

SUMMARY SHEET FOR LEAKAGE BENCHMARKING IN SOUTH AFRICA

P09661

S1. SYSTEM NAME AND CONTACT DETAILS

Name of Water Undertaking	Beaufort West Municipality	
Name of Water Supply System	Beaufort West	
Contact Details:	Name	Mr C Wright
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		Beaufort West
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S2. Performance Indicators of Water Loss

Viewpoint	Level	Parameter	Typical Range			Actual PI	Units
			Excellent	Good	Poor		
Operations management of distribution system at current pressure	Basic	% of year system is pressurised	100	100	<100	100	%
		Current Annual Real Losses (CARL) (when system is pressurised - see note 2)	30 to 100	100 to 200	>200	635	Litres/connection/day
	Detailed	Unavoidable Annual Real Losses (UARL) (see note 3)	n/a	n/a	n/a	51	Litres/connection/day
		Consumption	n/a	n/a	n/a	224	Litres/connection/day
		Infrastructure Leakage Index (ILI) (= CARL/UARL : see note 4)	1	2	>3.0	12.3	non dimensional
Financial management aspects of water losses	Basic	Volume of non-revenue water as a% of system input volume (see note 5)	<10%	20%	30%	77	%
	Detailed	Value of non-revenue water as a % of annual cost of running the system (see note 6)	<5%	10%	15%	47	%

Notes:

Note1: taken from data in "AQUA" article, December 1999 or estimated by WRP

Note 2: takes account of % of time system is pressurised, but not system pressure, density of connections or customet meter location

Note 3: takes account of density of connections and customer meter location at current pressure

Note 4: measures overall efficiency of management of distribution system at current operating pressure

Note 5: strongly influenced by average consumption per service connection

Note 6: Allows different values of Rand/m3 for different components of non-revenue water

S3. Key Operating Parameters which influence Unavoidable Annual Real Losses (UARL)

Variable	Typical Range			Actual PI	Units
	Low	Medium	High		
Average Operating Pressure	30	45	100	47	Metres
Density of connections	20	45	120	63	per km of mains

4. Key Components of Annual System Input Volume

Component	m3/year	m3/connection/day	% of System Input Volume
Water Exported		not applicable	
Authorised Consumption excluding exports	861702	0.22	23.1
Apparent Losses	430603	0.11	11.5
Actual Consumption excluding exports	1292305	0.34	34.6
Real Losses	2440085	0.64	65.4
System Input Volume	3732390	0.97	100.0

DATA ENTRY SHEET FOR LEAKAGE BENCHMARKING IN SOUTH AFRICA

Note: Note: An example has been included to assist you in completing this data sheet. The example input data can be seen in the pale blue shaded areas. Your input data should appear in the pale yellow shaded areas. The light green shaded areas are protected calculation fields and nothing can be entered in these fields.
Use the units as shown. If you have to use other units; you have to change the appropriate cells.

D1. GENERAL

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D2. SYSTEM DATA

Input Description	Variable	Example Data	Actual Data	Units
Length of Mains (Transmission + Distribution)	Lm	1500	167	km
Number of Service Connections	Ns	60000	10522	Number
Density of Service Connections (per km of mains)	Ns/Lm	40	63	Per km
Percentage of time system is pressurised during year	T	100	100	%
Average operating pressure when system pressurised	P	45	47	metres
Population served by the supply system	Pop	100000	43902	Number

See Notes 1 & 2

See Note 3

See Note 4

Note 1: The number of service connections is not always the same as the number of meters or billed accounts. For South African conditions, however, you can use the total of the number of metered accounts plus the estimated number of unmetered connections

Note 2: In South Africa customer meters are usually located close to the street/stand boundary. If this is not the case for your system, then add a note here.

Consumer Units Residential 9 004, Commercial and Industrial 320 and Other 1198 = 10 522

Note 3: Use T in % eg. If T = 80%, use 80 and not 0.8

Note 4: If you do not have an accurate figure, please make a best estimate and provide brief details of how you derived it.

Estimated from Water Master Plan.

D3. UNAVOIDABLE ANNUAL REAL LOSSES (UARL)

Details	Calculation	Example Result	Actual Data	Units
On mains	$18 \times \text{Lm} \times \text{P} \times 365 \times \text{T}/10^8$	443	52	$10^3 \text{ m}^3/\text{yr}$
On Service Connections	$0.8 \times \text{Ns} \times \text{P} \times 365 \times \text{T}/10^8$	788	146	$10^3 \text{ m}^3/\text{yr}$
Total Volume of UARL		1232	198	$10^3 \text{ m}^3/\text{yr}$
UARL in litres/service conn./day when the system is pressurised	Annual Volume of UARL $\times 10^6 / (\text{Ns} \times 365 \times \text{T}/100)$	56	51	Litres/ conn./day

D4. ANNUAL WATER BALANCE DATA

D4a. Data Period

12-MONTH PERIOD FOR WHICH DATA APPLIES		Example Data	Actual Data
	Start Date	April 1, 1998	July 1, 2023
	End Date	March 31, 1999	June 30, 2024

D4b. System Input Volume

Water Supplied	Example Data					Actual Data				
	Metered 10 ³ m ³ /yr	Correction to Source Meter data		Unmetered 10 ³ m ³ /yr	Total 10 ³ m ³ /yr	Metered 10 ³ m ³ /yr	Correction to Source Meter data		Unmetered 10 ³ m ³ /yr	Total 10 ³ m ³ /yr
		+/- %	10 ³ m ³ /yr				+/- %	10 ³ m ³ /yr		
From Own Sources:	36000	2.00%	720		36720	3732				3732
From Other Suppliers:	1000			280	1280					
Total:	37000		720	280	38000	3732				3732

D4c. Components of Authorised Consumption

Components of Authorised Consumption	Example Data					Actual Data				
	Billed Metered 10 ³ m ³ /yr	Billed Unmetered 10 ³ m ³ /yr	Unbilled Metered 10 ³ m ³ /yr	Unbilled Unmetered 10 ³ m ³ /yr	Total 10 ³ m ³ /yr	Billed Metered 10 ³ m ³ /yr	Billed Unmetered 10 ³ m ³ /yr	Unbilled Metered 10 ³ m ³ /yr	Unbilled Unmetered 10 ³ m ³ /yr	Total 10 ³ m ³ /yr
Water Exported:	1500				1500					
Households:	24500	500			25000	718				718
Non-households:	6900	100			7000	133				133
Standpipes:		500	10		510					
Firefighting:				100	100				4	4
Mains Flushing:				100	100				4	4
Building water:	1040				1040					
Other (specify):						4				4
Other (specify):										
TOTALS:	33940	1100	10	200	35250	854			7	862

D4d. Components of Water Losses

Details	Example Result	Actual Result	Units
Water Losses = System Input – Authorised Consumption	2750	2871	10 ³ m ³ /yr
Percentage of Total Losses estimated to represent the Apparent Losses	20	15	%
Apparent Losses	550	431	10 ³ m ³ /yr

Annual Real Losses (ARL) = Water Losses – Apparent Losses	2200	2440	10 ³ m ³ /yr
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D5. SELECTED OPERATIONAL PERFORMANCE INDICATORS

D5a. Current Annual Real Losses per Connection (CARL) at Current Pressures

Details	Calculation	Example Result	Actual Result	Units
CARL is expressed in Litres/service connection/day, when system is pressurised	$ARL \times 10^6 / (Ns \times T/100 \times 365)$	100	635	Litres /conn./day
Consumption in litres/conn/day		1610	224	Litres /conn./day

D5b. Infrastructure Leakage Index (ILI)

Details	Calculation	Example Result	Actual Result
ILI is the ratio of Current Annual Real Losses (CARL) to Unavoidable Annual Real Losses	$CARL / UARL$	1.79	12.35

D5c. Non-Revenue Water as a % by Volume of System Input

Description of Unbilled Items	Example Result			Actual Result		
	Volume	System Input	% of System Input	Volume	System Input	% of System Input
	$10^3 \text{ m}^3/\text{yr}$	$10^3 \text{ m}^3/\text{yr}$		$10^3 \text{ m}^3/\text{yr}$	$10^3 \text{ m}^3/\text{yr}$	
Unbilled Consumption	210	38000	0.55	7	3732	0.20
Apparent Losses:	550	38000	1.45	431	3732	11.54
Real Losses:	2200	38000	5.79	2440	3732	65.38
Total Unbilled:	2960	38000	7.79	2878	3732	77.11

D6. SELECTED FINANCIAL PERFORMANCE INDICATORS

D6a. Local Valuation of Real and Apparent Losses

Details	Example Result	Actual Result	Units
Unit Value of Real Losses (eg bulk purchase price)	0.15	0.46	R /m ³
Unit Value of Apparent Losses (eg selling price)	2.70	19.59	R /m ³

D6b. Annual Cost of Running System

Details	Example Cost	Actual Cost	Units
Annual Cost of running system in 1000's of Rand per year	45000	20552	10^3 R/year

D6c. Non-Revenue Water as % by Value of Cost of Running System

Description of Unbilled Items	Example Result				Actual Result			
	Volume	Unit Value	Value	% of Annual Running Costs	Volume	Unit Value	Value	% of Annual Running Costs
	$10^3 \text{ m}^3/\text{yr}$	R /m ³	10^3 R/year	Costs	$10^3 \text{ m}^3/\text{yr}$	(R /m ³)	10^3 R/year	Costs
Unbilled Consumption	210	2.70	567	1.26	7	19.59	146	0.71
Apparent Losses:	550	2.70	1485	3.30	431	19.59	8436	41.05
Real Losses:	2200	0.15	330	0.73	2440	0.46	1122	5.46
Total Unbilled:	2960		2382	5.29	2878		9704	47.22

D7. RELATIONSHIP BETWEEN REAL LOSSES EXPRESSED AS % OF SYSTEM INPUT

D7a. Real losses curve definition

Curve Definition					
Consumption litres/serv conn/day	Real losses in litres/service connection/day				
	50	100	200	500	1000
100	33.3	50.0	66.7	83.3	90.9
250	16.7	28.6	44.4	66.7	80.0
500	9.1	16.7	28.6	50.0	66.7
1000	4.8	9.1	16.7	33.3	50.0
2000	2.4	4.8	9.1	20.0	33.3
3000	1.6	3.2	6.3	14.3	25.0
5000	1.0	2.0	3.8	9.1	16.7
10000	0.5	1.0	2.0	4.8	9.1

D7b. Components of water balance in litres/service connection/day (Actual Results)

System Input Volume = 972	Total Consumption = 336	Billed Authorised Consumption = 222	Authorised Consumption = 224	Revenue Water 222
		Unbilled Authorised Consumption = 2		Non-Revenue Water = 749
		Apparent Losses = 112	Total Losses = 747	
	Real Losses = 635			

D7c. Current Real Losses as % of System Input Volume

Details	Calculation	Actual Result	Units
System Input Volume	from D7b	972	Litres/conn/day
Total Consumption	from D7b	336	Litres/conn/day
Annual Real Losses	from D7b	635	Litres/conn/day

ARL as % of System Input	ARL / System input volume x 100	65	%
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D7d. Potential Real Losses as % of System Input Volume

Details	Calculation	Actual Result	Units
Unavoidable Annual Real Losses (UARL)	from D3	51	Litres/conn/day
Target Loss Factor (TLF)	User defined for each system	2	Dimensionless
Target Annual Real Losses (TARL)	TLF x UARL	103	Litres/conn/day
Current Annual Real Losses (CARL)	CARL from D5a	635	Litres/conn/day
Potential savings	CARL - TARL	532	Litres/conn/day

Potential ARL as % of System Input	TARL / (System input volume-Potential savings) x 100	23	%
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D7e. Real Losses as a % of System Input Volume versus Consumption in litres/service connection for different values of Real Losses in litres/service connection/day

