

Profitability, Efficiency and Tariffs in Piped Water Systems in Rulindo and Gicumbi

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Executive Summary

In Rwanda, Water For People is present in the districts of Rulindo, Gicumbi and Kicukiro, where it has supported the construction and expansion of piped water schemes and provided technical assistance to local stakeholders. The management of these systems has been contracted to private operators. All the piped systems in Rulindo are operated by the Ayateke Star Company. In Gicumbi, some systems are operated by Ayateke, while others are operated by another firm, PAAK KAM. Ayateke has recently claimed that it cannot make a profit from running the systems in Rulindo, and it has called for an increase in the tariffs charged to users. These currently stand at RWF 8 and RWF 20 per jerry can in gravity and electrical pumping systems, respectively. In late 2018 a study found that the systems have the potential to be operated profitably, but the analysis was based on a single parameter (the population served by each system) and relied heavily on theoretical assumptions.

The analysis documented in this report has assessed the operational and financial performance of Ayateke and PAAK KAM in operating the water systems in Rulindo and Gicumbi, and, in particular, whether tariff increases are indeed necessary to turn Ayateke's losses into profits. For this purpose, a sophisticated spreadsheet model was built, based on performance data of the water systems in the two districts. Besides using real world data rather than theoretical assumptions, the model is a powerful tool that incorporates multiple variables and allows for specific measures to increase profitability to be quantitatively assessed.

	Rulindo (Ayateke)	Gicumbi – Ayateke	Gicumbi – PAAK KAM
Collected revenue	6,324,753	1,230,245	2,292,167
Private connections	1,865,748	211,030	217,887
Institutional connections	1,793,262	352,096	125,003
Public standpoints	2,630,885	658,248	1,869,646
Other connections	34,858	8,871	79,630
Operating costs	7,353,621	1,437,091	2,063,355
Fuel	333,825	1,739	0
Electricity	3,137,983	237,694	884,116
Staff	2,561,235	797,359	936,673
Material, maintenance	956,732	231,830	128,500
Others	363,845	168,469	114,067
Fees	715,719	142,008	272,487
Local government	694,873	137,872	264,551
Taxes	20,846	4,136	7,937
Net profit / loss	-1,744,588	-348,853	-43,675

The average monthly operating cash-flows over the period covered by the data (May 2017-April 2019 for Ayateke, August-October 2019 for PAAK KAM) are the following:



Ayateke is responsible for 36 piped systems in Rulindo and 31 in Gicumbi, nine of which – three in Rulindo and six in Gicumbi – are not functional or abandoned. In addition, 13 systems in Gicumbi do not have water meters, preventing Ayateke from billing users. Overall, only 57% of the population served by Ayateke in Gicumbi is served by systems which are functional and where Ayateke is able to bill users, compared to 87% in Rulindo. As to PAAK KAM, it is responsible for 24 piped systems in Gicumbi, five of which are not functional. In addition, one system does not have water meters. Overall, only 61% of the population served by PAAK KAM in Gicumbi is served by systems which are functional and where PAAK KAM is able to bill users.

Private connections, institutional connections and public standpoints (PSPs) are the three main types of user connections in the piped water systems in Rulindo and Gicumbi. While the number of connections of each type and the amount of water sold per type vary significantly between systems, both Ayateke and PAAK KAM sell most of the water through PSPs, in both districts.

According to the data, even if they are metered, not all connections are billed by the operators every month. Instead, the number of connections whose users are billed fluctuates significantly from month to month; on average, Ayateke bills only about 44-57% of existing connections in Rulindo and 21-47% in Gicumbi, while PAAK KAM bills 33-50% in Gicumbi. One possible reason behind these fluctuations may be component failure which stops the flow of water to some sections of the scheme.

As in any water system, the systems managed by Ayateke and PAAK KAM face the challenge of non-revenue water (NRW) – water which is produced but does not generate revenue to the operator. NRW includes both water which is produced but not billed to users (physical NRW), and water which is billed but for which the operator is unable to collect revenue (commercial NRW). Ten percent of produced water in each of these categories is usually considered acceptable. **NRW in all systems analyzed in this study is very high: in systems operated by Ayateke in Rulindo NRW averages 66%**, with 40% corresponding to non-billing and 26% to non-payment; **in systems operated by Ayateke in Gicumbi NRW averages 86%**, with 81% corresponding to non-billing and 26% to non-payment; **in systems operated by PAAK KAM in Gicumbi NRW averages 81%**, with 78% corresponding to non-billing and 3% corresponding to non-payment.





In order to address these challenges, the following measures are proposed:

- 1) Increase connection billing rates in all types of connections;
- 2) Decrease physical NRW;
- 3) Decrease commercial NRW;
- 4) Install water meters in systems where they are not in place;
- 5) **Rehabilitate** non-functional systems.

Measures 1, 2 and 3 do not require significant investments and can be implemented in the short-term, while measures 4 and 5 may require significant investments and be implementable only in the mid-term (say, within one to two years).

The key finding of the analysis documented in this report is that **if all the proposed measures are implemented, the private operators in both districts will vastly improve their profitability without the need to increase tariffs**. The only scenario where tariff increases could be necessary would be in Rulindo, if water treatment – which, despite being a formal requirement to water supply operators, neither Ayateke nor PAAK KAM are currently doing, and which would represent an additional cost to them – was enforced before all measures, including the mid-term measures of system rehabilitation and water meter installation, were implemented. This may be easily avoided if water treatment is enforced only after all measures are implemented.



1 Introduction

1.1 Opening Remarks

Water For People has its largest country program in Rwanda. Within Rwanda, Water For People is present in the districts of Rulindo, Gicumbi and Kicukiro. In Rulindo, together with the district local government and Rwanda's Water and Sanitation Corporation (WASAC), Water For People launched the Rulindo Challenge Program in 2010 with the aim of expanding water infrastructure and providing everyone in the district with access to water. The program made substantial investments in piped water systems in Rulindo. Investment costs were jointly borne by Water For People, the local government and WASAC. Coverage of water supply infrastructure in Rulindo has vastly increased thanks to the program, with 100% coverage expected to be achieved by the end of the first quarter of 2020; all of Rulindo's 17 sectors now have piped water supply systems. Water For People is also supporting water systems in Gicumbi, with a plan to achieve 100% coverage by 2023/2024. In terms of scheme technology, both in Rulindo and in Gicumbi the water systems comprise gravity and electrical pumping schemes.

As per Rwanda's national water policy, the management of these piped systems has been contracted to private operators. All systems in Rulindo together with some systems in Gicumbi are operated by the Ayateke Star company, and have been formally under Ayateke's management for over two years. The remaining systems in Gicumbi were previously operated by another firm, AGEOH. Due to poor performance from AGEOH, the district government terminated its contract and management of the systems was transferred to Ayateke for some time, albeit without a formal contract. A contract for the operation of the systems was eventually awarded in mid-2019 to a third firm, PAAK KAM.

Ayateke has repeatedly claimed that it cannot make a profit from running the systems, and it has called for increases in the tariffs charged to users. The current tariffs set by the Rwanda Utilities Regulatory Authority (RURA), stand at RWF 8 per 23-liter jerry can in gravity schemes and RWF 20 in electrical pumping schemes. A consultancy report was commissioned in late 2018 to assess the profitability of the systems. While the report found that the systems have the potential to be operated profitably, the assessment had a number of shortcomings, the main of which being that the analysis carried out was entirely based on one parameter – the population served by each system – and that it relied heavily on theoretical assumptions. Another assessment of the systems in Rulindo was undertaken in 2019 but it focused largely on technical parameters rather than profitability.

The broad purpose of the analysis documented in this report is to assess the operational and financial performance of the water systems in Rulindo and Gicumbi. The analysis also examines the legitimacy of Ayateke's claims about lack of profitability and investigates whether tariff increases are indeed necessary to make the company's water



business profitable. To achieve these goals, a sophisticated spreadsheet model of the systems, using detailed system performance data, has been built. For the systems operated by Ayateke, the data spans a period of two years – May 2017 to April 2019 – whereas for the systems operated by PAAK KAM the available data covers the period between August and October 2019.

The main strengths of the model, notably compared to the first assessment mentioned above, are the following:

- It incorporates multiple operational and financial variables;
- It uses real world data rather than theoretical assumptions;
- It is a powerful, flexible tool that allows for the evaluation of the financial impact of specific measures to increase profitability, and the calculation of various quantitative indicators of interest.

A fourth strength which should not be underappreciated is the fact that, in the process of building the model, the system performance data was compiled into a single spreadsheet. This is an achievement in itself given that the monthly data shared by both Ayateke and PAAK KAM is fragmented in a multitude of files which it would be very cumbersome to analyze systematically. Many small inconsistencies and errors were identified in the data during the compilation process; these are listed in annex.

1.2 Overview of Financial Performance

The table below displays the average monthly aggregate operating revenue, costs, and profit made by Ayateke and PAAK KAM in Rulindo and Gicumbi over the periods covered by the respective data. The figures shown were calculated based on the figures reported by the operators for the individual water systems, except for the last column, which shows aggregate figures reported by PAAK KAM.

	Rulindo (Ayateke)	Gicumbi – Ayateke	Gicumbi – PAAK KAM	Gicumbi – PAAK KAM (reported by firm)
Billed revenue	6,948,279	1,378,715	2,645,509	2,218,287
Private connections	2,280,081	271,458	291,289	291,289
Institutional connections	2,086,165	394,412	157,607	172,825
Public standpoints	2,572,085	700,945	2,107,082	1,664,643
Commercial, industrial and other connections	10,398	11,900	89,531	89,531
Collected revenue	6,324,753	1,230,245	2,292,167	2,140,491
Private connections	1,865,748	211,030	217,887	217,887
Institutions	1,793,262	352,096	125,003	139,024
PSPs	2,630,885	658,248	1,869,646	1,703,950

Figure 1 – Average Monthly Aggregate Revenue, Costs and Profit of Systems in Rulindo and Gicumbi (RWF)



Commercial, industrial and other connections	34,858	8,871	79,630	79,630
Operating costs	7,353,621	1,437,091	2,063,355	2,063,355
Fuel	333,825	1,739	0	0
Electricity	3,137,983	237,694	884,116	884,116
Staff	2,561,235	797,359	936,673	936,673
Material, maintenance	956,732	231,830	128,500	128,500
Others	363,845	168,469	114,067	114,067
Gross profit – billed revenue	-404,893	-58,376	582,154	154,932
Gross profit – collected revenue	-1,028,869	-206,846	228,812	77,136
Fees	715,719	142,008	272,487	532,563
Redevance royalties	694,873	137,872	264,551	187,525
RRA tax	20,846	4,136	7,937	345,038
Net profit – billed revenue	-1,120,612	-200,383	309,666	-377,631
Net profit – collected	-1,744,588	-348,853	-43.675	Not reported

Private connections are connections owned by individual households. "RRA" refers to the Rwanda Revenue Authority. "*Redevance* royalties" are the fees owed by the operators to the district local governments of Rulindo and Gicumbi, as part of the contractual arrangements governing the operation of the water systems. Profit is shown in terms of both billed revenue – the water sales that the operators billed to system users – and collected revenue – the revenue that the operators were able to collect from users.

The aggregate cost and revenue figures for the systems operated by Ayateke differ slightly from those reported by the company due to small calculation errors in the latter. The figures shown in the table were calculated based on individual system data and accurately represent costs and revenue. But both sets of figures lead to the same conclusion: in the period covered by the data, Ayateke made an operating loss from operating the water systems, according to what it claims.

As to PAAK KAM, the aggregate financial figures reported by the firm differ substantially from those that were calculated, for various reasons. One is the inexplicable omission in the firm's financial report, for the calculation of total revenue, of the revenue from PSPs in one of the systems operated by the company (Rwungo-Manyagiro) in one or more months. This happens to be a system with substantial revenue from PSPs, which causes the average reported revenue to be significantly smaller than calculated. Another reason is the inclusion, in PAAK KAM's report, of an additional component to the RRA tax which is not shown anywhere in Ayateke's reports, and calculated by means of a bizarre formula. *Redevance* royalties are also miscalculated. As a result of these errors, PAAK KAM's reports show an average net loss, in terms of billed revenue, of over RWF 377,000, whereas the calculations show an average net profit of almost RWF 310,000. This



represents a total discrepancy between what is reported by PAAK KAM and what is calculated of more than RWF 687,000, in billed revenue terms.

As shown in section 2.1 below, the number of systems operated by Ayateke in the two districts is similar, but the systems in Rulindo have revenue and operating costs that are more than five times larger than those in Gicumbi. This reflects the fact that the average functional system operated by Ayateke in Rulindo serves 4,450 people, compared to 1,580 in Gicumbi. The total revenue billed by PAAK KAM in Gicumbi is almost twice as large as that billed by Ayateke in the district, despite the fact that PAAK KAM operates thirteen functional systems while Ayateke operates twenty-five. This happens because the average functional system operated by PAAK KAM serves 5,265 people. In both districts and with both operators PSPs account for the largest share of revenue, particularly in the systems operated by PAAK KAM at a proportion of about 80%.

Ayateke's single largest cost item is electricity in Rulindo, which accounts for more than 40% of the firm's operating costs in the district and more than one third of its total operating costs in the two districts. An analysis to Ayateke's electricity costs found that they are reasonable considering the average volume of water pumped and pumping head, however. The other notable cost item is staff, which represents almost one third of Ayateke's operating costs in Rulindo and over 50% in Gicumbi, and is PAAK KAM's largest cost item. It is difficult to say whether the operators are over-staffed or not, given the lack of benchmarks for rural piped water scheme operators.

1.3 Summary

The main highlights of sections 1.1–1.2 above are:

- The piped water systems in the districts of Rulindo and Gicumbi, where Water For People has the bulk of its water supply activities in Rwanda, are operated by two private firms, Ayateke Star and PAAK KAM.
- Ayateke has claimed that it makes net operating losses from operating the systems and it has called for an increase in tariffs in Rulindo. Ayateke's performance reports for the period May 2017 to April 2019 show an average aggregate monthly net loss of over RWF 1.7 million in Rulindo and almost RWF 350,000 in Gicumbi, in collected revenue terms. PAAK KAM makes a net loss of RWF 44,000 in collected revenue terms and a net profit of about RWF 310,000 in billed revenue terms. This contrasts with the loss of RWF 377,000 that is reported by the firm.
- In order to analyze the operators' performance in detail and investigate the need for the increase in tariffs requested by Ayateke, a sophisticated model of the systems has been built. The model incorporates multiple operational and financial variables and it is a powerful tool that allows for the evaluation of possible measures to increase profitability.



2 Findings

2.1 System Type and Status

The water systems that Ayateke and PAAK KAM operate in Rulindo and Gicumbi are individual schemes that serve one or more villages.

No.	Name (village(s) served)
1	Bitete-Rwahi
2	Buramira
3	Gakoma
4	Gasuro
5	Gasama
6	Gisoro-Nyundo
7	Gatare
8	Kigarama
9	Kibuye
10	Kirambo
11	Kirikumuryango
12	Kishwi
13	Mutagata Gravity
14	Mutungo
15	Nkombe
16	Ntakara
17	Ntaruka
18	Nyabishengeshi
19	Nyagahondo
20	Nyakabizi
21	Nyakiriba
22	Rusave
23	Rushinya-Taba
24	Rutare-Nyirangarama
25	Rutembe-Mpango-Bushoki
26	Rutomvu
27	Rwamugaza
28	Rwiseke
29	Rwambogo
30	Kararama
31	Ngoma EPS
32	Kinywamagana
33	Marenge
34	Musenge
35	Mutagata EPS
36	Tare

No.	Name (village(s) served)
1	Byimana-Burimbi
2	Cyamuhinda-Kagogo
3	Gisiza
4	Gitoma
5	Bucyazo-Rebero
6	Byimana-Ruhondo
7	Gatoma
8	Jamba-Muko
9	Kabakene
10	Kagomero
11	Kagusa
12	Kamutora
13	Kanyirabuki-Cyeya
14	Kinnyogo-Kaniga
15	Kivomo-Rushaki
16	Muhondo
17	Nangara
18	Nyakeru
19	Nyagahanga
20	Nyakagezi-Nyabishambi
21	Nyamabuye II
22	Ruboroga I
23	Ruboroga II
24	Ruhondo-Mukono-Kanombe
25	Rurumbira
26	Rusebeya-Mulindi
27	Rwangabo-Bwisige
28	Rwengwe
29	Nyakabingo-Shangasha- Bwisige-Mukarange
30	Cyuru-Gisiza
31	Kamushure-Bugomba
Figures	O and O List of Water Ovetano

Figures 2 and 3 – List of Water Systems Operated by Ayateke in Rulindo (left) and Gicumbi (right)



No.	Name (village(s) served)
1	Rwungo-Manyagiro
2	Nyankenke-Kisaro-Mutete-Zoko
3	Murama-Rwamiko-Bukure
4	Nyiraruzenga-Maya
5	Bureranyana-Tanda
6	Gishambashayo-Gatuna
7	Gitaba-Mafurebo
8	Kigogo
9	Rwimbogo-Gaseke
10	Bukure-Karagari-Nyanza
11	Rutare-Gaseke
12	Gacyeri-Rwamiko-Bukure
13	Ruhurura-Yaramba
14	Kiriba-Mabare
15	Gatoki-Gatuna
16	Kamaganga-Mwange
17	Kamushenyi-Nyande
18	Bulindi-Cyumba
19	Rutare
20	Rumuli
21	Karwanira-Yaramba
22	Museke
23	Karushya-Ruzizi
24	Nyakagezi-Rwesero

Figure 4 – List of Water Systems Operated by PAAK KAM in Gicumbi

Three out of the thirty-six systems operated by Ayateke in Rulindo are recorded as being not functional as of April 2019. A further nine systems are recorded as functional or partially functional but no operational or financial data is available; the status of these systems is unclear. As to the systems operated by Ayateke in Gicumbi, five are not functional, thirteen are functional but do not have water meters, and one system is abandoned. One other system is recorded as being partially functional.

Regarding the systems operated in Gicumbi by PAAK KAM, five are recorded as being not functional as of October 2019. A further six systems have unclear status, as they are recorded as functional or partially functional but no data is available, and one system is partially functional but not metered.

The break-down of system functionality in terms of population served (rather than in number of systems) is shown in figures 5, 6 and 7. 87% of the population served by Ayateke in Rulindo is served by fully functional systems, compared to only 57% of the population served by Ayateke in Gicumbi and 61% of the population served by PAAK KAM.



Figures 5, 6 and 7 – Population Served by the Water Systems, by System Status, in Rulindo (left), Gicumbi – Ayateke (right) and Gicumbi – PAAK KAM (bottom)





In Gicumbi, 26% of the population served by Ayateke is served by systems that are functional but do not have water meters, where Ayateke is unable to bill users for water. 13% of the population was once served by systems which are presently not functional and a further 4% by a system that was abandoned. Looking at the population served in Gicumbi by PAAK KAM, 12% is served by partially functional systems, and 18% was once served by systems which are currently not functional.

Figures 8, 9 and 10 show the break-down of the population served by functional systems

(including partially functional systems and systems without water meters) by system technology.



Figures 8, 9 and 10 – Population Served by Functional Water Systems, by System Type, in Rulindo (left), Gicumbi – Ayateke (right) and Gicumbi – PAAK KAM (bottom)





Even though only seven out of twenty-four functional systems in Rulindo are electrical pumping systems, together they account for more than half of the population served by Ayateke in the district. A similar pattern occurs with PAAK KAM in Gicumbi, where three electrical systems out of thirteen serve half the population. Regarding the systems in Gicumbi operated by Ayateke, gravity systems dominate both in terms of absolute number and population served.

2.2 Connections

The water systems in Rulindo and Gicumbi have three main types of user connections: private connections, institutional connections and PSPs. Figures 11, 12 and 13 show the number of connections of each type in each functional system.







Figure 12 - Number of Connections per System, per Type, in Gicumbi - Ayateke





Figure 13 - Number of Connections per System, per Type, in Gicumbi - PAAK KAM



While the number of connections varies significantly between systems, in most systems private connections make up the majority of connections. However, this does not mean that most water is sold through private connections. Figures 14, 15 and 16 show the distribution of the average monthly water billed per type of connection in each functional system.



Figure 14 – Average Monthly Water Billed per Type of Connection per System (m³) in Rulindo



Figure 15 – Average Monthly Water Billed per Type of Connection per System (m³) in Gicumbi – Ayateke



Figure 16 – Average Monthly Water Billed per Type of Connection per System (m³) in Gicumbi – PAAK KAM





Overall, both Ayateke and PAAK KAM sell most of the water through PSPs. The reason why so few systems are represented on Figures 15 and 16 is that a high proportion of systems in Gicumbi either currently do not have water meters, are not functional, or have unclear status and no water billing data.

Not all connections are billed by the operators in every month, even if they are metered. Instead, according to the data, the number of connections whose users are billed fluctuates significantly from month to month. As an example, Figure 17 shows the number of private connections that were billed by Ayateke in the Mutagata Gravity system in Rulindo between May 2017 and March 2018.

Month	May -17	Jun -17	Jul- 17	Ago -17	Sep -17	Oct- 17	Nov -17	Dec -17	Jan -18	Feb -18	Mar -18
# of billed connections	70	54	55	57	51	70	70	70	46	46	46

Figure 17 – Number of Private Connections Billed by Ayateke Between May 2017 and March 2018 in the Mutagata Gravity System

This may be the result of natural variations in water consumption by users, with lower consumption in rainy months. Another possible cause for these fluctuations is component failure, in valves, pipes and fittings, which stops the flow of water to some sections of the scheme. If this is the case, the pattern in the example above suggests that such failures can last for several months and affect a substantial number of connections. In fact, on average, only 21-55% of private connections, 24-44% of institutional connections and 47-57% of PSPs are billed by the operators on any given month. Figures 18, 19 and 20 show the proportions of private connections billed. The proportions of institutional connections billed and PSPs billed are shown graphically in Annex 2.

Figures 18, 19 and 20 – Average Billed Private Connections in Rulindo (left), Gicumbi – Ayateke (middle) and Gicumbi – PAAK KAM (right), as Proportions of Total Private Connections





2.3 Non-Revenue Water

Even if a connection is functional and billed, the amount of water billed may be less than total water produced due to physical losses in pipe leakages or other factors (meter tampering, etc.). This is one component of NRW. The data shared by the operators included data on water produced, which was calculated to assess the extent of this component of NRW.

Figures 21, 22 and 23 – Average Proportions of Water Produced that are Billed to Users, in Rulindo (left), Gicumbi – Ayateke (middle) and Gicumbi – PAAK KAM (right)



A very large proportion of the water that is produced in the systems in Rulindo – 40% on average – is never billed by Ayateke to the systems' users, thereby not generating revenue. All systems have water meters, therefore the gap can only be explained by physical water losses or other factors. In Gicumbi the gap is even larger – a staggering 81% of the water produced by Ayateke and 78% of the water produced by PAAK KAM is not billed by the operators to users. In the case of Ayateke, this is partly explained by the fact that a substantial number of systems it operates in Gicumbi do not have water meters, meaning that users are never charged for water and effectively obtain it for free. In the case of PAAK KAM, however, all functional systems but one have water meters.

Figures 24, 25 and 26 show the proportion of water billed at the level of the individual systems. Note that whereas in the charts above, the blue color represents the proportion of water produced that is billed, in the figures below it represents total water produced.





Figure 24 – Total Water Produced vs. Billed per System (m³) in Rulindo







Figure 26 – Total Water Produced vs. Billed per System (m³) in Gicumbi – PAAK KAM



Out of the 57 individual systems analyzed, only one system – Musenge, in Rulindo – fulfils the operators' target of not exceeding 10% of NRW between production and billing.

The other component of NRW is commercial losses – water that is billed to users but not paid by them (immediately at least).



Figures 27, 28 and 29 – Average Proportions of Water Billed that are Paid by Users, in Rulindo (left), Gicumbi – Ayateke (middle) and Gicumbi – PAAK KAM (right)



PAAK KAM fares significantly better than Ayateke on this account, being able to collect 87% of water billed to users, on average. Ayateke collects only 56% in Rulindo and 71% in Gicumbi, on average.

Now looking at the individual systems:



Figure 30 – Total Water Billed vs. Paid per System (m³) in Rulindo

Figure 31 – Total Water Billed vs. Paid per System (m³) in Gicumbi – Ayateke





Figure 32 - Total Water Billed vs. Paid per System (m³) in Gicumbi - PAAK KAM



Combining the two measures, billing and payment, one can arrive at total NRW – the total proportion of water produced that ends up not being paid by users.





Besides the 40% of water that is lost in the systems operated by Ayateke in Rulindo, an additional 26%, on average, is not paid by users, bringing total NRW to 66%. In Gicumbi, an astounding 78-81% of water is lost or not metered and an additional 3-5% is not paid,



bringing total NRW to 81-86%, on average, in systems operated by Ayateke and PAAK KAM respectively. Total NRW at the individual system level is shown in Annex 3.

2.4 Summary

The main highlights of sections 2.1–2.3 above are:

- Of the thirty-six piped systems operated by Ayateke in Rulindo, three are nonfunctional and nine have unclear status. Of the thirty-one systems operated by Ayateke in Gicumbi, five are non-functional, one is partially functional, and thirteen are functional but do not have water meters. Of the twenty-four systems operated in Gicumbi by PAAK KAM, five are non-functional, one is partially functional but has no water meters, and six have unclear status. Overall, in Gicumbi, only 57% of the population served by Ayateke and 61% of the population served by PAAK KAM are served by fully functional and metered systems, compared to 87% in the systems operated by Ayateke in Rulindo.
- The main types of user connections in the systems are private connections, institutional connections, and PSPs. While private connections are on average the most numerous, most of the total water sold by Ayateke and PAAK KAM to users is sold through PSPs.
- Even if they are metered, not all connections are billed by the operators in every month. On average, Ayateke bills only 44-57% of connections in Rulindo and 21-47% in Gicumbi, and PAAK KAM bills only 33-50% of connections. This may be the result of failure of components which stops the flow of water to some sections in the systems for several months.
- NRW is very high. In the systems operated by Ayateke in Rulindo it is 66% on average, with 40% being water that is produced but not billed to users and 26% being water that is billed to users but not paid. In Gicumbi it ranges from 81-86% on average, with 78-81% being water that is not billed and 3-5% being water that is billed but not paid, on average.



3 Possible Measures to Increase Profitability

The previous section described the challenges faced by Ayateke and PAAK KAM in the operation of the schemes in Rulindo and Gicumbi: i) systems which are non-functional or whose status is unclear; ii) systems without water meters in Gicumbi; iii) low connection billing rates; and iv) high NRW, both physical and commercial. All these challenges negatively impact the operators' bottom line. The non-functional systems and systems without water meters, together with low connection billing rates, mean that total billed revenue is smaller than it could be. In addition, high commercial NRW affects collected revenue, and high physical NRW causes higher than necessary fuel and electricity costs with water extraction in electrical pumping systems.

At the same time, the rate of water infrastructure coverage is high, especially in Rulindo, where it is expected to reach 100% soon. The rationale for the measures that are presented and discussed in the following sub-sections is thus not to further expand infrastructure, but to address the above-mentioned challenges:

- 1) Increase in billing rates in all types of connections;
- 2) Decrease in physical NRW by reducing superfluous water production;
- 3) Decrease in commercial NRW by increasing commercial efficiency;
- 4) Installation of water meters in systems where they are not in place;
- 5) Rehabilitation of non-functional systems;
- 6) Accounting for systems of unclear status.

The model was used to estimate in detail the potential financial impact of each of these measures on Ayateke and PAAK KAM's financial results. Having done so, it is possible to ascertain whether their combined impact is sufficient for the operators to attain positive profits or whether an increase in tariffs, as requested by Ayateke, could be necessary.

3.1 Increase in Billing Rates

As demonstrated in section 2.2, both Ayateke's and PAAK KAM's current billing rates are quite low. It is unacceptable that only 21-57% of connections are ever billed (in several systems, the average rates are close to zero). It is imperative that this proportion increases.

From a purely financial perspective, if a connection is not billed, for all effects and purposes it is as if it did not exist. Therefore, an increase in billing rates can be modelled as if new connections were being added to the system. In the model, the additional revenue from billing one more connection of a given type (private, institutional or PSP) in a particular system was estimated as the average revenue per connection that is obtained from the connections that are billed. If two or more additional connections are billed, the



increase in revenue is estimated as the number of additional connections multiplied by the average revenue per connection.

By how much should Ayateke and PAAK KAM increase billing rates? Ayateke's draft business plan sets 20% as the target for NRW – 10% in physical losses and a further 10% in commercial losses (PAAK KAM's business plan is not available). This is equivalent to billing 90% of the water that is produced and collecting bills on 80%. In similar fashion to these targets, it is proposed that Ayateke and PAAK KAM strive to bill 90% of existing connections on average, ideally in every individual system. If the total number of connections in the system is five or less, 100% is proposed.

The estimated financial impact of increasing billing rates in private connections in the systems operated by Ayateke in Rulindo, using such assumptions, is shown on Figure 36.

An additional aspect must be considered to make the estimate more realistic. This is the imperfect link between the number of billed connections and revenue. When the number of billed connections increases, revenue increases less than proportionally because of various reasons. One is that when a connection isn't billed because it is unavailable for use, users may switch to neighboring connections, and still generate revenue for the operator. Therefore, this revenue would have to be subtracted from the revenue increase from billing the connection to determine the net additional revenue to the operator from billing it. Another reason is that users may at times choose not to use a connection even if it is functional, for example switching to alternative water sources in the rainy season. A simple and accurate way of expressing the relationship between the number of billed connections and revenue to the operator is their correlation. For private connections in Rulindo, this is approximately 0.29. This was multiplied by the preliminary estimates on Figure 36 to arrive at the final estimates, shown on Figure 37.

The procedures for estimating the additional revenue from increasing the billing rates on institutional connections and PSPs are identical. The respective correlation factors between number of billed connections and operator revenue are 0.26 and 0.17. Overall, if Ayateke increases the average billing rates on private and institutional connections and PSPs in Rulindo to 90%, it stands to gain nearly an estimated RWF 1 million in billed revenue and over RWF 800,000 in collected revenue per month, on average. The additional revenue to be got by Ayateke and PAAK KAM from the systems each operates in Gicumbi is shown with the same level of detail in Annex 2. For Ayateke, additional revenue amounts to approximately RWF 1.5 million / 1.3 million in billed / collected terms while for PAAK KAM it amounts to approximately RWF 675,000 / 593,000.



System	(1) Existing HH connections	(2) Connections currently billed, on average	(3) Target connections to bill = 0.9 x (1)	(4) Average monthly amount currently billed per connection (RWF)	(5) Estimated additional avg. monthly revenue billed from increasing billing rate (RWF) = (4) x [(3) - (2)] *	(6) Average monthly amount currently collected per connection (RWF)	(7) Estimated additional avg. monthly revenue collected from increasing billing rate (RWF) = (6) x [(3) - (2)]
Bitete-Rwahi	60	33	54	844	17,716	624	13,101
Buramira	1	1	1	113	0	0	0
Gakoma	154	112	138	1,482	39,871	1,533	39,871
Gisoro-Nyundo	7	1	6	2,725	13,727	2,745	13,727
Kigarama	5	0	5	N/A	7,662	N/A	5,412
Kibuye	27	12	24	1,456	17,474	750	9,000
Kirikumuryango	237	126	213	1,455	126,542	1,270	110,455
Mutagata Gravity	84	58	75	1,304	22,164	1,127	19,165
Ntaruka	47	23	42	1,505	28,594	890	16,908
Nyabishengeshi	71	40	63	814	18,722	436	10,037
Nyagahondo	103	41	92	1,656	84,467	1,259	64,225
Rusave	29	17	26	1,208	10,873	755	6,793
Rushinya-Taba	9	5	8	2,704	8,111	1,551	4,653
Rutare-Nyirangarama	22	2	19	3,098	52,672	556	9,457
Rutomvu	80	41	72	1,208	37,451	988	30,639
Rwamugaza	227	142	204	1,272	81,787	1,319	81,787
Rwiseke	145	85	130	1,676	75,440	1,512	68,041
Kararama	74	46	66	2,951	59,029	2,426	48,522
Ngoma EPS	6	3	5	3,878	7,756	3,197	6,395
Kinywamagana	278	149	250	3,037	306,747	2,449	247,374
Marenge	59	24	53	5,975	173,273	4,571	132,548
Musenge	41	1	36	1,366	47,825	180	6,293
Mutagata EPS	197	127	177	2,787	139,340	1,825	91,233
Tare	45	22	40	7,293	131,274	6,407	115,325
Figure 36 – Prelimina Increasing Billing	ry Estimate of A g Rate of Private	dditional Avg. Re Connections in	evenue From Rulindo	TOTAL	1,508,516	* Or [7] if larger	1,150,961



System	Existing HH connections	Connections currently billed, on average	Target connections to bill	Average monthly amount currently billed per connection (RWF)	Estimated additional monthly revenue billed from increasing billing rate (RWF)	Average monthly amount currently collected per connection (RWF)	Estimated additional monthly revenue collected from increasing billing rate (RWF)
Bitete-Rwahi	60	33	54	844	4,783	624	3,537
Buramira	1	1	1	113	0	0	0
Gakoma	154	112	138	1,482	10,765	1,533	10,765
Gisoro-Nyundo	7	1	6	2,725	3,706	2,745	3,706
Kigarama	5	0	5	N/A	2,069	N/A	1,461
Kibuye	27	12	24	1,456	4,718	750	2,430
Kirikumuryango	237	126	213	1,455	34,166	1,270	29,823
Mutagata Gravity	84	58	75	1,304	5,984	1,127	5,175
Ntaruka	47	23	42	1,505	7,720	890	4,565
Nyabishengeshi	71	40	63	814	5,055	436	2,710
Nyagahondo	103	41	92	1,656	22,806	1,259	17,341
Rusave	29	17	26	1,208	2,936	755	1,834
Rushinya-Taba	9	5	8	2,704	2,190	1,551	1,256
Rutare-Nyirangarama	22	2	19	3,098	14,221	556	2,553
Rutomvu	80	41	72	1,208	10,112	988	8,273
Rwamugaza	227	142	204	1,272	22,082	1,319	22,082
Rwiseke	145	85	130	1,676	20,369	1,512	18,371
Kararama	74	46	66	2,951	15,938	2,426	13,101
Ngoma EPS	6	3	5	3,878	2,094	3,197	1,727
Kinywamagana	278	149	250	3,037	82,822	2,449	66,791
Marenge	59	24	53	5,975	46,784	4,571	35,788
Musenge	41	1	36	1,366	12,913	180	1,699
Mutagata EPS	197	127	177	2,787	37,622	1,825	24,633
Tare	45	22	40	7,293	35,444	6,407	31,138
Figure 37 – Final E	Estimate of Addit	tional Avg. Reve	nue From Rulindo	TOTAL	407,299		310,759

Increasing Billing Rate of Private Connections in Rulindo



System	Existing institutional connections	Connections currently billed, on average	Target connections to bill	Average monthly amount currently billed per connection (RWF)	Estimated additional monthly revenue billed from increasing billing rate (RWF)	Average monthly amount currently collected per connection (RWF)	Estimated additional monthly revenue collected from increasing billing rate (RWF)
Bitete-Rwahi	7	6	6	3,262	0	2,336	0
Buramira	1	1	1	507	0	1,269	0
Gakoma	0	0	0	N/A	0	N/A	0
Gisoro-Nyundo	1	1	1	414	0	239	0
Kigarama	5	0	5	N/A	7,656	N/A	5,474
Kibuye	1	1	1	427	0	352	0
Kirikumuryango	24	10	21	6,198	13,636	5,287	11,631
Mutagata Gravity	19	2	17	8,538	25,818	8,606	25,818
Ntaruka	2	1	2	38,699	7,740	30,604	6,121
Nyabishengeshi	1	1	1	2,514	0	1,151	0
Nyagahondo	7	3	6	11,663	6,998	6,155	3,693
Rusave	9	6	8	6,925	2,770	5,321	2,128
Rushinya-Taba	1	1	1	3,840	0	1,057	0
Rutare-Nyirangarama	4	1	4	1,831	3,284	0	3,284
Rutomvu	3	2	3	15,206	3,041	9,685	1,937
Rwamugaza	13	6	11	9,245	9,245	6,522	6,522
Rwiseke	13	5	11	5,566	6,679	3,522	4,226
Kararama	21	8	18	34,779	69,557	31,073	62,146
Ngoma EPS	4	1	4	8,921	5,352	6,147	3,688
Kinywamagana	23	13	20	22,968	32,155	20,102	28,143
Marenge	14	8	12	23,005	18,404	21,939	17,551
Musenge	7	1	6	216	23,308	0	23,308
Mutagata EPS	24	11	21	18,660	37,319	17,476	34,953
Tare	15	10	13	77,322	46,393	66,418	39,851
Figure 38 – Estimated Billing Rate of	Additional Avera	age Revenue Fro nnections in Rul	om Increasing indo	TOTAL	319,356		280,475



System	Existing PSPs	PSPs currently billed, on average	Target PSPs to bill	Average monthly amount currently billed per PSP (RWF)	Estimated additional monthly revenue billed from increasing billing rate (RWF)	Average monthly amount currently collected per PSP (RWF)	Estimated additional monthly revenue collected from increasing billing rate (RWF)
Bitete-Rwahi	12	8	10	3,119	1,310	2,814	1,182
Buramira	4	1	4	2,909	1,832	2,246	1,415
Gakoma	20	10	18	16,024	28,217	16,796	28,217
Gisoro-Nyundo	12	4	10	3,146	3,963	3,133	3,948
Kigarama	5	3	5	1,437	604	1,080	454
Kibuye	3	1	3	3,068	1,289	2,567	1,078
Kirikumuryango	23	17	20	6,873	4,330	6,359	4,006
Mutagata Gravity	28	22	25	6,141	4,181	6,637	4,181
Ntaruka	4	1	4	7,634	4,809	7,068	4,453
Nyabishengeshi	4	1	4	11,020	6,942	9,710	6,117
Nyagahondo	5	1	5	3,753	3,152	2,301	1,933
Rusave	3	2	3	2,291	481	2,190	460
Rushinya-Taba	17	8	15	3,994	5,871	3,275	4,815
Rutare-Nyirangarama	0	0	0	N/A	0	N/A	0
Rutomvu	12	1	10	5,731	10,832	4,409	8,333
Rwamugaza	48	34	43	5,963	12,889	6,819	12,889
Rwiseke	24	20	21	9,804	2,146	10,217	2,146
Kararama	53	31	47	9,298	31,241	9,023	30,319
Ngoma EPS	33	12	29	7,104	30,474	8,536	30,474
Kinywamagana	23	16	20	13,707	11,929	14,201	11,929
Marenge	22	20	19	12,370	0	12,734	0
Musenge	37	1	33	7,298	49,039	6,300	42,336
Mutagata EPS	68	54	61	9,471	14,085	9,581	14,085
Tare	26	17	23	17,039	21,470	16,922	21,322
Figure 39 – Estimat Collected From In	ed Additional Av	verage Revenue Rate of PSPs in	Billed and Rulindo	TOTAL	251,085		236,091



3.2 Decrease in Physical NRW

In section 2.3 it was demonstrated how high NRW currently is in the systems operated by Ayateke and PAAK KAM. This is particularly the case with physical NRW. In the average system in Gicumbi, an unthinkable 80% of water produced (81% in Ayateke-operated systems and 78% in PAAK KAM-operated systems) is not billed, while in Rulindo 40% is not billed.

Physical NRW has implications on production costs of electrical pumping systems. More specifically, physical NRW in these systems means that fuel and electricity costs are higher than they could be, because the systems are pumping water which ultimately is lost. If physical NRW is reduced, less water will have to be pumped for the same amount of water billed to users, and production costs will decrease.

Ayateke's target for maximum physical NRW is 10%, i.e. the amount of water produced during a given period should be no more than 10% higher than the amount of water billed to users during the period. In this way, starting from the amount of water billed, the maximum "allowable" amount of water produced can be calculated. Figures 33 and 34 show the level of water production thus calculated for each system in Rulindo and Gicumbi. The amount of water billed in each system accounts for the increase in the connection billing rates described in section 3.1. From the target amount of water production, the proportional reduction compared to the current amount can be determined, and fuel and electricity costs are assumed to decrease in the same proportion. The savings are substantial. Overall, if physical NRW is reduced to 10%, Ayateke stands to save an estimated RWF 978,000 per month in fuel and electricity costs in Rulindo, while PAAK KAM will save RWF 662,000 in electricity costs in Gicumbi, approximately.

Because current water losses are high, in the vast majority of systems the target level of water production is significantly smaller than the current level, but in two systems it is the other way round. In these systems the target average amount of water produced is larger than the current amount, and fuel and electricity costs are therefore larger as well. They are evidenced in Figure 40 by a negative reduction. In one of the two systems, Musenge, the increase in fuel and electricity costs is more than compensated by the gains in revenue made possible by the increase in connection billing rates. However, in the other system, Ruboroga I in Gicumbi, the increase in costs is not compensated by the increase in revenue, and it would thus be counter-productive to try to increase billing. In this system, fuel and electricity costs per m³ of water produced must be reduced before considering increasing connection billing rates. The system is therefore excluded from all the proposed measures.



System	District/ Operator	Avg. monthly water billed after increase in billing rates (m ³)	Target avg. monthly water produced (m ³)	Reduction in avg. water produced compared to current level (%)	Reduction in avg. fuel costs (RWF)	Reduction in avg. electricity costs (RWF)
Kararama	Rulindo – Ayateke	1,079	1,199	8%	3,099	29,127
Ngoma EPS	Rulindo – Ayateke	233	259	65%	14,412	135,471
Kinywamagana	Rulindo – Ayateke	1,467	1,630	14%	7,839	73,688
Marenge	Rulindo – Ayateke	898	998	26%	10,506	98,756
Musenge	Rulindo – Ayateke	133	148	-1,003%	-3,996	-37,559
Mutagata EPS	Rulindo – Ayateke	1,729	1,921	46%	48,109	452,225
Tare	Rulindo – Ayateke	1,733	1,925	20%	14,024	131,829
				TOTAL	93,993	883,537
Rwungo- Manyagiro	Gicumbi – PAAK KAM	1,111	1,234	59%	0	112,019
Nyankenke- Kisaro-Mutete- Zoko	Gicumbi – PAAK KAM	763	848	44%	0	42,238
Murama- Rwamiko- Bukure	Gicumbi – PAAK KAM	1,295	1,439	85%	0	507,281
				TOTAL	0	661,538

Figure 40 – Estimated Reduction in Average Fuel and Electricity Costs From Decreasing Physical NRW in Rulindo and Gicumbi



3.3 Decrease in Commercial NRW

The procedure to estimate the gains to the operators from decreasing commercial NRW consisted of the following:

- 1. First, the target average monthly amounts of water produced and billed in each system, calculated as described in section 3.3, were used to determine the target average amount of water paid in each system, in exactly the same way as the target amount of water produced was determined based on the amount of water billed. Again, the target amount of water billed accounts for the increase in connection billing rates as described in section 3.1. The target amount of water paid was broken down in water paid through private connections, institutional connections and PSPs.
- 2. The target amount of water paid thus determined is *final*, i.e. it represents the amount of water that the operators must collect bills on in each system if the target of 10% commercial NRW is met. In revenue terms, this amount equals the current average amount which the operators collect plus i) the increase in collected revenue due to the increase in connection billing rates described in section 3.1, plus ii) the increase exclusively due to the decrease in commercial NRW. The increase caused by (i) was already determined in section 3.1; we are now interested in (ii). To determine it, the total collected revenue obtained from the amount of water paid calculated in step 1 was estimated, and the total revenue arising from (i) was then subtracted from this.

The results for Ayateke in Rulindo are shown on Figure 41, and the results for Ayateke and PAAK KAM in Gicumbi are shown in Annex 4. The total additional collected revenue to be obtained by Ayateke if commercial NRW is reduced amounts to nearly RWF 376,000 per month in Rulindo and RWF 187,000 in Gicumbi, while to PAAK KAM in Gicumbi it amounts to nearly RWF 209,000.

The additional revenue collected from decreasing commercial NRW is zero in many systems; this simply means that all the possible increase in collected revenue is achieved by increasing connection billing rates, with no further gains estimated from improving collection efficiency.



	Target ave	erage water paid	(m³)	Estimated addition from decreasir	nal monthly reve ng commercial N	nue collected RW (RWF)
System	Private connections	Institutional connections	PSPs	Private connections	Institutional connections	PSPs
Bitete-Rwahi	86	53	118	4,872	3,382	0
Buramira	0	1	20	100	0	553
Gakoma	463	0	880	0	0	0
Gisoro-Nyundo	14	1	68	0	128	0
Kigarama	0	0	20	0	0	675
Kibuye	63	1	22	8,296	28	228
Kirikumuryango	626	231	537	3,482	2,714	0
Mutagata Gravity	209	115	640	1,973	0	0
Ntaruka	115	117	59	12,598	4,553	0
Nyabishengeshi	105	4	78	13,270	1,083	140
Nyagahondo	251	109	32	11,659	15,162	1,904
Rusave	66	118	23	6,201	5,346	0
Rushinya-Taba	43	15	153	4,952	2,356	2,603
Rutare-Nyirangarama	54	13	0	14,483	1,262	0
Rutomvu	146	91	81	4,221	8,429	1,980
Rwamugaza	551	158	979	0	11,870	0
Rwiseke	367	142	865	0	8,841	0
Kararama	154	338	467	10,146	0	0
Ngoma EPS	16	32	158	884	2,851	0
Kinywamagana	599	361	344	44,137	4,521	0
Marenge	233	203	363	23,568	0	0
Musenge	15	24	79	10,814	0	1,441
Mutagata EPS	463	249	824	91,676	0	0
Tare	258	861	422	2,034	24,509	0
Figure 41 – Estimated / From Decreasing Comm	Avg. Additional Rev nercial NRW in Sys	enue Collected tems in Rulindo	TOTAL	269,367	97,035	9,523



3.4 System Metering & Rehabilitation & Accounting for Systems of Unclear Status

As mentioned in section 2.1, a significant number of systems are currently not functional – three systems in Rulindo and five in Gicumbi operated by Ayateke, and a further five in Gicumbi operated by PAAK KAM. An additional thirteen systems operated by Ayateke and one system operated by PAAK KAM in Gicumbi are functional but have no water meters, presumably allowing users to obtain water for free. Another nine systems operated by Ayateke in Rulindo and four operated by PAAK KAM in Gicumbi have unclear functionality status. All this infrastructure is presently not generating any revenue – or, in the case of the systems of unclear status, no revenue is recorded – to the operators.

Rehabilitation and metering of these systems would thus generate additional, potentially substantial revenue. As to the systems of unclear status, it is a matter of accounting for the revenue they can generate, whether they are functional or not; for the purposes of the model, they were treated in the same manner as non-functional systems. The analysis estimated the additional revenue in the same fashion as the revenue from increased billing rates. Given that it is mostly not reported in the operators' data, the number of connections in each non-functional / non-metered / unclear status system had to be estimated, following average ratios of people served per connection. These ratios were determined using the data on population served and number of connections in the functional systems. Similarly, the average revenue per connection was assumed to be equal to the current overall average revenue per connection of the functional systems¹.

Again setting as a target for the billing rate that 90% of connections should be billed on average, the additional revenue that the operators can obtain if systems are rehabilitated, metered or accounted for is shown in Figures 42, 43 and 44. Overall, system rehabilitation, metering and accounting for would provide Ayateke with approximately RWF 734,000 and RWF 2,070,000 in additional collected revenue per month in Rulindo and Gicumbi, respectively, and would provide PAAK KAM with approximately RWF 1,049,000 in additional collected revenue per month.

The newly rehabilitated systems will have to be maintained, and they will thus carry with them an increase in material and maintenance costs. Such increase was estimated as being in the same proportion as the increase in billed revenue. The total estimated average monthly increase in material and maintenance costs is RWF 106,234 in systems operated by Ayateke in Rulindo and RWF 28,607 in the systems it operates in Gicumbi, and RWF 15,824 in the systems operated by PAAK KAM in Gicumbi.

¹ In the systems operated by Ayateke in Gicumbi, the average revenue collected per institutional connection in the period covered by the data was slightly larger than the average billed revenue. Instead of assuming that this will also be the case in the systems to be metered / rehabilitated, it was considered that additional billed revenue will be equal to additional collected revenue.



	Estimated no. of conne target to be billed, on a				Estimated average additional ions – monthly revenue billed from erage rehabilitating / accounting for system (RWF)			Estimated average additional monthly revenue collected from rehabilitating / accounting for system (RWF)			
System	Status	Private	Institutional	PSPs	Private	Institutional	PSPs	Private	Institutional	PSPs	
Gasuro	Not functional	3	0	0	4,597	0	0	3,247	0	0	
Gasama	Unclear	7	0	1	10,727	0	5,807	7,576	0	5,476	
Gatare	Not functional	10	1	1	15,325	7,656	5,807	10,823	5,474	5,476	
Kirambo	Not functional	46	5	10	70,494	38,278	58,065	49,786	27,369	54,764	
Kishwi	Unclear	46	5	10	70,494	38,278	58,065	49,786	27,369	54,764	
Mutungo	Unclear	8	1	2	12,260	7,656	11,613	8,658	5,474	10,953	
Nkombe	Unclear	46	5	10	70,494	38,278	58,065	49,786	27,369	54,764	
Ntakara	Unclear	46	5	10	70,494	38,278	58,065	49,786	27,369	54,764	
Nyakabizi	Unclear	20	2	5	30,650	15,311	29,033	21,646	10,947	27,382	
Nyakiriba	Unclear	11	1	2	16,857	7,656	11,613	11,905	5,474	10,953	
Rutembe- Mpango- Bushoki	Unclear	10	1	3	15,325	7,656	17,420	10,823	5,474	16,429	
Rwambogo	Unclear	10	1	1	15,325	7,656	5,807	10,823	5,474	5,476	
Figure 42 – Estimated Additional Average Revenue Billed and Collected From Rehabilitating and Accounting for Systems in Rulindo			TOTAL	403,044	206,700	319,360	284,647	147,790	301,202		



		Estimated r target to be	o. of connection billed, on ave	ons – erage	Estimated monthly r rehabilitatin	average addit evenue billed f ng / metering s (RWF)	Estimated average additional monthly revenue collected from rehabilitating / metering system (RWF)			
System	Status	Private	Institutional	PSPs	Private	Institutional	PSPs	Private	Institutional	PSPs
Gitoma	Not functional	4	1	6	12,669	18,374	32,414	11,413	18,374	30,621
Kagomero	Not functional	3	0	3	9,501	0	16,207	8,560	0	15,311
Kagusa	Not functional	23	1	5	72,844	18,374	27,012	65,627	18,374	25,518
Nyakagezi- Nyabishambi	Not functional	23	5	14	72,844	91,870	75,633	65,627	91,870	71,449
Nyakabingo- Shangasha- Bwisige- Mukarange	Not functional	23	5	14	72,844	91,870	75,633	65,627	91,870	71,449
Cyamuhinda- Kagogo	Not metered	22	2	18	69,677	36,748	97,242	62,773	36,748	91,863
Gatoma	Not metered	5	4	17	15,836	73,496	91,840	14,267	73,496	86,760
Kabakene	Not metered	5	1	3	15,836	18,374	16,207	14,267	18,374	15,311
Kamutora	Not metered	5	1	2	15,836	18,374	10,805	14,267	18,374	10,207
Kanyirabuki- Cyeya	Not metered	23	1	8	72,844	18,374	43,219	65,627	18,374	40,828
Muhondo	Not metered	7	2	9	22,170	36,748	48,621	19,973	36,748	45,932
Nangara	Not metered	5	3	4	15,836	55,122	21,609	14,267	55,122	20,414
Nyakeru	Not metered	5	1	6	15,836	18,374	32,414	14,267	18,374	30,621
Nyagahanga	Not metered	5	1	5	15,836	18,374	27,012	14,267	18,374	25,518
Rurumbira	Not metered	2	2	3	6,334	36,748	16,207	5,707	36,748	15,311
Rusebeya- Mulindi	Not metered	23	1	14	72,844	18,374	75,633	65,627	18,374	71,449
Rwangabo- Bwisige	Not metered	2	3	15	6,334	55,122	81,035	5,707	55,122	76,553
Rwengwe Not metered 11 6				6	34,839	110,244	32,414	31,387	110,244	30,621
Figure 43 – Estimated Additional Average Revenue Billed and Collected From Rehabilitating and Metering Systems in Gicumbi – Ayateke				TOTAL	620,759	734,957	821,156	559,253	734,957	775,734



		Estimated target to	Estimated no. of connections target to be billed, on average			ed average add / revenue billed ating / account system (RWF)	litional d from ting for	Estimated average additional monthly revenue collected from rehabilitating / accounting for system (RWF)		
System	Status	Private	Institutional	PSPs	Private	Institutional	PSPs	Private	Institutional	PSPs
Bulindi-Cyumba	Not functional	8	2	9	27,176	16,662	63,440	25,177	12,782	56,201
Rutare	Not functional	8	2	9	27,176	16,662	63,440	25,177	12,782	56,201
Rumuli	Not functional	8	2	9	27,176	16,662	63,440	25,177	12,782	56,201
Karwanira- Yaramba (Kinishya)	Not functional	0	2	2	0	16,662	14,098	0	12,782	12,489
Museke	Not functional	8	2	9	97,847	16,008	366,563	90,690	13,014	351,537
Rutare-Gaseke	Partially functional, w/o water meters	1	1	4	3,397	8,331	28,196	3,147	6,391	24,978
Gitaba- Mafurebo	Unclear	0	1	3	0	8,331	21,147	0	6,391	18,734
Kigogo	Unclear	2	2	5	6,794	16,662	35,245	6,294	12,782	31,223
Ruhurura- Yaramba	Unclear	4	1	5	13,588	8,331	35,245	12,589	6,391	31,223
Gatoki-Gatuna	Unclear	0	0	4	0	0	28,196	0	0	24,978
Karushya- Ruzizi (Kareranyana)	Unclear	0	0	1	0	0	7,049	0	0	6,245
Nyakagezi- Rwesero	Unclear	8	2	9	27,176	16,662	63,440	25,177	12,782	56,201
Figure 44 – Estimated Additional Average Revenue Billed and Collected From Rehabilitating and Accounting for Systems in Gicumbi – PAAK KAM			TOTAL	230,332	140,972	789,497	213,430	108,881	726,208	



3.5 Summary

The main highlights of sections 3.1–3.4 above are:

- The measures proposed to increase the profitability of the piped systems operated by Ayateke and PAAK KAM are:
 - Increase in billing rates in all types of connections;
 - Decrease in physical NRW;
 - Decrease in commercial NRW;
 - Rehabilitation of non-functional systems, metering of non-metered systems and accounting for systems of unclear status.
- An increase in the average connection billing rates to 90% would allow Ayateke to collect an estimated additional average monthly revenue of over RWF 800,000 in Rulindo and approximately RWF 1.3 million in Gicumbi, and would allow PAAK KAM to collect an estimated additional average monthly revenue of approximately RWF 593,000 in Gicumbi.
- A reduction in physical NRW to 10% would save Ayateke an average of approximately RWF 978,000 per month in fuel and electricity costs in Rulindo and it would save PAAK KAM an average of approximately RWF 662,000 per month.
- A reduction in commercial NRW to 10% would provide additional collected revenue to Ayateke amounting to nearly RWF 376,000 per month in Rulindo and RWF 187,000 in Gicumbi, and it would provide additional collected revenue to PAAK KAM of nearly RWF 209,000 per month.
- System rehabilitation, metering and accounting for would provide Ayateke with approximately RWF 734,000 and RWF 2,070,000 in additional collected revenue per month in Rulindo and Gicumbi respectively, while representing an estimated increase in O&M costs of approximately RWF 106,000 and RWF 29,000. The same measures for the systems operated by PAAK KAM in Gicumbi would provide it with additional collected revenue of about RWF 1,049,000 per month while representing an estimated increase in O&M costs of around RWF 16,000 per month.



4 Should the Water Tariff in Rulindo and Gicumbi Be Increased?

4.1 Impact of the Proposed Measures

To answer the question, the combined financial impact of each of the measures discussed in the previous sections – increase in connection billing rates, rehabilitation of nonfunctional systems, metering of systems in Gicumbi, accounting for systems of unclear status, and decrease of both physical and commercial NRW – was calculated. The reference for revenue is collected revenue, because this is what remains to the operators after operating expenses, fees and taxes have been paid. Following the same logic as throughout the report, the impact of the measures on revenue and costs is expressed in average, monthly terms. Costs include both operating costs and the *redevance* fees and RRA tax owed by Ayateke and PAAK KAM to the district local governments and RRA.

Figures 45 and 46 display the cumulative financial impact to Ayateke of all the proposed measures combined. It should be noted that the revenue from private connections, institutional connections and PSPs represented in the charts refers to connections in the systems which are currently functional; the revenue from systems not currently functional, metered or accounted for is captured under "Rehab'ed/accounted for systems" and "Rehab'ed/metered systems" (represented by the green bars).



Figure 45 – Financial Impact of the Measures on Ayateke's Average Monthly Revenue and Costs in Rulindo (RWF)



Figure 46 – Financial Impact of the Measures on Ayateke's Average Monthly Revenue and Costs in Gicumbi (RWF)



In Rulindo, Ayateke's average monthly revenue collected from private connections will increase by an estimated 31%, revenue collected from institutional connections will increase by 21% and revenue collected from PSPs will increase by 9%. These gains would happen by force of the measures to increase connection billing rates and to decrease commercial NRW presented in sections 3.1 and 3.4, with the greatest gains to be reaped from private connections. On top of this, the rehabilitation of systems that are currently not functional and accounting for systems of unclear status would add almost RWF 734,000 per month, on average, bringing the total increase in collected revenue to over RWF 1.9 million – 31% of the current revenue. Total average monthly costs, on the other hand, would decrease by close to RWF 675,000 or 9%. This would be the impact of the decrease in physical NRW presented in section 3.3. In total, if all the proposed measures were implemented in the water systems in Rulindo, Ayateke would go from an average monthly net loss of over RWF 1.7 million to an estimated average monthly net profit of over RWF 860,000.

In Gicumbi, the gains would be even more remarkable. The improvements in billing rates and commercial NRW would increase the average monthly collected revenue from private and institutional connections by almost 200% each – a three-fold increase. Revenue from PSPs would increase by an estimated 75% (approximately). The rehabilitation and metering of systems would bring an additional RWF 2,070,000 (approximately), to a total increase in average monthly collected revenue of about 290% or four-fold. It should be noted that total costs would also increase, by about RWF 413,000. This would happen because the decrease in production costs achieved by reducing physical NRW would be offset by the increase in production that must follow the increase in connection billing



rates and system rehabilitation. But this increment in costs is dwarfed by the increase in revenue. In total, if all measures were implemented in Gicumbi, Ayateke would go from an average monthly net loss of practically RWF 350,000 to an average net profit of more than RWF 2.8 million. Combining the figures for the two districts, Ayateke would go from an overall average monthly net loss of approximately RWF 2.1 million to a net profit of over RWF 3.7 million.

Now looking at the impact of the measures on PAAK KAM's revenue and costs:



Figure 47 – Financial Impact of the Measures on PAAK KAM's Average Monthly Revenue and Costs in Gicumbi (RWF)

Increasing billing rates and decreasing commercial NRW would lead to an estimated increase of 156% in revenue collected from private connections, and to increases of 40% and 22% in revenue collected from institutional connections and PSPs, respectively. The rehabilitation and metering of systems would add an additional RWF 1 million per month, approximately. Overall, the measures would take PAAK KAM from a current average monthly net loss of about RWF 44,000 to an average monthly net profit of more than RWF 2.2 million.

If the analysis ended here, one would conclude that there would be no need for the tariffs to be raised. But important practical aspects must be considered first. In a reflection session on the achievements and challenges of water supply initiatives in its country program in Rwanda, Water For People identified water treatment in Rulindo and Gicumbi as a priority. Currently neither Ayateke nor PAAK KAM are treating the water supplied to users, despite this being a requirement from RURA to water operators. Estimates of the cost of water treatment that were obtained indicate that this would be of RWF 4.7 per m³



of water supplied plus RWF 18,000 per water system per month². Water treatment would represent a substantial additional cost to the operators. Treating the water supplied to users in all systems would cost Ayateke an average of more than RWF 753,000 per month in Rulindo and over RWF 600,000 in Gicumbi, to a combined monthly cost of more than RWF 1.3 million, and it would cost PAAK KAM an average of nearly RWF 492,000 per month. Figures 48, 49 and 50 present the operators' average revenue and costs in this scenario.





² This is the estimated cost of daily disinfection with chlorine and chlorine measuring, based on data from the Government of Rwanda and suppliers' quotes. It does not include the cost of laboratory tests to water quality.







Figure 50 – Financial Impact of Measures on PAAK KAM's Average Monthly Revenue and Costs, Considering Water Treatment Costs, in Gicumbi (RWF)



It can be concluded that while the cost of water treatment would diminish the aggregate financial impact of the measures proposed, such impact would still be very significant and sufficient to lead to positive net profits for Ayateke and PAAK KAM in Gicumbi. Ayateke would have a still comfortable net profit of RWF 2.2 million per month, on average, in Gicumbi, and PAAK KAM would turn a profit of almost RWF 1.8 million in Gicumbi. In



Rulindo, Ayateke would manage to break-even, with an average monthly net profit of around RWF 114,000.

Besides water treatment, another aspect must be taken into account. Looking at the proposed measures, the rehabilitation of currently non-functional systems and metering of non-metered systems in Gicumbi could require substantial investment and time, and thus might not generate returns in the immediate term. For conservativeness, the same can be assumed for systems of unclear status. In light of this aspect, the analysis re-evaluated the profitability gains to the operators if only "short-term" measures are considered. These are the measures that are *a priori* possible to implement in a relatively short period of time and do not require significant investments – the increase in billing rates and the decrease in physical and commercial NRW.

Figures 51, 52 and 53 show the revised financial impact of the measures under this scenario.



Figure 51 – Financial Impact of Short-Term Measures on Ayateke's Average Monthly Revenue and Costs in Rulindo (RWF)







Figure 53 – Financial Impact of Short-Term Measures on PAAK KAM's Average Monthly Revenue and Costs in Gicumbi (RWF)



In this short-term measure scenario, Ayateke would still be able to operate positively in Gicumbi, even if with a much smaller average net profit than in the all-measure scenario, of about RWF 530,000 per month. Also in Gicumbi, PAAK KAM would still see a solid average monthly net profit of over RWF 1 million. In Rulindo, however, Ayateke would register an average monthly net loss of around RWF 187,000. Under this scenario,



therefore, an increase in tariffs could be necessary for the operator to be able to generate a profit. If the target is a monthly net profit to Ayateke in Rulindo of at least RWF 500,000, and if the price elasticity of demand for water is assumed to be 0.3³, tariffs in Rulindo would have to increase by 14%. This would mean increasing the tariffs in gravity and electrical pumping schemes to RWF 10 and RWF 23 per jerry can respectively.

4.2 Conclusions

The major conclusion of this report is that if all measures discussed are implemented, both operators in both districts will turn from the current losses to significant net profits, without the need to increase tariffs. The only scenario where tariff increases could be in order would be in Rulindo, if water treatment was enforced before all measures, notably the longer term measures of system rehabilitation, were implemented. This may be easily avoided if water treatment is enforced only after all measures are implemented.

Recapitulating the financial impact of the measures:

- 1) Increasing connection billing rates to 90% and decreasing physical and commercial NRW to 10% each (to a total NRW of 20%) would take Ayateke from the current net loss in Rulindo of RWF 1.7 million per month to a net profit of RWF 335,000, on average, and from the current net loss in Gicumbi of RWF 349,000 per month to a net profit of over RWF 1 million. Likewise, PAAK KAM would go from the current net loss it makes in Gicumbi of RWF 44,000 per month to a net profit of over RWF 1.35 million. For Ayateke in Rulindo and for PAAK KAM in Gicumbi, the reduction in NRW would have the largest financial impact on net profitability, whereas for Ayateke in Gicumbi it would be the increase in billing rates.
- 2) The rehabilitation, metering and accounting for of systems would take Ayateke's average monthly net profit to more than RWF 860,000 in Rulindo and more than RWF 2.8 million in Gicumbi, and PAAK KAM's average monthly net profit in Gicumbi to over RWF 2.2 million.
- 3) After all measures are implemented, water treatment can be introduced without financially jeopardizing operations. Once it is introduced, Ayateke's average monthly net profit would be of RWF 114,000 in Rulindo and RWF 2.2 million in Gicumbi, while PAAK KAM's average monthly net profit in Gicumbi would be of RWF 1.8 million.

³ World Bank, "Estimation of Water Demand in Developing Countries: An Overview" (2009). A price elasticity of demand for water of -0.3 means that if price increases by 1%, the quantity of water sold to users decreases by 0.3%.



Annexes

Annex 1 Errors and Noteworthy Issues Identified in the Operators' Monthly Performance Reports

<u>Ayateke – Rulindo</u>

- i. The value for the total billed revenue of November 2017 is hardcoded rather than being equal to the sum of the billed revenue in each system. The value also happens to be incorrect
- ii. The formula for collected bills and collected arrears in November 2017 refers to the wrong cells for systems no. 22 and 23
- iii. In the formulas for billed revenue, bills collected and arrears collected between February and December 2018 and between January and April 2019, system no. 27 was added twice
- iv. In many systems, there are months where the value recorded for bills collected equals the amount billed plus arrears collected. Clearly, bills collected can never exceed the amount billed. On such systems/months, all billed revenue was collected in addition to arrears
- v. Between May and July 2017 the basis for EBIT is bills collected, but in the remaining periods it is the amount billed
- vi. Reported total collected revenue between May and December 2017 leaves out arrears collected during the period
- vii. Systems no. 5, 14, 15, 16, 20, 21, 25 and 29 are recorded as being functional or partly functional as of April 2019, but most of the data for these systems is missing
- viii. The electricity costs of 6 out of the 7 electrical systems are recorded as zero between January and April 2019, despite the fact that the systems were functional during that period. On system no. 34 electricity costs are recorded as zero for the entire two years of data
- ix. On some months, the volume of water billed in system no. 8 is greater than zero, but the amount billed in all types of connections is zero
- x. In the January-March 2019 data file, annexes C28 and T28 refer instead to system no. 29 and vice-versa
- xi. The recorded number of institutions billed in system no. 32 in January 2019 is 212, which is impossibly high



- xii. The recorded number of total private connections in system no. 27 goes from 211 in December 2018 to 80 in January 2019. In system no. 13 it goes from 63 to 237. Both are conspicuously high
- xiii. From March to April 2019, the recorded number of billed private connections in systems 33 and 36 goes from 32 and 28 respectively to zero
- xiv. The recorded total number of PSPs of systems no. 26 and 31 shows sharp reductions from January to February 2018. Ditto for systems no. 11 and 27 from December 2018 to January 2019
- xv. The recorded total number of PSPs of system no. 34 shows large fluctuations throughout the entire period covered by the data
- xvi. A substantial amount of data prior to 2019 is missing for system no. 34
- xvii. The recorded volume of water paid through PSPs in January 2018 is impossibly high. Ditto for system no. 30 in September 2017. It is likely that the monetary amount was recorded instead of the volume
- xviii. The recorded volume of water produced shows very large drops between December 2017 and January 2018

<u>Ayateke – Gicumbi</u>

- i. Systems no. 2, 7, 9, 12, 13, 16-19 and 25-28 are recorded as being functional or partly functional as of April 2019, but most data for these systems is missing
- ii. In the data files for June-August 2017 and September 2017, many figures in the "Commercial" sheet are hardcoded rather than being equal to the sum of the figures of the individual systems
- iii. In many systems, there are months where the value recorded for bills collected equals the amount billed plus arrears collected. Clearly, bills collected can never exceed the amount billed. On such systems/months, all billed revenue was collected in addition to arrears
- iv. Between June and August 2017, the basis for EBIT is bills collected, but in the remaining periods it is the amount billed
- v. On some months, the volume of water billed in system no. 6 is zero, but the total monetary amount billed is greater than zero
- vi. System no. 1 reportedly has no institutional connections, yet has positive billed revenue for institutional connections in August 2017



PAAK KAM – Gicumbi

- i. Systems no. 7, 8, 13, 15, 23 and 24 are recorded as being functional or partly functional as of April 2019, but most data for these systems is missing
- ii. Recorded electricity costs of system no. 3, an electrical pumping system, are zero in all three months of the reporting period, despite the system being functional
- iii. On system no. 1, billed revenue from PSPs in August and September 2019 is not included in the calculation of total billed revenue for these months. Similarly, on the same system, collected revenue from PSPs in September 2019 is not included in the calculation of total collected revenue for that month
- iv. Reported net profit is far below expected due to calculation errors:
 - The 10% royalty rate is applied to billed revenue minus "RURA regulation fees" and RRA tax, when in reality the rate is to be applied to billed revenue in its entirety
 - The reported "RURA regulation fees" are in fact the RRA tax
 - The reported RRA tax is incomprehensible. No such tax, as calculated in the report, exists



Annex 2 Billing Rates in Gicumbi

Ayateke - Private connections



System	Existing connections	Connections currently billed, on average	Target connections to bill	Average monthly amount currently billed per connection (RWF)	Estimated additional monthly revenue billed from increasing billing rate (RWF)	Average monthly amount currently collected per connection (RWF)	Estimated additional monthly revenue collected from increasing billing rate (RWF)
Byimana-Burimbi	5	2	5	1,965	3,595	1,499	2,743
Gisiza	27	9	24	1,250	11,434	1,111	10,166
Bucyazo-Rebero	37	16	33	1,528	15,849	1,045	10,840
Byimana-Ruhondo	85	7	76	2,204	96,141	2,284	96,141
Jamba-Muko	17	2	15	4,701	37,275	3,255	25,811
Kivomo-Rushaki	98	1	88	2,234	118,545	794	42,115
Nyamabuye II	92	40	82	2,614	66,964	1,815	46,500
Ruboroga II	18	6	16	2,165	13,208	1,729	10,549
Ruhondo-Mukono- Kanombe	5	1	5	1,751	4,273	382	932



Cyuru-Gisiza	7	1	6	7,366	28,950	9,492	28,950
Kamushure-Bugomba	1	1	1	162	0	44	0
				TOTAL	396,233		274,747

Ayateke - Institutional connections



System	Existing connections	Connections currently billed, on average	Target connections to bill	Average monthly amount currently billed per connection (RWF)	Estimated additional monthly revenue billed from increasing billing rate (RWF)	Average monthly amount currently collected per connection (RWF)	Estimated additional monthly revenue collected from increasing billing rate (RWF)
Byimana-Burimbi	0	0	0	N/A	0	N/A	0
Gisiza	6	1	5	5,763	13,485	5,009	11,722
Bucyazo-Rebero	10	4	9	9,596	28,067	7,322	21,416
Byimana-Ruhondo	15	1	13	17,003	119,359	14,798	103,882
Jamba-Muko	7	1	6	19,776	57,845	7,464	21,833
Kivomo-Rushaki	8	1	7	1,778	6,241	999	3,508
Nyamabuye II	16	6	14	20,745	97,087	18,420	86,206
Ruboroga II	6	1	5	125,838	294,462	140,570	328,934



Ruhondo-Mukono- Kanombe	3	1	3	5,616	6,570	5,157	6,034
Cyuru-Gisiza	4	1	4	12,719	22,321	8,508	14,931
Kamushure-Bugomba	1	1	1	73	0	0	0
				TOTAL	645,438		598,467

<u>Ayateke – PSPs</u>



System	Existing connections	Connections currently billed, on average	Target connections to bill	Average monthly amount currently billed per connection (RWF)	Estimated additional monthly revenue billed from increasing billing rate (RWF)	Average monthly amount currently collected per connection (RWF)	Estimated additional monthly revenue collected from increasing billing rate (RWF)
Byimana-Burimbi	5	3	5	7,874	10,023	7,892	10,023
Gisiza	20	9	18	1,880	10,744	1,713	9,787
Bucyazo-Rebero	35	6	31	2,641	41,922	2,370	37,624
Byimana-Ruhondo	44	7	39	3,739	76,114	3,746	76,114
Jamba-Muko	35	4	31	7,767	133,161	7,736	132,637
Kivomo-Rushaki	10	1	9	3,387	17,208	2,493	12,662
Nyamabuye II	44	27	39	7,770	59,210	7,227	55,070



Ruboroga II	5	3	5	14,054	17,849	13,479	17,118
Ruhondo-Mukono- Kanombe	4	1	4	320	609	274	522
Cyuru-Gisiza	27	9	24	14,192	135,178	13,208	125,804
Kamushure-Bugomba	11	4	9	2,286	7,259	2,104	6,679
				TOTAL	509,276		484,040

PAAK KAM – Private connections



System	Existing connections	Connections currently billed, on average	Target connections to bill	Average monthly amount currently billed per connection (RWF)	Estimated additional monthly revenue billed from increasing billing rate (RWF)	Average monthly amount currently collected per connection (RWF)	Estimated additional monthly revenue collected from increasing billing rate (RWF)
Rwungo-Manyagiro	10	1	9	19,391	78,340	18,816	76,015
Nyankenke-Kisaro- Mutete-Zoko	28	6	25	12,411	119,087	7,428	71,274
Murama-Rwamiko- Bukure	15	1	13	4,890	47,056	7,765	47,056
Nyiraruzenga-Maya	6	1	5	3,155	6,372	3,155	6,372



Bureranyana-Tanda	7	3	6	2,324	6,193	4,088	6,193
Gishambashayo- Gatuna	3	2	3	13,351	6,742	12,136	6,129
Rwimbogo-Gaseke	72	66	64	1,200	0	772	0
Bukure-Karagari- Nyanza	65	33	58	1,840	23,233	1,373	17,330
Gacyeri-Rwamiko- Bukure	10	3	9	3,983	12,069	2,331	7,062
Kiriba-Mabare (Kiriba- Mugera-Gatuna)	35	4	31	592	8,065	592	8,065
Kamaganga-Mwange	0	0	0	N/A	0	N/A	0
Kamushenyi-Nyande	3	2	3	732	370	732	370
				TOTAL	307,527		245,866

PAAK KAM – Institutional connections





System	Existing connections	Connections currently billed, on average	Target connections to bill	Average monthly amount currently billed per connection (RWF)	Estimated additional monthly revenue billed from increasing billing rate (RWF)	Average monthly amount currently collected per connection (RWF)	Estimated additional monthly revenue collected from increasing billing rate (RWF)
Rwungo-Manyagiro	4	0	4	N/A	9,925	N/A	8,069
Nyankenke-Kisaro- Mutete-Zoko	6	5	5	2,704	0	2,704	0
Murama-Rwamiko- Bukure	10	4	9	13,304	20,621	10,310	15,981
Nyiraruzenga-Maya	2	1	2	3,301	1,023	1,264	392
Bureranyana-Tanda	4	4	4	2,028	0	2,028	0
Gishambashayo- Gatuna	5	3	5	8,272	5,128	5,003	3,102
Rwimbogo-Gaseke	2	2	2	26,589	0	22,195	0
Bukure-Karagari- Nyanza	0	0	0	N/A	0	N/A	0
Gacyeri-Rwamiko- Bukure	0	0	0	N/A	0	N/A	0
Kiriba-Mabare (Kiriba- Mugera-Gatuna)	2	1	2	1,465	454	1,465	454
Kamaganga-Mwange	0	0	0	N/A	0	N/A	0
Kamushenyi-Nyande	0	0	0	N/A	0	N/A	0
				TOTAL	37,151		27,998



PAAK KAM – PSPs



System	Existing connections	Connections currently billed, on average	Target connections to bill	Average monthly amount currently billed per connection (RWF)	Estimated additional monthly revenue billed from increasing billing rate (RWF)	Average monthly amount currently collected per connection (RWF)	Estimated additional monthly revenue collected from increasing billing rate (RWF)
Rwungo-Manyagiro	27	8	24	55,305	256,615	54,262	251,774
Nyankenke-Kisaro- Mutete-Zoko	12	8	10	50,179	29,104	49,364	28,631
Murama-Rwamiko- Bukure	65	53	58	16,704	24,220	13,553	19,652
Nyiraruzenga-Maya	5	4	5	6,724	1,950	5,449	1,580
Bureranyana-Tanda	15	12	13	8,942	2,593	8,147	2,362
Gishambashayo- Gatuna	9	6	8	3,493	2,026	2,394	1,389
Rwimbogo-Gaseke	9	9	8	7,035	-1,786	6,159	-1,786
Bukure-Karagari- Nyanza	7	4	6	8,171	4,739	7,718	4,476



Gacyeri-Rwamiko- Bukure	11	9	9	11,167	0	8,427	0
Kiriba-Mabare (Kiriba- Mugera-Gatuna)	6	1	5	1,352	1,568	1,352	1,568
Kamaganga-Mwange	2	1	2	8,218	2,383	8,218	2,383
Kamushenyi-Nyande	5	2	5	8,337	7,253	8,337	7,253
				TOTAL	330,666		319,284



Annex 3 Water Produced and Paid Per System (m³)



Ayateke (Rulindo)



Ayateke – Gicumbi



PAAK KAM – Gicumbi





Annex 4 Estimated Additional Revenue Collected From Decreasing Commercial NRW in Gicumbi

<u>Ayateke</u>

	Target av	erage water pai	d (m³)	Estimated ad collected from d	ditional monthly ecreasing comr (RWF)	/ revenue nercial NRW
System	Private connections	Institutional connections	PSPs	Private connections	Institutional connections	PSPs
Byimana-Burimbi	18	0	152	946	0	0
Gisiza	61	65	118	0	378	0
Bucyazo-Rebero	116	178	215	8,258	8,363	0
Byimana-Ruhondo	130	142	209	0	2,530	0
Jamba-Muko	180	228	376	9,170	39,700	0
Kivomo-Rushaki	318	21	87	64,450	2,622	3,152
Nyamabuye II	208	259	392	33,357	212	0
Ruboroga II	82	1,099	390	2,362	0	0
Ruhondo-Mukono- Kanombe	16	31	4	4,040	0	29
Cyuru-Gisiza	36	42	414	0	7,707	0
Kamushure-Bugomba	0	0	71	100	65	0
			TOTAL	122,685	61,578	3,181



PAAK KAM

	Target av	erage water pai	d (m³)	Estimated ad collected from d	ditional monthly ecreasing comr (RWF)	/ revenue nercial NRW
System	Private connections	Institutional connections	PSPs	Private connections	Institutional connections	PSPs
Rwungo-Manyagiro	136	0	852	0	0	0
Nyankenke-Kisaro- Mutete-Zoko	214	14	451	56,206	0	0
Murama-Rwamiko- Bukure	151	65	935	0	8,409	70,476
Nyiraruzenga-Maya	3	11	88	0	2,188	2,267
Bureranyana-Tanda	35	21	289	0	0	0
Gishambashayo- Gatuna	111	77	42	0	8,504	4,674
Rwimbogo-Gaseke	203	134	173	19,479	2,879	1,050
Bukure-Karagari- Nyanza	238	0	99	12,002	0	0
Gacyeri-Rwamiko- Bukure	62	0	265	7,296	0	13,494
Kiriba-Mabare (Kiriba- Mugera-Gatuna)	27	5	8	0	0	0
Kamaganga-Mwange	0	0	27	0	0	0
Kamushenyi-Nyande	5	0	63	0	0	0
			TOTAL	94,983	21,981	91,960