Guma Valley Water Company, Freetown

Republic of Sierra Leone

STRATEGIC WATER SUPPLY AND SANITATION FRAMEWORK

PART 3

SANITATION IMPROVEMENT PLAN

August 2008
LIST OF ACRONYMS

ACF   Action Contre La Faim
ADA   Area Development Association
AfDB  African Development Bank
CLTS  Community-Led Total Sanitation
DFID  Department of International Development
DCPC  Directorate of Diseases Prevention and Control
FCC   Freetown City Council
FIRP  Freetown Infrastructure Improvement Project
FSWMC Freetown Solid Waste Management Company
GOSL  Government of Sierra Leone
GVWC  Guma Valley Water Company
MDGs  Millennium Development Goals
MOEP  Ministry of Energy and Power
MOHS  Ministry of Health and Sanitation
NGO   Non-Governmental Organisation
O&M   Operation and Maintenance
PRSP  Poverty Reduction Strategy Paper
SEA   Social and Environmental Assessment
SSHE  School Sanitation and Hygiene Education
SSIP  Small-scale independent provider
UNICEF United Nations Children Fund
VIP   Ventilated Improved Pit
WES   Water and Environmental Sanitation
WHO   World Health Organisation
WSD   Water Supply Division
WSS   Water Supply and Sanitation

Currency exchange rate

All prices of goods and services and estimations of investment requirements are quoted in US dollars based upon the Sierra Leone currency using the following currency equivalents (January 2008)

US$ 1.00 = 2900 Leone (Le)
GBP 1.00 = 5300 Leone (Le)

Note: In February 1994, US$ 1 = Le 570
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1.0 INTRODUCTION

1.1 URBAN DEVELOPMENT IN FREETOWN

Freetown is located on the Southern bank of the estuary of the Sierra Leone River. The city (otherwise referred to as the Western Urban Area) is divided into 8 wards (Central I and II, East I, II and III, and West I, II and III) and each ward is subdivided into sections. Most of the urban development is on the flat land adjacent to the coast, but increasingly urban developments are spreading up the hillsides due to a lack of land. As seen in Figure 1.1, a large number of households – both rich and poor - have built houses on the steep hillsides on the edge of the city, thus increasing their vulnerability to landslides caused by deforestation and soil erosion.

Figure 1.1 Development of housing up the steep slopes surrounding the city

The population in Freetown has increased dramatically as a result of internal conflict from 1992 – 2002 and also in part due to a large influx of people into the city in search of employment and other economic opportunities. The greatest growth areas within the city are in the eastern wards, which are areas occupied by new migrants.

Figure 1.2 shows the extent of growth of urban area from 1965, 1980 and 2007 and the total population for Freetown Western Urban Area is currently estimated to be approximately 1,173,000 for 2008. This figure has been derived from the 2004 census and is based on population growth estimates and population uplift factors to account for census error and also urban migration. The population growth rate within the capital varies significantly between ward to ward. It is currently estimated to be 2.46 % for Western Urban Area.

The overall population density for Freetown Urban is around 1200 persons per km2. However, local densities vary immensely between wards from under 650 persons/km2 in the West II Ward to almost 5000 persons/km2 in the East II ward (see Figure 1.3).

The highest population densities are in the slums and informal settlements – of which there are 18 officially recognised by the City Council (see Annex 1). Most of the slum and informal settlements with a population of over one thousand inhabitants are to be found along the seashore. Examples of foreshore slums with over 1,000 inhabitants are Kroo Bay, Susan’s Bay and Mabella.

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1 Base year mid year estimate based on census 2004 derived figures with 20% uplift for transient population. Refer to Main Report Part 1 for further details.
1.2 **LEVEL OF DEVELOPMENT AND ACCESS TO INFRASTRUCTURE**

The level of development and quality of infrastructure varies significantly from ward to ward and between sections within wards. Generally higher quality lower density housing is found in the western areas whereas lower quality, higher density housing is found in the eastern areas. The most poorly served live in slums, which are located next to the coast (see Figure 1.4). But other pockets of slums dwellers are found throughout the city on marginalised land; mainly on the steep banks of stream channels passing through the city. Overcrowding in urban slums is common and poor living conditions expose a large number of people to high health risks.
1.3 **HEALTH STATISTICS**

According to WHO statistics, life expectancy in Sierra Leone is 37.2 years. The infant and child mortality rates are 170 and 263 deaths/1000 live births respectively (WHO/UNICEF Joint Monitoring Report 2000). Detailed information for Freetown is not currently available but it is widely recognised that that environmental health conditions are very poor – notably in the slums and low-income settlements where diarrhoeal disease is a constant threat; mainly as a result of inadequate sanitation, lacking solid waste management and contamination of water supplies.

Slum residents who participated in the focus group discussions as part of the survey undertaken by GOAL reported that out of the 1380 under-fives, 20% had diarrhoea in the two weeks before the survey. This equates to 5.2 episodes of diarrhoea per child per year. Consequently, there are regular outbreaks of cholera which peak during the rainy season. The last major epidemic was in 2004, but outbreaks tend to occur on an annual basis.

According to the Emergency Preparedness and Response Plan for Prevention and Control of Cholera in Sierra Leone (2007) produced by the Directorate of Disease Prevention and Control of the Ministry of Health and Sanitation, the following neighbourhoods are at highest risk from outbreaks of Cholera: Rokupa, Kuntoloh, Mabella, Pamronkoh, Mayuba and other parts to the east of the city (DDPC 2007).

In the survey undertaken by ACF, 76% of latrines were observed to be located less than 30 m from a water supply facility. These are particularly exposed during the rainy season when the water table is near the surface and prone to faecal contamination. Other figures highlight that 61% of the water used for drinking purposes is highly contaminated with faecal coliforms (ACF 2007).

Action Contre La Faim (ACF), with funding from DFID, has prepared a ‘Freetown Cholera Atlas’ (see Figure 1.5) in order to assist in a diagnosis of domestic water management and prepare a Cholera Prevention strategy for the city. Table 1.1 indicates which areas in Freetown are particularly at risk of cholera outbreaks. The following reasons related to sanitation and hygiene are identified as contributory factors towards the outbreak of Cholera (DDPC 2007):

- Lack of adequate safe water supply
- Inadequate personal hygiene practices – esp. washing hands after using the toilet.
- Poor or inadequate waste disposal systems.
- Low knowledge of the causes, and prevention of the disease amongst community members.
- High population density and the movement of people from one district to another contribute to the rapid spread of disease.
Figure 1.5   Past years’ cholera cases - % of population affected based upon data from 2004, 2005, 2006 (ACF 2007)

Table 1.1  Areas where risks of cholera outbreaks are especially high (based on ACF 2007)

<table>
<thead>
<tr>
<th>Area type</th>
<th>Cause of environmental health risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slums</td>
<td>High density of inhabitation, lack of water and sanitation infrastructure and solid waste management, poor drainage</td>
</tr>
<tr>
<td>Police and army barracks</td>
<td>High density of inhabitation and poor sanitation; lack of hygiene awareness.</td>
</tr>
<tr>
<td>Market centres</td>
<td>High population density; poor facilities and lack of attention to operation and maintenance of communal latrines.</td>
</tr>
<tr>
<td>Hillsides</td>
<td>Due to lack of water, residents use springs and rivers which are contaminated as a result of poor sanitation.</td>
</tr>
</tbody>
</table>
2.0 EXISTING SANITATION SITUATION IN FREETOWN

There is only limited information available describing sanitation coverage within Freetown. In order to supplement the lack of a comprehensive data set, data was collected from various sources in order to determine the level and type of sanitation present in different areas of Freetown and to determine how much faecal sludge is produced, where it is produced and how likely it is that the sludge can be collected and treated.

This data was subsequently used to develop an appropriate sanitation and FS management system according to expected future requirements.

The sources used are briefly discussed below. Information was also obtained following discussions with officials from MoHS, WSD, Freetown City Council (FCC), visiting desludging companies and through local contacts and site visits.

- **2004 Census data** The Census provides information for the 8 Western Urban wards for private sanitation types only, household and shared facilities. The Census does not take into account the presence of communal or public latrines and also shows that the relative proportions between different sanitation types (pit, flushed, bucket etc) are the same for every Ward (approximately 7%). This poses some questions as to the reliability of the data as it does not reflect the variation in housing type, density, wealth or growth.

- **2008 Oxfam Community Survey** Oxfam carried out a comprehensive baseline survey for water supply and sanitation in Freetown in 12 communities spread out between the wards and for different levels of socio-economic development. A total of 1800 households were surveyed. As well as quantitative data, participatory focus group discussions were undertaken to assimilate perceptions and views relating to existing sanitation and potential improvement options.

- **2007 Goal Water and Sanitation Survey** The NGO Goal carried out a survey covering 9 slum communities to obtain information about local knowledge, attitudes, behaviours and practices relating to water, sanitation and hygiene as well as issues related to child protection, health and nutrition, and HIV/AIDS. The communities consisted of Maxwell, Rokupa Wharf, Brima Lane, Ferry Terminal, Kanikay, Mabella, Susan’s Bay, Pentagon and Tower Hill.

- **2008 Action Contre la Faim (ACF) - Cholera Atlas** As mentioned above, ACF has compiled a Cholera Atlas for Freetown in order to prepare a cholera prevention strategy and a diagnosis of water management. ACF is also undertaking a more detailed fieldwork in 4 communities in different parts of the city (Kroo Town, Susan’s Bay/Magazine, Quarry/Coconut Farm, Georges Brook/ Dowerak Farm).

- **UN-Habitat Slum Survey** UN-Habitat published a report on the ‘Improvement of slums and informal settlements in Freetown’ covering water and sanitation as well as a wide range of other issues. The particular focus of the study was on Susan’s Bay slum community.

**Hygiene awareness**

Although the infrastructure in slums is very poor, slum residents who participated in the focus group discussions as part of the survey undertaken by GOAL and Oxfam showed a good awareness of the links between water, sanitation and disease and the need for hygienic behaviours

- **Awareness of the importance of hand-washing** - According to the Goal survey, no respondent said that they never wash their hands and almost 80% prioritized hand
washing after using the toilet to be effective at preventing diarrhoea. Two-thirds also recognized the importance of hand-washing before eating. Respondents stated that they usually wash their hands after going to the toilet and 71% use soap or ash and water. However, little more than 40% referred to the use of soap for washing hands and less than 10% referred to washing hands before preparing food. 45% identified the linkages between ill health and contaminated / dirty water and 43% identified the health risks associated with contaminated food.

- **Cleanliness of the household environment** - More than half of the groups spoke of keeping the household environment clean. A smaller number talked about cleaning and covering the toilet. Killing or avoiding flies is a particular priority for some groups and a couple mentioned the importance of good drainage and one stated that rubbish bins should be covered. 94% of respondents claim to clean their compound daily (Oxfam, 2008).

Despite awareness of good hygiene awareness, translating this into behaviour is limited by infrastructure, especially the availability of safe and plentiful water supplies and access to latrines. As a result rates of diarrhoea among under-fives are high in these communities.

### 2.1 Household Sanitation

The legal framework for sanitation is based on the Public Health Ordinance of 1960 and its subsequent amendments (1970 and 1978) and has therefore changed very little since colonial times. The 1960 law stipulates that all houses should have a latrine. In Freetown, FCC is the local government authority responsible for enforcing the Ordinance and Sanitary Inspectors were responsible for checking that new constructions have latrine facilities and also made house to house checks to made sure that these facilities were kept clean. But this system of enforcement has broken down and the fines are extremely low as the law has not been updated (Ndomahina and Kabia 2004).

Private facilities include latrines that are used exclusively by one family as well as those that are shared between a group of neighbours or households who come to an informal agreement about their use. The 2004 Census data on sanitation is summarised in Table 2.1 and shows that approximately 25% of sanitation is private and 75% is shared. The latrine technologies associated with household latrines (private and shared) observed in Freetown includes the following:

**Improved**

- **Water closet toilet** connected to septic tank or sewer - There are relatively few flush toilets connected to waterborne sanitation in Freetown and even those households that have these systems installed often lack water to flush them.

- **Pour flush latrine** connected to cesspool. These use considerably less water than WC’s but are widespread in Freetown.

- **Ventilated Improved Pit** (VIP). These are similar to basic pit latrines, but include a vent pipe to remove odours and, provided the inside of the latrine remains dark, flies are not attracted to entering the latrine. In order to prevent insects from entering the pit, a screen must be placed securely over the top of the vent pipe. The VIP is generally of improved construction materials than a simple pit, which also increases the cost.

**Unimproved**

- **Simple unimproved pit** - Pit latrines are most common particularly in informal settlements because of the lack of water and the prohibitive costs associated with the installation of other forms of sanitation. In Freetown, latrines are generally installed by the residents and the pits are often crudely dug and unlined, with poor slabs and weal superstructures are
weak. The quality of these latrines is generally very poor. An example of a typical simple pit latrines found in Freetown is shown in Figure 2.1. These latrines are deemed to be structurally unstable, uncomfortable and difficult to clean as the surfaces are rough and absorbent.

- **Hanging latrine / bucket** - Although most latrines are connected to a pit or chamber for containment of excreta, some ‘hanging’ latrines are observed to discharge directly into surface waters (see Figure 2.2). The practice of discharging wastewater to the environment is commonplace, which causes widespread environmental pollution.

Some households who don't have access to a private or shared latrine use a communal latrine as described below (see Section 2.2) whilst others have no latrine and defecate into a plastic bag and dump of the waste. This is particularly true in the poorer slum communities. Children are observed to defecate directly on the seashore without any form of sanitation. These practices expose the communities to increased health hazards and the most affected are children themselves who often play around dumping areas.

![Figure 2.1 Typical pit latrine with wooden seat, Cline Bay area](image)

![Figure 2.2 Overhung latrines in Kroo Bay Slum](image)

**2004 Census**

The projections for 2007 based on the 2004 Census data shows that the majority of the population (75%) uses simple unimproved pit latrines whilst only 18% use some form of improved latrine - including VIP, pour flush and water closet latrines – both individual household and shared (see Table 2.1). The 2004 census data also showed that 7% of the population in Freetown does not have access to any type of sanitation facilities which suggests that they practice open defecation.

**UN-Habitat survey**

The UN-Habitat survey in Susan’s Bay, found that 96% (UN-Habitat 2006) of the respondents lacked access to a private toilet and due to lack of and poor drainage around almost every structure, there are stagnant, smelly, waters, which provide an excellent breeding ground for mosquitoes and houseflies. The survey also observed that 28.8% of people in slums use the sea or nearby open drains, whereas GOAL only observed open defecation being practiced by some 12% of slum households. In slum settlements next to the sea (e.g. Kroo Bay, Susan's Bay, Cline Town etc) local residents are reported to defecate in plastic bags, which are then disposed of on the seashore or into open drains or garbage heaps.
Table 2.1 Types of sanitation in Freetown (projections for 2007 based on the Census data 2004)

<table>
<thead>
<tr>
<th>Sanitation Type</th>
<th>Private</th>
<th>Shared</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncontrolled (Bucket, open defecation)</td>
<td>1%</td>
<td>6%</td>
<td>7%</td>
</tr>
<tr>
<td>Pit (traditional simple pit)</td>
<td>15%</td>
<td>60%</td>
<td>75%</td>
</tr>
<tr>
<td>Improved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ventilated Improved Pit (VIP)</td>
<td>1%</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>Flushed outside (pour flush)</td>
<td>1%</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>Flushed Inside (WC)</td>
<td>8%</td>
<td>5%</td>
<td>14%</td>
</tr>
<tr>
<td>Total</td>
<td>26%</td>
<td>74%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Oxfam survey

Figure 2.3 shows the percentage sanitation type available in the 12 communities surveyed during the Oxfam study. This shows that the majority of respondents do have access to some form of sanitation.

In relation to the question what excreta disposal systems exist in the community:

- On average, pit latrines are used in 37.5% except for Portree Old Wharf where there are many more connections to sewerage and only 7% use of pit latrines.
- On average, open defecation is practiced by 14% but in Kissy, Wilkinson and Calaba Town this was as high as 20%.
- Access to public toilet blocks varies considerably in the different areas. In Goderich and Hill Cot Road, public latrines are not used, whereas in Portee Old Wharf and Susan’s Bay users are as high as 40%.
- Hanging toilets are used considerably in slum areas - 13% in Susan's Bay and Wilkinson, and 23% in Marbella.
- 29% use an in house toilet connected to a septic tank, but this ranges from 44% in Grassfield to 3% in Susan’s Bay.
- On average, 4% have sewerage connections but most of these are in Portree Old Wharf.

Figure 2.3 Percentage of sanitation type available in each community (Oxfam 2008)
2.2 COMMUNAL SANITATION

In the past, public toilets were quite common in Freetown. But at present, in public areas, e.g. market areas, there are often inadequate sanitation facilities for traders/vendors. Factories are also lacking sanitation facilities for the workers. The migratory population therefore presents additional strain on households with private latrines, which do not have sufficient capacity for such a high usage.

However, there are some communal latrines located in public spaces, which are used by members of the local community that are willing to pay a small user charge. A total of 29 communal and market latrines were identified for Freetown (Figure A1.1 in Annex 1 shows their location). Unlike household toilet facilities, which are used by one household (or sometimes a group of households), communal toilets are used collectively. Communal toilets generally utilize pour flush systems or aqua privies and may also include washing facilities and sometimes other facilities.

There are two situations where a toilet block is appropriate:

- Communal toilet blocks for residential areas – notably for low-income informal and illegal settlements where household connections are either too expensive or not possible due to lack of legal tenure.
- Public toilets are used by the general public who require the use of a toilet. These are required for markets, stations or busy public areas where many people pass by.

Most of the toilets are located next to markets or in commercial and business areas. The majority of these toilets were constructed by the Ministry of Health and Sanitation in 1982 or under the Freetown Infrastructure Improvement Project (FIRP) in 1996 (Ginger Hall, Mabella, Congo Markets, Brookfields, Kroobay and Susan's Bay). Figure 2.4 provides an example of a communal latrine in Susan's Bay slum.

![Figure 2.4 Communal toilet in Susan's Bay](image)

The Freetown Infrastructure Rehabilitation project aimed to improve infrastructure in Greater Freetown, with particular regard to the needs of the urban poor. Six public ablution facilities and 11 public toilets were also constructed under the project. However, while the structures themselves are well built, many of these facilities are under-used due to poor maintenance. Overall, the impact of urban upgrading under the project is more substantial in the built-up areas than in the slum neighbourhoods.

The project also aimed to strengthen the capacity of responsible agencies. The FCC is formally responsible for the maintenance of infrastructure constructed under the project, but the project provided little capacity building help to the FCC to fulfil that responsibility and the resulting lack of proper maintenance is threatening the continued use of the facilities (World Bank 2004).

In some situations, public latrines attached to markets in Freetown also serve the local community and are therefore also communal latrines. These facilities are meant for community use and designed to be operated under the supervision of the Area Development Association (ADA). However, the majority have not been well maintained and some are now being used for other purposes. In some public
latrines, street boys have illegally occupied premises, from where they conduct drug dealing and street crimes.

As a result in some cases, FCC has reached an agreement with local youth groups and has authorised them to keep control of them and protect them from vandalism and the income they generate can be used to maintain the facilities clean. Under this agreement, FCC retains overall management responsibilities but is unable to generate income to maintain them or to provide a regular desludging service. The Council has a total of 29 toilet blocks (see Appendix 1) that are managed in this way and there is a bank account in which all the money from each of these toilet blocks should be deposited. But in many cases the arrangement has broken down as the income has not been enough and the City Council has not had the money for repairs.

The charge to use a public toilet appears is fairly uniform and relatively cheap. According to the community consultation undertaken by Oxfam, the majority of users (70%) pay in range between 100 – 200 Le (whereas approximately 20% pay between 10 – 50 Le) depending on whether the user is requiring use of the washing facilities or not. In some communities (e.g. Kroo Bay) access to latrines is free for children to promote good sanitation behaviour. Residents who cannot afford the charges and do not have a private latrine or toilet defecate in the open spaces or by the sea.

Income generated by communal latrines is generally insufficient to cover maintenance costs and consequently these facilities tend to dilapidate over time which acts as a disincentive and therefore are used less frequently by local residents. In addition, water shortages add to the problems facing these toilets and some (e.g. Big Market, King Jimmy) are prone to frequent blockages due to inadequate design.

As a result, the majority of the public/communal toilets within Freetown are in a deplorable and unsanitary condition and many are located within close proximity to market areas where foodstuffs are exchanged. The presence of flies, insects and odours emanating from the toilets is a hindrance to good business and poses an additional sanitary hazard. They are dilapidated, vandalised, and lack privacy (due to missing doors and windows). Roofing material and floor slabs are often damaged or absent. The water supply and electrical systems are often broken, following theft of piping, fittings, and other accessories.

Most facilities do not have regular supply of water. One ablution facility in Ginger Hall has not had running water in over three years. The public toilets are also under-used, either due to lack of water or because of lack of demand. Some buildings are now used as private storage areas instead of providing a public facility.

As is the case in assessments of public latrines in other parts of Africa, such as in Nairobi (Mbuvi and Njoroge), most toilets require repair of some or all of the following items: water supply, toilet-flushing system, cisterns, doors, windows, water storage facilities, washbasins, floor slabs, roof structure, walls, paint surface, and electrical system. Although interim measures have produced improvements in some public latrines, most are suffer from the following which discourage usage throughout the city:

- **Inadequate lighting.** Most communal latrines are poorly lit, making it both difficult and unsafe to use them.

- **Poor accessibility.** The accessibility of some toilets is poor, with approach paths in substandard condition and overgrown with weeds and other shrubs.

- **Lack of privacy.** Most latrines have broken doors and windows and so lack privacy.

- **Dirty and unhygienic environment.** Human waste and excreta, within and around many toilets, renders them unhygienic and unpleasant to use.

According to the community survey, 65% of participants who responded that they use public latrines, indicated that they do not pay. However, as seen below, this varies significantly depending upon the
location. In Susan’s Bay where there is an active and dynamic CBO (Susan’s Bay Youth Development Organisation), the proportion of users paying for use of public latrines was as high as 97% but is much lower in other areas with only Kissy and Mabella being greater than 50% and Red Pump, Godreich, Portree Old Wharf and Calaba Town all being less than 20% (see Table 2.2).

<table>
<thead>
<tr>
<th>Location</th>
<th>Paying Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Susan’s Bay</td>
<td>97%</td>
</tr>
<tr>
<td>Kissy</td>
<td>54%</td>
</tr>
<tr>
<td>Mabella</td>
<td>51%</td>
</tr>
<tr>
<td>Spur Loop</td>
<td>49%</td>
</tr>
<tr>
<td>Wilkinson</td>
<td>41%</td>
</tr>
<tr>
<td>Hillock Road</td>
<td>34%</td>
</tr>
<tr>
<td>Grassfield</td>
<td>18%</td>
</tr>
<tr>
<td>Tower Hill</td>
<td>13%</td>
</tr>
<tr>
<td>Red Pump</td>
<td>9%</td>
</tr>
<tr>
<td>Godreich</td>
<td>7%</td>
</tr>
<tr>
<td>Portree Old Wharf</td>
<td>3%</td>
</tr>
<tr>
<td>Calaba Town</td>
<td>1%</td>
</tr>
</tbody>
</table>

2.3  **ESTIMATES OF Faecal Sludge Production**

Different sources of data were used in order to estimate current FS production volumes for each ward and derive FS production volumes for the next 10 years. These sources include:

- Sanitation data for Freetown Western Area Urban District Wards obtained from Sierra Leone Statistics.
- OXFAM data, January 2008 on sanitation provision facilities in 12 target communities across the Western Urban area.
- The ACF study provides information as to the type of housing in each ward and the level of sanitation provision for each housing type for each ward.
- Population data Section 1.5 in Part 1.

**Existing coverage**

The sources of data reviewed allowed realistic estimates to be made with regards to the volume, type and location of FS produced for Freetown Western Urban area. The analysis used to estimate FS volumes produced for Freetown Western area takes into account:

- Housing type and density per ward and section,
- Population growth rates per wards and sections,
- Type of sanitation used in different wards and sections,
- FS types based on the sanitation used
- FS volumes based on sanitation used and FS types

Table 2.3 summarizes the different types and sources of domestic wastewater and faecal sludge produced in Freetown and describes their properties (which aids to determine the appropriate FS management strategy). The classification of FS into 4 types based on the type of sanitation used, allows reasonable estimates to be made in terms of what proportion of total FS produced can be collected and disposed of in appropriate treatment sites. Types 1 to 3 can be collected as the FS is stored in pits / septic tanks which can subsequently be emptied.
Table 2.3  Types and sources of domestic wastewater and faecal sludge

<table>
<thead>
<tr>
<th>Type</th>
<th>Source</th>
<th>Characteristics</th>
<th>Estimated volume (l cap⁻¹ day⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Septage</td>
<td>WCs connected to septic tanks or pour flush toilets connected to cesspools</td>
<td>A mixture of settled partially digested sludge and overlying wastewater removed from a septic tank, cesspool or similar system that receives only domestic sewage. The concentration of septage varies enormously depending upon the retention time and hydraulic loading of the septic tank. On average (15g/l)</td>
</tr>
<tr>
<td>2</td>
<td>Public latrines</td>
<td>Wastewater from WC flush toilets</td>
<td>Highly concentrated septic wastewater</td>
</tr>
<tr>
<td>3</td>
<td>Pit faecal sludge</td>
<td>Pit latrines – both ‘dry’ and ‘wet’ pits</td>
<td>Physical characteristics of sludge removed from pits depend on permeability of soil and whether water is used for anal cleaning. The sludge settles in the bottom of pits and is mixture of partially digested faecal solids combined with microbial biomass. The sludge is more consolidated and denser than fresh excreta and is therefore harder to remove from tanks. However, handling of this type of sludge involves less health risks (although still significant) and can be dewatered more easily.</td>
</tr>
<tr>
<td>4</td>
<td>Excreta</td>
<td>Fresh excreta from open defecation</td>
<td>Highly concentrated waste. High BOD and many pathogens</td>
</tr>
</tbody>
</table>

The results of the analysis carried out for estimating 2008 (Base Year) total FS produced, collected and treated are summarised below Table 2.4. Further details on the methodology used to obtain FS volumes for the base year and for future years are included in Appendix 4. The analysis shows that at present the majority of faecal sludge volumes produced are not collected or treated in a sanitary manner.

Table 2.4  Estimated volumes of faecal sludge per annum produced and collected in Base Year (2008) for Freetown Western Urban Area

<table>
<thead>
<tr>
<th>FS Type</th>
<th>Produced</th>
<th>Colllected(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>m³/yr</td>
<td>%</td>
</tr>
<tr>
<td>Type1</td>
<td>62,395</td>
<td>37%</td>
</tr>
<tr>
<td>Type 2</td>
<td>1,110</td>
<td>1%</td>
</tr>
<tr>
<td>Type3</td>
<td>63,993</td>
<td>38%</td>
</tr>
<tr>
<td>Type4</td>
<td>42,636</td>
<td>28%</td>
</tr>
<tr>
<td>Total</td>
<td>170,024</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

Note 1: Estimates of collected FS results of interview with desludging private operators. (See section 2.4.1)
2.4 **COLLECTION AND DISPOSAL OF FAECAL SLUDGE**

The majority of sanitation facilities in Freetown consist of pits. When pit latrines are full they either need to be decommissioned and then a new location for the latrine is sought and a new pit is dug, or as this is not feasible in urban areas the pit needs to be desludged (see Table 2.5).

<table>
<thead>
<tr>
<th>Table 2.5</th>
<th>Traditional desludging practices (Oxfam 2008)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Average</strong></td>
</tr>
<tr>
<td>Construct new one (also observe if there is space)</td>
<td>1%</td>
</tr>
<tr>
<td>Empty and bury the content nearby</td>
<td>12%</td>
</tr>
<tr>
<td>Pay for dislodging truck to empty the latrine/septic tank</td>
<td>2%</td>
</tr>
<tr>
<td>Drill hole in the toilet/septic tank to allow the content to flow out freely to create space for usage</td>
<td>2%</td>
</tr>
<tr>
<td>Others</td>
<td>84%</td>
</tr>
</tbody>
</table>

The frequency of cleaning varies considerably depending on the number of people using the latrine and the capacity of the pit/tank. Currently desludging services operate at government level, private sector level and informal sector level but these services are deficient in a number of ways.

The Ministry of Health/FCC owns a number of trucks as do the Army and Police Barracks but these were out of action during the time of the preparation of the strategy. The City Council was donated a truck by UNICEF which was originally funded by DFID and used in the refugee camps, but in less than a year, the truck broke down and since then has ceased to operate.

Three commercial operators provide desludging services in the city and they serve institutions, schools and colleges, industries and private residential properties. These operators use second hand imported desludging vehicles (Figure 2.5) and report a number of issues affecting their desludging activities, related to:

- Lack of spare parts for the vehicles which need to be imported
- Lack of discharge facilities, transfer points in the city

**Figure 2.5 Desludging vehicle operated by private company**
Informal sector and manual desludging

Accessibility of pit latrines and septic tanks for cleaning is a real problem in areas that cannot be served by larger trucks. These are areas where access roads are too narrow, housing density is too great or the steepness of slopes is prohibitive. Even in wards that have reasonable access, some houses are too remote to be able to use a vacuum desludging truck.

In addition many pits are not constructed in a manner that allows of mechanical desludging and are prone to collapse. In these cases latrine owners often employ the services of a group of men who clean the latrine manually. The informal sector is not regulated and the sludge is generally disposed of within the latrine owner’s compound, which poses significant health and environment hazards.

2.4.1 Pit Emptying Costs

Costs to customers

Desludging operators do not have fixed tariffs for desludging, and charges are made on a case-by-case basis depending on size of pit, and the location of pit with respect to the sludge disposal site.

- Mechanical desludgers (tankers) generally charge between US$ 40-60 but again this varies on the amount of waste collected and the location of the pit in relation to the only legal dumping site.

- The cost of desludging by manual emptying is greater than mechanical desludging. One family in Cline Bay reported having to clean their pit up to 3 times per year at a cost of Le 60 US$ for every visit and costs of up to US$ 80 (Le 250,000) were reported.

Operator costs

Daily operating cost is normally the cost of fuel (10 gallons per day) Le 14,500 per gallon = 145,000 = 50 USD per day = 300 USD per week. New tyres costs Le 3 – 5 million for large vehicles (less for smaller vehicles) and need to be replaced on average once every 3 years. The cost of importing a second hand vehicle is reported to be US$ 16, 000 + US$ 4,000 import and shipping = US$ 20,000 but a vehicle of this price is considered to be very cheap. One vehicle can collect the waste from about 2 – 3 septic tanks per day (which equates to approximately 25 – 50 customers per week which equates to an income of US$ 1000 USD – US$ 3000 per week per vehicle).

2.4.2 Faecal Sludge Disposal

At present there is no detailed information as to the volumes of sludge collected. Private desludging operators are reported by the site operator at King Tom to come 1 – 2 times during the day but they also come during the night when there is little or no traffic and they can operator more freely throughout the city. King Tom is the only official site for faecal sludge disposal in Freetown and is located on the King Tom solid waste disposal site located at the Congo Town Wharf area where the Congo Greek empties into the sea in the West of Freetown (see Figure 6.2).

The existing sludge disposal facilities consist of 2 parallel lagoons, which were designed to be operated intermittently. Material brought in by tanker is discharged at one end through a pile of broken stone into a pipe leading to the lagoon at White Man’s Bay. In theory, the resting lagoon that has filled up in the previous year matures and the water content is reduced by drainage and evaporation. Just before the onset of the annual rains in April/May, the dried sludge should be dug out using mechanical excavators and disposed to the adjacent solid waste tip.

However in reality, as can seen in Figure 2.6, these operating parameters have not been followed and there is no control over the discharge of septage onto the lagoons, which have now both become complete submersed in sludge, much of which is now becoming dry and established – so much so that vegetation is growing on the surface. The site is need for complete renovation or reconstruction with
new facilities. In addition, the site’s poor engineering and the gradients make manoeuvring of vehicles difficult.

Figure 2.6 Sludge Disposal Facilities at King Tom Solid waste dump site

2.5 SEWERAGE

The existing sewerage infrastructure in Freetown consists of approximately 4 km of pipes which partially covers the Central Business District; serving commercial, political and administrative establishments. As shown in Figure 2.7, this is only a small area of the city and the number or residential properties connected to the sewerage system is very low.

The sewerage system was constructed in two stages. The first stage in the early 1960’s running from Paramount Hotel (now the Ministry of Defence opposite the State House) along George Street down to the Government Wharf. The sewerage system was extended in completed in 2001. The other smaller system serving properties in the King Jimmy Catchment was funded by the World Bank and was completed in 2003/2004.

Guma Valley Water Company was the implementing partner for the construction of the new network but the facility was never handed over to the company (even though the Company provided the Engineer who was part of the Supervision Team). But the works were not formally handed over by the contractors and the works were never officially finished. In fact, the outfall at Government Wharf was never connected even though the outfall pipe was constructed. As a result of these problems, it was only recently (February 2008) that the sewerage network was handed over to the Water Supply Division.

Regarding financing, the owner of the property (proprietor) is expected to provide an inspection chamber at the boundary to which the authorities would do their connections. The connection costs US$ 200 and service charge is a flat rate of approximately US$ 85 per year, irrespective of the size of the property of the estimated water consumption. The current service charge differs from the previous tariff, which was based on property values in rateable values determined by Freetown City Council, but is only 2.5 times the value it was more than 15 years ago.

A listing obtained from the Non-Tax Revenue Department’s database for the CBD sewerage system from 2006 – 2006 show a total of 136 records. Each institution, irrespective of size, level of commercial activity or expected water consumption is expected to pay 250,000 Le per annum. In 2005, a total income of Le 24,250,000 and in 2006 23,000,000, which equates to 71% and 68% collection ratio.
Most of the existing property / house connections are old and are connected to the new lines through manholes and have provision for connections to all properties, including vacant lots and provision is made for these properties to be connected close to their boundaries. Not all the streets within the area classified to fall within the CBD has the sewerage network. Streets like Ecowas, Malama-Thomas, Charlotte, Liverpool, Barthurst, Wellington, Waterloo, and Brook streets do not have networks.

Since the completion of the extension works to the CBD sewerage system in 2001, it has never been operated in a structured and organized manner. At present there is only one supervisor and one labourer to carry out the function of cleaning / blockage removal as well as the removal of floatable at the grit removal chamber. No machines are available or installed at this chamber for the grinding of floatables. The WSP of MoEP who now operates the system does not have sufficient or adequate tools, protective clothing or the basic logistics to perform their duties adequately.

Current structural status and operational performance

After heavy rains in the wet season, some manholes (particularly those located along Wallace Johnson Street) are lifted up by force of the sewage. The WSD only has time to respond sewerage flowing out of manholes. Reports from the maintenance crew of WSD suspects that there are some sections within the network where the slopes have not been properly done which has been the cause of backup flows coming out the manholes. Also some other manholes which were constructed have failed and the covers have settled below the ground levels and are also causing blockages. Field inspections reveal that most of the manholes which spill sewerage are those along Lightfoot and Boston Street for the two catchments. Five of these have been opened for inspection.

In summary, the area is only partially served by a sewerage system but the following deficiencies have been identified:

- not all properties are connected;
the sewerage system is not connected to the sea outfall and wastewater is discharged untreated onto the foreshore;

- there is a lack of cost recovery without any formal collection of user charges;
- the institutional responsibility for maintaining the sewerage system rests with the Water Supply Division of the Ministry of Energy and Power. As MoEP is a national level government institution, its role should not be to be involved in managing infrastructure in Freetown. There have been discussions between MoEP and GVWC about handing over the responsibility for operation and maintenance to GVWC but to date GVWC has not assumed responsibility.
- there is a lack of finance, equipment and human resources to keep the system functioning well and there is no form of routine maintenance.

Proposed extension to the sewerage system as per the previous master plans

Howard Humphreys updated the Master Plan in 1994. As part of this, the consultants reviewed the previous feasibility studies and engineering designs that were undertaken by Daniel, Mann, Johnson and Mendenhall (DMJM) for all high priority projects scheduled for construction in the first phase of the 1977 Master Plan programme. The Master Plan put forward by DMJM envisaged that 70% of the population of Freetown would be served by sewerage. Howard Humphreys concluded that DMJM’s proposals were overly ambitious especially considering the limitations of the amount of water available for a waterborne flushed sewerage system to function properly. Even the priority area around the CBD referred to as Falcon Bridge catchment was thought to be unlikely to be affordable.

Howard Humphreys proposed that there sewers should be incorporated into a more extensive sewerage network to serve the Central Business District; only a few lengths of sewerage on Wallace Johnson Street would be replaced by a main interceptor trunk sewer.

The DMJM Master Plan recommended sewered services to 70% of the forecasted population by the end of the implementation programme by means of sewerage systems constructed in 4 natural catchments grouped around the city centre. The extreme western and eastern districts and some remote locations would retain other on-site sanitation method.

The Stormwater Drainage and Sewerage Master Plan (1994) prepared by Howard Humphreys accepted the general concept and design criteria used by DMJM but recognised the fact that limited water supply would limit the applicability of sewerage in Freetown and therefore proposed a much more modest extension of the sewerage system (to increase the length of sewerage system by 7 km to a total of 11 km; discharging into the Sierra Leone estuary by means of 2 short outfall pipelines in the vicinity of Government Wharf.

This proposal was a considerably more realistic proposition than the previous proposal put forward by DMJM who undertook the original master plan for Sanitary Sewerage, Stormwater Drainage and Solid Waste Disposal in Freetown and submitted various reports between September 1977 and November 1981. However, even the modest extension proposed by Howard Humphreys was estimated to cost 3.136 million USD (4.087 million USD with contingencies). At inflated prices in 2008, the proposed investment is considerably greater.

Sea disposal - outfall

In 1981, DMJM established design criteria for the four proposal short sea outfalls and presented designs based on the flows generated by the 1977 Master Plan. Updated cost estimates were undertaken in order to re-evaluate the Master Plan cost data and to reschedule the programme for implementation which had not progressed in accordance with the original plan.

The Master Plan proposed disposal of sewage by means of a short sea outfall into the deep water channel of the Sierra Leone estuary for each of the 4 catchments. The concept of using short outfalls
extending into the estuary was determined to be the most feasible alternative for sewage effluent disposal arising from the four catchments identified as being practical to sewer during the period covered (years 1976 – 2000). Preliminary engineering design was undertaken on the Phase One priority which it was considered to be implemented within the first 5 years of the Mater Plan Programme.

In 1980, DJMW undertook environmental studies to establish feasibility of the Master Plan, short outfall sewage disposal strategy. They concluded that "since shoreline pollution would be an infrequent occurrence and the effects on the marine environment would be minimal", the proposal short outfall could be considered as an acceptable means of sewage disposal up to the level of the design flows.

There is no treatment of wastewater and therefore raw sewage is discharged directly into the mouth of the Sierra Leone River. The communitor house at the Government Wharf outfall was never completed by the contractors and no grit remover/grinder has ever been installed.

Two sea outfalls have been constructed - 1 at Government Wharf 2 (Figure 2.8) and 1 at King Jimmy (Figure 2.8). However, the sewerage systems have never been connected and therefore these infrastructures have never been used for purpose. It is not possible to assess the condition of the sea outfall but it is assumed that after 8 years, there will inevitably have been wear and tear that will require repair and rehabilitation.

Most of the discharges from the sewerage network serviced by this outfall discharges into the sea through the emergency bypass. As a result the outfall which is said to extend a good distance in the sea from the end of the existing jetty has not been made to function since it was constructed. The outfall at the King Jimmy market has for years lost about 18meters of its length on its last leg towards the sea.
3.0 SANITATION STRATEGY - COMPONENTS AND INTERVENTION OPTIONS

3.1 AIMS AND PRIORITIES OF THE SANITATION IMPROVEMENT STRATEGY

The principal objective of the sanitation strategy is to uplift the health status of the population of Freetown and to reduce pollution of the environment. The strategy aims to be in line with the Government of Sierra Leone’s draft National Policy for Water and Supply Sanitation (January 2008) and is aligned to meet the policy statements and targets related to the Poverty Reduction Strategy Paper (2005 – 2007) and international targets defined by the Millennium Development Goals (MDGs).

These policy statements indicate that the GoSL is committed to improving environmental sanitation but does not intend to be directly involved in the implementation of sanitation improvement programmes. The strategy is therefore in line with a more contemporary approach towards improving sanitation, which focuses on supporting the development of localised delivery mechanisms for both implementation and management of facilities for excreta disposal in urban areas.

Millennium Development Goals (MDG’s)

The MDGs that are relevant to the Freetown sanitation strategy:

- Target 10 (No. 7) – 50% reduction of the proportion of people without sustainable access to safe drinking water and sanitation by 2015.
- Target 11 (No. 7) - improve the lives of at least 100 million slum dwellers by the year 2020.


The now outdated National Poverty Reduction Strategy Paper (PSRP) 2005 – 2007 includes objectives related to the need to increase access to sanitation facilities for deprived communities in both rural and urban areas. The strategy promotes a decentralised approach towards service delivery in order to improve environmental sanitation and to provide facilities for the management of liquid and solid wastes.

Although not specifically related to water and sanitation, the PRSP also prioritises the need for the production of affordable building materials and an enabling environment for the construction of low-cost housing – either by low-income families themselves or by the private sector. As latrines are an integral part of the home environment, upgrading and installation of new latrines in the private domain as part of a strategy for affordable housing for the poor can form an important component of urban upgrading and pro-poor housing programmes. Related to this, the priority strategies include:

- To build the capacity of communities for effective housing delivery through skills training in building materials production and housing construction;
- To facilitate access by the poor to affordable finance through micro-finance institutions aimed at sustainable self-help housing construction;
- To upgrade slum and squatter settlements in Freetown and other urban areas.

Vision 2025

Amongst a broad range of other policies, Vision 2025 encourages a competitive private sector-led economic development with effective indigenous participation to underpin all development programmes in the country. In essence, as well as promoting the concept of water as an economic good, it also supports the involvement of the private sector in aspects of service delivery related to sanitation as well as all other forms of infrastructure and service.
National Policy for Water and Supply Sanitation (draft January 2008)

The main objective related to urban sanitation stated by the draft policy is to minimize the pollution of water sources from poor environmental sanitation services and thus contribute to improving the health of urban communities. In order to achieve this, access to adequate sanitation service level needs to increase to at least 66% of the population by 2015.

The policy also aims to encourage commercial management and private sector participation in the provision of services related to water supply and sanitation. Thus, cesspit emptying services will be established and/or contracted to private operators. The operators will be required to discharge only at treatment facilities and legal enforcement mechanism with regard to wastewater disposal will be strengthened. In addition the policy highlights the need to have wastewater and treatment systems and sludge disposal facilities that meet environmental standards.

3.2 OVERVIEW OF THE SANITATION STRATEGY

Over a period of time, it is envisaged that there will be an increasing need for investments to increase sewerage coverage as water consumption increases. However, in the shorter term, sewerage is not considered to be a priority as the volume of water supplied via standposts will remain low for the foreseeable future. Even though there is expected to be considerably improved water supply as a result of the investments in the water resources development and distribution, the strategy for improving water supply is based upon a demand project of 25 l cap\(^{-1}\) day\(^{-1}\) for the majority of the population of Freetown, which is still insufficient to operate a sewerage system.

Although greywater will pollute the environment if discharged without treatment, the main objective of the strategy is to isolate and treat separately human waste. Pollutant loads in greywater and associated health risks are much smaller than those associated with combined wastewater. Therefore, greywater disposal is not considered to be a priority although, greywater can be used for flushing as described below and this therefore reduces the pollutant loads associated with greywater from entering the environment.

In terms of improving sanitation for the Freetown population, it is envisaged that the vast majority will remain served by on-site sanitation within the next 10 years. As such, the strategy prioritises the need for improved on-site sanitation and associated services for servicing these facilities. The strategy therefore aims to improve access to latrines throughout the city - decreasing the number of latrines that are shared by multiple households - and rehabilitating public and communal facilities in high-density slum settlements with the aim of eliminating the practice of open defecation.

The main aim is to contain excreta and reduce contamination of water sources used for water supply.

Over a 10-year timescale, it is expected that the sanitation situation will:

- Eliminate open defecation and other forms of excreta disposal that are considered to be unsanitary (e.g. hanging latrines).
- Upgrade unimproved sanitation (traditional pit latrines) to some form of improved sanitation. The aim is to reduce those using unimproved sanitation from the current level of more than 80% to 10%. Out of the 90% for improved sanitation, 50% are estimated to have either a simple improved pit or VIP whereas 40% are estimated to have either a pour flush or WC toilet.
- Reduce sharing of latrines by improving access to private facilities from 25% to 40% of the population.
- Increase access to communal latrines in low-income areas / slums and public latrines for locations in the city next to markets or points of transit. Access to communal latrines is expected to increase from current estimates of 4.3% to 10% at the end of Year 10.
In addition, there is a need for improved arrangements for servicing on-site sanitation (faecal sludge collection and disposal). Concurrent to these activities is a need to improve hygiene behaviours (notably hand-washing) related to the use of latrines and water use.

The emphasis of the strategy on on-site sanitation is supported by the findings from the community consultation undertaken by Oxfam. In response to the question “What would you invest the above amount of money in?”, and average of 42% of respondents indicated that they would invest the money in emptying their toilet/latrine and 27% indicated that they would invest the money in a new toilet/latrine/septic tank. Only 3% indicated that they would want to invest in sewerage as a means to improving sanitation problems (see Table 3.1). Table 3.2 indicates willingness to pay for sanitation improvements in response to the question “How much money are you prepared to spend in proper disposal of excreta in your household?” (Oxfam 2008).

<table>
<thead>
<tr>
<th>Table 3.1</th>
<th>Priorities for sanitation improvements according to household survey</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
</tr>
<tr>
<td>Connection to sewerage system</td>
<td>3%</td>
</tr>
<tr>
<td>An operational toilet/latrine system</td>
<td>12%</td>
</tr>
<tr>
<td>New toilet/latrine/septic tank</td>
<td>27%</td>
</tr>
<tr>
<td>Emptying toilet/latrine</td>
<td>42%</td>
</tr>
<tr>
<td>Constructing household system</td>
<td>12%</td>
</tr>
<tr>
<td>Others</td>
<td>4%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 3.2</th>
<th>How much money are you prepared to spend in proper disposal of excreta in your household? (Oxfam 2008)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
</tr>
<tr>
<td>&lt;1000</td>
<td>7%</td>
</tr>
<tr>
<td>1000 – 5000</td>
<td>22%</td>
</tr>
<tr>
<td>5000 – 10,000</td>
<td>24%</td>
</tr>
<tr>
<td>&gt;10,000</td>
<td>38%</td>
</tr>
<tr>
<td>Others</td>
<td>9%</td>
</tr>
</tbody>
</table>

In slum areas, sanitation improvements should be promoted as part of a more comprehensive slum upgrading programme. Some of these physical improvements are directly relevant to sanitation – for instance, access by desludging equipment is problematic due to poor access and therefore there is a need for realignment of some of the dwellings to enable the construction of surfaced pathways with sufficient width for entry of small vehicles. In addition, improved drainage and flood protection are prioritised by slum communities and these are a prerequisite for improved environmental sanitation; especially as some communal latrines are adversely affected by flooding.
3.3 **KEY SUB-COMPONENTS OF THE SANITATION IMPROVEMENT PLAN**

The main sub-components that are considered to be essential for the delivery of improved sanitation conditions in Freetown are illustrated in Figure 3.1. These interventions collectively form an integrated framework for reducing the incidence of diarrhoeal diseases. Figure 3.1 illustrates the need for complementary interventions in both the private domain and the public domain, but highlights that there are important linkages between the two. For instance, although household sanitation is predominantly the responsibility of private residents (and proprietors), the maintenance of these facilities is dependent upon the provision of a public service for pit emptying, collection and disposal of excreta.

![Figure 3.1 Integrated framework for improving excreta management and hygiene behaviour](image)

The one sub-component related to sewerage and wastewater management is not included. This sub-component is treated separately as it is only relevant for a relatively small number of people living in the core central area of Freetown. As this is predominantly a commercial district, there is not a high residential population.

**Sub-component 1 – Promotion of improved household sanitation**

Sub-component 1 aims to improve sanitation at the household level by promoting affordable but better quality latrines, by reducing sharing and open defecation. Increasing the quality of latrine design (upgrading of unimproved pits to improved on-site sanitation e.g. VIP, pour flush) and construction to enable more hygienic conditions within the household environment to be achieved is also emphasised by the strategy.

There is a range of different latrine types that may be utilized by households in Freetown. Recommended designs and construction guidelines for pit latrines and septic tanks should be monitored and enforced by Public Health inspectors and promoted by NGOs working amongst communities. The focus promotes the supply of cheap and good quality latrine components (low-cost sanitary rings and latrine slabs) and technical assistance for homeowners and landlords to install a good quality latrine at an affordable price.

*Details of this sub-component are provided in Section 4.1.*

**Sub-component 2 - Communal latrines and washing facilities**

This sub-component focuses on the rehabilitation of existing and construction of new communal latrines for slum communities and institutions (schools, army and police barracks and hospitals) and public latrines. Particular attention is placed upon improving the servicing of these latrines and upon setting up management systems to ensure their sustainable operation. This will involve supporting the existing management structures through the Public Health Department of the City Council.

*Details of this sub-component are provided in Section 4.2.*
Sub-component 3 – Sanitation promotion and improved hygiene behaviour (handwashing)

*Increasing demand for improved sanitation.* In areas where open defecation is practiced, the primary goal is to encourage communities to recognize the implications of their behaviour; and to support existing community structures to develop collective social consensus that open defecation is unacceptable.

*Hygiene promotion* Improved sanitation facilities are important, but physical investments do not automatically lead to reduced incidence of diseases unless accompanied by efforts to improve hygiene. It has been proven that hygiene promotion is the most cost-effective way of reducing incidence of diarrhoeal disease (Laxminarayan et al 2006). Thus, this sub-component aims to promote improve hygiene behaviours to ensure that the expected health benefits related to investments in sanitation facilities are realised.

*Details of this sub-component are provided in Section 8.0.*

Sub-component 4 - Desludging services and faecal sludge management

Faecal sludge management (collection and disposal) is a key issue that needs to be addressed as part of the sanitation strategy. A systematic pit emptying and septic tank cleaning service is needed to maintain sanitary conditions within the Freetown urban area and reduce the uncontrolled discharge of waste that is current polluting natural watercourses and contaminating water supplies.

An effective strategy for sanitation improvements must support an expanded pit and septic tank cleaning service in order to improve the frequency and quality of latrine and septic tank emptying operations. In addition, facilities for faecal sludge and proper treatment and disposal of collected faecal sludge are required. This requires the identification of possible sites for sludge disposal and development of appropriate management/regulatory arrangements for private sector operators.

*Details of this sub-component are provided in Section 5.0.*

Sub-component 5 - Sewerage and wastewater disposal

Due to the large capital investment requirements combined with ongoing operation and maintenance costs associated with sewerage and the need for large volumes of water for flushing, sewerage is not seen to be an appropriate solution for the sanitation problems for majority of communities in Freetown. The only area where sewerage is currently seen to be necessary is in the central business district to serve institutions and commercial properties where the resident population is fairly low.

The expansion of sewerage in the city is not perceived to be an immediate priority, but the strategy takes a long-term perspective (10 years) taking into consideration the implications on wastewater production as a result of increasing water consumption in the city, which will require investments in sewerage in the future in some areas.

*Details of this sub-component are provided in Section 7.0.*
4.0 SANITATION OPTIONS – TECHNOLOGIES AND LEVELS OF SERVICE

Various technologies exist for excreta-disposal, which may be utilised by households in Freetown as the basis for improved sanitation. Although these offer varying levels of user comfort and convenience, all have the potential to provide the same level of protection against the spread of diseases as long as they are used correctly and well maintained.

As the latrine is an investment and an integral part of the home environment, the resident (or homeowner) should decide the most appropriate sanitation technology according to their needs and affordability. The strategy for improving household sanitation is therefore based on the promotion of a range of different options in accordance with the choice of the homeowner as to which is most appropriate.

Although it is recognised that the majority of residents of Freetown would prefer to have a household latrine, factors related to affordability, land tenure restrictions or simply a lack of space precludes this option for some families. In this situation, alternative options will have to be explored and locations identified for any new facilities.

As described below in Table 4.1, there are four different levels of service. Determining which level of service is appropriate for different communities is an important step in the technology selection process. This cannot predetermine which latrines will be chose and therefore these need to selected at the local level.

It is not feasible to propose a universally acceptable and affordable technical solution for all households. Therefore, a successful sanitation strategy responds to the socio-economic status of households and various technical options at varying cost are required. For instance, although septic tanks are recommended for new developments to house more affluent families, the majority of poorer households cannot afford this form of technology.

<table>
<thead>
<tr>
<th>Table 4.1</th>
<th>Level of sanitation service provision</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Where is it appropriate?</strong></td>
<td><strong>Disadvantages</strong></td>
</tr>
<tr>
<td>Household</td>
<td>The immediate access, convenience and privacy offered by household sanitation means that this option is the preferred option.</td>
</tr>
<tr>
<td>Shared</td>
<td>In areas where there is insufficient space for individual household latrines or where affordability is a problem, the sharing of latrines between several families is a common solution.</td>
</tr>
<tr>
<td>Communal</td>
<td>Communal toilets are appropriate for low-income communities and slums where lack of space and tenure preclude the installation of private latrines and residents are too poor to invest in private facilities.</td>
</tr>
<tr>
<td>Public</td>
<td>Public latrines are provided for use by the general public in places such as bus stands, markets, which have a large throughput of people.</td>
</tr>
</tbody>
</table>

Regularisation of latrine constructions

There is a need for a standardised approach for design and construction, including the development of standards in order to promote a greater opportunity for quality of construction. The Ministry of Health and Sanitation is in the best position to develop and endorse these recommendations and support the City Council in terms of ensuring that they are implemented and monitored correctly. This will require the need to strengthen the role of the City Council to regulate household sanitation and related services.
New by-laws requiring that for new house constructions, adequate provisions for septic tank provisions should be checked and registered into a city database. Household septic tanks should be cleaned at least once every 5 years, whereas for commercial establishments, septic tanks should be cleaned once every 3 years. One option is for the Council to insist that, upon renewal of annual business licenses, the business owners must present a certification from City Environmental Health Inspectors that their septic tank has been cleaned at least once in the last 3 years.

4.1 HOUSEHOLD SANITATION OPTIONS

Various factors are important for the selection of the most appropriate form of sanitation for households in different areas. The level of sanitation service has significant implications on the types of sanitation facility and consequently the associated management arrangement (see Table 4.1). Other factors include water supply service levels, operational requirements, capital and maintenance costs and ease of construction. Other criteria include local physical constraints such as access for cleaning, density of housing as well as environmental considerations relating treatment and disposal of effluent and sludge.

4.1.1 Technical considerations relating to design and pit emptying

In Freetown, the soil and groundwater conditions do not permit leaching of wastewater into the ground and this, combined with the high density of housing and contamination of groundwater used for domestic purposes, means that infiltration of wastewater is not recommended. Large/deep unlined pits can collapse if they are sucked out too rapidly due to the saturation of the ground around the pit. Faecal sludge from pour flush latrine pits, and especially waste in lined pits where liquids are retained in the pit, are easier to remove than sludges in dry pit latrines.

All the sanitation technologies that are considered appropriate for the Freetown area rely upon desludging services to remove excreta from the pit or septic tanks once these become full. This system is reliant upon an effective and affordable system for emptying pits and transporting the waste to a waste processing/treatment facility. The frequencies at which these services are required are inherently related to the number of people using the latrine, the size of the tank, the amount of water used for anal cleaning and flushing.

Vacuum trucks are appropriate for removing septage from septic tanks, but there are a number of problems when these are used to desludge dry pit latrines.

- Pit latrine waste starts out as a low-density sludge with a high water content and low viscosity but becomes progressively difficult to remove by suction as dense sludge forms at the bottom of the pits, which is virtually impossible to remove by suction.
- Pits are often not well positioned to facilitate cleaning and access is only possible via a small squat hole which is used for defecation. As it is dark, it is generally not possible to see how much waste remains in the pit and the efficiency of desludging services to remove all the waste is questionable.

As a result, depending on the frequency of cleaning and the size of the pit, the capacity of the pit is progressively lost. It also gets harder to clean a pit and costs most. Many households cannot afford to pay for a complete desludging as it costs more to remove large sludge volumes and this means that the investment and effort involved in digging and lining a large pit also lost.

These factors support the argument that pits should be designed to be smaller than is traditionally accepted as part of engineering design. The regular removal of smaller amounts of waste is not only technically easier but it means that the transactions are smaller and therefore become acceptable to poorer households who are unlikely to have sufficient money available at any one time to pay for a large volume of waste to be collected (Coffey 2007).
4.1.2 Appropriate sanitation technologies for Freetown

The strategy at the household level is based upon the promotion of one of the technologies described below. These are considered in terms of their technical feasibility of the local physical conditions and income of those living in the community. The strategy encourages households to select from a range of technology options for sanitation, but the decision as to which latrine is most appropriate needs to be a household level decision. The following factors are considered to be relevant:

- Physical factors: housing density affects the space for installation of latrines.
- Financial considerations: the socio-economic status of households affects their ability of households to pay.
- Cultural factors: e.g. Muslims prefer to squat and use water for anal cleaning whereas Christians prefer to sit.

Option 1: Basic improved pit

The lack of design guidance specific to Freetown and the problems related to the construction of latrines means that the tradition pit is particularly unsatisfactory in terms of hygiene and local environmental health problems. However, a simple pit latrine is not a poor form of sanitation per se, however, with a proper slab and lining, the most affordable sanitation option is the basic improved pit. The pit can be made with precast SANPLAT slabs and lined with two concrete rings of 1.4 m internal diameter and 2 m depth. The pit may be dug deeper but it is not considered to be necessary to line the pit deeper than 1 m, but this will depend on the local groundwater conditions. The cost of this option (materials only) is estimated to be approximately US$ 120 – US$ 140.

Option 2: Ventilated Improved Pit

The Ventilated Improved Pit (VIP) latrine is similar to the basic pit latrine, but incorporates a number of additional design features in order to reduce the two major disadvantages of the simple pit latrine - odour and flies. The VIP includes a vent pipe to remove odours and, provided the inside of the latrine remains dark, flies are not attracted to entering the latrine. In order to prevent insects from entering the pit, a screen must be placed securely over the top of the vent pipe. The VIP is generally of improved
construction materials than a simple pit, which also increases the cost. The cost of this option (materials only) is estimated to be between US$ 160 - US$ 200

**Option 3: Pour flush toilet**

The pour flush toilet is envisaged to become more popular as the availability of water increases. It has the advantages of offering an enhanced level of hygiene than a pit latrine and has less odour problems. Water is required for flushing but greywater (from washing clothes etc) can potentially be used. In this case, pour-flush toilets will not contribute to any increase in household water consumption. Pour flush toilets are usually offset which makes the tank easier to access for desludging. Therefore, the toilet can be in the house and the tank outside and subsequently upgraded to a sewerage system in the future. In addition, the waste has a high moisture content and is therefore easier to desludge. The proposed design consists of 2 prefabricated cement rings of 1.4 m diameter, which are stacked on top of each other to form a tank. The cost of constructing the pour flush latrine is almost the same as for a conventional single compartment VIP latrine of the same capacity but if the capacity of the pit is reduced then the cost of the pour flush is less. The cost of this option (materials only) is estimated to be between US$ 180 - US$ 220.

**Option 4: Water closet flush toilets and septic tanks**

Water closets are the most expensive type of toilet, requiring considerable volumes of water for flushing and need to be connected to a septic tank or sewerage system. Thus, the capital and operation maintenance costs are high and this option is only affordable for the upper-middle and high income households. The cost of this option (materials only) is estimated to be between US$ 300 - US$ 500.
There are various alternative designs that are technically viable and these will be selected in accordance with local physical conditions and demands from local stakeholders. In addition to the standard latrines options described above, the following are potential options to be considered as part of local sanitation improvement plans.

Figures 4.5 and 4.6 show two variants to the conventional pour flush design. The first which has been used in Angola involves the combination of a latrine with a bathing facility and the greywater from washing is collected and then used for flushing. The second illustration shows an innovative design which incorporates a pipe extending to the bottom of the pit which can be used for adding water and air to the sludge at the bottom of the pits to fluidise dense wastes which are otherwise unsuckable.

In addition, as described above there is a strong argument for reducing the pit size to only use 1 prefabricated cement rings of 1.4 m diameter, which are stacked on top of each other to form a tank. In addition to proposed inclusion of a pipe for desludging, an alternative design will be explored as proposed by UN-Habitat which is based upon a latrine capacity of around 1.0 m³ which is adequate for an extended family of 10 people for up to 2 years (Coffey 2007).
Another potential option is the application of ecological sanitation (ecosan) which aims to manage faeces and urine as resources in order to harvest fertilizer soils and promote local food production. Ecosan latrines tend to be more expensive than conventional latrines but may have benefits as they reduce reliance on synthetic fertilizers. In principle, ecosan has some important advantages including a) reduced water demand for flushing; b) reduced wastewater management problems (no blackwater production); and c) improved nutrient recycling - particularly the nutrients in urine. The pollution of surface waters and groundwater is reduced and therefore ecosan may be appropriate in areas where local communities are dependent upon local water sources for water supplies.

Ecosan latrines are not considered appropriate in the denser urban areas of Freetown. But ecosan is more likely to be viable in the peri-urban areas and settlements on the hillsides surrounding the city where water supplies are poor and are in accessible by desludging vehicles. As ecosan requires a very different form of household sanitation, there will be a need for concerted efforts to promote these technologies and this will be dependent on an external organisation with local support to undertake the social mobilisation and potentially to subsidise the latrine construction.

Ecosan is currently being promoted in some other parts of Sierra Leone. There may be scope to discuss further with relevant organisations the development and implementation of ecosan latrines in Freetown. This would subsequently require a research study to develop culturally acceptable and affordable ecosan designs, details of construction and what local materials may be used.

4.2 COMMUNAL AND PUBLIC LATRINES

Communal latrines are a necessity for slum communities (and potentially other areas) where individual households cannot afford private latrines or there is no available space, as well as areas where access is particularly poor due to steep slopes. Communal latrines are also needed for schools, hospitals, army barracks etc. and public latrines are necessary for markets and other areas where there is high movement of people.

This sub-component therefore focuses on the rehabilitation of existing communal/public latrines and the installation of new ones in strategic locations as yet to be identified. As described below these can also be combined with faecal sludge collection points. These may also serve as washing facilities and may be combined with water kiosks.
There are variants to the design depending upon:

- the peak number of people that are expected to use the latrine facilities
- whether the waste is to be treated on site
- whether it is to be collected and treated off-site, and
- whether the latrine facilities are to be designed to provide washing facilities for personal hygiene and washing clothes as well as the basic sanitation function.

A reliable water supply is always required where pour flush toilets are utilised and for handwashing. But, where communal latrines are often combined with washing facilities, then the supply of water to these facilities needs more careful consideration.

### 4.3 Predicted Changes in Sanitation Coverage

Incremental step changes are required over the 10-year time frame in order to meet the objectives for improved and increased sanitation services as well as improvement and strengthening of FS collection and treatment. Table 4.2 shows how the type of sanitation facilities available need to change between the base year, year 1 and year 5 in order to meet the year 10 objectives. As is observed from this table, the number of VIP latrines increases whereas the number of simple Pit latrines decreases. Similarly, the strategy aims to provide access to sanitation facilities for everyone and eliminate open defecation; this is reflected in 0% values for use of other, none and bucket.

Table 4.3 presents the data in a slightly different format; it provides an indication as to what degree sanitation provision must change in the different wards in order to meet the Year 10 objectives. Further details as to how sanitation provision coverage was obtained and weighed for the different wards to reflect the differences in housing type and current sanitation provision are detailed in Appendix 2.

<table>
<thead>
<tr>
<th>Sanitation Facilities</th>
<th>Base Year (2008)</th>
<th>Year 1</th>
<th>Year 5</th>
<th>Year 10 Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIP</td>
<td>1</td>
<td>4</td>
<td>18</td>
<td>35</td>
</tr>
<tr>
<td>WC</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Pour flush</td>
<td>2</td>
<td>3</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>Pit</td>
<td>60</td>
<td>54</td>
<td>32</td>
<td>5</td>
</tr>
<tr>
<td>None</td>
<td>6</td>
<td>6</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Communal</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>VIP</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>WC</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Pour flush</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Pit</td>
<td>15</td>
<td>14</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 4.3 Percentage use of sanitation facilities over 10 year forecast

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Private</td>
<td>Shared</td>
<td>Communal</td>
<td>Private</td>
<td>Shared</td>
<td>Communal</td>
</tr>
<tr>
<td>East</td>
<td>I</td>
<td>25.8</td>
<td>71.1</td>
<td>3.2</td>
<td>31.7</td>
<td>65.6</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>29.4</td>
<td>67.5</td>
<td>3.0</td>
<td>36.3</td>
<td>61.2</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>22.0</td>
<td>74.6</td>
<td>3.4</td>
<td>27.1</td>
<td>70.0</td>
</tr>
<tr>
<td>Central</td>
<td>I</td>
<td>28.3</td>
<td>68.6</td>
<td>3.1</td>
<td>34.9</td>
<td>62.6</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>28.8</td>
<td>68.2</td>
<td>3.1</td>
<td>35.4</td>
<td>62.1</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>28.3</td>
<td>68.6</td>
<td>3.1</td>
<td>34.9</td>
<td>62.6</td>
</tr>
<tr>
<td>West</td>
<td>I</td>
<td>31.4</td>
<td>65.7</td>
<td>3.0</td>
<td>38.6</td>
<td>58.9</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>40.3</td>
<td>57.1</td>
<td>2.6</td>
<td>49.7</td>
<td>48.3</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>40.3</td>
<td>57.1</td>
<td>2.6</td>
<td>49.7</td>
<td>48.3</td>
</tr>
</tbody>
</table>

Figure 4.8 summarizes how the proportion of different sanitation types is expected to evolve over the 10-year horizon. Open defecation (Type 4) accounts for around 13% of sanitation facilities in the base year, but this is reduced to 0% in Year 10. On the other hand, Type 1 (which represents septage from septic tanks and pour flush toilets) is expected to increase significantly whereas the overall proportion of Type 3 (pit latrine sludge) is expected to be similar.
5.0 **SERVICING OF ON-SITE SANITATION AND FAECAL SLUDGE MANAGEMENT**

5.1 **FAECAL SLUDGE CHARACTERISTICS AND SPECIFIC QUANTITIES**

In order to estimate the required investments for vehicles for servicing of on-site sanitation, it is necessary to make an informed estimate of the amount of each type of faecal sludge that is produced from different types of latrine (See Appendix 2). The forecasted FS production volumes for the next 10 years takes population growth per wards into account and apportions them according to the proposed improvement objectives relating to improved latrine coverage. These trends affect the volume and composition of faecal sludge being produced which consequently influence the extent to which servicing arrangements and end-disposal requirements need to be extended.

Assuming a household occupancy rate of 6 (Census data 2004) and an excreta production rate per capita per day of 1.5l (see Table 5.1), a yearly household would produce 3.28m³ of FS a year. Assuming a pit/septic tank size of 1.3m² x 2m in depth, the storage volume provided is 3.4m³. This means that on average, the pit would have to be desludged once a year. This analysis is also slightly conservative as it is likely that the pit is larger and that over time the FS degrades, so desludging frequency should decrease slightly and hence households would be prepared to spend a greater amount on desludging.

<table>
<thead>
<tr>
<th>Year</th>
<th>East</th>
<th>Central</th>
<th>West</th>
<th>Total production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Year</td>
<td>11,411</td>
<td>16,576</td>
<td>73,517</td>
<td>17,733</td>
</tr>
<tr>
<td>1</td>
<td>11,536</td>
<td>17,034</td>
<td>76,331</td>
<td>10,914</td>
</tr>
<tr>
<td>2</td>
<td>11,661</td>
<td>17,264</td>
<td>79,253</td>
<td>11,089</td>
</tr>
<tr>
<td>3</td>
<td>11,788</td>
<td>17,497</td>
<td>82,287</td>
<td>11,266</td>
</tr>
<tr>
<td>4</td>
<td>11,916</td>
<td>17,734</td>
<td>85,436</td>
<td>11,446</td>
</tr>
<tr>
<td>5</td>
<td>12,046</td>
<td>17,973</td>
<td>88,707</td>
<td>11,629</td>
</tr>
<tr>
<td>6</td>
<td>12,177</td>
<td>18,216</td>
<td>92,102</td>
<td>11,814</td>
</tr>
<tr>
<td>7</td>
<td>12,309</td>
<td>18,462</td>
<td>95,627</td>
<td>12,003</td>
</tr>
<tr>
<td>8</td>
<td>12,443</td>
<td>18,712</td>
<td>99,287</td>
<td>12,195</td>
</tr>
<tr>
<td>9</td>
<td>12,578</td>
<td>18,964</td>
<td>103,087</td>
<td>12,389</td>
</tr>
<tr>
<td>10</td>
<td>12,715</td>
<td>19,221</td>
<td>107,032</td>
<td>12,587</td>
</tr>
</tbody>
</table>

5.2 **SERVICING OF ON-SITE SANITATION**

At present, the only desludging service available is operated by a limited number of small-private sector operators. The coverage is limited and there are many households in areas that are currently inaccessible by conventional desludging equipment.

There is clearly a need to expand and improve the conventional desludging operations but in addition is a need to consider the location and accessibility for desludging by vacuum pump trucks or other forms.
of equipment. Therefore, there is a need to develop systems for desludging pits in areas that are inaccessible. This may involve the following options:

- **Improve access** – in some cases this is also necessary for other reasons. For example, the high density of urban slums, which can only be accessed by narrow paths, is a real problem in situations where a fire breaks out. In this situation, investments in a more comprehensive upgrading scheme are required as well as those directly to upgrade water and sanitation facilities.

- **Provide manual workers with better equipment, protective clothing and provide local points for waste collection.** This is not proposed as a long-term solution but in the short-term, many pits will still need to be cleaned manually and there is a need to reduce the health risks associated with these unsanitary practices. In addition, as described below, due to the existing unsanitary practice of burial of faecal sludge within the household plot, there is a need to install a system of intermediary collection points where the waste can be stored prior to collection by a desludging truck for transport to a remote location for off-site treatment and disposal.

- **Introduce new technologies that can be used in narrow areas.** Smaller mechanical equipment (e.g. Vacutug and Dung Beetle) has been developed and used in other countries and there are opportunities to pilot these technologies in Freetown. The various technologies are discussed below.

These options are discussed in more detail below.

**Option 1 - Desludging trucks**

Conventional vacuum tankers (see Table 5.2) are expensive to operate as they consume a considerable about of fuel; they wear rapidly and cannot access high-density housing areas lacking reasonable roads. In addition, spare parts are a problem for ensuring sustainable operation of vehicles. Depending on the capacity of the sludge pumps, the distance between the septic tank and the vacuum truck can only be as far as 150 - 200 meters.

**Option 2 – Pit desludging in high-density settlements**

Pit desludging is problematic in high-density settlements due to the lack of access. Therefore, equipment is expected to cope with faecal sludges of different physical consistencies. In response to this problem, the Dung Beetle (which is used in Accra, Ghana) and the Vacutug (which has been used in Kibera, Kenya) (see Table 5.3) have been designed to provide an alternative method for emptying pit-latrines. In order for these technologies to be sustainable, it is proposed to support the development of equipment that can be produced and repaired locally.

One of the main problems is that there needs to be some form of local collection facility where the sludge can be discharged and then collected by a large vacuum desludging truck. The scope to introduce these collection points (transfer stations) in combination with public latrines is discussed below in Section 5.3.
### Table 5.2 Septage desludging vehicles

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional desludging truck</td>
<td>These are used in many cities throughout the world but are expensive and have difficulties in accessing densely populated areas. Capacity is 5000 litres and can be used for institutional buildings, schools and communal/public latrines.</td>
</tr>
<tr>
<td>Narrow wheel-base desludging truck</td>
<td>Essentially the same as the above but with a smaller wheel capacity and wheel axle, enabling them to enter narrower lanes. These have a capacity is 3000 litres and are more appropriate for servicing domestic properties.</td>
</tr>
<tr>
<td>Trailer mounted desludger attached to separate vehicle</td>
<td>This system has been designed for use for servicing pit latrines in the dense slums of Dhaka. The capacity of the tank is approximately 2000 litres. There is scope to utilise a similar design and manufacture the equipment in Sierra Leone.</td>
</tr>
</tbody>
</table>

---

### Table 5.3 Desludging options for servicing of pits in high-density settlements

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dung beetle</td>
<td>Previous manufactured by J. Hvidtved-Larsen A/S, Denmark (Cost US$ 50000) but currently not in production</td>
</tr>
<tr>
<td>Vacutug</td>
<td>Produced by UN-Habitat, (Estimated cost US$20000 but scope for UN-Habitat financing)</td>
</tr>
</tbody>
</table>
Option 3 - Manual emptying of pits

As mentioned above, the cleaning of the pits in areas where access lanes are either too steep or too narrow is problematic as these are often inaccessible by any form of motorized desludging equipment. The manual handling of faecal sludge is not considered to be acceptable as part of a long-term strategy of waste management. However, the development and implementation of other more sanitary waste collection services will take time and there is urgent need to improve current practices with a specific focus on protection of the workers.

In relation to the need to reduce health hazards associated with manual cleaning of pits, it is important to provide gloves, boots, masks etc for the workers. In addition, lime can be added to septic tanks and pit latrines to remove stench and suppress odours from human excreta. The strong alkalinity destroys most pathogens and also conditions the sludge prior to disposal.

There are some new ingenious technologies that have been designed for the purpose of a non-mechanical remove of sludge. These methods offer better protection to the operators as it reduces the operators’ contact with the pit contents and therefore reduce the risk of infection. One example is Mapet, which was designed by WASTE in the Netherlands to overcome the hygienic problems associated with manual excavation of pits in Dar es Salaam. More recently, the Gulper has been developed by Steve Sugden from the London School of Hygiene and Tropical Medicine (see Table 5.4).

<table>
<thead>
<tr>
<th>Table 5.4 The ‘Gulper’ – equipment for desludging pit latrines</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Gulper is a manually operated pump for emptying the contents from pit latrines. The device is based on a simple direct action hand pump, which is operated by either one or two pit-emptying operators. The handle is raised and lowered which lifts the contents of the pit up through the riser pipe, which is then discharged through the angle ‘T’ outlet pipe at the top of the Gulper. The estimated cost of a Gulper is approximately $1000 but it is based upon a simple design that should be replicated in Sierra Leone. As part of the strategy development, Oxfam will be testing the Gulper in Freetown.</td>
</tr>
</tbody>
</table>

5.3 Economics of Faecal Sludge Management

The time required to transport wastes to King Tom disposal site makes the majority of faecal sludge operations uneconomic. It is not known to be a fact, but this means that there is little incentive to transport the waste to the sludge disposal site and it is therefore possible that the drivers of the emptying truck dispose of the waste illegally in a watercourse out of the main urban areas in order to cut haulage time and cost.

In order to minimise the cost of cartage of faecal sludge and make the operations economically feasible, it is important to look at the scale and cost of treatment works and the cost of hauling FS to these works in an integral manner. The basis of these calculations will also influence decisions related to the tariffs charged for cleaning on-site sanitation facilities and any incentive mechanisms built into the contracts with private entrepreneurs responsible for FS haulage and treatment.

The main factors that influence the operator’s cartage costs are fuel consumption and labour costs. These are related to the financial costs are a) the distance between the point of collection and the
disposal point and b) the time taken. In addition, the capacity of the truck affects the number of households that can be served before the truck needs to drive to the disposal site.

**Transfer stations for faecal sludge and septage**

Whereas tankers of septage can transport sufficient quantities in one trip to make it economically viable, the economies of scale for pit latrine emptying mean that the waste management system is more akin to the solid waste sector. The cartage of relatively small faecal sludge volumes (Vacutug size) over a distance that is anything more than 1 – 2 km is impractical and uneconomic. It is therefore important to minimise haulage of FS volumes by the introduction of sludge transfer stations (or alternatively small decentralised treatment facilities). Therefore, in addition for a larger scale service to be operated by the municipality (or private operators under contract in different parts of the city), there is a need to support the development of local systems for faecal sludge collection.

The installation of collection points/transfer stations for faecal sludge is considered to be an important link in the faecal sludge management strategy for Freetown. A key consideration for this 2-phase collection system to operate efficiently is the need for the establishment of a localized collection system into which the faecal sludge can be deposited. These neighbourhood collection facilities will need to be installed at the periphery of informal settlements from where the waste can be stored prior to bulk collection. It will therefore be necessary to design the system as an underground chamber in order to reduce smell and nuisance from flies. Inside the chamber, the waste will undergo preliminary pre-treatment (anaerobic digestion), which improves the dewatering characteristics.

Collection and storage facilities have been constructed as underground tanks in Accra, Ghana in order to provide a sanitary means for the local collections without odour problems. However, the tanks tend to suffer from siltation problems if not cleaned sufficiently regularly enough and the volume of the UHTs reduces over time (starting from a volume of 23 m³). Once the tanks are silted up, they are very difficult to empty, which puts strains on the pumps of vacuum tankers, increasing both desludging and maintenance costs. The remedial process is a costly one, whereby the top of the tank must be removed using a crane, and workers have to climb inside and remove the contents of the tanks by hand (Boot 2008).

Another key issue relates to the location of the installation, as local residents are likely to oppose proposals to construct faecal sludge collection points nearby their houses. One possibility for further consideration is to combine these transfer stations with a public latrine and washroom, in order to improve acceptability amongst the local community. The public latrine option would also provide an opportunity to employ a caretaker for managing both the latrine / washroom as well as to regulate the discharge of faecal sludge.

The other option that can be adopted in the short-term and can be used for areas where it is not possible to install a more permanent sludge collection facility is to introduce a system whereby Freetown City Council provides a temporary collection point for a local area for a specified duration of time. To encourage local residents to have their pit cleaned and to ensure that they take advantage of this service, the City Council may choose to subsidize this service using funds from municipal taxes or operators licence fee.
6.0 **TREATMENT AND DISPOSAL OF FAECAL SLUDGE AND SEPTAGE**

6.1 **TECHNOLOGIES FOR FAECAL SLUDGE TREATMENT OPTIONS**

Faecal sludge disposal is particularly problematic because it cannot be discharged into surface waters or be treated like wastewater because its pollutant concentrations are too high, it cannot be landfilled or treated like solid waste because its moisture content is too high and it cannot be directly used for crop fertilizing because its pathogen content is too high.

Technologies developed in industrialized countries that are utilized for treatment of sludge produced from wastewater treatment plants are inappropriate for the treatment of faecal sludge because they tend to rely on mechanized equipment and power. They also require large initial capital expenditure and have high operation and maintenance requirements. In addition, they are not necessarily appropriate as the physical and biochemical characteristics of faecal sludge are different from sewage sludge.

While the economy-of-scale factor for the treatment works must also be taken into consideration, larger plants inevitable require greater capital investment. In addition although large plants may incorporate more sophisticated technologies to save on land requirements, and this in turn, increases capital and operating cost.

The first stage of faecal sludge treatment requires the stabilization of the sludge and the separation of the solid and liquid fractions. The liquid fraction is then treated specifically usually with wastewater treatment technologies whilst the solid fraction is further treated to enhance its characteristics for either land filling or agricultural reuse. Figure 6.1 summarizes some of the FS treatment options and treatment steps. The diagram shows primary treatment options followed by options for post-treatment of liquids and solids (sludge) residuals.

![Figure 6.1 Overview of faecal sludge treatment options (SANDEC 2002)](image)

6.2 **SELECTION CRITERIA FOR FAECAL SLUDGE TREATMENT**

A comprehensive review of FS and septage treatment options was carried out to select the most appropriate FS treatment option. Details of the different options considered are summarized in Appendix 3. The following criteria were used for selecting suitable FS treatment options for Freetown:

*Performance Criteria:*

- Consistency and biochemical stability of biosolids
Strategic Water Supply and Sanitation Framework
Part 3 Sanitation Improvement Plan

- Hygienic quality of solids
- Quality of liquid effluent

Process Simplicity and Reliability Criteria:
- Operation and maintenance requirements
- Skills required for operation and supervision
- Risk of failure related to installations or to managerial or procedural measures

Cost related Criteria:
- Land requirement
- Capital investment costs
- Operation and maintenance costs

Table 6.1 Summary of the different FS treatment options and their suitability

<table>
<thead>
<tr>
<th>FS Treatment</th>
<th>Capital investment</th>
<th>Operation and maintenance</th>
<th>Risk of failure</th>
<th>Land requirement</th>
<th>Suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-Composting with organic solid waste</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Planted drying bed</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Unplanted drying bed</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Settling/thickening tank</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Waste Stabilisation Ponds (Settling pond)</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Anaerobic Treatment</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Imhoff Tanks (settling,digestion)</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Co-treatment with sewage sludge/wastewater</td>
<td>Very High</td>
<td>Very High</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

Waste stabilisation ponds and sludge drying beds and are considered feasible under the socio-economic, technical and institutional conditions prevailing in Freetown at the moment. Details as to the indicative preliminary sizing of the works are summarized in Table 6.2. The plant sizes are indicative and likely to change during detailed design. Baseline data on the composition of FS in Freetown is required and may change the final design considerably.
### Table 6.2 Description of core treatment processes for selected FS treatment options

<table>
<thead>
<tr>
<th>Process Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Screening and storage of sludge</td>
</tr>
<tr>
<td>• Primary settling of sludge in anaerobic tanks</td>
</tr>
<tr>
<td>• Secondary settling and biological treatment of percolate in facultative ponds</td>
</tr>
<tr>
<td>• Post-treatment (storage) of solids for hygenisation prior to reuse in agriculture.</td>
</tr>
</tbody>
</table>

**Design Basis**: BOD loading of FS assumed at 400mg/l

**Plants consist of:**
- King Tom: 2 anaerobic 4 m deep RC tanks, 2 RC facultative ponds baffled at inlet and outlet. (Capacity 12,00m³, 1500m² land requirement)
- Aberdeen and Wellington: 4 anaerobic 4 m deep RC tanks, 4 1.5 m deep facultative ponds baffled at inlet and outlet. (Capacity 24,00m³ each, 2000 m² land requirement each)
- Hamilton: 4 anaerobic 4 m deep RC tanks, 4 1.5 m deep facultative ponds baffled at inlet and outlet. (Capacity 77,500m³, 2500m² land requirement).

**Operation:**
- Anaerobic pond loading for 2 days
- Facultative pond: 7 days retention time
- Desludging: Every 7 months
6.3 **Sites for Faecal Sludge Treatment**

Freetown western area was surveyed for potential FS treatment sites. Sites were initially selected by reviewing satellite imagery and maps and through visual inspection during site visits. In total, 6 sites were investigated and assessed for suitability.

- Aberdeen Creek (West III)
- Wellington Fishing Village (East II)
- Granville Brook dump site (East I)
- King Tom Dump (Central I)
- Lakka (West III)
- Hamilton (West III)

The locations of the sites are shown in Figure 6.2 and a summary of the engineering suitability of sites surveyed provides in Tables 6.3 and 6.4.

**Technical and engineering suitability**

Sites were initially identified and reviewed based upon the following criteria:

- Location within Freetown
- Accessibility
- Land availability (informal encroachment)
- Constraints relating to physical site conditions

Figure 6.2  Location of King Tom, Granville Brook and possible other sites for faecal sludge treatment
### Table 6.3  
**Engineering suitability of sites surveyed – existing waste disposal sites**

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Location (Ward)</th>
<th>Engineering suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Granville Brook Dump</td>
<td>East I</td>
<td>This site is currently being used as a dump. There is little remaining void space and the site is narrow and very steep. In addition the dump has been constructed over Granville brook Culverts that have been damaged due to the weight of the waste. This site is not suitable for the proposed use.</td>
</tr>
<tr>
<td>King Tom Dump</td>
<td>Central I</td>
<td>This site has been used as Freetown’s main solid waste treatment site for many years and is currently being rehabilitated by the GTZ. It benefits from a central location and a FS treatment plant has been built in the past. It would be able to service the Central Wards. There is sufficient land available. This site would require significant work to develop an operation FS treatment works. It is suitable for the proposed use.</td>
</tr>
</tbody>
</table>

### Table 6.4  
**Engineering suitability of sites surveyed - possible future waste disposal sites**

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Location (Ward)</th>
<th>Engineering suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aberdeen Creek West III</td>
<td>West III</td>
<td>The area of land is relatively undeveloped and benefits from decent access roads and relatively flat terrain. There is potential for development as a FS treatment site if provision is made for flooding. If this site is used there may be some need for land reclamation. This site is suitable for the proposed use providing environmental and social mitigation measures are provided.</td>
</tr>
<tr>
<td>Old Wellington Warf East II</td>
<td>East II</td>
<td>The area of land is relatively undeveloped and benefits from relatively flat terrain. There is potential for development as a FS treatment site if provision is made for flooding and environmental and social mitigation measures are provided. If this site is used there may be some need for land reclamation. Access roads would need significant upgrading. This site is suitable and would serve the eastern wards, which are the most populated and produce the most waste.</td>
</tr>
<tr>
<td>Lakka/Hamilton West III</td>
<td>West III</td>
<td>These sites are located out of Freetown main urban settlement. Compared to other sites investigated these meet the land space requirements necessary to treat a larger proportion of waste. Land is flat and largely undeveloped. However, due to their location these sites would only be able to serve the Western Wards. The site is suitable but needs to be secured now to prevent development on them if they are to be developed for FS waste treatment in the future.</td>
</tr>
</tbody>
</table>

### 6.4 Social and Environmental Assessment

A Social and Environmental Assessment (SEA) was carried out for each of the sites. Details of the methodology used can be found in Part 5 of the main report. Details of the sites and reasons for their inclusion or exclusion in the strategy can be found in Appendices of Part 5.

**Social objectives**

- Avoid impacts on existing communities (homes and associated community infrastructure)
- Avoid adverse impacts on, and where feasible enhance local livelihoods and employment
- To avoid and where feasible reduce detriment to human health
Avoid increased exposure to, and where feasible reduce potential nuisance to communities
Avoid losses of or adverse impacts on cultural property.
Avoid increasing flood risk, and where feasible reduce flood risk to affected communities

The main factors that were identified to be potential problematic from a social perspective relate to resettlement. Most of the sites are currently occupied and the existing houses would need to be demolished, although there are no significant infrastructures that are identified in the sites. Siting them can lead to involuntary resettlement but it should be noted that many of the inhabitants living on or close to the proposed sites are occupying land illegally.

Although those who would be affected by the construction would require resettlement, there are few who are depending upon the land for their livelihoods as the majority of the inhabitants are either into petty trading or are employed elsewhere in the city. Nonetheless, the majority of the inhabitants are vulnerable people who can least afford the cost of relocation and whose living condition is impaired.

Moreover, treatment and disposal of sewage sludge can cause nuisances in the immediate vicinity, at least occasionally. In addition, the increase in disposal vehicular traffic and haulage activities could lead to accidents in the area and undoubtedly there would be some objections from local residents about the siting of the treatment works nearby due to increased traffic, visual impact and odour problems.

Environmental objectives
To avoid adverse impacts on, and where feasible enhance biodiversity.
Protect and where feasible enhance the quality of surface and ground waters.
Protect and where feasible enhance river flows and groundwater availability.
To avoid adverse impacts on fluvial and coastal geomorphological processes
To protect and where feasible enhance the quality of land.
To minimise need for consumption of energy and natural resources.

The main factors that were identified to be potential problematic related to these environmental objectives related to the cumulative encroachments into the estuary or estuaries around Freetown may impact upon tidal prisms and alter coastal morphology which would have a negative impact on the Ramsar designation of the estuary. The changes in coastal morphology upstream and downstream of the facilities might also result in increased flood related problems. In addition, erosion may increase around the structure with associated deposition in other parts of the estuary, which could affect other habitat areas or settlements. In addition, loss of mangrove swamp is not covered by any conservation designations but it is considered to be an important coastal wetland habitat type and should be protected.

In conclusion, although some of the sites may be deemed to be inappropriate upon further more detailed investigation and consultation with stakeholders, it needs to be borne in mind that the existing public health and environmental impacts caused by indiscriminate discharge of untreated excreta into the environment is very significant. In addition, some of the negative impact caused by the siting of treatment plants might be mitigated by the selection of appropriate technology; inclusion of project mitigation plan to mitigate or offset adverse impacts on the human environment; and to manage resettlement with due consideration for compensation, housing and livelihood impacts.
### Table 6.5  Summaries of Engineering, Social and Environmental Impact Assessment

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Location</th>
<th>Engineering and Technical Issues</th>
<th>Social Issues</th>
<th>Environmental Issues</th>
<th>Potential for development as a FS treatment site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aberdeen Creek</td>
<td>West III Ward, Area of land adjacent to Aberdeen Creek.</td>
<td>The area of land is relatively undeveloped and benefits from decent access roads and relatively flat terrain.</td>
<td>A slum community is established near the area proposed.</td>
<td>Undeveloped mangrove swamps.</td>
<td>Yes</td>
</tr>
<tr>
<td>Wellington Fishing Village</td>
<td>East II</td>
<td>Access roads would need significant upgrading. Some land reclamation.</td>
<td>Fishermen’s village</td>
<td>Undeveloped mangrove swamp</td>
<td>Yes</td>
</tr>
<tr>
<td>Granville Brook Dump</td>
<td>East I</td>
<td>Little remaining void space, very steep site, constructed over Granville Brook culverts.</td>
<td>Located in the middle of residential area</td>
<td>No environmental standards met</td>
<td>No</td>
</tr>
<tr>
<td>Kingston Dump</td>
<td>West I</td>
<td>Little remaining void space, central location, serious remediation work necessary if this site is to be used for FS treatment. Previously used for FS treatment (drying Beds).</td>
<td>Located in the middle of a residential area</td>
<td>No environmental standards met</td>
<td>Yes</td>
</tr>
<tr>
<td>Lakka</td>
<td>West III</td>
<td>Severe Erosion sea erosion is threatening area considered</td>
<td>No communities present on site</td>
<td>No major impacts to immediate environment</td>
<td>No</td>
</tr>
<tr>
<td>Hamilton</td>
<td>West III</td>
<td>Land available</td>
<td>Limited neighbouring communities likely to be affected</td>
<td>No major impacts to immediate environment</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Recommended sites

Based upon the preliminary technical assessment and SEA, in addition to the existing King Tom solid waste dumpsite, three sites have been identified as potentially suitable for FS treatment given the 10-year master plan timeframe.

- Wellington
- Hamilton
- Aberdeen Creek

Although these sites may be deemed to be inappropriate upon further more detailed investigation and consultation with stakeholders, it needs to be borne in mind that the adverse existing public health and environmental impacts caused by indiscriminate discharge of untreated excreta into the environment is very significant. In addition, some of the negative impact caused by the siting of treatment plants might be mitigated by the selection of appropriate technology; inclusion of a plan to mitigate or offset adverse impacts on the human environment; and to manage resettlement with due consideration for compensation, housing and livelihood impacts.

6.5 Financial Assessment of Faecal Sludge Management

A financial assessment of the different treatment options was carried out to compare the financial viability of the different alternatives. The assessment detailed in Appendices 5 and 6 compares the net present value of the capital and operational expenditure (CAPEX and OPEX) to design build and operate the different FS treatment systems in each site against the potential revenue generated by customers paying to dispose of their waste. The analysis takes into account the design life of the capital assets and calculates the potential rates of return of the investment required.

The parameters used in the analysis of expenditure consist of:

- Civil and M&E component costs for each FS treatment option based on preliminary design and best available local costs.
- Operational expenditure to operate and maintain the treatment sites (local labour, fuel and general OM costs).
- Capital costs of purchasing of desludging trucks (imported vehicles).
- Operational expenditure to operate the trucks (based on number of trucks required to meet collection demands for each site, local labour costs, distance to site, fuel costs and general OM).

Costing data was obtained from a number of sources these are:

- Local industry rates for civil and M&E construction,
- Local labour rates for different staff grades
- Desludging vehicles-import prices (quoted from a commercial supplier based in the UK)
- Land costs based on discussions with local consultants

Further details and assumptions used in the costing calculations are detailed in Appendices 5 and 6.

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2 The discount rate used throughout the analysis is 11% based on current interest rate of 27% and inflation rate of 16% in Sierra Leone at time of study.
Strategic Water Supply and Sanitation Framework

Part 3  Sanitation Improvement Plan

Desludging vehicles - capital and operational costs

Assumptions regarding CAPEX costs for trucks

Desludging trucks CAPEX requirements for each FS treatment site are summarised in Tables A5.1 and A5.2. These costs which are indicative only were based on purchase and import cost of new trucks obtained from quotes desludging truck suppliers operating in the UK.

Assumptions regarding CAPEX costs for trucks:

- An additional provision of 25% of the initial capital outlay cost has been made to account for transport and duty import taxes.
- Annuited costs for purchase of desludging vehicles for the different sites were calculated based on the initial capital outlay and NPV per annum and per year were calculated using 11% discount rate and a 7 year asset life.

Assumptions regarding OPEX costs for trucks

The average haulage distance from the houses where FS is collected to the FS treatment plant is a very decisive variable for the total cost of the disposal system as well as for its efficiency and sustainability. Although FCC confirm that there is no uncontrolled dumping of FS, it is likely to still be common practice. The reason for such behaviour is that the distance to the plant is often excessively long and travelling to designated dumping sites does not make economic sense. These factors were taken into account in the operational costs to try and obtain as accurate as possible an indication of the true costs.

Table A5.3 summarizes the following parameters and costs that were taken into account in the vehicle OPEX analysis and the monthly OPEX costs calculated for each site are summarized in Table A5.4.

OPEX costs included in the analysis relate to:

- Drivers and drivers mates/operatives,
- Truck operation and maintenance (to account for insurance, repairs, replacement parts etc) and
- Collection costs, i.e. costs of fuel required to collect waste.

Faecal sludge treatment - capital and operational costs

Collection costs were developed for each site based on the number of trucks servicing the plant, the fuel efficiency rate (with an allowance for pumping), the average maximal distance from source to plant and the number of trips necessary to meet FS collection requirements for each site.

Other costs applied to civil and M&E CAPEX costs were added as percentage multipliers (see Table 6.6). In addition an allowance was made for instances where the truck was not reaching the plant at full capacity, i.e. travelling to the treatment site at less than 100% capacity. An allowance was also made for downtime i.e. weeks where vehicle is not in operation due to maintenance, breakages, drivers/operatives leave sickness etc.

Other assumption were as follows

- Land is suitable for proposed use and available to purchase either through private purchase or by government order. Nominal allowances have been made for purchase of land for each site depending on location and land requirements.
- Environmental, social and engineering mitigation measures are met and deemed acceptable and the sites proposed do not require any more significant capital to be developed for the proposed use.
- Spoil arising from excavation works during construction disposed of on site.
Contingency and ancillary costs have been applied to all treatment site options as detailed in Table 6.5.

Table 6.6 Other costs applied to civil and M&E CAPEX costs

<table>
<thead>
<tr>
<th>Other Costs</th>
<th>Rate applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preliminary and generals</td>
<td>20%&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Fees, survey, design and supervision</td>
<td>10%&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Contingency</td>
<td>25%&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Note 1: as a percentage of total civil and M&E costs
Note 2: as a percentage of total civil and M&E costs and preliminary and general allowance and fees, survey, design and supervision allowance.

A contingency rate of 25% was deemed to be necessary due to the relative uncertainty of data regarding biological, chemical and physical characteristics of FS in Freetown, the relative novelty of the treatment options and hence the need for pilot and monitoring studies and the uncertainty regarding the suitability of sites.

Details of the CAPEX costs used for each treatment option are summarised in Appendix 4.1.

Assumptions regarding OPEX costs for sites

OPEX Costs for FS treatment sites take into account monthly/annual staff costs, fuel costs for operation of small plant and generators on site and make a provision for general maintenance (3% of CAPEX costs over 12 months) to cover other costs such as small repairs, replacement of small tools and health and safety equipment (gloves, boots etc). Details of costs included as part of the Plant OPEX are summarised in Appendix 4.2.

Financial feasibility based upon willingness to pay

The potential revenue raised by servicing on-site sanitation was based upon willingness to pay according to the findings from the Oxfam sanitation survey (Oxfam 2008) in which residents were asked about the cost of desludging. Based upon the assumption that pits require desludging once a year, this suggests the WTP amount is 35 USD which is in line with the values quoted by the operator of the desludging vehicles (see Section 2.4.1). This equates to approximately 3 USD. This is more than the values given by participants in the Oxfam survey (1.72 USD per month) but poor communities are likely to be less able to pay. Based upon this figure, various scenarios of WTP were considered to analyse the robustness of the financial viability of FS treatment options (see Appendix 6).

A sensitivity analysis was carried out to test the robustness of the assumptions made in terms of potential to recuperate CAPEX and OPEX costs through revenue generated by people paying for a FS collection and treatment service. The CAPEX and OPEX assumptions are the same, however, Scenario 2 assumes a low willingness to pay which remains constant over time whereas Scenario 3 assumes a high willingness to pay which remains constant over time indicates WTP adjustment factors (see Table A.6.3).

The Willingness to pay factors used in Scenario 1 analysis are summarised in Table A.6.1. They indicate the adjustments made to reflect the possibility that the survey responses overstated the overall average WTP. Scenario 2 assumes that the WTP recorded in the community survey is too high and takes into account a low WTP (Table A6.4) whereas Scenario 3 (Table A6.5) assumes willingness to pay recorded during Community survey is accurate and that it does not vary proportionally to increases
in sanitation provision for Freetown. The net balance (monthly profit) for this scenario is very healthy for each of the treatment options and sites.

An analysis was also carried out to determine the IRR of the investments for each of the scenarios and each of the sites (see Table A.6.6).

### 6.6 Phasing of Treatment Options

Although there is a critical need to improve sanitation services in Freetown, it will be important to adopt a staged approach towards investments. Prior to any construction further detailed design is required in order to determine the optimal design.

In addition it is recommended that the final design and treatment method for FS at the Hamilton site is completed only once the pilot plants at Wilkinson road and Wellington have been deemed acceptable and the local capacity for managing faecal sludge operations has been developed.

The design sequence is only an indication and may change during detailed design. The sizing and phasing of the construction of the FS treatment facilities are based on the FS volumes and timeframe detailed in the sanitation strategy. This data is summarised in Table 6.7.

The greatest uncertainty in the financial viability of the different treatment options is the WTP. Scenarios 1, 2 and 3 analyse how medium, low and high WTP respectively, impacts on overall financial sustainability of the treatment plants. Given that the cost of borrowing is estimated at 27% and inflation at 16% the true discount rate is estimated to be 11%. This suggests that investing in these projects would be financially and economically viable for all but the low WTP scenario (see Scenario 2 in Appendix 5).

Based upon this analysis, the financial analysis findings indicate that there is potential to create a viable treatment and collection sanitation system in Freetown even when original willingness to pay is reduced and decreases over time. If willingness to pay is less than expected, it is expect that all the plants make a loss, but if there is a grant to assist with the construction of the FS treatment plants, the plants would be economically sustainable if monthly annuitized plant CAPEX does not form part of the balance sheet.

The results of analysis of Scenario 1 medium willingness to pay (see Table A5.1) shows that the net balance (profit) per month increases with the size of the plant. This scenario takes into account the fact that the there my be a discrepancy between the amount of money people state they are prepared to pay to have excreta disposed of and the actual amount they spend.

The scenario also takes into consideration the marginal willingness to pay amount to dispose of waste from on site sanitation, which may decrease over time proportionally to the increase of provision of sanitation services. It is likely that as the sanitation services provided in the first few years improves the people using the services are the ones more likely to be willing to pay, as sanitation services provision increase over time, there is likely to be a reduction in the number of people willing to pay for the collection and disposal services for FS.

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3 IRR is defined as the discount rate required to break even.
Table 6.7 Faecal sludge treatment sites and treatment capacity over 10-year strategy

<table>
<thead>
<tr>
<th>Year</th>
<th>Phase</th>
<th>Total FS Treated (m³/year)</th>
<th>Total FS Treated as a Percentage of total FS Produced</th>
<th>Truck requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Year</td>
<td>Reconstruction of drying beds and percolate treatment at King Tom</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Year 1</td>
<td>Pilot phase treatment at King Tom. Design and construction of WSP at Aberdeen and Wellington</td>
<td>12,063</td>
<td>7% at King Tom</td>
<td>Three 12m³ trucks operating 5 days a week, 47 weeks a year, 1.5 trips a day to service for King Tom</td>
</tr>
<tr>
<td>Year 2-5</td>
<td>Operation of King Tom, Wilkinson and Wellington Drying beds and/or WSP</td>
<td>60,443 by end of year 5.</td>
<td>31% at 3 sites</td>
<td>An additional six 12m³ trucks operating 5 days a week, 49 weeks a year, 1.5 trips a day each for Wellington and Aberdeen.</td>
</tr>
<tr>
<td>Year 5-6</td>
<td>Construction of large scale WSP at Hamilton and identification of suitable treatment site in the east.</td>
<td>Same as year 5</td>
<td>31% at 3 sites</td>
<td>No additional trucks required</td>
</tr>
<tr>
<td>Year 10</td>
<td>Operation of Hamilton WSP, operation of King Tom, Wilkinson and Wellington</td>
<td>137,918 for all sites by the end of year 10. Hamilton WSP accounts for 77,475</td>
<td>63% at 3 sites</td>
<td>An additional fifteen 12m³ trucks operating 5 days a week, 48 weeks a year, 2 trips a day.</td>
</tr>
</tbody>
</table>
7.0 SEWERAGE

7.1 STRATEGY FOR SEWERAGE

It is expected that in the long term, sewerage will become a more appropriate sanitation option for Wards located in the centre of the city and potentially some of the more affluent residential areas in the areas in the west of the city such as Babadori Catchment. However, previous proposals to expand sewerage in the city have been overly ambitious and capital investments in new sewerage infrastructure are not expected to be required for at least 5 years for various reasons summarized below.

According to the community consultation, there appears to be little expressed demand and insufficient willingness to pay for sewerage. However, the survey undertaken by Oxfam focussed predominantly on the poor who are unlikely to prioritise the need for investment in sewerage. Therefore, a more comprehensive survey would need to be carried out at some stage prior to a consideration of any large investment in sewerage.

For the time being, discharge of wastewater directly into drains is the cheapest and easiest solution for many residents and it is apparent that they are other priorities for the residents of Freetown, such as improved water supply and improved transport systems, which would invariably affect willingness-to-pay.

This, combined with the large investment and operation and maintenance costs combined with the need for large volumes of water for flushing (see Sections 3.2 and 3.3), sewerage is not seen to be an appropriate solution for the sanitation problems for the majority of communities in Freetown.

The only area where sewerage is viewed to be necessary at present is in the central business district, which is predominantly a commercial area with few residential properties. However, as noted in Section 2.5, there are a number of deficiencies with this system that need to be addressed prior to any consideration of extending the sewerage system. Once the system has been rehabilitated and service has improved to customer satisfaction and wastewater is managed without environmental health concerns, and commercially viability been demonstrated over a period of time, will there be a justification for sewerage expansion into other areas.

As described below and illustrated in Figure 7.1, investments in sewerage and wastewater infrastructure are envisaged to fall into 3 stages over a 10 year time frame:

- **Stage 1** – Rehabilitation and consolidation of existing sewerage network in CBD and sea outfalls.
- **Stage 2** – Expansion of existing sewerage network in CBD
- **Stage 3** – Sewerage and construction of wastewater treatment in Kroo Bay catchment.

This approach has been proposed in previous master plans and appears to still be an appropriate strategy for development, albeit less ambitious. It considers an area in the Central business district, which is an area of priority need for sewerage. The costs of construction preclude a more extensive network.
7.2 RECOMMENDATIONS FOR REHABILITATION WORK AND CONSOLIDATION OF EXISTING SEWERAGE NETWORK IN CENTRAL BUSINESS DISTRICT

The following interventions are proposed as priority measures:

- Provide equipment to the sewerage unit of the WSD – both office equipment to improve administration and equipment for cleaning and maintaining the sewers. This would subsequently be transferred to GVWC.

- Establish a separate account for the management of the sewerage system to be controlled by the Chief Engineer of the WSD and the Supervisor until longer-term management arrangements are made. This will be used to monitor the commercial viability of the operation and judge when responsibility for management can be handed to GVWW.

- As it is not known exactly which properties are connected to the sewerage system, it will be necessary to carry out some dye tracing from properties in the Central Business District.

Preliminary discussions indicated a willingness to pay from commercial properties within the CBD but a more systematic survey is required to assess willingness to pay and also to build up a database of existing properties connected to the sewerage system. Therefore, in Year 1, a detailed social marketing survey is proposed.

Additional activities will focus on:

- Determine the number of premises connected to the sewerage system, what they have been paying and their opinions on the performance of the system
Whether the design capacity of the existing system has reached its limit or whether it has potential to expand beyond the current limits. There may subsequently be a need to increase the capacity of the system at selected points, but this would require a more detailed wastewater investigation.

Establish how many properties are provided with lines for future connection and assess the ability of the existing system as performing to cope with such connections.

Prepare preliminary engineering and cost estimates for rehabilitation and expansion of the system to be served by the existing outfall.

7.3 Proposed Sewerage Network Expansion Within 10 Year Timeframe

It is expected that at the end of Year 5, the goal of commercial viability will have been attained and it will be possible then to revisit the proposed extension to the sewer network in the central business district as described by the previous Howard Humphreys master plan (as described in Section 2.5)

The 1994 Drainage and Sewerage Master Plan identified some areas that could be connected to the existing sewerage network that drains to Government Wharf or King Jimmy outfalls. This area consists of sections of Circular Road starting from the vicinity of the Circular Road Cemetery running down through Regent Road and linking up with the line at Upper Rawdon Street or through Regent Road to link up with the line at the intersection of Wilberforce Street and Garrison Street.

In addition, a line running down Hill Street to link up to the line at the section of Pademba Road towards the Cotton Tree and linking up to the line running down Percieval Street can be connected to the sewerage system those discharges into King Jimmy outfall.

The strategy takes a long-term perspective (10 years) taking into consideration the implications on wastewater production as a result of increasing water consumption in the city, which may require investments in sewerage in the future. In addition to the Central Business District, it is envisaged that there are few other locations for sewerage in the future. However, the more affluent communities in the West of the city who consume more water may be interested. The specific areas where this is potentially viable are Kroo Bay and Nooka.

7.4 Proposed Sewerage Network Expansion Post 10 Year Timeframe

An outfall at Kroobay has the potential to serve a wide area by gravity. The gentle slope at Kroobay and the longer length of land uncovered at low tides will facilitate a safer distance for deposition of effluents away from the population. This system could service residents falling within the following boundaries:

- The eastern boundary starting from Bathurst Street and Lower Circular Road at the intersection with King Street.
- The southern boundary at King Street where it intersects with Mend Street.
- The Western boundary running along Mends Street - Campbell Street –Adelaide Street.
- The Northern Boundary lower part of Lightfoot- Boston Street starting from Bathurst Street and terminating at Kroo Bay.

In addition an interceptor sewer may be installed to divert the flow from the other areas to Kroo Bay where a wastewater treatment plant can be installed. This will be subject to a detailed social impact assessment as it will involve resettlement of some of the residents living in Kroo Bay slum.

The outfall at Kroo Bay will be able to collect all the sewage from the public and private latrines. But a more detailed feasibility of this new coverage area is required to assess the population and number of
properties to serviced and also cost of this investment by determining the size of pipes, their lengths as well as number and types of manholes required.
8.0 IMPLEMENTATION PLAN

The implementation of the sanitation improvement plan is proposed as a phased implementation project as part of local area improvement programmes. Customer consultation during planning and implementation process should be based on a survey of the physical, social and economic settlement characteristics, in order to develop acceptable sanitation alternatives, system configurations, financing options and maintenance arrangements.

The main focus of the implementation will be towards area-based improvement schemes which will adopt a participatory approach towards capacity building and implementation initially involving consultation, promotion, training and planning (including a local area demand assessment) followed by implementation, monitoring, evaluation and learning feedback.

New technologies can be developed and tested through a series of pilot projects in target wards where these an identified demand for improved sanitation. The implementation of pilot demonstration projects in each new settlement during the planning phase may be used to provide the community with experience of the system and increase demand. Technical assistance to communities will be an important part of the community mobilisation and is considered as an important component of the sanitation improvement strategy.

Priority areas for sanitation improvements will be targeted based upon consideration of socio-economic status and expressed demands for infrastructure improvements. Local community groups will be encouraged to plan and implement local area sanitation improvement programmes in conjunction with FCC who will need to provide public infrastructure such as transfer stations and public latrines. FCC will need to establish a dedicated multi-disciplinary development team with social, construction and operations skills will need to be set up within the FCC.

8.1 SANITATION PROMOTION

A basic lack of understanding of supply and demand relationships for latrines often means that sanitation improvement projects are vulnerable to failure as they are unlikely to meet customer needs. Thus, for the sanitation strategy to be successful there is a need to generate a demand for sanitation and to ensure that there is a supply of latrine components to meet this demand.

Although the aim of improved sanitation is to result in improved public health, in the vast majority of situations, the decisions about whether to invest in improved sanitation rest in the private domain. Usually, health benefits are not the main driver for investment in household sanitation. There is a need to stimulate demand for improved sanitation focusing upon the benefits of access to sanitation from a perspective of convenience, prestige/status, cleanliness, privacy, and safety (notably for women).

Sanitation marketing is a new approach towards promoting sanitation which recognizes that sanitation components and household facilities are a “private good” whilst acknowledging the inherent “public good” associated with improved community health. Sanitation marketing is inherently a demand-driven approach, which aims at motivating residents to invest in sanitation facilities via a range of different social incentives. Social marketing techniques involves the use of marketing principles, more commonly associated with the commercial promotion of products, applied to the achievement of social goals, including those related to better hygiene and sanitation.

As part of the sanitation promotion campaign will be the need to promote awareness of the need for cleaning of septic tanks and technical information such as frequency of cleaning and ways in which cleaning frequencies may be reduced. This campaign will also provide the user with information about the services offered by FCC and the private companies for cleaning septic tanks. Each local area sanitation committee may negotiate a service contract for desludging at a specified rate.
Strategic Water Supply and Sanitation Framework

Part 3  Sanitation Improvement Plan

Sanitation promotion for rented properties

Promotion of latrines for properties in which residents are rented is problematic as the responsibility for the latrines construction rests with the landlord. Tenants are often reluctant to invest in housing (including sanitation) improvements as they do not know how long they will be living in the room they are renting. The lack of latrines is normally considered a nuisance but not something for which they would be prepared to pay. In addition, tenants may fear that if they themselves construct a latrine, then the landlord may raise their rent, which effectively makes them pay twice.

To ensure that landlords invest in sanitation, there will be a need to ensure to enforce the Public Health Ordinance (1960) but in addition it may prove to be beneficial to offer a reduction on the municipal taxes to landlords who can demonstrated that they have followed recommended guidelines for latrine construction and have installed an improved latrine.

8.2 Developing the Supply of Affordable Latrine Components

In addition to the emphasis on demand generation, there is a need to ensure that there is a supply of latrine components to meet this demand. The most effective mechanism to achieve the goal of low-cost, good quality latrines is to produce pre-cast latrine components, which can be mass-produced and transported to the local supply outlets.

In accordance with the National Policy for Water and Supply Sanitation (draft January 2008) and the Poverty Reduction Strategy Paper (PRSP), the strategy approach places emphasis on the role of the private sector in the delivery of improved sanitation. The strategy therefore aims to support the setting up of commercial outlets for latrine components. In addition, these local supply outlets may provide technical assistance to local communities; giving advice to households about siting and construction of latrines.

The sub-component should also ensure that supply – chain / distribution networks are effective so that consumers know where and how to get the products or services at a price that they can afford. Therefore funds will be required to help finance the establishment of commercial outlets for latrine components and materials. Responsibility for regulation of the manufacturers of these components to ensure quality control and if necessary price capping would rest with the MoHS, but NGOs could also be actively involved working alongside private companies to support the development of supply chains that meet both existing and expected future demands. This may involve collaboration between NGOs and local private sector enterprises.

8.3 Financing of Household Sanitation

The long-term vision of the sanitation strategy is to avoid direct investments in household latrines as much as possible as this tends to suppress the willingness of households to utilize there own financial resources and lead to a culture of dependency in which residents expect external support to improve their latrines. At the same time, subsidized latrines fail to install a sense of ownership, which undermines an interest and willingness to maintain the facilities.

Rather than to subsidize households directly, funds can be to support the supply and increased availability of latrine components. More specifically, the money can be used to help establish production centres and supply chains that enable households to purchase components that are affordable and of approved good quality. However, poor households may require assistance, either through direct financial subsidy or through offer of free materials and technical assistance for construction.

However, there is clearly a need to make greater investments to promote sanitation and finance can be used to mobilize household level finances. This will involve working with NGOs with a view to looking at alternative flexible financing options to enable householders to reduce the burden of the capital investment by sharing the cost with others and/or over a period of time.
In accordance with the PRSP, micro financing also be used as a means to get householders to invest in sanitation. A micro-financing scheme provides an opportunity to enable poor households to access funds to make housing and service improvements to facilitate works at the local level for improved household sanitation and drainage. The credit scheme should be based upon market research of locally based demand, appropriate financial and accounting systems, thorough understanding of the borrower and intermediary capabilities. Interest rates need to be based on the cost of funds, administration and labour costs, loan loss allowances, margin for inflation and a return on capital.

### 8.4 Community-Led Total Sanitation (CLTS)

One of the key problems relates to the difficulties of convincing households of the ‘costs’ of open defecation in terms of the impact of health particularly as it costs nothing and it has become accepted and is not perceived to be the cause of any harm. Given these entrenched habits and perceptions, something dramatic is needed to change people’s thinking and behaviour (Robinson 2006).

Community-Led Total Sanitation (CLTS) approach is proposed as an effective sensitisation tool to instigate changes. The CLTS promotes a different approach toward scaling-up of sanitation, which is gaining widespread support and popularity. The main features of the CLTS approach are as follows:

- community-led, encouraging people to recognise and solve their own sanitation problems, rather than imposing external ideas and solutions. However, external ideas and solutions can be constructive to support the community and are vital for servicing on-site sanitation etc
- requires minimal (or zero) hardware subsidies, thus is less costly to implement at large scale than most conventional rural sanitation programmes.
- focus on collective behaviour change, notably the eradication of open defecation, rather than simply building toilets.

It will be important to be able to follow up on the momentum generated by CLTS to ensure that households can access improved sanitation. Therefore, in dense slums, CLTS will be undertaken in combination with investments to improve communal water and sanitation facilities. As well as focussing on open defecation, the community mobilisation will focus on encouraging residents to utilise latrines and avoid unsanitary practices related to the disposal of excreta in plastic bags amongst the other refuse.

### 8.5 Hygiene Promotion

Although provision of improved water supply and access to sanitation facilities is essential for improvements in health, these need to be complimented by a concerted effort focused on hygiene promotion, which supports behaviours that are known to reduce diarrhoeal disease, especially amongst younger children. As the home environment is where many diseases are transmitted, it is important to consider a range of practices that can improve domestic hygiene, especially those related to sanitation (safe disposal of faeces, including children’s faeces; washing hands after defecation, before preparing meals and before feeding children).

GOAL found there to be a strong awareness of the links between hygiene and diarrhoea amongst the Freetown communities in which they undertook fieldwork. However, it is important to build on existing understanding of the linkages between hygiene and diarrhoea and promote hand washing with soap (Brown 2008).

As well as traditional health orientated messages to be promoted by NGOs working at the grass-roots level, social marketing techniques may be used to promote hand washing with soap in partnership with private sector soap retailers. This should involve a professional social marketing agency to undertake a formative research study prior to developing culturally appropriate advertising strategy and production of marketing and communications tools.
Although provision of safe water and access to basic sanitation hardware is essential for improvements in health, these need to be complemented by a concerted effort focused on hygiene promotion. To enable widespread improvements in sanitation and environmental health conditions to be realised, investments in physical components of the sanitation need to be complimented by campaigns to promote improved sanitation behaviour, health awareness, and awareness of the benefits of improved environmental health and waste management.

Hygiene promotion refers to activities that advocate and support behaviours that are known to reduce diarrhoeal disease. It is based upon an understanding of how behaviours contribute to the transmission of diseases and focuses on key messages such as the importance of handwashing. The successful implementation of hygiene improvement is dependent upon an effective communication strategy that raises awareness of hygiene facilities and practices and promotes behaviour change. The identification of channels for communicating messages to key target audiences and seeking appropriate and effective ways of working with them on hygiene promotion should be a priority. The main target groups should be with women and children, but hygiene promotion campaigns should also include men wherever possible.

Social marketing can also be used to promote change in hygiene behaviour, often a key component of improved sanitation. Social marketing can also be designed to promote improved hygiene behaviours, as is the case with the promotion of hand washing with soap. In this instance there are opportunities to work in partnership with soap marketing companies as it is also in their commercial interest to encourage habitual hand washing with soap.

Promotion of handwashing via public-private partnership

Specific health messages and hygiene awareness messages need to focus on the most important hygiene practices such as hand-washing after latrine use. Washing hands with soap is of primary importance as one of the most important routes for transmission of infection is via the hands. Washing hands properly with soap and running water can reduce the risk of diarrhoeal diseases by 42–47% (Curtis 2003) by the removal of transient microbial contamination picked up onto the hands by contact with a contaminated source (Beumer et al. 2002). Households will therefore be encouraged to store water close to their latrines so that people can wash their hands after defecating.

Promotion of handwashing via public-private partnership is based on the belief that it is mutually beneficial for private commercial firms and public entities (principally ministries of health) to work in partnership to achieve complementary goals in promoting handwashing for public health. Soap companies use new messages and methods of advertising soap designed to reach groups with low socioeconomic status in rural areas where diarrhoeal disease rates were high. Concurrently, these efforts would help each company increase sales and enhance its corporate image whilst the public sector endorses the promotional campaign, assists in dissemination and collaborates in special interventions—such as distribution of handwashing kits. This arrangement has been shown to be successful in a number of countries including El Salvador, Costa Rica, and Honduras in Latin America (Saadé et al. 2001) and in India, Hindustan Lever, a subsidiary of Unilever, has committed €4.5 million (US$ 5.4 million) to fund the campaign for five years. The company has already started to see a return on its investment, with sales of Lifebuoy growing by 20% in 2003-4. However, these programme are normally instigated at the country level and would not be attractive solely for Freetown.

School sanitation and hygiene promotion

Children can be highly effective as “agents of change” within their community and can have a direct influence on their family, both existing and in the future. It is important to focus on schools because, after the family, schools are most important places for learning and behaviour change for children.

Schools can also influence communities through outreach activities, since, through their students, they are in touch with a large proportion of the households in a community.

An important sub-component of the Freetown sanitation strategy involves a combination of software and hardware to promote improved hygiene behaviour amongst school pupils. School hygiene education is a specific form of the wider school health education. It deals only with water and sanitation-related health problems in and around the school and concerns all activities that promote health and reduce health risks of school children.
9.0 MANAGEMENT ARRANGEMENTS

Freetown City Council should hold overall responsibility for sanitation and faecal sludge management. However, as described below there are also roles for:

- Ministry of Health and Sanitation – policy and regulatory framework
- Guma Valley Water Company – sewerage and wastewater management
- UNICEF / NGOs – social mobilisation and sanitation/hygiene promotion
- Private sector - desludging services /supply chain of latrine materials / selling soap
- Ministry of Education, Youth and Sports / UNICEF– school sanitation

There are various possible management arrangements that may be adopted for different sanitation options according to the level of service.

9.1 HOUSEHOLD SANITATION

Household sanitation is managed at the household level by residents. This is the most obvious and rational form of management but in the case of shared sanitation, the ownership of the latrine generally belongs to one of the houses, the owner of all the houses, or occasionally ownership is shared between the households. Residents share the responsibility for keeping the latrine clean and the costs of desludging but this can result in problems.

Where latrines serve private properties, the onus of responsibility for maintenance rests upon the proprietor. Costs of pit emptying and other repairs are thus borne by the resident. If the property is rented, maintenance costs can be included in the rent, but often the landlord does little to improve facilities. However, in both cases (i.e. private household and shared), there is a need for community and utility (municipality) commitment to follow up and continuously working to address sanitation problems aiming for a progressive improvement in standards. This will require development of FCC’s resources and capacity to enforce the sanitation ordinances that specify that all properties should have an improved latrine to satisfy planning permission requirements. However, prior to this will be a need to revise and update the law to ensure that it is relevant and contemporary.

9.2 COMMUNAL AND PUBLIC LATRINES

If the system discharges to a sewer, then the operation and maintenance (OM) will be predominantly related to keeping the toilet block clean. If the toilet block has on-site wastewater collection and treatment then the OM requirements (desludging) will be greater. However, although the sustainability of public latrines depends on the technical system selected but their success is more critically determined by the approach taken for managing their operation and maintenance (Wegelin-Schuringa and Kodo 1997).

Public latrines have traditionally been managed by FCC with the aim to finance the on a pay-as-you-use basis for cost-recovery associated with the level of service. A proportion of the fees collected are retained to pay the salaries of the operators and the maintenance of the latrine. However, these fees are insufficient to pay for operation and maintenance costs (see Section 2.2) and there is a need for additional funds to rehabilitate the latrines.

There are essentially 2 management options: Private or Communal management – both of which are a form of small-scale independent provider (SSIP). It is intended to delegate operation and management to small-scale independent providers (SSIPs). The contracting parties would be existing and newly formed community and market committees set up as legal entities. SSIP management options involve a
CBO, NGO or private operator to operate and maintain the facility. The SSIP collects money from users to pay for the day to day fees to manage and maintain the facilities.

The aim of introducing private sector participation is to set up reliable and sustainable alternative arrangements for the rehabilitation and management of public toilets in the city. Private sector management of public toilets can realize increased productivity of employees, speed up decision-making, and, if firmly monitored, consistently maintain clean and hygienic toilets.

Where the operators are known locally, there is greater flexibility in the charging arrangements which means that particularly impoverished members of the local community may be allowed to use the services for free. Public latrine operators will be expected to make special arrangements for the destitute, senior citizens and children, who may not be able to afford user charges. They could use the services for free or at a subsidized rate.

There are various possibilities for payment for services related to sanitation and desludging. Potentially the simplest option is for the SSIP to pay a monthly fee to FCC who then is responsible for paying GVWC and either providing a vehicle for desludging or paying a private operator for removal of waste. This role of GWVC will be especially important where public latrine facilities are combined with the faecal sludge transfer station as proposed in Section 5.3.

At present, the income from user fees is evidently insufficient income to operate and maintain toilets. However, the Oxfam survey showed that many are not paying and therefore the SSIP’s will be encouraged to work closely with communities to encourage payments. However, with a view towards the public health benefits, FCC may consider subsidising these operations by paying for any more significant maintenance requirements that are needed every couple of years. If on the other hand, user fees can be set at a level above that required to provide finance needed to sustain operations and monitoring activities, they may even be able to finance the construction of additional public latrines in the city.

FCC will oversee the management of public toilets in the city with a designated officer in charge of public toilets who will undertake technical work and administrative duties such as:

- Procuring private operators to run public toilets.
- Setting performance standards for refurbishment and subsequent operations and maintenance.
- Monitoring performance of operators, and taking disciplinary action against defaulters.
- Reviewing contractors’ submissions on cost increases and approving user fee charges.
- Commissioning public awareness campaigns.
- Arranging capacity-building for community committees.
- Approving construction of additional public toilets.
Monitoring and regulation

Where the SSIP hires operators from the community, there is a level of control on the hygienic maintenance of the latrines as there is greater local accountability. But, FCC Public Health Inspectors will check that facilities are being well managed and maintained. A monitoring plan will be included as part of the operational guidelines in the contract documentation. It will clearly spell out performance standards to be achieved and reported on, and actions to be taken or penalties imposed in the event of deviations or default. The monitoring plan will include assessment of cleansing, disinfecting, maintenance and repairs, and general cleanliness.

Depending upon the location, some public toilets have much greater potential for profit then others. FCC will therefore need to play close attention to the monitoring all costs and income – especially during the first few years in order to ensure that the users of the latrines are paying the same and the collection of charges from the latrines that are used most frequently or cost the least to operate and maintain can subsidise those that are seen to be more expensive. Therefore SSIPs will be expected to keep accurate records of usage and all costs associated with provision of services, which would be carefully monitored by the NCC.

FCC will control the tariffs and will publicize the rates to ensure that fees are the same throughout the city. Periodical reviews of user charges may be needed, for example when there are significant changes in the input costs of providing services. When a review of user fees is sought, the contractors shall prepare detailed justification for the increase and present it to FCC for deliberation and recommendation. Education and information campaigns will also be required to explain the user charges and to improve the standard of hygiene in the toilets.

9.3 MANAGEMENT ARRANGEMENTS FOR FAECAL SLUDGE COLLECTION

The overall responsibility for managing the faecal sludge management should rest with the municipality but in line with the GoSi policies, there are various management arrangements involving the private sector can be utilized (see Table 9.1). All vehicles can be owned and operated by City Council, vehicles can be owned by Freetown City Council and leased to the private operators, or the private sector can purchase and operate the equipment.

<table>
<thead>
<tr>
<th>Option</th>
<th>Ownership</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>City Council</td>
<td>City Council</td>
</tr>
<tr>
<td>2</td>
<td>City Council</td>
<td>Private sector</td>
</tr>
<tr>
<td>3</td>
<td>Private sector</td>
<td>Private sector</td>
</tr>
</tbody>
</table>
The incentives, regulatory conditions and potential return on investment are key factors affecting the private sector’s further decision to invest or increase investment in septic tank cleaning service provision. Therefore, leasing out of septage collection trucks to the private sector under agreements may provide the most appropriate option. Franchised operators (franchisees) will be expected to pay an annual operator’s fees and will be fined for operating outside of the areas designated in their contract.

In order to provide the incentive to encourage private operators of desludging trucks to take waste to designated sites, an incentive for delivering the sludge to the landfill site, the operator of the truck will receive a signed note or token which the operator can collect and then submit to the City Council in order to claim back costs which can then be used to reduce the next years annual operators fee. Or alternatively the operator may be given a receipt when they take the waste to the site and the site operator keeps a record and then the City Council gives a rebate (see Figure 9.1).

Figure 9.1 Diagram to show how an incentive-based mechanism can be used encourage private operators to take the waste to designated sites for disposal

Pricing of service / regulation of Fees

The fee paid by householders or residents for desludging should be adequate to meet the full costs of the desludging operations plus profit and this should be paid directly to the service provider. The cost of treatment costs should be paid for out of the operators licensing fee. It is recommended that the treatment and disposal fee be treated as a fixed percentage, say 5%, of the collection fee. Fixing treatment and disposal fees as a percentage will avoid possible any conflict of interest on the part of FCC in reviewing fee adjustment proposals by the septic tank cleaners. However, a thorough study of the pricing strategy will have to be done to ensure that the correct incentives are provided for safe and adequate disposal of the septage and the tariffs are set at a level that is affordable.
9.3 MANAGEMENT ARRANGEMENTS FOR FAECAL SLUDGE TREATMENT

It is not envisaged that FCC would take on board responsibility for management of proposed faecal sludge treatment facilities. There are various alternative options that need to be considered in more detail. Briefly, these could involve various contracting out arrangements – with design, build and operate as being the preferred option with a strong emphasis on developing the local technical skills for operating these treatment technologies as well as development of the regulatory framework for monitoring the companies. In the future, responsibility for operations could then be transferred to the Freetown Solid Waste Management Company which has recently been established to manage solid waste in the city.

9.4 MANAGEMENT ARRANGEMENTS FOR SEWERAGE AND WASTEWATER MANAGEMENT

In addition to its present function of water supply and distribution, it is proposed that sewerage services and wastewater management operations are also brought together under the management of GVWC. This recommendation is not new. It was considered in the DMJM Master Plan in 1977 and a similar recommendation put forward by Howard Humphreys in the 1994 Master Plan. This would require amendments to the 1961 Ordinance that forms the legal basis for the establishment of GVWC.

Although a more detailed institutional review and organisational assessment has been undertaken by DHV consultants, there has been little consideration of the capacity of GVWC to management sewerage services and operate facilities for treatment and disposal of wastewater. Therefore, in addition to the need for increased human resources at the operational level, GVWC will invariably require greater capacity for managing wastewater infrastructure. Particular consideration will need to be made of the charging structure and tariff collection.

To ensure continuity of operations, the staff employed by the WSD involved in operations and maintenance of sewerage and wastewater facilities should be transferred to the GVWC but only at the appropriate moment i.e. after GVWC has taken on board the full responsibilities.
10.0  **STRATEGY DEVELOPMENT - PRIORITISATION AND PROGRAMMING OF INVESTMENTS**

10.1 **STRATEGY DEVELOPMENT – NEXT STEPS**

Although the sanitation situation in Freetown is critical and there is an obvious need for a concerted effort to improve sanitation and faecal sludge management at all levels, the recommended approach is to engage in the sector systematically with a staged approach towards improvement. The programming of interventions proposed as part of the 10 year strategy (see Table 10.1) provides an opportunity to take this long-term vision into consideration and the following prioritisation and programming of investments is based upon a realistic assessment of what improvements are feasible and at what stage.

A more detailed breakdown of the investment requirements is provided in Annex 7.

### Table 10.1  Investment requirements (10 year planning horizon)

<table>
<thead>
<tr>
<th>Item</th>
<th>Total</th>
<th>Year 1</th>
<th>Year 2 - 5</th>
<th>Year 6 - 10</th>
</tr>
</thead>
</table>
| 1 Support to supply chain of latrine components | $650 | $300 | $350 | $-
| 2 Communal latrines and washing facilities | $745 | $185 | $440 | $120 |
| 3 Sanitation promotion and improved hygiene behaviour. | $890 | $270 | $480 | $140 |
| 4 Desludging services and faecal sludge management | $5,690 | $1,025 | $1,690 | $2,975 |
| 5 Sewerage and wastewater disposal | $5,975 | $250 | $2,225 | $3,500 |
| TOTAL | $13,950 | $2,030 | $5,185 | $6,735 |

10.2 **RECOMMENDATIONS FOR FURTHER INVESTIGATION**

Prior to the finalisation of the strategy, the following activities are proposed:

- **Institutional and management arrangements** A definitive management structure and regulatory framework as proposed by the draft sanitation strategy has yet to be finalised agreed between government ministries, FCC and private operators. There will be a need therefore to focus on the institutional structures and responsibility sharing to enable implementation of the strategic plan – notably in relation to the respective roles and sharing of responsibilities between the public and private sector.

- **Willingness to pay:** This is seen as the most critical and vulnerable issue and should be treated with caution even though a sensitivity analysis was carried out to identify the impact of reduced willingness to pay rates and the decrease/variation of willingness to pay over time and as the sanitation coverage reaches a greater number of people.

- **Detailed design of faecal sludge treatment** Although the financial analysis has tried to be accurate in representing the true costs of the FS disposal system over its design and operational life there still remains a few uncertainties and risks which may impact on the overall system financial sustainability. Further study is required in order to ascertain some of these uncertainties in order to rank and assess the risks accordingly.
The uncertainties that need to be considered further include, but are not limited to:

- **Land and soil geology**: Suitability of sites to house proposed treatment options, in particular soil stability and water table height.

- **Environmental and Social impacts of the proposed schemes**: the real suitability of the sites proposed in the analysis remains a risk and mitigation measures required may impact on the initial CAPEX outlay required and therefore affect the long term viability of the plants.

- **Reuse potential of treated biosolids**: Various treatment options for faecal sludge management have been evaluated from a technical and financial perspective and also taking into consideration their site requirement related to social and environmental feasibility, additional work is required to assess the potential market for the reuse (and potential sale) of the residual biosolids produced by treatment.

### 10.3 Formative Research

Although a detailed baseline survey has been carried out by Oxfam as part of the activities during the strategy development, there will be a need for a more detailed sanitation marketing survey to be funded as part of Year 1 priority investments.

The sanitation marketing survey will provide a detailed assessment of demand taking into consideration:

- the level at which different potential customers have reached in relation to their demand for sanitation.

- the production and supply chains of materials and components for latrine construction, and

- the options for marketing sanitation and promoting improved hygiene behaviour taking into customers perceptions of products and prices and their susceptibility to different social marketing messages and communication strategies.

Although some targeted invested in system upgrade have been prioritised for the first year, the main focus of the investment is to implement proposed demonstration schemes in order to pilot technical-managerial options. These demonstration projects will provide and opportunity for learning and subsequently, subject to further iterations of development can be fed back into the strategy prior to scaling up.

Social marketing requires a systematic data collection and analysis to develop appropriate strategies in order to ensure that products, services, or behaviours fit the felt needs of the consumers/users. This entails a period of formative research is to provide a solid basis for effective program actions, notably in relation to the design of interventions that aim to promote sanitation and change hygiene behaviours.

Formative research aims to develop understanding of:

- current practices and the reasons for them.

- what feasible improvements in practices people can make.

- obstacles to and motivations for improved practices.

- skills and resources available to reduce barriers.

Although there have been a number of baseline surveys undertaken by NGOs, including Oxfam as part of the activities associated with the Freetown Water and Sanitation Strategy, there would need to be a further more detailed qualitative information-gathering process in order to clarify in current behaviours in order to enable project designers to identify and explore the key barriers to and meaningful motivations for improved behaviours (Favin et al 2004).
A key activity that forms part of the formative research involves trials of improved practices to determine feasible hygiene promotion activities, the barriers to their successful practice and meaningful motivations and benefits. It is therefore recommended that funding is allocated for these activities which should be programmed for Year 1.

10.4 PILOT PROJECT AND DEMONSTRATION ACTIVITIES

The proposed technical innovations and associated managerial arrangements proposed as part of the sanitation strategy have not been seen to be adopted at the scale envisaged to be necessary for the implementation of the Freetown Sanitation strategy. The first stage consists of ongoing activities funded under the DFIDs Innovation Fund, which aim to contribute towards the development of Freetown Water and Sanitation strategy. These include various small scale activities to promote local level initiative and to pilot new technologies and potential management options.

UN-HABITAT now have funds to follow through with the Vacutug and latrine pit development project using funds which are available from AfDB but are looking for co-financing and a location for implementing the project. There is an opportunity to interlink the UN-HABITAT project into the Freetown Sanitation Improvement Plan. The Irish NGO Goal is also interested and one of there staff (who has studied the desludging arrangements in Accra, Ghana as part of his MSc dissertation) may be a suitable candidate for managing these activities. Typically the UN-HABITAT inputs could consist of Vacutug machines for Freetown and the development of the moulds and trial mouldings for Freetown and would involved inputs for the design of the moulds, the start up and on-going monitoring of the three trial sites over a two / three year period. This proposal will require further discussion and negotiation between the different parties concerned.

10.5 SOURCES OF FUNDING

In addition to the potential funding from DFID, UN-Habitat and Cities Alliance for projects that may be linked to the further development and implementation of the

- **African Water Facility** (Administered By The African Development Bank) – the purpose of the Water Fund shall be to pool the resources mobilized from donors to finance water infrastructure and water investment facilitating activities in Africa.

- **Global Partnership on Output-Based Aid (Administered By The World Bank)** – the GPOBA funding can be used to facilitate learning on the potential contribution of Output-Based Aid (OBA) approaches through i) Technical Assistance: Supporting the design, implementation and evaluation of individual projects and ii) OBA subsidy funding: Funding of OBA subsidies that will complement user fees which can be applied for sanitation projects. GPOBA funding may be sought to support the development of the private sector involvement in the implementation and management of faecal sludge management operations and potentially for the mass production of latrine components.
### Table 10.2 | Priority Phase Investment Plan

<table>
<thead>
<tr>
<th>Sub-components and interventions</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Improved household sanitation</td>
<td></td>
</tr>
<tr>
<td>1.1 Undertake applied research to assess scope to reduce pit latrine (to be carried out in conjunction with Activity 3.3).</td>
<td></td>
</tr>
<tr>
<td>1.2 Development of recommended designs and construction guidelines</td>
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<tr>
<td>1.3 Institutional strengthening and capacity building of FCC to support the development of regulatory framework for recommended designs</td>
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<tr>
<td>1.4 Production of guidance materials</td>
<td></td>
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<tr>
<td>1.5 Equipment for manufacture of latrine components and technical training for quality control</td>
<td></td>
</tr>
<tr>
<td>1.6 Setting up of outlets for sale of latrine components.</td>
<td></td>
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<tr>
<td>1.7 Area based improvement of on-site sanitation in conjunction with Subcomponent 3</td>
<td></td>
</tr>
<tr>
<td>1.8 Continuation of area based improvement of on-site sanitation (in conjunction with Subcomponent 3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 - 5</td>
</tr>
<tr>
<td>Communal latrines and washing facilities</td>
<td></td>
</tr>
<tr>
<td>2.1 Develop contracts for managing communal / public latrines</td>
<td></td>
</tr>
<tr>
<td>2.2 Detailed survey and costing of improvements for communal / public latrines</td>
<td></td>
</tr>
<tr>
<td>2.3 Rehabilitation of existing communal and public latrines</td>
<td></td>
</tr>
<tr>
<td>2.4 Construction of new communal and public latrines</td>
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<tr>
<td></td>
<td>6 - 10</td>
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<tr>
<td>Sanitation promotion and improved hygiene behaviour.</td>
<td></td>
</tr>
<tr>
<td>3.1 Sanitation marketing survey and development of marketing tools</td>
<td></td>
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<tr>
<td>3.2 Promotion of a range of different latrine options in accordance with needs and affordability</td>
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<tr>
<td>3.3 Community Led Total Sanitation in areas where open defecation is practiced</td>
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<tr>
<td>3.4 Improved school sanitation campaign</td>
<td></td>
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<tr>
<td>3.5 Handwashing campaign - city level</td>
<td></td>
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</tbody>
</table>

[Note: The table is represented in text format due to limitations in the image representation.]
<table>
<thead>
<tr>
<th>Sub-components and interventions</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
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<td></td>
<td>2-5</td>
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<tr>
<td></td>
<td>6-10</td>
</tr>
</tbody>
</table>

### Desludging services and faecal sludge management

#### 4.1 Formative research to test equipment of desludging pit latrines (Vacutug and ‘Gulper’ equipment (links to Activity 1.1))

#### 4.2 Develop equipment that can be manufactured locally for desludging pits.

#### 4.3 Improve current manual desludging practices with a specific focus on protection of workers from health risks and waste disposal.

#### 4.4 Acquisition and commissioning of desludging vehicles

#### Faecal sludge cartage

#### 4.4 Evaluate Accra transfer stations

#### 4.5 Develop alternative options for localised collection (transfer stations) and on-site treatment

#### Desludging services and faecal sludge management

#### 4.6 Carry out detailed EIA of faecal disposal sites

#### 4.7 Evaluate demand for sludge and reuse options

#### 4.8 Detailed design of treatment plants

#### 4.9 Detailed evaluation of resettlement options

#### 4.10 Stakeholder consultation to assess social acceptability of different options

#### 4.11 Reconstruction of King Tom FS treatment

#### 4.12 Construction of FS treatment facilities (potentially at Aberdeen and Wellington)

#### 4.13 Construction of FS treatment facilities (potentially at Hamilton)

### Sewerage and wastewater disposal.

#### 5.1 Set up autonomous unit for wastewater management (within MoEP) with separate account and build technical and financial capacity of wastewater management unit

#### 5.2 Detailed assessment of current capacity of sewerage system (including manhole survey taking levels to invert to calculate as built pipe capacities).

#### 5.3 Inventory of existing customers and identification of potential customers including Customer survey/consultation and a detailed willingness to pay survey

#### 5.4 Detailed cost estimate for rehabilitation and expansion of the system

#### 5.5 Undertake structural repairs to existing sewerage system (especially outfalls)

#### 5.6 Set up autonomous unit for wastewater management (within MoEP) with separate account

#### 5.7 Provide equipment to the sewerage unit of the WSD for maintaining the piped network.

#### 5.8 Connections unserved properties in CBD to existing sewerage

#### 5.9 Transfer responsibility for management to GVWC

#### 5.10 Extend CBD sewerage

#### 5.11 Carry out willingness to pay for sewerage in areas identified to be appropriate for sewerage

#### 5.12 Install sewerage in areas identified to be appropriate for sewerage depending on WTP in Activity 5.10
REFERENCES AND KEY SOURCES OF INFORMATION


