Meter Audits in the Industrial Areas of the City of Tshwane

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Abstract

The City of Tshwane has undertaken various initiatives over the past 10 years to quantify and reduce its non-revenue water. The City of Tshwane has an advanced Management Information System in place which is used for, amongst other things, to identify areas with high non-revenue water levels, graphically display the demand per stand and to graphically display where un-metered stands are located. Through assessment of the outputs available in the management information system it became apparent that there were unmetered or unbilled stands in some of the industrial areas. It is crucial that all industrial consumers are metered properly because these consumers contribute to approximately 30% of the total water consumption of Tshwane even though they represent only 3% of the total number of consumers. This implies that if a relatively small number of industrial or commercial consumers are not correctly metered and billed, the impact can be severe on the water sales and non-revenue water of the municipality.

It was recognised that detailed field inspections were required to investigate the metering and billing anomalies pointed out by the management information system in industrial areas. In this regard, the City of Tshwane initiated a series of meter audit exercises in industrial areas to locate un-metered connections and to determine any anomalies with the metering and billing. Key issues, which were identified through the field inspections, included unmetered connections, broken meters and meters which do not appear on the billing system. What appears on paper to be a relatively simple process was in fact very complicated and time-consuming. The water supplies to each property were shut down completely to ensure that all unmetered connections could be identified. This included many large car manufacturers including BMW, Nissan and Ford who each produce thousands of vehicles each week and so great care had to be taken to minimise any problems to the customer.

Of the 1423 connections audited, 97 un-metered connections and 142 broken/malfunctioning meters were identified. The municipality installed new meters as a matter of priority and the water sales figures before and after the intervention were collected and compared. From the results for three of the five areas (which are already available), it is clear that the exercise has been a great success. The increase in metered consumption for three of the five areas was 180 000kl/yr which will result in an additional income of approximately R1.4million/yr (about $140 000/yr). Based on these initial results, it has been agreed to repeat the exercise throughout all industrial/commercial areas in the city.

This paper clearly highlights the importance of effective metering and billing in areas with large water users. It also illustrates the potential increase in metered consumption that municipalities may achieve through similar exercises.

Introduction

The importance of water conservation has been highlighted through various studies throughout South Africa. The rapidly increasing water demands cannot be sustained indefinitely and many parts of South Africa are already in a situation of severe and permanent water stress. Other areas face the prospect of prolonged and more frequent periods of water shortage as the demand for water outstrips the available resources. Water conservation is therefore becoming a major issue and government is requesting water utilities to actively implement programmes aimed at reducing water demand and non-revenue water.

The City of Tshwane is one of the largest municipalities in South Africa and covers an area of 2 200km^2 supporting a population of approximately 2.3 million people. The area is located in the industrial heartland of South Africa and includes the capital city of Pretoria and several other former municipalities which have all been incorporated into what is now known as the City of Tshwane. An average of 750 Ml/day (± 270 million m^3/yr) of potable water is supplied to the area which is distributed to approximately 370 000 consumer meters via a network of 9 700km of mains.

The City of Tshwane has developed a water demand management (WDM) strategy that incorporates a full spectrum of initiatives aimed at reducing water demand and non-revenue water. These initiatives include, but are not limited to, the timeous and effective repair of all reported leaks, active leakage control, implementation of a management information system, upgrading of worn out reticulation networks, meter audits to detect metering and billing anomalies, replacement of old consumer meters, implementing selected pressure management and adapting water tariffs every year to control excessive demand.

A number of the WDM initiatives, identified through the strategy, have been successfully implemented over the past few years and the impact on the overall water demand and the non-revenue water as a result of these actions are shown in **Figure 1.**

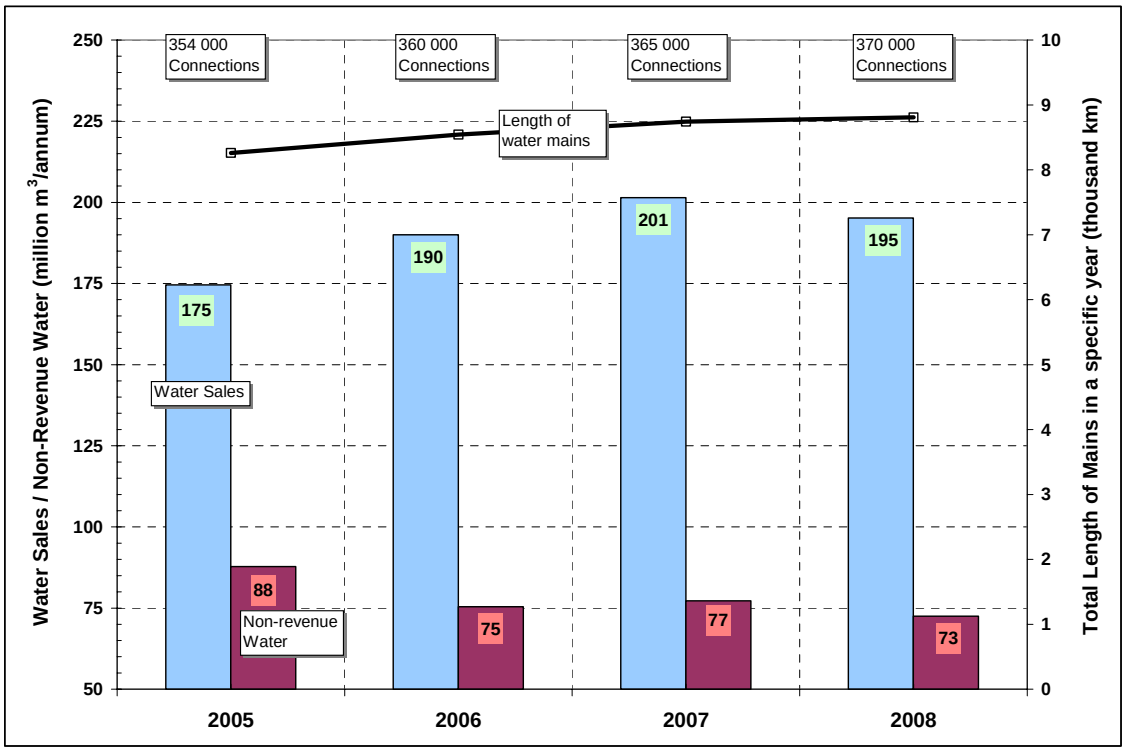

Figure 1: Graphical summary of water demand for the City of Tshwane over the last three years.

The results shown in **Figure 1** indicate that the overall water demand and the non-revenue water reduced over the last few years, even though the number of consumers and length of water mains increased over the same period. This was achieved through implementing a range of WDM interventions and carrying out maintenance activities, which included repairing approximately 29 000 reported leaks per year and replacing approximately 26 000 old / faulty consumer meters every year.

This paper will focus on one of the initiatives included in the WDM strategy of Tshwane, namely the undertaking of meter audits specifically in industrial areas with large water consumers. The paper will also illustrate how the management information system was initially used to identify billing and metering anomalies in these areas.

Management Information System

One of the tools available in Tshwane to monitor water demand is an advanced management information system, which is used for, amongst other things, to:

- identify district metered areas (DMA's) with high non-revenue water levels;
- graphically display the demand per stand to determine extreme high or low demands and to;
- graphically indicate which stands are metered to determine where un-metered stands are located. See **Figure 2** to **Figure 4** for different examples of some of the available outputs from the management information system.

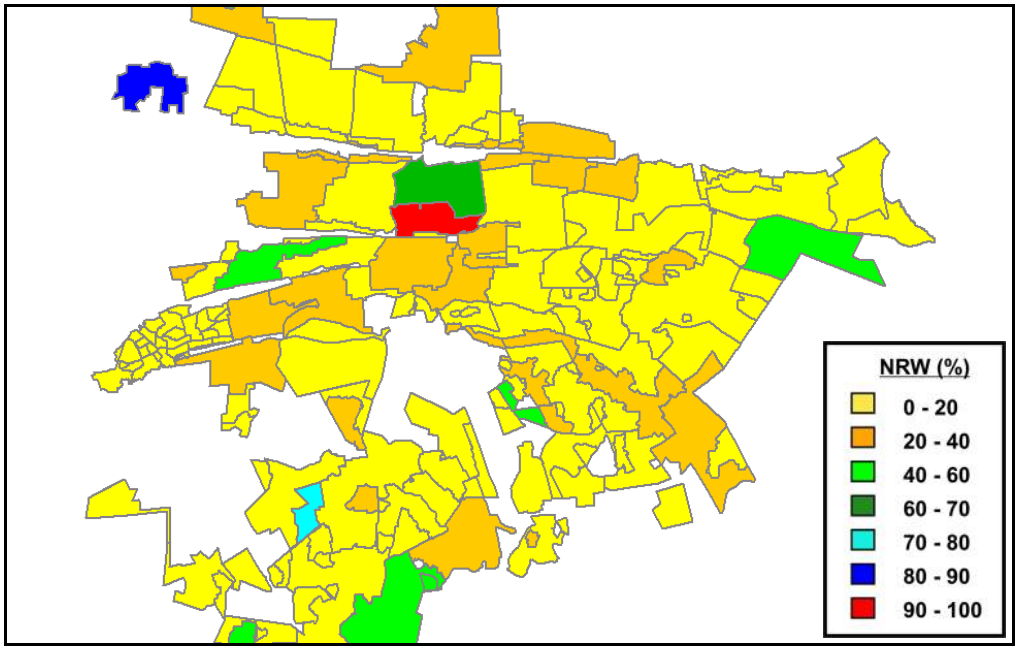

Figure 2: Screen from Management Information System of the City of Tshwane showing the DMA's with a colour coding which is based on the non-revenue water levels.

Figure 3: Screen from Management Information System of the City of Tshwane showing the Average Annual Daily Demand (AADD) for the different stands in an industrial area.

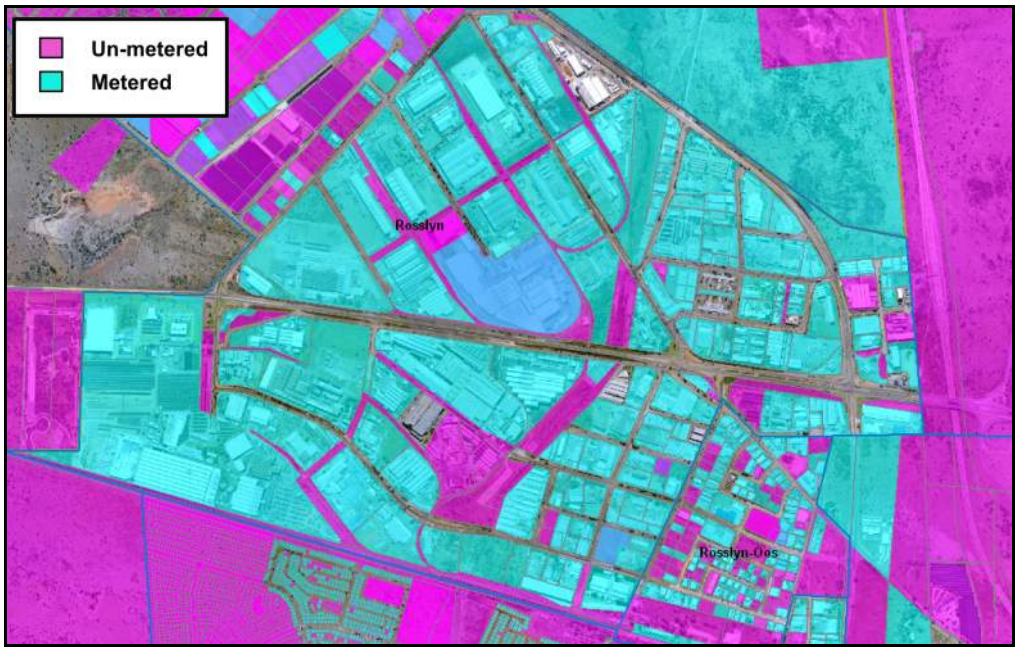

Figure 4: Screen from Management Information System of the City of Tshwane showing the metered stands in blue and the un-metered or unbilled stands in purple for the same industrial area shown in **Figure 3**.

Through assessment of the outputs available in the management information system it became apparent that there were unmetered or unbilled stands in some of the industrial areas (see **Figure 4**). It is crucial that all industrial consumers are metered properly because these consumers contribute to approximately 30% of the total water consumption of Tshwane even though they represent only 3% of the total number of consumers. This implies that if a relatively small number of industrial or commercial consumers are not correctly metered and billed, the impact can be severe on the water sales and non-revenue water of the municipality.

It was recognised that detailed field inspections were required to investigate the metering and billing anomalies pointed out by the management information system in industrial areas. In this regard, the City of Tshwane initiated a series of meter audit exercises in industrial areas to locate un-metered connections and to determine any anomalies with the metering and billing.

Meter Audits

The five largest industrial areas in Tshwane were identified for meter audits in an effort to ensure that all consumers in these areas are correctly metered and billed. The different steps of the audits are described below.

Field Investigation of existing metered connections and un-metered connections

Field inspections were carried out which included the identification and capturing of all relevant meter information, meter readings, problems observed with the meter installations and consumer details (see **Figure 5**). The typical problems identified during the field investigations included illegible meters, buried isolating valves which had to be exposed, broken meters, stolen meters, incorrect meter installations, un-metered connections and erratic meters. A standard form was prepared for the capturing of all the information. Where possible a copy of every consumer's water bill was requested and attached to the capturing form for the verification of meter and account details.

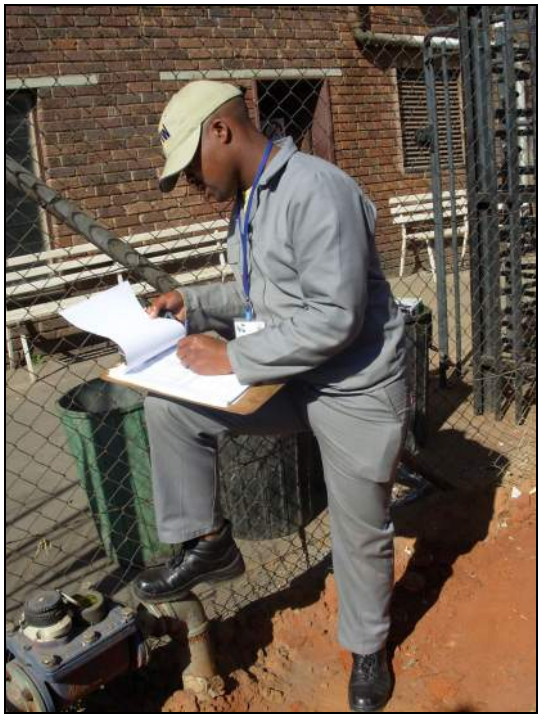

Figure 5: Example of a field technician completing a form during a meter audit exercise undertaken in the industrial areas of the City of Tshwane.

Water Supply Tests

As part of the meter audit, a water supply test was carried out for every consumer to detect if there were any un-metered connections. These tests were carried out as follows:

- The consumers were informed of the water test in a letter distributed before the commencement of the audit;
- Each consumer was contacted for the arrangement of an agreed date and time for the test;
- The supply test was carried out by the investigation team. All known metered connections to the stand were temporarily shut-off by the audit team;
- Water usage points such as tank inlets, hydrants and taps within the stand were monitored / opened to verify that there were no un-metered connections (flow and pressure reduced to zero);
- All un-metered connections identified during the course of the water supply test were recorded together with details of the supply points (hydrants and taps) receiving un-metered water.

A number of water supply tests were carried out for large industrial consumers. These included large car manufacturers (BMW, Nissan, and Ford), breweries (SAB-Miller) and food manufacturing factories (Premier Foods, Sunbake). For these industries arrangements for the tests had to be made well in advance due to the impact on production and of the fire risks associated with temporary shutting down the water supply. The Fire Department provided the necessary backup where the fire risk was considered serious.

Meter Installations and Replacements

Based on the outcome of the meter audits the municipality undertook the necessary meter installations, as summarised as follow:

- The first priority was to install meters for connections where meters had been stolen or unlawfully removed. (see **Figure 6**)
- Meters were installed on all un-metered connections (see **Figure 7**). Many of the older stands had un-metered fire connections, and in some instances these pipes had been connected to the normal reticulation of the stand;
- Meters that were illegible, broken or severely erratic were replaced. A summary of the meter installations and repairs per area are summarised below.
- At a few stands water leaks were identified upstream of the consumer meters. These leaks were repaired during the meter replacement exercise.
- Meters which were located inside stands were moved out to the roadside in an effort to simplify the reading of the meters by the municipal meter readers.

A summary of the meter installations in the industrial areas are summarised in **Table 1**.

Table 1: Summary of Meter Installations in Industrial Areas.

Industrial / Commercial Area	Number of Connections audited	Un-metered connections	Replace meter (Illegible, broken, stolen or erratic)		Repair Leak at meter
			Main Meter	Sub-meter of combination meter	
Rosslyn North	138	7	28	11	4
Rosslyn South	236	3	6	6	4
Pretoria Industrial	144	7	1	19	4
Pretoria West Light Industrial	355	52	9	24	5
Waltloo & Silvertonadale	550	28	54	18	8
Total	**1423**	**97**	**64**	**78**	**37**

Figure 6: Photos of connections where meters had been stolen or unlawfully removed.

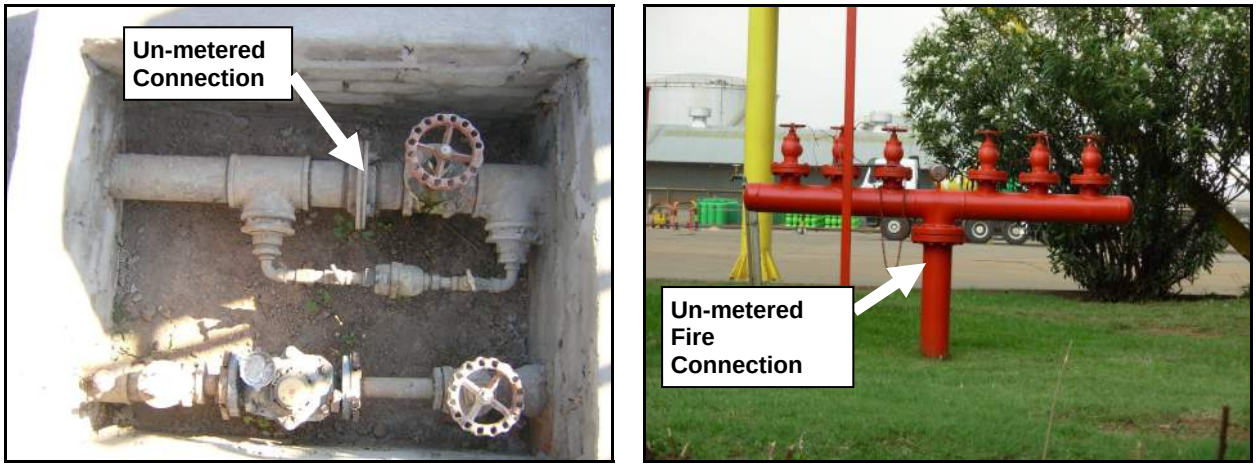

Figure 7: Photos of un-metered Fire Connections identified during the meter audits.

Updating of billing system

The City of Tshwane billing system had to be updated to ensure that it reflected all the existing meters identified during the audit as well as all the new meters which were installed. This process to update the billing system was summarised in a flow diagram to ensure that all the different scenarios would result in the billing of all active connections. (**Figure 8**)

An Infrastructure Management Information System (IBIS) manages the installation and management of all water meters in the city. Any updated information on meters is interfaced on a daily basis from IBIS to the SAP billing system to ensure that all new or replaced meters will be read and billed. Meters, which previously existed on site but did not appear on the billing system, had to be placed manually onto the billing system.

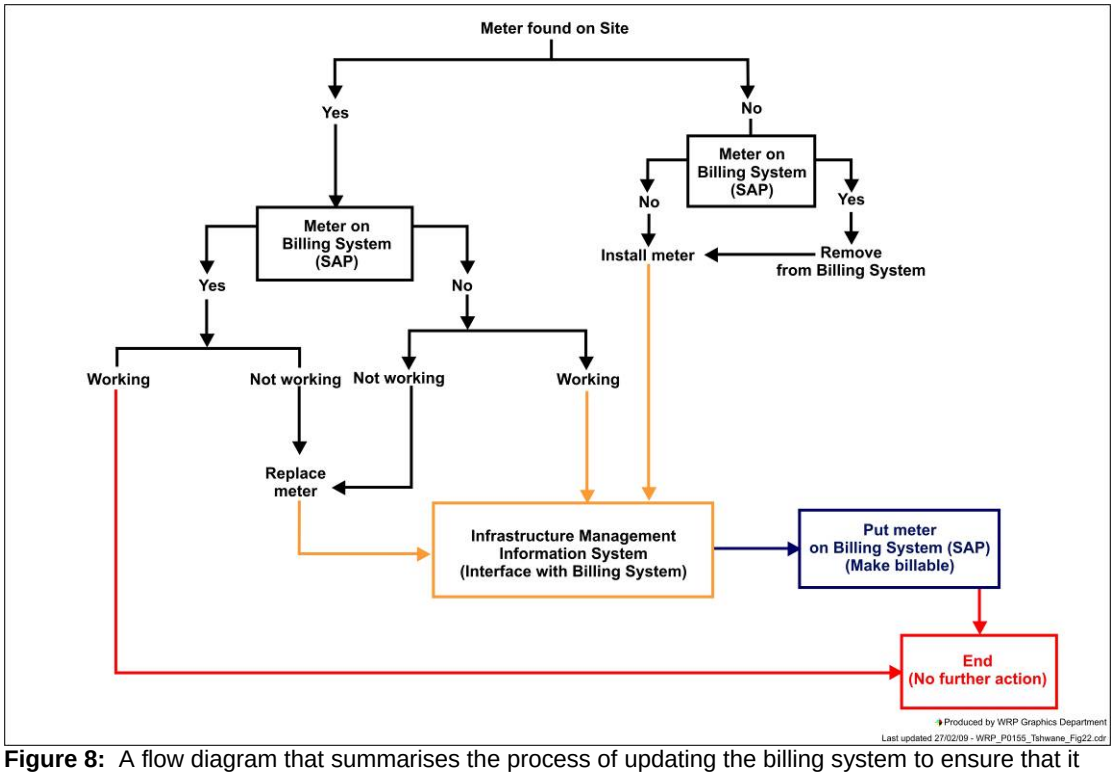

Figure 8: A flow diagram that summarises the process of updating the billing system to ensure that it reflected all the existing meters as well as all new meter installations

Results

Of the 1423 connections audited, 97 un-metered connections and 142 broken/malfunctioning meters were identified. The municipality installed new meters as a matter of priority and the water sales figures before and after the intervention were collected and compared. The results for three of the five areas are summarised in **Table 2** (the results for the remaining two areas are expected by March 2009).

Table 2: Summary of Results.

Industrial/ Commercial Area	No. of Connections audited	Increase in Consumption (kl/yr)	Cost of Interventions (R)	Increase in Revenue (R/yr)	Return on Investment
Rosslyn North	138	60 000 kl/yr	R338 541	R438 000	10 months
Rosslyn South	236	36 000 kl/yr	R438 238	R278 000	1 Yr, 6 Months
Pretoria Industrial	144	87 600 kl/yr	R455 897	R678 000	8 Months
Total	**518**	**183 600 kl/yr**	**R1 232 676**	**R1 394 000**	

From the results for three of the five areas (which are currently available) it is clear that the meter audit and subsequent meter installation exercise has been a great success. The increase in metered consumption for three of the five areas was 180 000kl/yr which will result in an additional income of approximately R1.4million /yr (about US$140 000/yr). The additional income was calculated based on the increase in metered water consumption and on the increase in tariff for industrial effluent discharge. In the City of Tshwane the effluent discharge tariff is calculated using the water consumption and, therefore, an increase in water consumption will also result in additional charges for effluent discharge.

Conclusions

Based on the results presented, the meter audit exercise has been highly successful showing payback periods of less than two years in some cases payback periods of less than one year, making it a highly viable intervention. Any payback period of less than two years are usually considered feasible for water demand management interventions. The next step for the City of Tshwane will be to extend the meters audits to all other non-domestic consumers (e.g. flats, hotels, office buildings).

This paper clearly highlights the importance of undertaking detailed field work in conjunction with using other systems such as a management information system, to reduce non-revenue water. It also illustrates the potential increase in metered consumption that water utilities may achieve through similar exercises.

Acknowledgements

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- Mr David Moore (WRP Engineers)
- Mr Guy Price (WRP Engineers)

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