Improving Utility Performance in Fragile Environments
Lessons from Liberia Water and Sewer Corporation in Liberia and Guma Valley Water Company in Sierra Leone

Max Hirn and Dominick de Waal

July 2015
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Photo credits: Mr. Bankie Mansaray

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This note summarizes lessons from the Water and Sanitation Program’s (WSP) technical assistance to improve performance and cost-recovery at the Liberia Water and Sewer Corporation (LWSC) and Sierra Leone’s Guma Valley Water Company (GVWC). The focus on cost-recovery reflects its critical importance to the viability of utilities. There are “almost no examples in developing countries” of utilities “whose operating revenues are significantly below O&M costs and that are nevertheless able to develop and maintain their infrastructure and provide a reliable and efficient service”. (McPhail, et al., 2012).

WSP’s technical assistance sought to strengthen reform efforts initiated by the management teams at LWSC and GVWC by improving the utilities’ ability to sustainably fund their operations. Three aspects of cost-recovery were prioritized: (a) improving metering, billing and collection processes (b) reducing commercial non-revenue water and (c) investigating options to expand the utilities’ revenue base by connecting new customers more effectively.

Under the first priority, WSP supported the enumeration of customers to update incomplete and flawed databases – a precondition for more accurate metering and billing. WSP helped map over 19,500 GVWC customers and over 5,000 customers in Liberia, even as an unprecedented Ebola virus disease outbreak was ongoing. WSP also carried out an in-depth review of LWSC’s current meter reading procedure and of the billing systems in use at the utilities. The study of the billing system identified outdated software as a significant bottleneck in both utilities and made specific recommendations for upgrades which have since been implemented at LWSC and GVWC.

Under the second priority, WSP backed approaches to address non-revenue water, which has been estimated to be as high as 45 to 50 percent of production at GVWC and 80 percent at LWSC. LWSC and GVWC were supported to identify over 3,000 and 2,000 unregistered connections, respectively, which were then targeted in campaigns to reduce non-revenue water. Both utilities initiated robust campaigns to request illegal users to register their connections or face disconnection.

The third priority aimed to improve the capacity of LWSC and GVWC to expand their customer-base, and thus revenue potential. Both utilities are supplying fewer customers than in the 1980s, even though the populations of Monrovia and Freetown have since doubled. Critical bottlenecks identified were the inefficient, complicated connection procedures and high connection fees. WSP funded a LWSC pilot with streamlined procedures that more than doubled the customers connected per month, and carried out a scoping study for a future GPOBA project to subsidize connections for poor households.

The interventions undertaken by WSP contributed to a positive trend in cost-recovery at both LWSC and GVWC:

- At LWSC, revenues from bill collections increased from US$1.9m in the fiscal year 2011 (FY11) to US$4.7m in FY14.
- The company has recorded a significant narrowing of its deficit since FY11 and if annual subsidies from the Government of Liberia (GoL) are taken into account, even achieved a positive balance in FY13 and FY14. At GVWC, interim financial reports indicate that collection efficiency has risen from approximately 30 percent in 2012 to close to 75 percent in March 2015. Average monthly collections of approximately SSL1.5 billion are more than twice the average monthly collections in the immediate post-war period in 2002.
### Abbreviations and Acronyms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AfDB</td>
<td>African Development Bank</td>
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<tr>
<td>DfID</td>
<td>United Kingdom’s Department for International Development</td>
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<tr>
<td>EMS</td>
<td>Enterprise Management Systems</td>
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<tr>
<td>FY</td>
<td>Financial Year</td>
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<tr>
<td>GoL</td>
<td>Government of Liberia</td>
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<tr>
<td>GPOBA</td>
<td>Global Partnership of Output-Based Aid</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
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<tr>
<td>GVWC</td>
<td>Guma Valley Water Company</td>
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<td>HR</td>
<td>Human Resource</td>
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<tr>
<td>HWA</td>
<td>Hargeisa Water Agency</td>
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<td>IDA</td>
<td>International Development Association</td>
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<td>IT</td>
<td>Information Technology</td>
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<td>LWSC</td>
<td>Liberia Water and Sewer Corporation</td>
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<tr>
<td>MDG</td>
<td>Millennium Development Goal</td>
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<tr>
<td>NCP</td>
<td>National Commission for Privatization</td>
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<tr>
<td>NRW</td>
<td>Non-Revenue Water</td>
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<td>O&amp;M</td>
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<tr>
<td>PHWC</td>
<td>Port Harcourt Water Corporation</td>
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<td>SLL</td>
<td>Sierra Leonean Leone</td>
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<tr>
<td>SMS</td>
<td>Short Message Service</td>
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<tr>
<td>TA</td>
<td>Technical Assistance</td>
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<tr>
<td>WASH</td>
<td>Water, sanitation and hygiene</td>
</tr>
<tr>
<td>WSP</td>
<td>Water and Sanitation Program - Africa of the World Bank</td>
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<tr>
<td>UNICEF</td>
<td>United Nations Children’s Fund</td>
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I. Introduction

The ability of public utilities to successfully deliver services to citizens depends on a wide set of factors – adequate infrastructure, access to energy and spare-parts, competent staff, a performance-oriented institutional culture, and a population willing and able to pay, to name but a few. Fragility and conflict can be extremely disruptive to these interdependent elements – infrastructure is destroyed or decays, energy and spare-parts become unavailable, employees flee or are killed, a culture of impunity and parasitic survivalism can infect the utility and an impoverished population may struggle to pay its bills.

In Liberia and Sierra Leone, urban water utilities were plunged into crisis during the intense civil conflict that devastated both countries after 1989. Prior to the war, the Liberian Water and Sewer Corporation (LWSC) supplied some 18,000 accounts in 12 cities with piped water. In 2012, almost a decade after the re-establishment of peace, piped supply had still not been re-established, except in the capital Monrovia and nearby Kakata, where as few as 6,000 accounts were actively billed, covering barely two-thirds of operating costs from collections. A corporate audit found LWSC to be “an organization in crisis […] unable to meet basic service deliverables” with management in “fire-fighting mode with almost all of its limited capacity dedicated to dealing with daily emergencies” (GBSI / Government of Liberia, 2012).

### Figures 1 & 2: Reported Total Connections and Finances of LWSC

<table>
<thead>
<tr>
<th>Year</th>
<th>FY11</th>
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<td>excl. subsidy</td>
<td>$1,743,181</td>
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<td>$2,800,908</td>
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In Sierra Leone, the Guma Valley Water Corporation (GVWC), responsible for supplying the capital Freetown with a population of approximately 1.2 million, billed less than 20,000 accounts (NestBuilders Int., 2015), and managed to cover only 15 percent of its total costs (including capital depreciation) from tariff revenues (Harris, et al., 2012, p. 12).

As a result, the company has for long been in “a critical state – only kept together through occasional emergency cash injections from central government and donors” (Harris, et al., 2012, p. 15).

The low access to piped water perpetuated by the institutional crises of LWSC and GVWC has major health implications as it forces the vast majority of the urban population to rely on point sources such as hand-dug wells (WHO / UNICEF, 2014, p. 55), which are unsuitable for a dense urban environment, even if they have been included as “improved” sources in MDG tracking definitions. A WSP-funded study of the water quality of “improved” point sources in Monrovia found a majority contaminated with *E. Coli* bacteria (UHL & Associates, 2011). WASH-related diseases such as diarrhea are common, and cholera remains endemic. Liberia experienced an outbreak of over 34,000 cases in 2003 and has consistently reported over 1,000 cases a year up to 2011 (WHO, 2012) and Sierra Leone experienced a major outbreak in late 2012 that infected over 20,000 and killed 392 people.
An institutional crisis of the scale experienced by LWSC and GVWC can be difficult to reverse. Utilities can be stuck in a low performance equilibrium in which, for instance, low performance discourages outside investors and staff, thus in turn reinforcing low performance. The many-faceted nature of institutional breakdowns ensures that no one measure will suffice to restore efficient services. Even idealized models of reform acknowledge that turnarounds are typically gradual and performance may at first get worse before it gets better (see Figure 2).

Sequencing reform steps can inform a general strategy, but following a set path strictly can be difficult when local circumstances block one reform component while leaving others open. For instance, even with a reform-oriented management, tariff restructuring may be impossible due to political opposition outside of the utility. Reform, thus, is often opportunistic in nature – identifying and addressing low-hanging fruits, step by step.

The guiding principle of an opportunistic approach should be to gradually strengthen benign management, and expand its freedom of action to address challenges of increasing complexity, following the ideal reform sequence to the degree possible. Once an immediate crisis is stabilized, perhaps the most important aspect of strengthening a utility’s freedom of action is to stop the drain of its resources and restore the utility’s ability to sustainably fund its operational costs from sales, that is, “cost recovery”.

Cost recovery is of fundamental importance to the viability of water utilities for operating and maintaining services and is a prerequisite for sustainable expansion. Cost recovery, unlike government subsidies and donor projects, is a predictable and stable source of revenue matching the generally stable cost base of utilities. There are “almost no examples in developing countries” of utilities “whose operating revenues are significantly below O&M costs and that are nevertheless able to develop and maintain their infrastructure and provide a reliable and efficient service to customers” (McPhail, et al., 2012, p. 5).

Despite its importance to service delivery – the very purpose of utilities – cost recovery has been an elusive goal even in stable developing countries. As few as 9 percent of water utilities in low-income countries have been estimated to cover even operations and maintenance expenses (Komives, et al., 2008, p. 2). A recent World Bank analysis stated that after “some 30 years there is not much progress to report” regarding the “limited success with full cost recovery”. (McPhail, et al., 2012, p. 15).

Although cost recovery is an ambitious goal in fragile states, WSP chose it as a focus in urban Liberia and Sierra Leone not only because of its ultimate importance to service sustainability, but due to its direct link to a broad set of operational improvements. From this perspective, improving cost-recovery is both a goal to organize and
prioritize reform-steps and an indicator whether such steps succeed, as success, for instance in improving metering, streamlining staff or reducing illegal connections, should reflect in an improved cost-revenue ratio.

Moreover, improving cost recovery can itself become a driver of reform, as it progressively relieves financial constraints and builds the utility’s credibility, which is critical to attract additional financing from domestic and external sources. While improving cost-recovery cannot guarantee that GVWC and LWSC will sustainably improve, extend and maintain water supply services, thus reducing the risk from unsafe water, it is a pre-condition for them to be in a position to do so.
III. Approaches to Improving Cost Recovery at LWSC and GVWC

The elements of cost recovery are well-understood among development practitioners, so the “challenge is not to find missing links and new approaches, but rather to operationalize what is known, through policy guidance that is practicable, unambiguous and stable” (McPhail, et al., 2012, p. 8). To improve cost recovery at GVWC and LWSC, WSP aimed for practical actions that would have an immediate operational impact, maintaining staff presence and technical assistance even during the height of the 2014 Ebola epidemic.

Improving cost-recovery can be approached from three angles: the first is to improve revenue collection, broadly defined as how much of the produced water is regularly billed and collected on by the utility; the second is to change tariffs, that is, try to increase the revenue generated by each unit of water sold; thirdly, by addressing the other side of the equation and reducing production costs. WSP focused on aspects of revenue collection, because unlike cost-recovery challenges related to tariffs (relying on often difficult political buy-in) or reduction of production costs (relying on infrastructure interventions to reduce energy costs and physical water losses), improving the revenue collection process is amenable to short-term, low-cost management intervention and thus an ideal starting point when stabilizing a utility recovering from crisis.

There was significant improvement potential in the area of revenue collection too: In 2012, GVWC recovered payment from as few as 30 percent of 20,000 bills issued (Harris, et al., 2012, p. 12), while LWSC collected approximately 70 percent on as few as 6,000 accounts (GBSI / Government of Liberia, 2012, p. 59).

To improve revenue collection, WSP has helped LWSC and GVWC locate and enumerate tens-of-thousands of their own customers to update their customer database, found thousands of suspicious connections triggering a clampdown on unregistered and non-paying users, facilitated the upgrading of billing software systems at both utilities, piloted improved metering and customer acquisition processes, and worked on developing a pro-poor output-based connection subsidy program to overcome a major barrier to expanding the customer base – high connection fees.

The progress made is reflected in clearly positive cost recovery trends both at GVWC and LWSC, the latter recording more than a 100 percent increase in revenue in 2014 compared to 2011 through a combination of these interventions and tariff reform. Moreover, the increased credibility gained was pivotal in achieving the first stand-alone IDA allocation to urban water in post-war Liberia – a US$10 million investment targeting improvements of LWSC’s infrastructure expected to start in 2016.
Within the area of revenue collection, the three aspects WSP prioritized were (a) improving the metering, billing and collection processes by updating customer databases, upgrading billing systems and advising on meter-reading processes (b) reducing commercial non-revenue water (illegal connections); and (c) encouraging the utilities to expand their revenue base by connecting new customers more effectively.

I. Updating Customer Databases
Neither LWSC nor GVWC had reliable customer databases, that is, the companies did not have consistent knowledge of who and where their customers were. The databases inherited from the pre-war years were not systematically updated, making it difficult to distinguish active and inactive accounts, metered and unmetered customers, and even basic customer information was incomplete and outdated. In particular, data on the location or phone numbers of customers was missing, making it difficult for management to ensure that issued bills are accurate and actually delivered. At LWSC, a typical customer address in database would simply read “Logan Town” with no meter number, street address, GPS coordinates or phone number. Staff taking meter readings and distributing bills (typically the same person) relied on their memory to find customers, making the process vulnerable to staff turnover, corruption and almost impossible for management to verify readings or bill delivery.

At GVWC, the database consisted of a total of 79,000 accounts, of which around 18,000 were actively billed and only 6,000 paid regularly (NestBuilders Int., 2015, p. 2). Of more than 8,000 meter numbers registered in the database, only 2,814 functional meters could actually be ascertained on the ground in late 2012 (ASPA Utilities, 2013).

At LWSC, the database contains more than 10,000 accounts, none of which had precise addresses, meter numbers or phone numbers, contributing to the fact that only around 5,000-6,000 were formally billed. The lack of knowledge about the actual number and location of customers has limited management’s ability to systematically collect debts or carry out any planning tasks that require an understanding of where current customers are actually located.

To address this central information gap, WSP provided technical and financial assistance to implement major customer enumeration projects in both Freetown and Monrovia. Using modern mobile-to-web survey tools, WSP helped enumerate and map over 19,500 existing GVWC customers and over 3,000 suspected illegal connections in Freetown, and over 5,000 customers in Liberia and 2,000 illegal connections.

“We needed a more realistic picture of our customers. We wanted to make this data as accurate as possible. We also needed to capture new information for a new billing system – including corrections to account names, addresses and phone numbers, and also new geographic data such as GPS location of our customers.”

- Maada Kpenge, GVWC Deputy General Manager

The objective of the assignments was to update the current database of customers for both utilities with key data including but not limited to: (a) GPS location of the customer to within 15m accuracy (b) the current account number (c) confirm the full name of the customer (d) collect phone number; (e) photograph of the property (f) detailed address description (g) details of meter (where applicable, for GVWC).

In Freetown, WSP hired a company to carry out the enumeration in close cooperation with GVWC, while in Monrovia LWSC employees were trained to carry out the mapping directly (but with partial funding of expenses and supervision support from WSP). The basic methodology involved teams of enumerators moving with regular bill distribution and meter reading teams through neighborhoods, interviewing customers receiving bills and
having their meters read. In Freetown, where the number of customers was higher and more widely spread, with bill distributors moving too fast for surveying teams to keep up, a method involving bill distributors placing customized stickers onto houses was developed. In Freetown, all data was also collected using mobile-to-web survey applications running on hand-held smartphones and tablets. Surveying teams were also instructed to scan the area for suspected illegal connections, that is, properties receiving piped water, but not being billed.

The Ebola epidemic that struck Sierra Leone and Liberia in mid-2014 posed a risk both to the surveying but also to utility revenues and viability. The field teams faced a number of unique challenges including:

- Homes that were quarantined, restricting the ability to collect data in certain areas.
- Nationwide lock-downs that interrupted work.
- Reluctance of customers to interact with strangers and thus to participate in the enumeration exercise with the field teams.
- Increased probability of irritation and refusal to be interviewed by customers due to the rising hardship caused by unemployment, food price rises and a general sense of crisis;
- Fears of enumerators in the field team regarding the possibility of infection.

An “Ebola protocol” was developed to ensure the surveying efforts could continue with the help of hard-working, dedicated employees. The protocol involved a series of measures including frequent hand-washing, using replaceable gloves during work, minimizing any contact (especially in public transport and during interviews), use of dedicated vehicles to enter communities under quarantine, not entering any buildings for interviews and a reporting procedure should employees develop Ebola symptoms. Using this protocol, the work continued in both Sierra Leone and Liberia during the epidemic.

The results of the customer surveys have already had an impact. At both GVWC and LWSC, the customer data collected has been transferred into upgraded billing systems (see section on billing below), allowing the management to review and track metering routes better. At GVWC, the precise localization of customers has helped field officers to assign and supervise collections more effectively. As the commercial manager of Freetown’s eastern area stated: “Since we have been using this new data, we have been able to reach [our] target…If we exceed [it], the team receives a bonus. As we have been achieving these past months, our [employees] have received a bonus and are now more motivated to work.

In Freetown, the data has also helped to identify additional cost-recovery opportunities through improved accuracy of billing, including identification of water-intensive businesses such as hotels that were being billed at lower

“You had to be very careful going from house to house in Freetown. We did not enter anyone’s house and we were very careful to avoid body contact. It was sometimes very difficult and frustrating for our work. Some days we travelled far to do surveys in one area, but you could not speak to anyone as their homes were quarantined. But we persevered. Even once, I conducted a survey at a quarantined property by talking to someone leaning out of their second floor window. It was very important to reassure any respondents, as now in Freetown – we do not trust anyone and are wary of strangers.”

- Abrahim Mansaray, Enumerator

“From looking at the number of dwelling units for one account, our billing has changed a lot. Before, a building with five apartments had outdated information in the database and would only pay for one connection, sometimes as low as 20,000SLL (US$4.74). But now, each apartment pays for their own water connection and we will charge five times that […] This is being applied to all of Freetown. It has made a big difference to our earnings.”

- Mariam Umaro, GVWC Commercial Manager Western Area
residential rates, or multiple, separate properties sharing one account and thus profiting illegally from single property flat rates. Moreover, GVWC has also launched an initiative to use phone numbers collected during the exercise to send monthly bills by SMS, thus reducing costs and delays associated with paper billing. This was a particularly helpful step during the Ebola epidemic, which complicated the physical delivery of paper bills.

**ii) Meter Reading Procedures**

A particular weakness in the revenue collection process is meter reading. Even with improved customer databases that allow easier tracing of customers and spot-checks by management, the process by which meters have been read at GVWC and LWSC has been irregular, prone to error and vulnerable to fraud.

As the LWSC audit had noted in 2012, “while all metered accounts should be read monthly, our review revealed that the organization has weak processes in place to ensure that
this happens, resulting in untimely and inconsistent meter readings” (GBSI / Government of Liberia, 2012). WSP carried out an in-depth review of the current meter reading process at LWSC to identify weaknesses and propose improvements.

The core weakness of the current metering method lies in a combination of multiple, manual steps carried out without effective supervision or error-checking. At LWSC, the metering cycle has at least four such manual, unsupervised steps: First, meter readers visit customer locations and write the current consumption figures into a field notebook. As there is no reliable (for example, photographic) evidence of the reading, and readers operate on their own, it is easy to make errors or commit fraud such as by taking a bribe to record a lower reading, by claiming a meter is broken to allow the customer to pay a cheaper flat-rate, or, indeed, to ignore illegal connections without a meter. Meter readings are then transferred by the meter reader from the field notebook to customers’ meter cards by the meter reading, a second opportunity for inadvertent errors or false recording.

Thirdly, the meter cards are handed to billing officers who manually calculate water use based on the reading, which is recorded on a “billing input form”. The lack of a tamper-proof link between the meter-card and billing input form compounds the problem due to transcription errors and the opportunity for billing officers to cut informal deals with customers to change the calculated usage amounts before it is entered into the billing system. In a fourth step, the billing input form is sent to the data center, where it is manually entered into the billing system by IT officers to generate the bill. The IT officer has yet another opportunity for transcription errors or fraud, and anecdotally interviewed staff conveyed at least one case in which customers were called and asked for money in return for not inputting billing forms.

Figure 1 outlines the current metering and billing process of LWSC and contrasts it to the good-practice device-assisted approach implemented at other African utilities such as Nairobi City Water and Sewerage Company. WSP has recommended a number of measures, including the institution of a dedicated billing integrity officer, as well as a device-assisted approach in order to replace what the audit called a metering process that is “slow, tedious and prone to human error” (GBSI / Government of Liberia, 2012, p. 6). After a recent request by the Managing Director of LWSC to move ahead with this improvement, WSP is planning its implementation in the next fiscal year.

Reacting to a similar meter reading challenges, GVWC has already started to experiment with using iPads for meter reading processes. (NestBuilders Int., 2015, p. 15)

### Billing Systems Software

As the pivotal aspect of the revenue collection process, billing software systems – part of the broader customer management system – depend on a number of inputs including accurate customer databases and an efficient meter reading process (Figure 6). However, as the central system aggregating and processing all billing and payment related data, the billing system itself is critical to enable the utility to issue accurate bills to customers in a timely manner, and to monitor its revenue collection process and financial statistics efficiently.
### FIGURE 5: CURRENT LWSC METERING PROCESS & BEST-PRACTICE

**Current Method**
- **Step 1: Manual reading of meter**
  - Problem: No reliable proof of reading
  - Problem: Opportunity for fraud
- **Step 2: Manual transfer to meter card**
  - Problem: Inadvertent Mistakes
  - Problem: Opportunity for fraud
- **Step 3: Billing input form compiled**
  - Problem: Slowness of calculation
  - Problem: Inadvertent Mistakes
  - Problem: Opportunity for fraud
- **Step 4: Manual entry into Sage50**
  - Problem: Input slow
  - Problem: Inadvertent Mistakes
  - Problem: Opportunity for fraud
- **Step 5: Bill Creation & Printing**
  - Problem: May not be logged properly
  - Problem: Delays

**Device Assisted**
- **Step 1: Mobile phone reading**
  - Photo of reading & meter ID as proof
  - Reading saved & transmitted to Sage50
- **Step 2: Bill Creation & Printing**
  - Recognize unusual patterns
  - Calculate & log bill automatically

### FIGURE 6: BILLING SYSTEMS AS PIVOTAL PART OF COST RECOVERY
WSP funded a detailed study of billing system options for recovering utilities in fragile states, and in particular, of the situation and options at LWSC and GVWC. The study identified that outdated billing software was a major bottleneck in both utilities. Specifically, in Freetown’s case:

“[the software in use had] reached the end of its useful life a number of years ago […] There is no maintenance and support contract […] any technician with basic knowledge of MS-Access can have an easy way into the database and physically change/insert/delete values. […] most current operations are performed manually, due to security and functional limitations which do not permit a full control of the commercial processes […] area offices have no online (live) access to the billing system. The document exchanges between Commercial HQ and the area offices is source of extra work and many mistakes (ASPA Utilities, 2013, pp. 14-15)

In GVWC, it took between six and eight hours for the system to update customer bills. The system often crashed and corrupted data tables, necessitating the employees to rebuild from backup files. Similarly, at LWSC in Liberia, the billing system was:

“Not a billing system in the proper sense. All operations specific to utility customer management are done manually […] It is an old version with many limitations, both technical […] and functional […] LWSC’s maintenance license for the software [has] expired […] bills are not calculated automatically […] other applications, such as new connections or disconnection/reconnection processes, are carried out manually or with Excel files […] The existing billing system has too many limitations and should be immediately replaced” (ASPA Utilities, 2013, pp. 16-17)

WSP made concrete recommendations to both LWSC and GVWC which have since led to upgrades. In Liberia, the study recommended that the utility continue with an integrated commercial accounting package for a medium-size business (ASPA Utilities, 2013). LWSC has since upgraded to SAGE 50.

In Sierra Leone, WSP worked closely with the UK’s Department for International Development (DFID) who committed to financing a billing system upgrade following the recommendation that at GVWC, the existing billing system had numerous limitations and the company supporting had gone out of business (ASPA Utilities, 2013). With funding from DFID (US$220,000) and around US$70,000 in counterpart funding from GVWC, hardware and software was upgraded and the new billing system was rolled out in early March 2015 (see box 1). The rollout has been a success in terms of improved bill generation and accuracy, improving critical commercial processes like automating the calculation of bills with the correct application of tariff levels by use, tracking applications for new connections and generating and assigning work orders. With the new system, billing takes just five minutes and the commercial team are able to use a series queries to run integrity checks on the bills generated (for example, checking for large deviations in consumption and ensuring bills are properly addressed).

Remaining challenges at GVWC include the completion of user training. The utility reports that while core cashier and billing employees have fully embraced the system, “a significant group is conspicuous for their reticence, probably because for most of them this is their first exposure to a real IT system and they don’t want to put a foot wrong”. Moreover, the increasing reliance on software and reliable network links for billing necessitates a more robust IT unit “both in terms of increasing the number of personnel and improving their skill sets”. As WSP’s billing system study emphasized, “it is impossible to have a performing billing system, regardless of the software quality, if the database is wrong, outdated or incomplete” (ASPA Utilities, 2013), in this sense, the customer enumeration projects complemented the billing system upgrades in both Liberia and Sierra Leone.
Box 1: Procuring Billing Systems for Utilities in Fragile States

WSP provided technical assistance to GVWC for the diagnosis of their existing billing system and procurement of a replacement, with financial assistance from DfID.

Assisted by ASPA utilities, WSP visited and studied a number of utilities in fragile states to take stock of the sorts of billing systems they had in place, their particular constraints and gain insight into how (and if) the numerous challenges of a weak governance environment were overcome. WSP also visited a number of small utilities in Kenya and Uganda, where various small-scale computerized billing systems had been successfully implemented.

The first striking finding was that the utilities strongly preferred paying for locally-supported and adapted software rather than having donors provide generic applications. The ability to tailor and support the software locally was highly valued but this often came at a relatively high cost, was single-sourced and depended on a single developer.

The second key finding was that identifying providers of utility billing software is not simple. A search leads one to a plethora of small providers who appear to be offering variations on bespoke applications developed for municipalities. Drawing on the World Bank and ASPA's experience with major utilities in both developing and industrialized countries, a list of known software brands used by large urban utilities was prepared. Finding the actual providers of the software was complicated by the fact that software brands frequently change name, are upgraded, phased out, bought and sold between different IT service providers, and are merged into other systems. Also, many utilities either used “in house” software (Veolia, Suez), or regional providers (the case of the UK and Australia), used bespoke systems, or used billing modules of highly sophisticated Enterprise Management Systems (EMS) such as SAP. There appeared to be few truly international utility billing software providers.

The lessons from the visits, as well as the diagnosis of GVWC's current billing system, were used to develop a strategy for procuring the new billing system for GVWC. To ensure maximum participation in the procurement process, as well as advertising the contract on dgmarket.com, identified potential providers were directly contacted. Ten companies expressed interest in the project, of which five were shortlisted.

A challenge was the scope of the billing system. These can vary enormously between providers, some of whom propose simple MS Access-based systems of the sort GVWC already had in place, or C++ stand alone, single PC type systems, through to very sophisticated web-enabled EMS. From our site visits, it was known that utility billing systems often claim to perform a large number of functions, making assessment of quality difficult in a tender evaluation where there is a very wide range of prices (from $2,000 to $50 million).

GVWC had a specific budget constraint, and it was felt that unless bidders had some idea of the budget, such a wide range of prices (and scope) risked that the “quality” weighting of the procurement would be entirely outweighed by the price weighting, leading to the cheapest product being selected even if we had misgivings about the quality. It was therefore decided to announce the budget, and to some extent remove price competition. The terms of reference noted that the budget was a “maximum”, which allowed competitive pricing, and also included minimum software, hardware, support and service requirements, as well as optional items to be priced separately. Ongoing costs had to be made explicit, so that some consideration could be given to the effect on GVWC's operating budget. Services included a training component and three years of support from a local partner as well as two visits per year from the international partner if requested by GVWC.

The three tenders submitted were of good quality, although the bidders proposed different hardware scope, which necessitated some adjustment to allow a like-for-like price comparison. Bidders also included different tax assumptions which needed to be equalized to allow a fair comparison. The company that won the tender worked closely with GVWC and persevered during the very difficult circumstances of the Ebola outbreak. The billing system finally went live in March 2015.
iv) Reducing Commercial Non-Revenue Water

While improving the billing and collection process is an attractive area of intervention due its comparatively low cost and rapid impact, revenue losses also are attributed to non-revenue water, that is, water that is produced and distributed but never even billed. The two principal causes are physical losses in the dated, low-quality network infrastructure, and commercial losses in the form of illegal connections.

At GVWC, non-revenue water was estimated at 45 to 50 percent of water production in 2012 (Harris, et al., 2012), while at LWSC non-revenue water is believed to be as high as 80% (World Bank, 2014, p. 39). It is not possible to determine exactly how much of these enormous losses are due to illegal connections and how much is due to leakage from the old and damaged piped network, however, both causes are likely significant.

The water supply system in Freetown was designed some 60 years ago and has seen very limited maintenance since the 1980s (Harris, et al., 2012). Similarly, much of the core infrastructure and piped network of LWSC dates back to the 1950s and 1960s.

As the corporate audit noted in 2012, LWSC does not even have an up-to-date database of its own distribution network, which is “in disrepair and has extensive leaks” with the company “not equipped, both in terms of manpower and equipment [to] implement a leak detection program” (GBSI / Government of Liberia, 2012, p. 38). It should be noted that these network inadequacies not only cause direct physical losses, but reduce service regularity and quality to existing customers, thus lowering their willingness to pay. While steps such as establishing district meter areas (DMAs) would help detect leaks and is part of WSP’s next round of proposed support to LWSC, addressing physical losses in a fundamental way will ultimately require additional substantial infrastructure rehabilitation investments that go beyond just technical assistance.

WSP has thus focused on commercial non-revenue losses attributable to illegal connections. Tracking illegal connections was done as part of the customer enumeration exercises, with dedicated teams following the enumerators and investigating each area for signs of water access (for example,, informal “spaghetti pipes” leading away from formal infrastructure, or pipes running into buildings that were not visited by bill distributors). The evidence thus collected suggests that commercial losses from illegal connections are substantial. Over the past year, LWSC and GVWC have identified over 2,000 and 3,100 suspected illegal connections respectively, that is, between 15 and 30 percent of the number of legal connections in the
networks. Images 2-4 show a pipe hidden behind a gate that was illegally connected to LWSC’s network and used as a free water point by local residents, discovered during the enumeration exercise.

In Monrovia, the identified suspected illegal connections have inspired an aggressive revenue recovery and (where necessary) disconnection campaign to clamp down on illegal access. Similarly, GVWC has initiated a follow-up process with the suspected illegal (“unregistered”) connections. As a first step, over 3,000 letters were sent to unregistered customers identified during the enumeration. These letters have requested registration and threatened disconnection in case of continued illegal water use. These registration campaigns were ongoing in mid-2015.

v) Expanding the Revenue Base by Connecting New Customers
An important aspect of revenue collection is the revenue base, that is, the actual number of registered customers which are supplied with water and are subject to revenue collection. A utility’s customer or revenue base is determined by a complex set of factors, including infrastructure constraints such as water production and the reach of the piped network; service quality, tariff setting and willingness to pay by consumers; the ability of a utility to advertise its services and register new customers, and related to that, the availability and price of competing water sources.

Although the population in Monrovia and Freetown has doubled to over one million inhabitants each, both LWSC and GVWC supply fewer registered customers than they did before the wars, less than 10,000 and 20,000 accounts respectively. Given the economies of scale involved in water production and distribution, the lack of customers in the network certainly contributes to the difficulty the two utilities are facing in recovering their costs.

In Liberia, one of the few major infrastructure rehabilitation investments of the past years has made progress in addressing the prior constraint on water production. Under AfDB-financed projects, the White Plains production plant has been restored from approximately 15 percent of its original capacity, to approximately 40 percent today, with work underway to reach the pre-war capacity of 16 million gallons per day in the next two years. This improvement has started to relieve the production limitation; however, the small size of the distribution network and its lack of maintenance still impose a clear infrastructure constraint on increasing the customer base. The current network size is approximately 200km, compared to an estimated 6,000km required to connect the entire population of the capital (World Bank, 2014, p. 23), and of these 200km of current network, only approximately 25 percent have been the subject of significant rehabilitation works since the 1980s.Major increases in the customer base will thus not only require a full restoration of (and eventually expansion beyond) the pre-war water production capacity, but large scale investments in the piped distribution network set out in the sector investment plan for Liberia (Government of Liberia, 2013).

However, expansion of an urban utility customer base requires more than infrastructure. There is an inherent social dimension built on demand, economics and elements of public trust. In the short- and medium-term, a recent WSP-funded study of existing infrastructure and willingness to pay in selected poorer neighborhoods of Monrovia found at least 3,000 potential new connections within reach of the current network, and a further 2,500 potential customers within reach if an additional 20km of extension lines were built (World Bank, 2014). Even though these 5,500 connections would represent at least a 50 percent increase of potentially billed accounts, two challenges that go beyond infrastructure issues have constrained this limited customer base expansion. The first is that high connection fees act as a barrier to entry even to those who can afford tariffs. Second, a complicated, non-transparent and slow connection process puts unreasonable burdens on potential customers. WSP has worked towards addressing these two constraints.

A recent pilot in the Paynesville area of Monrovia revealed average household connection costs of US$188 in streets with existing water branch-line pipes. Given the likelihood that such branch-line infrastructure often has to be extended or rehabilitated to reach customers connection costs may be as much as US$400 per connection. This constitutes a major barrier in a city in which over 40 percent of households have a monthly income of less than US$150 – which may suffice
to pay ongoing bills but not the initial connection cost. In partnership with the Global Partnership on Output-Based Aid (GPOBA), WSP has thus implemented a scoping study assessing the feasibility of implementing an OBA approach to expand access to piped water supply to low-income households in Monrovia. Using willingness to pay and infrastructure analysis, the study showed that targeted pro-poor subsidies of up to US$325 per household connection would be required to overcome the barrier to access posed by high connection fees. Based on the completed feasibility study, WSP is now negotiating with LWSC and the GPOBA program to launch a pro-poor subsidized connections program.

A second major constraint on increasing access to LWSC’s piped network is the complicated and slow connection process for new customers. Over the past five years, LWSC averaged only 776 new domestic connections per year (World Bank, 2014). At this pace, adding the proposed 5,500 connections would take more than five years. To address this issue, WSP assisted LWSC in piloting a new approach to connecting customers in the Paynesville area between 18th July and 29th September 2013. The pilot team managed to add more than twice the average number of new customers by improving on the current approach of connecting LWSC customers in a number of specific ways:

- **Direct customer targeting:** Instead of waiting for customers to request connections spontaneously as is currently the case, the pilot team actively went to streets with existing branch lines, measured connection requirements, estimated cost and then delivered offers to potential customers with transparent fees and clear instructions on how to get connected. This approach was based on an earlier survey that revealed that up to 85 percent of potential customers were interested in an LWSC connection, but may lack the knowledge or initiative to instigate the process themselves.

- **Simplification of Application Process:** Instead of requiring interested customers to make multiple trips to the LWSC head-office in central Monrovia as is currently the case, a strategy of community outreach that set up temporary registration and pay-points within the Paynesville neighborhood allowed interested customers to request connections and pay fees faster and with fewer complications. The official process flow chart for an application has more than 25 steps, which can be considerably reduced in practice.

- **Direct hardware procurement:** Instead of asking interested customers to buy required hardware themselves as has regularly happened in the past, LWSC provided pilot customers with a transparent connection offer, and then bought parts directly to achieve better prices, quality, and faster turnaround times (no need to wait until customers had time to buy it). Prices for hardware parts were pre-negotiated prior to the pilot with available vendors.

- **Strengthening of engineering standards:** The pilot team took first steps to improve on connection practices, which are currently largely unregulated. For instance, the practice of connecting individual households to ¾” or unburied pipes was avoided. Aside from reducing leaks, this measure is expected to improve customer satisfaction, payment morale and the propensity to recommend LWSC connections to other potential customers.

These practices have rarely been applied consistently and comprehensively at LWSC, and are not codified in company policy and guidelines. In the next support cycle, WSP hopes to mainstream the pilot practices, ideally as part of a GPOBA project, which will require a major effort to reach and register the targeted number of customers, even if subsidies are offered to overcome the barrier of connection fees.

### Other Factors in Cost Recovery - Tariffs and Costs

As described in the introduction, in order to improve the financial viability of the urban water utilities, WSP chose to focus its efforts on cost recovery through improved billing and collection and expansion of the customer base. However, going forward, there is significant potential for addressing the setting of tariffs and the reduction of operating costs.

#### i) Tariffs

In both Liberia and Sierra Leone, the tariff setting process is highly politicized. WSP opted to focus on the more socially acceptable areas of cost reduction and improved billing as ways to increase operating revenue for the utilities. As customer confidence grows, sector
data improves and the capability of the sector institutions increases, it will be possible to re-examine the tariff levels in place in both countries.

In Sierra Leone, setting tariffs is particularly political and bureaucratic, requiring approval by the GVWC’s board, the National Commission for Privatization (NCP), the Ministry of Water Resources, and, subsequently the Cabinet. This lengthy process has kept water charges relatively low and made any upwards adjustments difficult. The problem is aggravated by the fact that prices have been quoted in the national currency which have steadily lost value relative to the US dollar and thus relative to a “majority of operating costs” such as energy costs, treatment chemicals or spare-parts which have to be purchased in hard currencies. In 2012, GVWC charged “ridiculously low tariffs” with per unit usage rates set as low as US$ 0.0003 per gallon (US$ 0.08 per cubic meter) for domestic users (Harris, et al., 2012, p. 13), while the average tariff stood at $0.22 per cubic meter versus an estimated $0.65 per cubic meter average cost recovery tariff (Pushak, 2011).

In Liberia, currency depreciation is less of an issue as water prices are quoted in US dollars, which is legal tender alongside the Liberian dollar. The new LWSC management in place since 2012 has itself prioritized tariff simplification and increases, and achieved these at the beginning of 2014. Business tariffs were raised from the volumetrically determined range of US$2 to 3 to a rate of US$4 per cubic meter, while consumer tariffs were changed from the volumetrically determined range of US$0.4 to 1.4 per cubic meter to a rate of US$1.3 per cubic meter.1

ii) Costs

While endeavoring to increase collections against water produced, utilities should also be working to reduce operating costs – so enhancing affordability and enabling higher rates of cost recovery. In Liberia, the completion of a World Bank-financed audit in 2012 and recent release of LWSC’s 2014 financial statements allows a particularly detailed understanding of the utility’s costs. Two types of costs stand out: employees and energy, which account for approximately 31 percent and 20 percent of total annual expenses respectively (Liberia Water and Sewer Corporation, 2014).2

In the post-war period, LWSC has operated with a bloated organization relative to its size. The number of employees per 1,000 clients was as high as 61 in the post-war period (GBSI / Government of Liberia, 2012), and is still estimated at 22 at present (World Bank, 2014). This compares to an efficient benchmark value of approximately five employees per 1,000 connections for developing countries, and actual ratio of six to seven employees per 1,000 connections among the best sub-Saharan performers such as Uganda’s national utility (African Water Association, 2009, pp. 93-94).

This high ratio of employees per 1,000 connections was due both to the shrinking of LWSC’s operations during the war and the lack of any hiring policies or discipline. As the 2012 audit noted, “job descriptions do not exist” at all and the formal “hiring process […] has completely broken down”. There has been no “HR management […] to ensure that the goals of HR are in alignment with the Mission, Vision and Strategic goals of LWSC” and “some senior management members conduct their own recruitment activities”. Cost control is similarly weak. For employees, “there is no formal pay structure” and “salaries [are set] in an ad hoc manner which may or may not reflect experience or educational level”. More generally, the audit “could not ascertain the process used […] to oversee […] contracts and evaluate performance requirements” and there “is no process for supervisory review of employee hours worked or leave taken” (GBSI / Government of Liberia, 2012, p. 8;p.12;p.79).

The lack of well-defined roles is matched by the absence of rules and procedures: Except for an employee policy dating to the civil-war years, auditors were “unable to ascertain the existence of any other written/formal regulations or policies”. Notable in their absence were any procurement regulations. The new management, put in place at the same time as the audit was carried out, has started to address

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1 The majority of metered users were charged between US$1.41-US$ 3.52, only certain wealthier areas (Mamba Point, Water Street, UN Drive) were in the US$5.63 bracket for consumption above 2,250 gallons

2 While comparable financial data is not available for GVWC, staff costs are a larger cost driver than energy costs as the elevation of Guma Valley dam allows much of the existing customer base to be supplied by gravity. However, energy costs will be a significant cost driver when extending coverage to areas such as Hill Station. The issues in LWSC are therefore representative of both utilities in the medium term.
some of these issues, for instance, imposing more hiring discipline and reducing the employee to connection ratio. However, a further strengthening of cost-control will be critical going forward.

The situation is also true for LWSC’s energy costs, which remain exceptionally high due to the reliance of the primary production plant and pumps on diesel generators. Fuel and lubricants alone have cost LWSC over US$22,000 per week in 2014 (Liberia Water and Sewer Corporation, 2014). LWSC’s management is currently pursuing a project to connect the White Plains production plant to grid electricity, though given frequent power outages, partial reliance on generators will likely persist. GVWC is more fortunate with respect to energy costs due to its ability to generate hydroelectric power at its water dam in Sussex, close to Freetown.

As cost-reduction schemes are highly controversial if affecting staff numbers and compensation, or require major infrastructure investments in terms of reducing energy usage, WSP did not directly engage on this theme during its initial support cycle. However, the LWSC and GVWC management were consistently encouraged to pursue initiatives in this respect.
V. Cost Recovery Trends at LWSC and GVWC

Disentangling the impact on cost recovery of the various interventions supported by WSP, other partners as well as GVWC and LWSC themselves, is difficult. This is particularly so given synergies among improvements such as better customer databases, more targeted meter reading and modernized billing systems. When accomplished together, the combined impact is certainly greater than the impact of any one improvement by itself. While attributing causality to specific interventions is difficult, the combined reform measures undertaken at LWSC and GVWC are improving cost recovery.

At LWSC, revenues from bill collections increased from US$1.9m in the fiscal year 2011 (FY11), to US$2.5m in FY13 and US$4.7m in FY14 (Liberia Water and Sewer Corporation, 2014).³ A tariff increase at the start of FY14 played a significant role in the improved revenue performance; however, this does not explain the entire story. Analyzing actual water sales and achieved average tariff between FY11 and FY14 shows that the pre-dominant effect (80%) increasing overall revenues from water has been related to higher volumes successfully sold to customers (for example, due to less revenue water and better collection efficiency) rather than the tariff increase (Figure 7 below).

The Government of Liberia continues to provide a significant operating subsidy to LWSC, but that fell to 23 percent of total LWSC revenues in FY14, compared to an average of 39.5 percent annually in FY11-FY13.

The trend since FY11 has thus shown an improvement towards cost recovery, which may come into reach once fuel costs (US$1.2m in FY14) are reduced by connecting production plants to grid electricity. It should be noted that the impact of the Ebola epidemic will only be reflected in FY15 figures, which are not yet available.

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³ Figures for FY11-FY13 from cited Financial Statement, the 2012 Corporate Audit and an early 2015 presentation provided by LWSC.
Based on GVWC’s interim financial reports, collection efficiency has risen to 75 percent in March 2015, that is, collections of SLL1.58 billion (US$362,000) against SLL2.1 billion (US$510,000) in billings. This compares favourably to the estimated 30 percent collection efficiency in 2012 (Harris, et al., 2012, p. 16). Average monthly collections of approximately SLL 1.5 billion are also more than twice the average monthly collections in the immediate post-war period in 2002 (World Bank, 2003).

GVWC collection trends for the calendar year of 2014 indicate a strong negative impact of the Ebola epidemic, with collections decreasing by more than US$ 100,000 per month (25%) between May and August 2014. However, collections have since recovered and surpassed pre-epidemic levels. The recovery in collections has been driven not only by a decline in Ebola cases, but a deliberate strategy of intensified collection efforts and novel methods such as the SMS billing enabled by the customer enumeration exercise (NestBuilders Int., 2015).

“Most of our commercial customers have run away. Hotels, guesthouses, restaurants and factories have all closed down because of the economic situation brought by this Ebola. It has caused a big drop in our revenue from commercial customers. And commercial customers are the most profitable for Guma.”

- Mariam Umaro, GVWC Commercial Manager Western Area
VI. Conclusion

Improving cost recovery can be both a goal to prioritize reform options, and an indicator whether interventions succeed, as success, for instance in improving metering, raising tariffs or reducing illegal connections, should reflect in a more favorable cost-revenue ratio.

Though improving cost recovery in fragile states may seem particularly intractable, as conflict has left utilities with severely damaged infrastructure, inefficient organizations and widespread illegal connections, the experience in Liberia and Sierra Leone shows that it is possible and indeed an essential building block for sustained and improved service provision. Government budgets are highly constrained and both governments and development partners have to address multiple development demands. Development partners in particular are seeking the greatest development impact through limited resources and reticent to invest in utilities that are not able, or committed, to cover at least operations costs. Moreover, there may only be a narrow window of opportunity for fragile states to put in place cost recovery. Both Liberia and Sierra Leone are resource rich countries and there is a danger that not addressing cost recovery early in the emergency to development transition will leave utilities dependent on subsidy as has been the case in a large number of utilities in Nigeria.

The initial opening to tackle cost recovery at both LWSC and GVWC was created by organizational change processes in response to institutional crises faced by each of the institutions (see figure 4).

Following a rapid succession of managing directors – three in as many years – and the highly critical institutional audit, a new management team was brought into LWSC in 2012. The utility then also benefitted from a tariff review in 2013. Together these changes opened up the possibility to address the technical and efficiency aspects of cost recovery that have bolstered a recovery phase at the utility: upgrading the accounting and billing system; updating customer databases; reducing non-revenue water by regularizing connections; and; expanding the revenue base by connecting new customers.

Meanwhile at GVWC, turnaround support, led by Dr William Muhairwe, had reinvigorated the management team and brought the utility out of near crisis in 2012 during which revenues were well below operational costs. Though GVWC did not receive a tariff increase the additional effort put in by staff – even without addressing technical aspects of cost recovery – brought revenues just above basic operating costs by February 2013, though revenues then plateaued. Raising revenues further required addressing systemic problems including replacement of the billing system, improving data on customers to introducing SMS billing, re-categorizing customers in line with changes in the way properties had been expanded or were being used as business premises, and reducing non-revenue water by identifying and regularizing connections.

At both LWSC and GCWC, continued support will be required to help the utilities continuously improve cost recovery. At LWSC further TA is needed to fully integrate the customer enumeration data into their new billing system, to introduce device-assisted meter reading, to codify their streamlined customer connection process and simplify payment mechanisms for customers. At GVWC internal resistance to the new billing system – especially from

### FIGURE 8: COST-RECOVERY INTERVENTIONS AT LWSC & GVWC

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meter readers – needs to be confronted while continuing to regularize illegal connections. GVWC is now well into a recovery phase and is also in a position to meaningfully tackle metering. With the comprehensive data on customers and an effective billing system, introducing new meters to customers currently on flat-rate connections and replacing non-functioning meters will raise revenues and improve demand management – a critical step given the constrained availability of water in the Guma Valley dam and the limited prospect of developing a new source in the near future.

The focus on cost-recovery may be explicit, as in the case of LWSC and GVWC, or merely an implicit target of other reform steps. For instance, in two other utilities operating in fragile environments – Port Harcourt Water Corporation (PHWC) in Rivers State, Nigeria and Hargeisa Water Agency (HWA) in Somaliland – cost-recovery was not as directly targeted by WSP, but for two different reasons. In the case of PHWC the utility was in the midst of crisis requiring leadership change, complete review of staffing skills and an emergency line of credit to keep it going at all. Working directly on cost recovery would have been premature, though it remained an implicit target even of efforts to stabilize the immediate crisis. In the case of HWA, water sales were enough to cover its basic staff, electricity, chemical and other costs. Cost recovery mechanisms were ‘good enough’ so WSP’s TA focused on strengthening the utilities’ corporate governance by setting up a board of directors to oversee the organizations operations and ring-fence its revenues in advance of a large increase of production capacity coming on stream. Even in this case, however, safeguarding future (increased) revenues was a primary implicit concern.

Figuring out at which point a utility is in the sequence of reforms is critical to avoid misdiagnosis, leading to the wrong medicine. An awareness of the central importance of cost-recovery can help prioritize approaches.


