Prepaid Water in Mogale City: Case Study

Overview
The Mogale City municipality, which borders western Johannesburg in South Africa, is a pioneer of prepaid water, and possibly the first urban center to adopt prepaid water at scale. It installed its first prepaid system in 1999, and within three years had 30,000 meters in low and high income areas. Today roughly half of Mogale City’s 72,300 metered connections are prepaid, and the municipality aims to make prepaid meters the default in all areas.

Most current prepaid users are low income, living in formal settlements with individual connections. Despite unemployment levels of 28 percent and often more across the municipality, all Mogale City customers get the first 6 kiloliters free each month, in line with a national policy of providing free basic water to poor households, with a direct national subsidy to the municipality, allocated automatically to each customer on the first day of each month. Each prepaid meter is programmed for the rising block tariff, with the tariff for the 0–6 kl consumption block set at zero. Roughly half of all prepaid customers in low-income areas manage to keep their monthly consumption within the 6 kl of free water threshold monthly, monitoring consumption closely, paying nothing for water at all.

Most low-income customers covered in our surveys and focus groups said they would recommend prepayment, because it helps them manage consumption and avoid debt and disconnection. They say they prefer them to postpaid, but complain that there are too few convenient vending sites.

Lessons
The financial potential of prepaid systems is ambiguous for both customers and the utility. Prepaid meters offer poor households mechanisms for managing the costs of household connections without getting into debt, but they are expensive. The revenue generated from low-income sales is not enough to cover the costs of prepayment without big capital and operating subsidies.

Prepaid meters can alter customer behavior and improve demand management, but they are not a magic bullet. Ongoing interaction and communication with customers, and good customer care, remain essential, whereas the financial models and their implications need to be carefully constructed and applied to ensure the systems are viable or effectively subsidized. Convenient credit purchase sites and options are important for customers and may secure broader acceptance of prepayment.

Strong political support and leadership, with a strongly pro-poor message, was decisive. The Mogale Water Department has been able to weather the financial pressures, customer questions, and technical challenges because the political leadership was clear about its support. This also helped build acceptance for prepayment among customers.

Regular monitoring with exception reporting and rapid follow-up is essential. Mogale has focused on ensuring that all devices have a mechanical meter to track consumption over time, and learned the need for checking that nonrevenue water (NRW) does not rise as a result of faults, bypasses, or tampering. “If you put in prepaid meters and forget about them, you can forget about your money too,” said the head of Mogale’s monitoring team. Installing, managing, and monitoring a prepayment system needs not just the new technology, but a well-resourced dedicated team, in-house or contracted.

Installing different types of meters mitigates risk, but can be costly. Mogale City deployed different meters, each with its own proprietary hardware and system to spreads the risk of one system performing poorly, but this raised the cost of service provision and vending infrastructure.
Why the municipality introduced prepayment

Municipalities across South Africa struggled to improve service payment levels after the country’s first democratic elections in 1994. The anti-apartheid movement had led an effective campaign of service payment boycotts from the early 1980s to cripple race-based local administrations financially, but post-1994, the newly restructured municipalities needed a rapid turnaround in income to fund settlement upgrading and service improvement. They found that nonpayment had become entrenched as the norm for most township residents, and a mid-1990s national leadership of the African National Congress – earlier the lead anti-apartheid organization but now in government - led a campaign to encourage people to pay their bills had limited impact. Municipalities began disconnecting customers’ water and electricity services when they were in arrears to compel payment. This policy of disconnection by municipalities was deeply contentious and unpopular, and the political cost for the ANC was high.

In the area later called Mogale City, municipal leaders introduced individual metering and volumetric tariffs in local townships to incentivize more efficient use of water, after decades of charging a flat rate irrespective of volume (Photo 1). The conventional meters changed little in people’s behavior, and simply led to large-scale disconnections when people did not pay their high water bills.

In late 1997, Mogale City’s ANC leaders heard about the new prepaid standpipe meters that were being used in some parts of rural South Africa and decided to introduce them in an urban context. They believed that prepaid meters were the best tool available to them to shift the awareness and consumption behavior of customers who were not used to paying (let alone paying a volumetric tariff) and to help poor households take charge of their consumption and avoid running up bills they could not afford. A decision was made in January 1998 to adopt prepaid meters, and physical installation began 12 months later after a period of intensive preparation.

Implementation

Within a year the municipality had installed more than 10,000 meters. The municipality prioritized two low-income townships, Kagiso and Munsieville, but from the start also included the affluent residents of an exclusive new thousand-unit housing estate in a mainly white suburb, to avoid stigmatizing prepaid meters as a payment system only for poor black people (Photo 2). Existing water customers could choose to stay with postpayment or move to prepayment; customers in all new developments got a prepaid meter, without a choice.
The new technology made payment for water nonnegotiable, yet there was very few opposition from residents, largely because local politicians took the lead in building acceptance of the new prepayment system as a tool that would help poor households manage their water costs (Photo 3). They emphasized that households would be able to manage their consumption better, use only what they could afford, and avoid arrears and disconnection altogether. Politicians worked closely with ward councilors, the water department, and community development staff explaining the benefits and how to use the new system. About 60 percent of low-income households accepted prepayment, and signed up for new meters in the first round of house-to-house marketing. Those who wanted to retain postpaid meters were free to do so. Once installations began, municipal officials said they could not keep up with demand as residents began to see the benefits of being able to manage their consumption and their spending on water better. The rate of vandalism was reported to be very low, below 1 percent.

“We won the political debate, we achieved behavioral change, and we got community buy-in,” said a former senior manager in the water department. “But the meters failed us.” Mogale City’s first prepay meters were a crude prototype, with iterative development and testing happening in the field as they were implemented at scale. They used a Dallas iButton for loading credit. They leaked and failed frequently, so residents lost some of the water they had paid for, while internal moisture caused the electronics to malfunction. One official estimated that about 80 percent had to be removed and returned to the supplier for repairs. “It was the maintenance department that felt the heat,” said one official. “I don’t think customers felt hugely disadvantaged, because we moved swiftly to remove the faulty meter, usually the same day.” Technicians installed a “straight through” unmetered connection, ensuring that customers could still access water supply. The turnaround time to repair a meter was one to three months, during which the municipality forfeited the revenue.
After three years, the municipality decided to remove all of the meters because of their poor performance. Despite problems, most residents with prepaid meters seemed to prefer them to postpaid meters, and accepted the council’s decision to replace them with a different type of prepaid meter. Installation of a second prepaid metering system began in 2003.

By the mid-2000s, the municipality was still struggling with payment levels for water as low as 10 percent in some postpaid areas, an overall NRW rate of 47 percent, and escalating municipal debt. Expansion of prepaid metering was seen as part of a broader strategy to turn this around. Household consumption usually fell steeply when customers started using prepayment; revenue was lower, but there was full payment.

The municipality saw prepaid meters as an important part of its NRW reduction strategy, which consisted of three components:

- **Water distribution management**, with improved zone and pressure management
- **Customer demand management**, with prepaid water meters introduced to address faulty water meters, unmetered connections, and unauthorized connections. This was complemented by a subsidized leak repair program to address internal plumbing leaks on private properties and emphasized interacting with customers to explain the importance of managing their water consumption.
- **Repair, operations, and maintenance to upgrade the network**

The initial results were very encouraging. In 2007, the municipal team calculated that the costs of their investment in prepaid metering would be recovered within 17 months—*not* from revenue income from prepaid sales, but by reducing NRW. “The business case for saving water is very different to that for recovering the costs of supply,” said a former manager who worked on this program. “Prepaid meters are a water demand management tool—not a cash cow or a silver bullet.”

These early gains were not sustained, however, and the anticipated payback was not achieved. Changes in the management of the water department led to a shift in operational focus; concurrently, a range of technical problems began to surface in the performance of the new prepaid meters. A frequent problem was that the valve in the prepaid meter controlling the flow of water to the consumer jammed open, providing free water. In addition, problems with the system’s software meant that some customers had problems using their Dallas keys to load credit, or there were errors in the way the meter deducted payment from the remaining credit. The meters were not reparable by municipal staff at all, because the component were spring loaded in highly compressed form inside the casing, so the device could only be removed and sent away for repair. In the interim, the municipality again would install a dummy meter with a straight-through connection, in the apparent hope that the customer would not notice they were getting their water for free.

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In 2012, prompted by adverse comments by the auditor general on the municipality's high NRW figures in its annual financial statements, the municipality commissioned a performance audit of their prepaid metering system. Nearly a third of all prepaid meters (more than 10,000) were inspected. The results were sobering. Eight years after installation, more than 90 percent of the meters were found to be faulty. The vast majority were delivering free water—either because the valves were jammed open, or because customers had bypassed or tampered with them (Photo 4). Two years later, in 2014, the city's finance department said that no more than 5 percent of those meters were generating any revenue income.

The audit findings prompted a far-reaching rethink within the municipality. The chief financial officer was as concerned about high NRW in prepaid areas as with high amounts of bad debt in areas with conventional metering and billing, and opted to extend prepayment to new areas. An external team was appointed to formulate a new approach to managing prepayment, and then pilot it across 1,026 sites (see Box A).

The encouraging results informed the design of a huge 39,000-meter tender in 2013. It called for the replacement of the old prepaid meters under an outsourced three-year turnkey contract to supply, install, maintain, and monitor the new system. The new tender specified that every meter should include a mechanical meter in addition to the electronic meter, to enable the municipality to issue a bill based on the historical readings of the conventional meter in case of a fault or tampering. A major drawback of the earlier meter was that if the electronic meter failed, all consumption data was lost.

When awarded, the tender was initially split 60/40 across two consortiums, each supplying a different make of meter. This approach would spread the risk if one type of meter performed poorly. However, it also meant that the municipality would need to straddle different software systems, with different suppliers, different spares, and different monitoring arrangements (as one was equipped for automatic meter reading and the other was not). Two vending systems would be needed—one proprietary, and one STS-compliant—on top of the one already in place.

### Box A: Key Features of the Post-2012 Prepaid System Pilot in Mogale City

**A different type of prepaid meter**, which was reparable in-house, and had a better track record elsewhere.

**Included both an electronic and a mechanical meter**, and could track both absolute consumption and consumption relative to the last credit purchase.

**Regular monthly monitoring on-site** to collect consumption data and inspect the device for evidence of faults, bypasses, and tampering. The data was then analyzed, and with follow-up on exceptions showing no- or low-buy or unusually high consumption.

**The combination of more reliable technology and close monitoring** soon showed good results. In one high-income housing estate, water sales quadrupled in the first month and subsequently stabilized at more than three times higher than with the old meters. The municipality appointed a supply team to install 4,700 new meters under a three-year supply, install, maintain, and monitor contract.

**Photo 5. The new STS-compliant meters being installed in Mogale City. Customers load credit by entering a 20-digit encrypted number, using a keypad that is linked via a radio signal to the meter.**
for the old meters, with implications for the cost to the municipality and the number of conveniently located vending sites for customers. One of the consortiums soon proved unable to deliver at scale, and so the vast majority of the new meters will be of the same type, Standard Transfer Specification (STS)-compliant and equipped for automatic meter reading (Photo 5).

**Vending**

A new type of meter with a good performance profile will soon predominate in Mogale City. Customers using these STS-compliant meters buy credit from existing vending sites—petrol stations, supermarkets, and municipal offices—and receive a paper printout with an encrypted 20-digit number. They load credit by entering this number via a keypad at home. Customers will soon have many more sites and options for buying credit, such as by mobile phone, over the Internet, and from vendors who sell prepaid electricity.

The 4,700 customers using the newer meters with Dallas iButtons and proprietary vending equipment and management software are currently served by 10 handheld vending machines, allocated across 10 settlement clusters in different parts of the municipality. At a cost of about USD 1,800 per handheld device, it is unlikely the city will invest in more.

**Monitoring**

When the system was first installed in 1999, the municipality did not collect meter readings from prepaid meters. It removed the details of prepaying customers from the municipal revenue management system. Not having consumption data, however, weakened the ability to calculate the water balance or NRW, or to locate faults, bypasses, and tampering to which prepaid meters are prone.

The second round of meters, of which installation began in 2003, had no mechanical meters, and provided information only on consumption relative to credit purchases. Even this limited data was lost if the software was reset when the meter was sent for repairs.

In the absence of regular monitoring, vendors were often the first to notice faults or tampering in their area because it affected their sales and they sold on commission (Photo 6). However, identifying which meters were affected was difficult without visual inspection. It was possible to track an individual customer’s sales history, but this was seldom done. Prepayment was managed as a technical service provided by the water and sanitation department, without the involvement of the city’s finance or revenue management departments. The Finance Department is now taking over management of the financial aspects of prepayment, and has put a strong emphasis on monitoring.
Box B: Some Findings from Analyzing Consumption and Sales Data

Figures 1 to 3 summarize consumption and sales data from a sample of 4,504 prepaid customers over a 31-day period in January 2014. Three upmarket settlements (Featherbrooke, Ruimsig, and Pinehaven) with average monthly consumption per customer of 33.1 ksl, 28.8 kls, and 27.3 kls, respectively. Kagiso Extension 8, Sinqobele, and Chief Mogale are low-income settlements (all part of Kagiso) with average consumption of 8.7 kls, 6.8, and 6.5 kls respectively.

The data shows that average consumption for Kagiso residents using postpaid meters is more than four times as high as the prepaid consumption. There is less difference between the consumption of prepaid and postpaid users in high-income suburbs.

All customers in Mogale City, irrespective of income, receive the first 6 kls of water free. More than half (53.5 percent) of customers in the three low-income settlements used 6 kls or less during the review period, and paid nothing for water. The average amount purchased per transaction by those who did buy water credit was a modest R25.12 (about USD 2.40). In stark contrast, the average amount per purchase in the upmarket housing estates was R377.92 (USD 36).

Featherbrooke, with 1,028 customers (23 percent of the total), accounts for 69 percent of the total R687,922 credit purchased over the review period. Together the 2,315 metered customers in Kagiso Extension 8, Sinqobele, and Chief Mogale comprise just over half (51 percent) of the sample, but bought just 6 percent of the prepaid sales sample.

Reasons that some residents did not buy credit during the month include credit remaining from the previous month, meter faults, bypasses, and other forms of tampering. The incidence of bypasses was slightly higher in the more affluent suburbs, and several involved high-quality brass coupling. Two meters from Pinehaven were enclosed in a welded steel box to prevent casual inspection. But monitoring has reduced the number of customers who get more water free by removing the valve diaphragm and cutting a hole in it, before put it back and closing up the meter.

Figure 1. Number of prepaid customers using a particular type of prepaid meter and being monitored, per suburb

Figure 2. Contribution to revenue, by suburb

Figure 3. Average monthly household consumption, by suburb
With the support of a specialist revenue management company, Mogale City has started monitoring consumption on sales and analysis monthly on a limited basis (Box B), and is expanding the number of meters it inspects using a combination of manual and automatic meter reading (AMR). AMR will soon predominate as the number of meters fitted with this capability rises. “AMR takes away the fear of bypasses,” says the city’s chief financial officer. AMR allows drive-by data collection, but the technology is expensive (about USD 50 for a factory-fitted AMR device, or about USD 100 for a retrofitted device). Manual meter reading is more labor intensive, raises access challenges, and is prone to recording errors, but is better at spotting bypasses and tampering. The rate of bypasses is now below 3 percent and falling in areas where there is regular visual inspection. Customers found tampering with their meters can be fined R3,000 (USD 285.70). If they are caught again, their connection will be removed and they will have to reapply for a connection and meter. They can be charged R5,000 for a replacement, but the penalties are seldom applied.

Finance, funding, and revenue

The municipality receives significant annual grant funding for infrastructure from the national government, in addition to substantial operating subsidies to fund basic service provision to low-income households. This largely explains why Mogale City’s commitment to prepaid metering is not informed by detailed cost modeling, and no detailed analysis has been done of the payback period or the volume of sales needed to cover costs. Their main driver is helping low-income customers keep their water consumption affordable, and changing the consumption behavior of customers to limit wastage.

The unit cost of the meters being installed currently averages about USD 270, including the device, installation, management software, and vending equipment. The municipality does not have figures on the cost of maintenance.

The chief financial officer would prefer to focus prepayment in high-income areas, and acknowledges that the utility receives no revenue benefit from putting prepayment in low-income areas, although it does preempt bad debt. The city’s revenue management service provider believes that even with grants and subsides, the utility only breaks even when average monthly household consumption is more than 25 kls per month.

Summary

Mogale City is one of the pioneers of prepaid water and remains committed to trying to make it work, despite the poor performance of many meters and low revenue relative to cost. Municipal leaders believe the new system currently being installed will offer greater reliability, better sales and consumption tracking, and more vending options. The outsourced service contract aims to take care of monitoring, maintenance, and repairs over a three-year period, but plans are not clear beyond this period.

“For us, prepaid water is like a marriage,” says Mogale City’s Water and Sanitation Manager, Sandile Mbanjwa. “We really believe in the idea of marriage, and we’re very committed to making it work. But sometimes a marriage just doesn’t work out. You don’t throw out the idea of marriage, you look for a new partner and you try to make it work. Yes, we still believe in it, and we really believe we can make it work.”

Prepaid meters are currently installed mainly in low-income areas, with some in high-income housing estates. Despite demand from middle- and high-income residents for prepaid water meters, the municipality says its priority is to offer prepayment to all poor customers first. It aims to install prepaid
as the default in all areas over the next five years. It has no plans to offer prepayment to institutions or business, as it believes they should be able to manage their own accounts. It is concerned that many government departments do not pay, and that collection from schools is particularly poor; but it is adamant that schools cannot be disconnected, and that prepayment is not appropriate in such cases.

Critics might argue that the high rate of failure in many of Mogale City’s prepaid meters, and resulting provision of free water, may explain the high level of customers’ satisfaction there with prepayment; household surveys found that 98 per said they prefer prepaid meter. But customers are equally positive about newer meters that have a low rate of failure and are monitored regularly to prevent tampering. They say the meters help them monitor and manage their consumption. “Unemployment is high here and many of us here are not working,” said one customer. “These meters are the best for us.”