A guide to the effective use of the South African national water quality database for monitoring change

Mike Silberbauer, June 2018

Introduction

South Africa's database of surface water quality, the Water Management System, is widely used as a chronicle of change in rivers and dams. A selection of publications and reports is available at www.dwa.gov.za/iwqs/water_quality/NCMP/publication.aspx. These include Van Niekerk et al. (2009 DOI 10.1007/s10661-008-0407-2), Griffin (2017, DOI 10.17159/sajs.2017/20170020), Griffin (2014, WRC Report No. 2184/1/14), Slaughter et al. (2017, DOI 10.4314/wsa.v43i3.15 - modelling), Day & King (1995- spatial distribution), Van Niekerk et al. (2014 DOI 10.4314/wsa.v40i1.16 Maucha ionic diagrams and trends. The database also supports reporting for the sustainable development goals, especially SDG 6.3.2.

Obtaining data

Anyone may request data from the database, either by contacting the help desk or by downloading files directly from the RQIS website. The help desk is run by Marica Erasmus: MaricaE@dws.gov.za or +27 12 808 9610. The data line to RQIS is frequently down, so an alternative contact number is the switchboard cellphone, +27 82 908 2895. The website is www.dwa.gov.za/iwqs.

The database archives more than 10 million results for samples collected since the 1970s, and records of analytical methods are available for most analysis types (Figure 1).

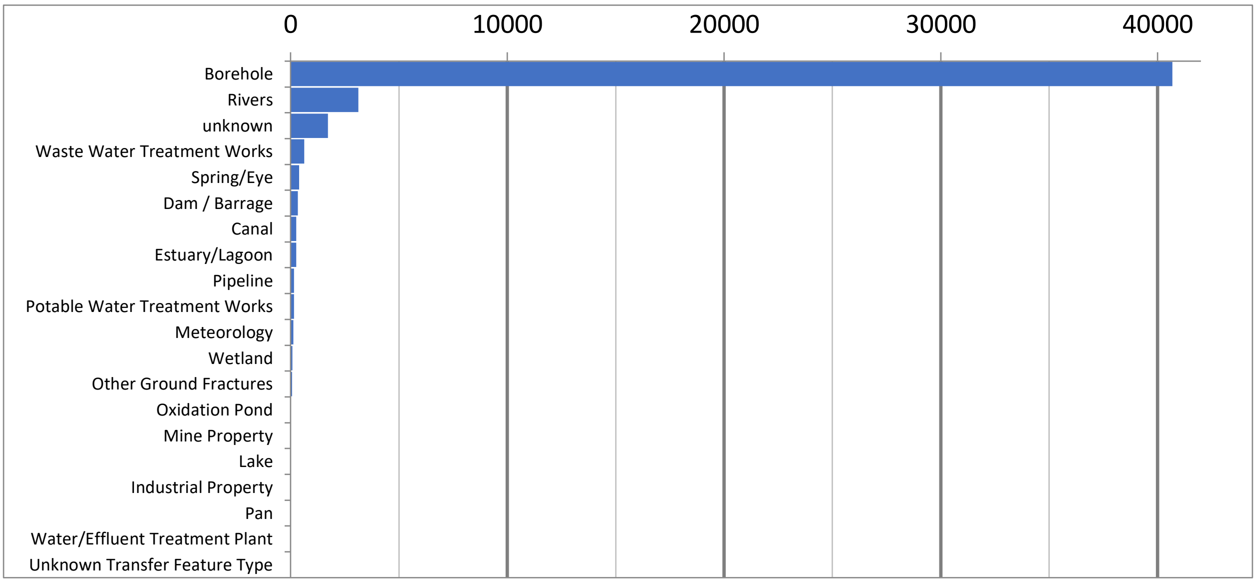

Figure 1. Number of sites for each site type, where the number exceeds 10. The figure excludes 21 other site types which represent only 76 sites in all.

Caveats

Users need to be aware of the characteristics of the data if they are to draw realistic conclusions. Some records on the database date to the 1960s, spanning a longer period than many working careers, so even the database curators have only a vague idea of how these early samples were collected, stored and analysed. For example, results from Schutte & Bosman (1973, Technical report TR 56 for dams from 1968 to 1972) are available on the database, but not all methods are described in detail.

Additional layers of complexity include method changes and fluctuating detection limits. Delays before analysis are not always apparent in the standard reports. Some results are from archived paper documents with no method description. In the case of pH, a significant anomaly in the data record for the 1980s suggests that the results are not reliable (Ramjukadh et al. www.dwa.gov.za/iwqs/water_quality/NCMP/nwrqsr.aspx).

The database records the institutions that provided data and their analytical methods. Most analyses are from the Department of Water and Sanitation laboratories of the Resource Quality Information Services laboratories at Roodeplaat Dam (Figure 2).

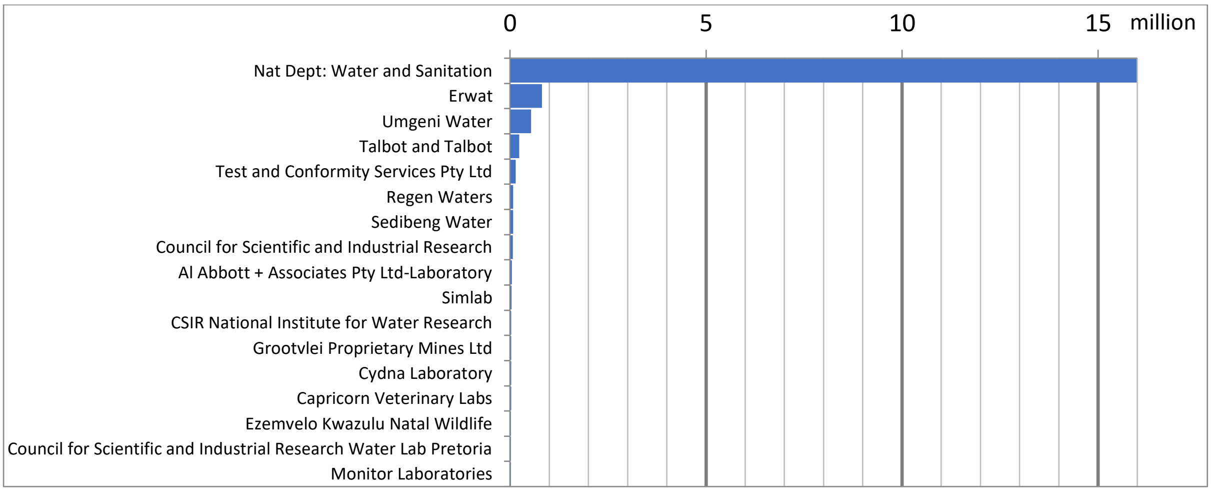

Figure 2. The main laboratories that performed the analyses recorded on the national water quality database. Only those with more than 20 000 results are shown. More than 100 other laboratories have together contributed 345 000 analyses.

The database has a few instances of overlapping datasets, where two entities unwittingly sampled the same site for months or even years: these periods of overlap provide a useful insight into the reliability of methods (Figure 3).

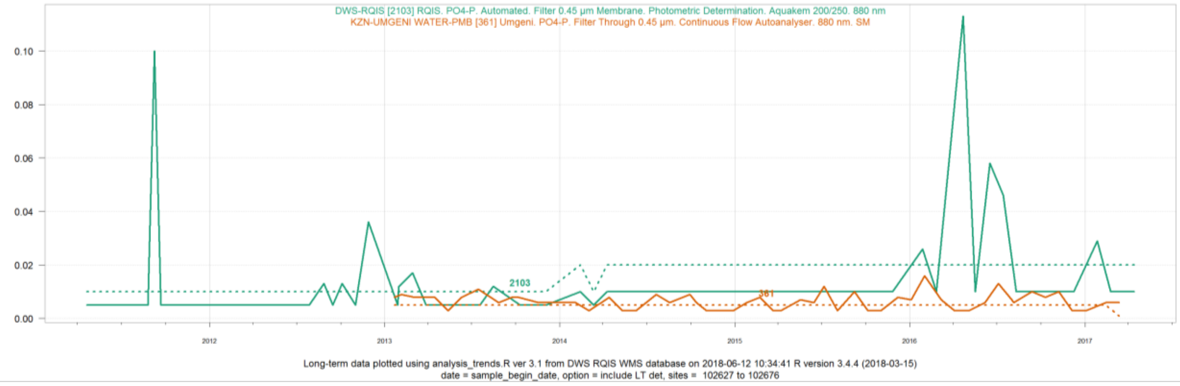

Figure 3. Dissolved inorganic phosphorus in mg/L at U3H005 Weir downstream of Hazelmere Dam. Note the different detection limits between the methods used by RQIS and Umgeni Water laboratories.

Information about data

Data provided on request by the RQIS helpdesk will usually include a set of files with information about the monitoring sites, individual sample results and, if required, statistical summaries (Table 1). Users of Microsoft Windows may find that the file extensions, e.g. CSV or TXT, are hidden – which can be confusing. Also note that the CSV file convention is comma-separated-values, and computers set up to use commas as decimal markers will import the data incorrectly.

Table 1. A typical set of files provided by the RQIS help desk in response to a request for data.

Example file	**contents**
Client inventory 06-10-2015.CSV	Site descriptions, coordinates, number of samples and dates of first and last monitoring events
Client inventory 06-10-2015_CSV.TXT	Description of the inventory file contents
Client standard results 06-10-2015.CSV	Comma-separated-value file for import into spreadsheets and databases, with each sample's preservation type, results, detection limits and, rarely, indicators of exceedance of the maximum value measurable by each method
Client standard results 06-10-2015_CSV.TXT	Description of the type and date of data extraction, with measurement units and explanations of abbreviations
Client statistics report 06-10-2015.CSV	Percentiles, means, confidence limits and ranges for each variable at each site, for the time period selected
Client statistics report 06-10-2015_CSV.TXT	Explanation of the abbreviations in the statistics file

Data files provided on the website include the methods, detection limits and other descriptive information in a separate data description text file. The Appendix includes an example of a data description file and the first few lines of a CSV data file.

Data descriptions, or metadata, are becoming increasingly important because oral sources of anecdotal information are disappearing. Distinguishing between erroneous data and interesting results becomes a puzzle. In some cases, aquatic chemistry rules out impossible concentrations—in others, unlikely results may be true. Hartbeespoort Dam has some record chlorophyll results, for example.

A problematic trend is the decrease in the rate and extent of water quality monitoring, which has declined by 50% since the late 1990s (Figure 4). Indirect methods such as numerical modelling and remote sensing, if we can afford them, will increase in importance as ways of patching up the widening gaps in South Africa's surface water monitoring network.

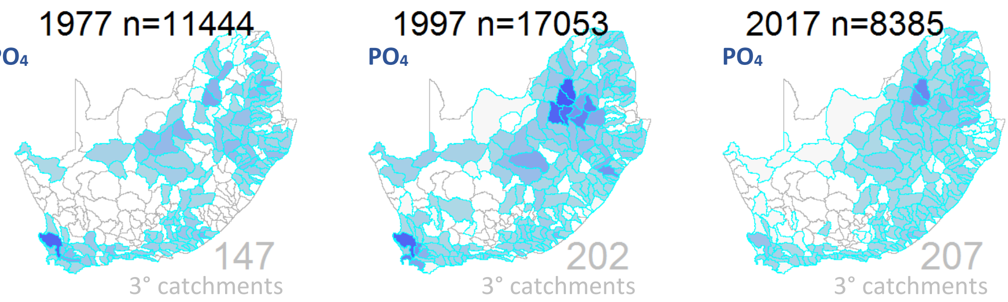

Figure 4. Changes in numbers of rivers monitored from 1977 to 2017. The density of shading is proportional to the number of sites monitored per each tertiary drainage region.

HTTP and HTTPS errors

The www.dwa.gov.za server used the secure hypertext transfer protocol (HTTPS) for a few years, ending on 1 January 2017. After this date, the Department of Water and Sanitation no longer maintained a secure sockets layer (SSL) digital certificate, which meant that all links to the site starting with "https" started giving a security warning, e.g. Figure 5. This usually happens with internal links on the website that have not been corrected, or web searches that have picked up an old link to the site. Simply change the https:// to http:// and all should be well.

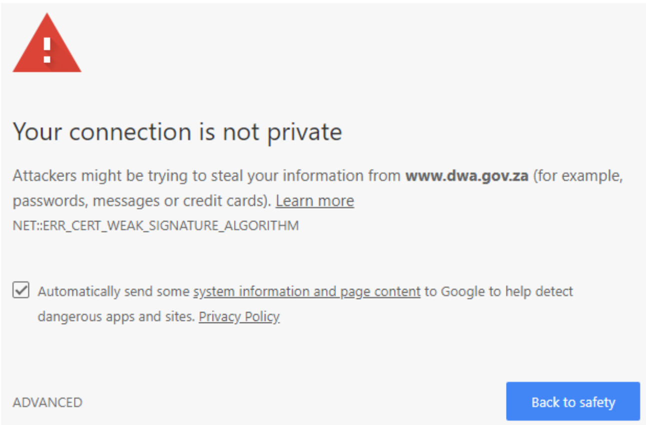

Figure 5. The warning generated by the Chrome browser to a user landing on https://www.dwa.gov.za/iwqs/.

Note that the old http://www.dwaf.gov.za/iwqs/ link still works.

Conclusion

The managers of the WMS water quality database at RQIS greatly value the contributions of all aquatic scientists to understanding the complex national water quality dataset. Past studies have analysed the data from different viewpoints, combined flow and chemical data sets (e.g. Figure 6), have added value by integrating data into models and have detected anomalies along the way.

Users are encouraged to request datasets or download them from the website or the helpdesk – if you have any doubts or queries about the data sources, please ask.

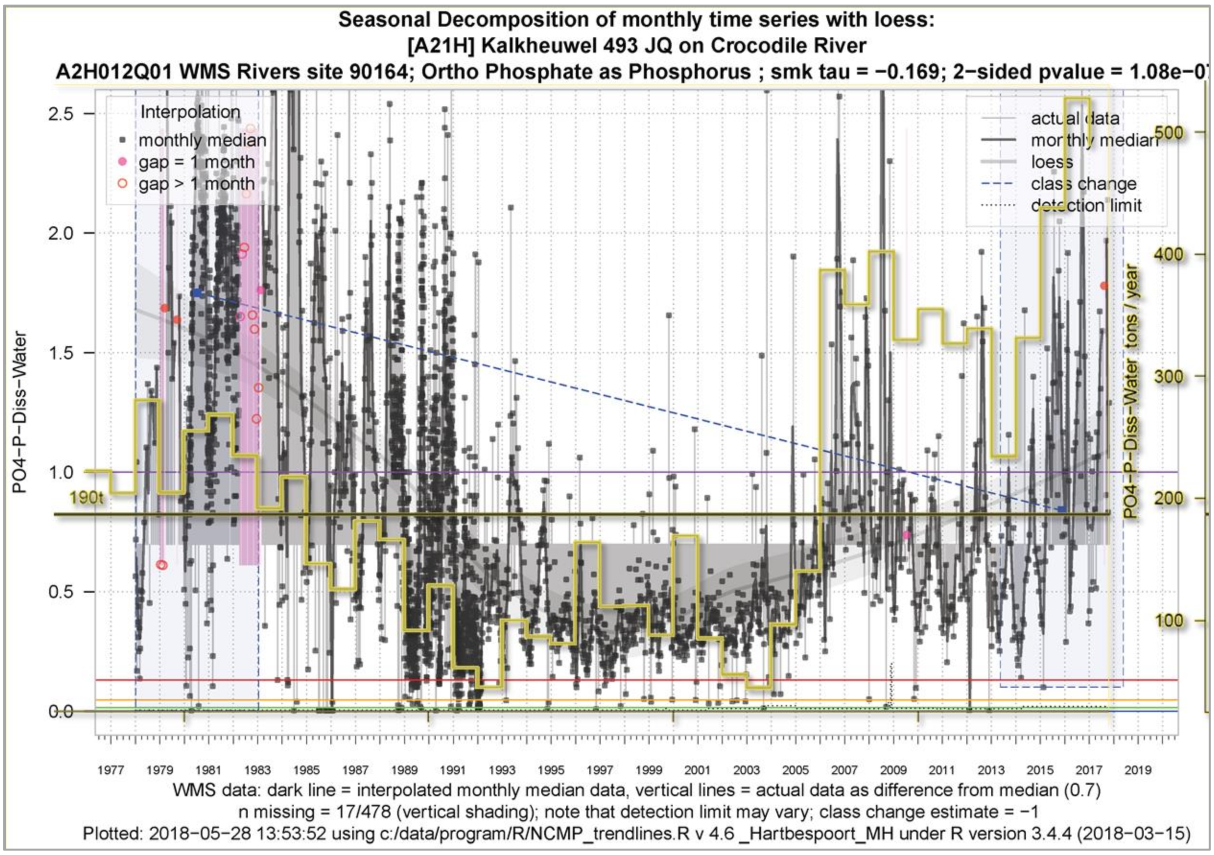

Figure 6. Combining data sources: Using flow and concentration to estimate annual load of PO4-P to Hartbeespoort Dam.

Appendix: example of description and data files supplied with data from the RQIS website

Data description file

Suggested citation:
DWS 2018. National Water Management System data extracted on 2018-05-18. Department of Water and Sanitation, Pretoria.

Laboratory analysis for site 90160 (A2H006Q01) by:
Nat Dept: Water and Sanitation. (DWS-RQIS)

Most analytical methods have changed through the years, as listed below.
For historical methods, see Analytical Methods Manuals TR136 and TR151 at http://www.dwa.gov.za/iwqs/reports/tr.aspx

Be particularly careful when using pH data from 1978 to 1989 - http://www.dwa.gov.za/iwqs/water_quality/NCMP/nwrqsr.aspx

These summary files do not include method detection limits, and instead insert 0.5 * the detection limit in place of any result less than the detection limit.
The lists below show the range of detection limits per variable, and the dates between which detection limits occurred.
For results that include method detection limits per variable per date, please request full data files from the Contact email at the end of this file.

Database site description:
Pienaarsrivier 90 JR at Klipdrift on Pienaars River

Database site coordinates:
latitude -25.380556
longitude 28.316667

Data extraction:
2018-05-18 16:17:06 using script barcode.R v 16.8 with the macro option, under R version 3.4.4 (2018-03-15)

Abbreviations:

mon_variable_abbr	measure_unit_abbr	mon_variable_name	measure_unit_name	mon_variable_id
Ca-Diss-Water	mg/L	Calcium	Milligram per Litre	52
Cl-Diss-Water	mg/L	Chloride	Milligram per Litre	46
DMS-Tot-Water	mg/L	Dissolved Major Salts	Milligram per Litre	63
EC-Phys-Water	mS/m	Electrical Conductivity	Millisiemens per Metre	56
F-Diss-Water	mg/L	Fluoride	Milligram per Litre	24
K-Diss-Water	mg/L	Potassium	Milligram per Litre	50
KJEL N-Tot-Water	mg/L	Kjeldahl Nitrogen	Milligram per Litre	9
Mg-Diss-Water	mg/L	Magnesium	Milligram per Litre	32
Na-Diss-Water	mg/L	Sodium	Milligram per Litre	30
NH4-N-Diss-Water	mg/L	Ammonium Nitrogen	Milligram per Litre	13
NO3+NO2-N-Diss-Water	mg/L	Nitrate + Nitrite Nitrogen	Milligram per Litre	11
P-Tot-Water	mg/L	Total Phosphorus	Milligram per Litre	37
pH-Diss-Water	pH units	pH	Units of pH	3
PO4-P-Diss-Water	mg/L	Ortho Phosphate as Phosphorus	Milligram per Litre	39
Si-Diss-Water	mg/L	Silicon	Milligram per Litre	34
SO4-Diss-Water	mg/L	Sulphate	Milligram per Litre	42
TAL-Diss-Water	mg/L	Total Alkalinity as Calcium Carbonate	Milligram per Litre	27

Dates when laboratory methods were in use (detection limit range in brackets):

1976-04-20 13:04 to 2017-12-12 09:12 DMS-Tot-Water (1) Not a laboratory method.
1976-02-02 14:02 to 2010-09-07 08:09 EC-Phys-Water (0.1-2) RQIS. EC. Automated Measurement, Temperature Compensated to 25°C
2010-09-21 09:09 to 2017-12-12 09:12 EC-Phys-Water (0.1-2) RQIS. EC. Automated Measurement. Compensated to 25°C. Radiometer TIM870
2013-07-23 08:07 to 2014-02-04 08:02 EC-Phys-Water (0.1-2) RQIS. EC. Automated Electrode. Compensated at 25°C. 4 Point Calibration. Gallery
1976-02-02 14:02 to 2010-09-07 08:09 pH-Diss-Water (2) PH. Automated Measurement - 2 Point Calibration. Instrument: Radiometer TTT85
2010-09-21 09:09 to 2017-12-12 09:12 pH-Diss-Water (2) RQIS. pH. Automated Measurement. Radiometer TIM870
2013-07-23 08:07 to 2013-10-15 08:10 pH-Diss-Water (2) RQIS. pH. Automated Electrode. Compensated at 25°C. 3 Point Calibration. Gallery
1976-02-02 14:02 to 1996-09-03 08:09 Na-Diss-Water (0.338-5) RQIS. Na. Automated. Flame Emission. Lithium as Internal Standard. Air/Propane. Technicon Flame Photometer (Iv)
1996-09-10 08:09 to 2008-05-06 09:05 Na-Diss-Water (0.338-5) RQIS. Na. Automated. Flame Emission. LP Gas. 0.45 µm Membrane. Jenway Pfp 7
2008-08-12 08:08 to 2013-12-23 11:12 Na-Diss-Water (0.338-5) RQIS. Na. Automated. Filter 0.45 µm Membrane. Atomic Absorption. Gbc Avanta. 330.2 nm
2009-05-05 08:05 to 2013-08-06 08:08 Na-Diss-Water (0.338-5) RQIS. Na. Automated. Filter 0.45 µm Membrane. Atomic Absorption Spectrometer Air/Acetylene - Spectraa 220 Fs
2015-03-03 09:03 to 2016-11-23 08:11 Na-Diss-Water (0.338-5) RQIS. Na. Automated. Filter 0.45 µm Membrane. Atomic Absorption. AA500. 330.23 nm
2015-08-19 08:08 to 2017-12-12 09:12 Na-Diss-Water (0.338-5) RQIS. Na. Automated. Filter 0.45 µm Membrane. Atomic Absorption. Gbc Savantaa. 330.2 nm. Method 5008.1
1976-02-02 14:02 to 1996-09-03 08:09 K-Diss-Water (0.116-2.5) RQIS. K. Automated. Flame Emission. Lithium as Internal Standard. Air/Propane..Technicon Flame Photometer (Iv)
1996-09-10 08:09 to 2008-05-06 09:05 K-Diss-Water (0.116-2.5) RQIS. K. Automated. Flame Emission. LP Gas. 0.45 µm Membrane. Jenway Pfp 7
2008-07-13 08:07 to 2013-12-23 11:12 K-Diss-Water (0.116-2.5) RQIS. K. Automated. Filter 0.45 µm Membrane. Atomic Absorption. Gbc Avanta. 766.5 nm
2015-03-03 09:03 to 2017-12-12 09:12 K-Diss-Water (0.116-2.5) RQIS. K. Automated. Filter 0.45 µm Membrane. Atomic Absorption. AA500. 766.49 nm
2015-09-15 08:09 to 2017-07-18 09:07 K-Diss-Water (0.116-2.5) RQIS. K. Automated. Filter 0.45 µm Membrane. Atomic Absorption. Gbc Savantaa. 766.5 nm. Method 5008.2
1976-02-02 14:02 to 2008-05-06 09:05 Ca-Diss-Water (0.7-2.5) RQIS. CA. Automated. AA Spectrophotometer. Potassium Ionisation Buffer. Air/Acetylene. 0.45 µm. Varian AA-1275. 422.7 nm
2008-07-13 08:07 to 2017-12-12 09:12 Ca-Diss-Water (0.7-2.5) RQIS. CA. Automated. Filter 0.45 µm Membrane. Photometric Determination. Aquakem 200/250. 660 nm
2017-06-06 08:06 to 2017-07-04 08:07 Ca-Diss-Water (0.7-2.5) RQIS. CA. Automated. Filter 0.45 µm Membrane. Atomic Absorption. Agilent AAS 240 Fs
1976-02-02 14:02 to 2008-05-06 09:05 Mg-Diss-Water (0.94-1.5) RQIS. Mg. Automated. AA Spectrophotometer. Potassium Ionization Buffer. Air/Acetylene. 0.45 µm. Varian AA-1275. 285.2 nm
2008-07-13 08:07 to 2017-12-12 09:12 Mg-Diss-Water (0.94-1.5) RQIS. Mg. Automated. Filter 0.45 µm Membrane. Photometric Determination. 520 nm. Aquakem 200/250.
2017-06-06 08:06 to 2017-07-04 08:07 Mg-Diss-Water (0.94-1.5) RQIS. Mg. Automated. Filter 0.45 µm Membrane. Atomic Absorption. Agilent AAS 240 Fs

1976-02-02 14:02 to 1992-02-25 10:02 Cl-Diss-Water (0.09-10) RQIS. Cl. Automated. Colorimetric. Ferric Thiocyanate. Technicon Auto Analyzer. 480 nm
1992-03-24 10:03 to 2008-07-01 08:07 Cl-Diss-Water (0.09-10) RQIS. Cl. Automated. Colorimetric. Ferric Thiocyanate. 0.45 µm Membrane. TRAACS. 480 nm
2008-07-13 08:07 to 2015-12-08 08:12 Cl-Diss-Water (0.09-10) RQIS. Cl. Automated. Filter 0.45 µm Membrane. Photometric Determination. Aquakem 200/250. 480 nm
2014-07-22 09:07 to 2017-12-12 09:12 Cl-Diss-Water (0.09-10) RQIS. Cl. Automated. Filter 0.45 µm Membrane. Photometric Determination. Gallery. 480 nm
1976-02-02 14:02 to 1992-02-25 10:02 SO4-Diss-Water (0.75-6) RQIS. SO4. Automated. Colorimetric. Turbidity Measurement. Technicon Auto Analyzer. 405 nm
1992-03-24 10:03 to 2008-07-01 08:07 SO4-Diss-Water (0.75-6) RQIS. SO4. Automated. Colorimetric. Turbidimetric. 0.45 µm Membrane. TRAACS. 420 nm
2008-07-13 08:07 to 2015-12-22 07:12 SO4-Diss-Water (0.75-6) RQIS. SO4. Automated. Filter 0.45 µm Membrane. Photometric Determination. Aquakem 200/250. 420NM
2014-07-22 09:07 to 2017-12-12 09:12 SO4-Diss-Water (0.75-6) RQIS. SO4. Automated. Filter 0.45 µm Membrane. Photometric Determination. Gallery. 420 nm
1976-02-02 14:02 to 2008-07-01 08:07 TAL-Diss-Water (4-10) RQIS. TAL. Automated. Colorimetric. Bromophenol Blue. 0.45 µm Membrane. Technicon Auto Analyzer. 600 nm
2008-08-26 08:08 to 2017-12-12 09:12 TAL-Diss-Water (4-10) RQIS. TAL. Automated. Filter 0.45µM Membrane. Photometric Determination. 600 nm. Aquakem 200/250
1976-02-02 14:02 to 2008-07-01 08:07 F-Diss-Water (0.05-0.2) RQIS. F. Automated. Ion Selective Electrode. 0.45 µm Membrane. Technicon Auto Analyzer
2010-07-13 08:07 to 2017-12-12 09:12 F-Diss-Water (0.05-0.2) RQIS. F. Automated. Filter 0.45µM Membrane. Flow Injection Analysis. Lachat Quikchem 8500 Series 2
2013-06-25 09:06 to 2017-09-12 07:09 F-Diss-Water (0.05-0.2) RQIS. F. Automated. Filter 0.45µM Membrane. F. Photometric Determination. 630 nm. Aquakem 250
1976-02-02 14:02 to 1990-09-12 07:09 PO4-P-Diss-Water (0.005-0.023) RQIS. PO4-P. Automated. Colorimetric. Ortho-Phosphate as Phosphomolybdate. Technicon Auto Analyzer. 660 nm
1990-10-10 07:10 to 2008-07-01 08:07 PO4-P-Diss-Water (0.005-0.023) RQIS. PO4-P. Automated. Colorimetric. Ortho-Phosphate as Phosphomolybdate. 0.45µM Membrane Filter. TRAACS. 660 nm
2008-08-26 08:08 to 2017-12-12 09:12 PO4-P-Diss-Water (0.005-0.023) RQIS. PO4-P. Automated. Filter 0.45 µm Membrane. Photometric Determination. Aquakem 200/250. 880 nm
1999-09-28 08:09 to 2008-07-01 08:07 P-Tot-Water (0.005-0.03) RQIS. TP. Automated. H2SO4-(NH4) 2S2O8 Digestion. Colorimetric. Phosphomolybdate. TRAACS. 660 nm
2008-08-26 08:08 to 2014-07-08 08:07 P-Tot-Water (0.005-0.03) RQIS. TP. Automated. Filter 0.45 µm Membrane. Photometric Determination. Aquakem 200/250. 880 nm
2014-07-22 09:07 to 2017-12-12 09:12 P-Tot-Water (0.005-0.03) RQIS. TP. Automated. Filter 0.45 µm Membrane. Photometric Determination. Gallery. 880 nm
1976-02-02 14:02 to 1990-10-10 07:10 NO3+NO2-N-Diss-Water (0.01-0.11) NO3+NO2-N. Automated. Colorimetric. Cadmium Reduction, Diazo Dye. Technicon Auto Analyzer. 520.0 nm
1990-11-07 06:11 to 2008-07-01 08:07 NO3+NO2-N-Diss-Water (0.01-0.11) RQIS. NO3+NO2-N. Automated. Colorimetric. Cadmium Reduction, Diazo Dye. 0.45 µm Membrane. TRAACS. 520.0 nm
2008-12-03 11:12 to 2017-12-12 09:12 NO3+NO2-N-Diss-Water (0.01-0.11) RQIS. NO3+NO2-N. Automated. Filter 0.45µM Membrane. Photometric. Aquakem 200/250. 540 nm
1976-04-20 13:04 to 1990-09-12 07:09 NH4-N-Diss-Water (0.03-0.1) RQIS. NH4-N. Automated. Colorimetric. Indophenol-Blue. Technicon Auto Analyzer. 630 nm
1990-10-10 07:10 to 2008-07-01 08:07 NH4-N-Diss-Water (0.03-0.1) RQIS. NH4-N. Automated. Colorimetric. Indophenol-Blue. 0.45 µm Membrane. TRAACS. 630 nm
2008-08-26 08:08 to 2017-12-12 09:12 NH4-N-Diss-Water (0.03-0.1) RQIS. NH4-N. Automated. Filter 0.45µM Membrane. Photometric. 660 nm. Aquakem 200/250.
1999-09-28 08:09 to 2008-07-01 08:07 KJEL N-Tot-Water (0.04-0.3) RQIS. Kn. K2SO4/H2SO4 Digestion. Automated. Colorimetric. Indophenol-Blue. 630.0 nm. TRAACS
2008-08-26 08:08 to 2016-03-30 08:03 KJEL N-Tot-Water (0.04-0.3) RQIS. Kn. Automated. Filter 0.45µM Membrane. Photometric Determination. Aquakem 200/250. 660 nm
2014-07-22 09:07 to 2017-12-12 09:12 KJEL N-Tot-Water (0.04-0.3) RQIS. Kn. Automated. Filter 0.45µM Membrane. Photometric. Gallery. 660 nm
1976-04-20 13:04 to 1990-10-10 07:10 Si-Diss-Water (0.1-1) RQIS. Si. Automated. Colorimetric. Molybdate Blue. Technicon Auto Analyzer. 660 nm
1990-11-07 06:11 to 2008-07-01 08:07 Si-Diss-Water (0.1-1) RQIS. Si. Automated. Colorimetric. Molybdate Blue. 0.45 µm Membrane. TRAACS. 660 nm
2008-08-26 08:08 to 2017-10-10 07:10 Si-Diss-Water (0.1-1) RQIS. Si. Automated. Filter 0.45 µm Membrane. Photometric Determination. Aquakem 200/250. 700 nm
2017-08-01 08:08 to 2017-12-12 09:12 Si-Diss-Water (0.1-1) RQIS. Si. Automated. Filter 0.45 µm Membrane. Photometric Determination.700 nm. Gallery

Dates when detection limits were in effect - they may overlap:

1976-04-20 13:04 to 1999-09-21 08:09 DMS-Tot-Water detection limit = 1
1976-02-02 14:02 to 2017-12-12 09:12 EC-Phys-Water detection limit = 1
2001-05-22 08:05 to 2003-10-21 07:10 EC-Phys-Water detection limit = 2
2001-11-15 08:11 to 2011-01-04 08:01 EC-Phys-Water detection limit = 0.1
1976-02-02 14:02 to 2017-12-12 09:12 pH-Diss-Water detection limit = 2
1976-02-02 14:02 to 2010-08-10 10:08 Na-Diss-Water detection limit = 2
2008-08-12 08:08 to 2011-01-25 09:01 Na-Diss-Water detection limit = 0.338
2010-09-21 09:09 to 2011-07-26 08:07 Na-Diss-Water detection limit = 0.442
2010-12-14 09:12 to 2011-02-22 07:02 Na-Diss-Water detection limit = 1.92
2011-05-17 08:05 to 2016-11-23 08:11 Na-Diss-Water detection limit = 3
2011-09-06 07:09 to 2013-12-23 11:12 Na-Diss-Water detection limit = 4
2015-08-19 08:08 to 2017-12-12 09:12 Na-Diss-Water detection limit = 1.6
2015-09-15 08:09 to 2015-12-08 08:12 Na-Diss-Water detection limit = 5
1976-02-02 14:02 to 2008-05-06 09:05 K-Diss-Water detection limit = 0.3
2008-08-12 08:08 to 2011-07-26 08:07 K-Diss-Water detection limit = 0.116
2011-05-17 08:05 to 2013-12-23 11:12 K-Diss-Water detection limit = 2
2015-03-03 09:03 to 2017-12-12 09:12 K-Diss-Water detection limit = 1
2015-09-15 08:09 to 2017-07-18 09:07 K-Diss-Water detection limit = 2.5
2015-10-27 07:10 to 2017-01-17 06:01 K-Diss-Water detection limit = 0.8
1976-02-02 14:02 to 2014-03-18 09:03 Ca-Diss-Water detection limit = 1
2014-04-01 08:04 to 2017-12-12 09:12 Ca-Diss-Water detection limit = 2.5
2017-06-06 08:06 to 2017-07-04 08:07 Ca-Diss-Water detection limit = 0.7
1976-02-02 14:02 to 2008-05-06 09:05 Mg-Diss-Water detection limit = 1
2008-08-12 08:08 to 2017-12-12 09:12 Mg-Diss-Water detection limit = 1.5
2017-06-06 08:06 to 2017-07-04 08:07 Mg-Diss-Water detection limit = 0.94
1976-02-02 14:02 to 1999-09-21 08:09 Cl-Diss-Water detection limit = 3
1999-04-13 08:04 to 2003-10-21 07:10 Cl-Diss-Water detection limit = 10
2001-11-15 08:11 to 2005-01-04 07:01 Cl-Diss-Water detection limit = 5
2005-01-18 09:01 to 2008-07-01 08:07 Cl-Diss-Water detection limit = 4
2008-08-12 08:08 to 2012-02-21 08:02 Cl-Diss-Water detection limit = 0.9
2010-09-21 09:09 to 2011-07-26 08:07 Cl-Diss-Water detection limit = 0.09
2011-07-12 07:07 to 2015-12-08 08:12 Cl-Diss-Water detection limit = 1
2014-07-22 09:07 to 2017-12-12 09:12 Cl-Diss-Water detection limit = 2
1976-02-02 14:02 to 2008-07-01 08:07 SO4-Diss-Water detection limit = 4
2001-11-15 08:11 to 2005-01-04 07:01 SO4-Diss-Water detection limit = 6
2008-08-12 08:08 to 2011-01-25 09:01 SO4-Diss-Water detection limit = 0.75
2010-09-21 09:09 to 2015-12-22 07:12 SO4-Diss-Water detection limit = 3
2014-07-22 09:07 to 2017-12-12 09:12 SO4-Diss-Water detection limit = 1.2
1976-02-02 14:02 to 2003-10-21 07:10 TAL-Diss-Water detection limit = 4
2001-11-15 08:11 to 2011-01-25 09:01 TAL-Diss-Water detection limit = 8
2010-09-21 09:09 to 2014-03-18 09:03 TAL-Diss-Water detection limit = 5
2014-04-01 08:04 to 2017-12-12 09:12 TAL-Diss-Water detection limit = 10
1976-02-02 14:02 to 2017-09-12 07:09 F-Diss-Water detection limit = 0.1
2001-11-15 08:11 to 2005-01-04 07:01 F-Diss-Water detection limit = 0.2
2010-07-27 08:07 to 2017-12-12 09:12 F-Diss-Water detection limit = 0.05
1976-02-02 14:02 to 2001-05-17 08:05 PO4-P-Diss-Water detection limit = 0.005
2001-05-22 08:05 to 2008-07-01 08:07 PO4-P-Diss-Water detection limit = 0.011
2001-11-15 08:11 to 2005-01-04 07:01 PO4-P-Diss-Water detection limit = 0.023

```
2008-08-26 08:08 to 2011-01-25 09:01 PO4-P-Diss-Water detection limit = 0.012
2010-09-21 09:09 to 2014-03-18 09:03 PO4-P-Diss-Water detection limit = 0.01
2014-04-01 08:04 to 2017-12-12 09:12 PO4-P-Diss-Water detection limit = 0.02
1999-09-28 08:09 to 2001-05-17 08:05 P-Tot-Water detection limit = 0.005
2001-06-05 08:06 to 2003-09-16 07:09 P-Tot-Water detection limit = 0.009
2001-11-15 08:11 to 2005-01-04 07:01 P-Tot-Water detection limit = 0.03
2005-01-18 09:01 to 2008-07-01 08:07 P-Tot-Water detection limit = 0.01
2008-08-26 08:08 to 2011-01-25 09:01 P-Tot-Water detection limit = 0.006
2010-09-21 09:09 to 2014-03-18 09:03 P-Tot-Water detection limit = 0.012
2014-04-01 08:04 to 2017-12-12 09:12 P-Tot-Water detection limit = 0.02
1976-02-02 14:02 to 2003-10-21 07:10 NO3+NO2-N-Diss-Water detection limit = 0.04
2001-11-15 08:11 to 2005-01-04 07:01 NO3+NO2-N-Diss-Water detection limit = 0.11
2005-01-18 09:01 to 2008-07-01 08:07 NO3+NO2-N-Diss-Water detection limit = 0.08
2008-12-03 11:12 to 2011-01-25 09:01 NO3+NO2-N-Diss-Water detection limit = 0.01
2010-09-21 09:09 to 2014-03-18 09:03 NO3+NO2-N-Diss-Water detection limit = 0.05
2014-04-01 08:04 to 2017-12-12 09:12 NO3+NO2-N-Diss-Water detection limit = 0.1
1976-04-20 13:04 to 2008-07-01 08:07 NH4-N-Diss-Water detection limit = 0.04
2001-11-15 08:11 to 2005-01-04 07:01 NH4-N-Diss-Water detection limit = 0.03
2008-08-26 08:08 to 2014-03-18 09:03 NH4-N-Diss-Water detection limit = 0.05
2014-04-01 08:04 to 2017-12-12 09:12 NH4-N-Diss-Water detection limit = 0.1
1999-09-28 08:09 to 2001-05-17 08:05 KJEL N-Tot-Water detection limit = 0.04
2001-06-05 08:06 to 2003-09-16 07:09 KJEL N-Tot-Water detection limit = 0.19
2001-11-15 08:11 to 2005-01-04 07:01 KJEL N-Tot-Water detection limit = 0.3
2005-01-18 09:01 to 2006-02-14 09:02 KJEL N-Tot-Water detection limit = 0.05
2006-02-28 08:02 to 2011-01-25 09:01 KJEL N-Tot-Water detection limit = 0.09
2010-09-21 09:09 to 2017-12-12 09:12 KJEL N-Tot-Water detection limit = 0.1
2014-04-01 08:04 to 2016-03-30 08:03 KJEL N-Tot-Water detection limit = 0.2
1976-04-20 13:04 to 2003-10-21 07:10 Si-Diss-Water detection limit = 0.4
2001-11-15 08:11 to 2005-01-04 07:01 Si-Diss-Water detection limit = 0.6
2005-01-18 09:01 to 2008-07-01 08:07 Si-Diss-Water detection limit = 0.8
2008-08-26 08:08 to 2014-03-18 09:03 Si-Diss-Water detection limit = 0.125
2014-04-01 08:04 to 2017-10-10 07:10 Si-Diss-Water detection limit = 1
2017-08-01 08:08 to 2017-12-12 09:12 Si-Diss-Water detection limit = 0.1
```


Please inform us of any results or site descriptions that appear to be incorrect.

Contact:

For data directly from the WMS database, please contact Marica Erasmus, Resource Quality Information Services, Department of Water and Sanitation.
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For official correspondence, please write to:
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Department of Water and Sanitation,
Private Bag X313
Pretoria
South Africa
0001

Data file – first few lines

mon_feat	date_time	sample_b	institution	preservati	Ca_Diss_W	Cl_Diss_W	DMS_Tot_	EC_Phys_\	F_Diss_Wa	K_Diss_W	KJEL_N_To	Mg_Diss_\	Na_Diss_W	NH4_N_Di	NO3_NO2	P_Tot_Wa	pH_Diss_\	PO4_P_Di	Si_Diss_W	SO4_Diss_	TAL_Diss_	Station	Qat
90160	1976-02-02 14:30	0	DWS-RQIS	NONE	22.8	24.9	#N/A	40	0.57	3.26	#N/A	19.1	25.5	#N/A	0.26	#N/A	7.76	0.007	#N/A	25	133.4	A2H006Q0	A23B
90160	1976-02-18 09:45	0	DWS-RQIS	NONE	21.5	21.1	#N/A	35.9	0.53	3.09	#N/A	17.7	25.3	#N/A	0.2	#N/A	7.65	0.007	#N/A	24.8	138.7	A2H006Q0	A23B
90160	1976-02-24 14:30	0	DWS-RQIS	NONE	22.5	22	#N/A	40	0.65	3.22	#N/A	19.3	25.8	#N/A	0.45	#N/A	7.48	0.029	#N/A	24.8	136.3	A2H006Q0	A23B
90160	1976-03-09 14:35	0	DWS-RQIS	NONE	19.4	21.3	#N/A	34	0.52	3.41	#N/A	16.8	31.3	#N/A	0.02	#N/A	7.35	0.003	#N/A	22.2	121.7	A2H006Q0	A23B
90160	1976-03-16 12:05	0	DWS-RQIS	NONE	20.7	23.2	#N/A	37	0.59	3.85	#N/A	18.5	27.2	#N/A	0.02	#N/A	7.53	0.003	#N/A	24.4	136	A2H006Q0	A23B
90160	1976-03-23 11:00	0	DWS-RQIS	NONE	19.7	21.5	#N/A	31.1	0.47	3.55	#N/A	11.3	20.5	#N/A	0.02	#N/A	7.41	0.007	#N/A	21.4	104.1	A2H006Q0	A23B
90160	1976-03-30 10:00	0	DWS-RQIS	NONE	18.4	19.3	#N/A	36.5	0.47	3.18	#N/A	14.9	22.1	#N/A	0.02	#N/A	7.36	0.003	#N/A	21.7	120.8	A2H006Q0	A23B
90160	1976-04-06 16:05	0	DWS-RQIS	NONE	19.5	17.3	#N/A	33	0.48	3.61	#N/A	14.1	20.5	#N/A	0.02	#N/A	7.52	0.007	#N/A	18.7	111.7	A2H006Q0	A23B
90160	1976-04-13 14:45	0	DWS-RQIS	NONE	21.2	19.1	#N/A	35.5	0.53	2.99	#N/A	15.8	22.2	#N/A	0.02	#N/A	7.91	0.007	#N/A	20.9	124.1	A2H006Q0	A23B
90160	1976-04-20 13:40	0	DWS-RQIS	NONE	22	19.7	267	36.6	0.57	3.47	#N/A	18.2	24.1	0.02	0.04	#N/A	7.83	0.014	4.33	19.6	130.7	A2H006Q0	A23B
90160	1976-04-27 08:35	0	DWS-RQIS	NONE	22.8	19	280	38	0.57	3.54	#N/A	19.2	25.6	0.02	0.04	#N/A	7.78	0.003	4.06	20.4	138.3	A2H006Q0	A23B
90160	1976-05-04 13:10	0	DWS-RQIS	NONE	16.8	22.2	#N/A	30.8	0.37	3.19	#N/A	16.5	19.2	#N/A	0.35	#N/A	7.38	0.003	#N/A	17.5	116	A2H006Q0	A23B
90160	1976-05-11 08:55	0	DWS-RQIS	NONE	18	22.1	#N/A	33.2	0.43	3.04	#N/A	17.7	22.6	#N/A	0.24	#N/A	7.69	0.003	#N/A	18.5	133.3	A2H006Q0	A23B
90160	1976-05-18 14:30	0	DWS-RQIS	NONE	23.9	18.8	269	37.2	0.44	2.91	#N/A	17.2	22.8	0.08	0.29	#N/A	7.48	0.007	5.59	17.9	134.3	A2H006Q0	A23B