nyarko (2002)

Flooding is common along the 8km of the Densu River below the Weija dam whenever there is overtopping or deliberate release of water over the spillway. Flooding is also prevalent in the Dansoman area and along the Lafa stream where it crosses the Winneba and motorway extension roads (AMA, 2006a). This is in line with the high flood risk as indicated in the map above (the orange/ brown areas in the Densu and Lafa Basin).

[21] Twumasi and Asomani-Boateng (2002) present an almost identical map of flood risks in GAMA.

In low-lying areas of the Korle-Chemu Catchment, flooding is a serious problem with many houses being inundated by floodwater during and after heavy rains. In low lying areas near the Accra Academy School in Kaneshie, rapid run off from Asoredanho overflows into the Bank of Ghana flats, because the inlet to the Kaneshie drains is inadequately designed. Similar problems occur in the industrial land cemetery area around the Obetsebi Lamptey Circle where the interceptor drain and gullies are inadequate. There are many other areas like Nima, Dzorwulu, Darkuman and Alajo which have localised flooding problems caused by inadequate drainage channels and the flat nature of the terrain (AMA, 2006a). Most of these areas are indicated in the map above as the green areas in the Korle Basin.

In the Kpeshie Catchment, drainage in the La Township is inadequate and many waterlogged areas become flooded with light rains. In heavy rains, fence walls collapse and foundations are undermined. (AMA, 2006a). This area is indicated in the map as the light blue part in the Kpeshie basin.

Drainage channels in the western part of the Songo-Mokwe Catchment are not adequate, resulting in serious flooding in the Teshie-Nungua estates and the cutting of the main coastal road to Tema. The storm water channels constructed alongside and under this road are completely inadequate. Southern Teshie is subject to severe flooding in the rainy season. Large parts of Teshie are without proper drainage with only the lower channel sections leading to the sea outfall. Most channels are heavily silted and choked with refuse in the middle reaches. In central Nungua, the market cannot operate regularly because of waterlogged ground and poor drainage. The valley before the police barrier at Nungua also has inadequately sized culverts. Poor maintenance of the earth drains along the area of the Maritime Academy also causes flooding of the coastal road (AMA, 2006a).

As shown in the map in pink, areas especially prone to flooding are Tema and Ashaiman. People in these areas are often the victim of heavy flooding. On 20 June 2010, for example, 11 people lost their lives due to heavy floods in Ashaiman and Tema, which in addition left hundreds of people homeless, as reported by CitiFM, quoting the National Disaster Management Organisation (NADMO) (CitiFMonline, 2010).

7.3.2 The use of storm water drainage in urban agriculture

Part of the drained storm water is used for urban agriculture. Urban agriculture comprises a major part of the green area in the Greater Accra Metropolitan Area, producing a large part of the city’s fresh food and vegetables, giving esthetical value to city and contributing to groundwater recharge and decreasing storm water run-off. Also, the importance of urban agriculture for income generation and food security should not be underestimated. According to Obuobie et al (2006), about 800-1,000 farmers earn an income from this activity.

Abraham et al. *(*2007) estimate that about 680 ha is cultivated with maize, 47 ha with vegetables and 251 ha with mixed cereal-vegetable systems. In addition, there are an estimated 80,000 tiny backyards covering a total area of about 50-70 ha. Plot sizes under cultivation in the city range from 0.01-0.02 ha per farmer and increase up to 2.0 ha in peri-urban areas. Practically any open space is used for farming vegetables and other crops because of the high demand from the city. Based on the mentioned irrigated areas, the annual volume of wastewater that is used in Accra in urban and peri-urban agriculture is estimated to be 4.4 million m^3.

7.4 Current and future storm water challenges

The figure below gives a schematic overview of the storm water drainage and flood situation in the Greater Accra Metropolitan Area. It shows that the areas with limited infrastructure (unlined drains) and high run-off, like the Lafa and Sakumo II Basin, are very prone to flooding.

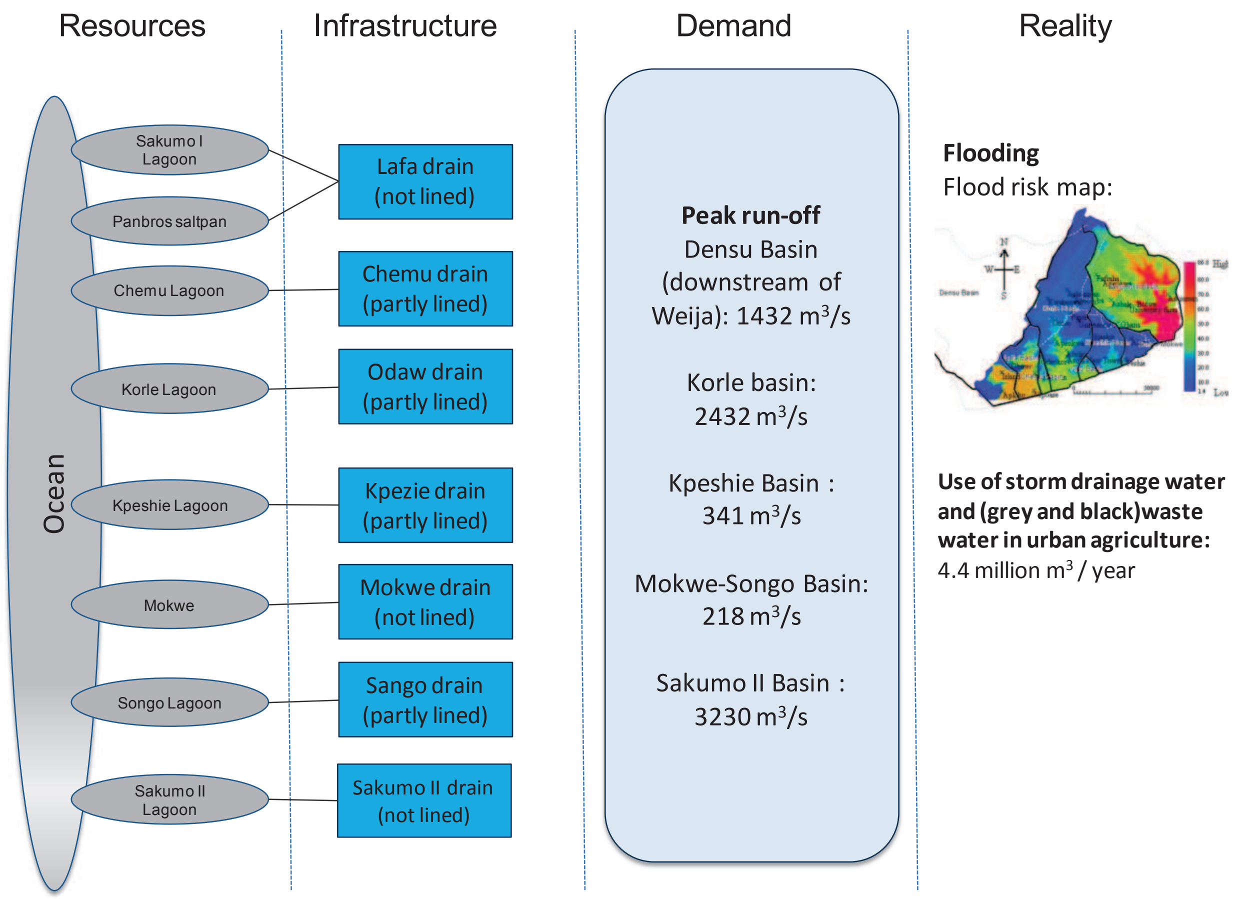


Figure 32: Overview of storm water drainage
Source: flood risk map, adapted from Nyarko,2002

Natural features such as geology, soil conditions and topography contribute to the occurrence of floods to some extent, but the majority of the flooding problems are created by the inadequate storm water drainage system, in combination with the growing urbanisation of the metropolis and the resultant impact of decreased infiltration and increased surface water run-off (AMA, 2006b). The sections below take a closer look at these challenges and their root causes.

7.4.1 Inadequate storm drainage system

The inadequate nature of the storm drainage system has a number of causes, which must be considered when developing strategic directions for improving storm water drainage. These include:

- Under-sizing of culverts and drainage channels
- The construction of structures in water ways
- Poor maintenance
- The blockage of storm drains by solid waste (see box below)

- The lack of coordination and lack of clarity on who has the mandate to maintain drains in the city. (for example, the challenge for AMA is funding to maintain the drains. However, the Department of Urban Roads has funds for which it puts out tenders for contractors to bid)
- Focus on ad-hoc solutions after flood occurrences rather than on long term solutions

Box 7: Solid waste generation and management

Per capita production of refuse is estimated at 0.40 kg/day (Fobil, 2001). Fobil (2001) estimated that 60 percent volume weight of this amount of waste generated is organic. The current solid waste production (based on 2007 population) can thus be estimated to be 1.4 to 1.6 million kg per day and might increase to anywhere between 3.0 and 6.5 million kg per day by 2030.

According to Anomanyo (2004), about 60 to 75 percent of the solid waste generated in the city is collected. The solid waste that remains uncollected often finds its way into open drains, blocking them and creating a breeding ground for mosquitoes and flies but also for foul smells (Fobil, 2007). The worst solid waste contributor is plastics like empty water sachets, due to its high presence, slow breakdown and impermeability.

Solid waste management in Accra has been characterized by single and ad hoc solutions such as: mobilising people to collect waste and de-silt choked gutters after a flood disaster or for an occasion; temporal allocation of waste collection contracts and damping or building a central solid waste composting plant (Anomanyo, 2004). The WMD of the AMA itself is unable to collect most of the waste and therefore engages the services of private operators to collect the waste generated. In recent times, there have been attempts by one of the private operators (Zoom Lion) to solve the problem of waste management through the introduction of the tricycle concept, which was aimed at clearing waste and at the same time reducing unemployment. Years on, even though there has been some level of improvement, solid waste management still remains a problem that the city grapples with. Another problem facing the collection of solid waste is the final disposal. At the moment, the existing landfill sites are full and the proposed new ones have not been operationalised due to local resistance.

Figure 33: Solid waste clogging a drain

7.4.2 Increasing surface run-off caused by decreasing permeability

The Greater Accra Metropolitan Area is developing and expanding, especially to the northern and western outskirts. This development can result in increasing 'sealing' of the soils in the upstream parts of the urban catchments. The loss of permeability can result in a large increase in storm water flows in the southern part of the city, which is likely to increase the flooding frequency and the subsequent damage to infrastructure, the economy and could endanger human lives. The future urbanised areas in the northern part of the city are likely to also result in a large increase in grey and black wastewater flows through the storm drains.

As large areas of the Greater Metropolitan Area become urbanised, urban farmers will find it more and more difficult to find land in the city to satisfy the city's demand for fresh vegetables.

7.5 Strategic directions for addressing storm water drainage

As presented in chapter 2, the Accra Learning Alliance formulated the following vision related to storm water drainage: "In 2030, Accra will be a cleaner city with a well-functioning drainage system. There will be integrated solid waste management (collection, transport, treatment and final disposal) of solid waste in a sustainable way. At least 90 percent of the solid waste will be collected. The improved collection of solid waste will have eradicated the dumping of solid waste into small and larger drains. The drains will be free from solid waste, and pollution of the surface waters and the risk of flooding will have reduced. There will be improved productive uses of water for livelihood (micro enterprises and agriculture), especially through the reuse of storm water and/or wastewater in urban agriculture."

Below, a number of strategic directions are discussed for achieving this vision. These include options for improving storm water discharge and options for reducing surface run-off.

7.5.1 Strategic directions for improving storm water discharge

Improving storm water drainage will reduce flooding and will contribute to a healthier and safer Accra.

In order to **improve the discharge of storm water in existing drains** and waterways, which are currently often blocked by solid waste and silt, the following interventions could be considered:

- Covering storm drains to prevent inflow of solid waste (this option was highly debated since LA members were of the view that it is highly expensive and may not have a high impact due to the poor attitude of citizens and the low maintenance culture of the society)
- Preventing the inflow of sand and gravel of roads into drains
- Improving solid waste management
- Improving maintenance of storm drains
- Enforcement of by-laws to prevent the construction of real estate in water courses

These interventions will require the involvement of different institutions and good coordination between the institutions involved. There is a high need to clarify and spell out who is responsible for what when it comes to storm water drainage. Clarifying roles and responsibilities and coordination between different institutions involved in water management in the Greater Accra Metropolitan area is discussed in more detail in the chapter eight.

Besides improving existing drains, there is a need to **expand the existing drainage system**, especially in the long term. Even though there is a proposed drainage master plan for the city, there are challenges with funding for the implementation of these plans (Personal communication, Mr Wise Ametefe (2008) and Ametefe, forthcoming). Extending the storm water drainage system is expensive. Concrete lined drainage channels on both sides of residential streets are often more expensive to construct than the road itself. There is the need to review the current design standards to ensure all drainage systems have adequate capacity but also that standards adopted are not excessively expensive (AMA, 2006b).

7.5.2 Strategic directions for reducing surface run-off

In order to prevent some of the potential problems raised above, it is proposed to carefully plan for the expansion of the city, such that the expanded urban water system is flexible and will be able to cope with the changed situation.

It is recommended that the city adopts a **water sensitive urban design (WSUD) approach** where future developments are done with an "interdisciplinary cooperation of water management, urban design and landscape planning which considers all parts of the urban water cycle, combines water management functions and urban design approaches and facilitates synergies between ecological, economic, social and cultural sustainability" (Wagner, 2009). The objective of WSUD for storm water management includes:

- Protection of natural systems: that is to protect and enhance natural water systems within urban developments. This is recognised in the National Environmental Sanitation Policy, which states that regulations preventing the use of wetlands as disposal sites will be enforced. It goes on to state that awareness of the importance of wetlands and water courses will be increased through the support of advocacy on interventions aimed at restoring and improving wetlands.
- Integration of storm water treatment into the landscape: that is use storm water in the landscape by incorporating multiple use corridors that maximise the visual and recreational amenity of developments
- Protection of water quality: that is to protect the water quality draining from urban development
- Reduction in run-off and peak flows: that is to reduce peak flows from urban development by local detention measures and minimising impervious areas. This is lined to the availability of space to hold storm water
- Addition of value while minimising development costs: that is minimise the drainage infrastructure cost of development (Beecham, 2003)

A range of sustainable urban drainage measures could be adopted to reduce the run-off which leads to flooding. A green belt approach could be applied around the 2010-city and develop the new city to the north and north-west of the green belt. The green belt will accommodate a number of functions:

- It will provide space for storm water retention, storage and/or infiltration, thus reducing the storm water flows that pass through the 2010-city
- It will provide space for urban agriculture and for reuse of storm water, treated wastewater and/or composted sludge. For that purpose the wastewater and sludge will have to be treated in treatment plants located just north of the green belt
- It will provide the opportunity to develop high quality housing along the edges of the green belt
- It will provide opportunities for recreation

In order to realise this, there will be a need for good planning and strict enforcement which may be a big challenge for a city like Accra.

At the household level, rainwater harvesting (as discussed in chapter 5) and the reuse of grey water can reduce the run-off of grey and storm water. This can be stimulated by education and awareness raising campaigns on the use of rainwater harvesting and grey water reuse techniques and by providing incentives for installing these technologies at the household level.

8 Institutional Coordination and Planning

This chapter focuses on the cross-cutting institutional issues. It is to a large extent based on the institutional mapping done within the framework of the SWITCH Project (Darteh, forthcoming) and on discussions within the Accra Leaning Alliance. Section 8.1 presents an overview of the institutional set-up of urban water management in Ghana and the Greater Accra Metropolitan Area in particular. This is followed by an analysis of the main challenges in section 8.2 and the presentation of suggested strategic directions to address the challenges in section 8.3.

8.1 Overview of institutional setup for urban water management

There are various institutions, both at the national and local levels, that have authority over the different aspects of urban water management. Institutions in this case refer to organisations, legislations and regulations, national policy framework and by-laws of the Metropolitan Assembly in Accra. The table below gives an overview of these institutions. The table demonstrates the clear separation of functions, which was part of the sector reforms begun in the 1990s. This sometimes serves as a barrier to integration.

Table 43: Overview of institutional arrangements in urban water management in GAMA

	Water resources and supply	Excreta and wastewater management	Storm water drainage
Policies	Upcoming National Urban Policy		
	National Water Policy	National Environmental Sanitation Policy	
Policy making, planning and financing	NDPC MoFEP		
	MWRWH	MLGRD MRT	MLGRD MWRWH
Legislation	Parliament MMDAs		
Bye-laws		e.g. MMDA bye-laws, requiring each household to have a latrine	
Regulation	WRC PURC	EPA	
Service Provision	GWCL/AVRL Private service providers Water and sanitation development boards (community management service providers, facilitated by CWSA)	WMD-AMA Public latrine operators	Hydrological Services Department, Department of Urban Roads MMDA (drainage maintenance unit)
Consumers and civil society groups	Citizens of the Greater Accra Metropolitan Area, NGOs		

Source: Darteh, forthcoming

As service provision and regulation have been discussed for the various elements of the urban water cycle in the previous chapters, the emphasis will here be on law and formal regulations and ministries and key government agencies.

8.1.1 Law and formal regulations

Parliament (constitution of Ghana, 1992)

The functions of parliament are guided by the 1992 constitution of Ghana. This is the supreme law of the country and it promotes the rights of all citizens including access to water. This is found in Article 35 (3) which enjoins the state to promote just and reasonable access by all citizens to public facilities and services (including water). Within parliament, there are the Parliamentary Select Committees; the relevant ones in this case are the Select Committees on Water Resources and Local Government.

All formal agencies also act within an overall sector policy. A cursory glance at the institutional set up shows strength at the level of policy. For example the existence of a National Water Policy that gives an overall direction for the water resources and water supply (rural and urban) subsectors. The National Sanitation Policy which has recently been approved by Parliament gives an overall direction for the wastewater and storm water subsectors.

8.1.2 Ministries and key government agencies

The **Ministry of Water Resources, Works and Housing (MWRWH)** used to be known as Ministry of Works and Housing; significant even is the addition of water to the name of the ministry to show the recognised importance of its functions for water supply. A water directorate was created in 2004.

The MWRWH is responsible for setting the water policies for the country – resource management and supply of drinking water (both urban and rural). The policy objectives are achieved through its agencies - WRC, CWSA and GWCL. Regulatory functions in respect of the supply of drinking water and consumer protection are the responsibility of the PURC (for urban water) and District Assemblies (for community-managed water systems).

The **Ministry of Local Government and Rural Development (MLGRD)** is responsible for the policies and programmes for the efficient administration of local government structures. With the current emphasis on decentralisation, most of these policies are carried out through Metropolitan, Municipal and District Assemblies (MMDAs). These are responsible for environmental sanitation – both water-borne and solid waste. They mobilise and negotiate for international funding for capital projects in the sanitation sector. This has in some cases involved water projects as part of urban renewal programmes which have a poverty reduction focus.

Water and sanitation are cross-cutting and health outcomes can be achieved through a holistic approach to both water and sanitation. Hence there is need for MWRWH and MLGRD to harmonise policies and programmes.

Ministry of Finance and Economic Planning (MOFEP) provides the finance to support the delivery of urban water and wastewater infrastructure as well as the operational and capital expenditure budgets of the sector institutions. Most development assistance from donors is channelled through the ministry. The sector relies substantially on donor funds (agreements are between donors and the ministry acting on behalf on the government).

The **National Development Planning Commission** (NDPC, Act 479, 1994) is the main body responsible for broad policy formulation on which basis Ministries, Departments and Agencies formulate their sectoral policies. The NDPC may at the request of the President or parliament, or on its own initiative, study and make strategic analyses of macro-economic and structural reform options and make proposals for ensuring the even development of the districts of Ghana by effective utilisation of available resources. It also monitors, evaluates and coordinates development policies, programmes and projects. The NDPC organises orientation regarding national policies and programmes for MMDAs as and when needed. One of the major tasks for the NDPC in recent times has been to co-ordinate the preparation of the Medium Term Development Plans for the MMDAs. The NDPC is currently in the process of developing an urban policy and this provides an avenue for including issues of Integrated Urban Water Management as a strategic direction for urban authorities.

In line with Ghana's decentralisation programme, Local Government Authorities (LGAs) – **Metropolitan, Municipal, and District Assemblies** - have been given clear-cut quasi-legislative, and administrative powers enshrined in the Local Government Act, 462(1993). DAs may as appropriate delegate any of its functions to Town, Area, Zonal or Urban Council or Unit Committee or such other body or person it may determine. Within Accra, or what is referred to as GAMA, the relevant local authorities are the Accra Metropolitan Assembly, Ledzekuku-Krowor Municipal Assembly, Tema Metropolitan Assembly, Ga East Municipal Assembly, Ga West Municipal Assembly, GSMA, Adenta Municipal Assembly and the Ashaiman Municipal Assembly.

Even though Ghana has been practising decentralisation for more than a decade and the Local Government Act 462 (1992) also prescribes that district assemblies should provide social amenities to their inhabitants, the water sector is not fully decentralised to the district level, thus the city of Accra does not plan for its water supply. However, the concept of community management of water supply in rural and small towns places considerable responsibility on the MMDAs in ensuring that water facilities are well-managed in a sustainable manner.

Even though Integrated Urban Water Management is not explicitly mentioned in the National Water Policy, the guiding principle for water resources management is that of Integrated Water Resources Management (IWRM). This is captured in the NWP (MWRWH, 2007) as follows:

"It is important to adopt a holistic approach to water resources management and development."

8.2 Challenges

A study conducted by the UN-Habitat in 2009, showed that the AMA administration structure is weak and is confronted with the following: "*Dual allegiance of decentralised departments, incomplete decentralisation, non-connectivity of departments, lack of transparency, over centralisation of administration and financial issues. There is also the problem of functional duplication of public and parastatal agencies in performing their statutory obligation in the same geographical location of the city authority; these most often create friction and duplication*" (UN-Habitat, 2009). Here we will have a closer look at a number of these challenges and their root causes.

8.2.1 Incomplete decentralisation

While the Local Government Act, 1993 (Act 462) and Local Government Service Act, 2003 (Act 656) seek to effectively transfer the functions and offices of central ministries, departments and agencies to the

Assemblies, this has not happened and many still exist and function as central government dependencies (MLGRD, 2010). An example is the Ghana Water Company Limited and the role it plays in the AMA with regards to water supply. These problems listed above are not peculiar to AMA but also common to the other District Assemblies that make up GAMA. The Local Government (Departments of District Assemblies) (Commencement) Instrument LI 1961 was passed in 2009 also to ensure that in line with the 1992 constitution [article 240 (2) (d)], persons in the service of local government shall be subject to the effective control of local authorities for purposes of accountability and good governance.

8.2.2 Inadequate planning and coordination

The action of the various institutions responsible for the different aspects of IUWM are not well coordinated, and in many cases planners and operators are hampered by limited sharing/access to accurate data on key aspects to inform their planning, decision making and monitoring of progress towards objectives.

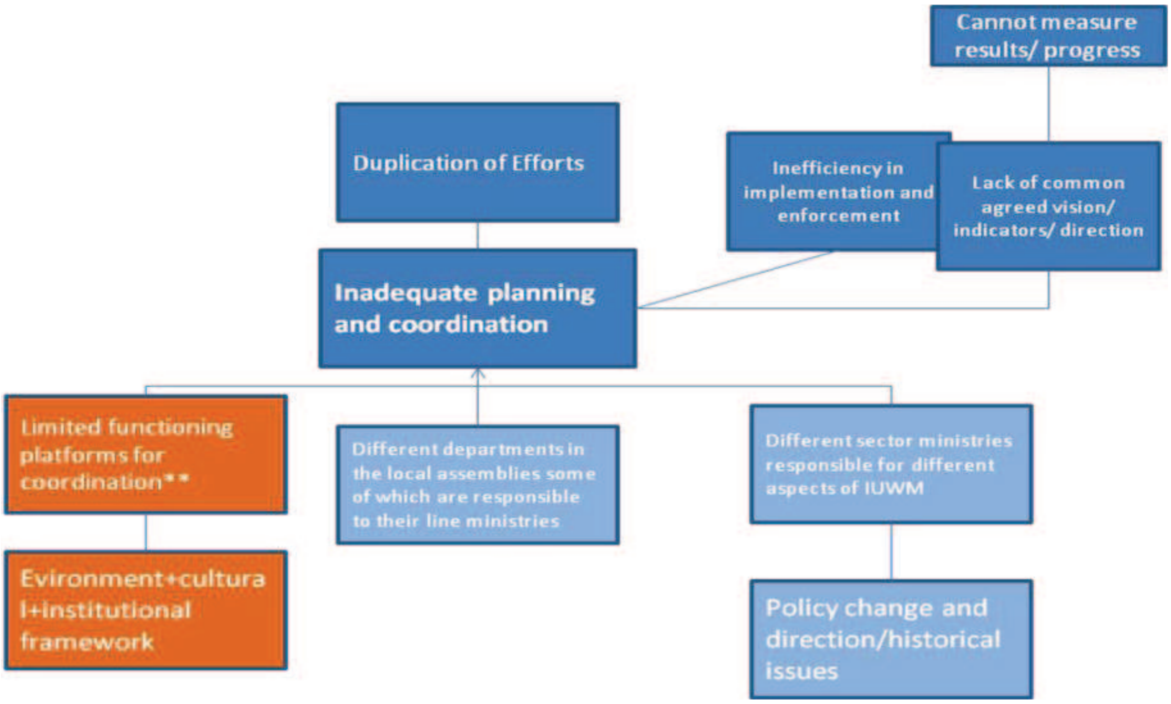


Figure 34: Causes and consequences of inadequate planning and coordination

One of the root causes of inadequate planning and coordination is the fact that different sector ministries are responsible for different aspects of integrated urban water management. There are various plans and planning processes related to various aspects of water management and sanitation within Accra (e.g. the Medium Term Development Plans of the MMDAs, and the Strategic Investment Programme of GWCL). However, responsibilities for different aspects of water management and planning are fragmented and the enforcement of existing plans is weak. Currently there is no master plan or overarching strategy for delivering water, sanitation and drainage.

Because all these agencies are directly responsible to their line ministries and each of them works with their own 'rules and regulation' they are often found 'doing their own thing'. As a result, even though opportunities exist for investment in the sector through government/ESA/DPs, there is the threat that inadequate planning and coordination among sector agencies will prevent these from being achieved. Interviews of stakeholders in the sector show that stakeholders perceive that there is a minimal level of coordination in the sector. This is also a common topic of discussion. A communiqué released at the end of the 4th Accra LA (which was combined with the 2nd National Level Learning Alliance Platform meeting) indicated the lack of coordination is a contributing factor to the low delivery of improved services for water and sanitation (SWITCH /RCN, 2009).

Some of the issues relating to urban water management in Accra stem from other municipalities and regions. For example, water supply to the city depends to a large extent on sources from outside the city and indeed the region. This means that pollution of water sources or even problems with the pipelines in the areas through which they pass before getting to Accra, cuts across municipalities and district assemblies. As can be seen from chapter two, 'Accra' has gone beyond the AMA boundary and now involves municipalities that surround the city. This has an effect on water supply, sanitation and storm water management. The rapid development of communities on the fringes of Accra (in areas along the main water supply distribution lines) has reduced how much water is available to residents thereby having an adverse effect on water supply in the city. It has also affected the volumes of storm water that the city has to deal with. Septic waste volumes in the city have also been increased since septic waste from these areas are brought to 'Lavender Hill' to be dumped.

This rapid growth of the city, especially around its fringes, poses a challenge to the already fragmented institutional set up and affects planning and coordination within the city. This is because more than one planning authority comes into play when looking at a broader Greater Accra Metropolitan Area (GAMA).

As mentioned above, the Ministry of Water Resources through its sector agencies have responsibility for water supply and resource management while the Ministry of Local Government through the metropolitan, municipal and district assemblies have responsibility for wastewater management. To make matters worse, within the metropolitan and municipal assemblies, different departments are also responsible for different aspects. For example, within the Accra Metropolitan Assembly there is a now a separate waste management department and sewerage department (previously, the sewage unit was under the waste management department). There is also the Urban Environmental Sanitation Project which is investing in new sanitation facilities and programmes. More often than not there is very little room for coordination even among the different units under the same department. Some of the departments are responsible to their line ministries and sometimes receive funding from their line ministries even though they are under the assemblies. The planning and coordination units of the assemblies are supposed to coordinate activities at the assembly level, but because of the challenges of information flow among these departments, each department seems to be locked up in its own 'silo'.

The result is that there is duplication of activities and interventions. For example, the Hydrological Services Department has in its mandate to develop a drainage master plan for which funding has been a challenge but the Urban Roads Department under Ministry of Road Transport has funds to construct drains as part of their work. They also have funds to maintain the tertiary and secondary drains, but the drainage unit of the Waste Management Department, which is also responsible for cleaning/maintaining drains, remains challenged in doing their work. This makes it difficult to also measure the results and progress towards a set target. Another result of the lack of planning and coordination are inefficiencies in the system, some of which are due to the fact that each department sets its own targets and definitions and works towards them.

8.2.3 Functional duplication

The above compounds the already existing situation where there is functional duplication of public and parastatal agencies in performing their statutory obligation in the same geographical location of the city authority. As mentioned earlier, a classic example is in the area of water supply. Local Government Act, Act 462 gives one of the functions of district assemblies as providing for amenities including water services. In practice the delivery of water services has to a larger extent been delegated to GWCL with municipalities playing a minor role. This brings about more than one planning authority for water supply - the GWCL planning unit and the metropolitan or municipal planning (in this case different municipalities are autonomous). The Ghana Water Company is not decentralised to the municipality level and their regional/ district offices are not accountable to the assembly but rather to the main GWCL Headquarters which is under the Ministry of Water Resources. The challenge of having more than one planning authority is with getting them all to work together. Compounding this situation is the fact that the utility (GWCL/AVRL) operates with one set of boundaries and municipalities have different boundaries, as was presented in Box 2.

Individuals get permits to build houses in new areas without much regard to whether that is within the planning horizon of the service provider (i.e. GWCL) or not. They go ahead and build and later request water services. Once these people are not connected to the formal utility they are not considered to be customers. This brings to the fore another issue of institutional accountability for provision of water services and sanitation. There is lack of clarity on who is responsible for the extension of water and sanitation services to the people who are currently unserved (especially the urban poor). There is a lack of central oversight and there are no plans to systematically deal with the un-served especially the urban poor and those living in peri-urban areas. It would seem in principle though that it is the responsibility of the municipality (based on Act 462) even though it doesn't have a clearly defined mandate for water supply. People not connected to the networked water and sanitation services, rely to a large extent on informal service providers. Regulation of these informal service providers is weak to non-existent due to the fact that they are not formally recognised and thus it is difficult to regulate them.

8.2.4 Challenges with long term strategic planning

Beyond coordination, long term strategic planning is a challenge. This is the result of inadequate reflexive analysis. This is a vicious cycle because it goes back and forth between the problem and effects. When problems emerge, social and political pressures coupled with the lack of capacity for dealing with problems in a strategic way prevents a proper analysis of the problem. A study of the Strategic Investment Plans (SIPs) of some sector agencies show more emphasis on the expansion and provision of new/more facilities without much consideration for management of existing facilities. Aspects such as operation and maintenance (O& M) appear to have low emphasis. The result of inadequate problem analysis is that proper plans are not put in place to adequately deal with problems leading to ad-hoc measures which are not sustainable. Inadequate implementation of plans is also due to the inadequacy of implementation capacity and inadequate enforcement.

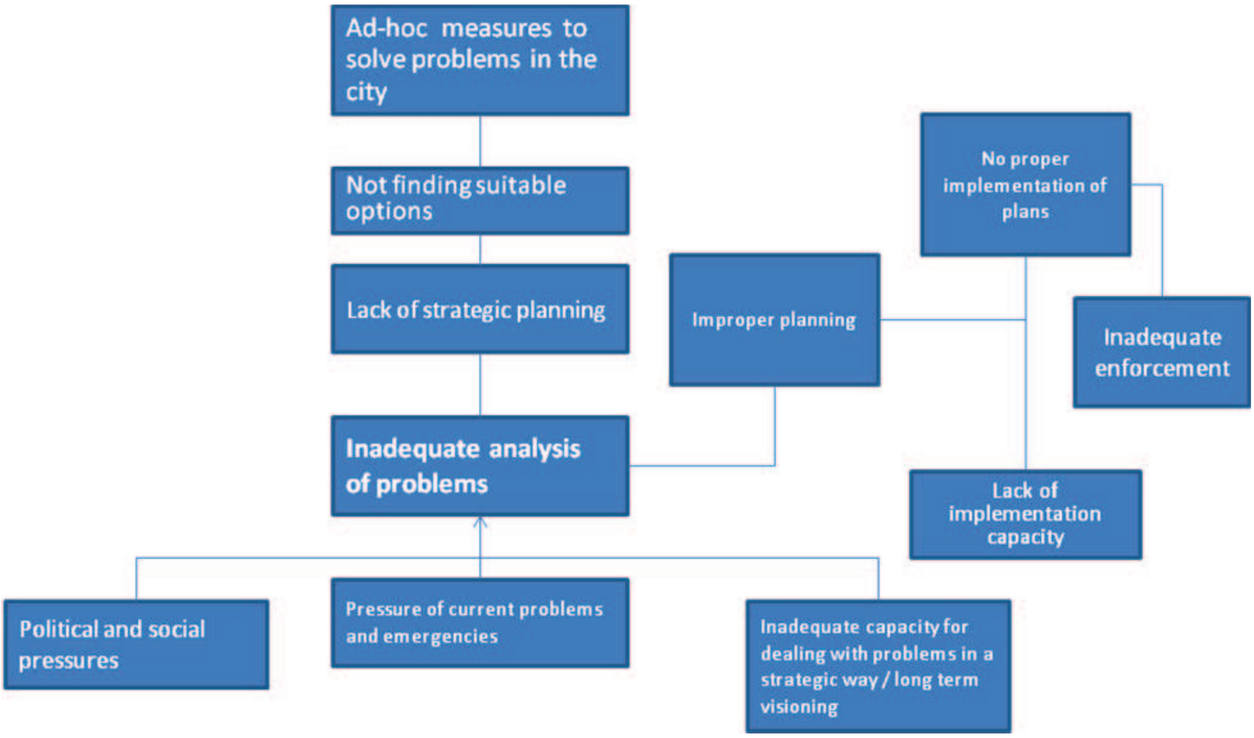


Figure 35: Causes and consequences of inadequate analysis of problems

8.3 Strategic Directions

The Accra Learning Alliance, as part of a strategic planning process, identified a number of strategic directions that could address the above discussed challenges. The strategic directions require changes at the policy/ sector level and at the institutional levels to provide an enabling environment. Cutting across all strategic directions is the issue of planning and coordination. This will be dealt with a little later in this section. There is also the need for explicit delineation of roles and responsibilities for sector agencies.

The Accra Learning Alliance recognised that there is the need for a policy move/recognition towards integrated urban water management. This is supported by the already existing National Water Policy which has Integrated Water Resources Management (IWRM) as its guiding principle.

As mentioned earlier on in this chapter, some of the challenges to implementing programmes/policies at **city (GAMA) level** are due to the inability of the utility to coordinate with municipal authorities. And also due to the fact that there is inadequate linking of agencies in planning (some of the institutions are invited to meetings not as part of the planning but more often as part of the implementation process). In order to overcome this challenge, the Accra Learning Alliance proposed that the **GAMA Integrated Urban Water Management Planning and Coordination Platform** should be established for city wide planning alignment and development of water and sanitation services. It could serve as a platform for stakeholder to interact, in order to share and collate information. Furthermore, the platform should play a role in the coordination, harmonisation and monitoring of strategic plans and activities related to achieving the vision of a safe and healthy city where everyone has access to safe, sufficient and affordable water and sanitation services. The platform can advise on national level and decentralised level policy formulation. The 'Greater Accra Metropolitan Area Coordination Platform' could build on the existing Accra Learning Alliance and could be a way of institutionalising and continuing the Learning Alliance process for the city.

It is proposed that the GAMA IUWM Planning and Coordination Group should include representatives from the Regional Planning and Coordination Unit, the different MMDAs (DCD + Planning Department), Regional level GWCL/AVRL, CWSA Regional Office Greater Accra Region, Regional Environmental Health Officers (REHO), the Hydrological Services Department, Community Development Officers, the Water Resources Commission, Civil Society organisations (e.g. the Coalition of NGOs in the Water and Sanitation Sector), alternative service providers like the Associations of Tanker Operators and ideally customers (e.g. Consumer Association of Ghana).

Stakeholders recognised that despite the proposal of the platforms there could be challenges in the implementation of such a process and the threat that there is the potential of this platform to become like existing institutions. To get this going, there is the need to continue the stakeholder consultation process that has been started by the Accra Learning Alliance process, facilitated by the SWITCH project, and get the idea streamlined into the activities of the metropolitan and municipal assemblies. This platform that is looking at urban water management could be hinged on existing coordination that is mentioned in Act 462. What is needed is to have a unit that will facilitate the continued interdepartmental dialogue, sharing of information and planning alignment. At a policy forum held as part of stakeholder consultations on the formation of the planning and coordination group, it was agreed that while it is a good idea, the immediate implementation on a large scale may prove to be challenging. It was suggested that the platform be piloted at the metropolitan level (using one of the municipalities in Accra) before being extended to other areas.

At the level of the **metro and municipal assemblies** there is a need for better planning and coordination between assembly departments and other stakeholders, including service providers. This includes the coordination of activities related to water service provision, sanitation services (for example, within the AMA there is the need to coordinate activities of all agencies that handle wastewater management; Sewage Unit, Waste Management Department and the Urban Environmental Sanitation Project office) and storm water drainage (for example, there is a need for collaboration between AMA Drainage Unit under WMD, the Metro Roads Department and the Hydrological Services Department. Related to this, there is a need for

- Resolution of ambiguities regarding the respective roles of the municipalities and Ghana Water Company Limited in providing water services
- Resolution of ambiguities on responsibilities for drainage
- Resolution of ambiguities regarding responsibilities for wastewater management

The office of the Coordinating Director could take the lead in this. Furthermore, departments that handle storm water also need to be coordinated.

In addition to improved coordination and planning at the metro/municipal and at the GAMA level, there is the need for an enabling environment for IUWM at the **national level**, which should include enabling and regulating legislation and policies for improved urban water management. Currently at the national level there are efforts towards a sector wide approach (SWAP), but the focus seems or appears to be more on water supply/resources. It will be good for a similar process to be developed for wastewater (sanitation) and the needed linkages identified and addressed for the urban water and sanitation sub-sectors. This process could be led by the National Development Planning Commission (NDPC), and the

Ministries of Water Resources, Works and Housing (MWRWH) and Local Government and Rural Development (MLGRD). Various sector agencies should also be involved in the process, including EPA, PURC, WRC etc.

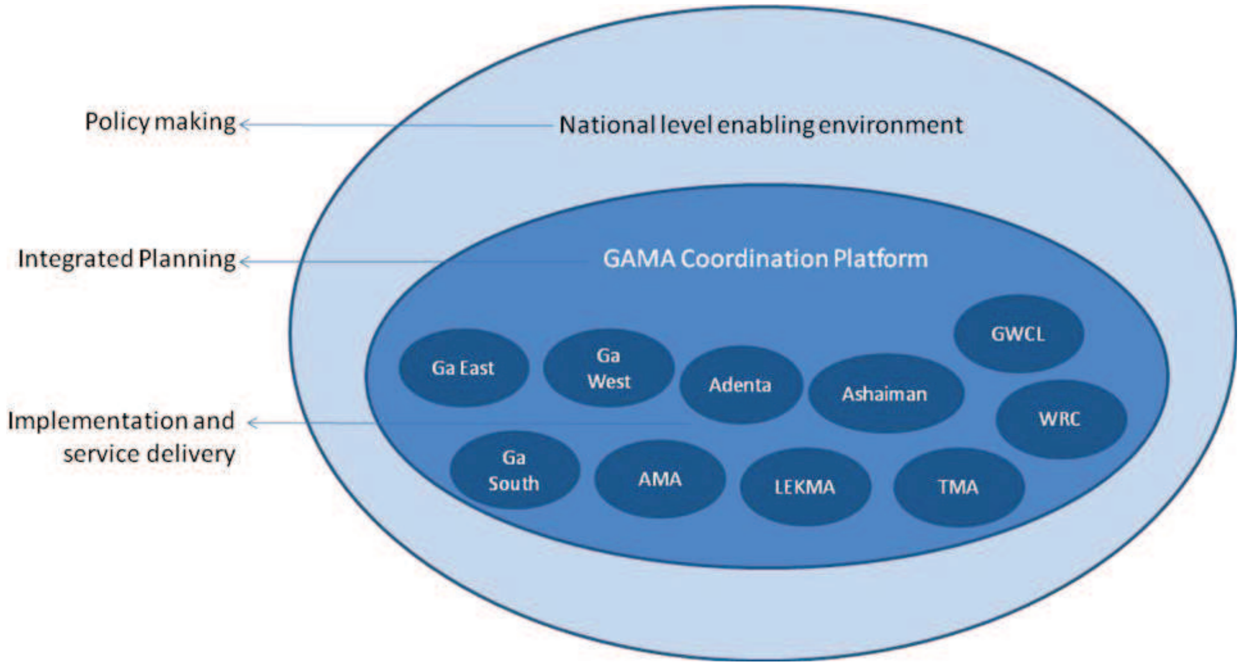


Figure 36: The GAMA IUWM Planning and Coordination Platform

9 Conclusions

Accra lies at the bottom of one of the region's major rivers. It is blessed with abundant access to water resources. There does not seem to be a short or medium term threat to these, unless major unprecedented climate change or changes in upstream abstraction intervenes.

The main threat to water supply for the Greater Accra Metropolitan Area is not availability of water resources but mismanagement of the water supply system. The system has been shamefully mismanaged over the last decades to the extent that it is now at the point of collapse. Levels of non-revenue water are high, and there are constant supply interruptions.
While the treatment capacity is currently almost sufficient for supplying today's population, this will undoubtedly have to be expanded to deal with inevitable growth in population. It is crucial that this happens in a planned manner. In addition, steps will have to be taken to decrease the amount of non-revenue water.

Barriers to access to water supply services need to be sorted out and appropriate service delivery models need to be identified for high density and unplanned urban areas that are not suited to household connections. Promising approaches include:

- Community managed distribution of utility bulk supplies
- Registration and regulation of alternative providers

It should be noted that bringing the water supply up to scratch – i.e. a tap in every house – has to go hand-in-hand – and cannot run ahead of – bringing the housing stock up to scratch (i.e. a tap in every house does not equal a tap in every shack)

Accra's excreta and wastewater management is arguably even more shamefully mismanaged than its water supply. The system is to all intents and purposes non functional. There is an urgent need to identify realistic options to provide dignified and affordable access to sanitation facilities, and there is an urgent need to identify appropriate means to collect, transport and treat urban liquid waste. In addition, long term solution(s) to liquid waste need to be identified urgently. This will likely mean a service ladder approach with different service levels in different areas. As with water, sanitation improvement cannot run (far) ahead of housing stock improvement. Promising approaches include:

- Privately managed public latrines, especially as a short and medium term solution
- Rehabilitation of sludge treatment and disposal facilities

Many areas of Accra are prone to flooding**.** Floods are exacerbated by the increase of paved areas without a concomitant increase in drainage capacity, building in waterways and by blockage of existing drainage capacity due to poor solid waste management. Urban flood reduction requires the development of more sustainable drainage systems and better solid waste management. In addition, there is a need to identify options for reducing surface run-off.

Institutionally, the sector is fragmented with overlapping and contradictory areas of responsibility. There is poor-to-no enforcement of existing (planning) regulations and a lack of frameworks for integrated planning. In order to improve this situation, the following is suggested:

- Clear delineation of boundaries and responsibilities
- Creation of integrated planning frameworks and coordination structures
- Enforcement of existing laws and by-laws

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Annex 1: Bibliography of data and information on water in Accra

The tables below give details on a great number of documents reviewed for this study. Not all these documents have been used in this final document and therefore cannot all be found back in the reference list. Many of these documents are also available from the digital library of the Resource Centre Network Ghana: http://www.ghana.watsan.net/docsearch/search.

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Reference	Availability	Abstract / Remarks
Abraham, E., D van Rooijen, O. Cofie, L. Raschid-Sally (2006) Review on urban water resources and water demand for agriculture and other livelihoods opportunities in Accra, International Water Management Institute	PDF on Accra starter kit	56 page report that gives an overview of water sources and demand, livelihood issues and urban agriculture.
Ghana districts website	http://www.ama.ghanadistricts.gov.gh	Website with information, data and articles about Ghana's districts
Ghana Health Services (2008) Greater Accra Region.	http://www.ghanahealthservice.org/region.php?dd=4&region=Greater%20Accra%20Region	Description of the administrative set-up of the Greater Accra Region
GSS (2002) 2000 population and housing census; Summary report of Final Results. Accra, Ghana. Ghana Statistical Service		
Ghana Statistical Services, 2008, Report of the fifth round of the Ghana Living Standards Survey	http://www.statsghana.gov.gh/docfiles/glss5_report.pdf	Statistics on living standards in Ghana, including access to water supply and the use of sanitation facilities.
Ghana Statistical Services (2005) Analysis of District data and implications for planning Greater Accra Region		Analysis of District data and implications for planning Greater Accra Region, based on 2000 census
GoG (2003) Ghana poverty reduction strategy 2003-2005, an agenda for growth and prosperity		
IWMI (2006) Accra population and urban area estimation, Unpublished discussion note		Internal (not published) small paper on population growth in Accra
Konadu-Agyemang, K., 2001, A survey of housing conditions and characteristics in Accra, an African city, Habitat International 25 (2001) 15}34	PDF on Accra starter kit: Accra_Starter_Kit DVD\All Papers\Literature on Ghana-Accra water\ACCRA WATER_Livelihoods & Urban poor	20 page paper. The paper discusses population growth and housing conditions in the city, comparing the situation in the 1950s and the 1990s. It is based primarily on the analysis of surveys conducted in 1954 and 1989 by Acquah and the author, respectively. The survey data is supplemented with data from a small-scale interview of 52 households conducted in 1997, and the three Ghana Living Standard Surveys conducted in 1987/88, 1988/89 and 1991/92 by the Ghana Statistical Services. Interesting but dated.

Reference	Availability	Abstract / Remarks
Sarpong Manu, K and K.M. Abrampah (2006) Small water enterprises in Africa. 4: Ghana, A study on small water enterprises in Africa, WEDC, Loughborough University	PDF on Accra starter kit: Accra_Starter_Kit DVD\All Papers\Literature on Ghana-Accra water\ACCRA WATER_Alternative water supply	Report (162 page), part of the project "Better Access to water in informal urban settlements through support to water providing enterprises" in 4 countries, undertaken by WEDC and local partners. Ghana research conducted by MINE consult in collaboration with WaterAid and GWCL. Report provider general information and results from case studies in Teshie and Ashallay Botwe.
Songsore, J. et al, 2005, State of environmental health : Report of the Greater Accra Metropolitan Area. 2001, Ghana Universities Press	Available in hard copy from University of Ghana - Legon	
Table of Urban Localities	http://www.citypopulation.de/Ghana.html	Population data from 1970, 1984 and 2000, from Accra (incl. Teshie, Nungua), Adenta East, Ashiaman, Awoshie, Dome, Gbawe, Lashibi, Madina, New Achimota, Sakumono, Taifa, Tema, Tema New Town, based on Ghana Statistical Service: 2000 Population and Housing Census, Special Report on Urban Localities, 2002
Twum-Baah, K.A. (2002) Population growth of Mega-Accra: Emerging issues. In: Mills-Tettey, R and K. Adi-Dako (eds). Visions of the City. Accra in the 21st Century. Woeli Publishing Services, Accra, p. 31-38	Referred to in "ACCRA POPULATION AND URBAN AREA ESTIMATION A discussion note (IWMI, 2006, unpublished)", which can be found on Accra_Starter_Kit DVD\All Papers\Literature on Ghana-Accra water\ACCRA WATER_Accra Demographic Growth	
Yankson, Paul W. K. Kofie, Richard Y. Moller-Jensen, Lasse (2004) Monitoring urban growth: urbanisation of the fringe areas of Accra, Working paper	Accra starter kit	

Water resources

Reference	Availability	Abstract / Remarks
Meteorological Service (2007) Rainfall and ET records Accra, data from 1970-2005	Meteorological Service	Data on rainfall and ET
Abraham, E. M., D van Rooijen, O Cofie, L Raschid-Sally, 2007, Planning urban water – dependent livelihood opportunities for the poor in Accra, Ghana, SWITCH Scientific Meeting University of Birmingham, UK 9-10 Jan 2007	PDF on Accra starter kit: Accra_Starter_Kit DVD\All Papers\Literature on Ghana-Accra water\ACCRA WATER_Livelihoods & Urban poor	13-page paper presented at SWITCH Scientific Meeting University of Birmingham, UK 9-10 Jan 2007 Exploratory study into the productive uses of urban water supply in Accra

Reference	Availability	Abstract / Remarks
Ameko, E. M.K. 2007, Managing the challenges of climate change and impacts of hydrological change on hydro power production from the water resources of the Volta Lake in Ghana – a case study, presented at 3rd International Conference on Climate&Water Helsinki 3-6 Sep 07, Finnish Environment Institute	http://www.ymparisto.fi/download.asp?contentid=74550&lan=EN	33 slide presentation about the Volta Lake and climate change, from the perspective of the Volta River Authority
Andreini, Van de Giesen, Van Edig, Fosu, Andah, 2000		
Anku, S.K., MANAGING WETLANDS IN ACCRA, GHANA, African Regional Workshop Cities, Ecosystems and Biodiversity Nairobi, 21 September 2006 Side Event at the Africities Summit (18-24 September 2006)	PowerPoint on Accra starter kit: Accra_Starter_Kit DVD\All Papers\Literature on Ghana-Accra water\ACCRA WATER_Environmental aspects	28 slide PPP on the Importance of Wetlands, description of Wetlands in Accra (focussing on Sakumo Ramsarwetland , Korle lagoon and Densu), uses of the wetlands, threats and challenges to wetlands, description of policies, project programmes etc related to wetlands
Ansa-Asare OD and Asante KA. (2005) Changes in the Chemistry of the Weija Dam Reservoir in Ghana, Twenty Years after Impoundment, *CSIR-Water Research Institute*	http://www.wajae.org/papers/papers_vol8/papers8_weija_dam_full.pdf	
Ansa-Asare OD. (2001) Land-based sources of pollution and environmental quality of Weija Lake, (Journal of the Ghana Science Association: 2001 3(3): 100-108)	http://www.ajol.info/viewarticle.php?jid=94&id=7912&layout=abstract	Very technical paper on the water quality of the Weija dam. The paper presents a survey of land-based sources of pollution that was undertaken in the catchment area of Weija Lake. Activities that may influence the quality of the environment, and the sources, amounts and effects of the pollution of the water body were assessed for the paper.
Ansong Asante 1999, Nutrient status of two Ghanaian water reservoirs, WEDC conference, Addis Ababa	http://wedc.lboro.ac.uk/conferences/pdfs/25/276.pdf	WEDC paper from WRI researcher, describing chemical characteristics of water is Weija and Kpong. Includes analysis of DO, BOD, nitrogen, Orthophosphate , Silicate, Sulphate, based on 5 year data collection
Asante, K. A., T. Quarcoopome, et al. (2008). "Water Quality of the Weija Reservoir after 28 Years of Impoundment." West African Journal of Applied Ecology **13**.	*ajol.info/index.php/wajae/article/view/40588/8121*	
Awuah and Abrokwa (2008) Performance evaluation of the UASB sewage treatment plant at James Town (Mudor), Accra, 33rd WEDC conference	http://wedc.lboro.ac.uk/conferences/pdfs/33/Awuah_E_2.pdf	The paper analyses the physical, chemical and biological parameters of the influent (raw sewage) as well as the effluent from the plant. The paper evaluated the overall performance of the plant as satisfactory, but did mention that current management practices may cause the plant to work inefficiently.
Awuah, E., Ansah M. and N.O.B. Ackerson (2009) The use of natural system for the treatment of grey water: a case study of Kpeshie Lagoon, Accra, Ghana		

Reference	Availability	Abstract / Remarks
Boadi, K.O. and M. Kuitunen (2002) Urban waste pollution in the Korle Lagoon, Accra, Ghana, The Environmentalist, 22, 301–309, 2002, 2002 Kluwer Academic Publishers		9 page article on population in the Korle Lagoon, which is called one of the most polluted lagoons in the world.. Paper is mainly based on secondary sources.
Environmental Protection Agency (EPA) Ghana (2000) General Environmental Quality Standards (Ghana), Regulations 2000		
Esty DC, Levy MA, Srebotnjak T, de Sherbinin (2005), A Environmental Sustainability Index: Benchmarking National Environmental Stewardship. New Haven, Yale Center for Environmental Law and Policy.	Referred to in Christina Lundéhn*, Gregory M. Morrison* and Kwesi Andam (2006)	
Friesen, J. M. Andreini, W. Andah, B. Amisigo and N. van de Giesen, Storage capacity and long-term water balance of the Volta Basin, West Africa, in: Franks. S. et al (ed), 2005, Regional Hydrological Impacts of Climatic Change – Hydroclimatic Variability, International Association of Hydrological Sciences 2005		This study examines whether long-term changes in the run-off regime can be observed at the level of the whole Volta Basin. On the basis of a storage capacity and water balance analysis, it shows that climatic changes do result in changes in run-off behaviour.
Giesen, N. Van der, M. Andreini, A. Can Edig, P. Vlek (2004) competition for water resources of the Volta Basin, in: Regional Management of water resources, Proceedings of a Symposium held during the 6th IAHS Scientific Assembly at Maastricht, the Netherlands		
Bourgoing (1996) GHANA: The nightmare lagoons	http://archive.idrc.ca/books/reports/e234-13.html, (accessed on 22 March 2010).	
Mining portal of Ghana (2006) Hydrology: OCCURRENCE OF GROUNDWATER IN THE VARIOUS ROCK TYPES IN GHANA	http://www.ghana-mining.org/ghweb/en/geologymining/geology/hydro.html	Website
Kankam-Yeboah, Dr K. et al (2007) ASSESSMENT OF THE WATER RESOURCES MONITORING (SURFACE AND GROUND-WATER) OF GREATER ACCRA REGION, CSIR-WRI, Accra	PowerPoint on Accra starter kit: DVD\All Papers\Literature on Ghana-Accra water\ACCRA WATER_Environmental aspects\WRI OVERVIEW OF WATER RESOURCES QUALITY in GAMA	A summary of data on water resources in the Greater Accra area compiled by WRI and presented on 16 October 2007 at CSIR-WRI (Accra) to the UNESCO country representative
Karikari, A. Y., K. A. Asante and C. A. Biney, 2006, Water Quality Characteristics at the Estuary of Korle Lagoon in Ghana, West African Journal of Applied Ecology 10 (2006)	http://wajae.org/	As part of the environmental impact assessment of the Accra waste project, a water quality survey was conducted in April 1997 by measuring the concentrations of selected pollutants at the entrance to the Korle lagoon from offshore of the lagoon, and the raw sewage discharge onto the beach adjacent to the lagoon. This paper reports the findings of the survey.

Reference	Availability	Abstract / Remarks
Kortatsi B. K. and N. O Jørgensen, 2001, THE ORIGIN OF HIGH SALINITY WATERS IN THE ACCRA PLAINS GROUNDWATERS, First International Conference on Saltwater Intrusion and Coastal Aquifers. Monitoring, Modeling, and Management. Essaouira, Morocco, April 23-25, 2001	PDF on Accra starter kit: DVD\All Papers\Literature on Ghana-Accra water\ACCRA WATER_Environmental aspects Internet: http://www.olemiss.edu/sciencenet/saltnet/swica1/Kortatsi-Jorgensen-paper.pdf	This paper describes the origin and distribution of saline groundwaters in the Accra Plains of Ghana.
Lundéhn, C., G. M. Morrison and K. Andam (2006) Assessment of the Urban Water System in Accra through combined environmental sustainability indicators and stakeholder-consumer dialogue	pdf	
Lundgren, A. and H. Åkerberg, 2006, Rainwater harvesting in the peri-urban areas of Accra: status and prospects, TRITA – LWR Master Thesis, Department of Land and Water Resources Engineering, Royal Institute of Technology Stockholm, Sweden	http://www.lwr.kth.se/Publikationer/PDF_Files/LWR_EX_06_13.PDF	Master thesis about rainwater harvesting in peri-urban areas in Accra. Large part is introduction about Ghana and the WASH sector, but also interesting findings from field research into roof water harvesting.
Martin, N. and N. van de Giesen, 2005, Spatial distribution of groundwater production and development potential in the Volta River basin of Ghana and Burkina Faso, Water International, Volume 30, Number 2, p 239-249, International Water Resources Association	http://www.glowa-volta.de/fileadmin/template/Glowa/Downloads/martin_vandegiesen_2005.pdf	
Ministry of Works and Housing, 1998, Ghana water resources: management challenges and opportunities. Water resources management study, Ministry of Works and Housing	ref in Agodzo, etc al, 2003	
Nai G. G. (1994) Quantitative Evaluation of Pollution in the Korle lagoon. Ministry of Works and Housing, Accra.43 pp	Referred to in A. Y. Karikari*, K. A. Asante and C. A. Biney, 2006, Water Quality Characteristics at the Estuary of Korle Lagoon in Ghana, West African Journal of Applied Ecology 10 (2006) http://wajae.org/	
Nyarko, B. K., (2002) Application of rational model in GIS for flood risk assessment in Accra, Ghana, J. Of Spatial Hydrology, vol.2 No 1	http://www.spatialhydrology.com/journal/paper/Floodzone/floodrisk.pdf	Paper as part of Dphil research work in the Dept of Geology & Tourism at University of Cape Coast. Uses Vriessman & Lewis 1996 and Mannaerts 1996 equation to calculate run-off for catchments within Accra. DEM, discharge map with GIS model were combined to assess flood risks. Use of colours for the maps seems strange.
Salifu, L.Y. and F. Mumumi (2000) Sanitation and Health, World Health Organisation series 389		
Spalthhoff, 2007, Unpublished data from the Volta River Authority, unpublished		

Reference	Availability	Abstract / Remarks
Timbutto (1991)		Under this study, sediment yields were estimated for the following basins: Densu/Sakumo I, Korle/ Chemu I, Kpeshie, Songo-Mokwe, Sakumo II, Chemu II and Laloi . The estimation of both run-off and total sediment yields from the basins was based on available records on the Densu river basin and the catchment areas of the basins estimated from the hydrological map of the coastal area.
Uusitalo, K. (2002) An Evaluation of Urban Water Systems using Environmental Sustainability Indicators: A case of study in Adenta, Ghana. Water Environment Transport, Göteborg Sweden, Chalmers University of technology		
Van de Giese et al (2001)		
Water Research Institute (WRI) (2000) Climate change vulnerability and adaptation assessment on water resources in Ghana	Referred to in Leube, W. C. Leemhuis and B. Amisigo, 2008, Impact of climate change on the Black Volta basin and the Bui dam, GLOWA Volta policy briefGLOWA Volta policy brief. Available at http://www.internationalrivers.org/files/GLOWA%20Volta%20Policy%20Brief%20Bui%20Dam%2017%2003%2008.pdf	3 page brief, looking into the WRI study (2000) and GLOWA Volta Project (GVP) study (2005-2006) on the impact of climate change on the water flows in the Volta Basin.
WRC (2008) Water Resource Commission of Ghana, River Basin Activities	http://www.wrc-gh.org/riverbasinactivities.html	Website of the Water Resources Commission
WRRI (1996) Groundwater assessment report on the Accra Plains. Unpublished technical report, Water Resources Research Institute. C.S.I.R. Ghana	Ref in Kortatsi B. K. and N. O Jørgensen, 2001, THE ORIGIN OF HIGH SALINITY WATERS IN THE ACCRA PLAINS GROUNDWATERS, First International Conference on Saltwater Intrusion and Coastal Aquifers. Monitoring, Modeling, and Management. Essaouira, Morocco, April 23-25, 2001	

Water supply

Reference	Availability	Abstract / Remarks
AMPADU, P. F. (forth coming) The cases of Abokobi and Pantang, peri-urban communities in the GAR, TPP case study, TPP Project, Ghana	www.ghana.watsan.net	
AVRL (2008), AVRL database data of 2007 production and sales data	Excel file: AVRL_database_140609	Data on production and sales for the ATMA districts and systems from 2007. Processed from data from AVRL databases, received from Mr Cor Lievers mid 2008.
Awuah, E. (2007), SWITCH visioning workshop	ppp	
Benneh, G. Et al (1993), Environmental Problems and the Urban Household in the greater Accra Metropolitan Area (GAMA)-Ghana, Stockholm Environmental Institute		
Columbia University (2003) International Studio: Disaster resilient Accra, Columbia University International Planning studio spring 2003	http://www.arch.columbia.edu/Studio/Spring2003/UP/Accra/	
Eguavoen, I. and D. Spalthoff (2008) Getting Access Right: Human rights and household water rights in Ghana, 13th World Water Congress, Montpellier, 1-4 September 2008	http://wwc2008.msem.univ-montp2.fr/resource/authors/abs271_article.pdf	14 page conference paper
Haffner.F. (2006) PPP-policies, practices and problems in Ghana's urban water supply	pdf	
Kessie, C. (2007) Update on infrastructure development and urban water supply 2007	ppp on Accra starter kit: DVD\All Papers\Literature on Ghana-Accra water\ACCRA WATER_Govt Strategic Plans & Infrastructural projects	
Kwakye-Nuako, G., P. B. Borketey, et al. (2007). Sachet drinking water in Accra. The potential threats of transmission of enteric pathogenic protozoan organisms. Ghana Medical Journal **41**(2): 62-67	PDF on Accra starter kit	The study indicated the presence of contaminants of faecal and zoonotic origin in some of the sachet water examined. This has grim public health implications as the organisms identified can cause water related diseases which have serious complications in children and adults particularly immunocompromised individuals. Sachet water should be constantly monitored for its microbial quality
Lievers C., and A. Barendregt, 2009, Implementation Of Intervention Techniques To Decrease Commercial Losses For Ghana	Pdf paper	This paper discusses the impacts of the intervention techniques which have been implemented by AVRL since 2006, targeting decreasing non revenue water (NRW) in the Accra Tema Metropolitan Area (ATMA), Ghana (West Africa).

Reference	Availability	Abstract / Remarks
Lulani, I., P. van der Steen and K. Vairavamoorthy, 2008, Analysis of the public health risks of the Urban Water System in Accra by Microbial risk assessment, WaterMill, working paper series, 2008, no 8, Unesco IHE	http://www.unesco-ihe.org/WaterMill-Working-Paper-Series/Working-Paper-Series/No.-8-Analysis-of-the-Public-Health-Risks-of-the-Urban-Water-System-in-Accra-by-Microbial-Risk-Assessment-Isabella-Lulani-Peter-van-der-Steen-and-Kala-Vairavamoorthy	
Lundéhn C. and G.M. Morrison (unpublished) Assessment Framework for Urban Water Systems – a new approach combining environmental sustainability indicators with stakeholder and consumer interviews and questionnaires (or 2007, An assessment framework for urban water systems – a new approach combining environmental systems with service supply and consumer perspectives, in: Gregory M. Morrison and Sébastien Rauch, 2007, Highway and Urban Environment Proceedings of the 8th Highway and Urban Environment Symposium, Alliance For Global Sustainability Bookseries)	PDF on Accra starter kit Or http://www.springerlink.com/content/k1xt2452411g0m6p/	
Lundgren, A. and H. Åkerberg (2006) Rainwater harvesting in the peri-urban areas of Accra: status and prospects, TRITA – LWR Master Thesis, Department of Land and Water Resources Engineering, Royal Institute of Technology Stockholm, Sweden	http://www.lwr.kth.se/Publikationer/PDF_Files/LWR_EX_06_13.PDF	Master thesis about rainwater harvesting in peri-urban areas in Accra. Large part is introduction about Ghana and the WASH sector, but also interesting findings from field research into roof water harvesting.
MIME Consult Ltd (2004) Better access to water in informal urban settlements through support to water-providing enterprises, Ghana country status report.	PDF on Accra starter kit: Accra_Starter_Kit DVD\All Papers\Literature on Ghana-Accra water\ACCRA WATER_Alternative water supply	Comprehensive 125 page report, submitted to WaterAid and WEDC. General description, as well as case studies from Teshie and Ashalley Botwe
Nii Consult (2003). Study on Provision of Services provided by GWCL - Final Report. Unpublished document, Accra.	Ref in Fuest Haffner 2006 PPP-policies, practices and problems in Ghana's urban water supply	
Nyarko, K.B.,Odai S.N.,Owusu P.A.Quartey E.K. (2008) Water supply coping strategies in Accra, 33rd WEDC International Conference, Accra, Ghana.	http://wedc.lboro.ac.uk/conferences/pdfs/33/Nyarko_K2_GHA.pdf	WEDC paper. Presents a study done from Dec 2006-February 2007, administering 170 questionnaires in low income, middle income and high income areas.
Puplampu, M (2009) WaterHealth International, Inc. , (WaterHealth Ghana), Presentation at the MOLE XX Conference in HO. Ghana, 16 July 2009	PowerPoint presentation	
Puplampu, M (2010) WaterHealth International, Inc. , (WaterHealth Ghana), Presentation at the 3rd National Level Learning Alliance Platform, January 2010	PowerPoint presentation	

Reference	Availability	Abstract / Remarks
Rooijen D.J. van, and P. Drechsel (2008) Exploring implications of urban growth scenarios and investments for water supply, sanitation , wastewater generation and use in Accra, Ghana, 33rd WEDC conference	http://wedc.lboro.ac.uk/conferences/pdfs/33/Van_ROOIJEN2_GHA.pdf	The paper argues that the current situation in Accra shows a need and potential for improvement of water supply and wastewater treatment, through ways that do not require more concrete pipes.
Sarpong Manu, K and K.M. Abrampah (2006) Small water enterprises in Africa. 4: Ghana, A study on small water enterprises in Africa, WEDC, Loughborough University	PDF On Accra starter kit: Accra_Starter_Kit DVD\All Papers\Literature on Ghana-Accra water\ACCRA WATER_Alternative water supply	Report (162 pages), part of the project "Better Access to water in informal urban settlements through support to water providing enterprises" in 4 countries, undertaken by WEDC and local partners. Ghana research conducted by MINE consult in collaboration with WaterAid and GWCL. Report provider general information and results from case studies in Teshie and Ashallay Botwe.
Sarpong Manu, K and K.M. Abrampah (2006) Small water enterprises in Africa. 4: Ghana, A study on small water enterprises in Africa, WEDC, Loughborough University	PDF on Accra starter kit: Accra_Starter_Kit DVD\All Papers\Literature on Ghana-Accra water\ACCRA WATER_Alternative water supply	Report (162 pages), part of the project "Better Access to water in informal urban settlements through support to water providing enterprises" in 4 countries, undertaken by WEDC and local partners. Ghana research conducted by MINE consult in collaboration with WaterAid and GWCL. Report provider general information and results from case studies in Teshie and Ashallay Botwe.
Smit T. (2007) Current Situation of Water Supply ATMA, presented to SWITCH Accra Learning Alliance on 2007-03-15	PPP Q:\Special Projects\S0713900 SWITCH\cities\Accra\first stakeholders forum march 07\presentations SWITCH Accra march07\Day 2	PPP presented at SWITCH Accra Learning Alliance on 15 March 2007on the current status of water supply in Accra and AVRL's role
TAHAL Group (2008) Review and Updating of the Strategic Investment Program (SIP) of the Ghana Water Company Ltm (GWCL), and engineering studies for the preparation of the Subsequent Year Investment Programme (SYIP) of the Urban Water Project, SIP review and updating, final report, Volume 1: main report and appendices	Available in hard copy at the WASHCost office	3 volumes
Tuffuor, B. (2010) Tanker Services as an Alternative Model for Delivering water to the Urban Poor, TPP case study	www.ghana.watsan.net	Based on an evaluation on the AVRL tanker service operation in Accra
Uusitalo, K. (2002) An Evaluation of Urban Water Systems using Environmental Sustainability Indicators A case of study in Adenta, Ghana. Water Environment Transport, Göteborg Sweden, Chalmers University of Technology		
WaterAid (2005) Ghana National Water Sector Assessment	http://www.wateraid.org/documents/plugin_documents/ghananationalwatersectorassessment.pdf	
Yepes, G, K. Ringskog and S. Sarkar (unpublished, 2000). *The high costs of intermittent water supplies*	http://www.liemberger.cc	

Sanitation

Reference	Availability	Abstract / Remarks
Agodzo Sk, Huibers FP, Chenini F, van Lier JB, Duran A. (2003) Use of wastewater in irrigated agriculture, country studies from Bolivia, Ghana and Tunisia, volume 2: Ghana, Wageningen, WUR (W4F – wastewater)	www.dow.wau.nl/iwe ISBN 90-6754-704-2	
Awuah, E.,Fiakuma (2007) State of sanitation in Accra, SWITCH Accra visioning and scenario planning workshop,23-24 August.	http://www.switchtraining.eu/fileadmin/template/projects/switch_training/db/event_upload_folder/63/state-of-sanitation-in-accra.pdf	The objective of this study was to evaluate the state of waste management in Accra and to propose an urban integrated waste management strategy which includes all aspect of: Waste generation, Waste collection, Waste transportation, Waste treatment, Waste disposal and Waste impact on the environment, Waste re-use and recycle
Cofie and Awuah (2008) Technology and Institutional Innovation on Irrigated Urban Agriculture in Accra, Ghana, UA Magazine no. 20 - Water for Urban Agriculture, pp. 14-16	http://www.ruaf.org/index.php?q=system/files/files/UAM+20+-+pagina+14-16_1.pdf	3-page article on SWITCH works in Accra on the use of urban water for agriculture and other livelihood opportunities.
Columbia University (2003) International Studio: Disaster resilient Accra, Columbia University International Planning studio spring 2003	http://www.arch.columbia.edu/Studio/Spring2003/UP/Accra/	
Mara, D.D., A. Sleigh and K. Tayler, 2001, PC-based simplified sewer design, University of Leeds, Leeds, UK	http://www.efm.leeds.ac.uk/CIVE/Sewerage/manual/pdf/simplified_sewerage_manual_full.pdf	
Mara, D.D. 2003, Domestic wastewater treatment in developing countries, Earthscan, London, UK		
Obuobie, E. Keraita, B. Danso, G. Amoah, P. Cofie, O.O. Raschid-Sally L. and P. Drechsel, (2006) Irrigated Urban Vegetable Production in Ghana - Characteristics, Benefits and Risks, IWMI-RUAF-CPWF.	http://www.ruaf.org/index.php?q=system/files/files/Chap6-Sanitation.pdf	Chapter 6. Sanitation and urban wastewater management, discusses key sanitation and wastewater management issues in Ghana and their relevance to urban agriculture. It reviews common wastewater concepts and describes the domestic wastewater disposal and treatment facilities in Ghana's main urban centres and how they are managed.
OCIN (2005) Accra Sewerage Improvement Project (ASIP), Appraisal Report, African Development Fund.	http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/GH-2006-010-EN-ADF-BD-WP-GHANA-AR-ASIP.PDF	Appraisal report for the Accra sewerage improvement project

Reference	Availability	Abstract / Remarks
Tettey-Lowor, F. (2009) Closing the loop between sanitation and agriculture in Accra, Ghana, Improving yields in urban agriculture by using urine as a fertilizer and drivers & barriers for scaling-up, MSc thesis report, Wageningen University and Research Centre, the Netherlands.	http://switchurbanwater.lboro.ac.uk/outputs/pdfs/W4.1_CACC_RPT_Drivers_and_barriers_for_introducing_urine_as_fertilizer_in_urban_agriculture.pdf	
Van der Geest, S. And N.Obirih-Opareh, 2006, Getting out of the shit : toilets and the daily failure of governance in Ghana, Le bulletin de l'APAD, n° 23-24, La gouvernance au quotidien en Afrique , Put online 15-12-2006	URL : http://apad.revues.org/document150.html.	Interesting paper on sanitation in Accra, though a bit dated.
OCIN (2005) Accra Sewerage Improvement Project (ASIP) Appraisal Report, October 2005 African Development Fund (Infrastructure Department),		
Mega Cities Project; Accra at a Glance (internet publication)	http://www.megacitiesproject.org/network_accra.asp	

Storm drainage

Reference	Availability	Abstract / Remarks
AMA (2006) Accra's Water Drainage Catchments	http://www.ama.ghanadistricts.gov.gh/	
Ametefe, W. (forth coming) Using reservoir storage effects for urban flood management, case study of Mamahuma Basin of Tema, Mphil thesis KNUST	Upcoming	
Fobil, J.N. (2001) Factors to be considered in the design of an integrated municipal solid waste management in the Accra metropolis, *A Master's Thesis,* University of Ghana, Legon, Accra	Referred to in Fobil et al 2007	
Fobil, J.N., et al., The influence of institutions and organisations on urban waste collection systems: An analysis of waste collection system in Accra, Ghana.... Journal of Environmental Management (2007), doi:10.1016/j.jenvman.2006.12.038	PDF On Accra starter kit: DVD\All Papers\Literature on Ghana-Accra water\ACCRA WATER_Sanitation & Wastewater	10 page paper
Nyarko, B. K. (2002) Application of rational model in GIS for flood risk assessment in Accra, Ghana, J. Of Spatial Hydrology, vol.2 No 1	http://www.spatialhydrology.com/journal/paper/Floodzone/floodrisk.pdf	Paper as part of MPhil research work in the Dept of Geology & Tourism at University of Cape Coast. Uses Vriessman & Lewis 1996 and Mannaerts 1996 equation to calculate run-off for catchments within Accra. DEM, discharge map with GIS model were combined to assess flood risks. Use of colours for the maps seems strange.

Reference	Availability	Abstract / Remarks
Twumasi Y.A and R. Asomani-Boateng (2002) Mapping Seasonal Hazards for Flood Management in Accra, Ghana Using GIS	PDF On Accra starter kit: Accra_Starter_Kit DVD\All Papers\Literature on Ghana-Accra water\ACCRA WATER_Environmental aspects http://ieeexplore.ieee.org/Xplore/login.jsp?url=/iel5/7969/22040/01026807.pdf	First author is from 1Center for Hydrology, Soil Climatology, and Remote Sensing. Department of Plant and Soil Science Alabama A&M University. This paper reports an investigation into the application of GIS and other technologies for mapping urban flood zones in Accra for managing urban flood hazards.
Abraham, E. M., D van Rooijen, O Cofie, L Raschid-Sally, 2007, Planning urban water – dependent livelihood opportunities for the poor in Accra, Ghana, SWITCH Scientific Meeting University of Birmingham, UK 9-10 Jan 2007	PDF On Accra starter kit: Accra_Starter_Kit DVD\All Papers\Literature on Ghana-Accra water\ACCRA WATER_Livelihoods & Urban poor	13 page paper presented at SWITCH Scientific Meeting University of Birmingham, UK 9-10 Jan 2007 Exploratory study into the productive uses of urban water supply in Accra.
Roojen, D.J. van, D. Spalthoff and L. Raschid-Sally (2008) Domestic water supply in Accra: How physical and social constraints to planning have greater consequences for the poor, 33rd WEDC conference	http://wedc.lboro.ac.uk/conferences/pdfs/33/Van_Rooijen_D_GHA.pdf	The paper describes the water situation in Accra and in 2 distinctive areas, characterised by the presence or absence of piped water distribution infrastructure.

Annex 2: GAMA population projections

The table below shows the expected population size of GAMA, in the case of constant growth rates, based on the 1984-2000 growth rates per district as well as in case of a constant growth rate for the entire GAMA area of 4.4 percent.

	Growth rate	2000*	2007	2011	2015	2025	2030
Ablekuma	3.4%	518,112	657,333	753,095	862,807	1,212,199	1,436,825
Ashiedu Keteke	3.4%	88,717	112,556	128,953	147,740	207,566	246,030
Osu Clottey	3.4%	96,634	122,600	140,461	160,924	226,089	267,985
Kpeshie	3.4%	387,013	491,007	562,538	644,489	905,474	1,073,262
Ayawaso	3.4%	335,394	425,517	487,508	558,529	784,704	930,113
Okaikoi	3.4%	233,067	295,694	338,772	388,124	545,294	646,340
AMA		1,658,937	2,104,709	2,411,327	2,762,613	3,881,327	4,600,555
Ga	6.4%	550,468	861,581	1,112,949	1,437,655	2,726,486	3,754,719
Tema	9.2%	506,400	964,227	1,393,156	2,012,890	5,050,926	8,001,040
Total GAMA (1984-2000 district growth rates)		2,715,805	3,930,517	4,917,432	6,213,159	11,658,739	16,356,315
Total GAMA (total growth rate 4,4%)	4.4%	2,715,805	3,695,399	4,406,534	5,254,519	8,158,729	10,166,402
Total GAMA (total growth rate 3.4%)	3.4%	2,715,805	3,445,567	3,947,523	4,522,606	6,354,025	7,531,456

*Source: 2000 Population and housing census, GSS

Population according to SIP

AREA SERVED	Population census 2000	ESTIMATED POPULATION 2005	2007	2011	2015	2025
Accra Rurals A	195,504	232,891	249,830	287,597	331,228	472,424
Accra Rurals B	70,777	80,971	85,458	95,209	106,099	139,245
Accra Rurals C	61,983	70,158	73,723	81,406	89,891	115,184
Accra Rurals D	26,994	32,842	35,522	41,556	48,615	71,961
Accra Rurals E	23,511	28,126	30,224	34,914	40,353	58,077
Total Accra Rurals	378,769	444,988	474,757	540,682	616,186	856,891
Accra Met	546,727	649,340	695,589	798,205	915,958	1,292,050
Accra Met	931,236	1,106,016	1,184,792	1,359,576	1,560,145	2,200,739
Accra Met	181,024	215,000	230,313	264,290	303,278	427,804
Accra East	241,871	287,267	307,727	353,124	405,218	571,600
Accra West	209,934	249,336	267,095	306,497	351,713	496,125
Total Accra	2,110,792	2,506,959	2,685,516	3,081,692	3,536,312	4,988,318
Tema	428,257	508,635	544,863	625,242	717,480	1,012,076
TOTAL ATMA	2,917,818	3,460,582	3,705,136	4,247,616	4,869,978	6,857,285

Annex 3: GAMA rainfall data

Year	Annual rainfall (mm/year), based on: daily rainfall data, station 23016ACC Accra (airport station)
1970	894.1
1971	919.1
1972	740.6
1973	980.9
1974	999.1
1975	869.9
1976	549.6
1977	454.7
1978	537.4
1979	917.4
1980	1000.8
1981	687.5
1982	774
1983	333.1
1984	704.9
1985	680.6
1986	465.9
1987	640.8
1988	988.9
1989	656.7
1990	568.6
1991	1008
1992	557
1993	509.3
1994	547.9
1995	1029.8
1996	716.6
1997	1223.5
1998	513.6
1999	641.8
2000	512.2
2001	837.6
2002	1010
2003	887
2004	573.8
2005	777.6
2006	648.4
2007	867.6
2008	1264.7
Average	756

Monthly averages over 1999-2008	
Month	Average rainfall (mm/month)
January	16.36
February	12.06
March	49.33
April	91.56
May	162.03
June	209.30
July	54.28
August	22.95
September	49.71
October	62.87
November	40.06
December	31.56

Annex 4: Projected water demand in the Volta Basin

Projected domestic and industrial water demand (millions m3)					
	1990	2000	2010	2020	2025
Benin		56	196	336	448
Burkina Faso	67	85	106	132	149
Cote d'Ivoire		4	5	12	14
Ghana	82	138	192	272	284
Mali	5	9	13	16	18
Togo	51	68	92	123	145
Total	205	360	604	891	1058
Projected irrigation water demand (millions m3)					
	1990	2000	2010	2020	2025
Benin		152	548	1225	1600
Burkina Faso	43	203	384	554	639
Cote d'Ivoire		19	57	166	276
Ghana	75	565	1871	3605	3733
Mali	126	180	219	291	311
Togo	43	50	91	133	171
Total	287	1169	3170	5974	6730
Projected livestock water demand (millions m3)					
	1990	2000	2010	2020	2025
Benin		40	94	133	175
Burkina Faso	37	46	61	78	88
Cote d'Ivoire		1	2	3	3
Ghana	18	26	41	63	67
Mali	4	34	74	123	142
Togo	15	19	22	30	36
Total	74	166	294	430	511
Projected total water demand (millions m3)					
Grand total	566	1695	4068	7295	8299

Source: Andah,2005

Annex 5: Use of water and sanitation services in GAMA

	Main source of drinking water	Main source of water for general use
Indoor plumbing	10.9%	11.3%
Inside standpipe	31.3%	35.4%
Pipe in neighbouring household	28.7%	29.3%
Private outside standpipe / tap	9%	9.2%
Public standpipe	4.5%	4.5%
Pipe-borne	84.3%	89.7%
Tanker supply	1.3%	2%
Water vendor	4.5%	4.7%
Sachet / bottled water	8.6%	0.7%
River / stream	0.1%	1.1%
Well	1.1%	1.7%
Borehole	0.1%	0.2%

Source: GSS, 2008

	Use of sanitation facilities
Flush toilet	33.2%
KVIP	15.8%
Pit latrine	5%
Facility in another house	0.4%
Public toilet	41.3%
Bucket / pan latrine	3.2%
No facility (bush, beach, field)	1.1%

Source: GSS, 2008

	Liquid waste disposal
Sewerage system	15.3%
Gutter	41.1%
Street / outside	18.3%
Compound	24.8%
Other	0.6%

Source: GSS, 2002

Annex 6: GWCL clients and water use

IDCODE	DIST_NAME	Dis_Off	Qty_sold	Ser_Area	TANKER SERVICE	DOMESTIC METERED	P'STAND PIPE UNMTD	STANDPIPE MTD	SACHET WATER PRODUCERS	BOTTLED WATER PRODUCERS	COMMERCI AL SALES	INDUSTRIAL SALES	INSTITUTIO N(PRIVATE)	INSTITUTIO N (GOV'T)	SEWER	OTHERS
R01B-D01	Accra Central	ACCRA	4,347,556	SA-01-1	0	535	0	628	0	50295	1103	7186	1704	17330	1130929	1746
R01B-D02	Accra North	KANDA	8,209,283	SA-01-2	64,425	521	1793	29	0	0	994	112514	2553	13627	54467	0
R01B-D03	Accra East	PALM WINE	6,005,874	SA-01-3	0	444	0	79	0	0	1554	39312	2336	16190	6719	1137
R01B-D04	Accra North East	LEGON	2,418,549	SA-01-4	0	270	0	1550	0	0	1023	2069	1446	1042	6027	1519
R01B-D06	Mile 4	37 MILITARY AREA	0	SA-01-1	0	0	0	0	0	0	0	0	0	0	0	14401
	Total Accra East				51540	425	1793	317	0	50295	1159	36567	2175	12403	2712	4276
R01C-D01	Accra West	ZONGO JUNCTION	2,379,019	SA-01-2	0	558	0	832	0	0	920	0	934	20019	4285	0
R01C-D02	Dansoman	DANSOMAN	3,533,883	SA-01-3	271,479	610	0	633	0	0	883	0	1516	6451	1036	3005
R01C-D03	Accra NW I	CIRCLE	4,758,635	SA-01-4	114,903	654	0	0	0	0	1382	11990	1379	20975	95176	16206
R01C-D04	Accra NW II	KOKOMPE	3,564,642	SA-01-5	317,373	459	0	3005	0	0	583	0	852	9697	9647	1955

IDCODE	DIST_NAME	Dis_Off	Qty_sold	Ser_Area	TANKER SERVICE	DOMESTIC METERED	P'STAND PIPE UNMTD	STANDPIPE MTD	SACHET WATER PRODUCERS	BOTTLED WATER PRODUCERS	COMMERCIAL SALES	INDUSTRIAL SALES	INSTITUTION(PRIVATE)	INSTITUTION (GOV'T)	SEWER	OTHERS
R01C-D05	Bortianor	BORTIANOR (GIEZEL ESTATE)	1,494,219	SA-01-6	60,737	621	0	13465	0	0	781	35635	1140	3572	142	1675
	Total Accra West				162494	566	0	1488	0	0	948	13095	1166	3947	11123	270
R01D-D01	Tema Central	COM M 1	2,073,150	SA-01-7	0	516	0	1675	2420	0	818	0	1590	3674	4527	0
R01D-D02	Tema West	COM M 1	3,418,370	SA-01-8	41,399	530	0	0	3339	0	1440	0	2440	2869	9322	184
R01D-D03	Tema Industrial	COM M 1	6,190,610	SA-01-9	66,095	514	0	184	22978	27648	3717	165540	571	19030	2187	1885
R01D-D04	Ashaiman	ASHAIMAN	5,443,107	SA-01-10	29,729	511	0	1885	2505	172745	1062	72137	914	58142	375	0
R01D-D05	Pramporam	PRAMPRAM	559,498	SA-01-11	0	424	0	0	2552	0	875	28416	104	5931	4140	0
R01D-D07	Kpong / Akuse	KPONG/AKUSE	637,546	SA-01-1	0	588	0	0	637	0	267	0	0	88038	2473	0
	Total Tema				44914	518	0	947	3355	88495	1444	137783	1328	6520	175	821
	Total GAMA				123,362	501	1,160	922	3,355	80,659	1,189	73,616	1,532	9,367	2,721	894

Source: AVRL,2008, AVRL database data of 2007 production and sales data

Note: Total amount of water sold presented here does not take into account income from sewer charges, P.& T Corp. sales and inter corp. Sales

Water use (in m^3 per year)

Area	Tanker services	Dom. metered	P'stand unmtd	Standpipe mtd	Sachet water producer	Bottled water producer	Commercial sales	Industrial sales	Institution (private)	Institution (gov't)
Accra East	23,515	8,888,145	600	8,458	0	16,318	5,021,913	778,582	359,690	4,784,606
Accra West	552,215	11,630,279	0	30,309	0	0	2,253,099	309,486	277,799	483,900
Tema	57,377	7,683,909	0	170,768	266,669	111,258	3,959,479	4,765,057	125,013	1,160,543
Total GAMA	633,107	28,202,333	600	209,535	266,669	127,576	11,234,491	5,853,125	762,502	6,429,049

Source: AVRL, 2008 (data 2007)

Water use per connection (l/connection/day)

Area	Tanker services	Dom. metered	P'stand unmtd	Standpipe mtd	Sachet water producer	Bottled water producer	Commercial sales	Industrial sales	Institution (private)	Institution (gov't)
Accra East	51540	425	1793	317	0	50295	1159	36567	2175	12403
Accra West	162494	566	0	1488	0	0	948	13095	1166	3947
Tema	44914	518	0	947	3355	88495	1444	137783	1328	6520
Total GAMA	123,362	501	1,160	922	3,355	80,659	1,189	73,616	1,532	9,367

Source: AVRL, 2008 (data 2007)

Note: The relatively high amount of water use per domestic use client displayed in the figure below is explained by the fact that a bit more than half of the population in AMA lives in compound housing, generally comprising about 50 people per connection, as mentioned in chapter two.

Annex 7: Details of the community managed CWSA systems in Abokobi and Pantang

	Abokobi	Pantang
Source	Mechanised borehole	Mechanised borehole
Yield of the borehole (m^3/hour)	50	45
Yield of the borehole (m^3/day)	1,200	1,080
Yield of the borehole (m^3/year)	438,000	394,200
Actual production (m^3/year)	116,788	94,337
% of borehole yield that is used to produce water	27%	24%
Distribution network (km)	12	10
Service level	21 public standpipes 374 household connections	22 public standpipes 267 household connections

Source: Ampadu (forthcoming)

	ABOKOBI	PANTANG
Number of standpipes	21	22
Quantity of water consumed in one year, SP (m^3)	26,308	19,838
Average consumption per standpipe (m^3)	1,253	902
Average consumption per standpipe (m3/day)	3	2
Number of hh connections	374	267
Quantity of water consumed in one year, household connections (m^3)	41,958	36,429
Average consumption per hh connection (m3/day)	112	136
Average consumption per household connection (m3/day)	0.307	0.374
Quantity of water consumed total (m3)	68,266	56,267
Non revenue water	42%	40%

Source: Adapted from Ampadu (forthcoming)

Schemes	Oyibi Area WSS	Ashalaadza Area WSS	Abokobi Area WSS	Pantang Area WSS
Year	2003	2003	2004	2005
Population	6,551	2,968	9,032	12,758
Total investment cost (old GH¢)	4,023,016,149	830,768,860	4,445,993,882	4,836,068,256
Per capita (GH¢)	61.41	27.99	49.22	37.91
Per capita costs, using 2008 as common base year (GH¢ per capita)	**150.55**	**65.27**	**99.28**	**58.33**

Source: Bismark, 2009

Annex 8: Projected water demand according to SIP (m^3/day)

SYSTEM NAME	AREA SERVED	PROJECTED WATER DEMAND (M^3/DAY)			
		2007	2011	2015	2025
Old Kpong	Accra Rurals A	11,716	15,099	18,289	29,696
Old Kpong	Accra Rurals B	4,359	5,746	6,774	10,159
Old Kpong	Accra Rurals C	4,913	5,852	7,218	10,301
Weija	Accra Rurals D	2,628	3,410	4,135	6,692
Weija	Accra Rurals E	1,826	2,203	2,654	4,841
	Total Accra Rurals	25,442	32,310	39,070	61,689
New Kpong	Accra Met	96,687	112,547	130,982	187,347
Weija	Accra Met	164,686	191,700	223,101	319,107
New Kpong& Weija	Accra Met	32,014	37,265	43,369	62,032
New Kpong	Accra East	42,774	49,791	57,946	82,882
Weija	Accra West	37,126	43,216	50,295	71,938
	Total Accra	373,287	434,519	505,693	723,306
New Kpong	Tema	75,736	88,159	102,600	146,751
TOTAL ATMA		474,465	554,988	647,363	931,746

Source: SIP, 2008

Water demand per capita according to SIP (in lpcd)

Area	2007	2011	2015	2025
Total Accra rural (average over 5 rural areas)	54	60	63	72
Accra urban	139	141	143	145
Total Accra	139	141	143	145

Source: Adapted from SIP, 2008

Annex 9: Water tanker services in GAMA

Tanker Association	No. of Tankers	Areas Served
Private Water Tanker Owners Association (PWTOA) – Accra	300	Kasoa & Bortianor Area (Accra West)
Odorkor Tanker Owners Association	10	Odorkor (Accra West)
Madina Water Tanker Owners/Drivers Association	50	Madina, Ashongman, Ashaley Botwe, Adenta, Frafraha
Lashibi Tanker Association	150	Labadi, Teshie & Nungua,Batsoona, Sakumono, Ashiaman, Tema,
Sakaman	10	Bortianor, Odorkor (Western part of Accra)
Labour Enterprise Trust (LET)	4	Eastern Accra
Ghana Water Company Limited	4	Not specified (however mostly Eastern Accra)

Source: Sarpong Manu and Abrampah,2006

Annex 10: Population and sewage flows ASIP

STP	Area	Pop unserved 2010	Pop unserved 2020	Pop unserved 2030	Pop served 2010	Pop served 2020	Pop served 2030	% served 2010	% served 2020	% served 2030
AWP/CAPS	Accra Central	2,892	3,103	2,634	4,830	6,038	7,904	63%	66%	75%
AWP/CAPS	Adabraka	28,025	18,677	20,267	0	12,451	13,511	0%	40%	40%
AWP/CAPS	Adedenkpo	15,797	16,804	16,239	8,309	10,386	11,233	34%	38%	41%
AWP/CAPS	Asylum Down	12,221	1,771	1,222	0	13,054	16,272	0%	88%	93%
AWP/CAPS	Avenor					6,098	7,615		100%	100%
AWP/CAPS	James Town	18,888	18,445	19,426	15,551	19,439	21,000	45%	51%	52%
AWP/CAPS	Korle Dudor	19,169	22,883	27,370	11,527	14,409	16,449	38%	39%	38%
AWP/CAPS	Korle Gonno	19,149	21,069	22,572	19,149	21,069	22,572	50%	50%	50%
AWP/CAPS	Ministries	2,466	2,632	2,790	0	0	0	0%	0%	0%
AWP/CAPS	North Industrial	0	0	0	0	19,063	25,257	0%	100%	100%
AWP/CAPS	Osu	53,503	64,479	74,634	2,816	3,394	3,928	5%	5%	5%
AWP/CAPS	Ridge/WestRidge	4,358	5,206	6,130	484	579	681	10%	10%	10%
AWP/CAPS	RingwayEstates	2,758	3,379	4,226	0	0	0	0%	0%	0%
AWP/CAPS	South Industrial	9,634	4,395	4,693	0	6,466	7,422	0%	60%	61%
AWP/CAPS	Tudu	7,399	9,716	12,313	5,088	6,360	7,605	41%	40%	38%
AWP/CAPS - Burma camp	LaBONE-NorthLabone	20,216	25,094	31,070	3,000	3,750	4,570	13%	13%	13%
AWP/CAPS - Burma camp	MH/Cantonments (33%) and Labone/Cantonments(67%)	8,157	9,936	12,039	906	1,104	1,338	10%	10%	10%
Total AWP		224,632	227,589	257,625	71,660	143,660	167,357			
Burma Camp	Airport Res. Area	2,881	2,928	4,114	2,280	9,500	12,540	44%	76%	75%
Burma Camp	Burma Camp	21,658	26,482	31,062	29,115	36,394	46,373	57%	58%	60%
Burma Camp	Labadi	104,958	130,294	157,923				0%	0%	0%
Burma Camp	OldTeshie/South	45,813	60,540	77,483				0%	0%	0%
Burma Camp	Roman Ridge	0	0	0	4,335	5,520	7,078	100%	100%	100%
Burma Camp	South Labadi	17,508	21,270	26,268				0%	0%	0%
Burma Camp	Teshie Camp	3,838	4,828	6,044	2,559	3,218	4,030	40%	40%	40%
Burma Camp	Teshie-Nungua	43,485	68,550	96,370	11,651	14,564	22,733	21%	18%	19%
Burma Camp	Trade Fair	0	0	0	2,211	2,538	2,900	100%	100%	100%
Total Burma camp		240,141	314,892	399,264	52,151	71,734	95,654			
Densu Delta	Abbosey Okai	123,727	159,177	199,377				0%	0%	0%
Densu Delta	Bubuashie	38,359	50,817	64,651				0%	0%	0%
Densu Delta	Chorkor	31,942	40,718	50,384				0%	0%	0%
Densu Delta	Darkuman	86,276	100,925	100,589				0%	0%	0%
Densu Delta	Gbegbeyise	64,411	81,856	100,725	16,103	20,464	25,181	20%	20%	20%
Densu Delta	Kaneshie	29,988	33,699	37,842				0%	0%	0%
Densu Delta	Lartebiokorshie	52,185	66,543	82,308				0%	0%	0%

Densu Delta	Mamprobi	34,078	43,521	53,851				0%	0%	0%
Densu Delta	New Dansoman	40,017	61,762	23,059	27,517	24,062	82,550	41%	28%	78%
Densu Delta	New Mamprobi	19,491	26,118	33,936				0%	0%	0%
Densu Delta	North Kaneshie	39,546	52,950	68,579				0%	0%	0%
Densu Delta	North Odorkor	65,629	87,819	113,972				0%	0%	0%
Densu Delta	Old Dansoman	7,222	7,349	7,437				0%	0%	0%
Densu Delta	Sabon Zongo	24,770	30,956	33,604				0%	0%	0%
Densu Delta	South Odorkor	56,316	80,891	110,749				0%	0%	0%
Densu Delta	Sukura/Russia	57,589	80,854	110,369				0%	0%	0%
Total Densu		771,546	1,005,955	1,191,432	43,620	44,526	107,731			
Legon	East Legon	27,678	34,586	42,325				0%	0%	0%
Legon	Legon	13,200	11,000	10,000	19,800	33,000	40,000	60%	75%	80%
Total Legon		40,878	45,586	52,325	19,800	33,000	40,000			
Total		1,277,197	1,594,022	1,900,646	187,231	292,920	410,742			

Source: adapted from OCIN, 2005

Treatment plant	District	Average daily flow, including infiltration		
AWP		Daily flow 2010	Daily flow 2020	Daily flow 2030
Densu Delta	Dansoman No1	400	450	1,180
Densu Delta	Dansoman No.2	380	430	1,130
Densu Delta	Dansoman No.3	2,190	2,490	6,500
Densu Delta	Dansoman No.4	1,449	2,554	3,853
Densu Delta	**Total**	**4,419**	**5,924**	**12,663**
Legon	Legon	1,621	3,041	4,103
Legon	Other areas	1901	3,393	4,455
Legon	**Total**	**3,522**	**6,434**	**8,558**
Burma Camp	Roman Ridge	540	750	1,050
Burma Camp	Airport Collector	1,220	5,200	7,070
Burma Camp	Military Hospital	1,200	1,450	1,810
Burma Camp	Trade Fair	260	320	400
Burma Camp	Military Camp	960	1,220	1,540
Burma Camp	Teshie-Nunguna	1,080	1,500	2,540
Burma Camp	Burma Camp	3,686	8,608	11,314
Burma Camp	**Total**	**8,946**	**19,048**	**25,724**
AWP	Accra Central	5,070	6,760	8,600
AWP	Agbogbloshie		5,810	7,510
AWP	**Total**	**5,070**	**12,570**	**16,110**
	GRAND TOTAL	**21,957**	**43,976**	**63,055**

Source: OCIN, 2005

Annex 11: Storm drains in GAMA

NAME OF DRAIN	AREA/LOCATION	Lining (%)	CONDITION
Densu basin			
Lafa stream	Sowutuom, Santa Maria, Race Course, Gbawe	0	Not Good. Upstream choked
Mallam drain (Bawere)	Mallam	0	Channel deepened and widened, no lining
Korle basin – Odaw river			
Odaw	Abokobi, Agbogba, Haasto, Atomic, West Legon, Achimota, Alajo, Abelemkpe, Avenor, Circle, Old Fadama, Korle Lagoon		Channel improvement upstream by excavating. Early section still virgin state. Lower stream lined (about 6km)
Apenkwa	Azumah Nelson Sports Complex, Apenkwa	0	Natural
New Ashongman	Ashongman (tributary of Odaw) and drains at eastern part of Atomic Energy	0	Natural
Kwabenya	Kwabenya, Odaw	0	Natural
Haasto	Madina Point 5, Yam market, Odaw	0	Natural
Taifa	North Dome, West Ashongman	0	Natural
Dome	As part of the Taifa Drain	0	Natural
New Achimota	Ofankor, Mile 7, Achimota Brewery, Odaw(at Paraku estate)		Channel improvement
Ofankor	Ofankor, Achimota, Odaw	0	Natural
Tesano	Abeka Lapaz, Tesano, Alajo	45	40-50% lined
Onyasia	East Legon, Dzorwulu, Kotobabi, Alajo, Caprice		Earth improvement undertaken (short section lined)
Nima	Airport, WRI, Mamobi, Nima, Asylum down, Circle, Odaw	80	Lined(80%)
Mukose	North Kaneshie, Last stop, Avenor, Odaw	100	Completely lined
Awudome	Awudome Estate, Awudome cemetery, South Kaneshie	100	Completely lined
South Kaneshie	Accra Academy, (Mataheko & Kaneshie), Zongo Junction, Kaneshie, Graphic Road, Auto Parts, South Kaneshie	100	Lined (Graphic and Abbosey Okai)
Chemu			
Chemu	Dansoman, Chemu lagoon	0	Not lined
Mamponse	Dansoman, Chemu lagoon	0	Not lined
Osu			
Osu Klottey	Licence Office, WAEC, Osu Regal to the sea	60	Lined from Aquainace to the sea
Kpeshie			
Kpeshie	Burma Camp, Agric Mechanisation, East Airport	50	Partly lined
Napraadjor stream	Tshie camp 2 area to Tsui Bleo	0	Natural
Kordjor (east airport)	Atraco, East Legon, Spintex, Regimanuel Gray, Teshie Camp 2, Kpeshie Lagoon	0	Natural
Sango			
Nii Dzor	Teshie, Sango Lagoon	10	Party lined
Ngaa Dzor	Teshie	30	Party lined
Teshie Nungua	Bastonaa, Greda estate, Teshie Nungua estate, Songo lagoon	20	Party lined
Mokwe			
Brekese	Baastona, Nungua, Maritime Academy, Mokwe lagoon	0	Earth improvement, no lining
Mukoe Dzor			

Sakumo II (East)			
Mamahuma	Frafraha, Adenta, Ashale Botwe, Comm. 20,18,19, Lashibi, Sakumono	0	Natural
Onupkawahe	Madina, Mayehot,Obgodzo, comm. 20	0	Natural
Dzorwulu	Oyibi, Ashiaman, Lashibi, Sakumono	0	Natural
Gbagbla	Michel Camp, Kakasunanka,Ashiaman, Comm. 22, Links Dzorwulu to Sakumono	1	Partly lined (40m out of 4km)

Source: HSD, 2007

Annex 12: Peak run-off in GAMA basins

	Area (km^2)	Run-off coefficient	Storage coefficient	Rainfall intensity (mm/hours)	Peak run-off (m^3/s)
Densu catchment (downstream of Weija)	122				1432
Upper Sakumo	9	0.6	0.7	140.2	154
Middle Sakumo	155	0.6	0.5	140.2	1811
Lower Sakumo	116	0.7	0.4	140.2	1265
Korle basin	291				2432
Upper Densu	25	0.6	0.7	140.2	407
West Densu	17	0.6	0.7	140.2	283
Lower Densu	79	0.4	0.6	140.2	742
Kpeshie catchment	62.6	0.7	0.2	140.2	341
Mokwe catchment	13.9	0.7	0.3	140.2	114
Songo catchment	16.8	0.8	0.2	140.2	105
Mokwe-Songo catchment	31				218
Upper Odaw	64.5	0.6	0.7	140.2	1055
Middle High Odaw	18.7	0.7	0.2	140.2	102
Middle Odaw	118	0.7	0.2	140.2	643
Lower Odaw	90.1	0.9	0.2	140.2	632
Sakumo II catchment	280				3230

Source: Nyarko,2002

Towards integrated urban water management in the Greater Accra Metropolitan Area

Accra, the administrative and economic capital of Ghana, just like cities all over the world, is facing ever increasing difficulties in efficiently managing water resources and providing water and sanitation services to its citizens. Meeting these challenges and adopting a more integrated approach to urban water management requires a firm understanding of the current situation.

This book presents a situational analysis of Accra, bringing together a wealth of information and data from different sources, including stakeholder dialogues, in the areas of water service provision, excreta and waste water management, storm water management and planning and coordinating. It is presented and analysed through the Resources, Infrastructure, Demand and Access Framework (RIDA) which provides a thorough overview of the current situation and challenges that the city is facing.

This book is the consolidation of a four-year strategic planning process, undertaken by the Accra Learning Alliance, which brings together policy makers, service providers, researchers and civil society. In addition to analysis, it presents a vision for water management in the city of Accra and strategic directions towards achieving the vision as defined by the Accra Learning Alliance.

The SWITCH project facilitated this process, aiming to bring about a paradigm shift in urban water management away from existing ad hoc solutions to urban water management and towards a more coherent and integrated approach.

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