water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

REVIEW, EVALUATION AND OPTIMISATION OF THE SOUTH AFRICAN WATER RESOURCES MONITORING NETWORK

Network Inventory

VOLUME 2: MAP BOOK

DRAFT

MARCH 2015

Obtainable from

Chief Directorate: Water Information Management

Department: Water and Sanitation

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PRETORIA

0001

PREFACE

The Department of Water and Sanitation (DWS) is the custodian of ten national monitoring programmes. The overall aim of this project is to undertake an evaluation of each monitoring network, in its present condition, and to redesign and realign the network based on scientific analysis and the strategic and management objectives of DWS and of the country as a whole. The water resources monitoring network will be optimised to ensure sustainable, relevant and up-to-date data of an acceptable quality

This Network Inventory Task focussed on the production of maps to illustrate the spatial distribution of the existing monitoring stations for these ten monitoring programmes. The deliverable from this Network Inventory task, together the User Requirements Task will be used to identify shortcomings in the current networks.

The metadata from each of the ten monitoring networks was analysed and descriptive labels were developed for each station to describe the temporal information (record period), open/closed, completeness, etc.

This task was undertaken by a team of specialists, one for each of the following categories of data:

- *Surface water quantity.*
- *Surface water quality.*
- *Groundwater levels and quality.*
- *Biophysical Data*
- *Hydro-meteorology*

This was followed by the development of five thematic maps with information on the spatial distribution of these ten monitoring points per new Water Management Area (WMA) have been compiled. Even though other institutions in South Africa are also collecting surface water, groundwater, Hydro-meteorological, water quality, eco-health, mostly for their own interests and applications, only the Hydro-meteorological networks of ARC and SAWS data were included on these maps since these data are used daily by DWS. Due to an abundance of groundwater stations in a number of WMA's, station numbers, rather than the detailed developed labels, were adopted for labelling the groundwater maps. The detailed groundwater labels are included as Appendix A.

The thematic Maps produced per nine WMA's are as follows:

A2-size maps were developed for the nine new WMAs per data category, as follows:

1) *Limpopo WMA*
2) *Olifants WMA*
3) *Inkomati-Usuthu WMA*
4) *Pongola-Mtamvuna WMA*
5) *Vaal WMA*
6) *Orange WMA*
7) *Mzimvubu-Tsitskamma WMA*
8) *Breede-Gouritz WMA*
9) *Berg-Olifants WMA.*

Other products developed as part of this Task are data catalogues and Google Earth KMZ-coverages which are very useful to the DWS, external users and to the project team during the new network design.

Subsequent to the completion of the Network Inventory and User Requirements tasks, the Data integrity assessment task will continue to determine the quality of the available data.

Table of Contents

Appendix A

WMA 3:

Inkomati-Usuthu

Legend

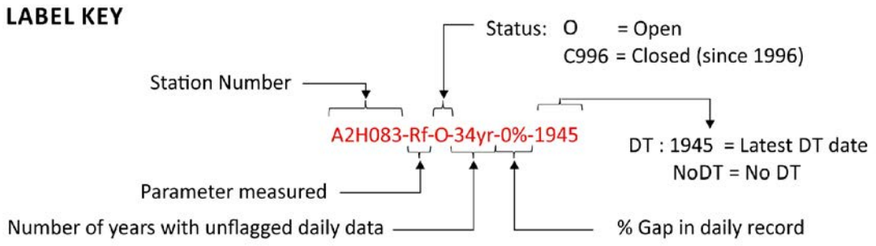
Surface Water Quantity Stations

- River Flow
- Dam Volume
- Canal Flows
- Groundwater Eyes
- Tidal Stations
- Closed
- Rivers
- Dams
- Primary Catchment Boundaries
- Secondary Catchment Boundaries
- Quarternary Catchment Boundaries
- Water Mangement Area

Mean Annual Runoff

- 0 - 2.5 mm
- 2.5 - 5 mm
- 5 - 10 mm
- 10 - 20 mm
- 20 - 50 mm
- 50 - 100 mm
- 100 - 200 mm
- 200 - 500 mm
- > 500 mm

LABEL KEY



Parameters:

R = River stage data only	C = Canal stage data only	D = Reservoir levels data
Rf = River flow (DT Present)	Cf = Canal flow (DT Present)	Dv = Reservoir volume (survey present)
Pf = Pipe flow	G = Stage data from GW Eyes	B = Dam balance done
	Gf = Flow from GW Eyes	T = Tidal stage data

N

Kilometers
0 15 30 60 90 120

Project Title:	**Review, Evaluation and Optimisation of the South African Water Resources Monitoring Network**
Map Title:	**WMA 3 - Inkomati-Usuthu: Surface Water Quantity Monitoring Stations**

Whilst every care has been taken in compiling the information on this map, AECOM cannot accept responsibility for any inaccuracies.

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Scale 1:700 000
(When page size is: A2 portrait)

Figure 3.1

Projection:	Geographic
Datum:	Hartebeesthoek 1994
Compiled By:	LC Gallagher
GIS QC By:	M Storie - PGP 0124
Approved By:	E van Niekerk
Date Saved:	2015/03/17
Project Number:	60326707
Map Ref:	SW_Quantity_Inkomati_Usuthu_A2P.mxd
Revision:	01

Sources:

DWS: Water Information Management
Water Resources of South Africa 2005 (WRC)

Legend

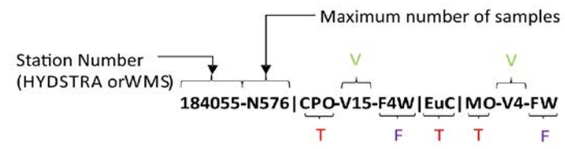
Surface Water Quality Stations

- River Flow
- Dam Volume
- Canal Flows
- Groundwater Eyes
- Tidal Stations
- Closed
- Rivers
- Dams
- Secondary Catchment Boundaries
- Quarternary Catchment Boundaries
- Primary Catchment Boundaries
- Water Mangement Area

Mean Annual Runoff

- 0 - 2.5 mm
- 2.5 - 5 mm
- 5 - 10 mm
- 10 - 20 mm
- 20 - 50 mm
- 50 - 100 mm
- 100 - 200 mm
- 200 - 500 mm
- > 500 mm

LABEL KEY



T = Monitoring Network Types:

CO = Open Chemical	MO = Open Microbial	TO = Open Toxicity
CPO = Open Priority Chemical	MC = Closed Microbial	TC = Closed Toxicity
CC = Closed Chemical	RO = Open Radioactivity	WO = Open Wetlands
EuO = Open Eutrophication	RC = Closed Radioactivity	WC= Closed Wetlands
EuC = Closed Eutrophication		
EsO = Open Estuarine		
EsC = Closed Estuarine		

V = Number of Variables Monitored for Network

F = Recommended Frequency of Sampling

FW:	Weekly Action Frequency	F8W:	8 Weekly Action Frequency
F2W:	2 Weekly Action Frequency	F12W:	12 Weekly Action Frequency
F4W:	4 Weekly Action Frequency	F24W:	12 Weekly Action Frequency
F6W:	6 Weekly Action Frequency		

N

INKOMATI-USUTHU

B1 B3 B4 B7 C C1 V V3 W W4 W5 W6 X X1 X2 X3 X4 Y

Kilometers
0 15 30 60 90 120

Project Title:	**Review, Evaluation and Optimisation of the South African Water Resources Monitoring Network**
Map Title:	**WMA 3 - Inkomati-Usuthu: Surface Water Quality Monitoring Stations**

Whilst every care has been taken in compiling the information on this map, AECOM cannot accept responsibility for any inaccuracies.

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Figure 3.2

Projection:	Hartebeesthoek 1994
Datum:	
Compiled By:	LC Gallagher
GIS QC By:	M Storie - PGP 0124
Approved By:	E Van Niekerk
Date Saved:	2015/03/16
Project Number:	60326707
Map Ref:	SW_Quality_Inkomati_Usuthu_A2P.mxd
Revision:	01

Sources:

DWS: Water Information Management
Water Resources of South Africa 2005 (WRC)

Legend

- Groundwater Quality Stations

Groundwater Levels Stations

- Open
- Closed
- Rivers
- Primary Catchment Boundaries
- Secondary Catchment Boundaries
- Quarternary Catchment Boundaries
- Water Management Areas

Simplified Geology (WR90)

- *Undifferentiated assemblage of compact sedimentary extrusive and intrusive rocks*
- *Intercalated assemblage of compact sedimentary and extrusive rocks*
- *Compact sedimentary strata*
- *Porous unconsolidated and consolidated sedimentary strata*
- *Tillite*
- *Assemblage of tillite and shale*
- *Assemblage of tillite, shale and sandstone*
- *Principally arenaceous strata*
- *Principally argillaceous strata*
- *Intercalated arenaceous and argillaceous strata*
- *Dolimite and limestone*
- *Acid and intermediate lavas*
- *Basic / Mafic lavas*
- *Acid and intermediate extrusives*
- *Basic / Mafic and ultramafic intrusives*

N

X

Y

W

C

V

INKOMATI-USUTHU

ZQMNKW5-N32|GO-V38-F24W
ZQMNKW6-N31|GO-V38-F24W
ZQMGKP1-N44|GO-V38-F24W
ZQMHAZ2-N1|GO-V18-F24W
ZQMSAB1-N45|GO-V38-F24W
ZQMNKW7-N30|GO-V38-F24W
ZQMKMP3-N0|GO-V18-F24W
ZQMNKW8-N7|GO-V18-F24W
ZQMKMP1-N36|GO-V38-F24W
ZQMMLL2-N43|GO-V38-F24W
ZQMMCD1-N45|GO-V38-F24W
ZQMKKD1-N24|GO-V18-F24W
ZQMBBT1-N43|GO-V38-F24W
ZQMBPS1-N43|GO-V38-F24W
ZQMCRL1-N41|GO-V38-F24W

X1N0014 X1N0015 X1N0013 X1N0012 X1N0011 X1N0007 X1N0008 X1N0003 X1N0004 X1N0002 X1N0001 X1N0006 X1N0016 X1N0017
X2N0018 X2N0019 X2N0034 X2N0013 X2N0017 X2N0025 X2N0031 X2N0027 X2N0032 X2N0030 X2N0028 X2N0016 X2N0043 X2N0041 X2N0042 X2N0040 X2N0024 X2N0037 X2N0038 X2N0021 X2N0022
X3N0006 X3N0004 X3N0002 X3N0007 X3N0008 X3N0001 X3N0009 X3N0010 X3N0005 X3N0012

LABEL KEY

Groundwater Levels

Station Number — Status: O = Open; C996 = Closed (since 1996)

D4N1860-Gl-O-34yr-0%

Parameter measured — Number of years with unflagged daily data — % Gap in daily record

Parameters:
Gl = Groundwater Levels

Water Quality

Station Number (HYDSTRA orWMS) — Maximum number of samples

ZQMPL-N43|GO-V38-F4W

T F V

T = Monitoring Network Types:

GO = Open Groundwater Quality
GC = Closded Groundwater Quality
PO = Open Rainfall Quality
PC = Closed Rainfall Quality

V = Number of Variables Monitored for Network

F = Recommended Frequency of Sampling

FW: Weekly Action Frequency
F2W: 2 Weekly Action Frequency
F4W: 4 Weekly Action Frequency
F6W: 6 Weekly Action Frequency
F8W: 8 Weekly Action Frequency
F12W: 12 Weekly Action Frequency
F24W: 12 Weekly Action Frequency

0 15 30 60 90 120 Kilometers

Project Title:	**Review, Evaluation and Optimisation of the South African Water Resources Monitoring Network**
Map Title:	**WMA 3 - Inkomati-Usuthu: Groundwater Quality and Water Level Monitoring Stations**

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Figure 3.3

Projection:	Geographic
Datum:	Hartebeesthoek 1994
Compiled By:	LC Gallagher
GIS QC By:	M Storie - PGP 0124
Approved By:	E Van Niekerk
Date Saved:	2015/03/16
Project Number:	60326707
Map Ref:	GWQuality_Inkomati_Usuthu_A2P.mxd
Revision:	01

Sources:
DWS: Water Information Management
Water Resources of South Africa 2005 (WRC)

Legend

- DWS Rivers Database Sites with Data
- River reaches with indicated number of observed fish species
- Rivers
- Primary Catchment Boundaries
- Secondary Catchment Boundaries
- Quaternary Catchment Boundaries
- Water Management Area

Ecoregions Level

1 LIMPOPO PLAIN
2 SOUTPANSBERG
3 LOWVELD
4 NORTH EASTERN HIGHLANDS
5 NORTHERN PLATEAU
6 WATERBERG
7 WESTERN BANKENVELD
8 BUSHVELD BASIN
9 EASTERN BANKENVELD
10 NORTHERN ESCARPMENT MOUNTAINS
11 HIGHVELD
12 LEBOMBO UPLANDS
13 NATAL COASTAL PLAIN
14 NORTH EASTERN UPLANDS
15 EASTERN ESCARPMENT MOUNTAINS
16 SOUTH EASTERN UPLANDS
17 NORTH EASTERN COASTAL BELT
18 DROUGHT CORRIDOR
19 SOUTHERN FOLDED MOUNTAINS
20 SOUTH EASTERN COASTAL BELT
21 GREAT KAROO
22 SOUTHERN COASTAL BELT
23 WESTERN FOLDED MOUNTAINS
24 SOUTH WESTERN COASTAL BELT
25 WESTERN COASTAL BELT
26 NAMA KAROO
27 NAMAQUA HIGHLANDS
28 ORANGE RIVER GORGE
29 SOUTHERN KALAHARI
30 GHAAP PLATEAU
31 EASTERN COASTAL BELT

N

INKOMATI-USUTHU

LABEL KEY
DWS River Database:

Status Indicator:
M = Identified Macro Site (no data in River Database)
R = Rivers Database Data available
MR = All of the above

Site Code → E2DORI-BIEDO|MR|E|S5,3jH|C|LQ

IFR/EWR site (based on site code and description)
Channel condition data available
SASS Indicator:
S5,3 = Version of SASS (4 or 5), with number of samples
H = Macroinvertebrate habitat integrity data available
Landuse and/or Water Quality data available

Fish Species Data from PES EI ES Project:

Sub-quaternary Reach Number → M20B-09078-F6
Number of fish species observed in sub-quaternary river reach and/or adjacent river reach

0 12.5 25 50 75 100 Kilometers

Project Title:	**Review, Evaluation and Optimisation of the South African Water Resources Monitoring Network**
Map Title:	**WMA 3 - Inkomati-Usuthu: Biophysical Monitoring Stations**

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Scale 1:700 000
(When page size is: A2 portrait)

Figure 3.4

Projection:	Geographic
Datum:	Hartebeesthoek 1994
Compiled By:	LC Gallagher
GIS QC By:	M Storie - PGP 0124
Approved By:	E van Niekerk
Date Saved:	2015/03/17
Project Number:	60326707
Map Ref:	Biophysical_Inkomati_Usuthu_A2P.mxd
Revision:	01

Sources:
DWS: Water Information Management
Water Resources of South Africa 2005 (WRC)
Desktop PES, EI + ES (DWS, 2014)

Legend

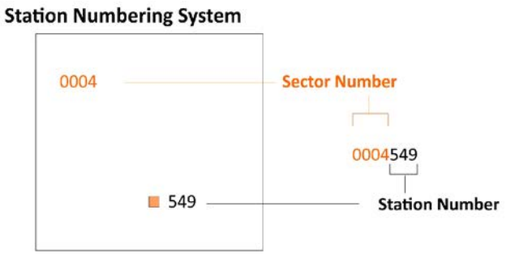
DWS Climate Stations
- Open
- Closed

ARC Meteorological Stations
- Open (Data Post - 2010)
- Closed

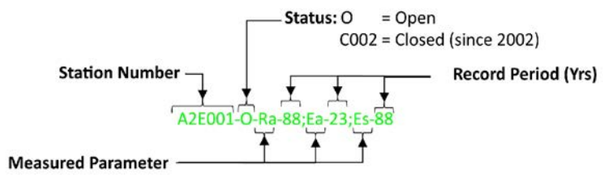
SAWS Rainfall Stations
- Open
- Closed
- Rivers
- Dams
- SAWS Sector
- Primary Catchment Boundaries
- Secondary Catchment Boundaries
- Quaternary Catchment Boundaries
- Water Management Areas

Mean Annual Precipitation
- 0 -100 mm
- 101 - 200 mm
- 201 - 300 mm
- 301 - 400 mm
- 401 - 500 mm
- 501 - 600 mm
- 601 - 700 mm
- 701 - 800 mm
- 801 - 1 000 mm
- > 1 000 mm

SAWS Station Numbering System



DWS Stations



Parameters:
Ra = Rainfall
Ea = A-Pan Evaporation
Es = S-Pan Evaporation

Project Title:	**Review, Evaluation and Optimisation of the South African Water Resources Monitoring Network**
Map Title:	**WMA 3 - Inkomati-Usuthu: Hydro-meteorological Monitoring Stations**

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Scale 1:800 000
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Figure 3.5

Projection:	Geographic
Datum:	Hartebeesthoek 1994
Compiled By:	LC Gallagher
GIS QC By:	M Storie - PGP 0124
Approved By:	E Van Niekerk
Date Saved:	2015/03/16
Project Number:	60326707
Map Ref:	CMN_Inkomati_Usuthu_A2P.mxd
Revision:	02

Sources:

DWS: Water Information Management
Water Resources of South Africa 2005 (WRC)
Agricultural Research Council (ARC)

APPENDIX A:

Detailed Groundwater Level and Quality

Monitoring Station Labels

WMA 3: Inkomati-Usuthu

WMA 3 - Inkomati-Usuthu: Groundwater Level and Quality Monitoring Stations

Station	Name	Catchment	Province	Label
X3N0004	Ludlow	X32G	MP	X3N0004-Gl-O-11yrs-0%
X3N0005	Merry Pebble Stream	X32G	MP	X3N0005-Gl-O-11yrs-0%
X3N0006	Eglington	X32G	MP	X3N0006-Gl-O-11yrs-0%
X3N0002	Kasteel	X32A	MP	X3N0002-Gl-O-12yrs-0%
X3N0007	Craigieburn	X32A	MP	X3N0007-Gl-O-12yrs-0%
X3N0001	Zoeknog	X32D	MP	X3N0001-Gl-O-12yrs-0%
X3N0008	Orinoco	X32D	MP	X3N0008-Gl-O-12yrs-0%
X3N0009	London	X32D	MP	X3N0009-Gl-O-12yrs-0%
X3N0010	Orinoco	X32E	MP	X3N0010-Gl-O-12yrs-0%
X1N0014	Injaka ptn. Bushbuckridge	X12J	MP	X1N0014-Gl-O-7yrs-0%
X3N0011	Injaka	X31E	MP	X3N0011-Gl-O-7yrs-0%
X2N0018	Makoko	X24A	MP	X2N0018-Gl-O-12yrs-0%
X2N0040	Sudwalaskraal ptn. Sudwala	X22B	MP	X2N0040-Gl-O-7yrs-0%
X2N0041	Sudwalaskraal ptn. Sudwala	X22B	MP	X2N0041-Gl-O-7yrs-0%
X2N0042	Sudwalaskraal ptn. Sudwala	X22B	MP	X2N0042-Gl-O-7yrs-0%
X2N0043	Sudwalaskraal ptn. Sudwala	X22B	MP	X2N0043-Gl-O-7yrs-0%
X2N0013	Kiaat	X24B	MP	X2N0013-Gl-O-13yrs-0%
X2N0017	Hlauhlau	X24B	MP	X2N0017-Gl-O-12yrs-0%
X2N0019	Ga-Tshwene Ptn Tshweni	X24B	MP	X2N0019-Gl-O-12yrs-0%
X2N0034	Stateland ptn. tshweni	X24B	MP	X2N0034-Gl-O-12yrs-0%
X2N0032	Symington ptn. Hectorspruit	X24F	MP	X2N0032-Gl-O-13yrs-0%
X2N0016	Mpakeni	X24C	MP	X2N0016-Gl-O-12yrs-0%
X2N0025	Luphisi	X24C	MP	X2N0025-Gl-O-12yrs-0%
X2N0027	Mhlati ptn. Malelane	X24D	MP	X2N0027-Gl-O-13yrs-0%
X2N0028	Mhlati ptn. Malelane	X24D	MP	X2N0028-Gl-O-13yrs-0%
X2N0030	Mhlati ptn. Malelane	X24D	MP	X2N0030-Gl-O-13yrs-0%
X2N0031	Mhlati ptn. Malelane	X24D	MP	X2N0031-Gl-O-13yrs-0%
X2N0021	Grootgeluk Ptn. Ngodwana	X21J	MP	X2N0021-Gl-O-12yrs-0%
X2N0022	Grootgeluk Ptn. Ngodwana	X21J	MP	X2N0022-Gl-O-12yrs-0%
X2N0024	Grootgeluk Ptn. Ngodwana	X21J	MP	X2N0024-Gl-O-12yrs-0%
X2N0037	Elandsfontein ptn. Ngodwana	X21J	MP	X2N0037-Gl-O-7yrs-0%
X2N0038	Elandsfontein ptn. Godwana	X21J	MP	X2N0038-Gl-O-7yrs-0%
X1N0012	Valkbult ptn. Hectorpruit	X14H	MP	X1N0012-Gl-O-7yrs-0%
X1N0013	Valkbult Ptn. Kwamhlushwa	X14H	MP	X1N0013-Gl-O-13yrs-0%
X1N0015	Vlakbult ptn. Tonga ptn. Kwamhlushwa	X14H	MP	X1N0015-Gl-O-7yrs-0%
X1N0007	Mzinti	X13J	MP	X1N0007-Gl-O-11yrs-0%
X1N0011	Kwazibukwane	X13J	MP	X1N0011-Gl-O-11yrs-0%
X3N0012	Eglington ptn. Mbangwana	X32H	MP	X3N0012-Gl-O-7yrs-0%
X1N0003	Hooggenoeg Ptn. Mbejela	X12G	MP	X1N0003-Gl-O-13yrs-2%
X1N0004	Tjakastad Ptn. Tjakastad	X12G	MP	X1N0004-Gl-O-13yrs-0%
X1N0001	Geluk Ptn. Mbejela	X12H	MP	X1N0001-Gl-O-13yrs-4%
X1N0002	Geluk Ptn. Mbejela	X12H	MP	X1N0002-Gl-O-13yrs-0%
X1N0006	Hooggenoeg Ptn. Eerstehoek	X12H	MP	X1N0006-Gl-O-13yrs-0%
X1N0009	State Land	X13J	MP	X1N0009-Gl-O-11yrs-2%
X1N0016	Honinglip ptn. Elukwatini	X12F	MP	X1N0016-Gl-O-7yrs-0%
X1N0017	Witklip ptn. Oshoek	X12K	MP	X1N0017-Gl-O-7yrs-0%