

Water Resource Planning
Systems Series

SUB-SERIES NO. WQP 1.7.2.1

Resource Directed Management of Water Quality

MANAGEMENT INSTRUMENTS

Volume 4.2.1

Users' Guide

Resource Water Quality
Objectives
(RWQO) Model
(Version 2.0)

August 2006
Edition 2



water & forestry

Department:
Water Affairs & Forestry
REPUBLIC OF SOUTH AFRICA

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Reports as part of this project:

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1.2	National and International Literature Survey and Contextual Review
1.3	Glossary of terminology often used in the Resource Directed Management of Water Quality
1.4	Volume 1: <i>Policy Document Series</i>
1.4.1	Volume 1.1: Summary Policy
1.4.2	Volume 1.2: Policy on the Resource Directed Management of Water Quality
1.5	<i>Strategy Document Series</i>
1.5.1	Volume 2.1: Summary Strategy
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1.6.1	Conceptual Review of water use licence applications in the context of the Resource Directed Management of Water Quality
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1.7.5	Project Document: Guidelines for Setting Licence Conditions for Resource Directed Management of Water Quality
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1.8	Implementation Plan

Bold type indicates this report

APPROVAL

TITLE: Resource Directed Management of Water Quality: Management Instruments. Volume 1.7.2.1: Users' Guide: Resource Water Quality Objectives (RWQOs) Model (Version 2.0)

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ACRONYMS

DWAF	Department of Water Affairs & Forestry
Ecospecs	Ecological Specifications
IWRM	Integrated Water Resource Management
RDM	Resource Directed Measures
RDMWQ	Resource Directed Management of Water Quality
REC	Recommended Ecological Category
RWQOs	Resource Water Quality Objectives
WQM	Water Quality Management

SUPPORT

For enquiries please contact the:
Department of Water Affairs and Forestry,
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Further supporting documentation may be obtained from
<http://www.dwaf.gov.za/>

Developed for the Department of Water Affairs and Forestry by the



1. System

This guide provides assistance to users of the software package (RWQO Model vs. 2.0) for the determination of Resource Water Quality Objectives (RWQOs) for surface water resources. For detail on the methodology behind this system, the user is referred to the "Guideline for determining Resource Water Quality Objectives (RWQOs) , Allocatable Water Quality and the Stress of the Water Resource" (DWAF, 2006), accessible from within the Model or on the enclosed CD. The software is freely available from the Department of Water Affairs and Forestry.

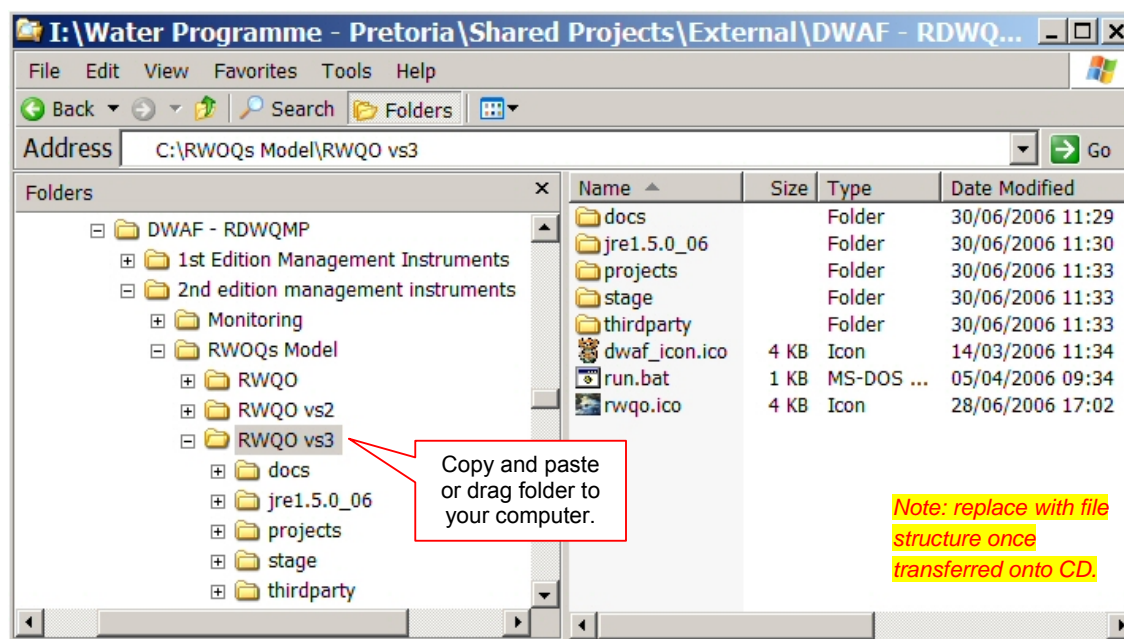
2. Setup

■ Software Version

This Users Guide is applicable to version 2.0 of the RWQOs Model, developed by the CSIR for the Department of Water Affairs and Forestry (DWAF).

■ Setting Up

The RWQOs Model is a computer-based application which can be run either from the setup CD or from a computer. To run the Model from the CD locate and open the file run.bat. To run the Model from the computer, the user should copy the relevant folder and associated files from the CD and paste them into a folder created for the application.



The Model is a standalone application and requires no additional software to run. Should users wish to open any of the available documents within the Model [See Functions], they will need Acrobat Reader. The setup file for Acrobat Reader is enclosed on the attached CD or can be downloaded from www.adobe.com.

3. System Requirements

There are no specific system requirements to operate the RWQOs Model.

4. Quick Start

What you need to know and do to get started:

1. Copy the folder from the CD to your computer
2. Locate and Open the file run.bat
3. You are now ready to begin a new project, or an existing saved project.

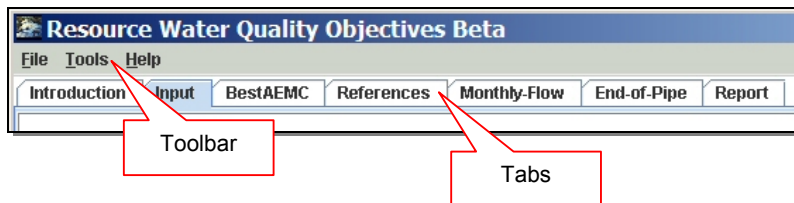
5. Overview

The RWQOs Model (vs 2.0) provides users with a standard approach to consistently setting Resource Water Quality Objectives (RWQOs) for surface water resources in South Africa. By selecting the water resource and user requirements, the Model generates RWQOs that are based on a database of provided and entered water quality parameters.

The Model provides a quick approach to setting RWQOs based on the guidelines for determining Resource Water Quality Objectives (RWQOs), Allocatable Water Quality and the Stress of the Water Resource (DWAF, 2006).

6. Functions

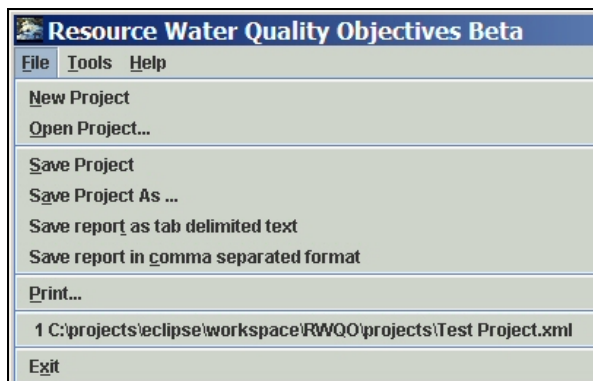
The Model provides two levels of functions; these are accessible through the Toolbar and through the Tabs.



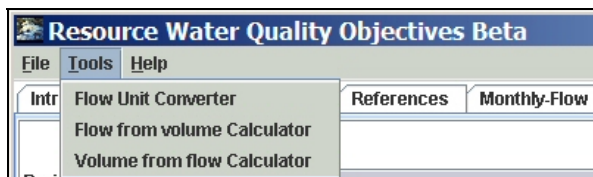
■ Toolbar

Toolbar options include:

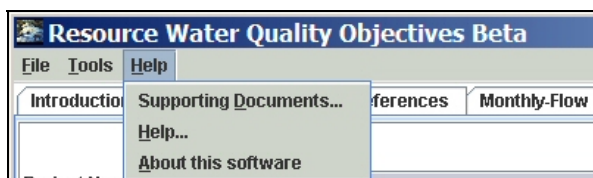
- File
- Tools
- Help



The 'File' dropdown menu on the toolbar, allows users to create a new project, open an already saved project, save a project, save a report, or print a report.



The 'Tools' dropdown menu on the toolbar, allows users to easily convert a number of flow units into the required flow format of m³/s and vice versa.



The 'Help' dropdown menu on the toolbar, allows users to access supporting documents, e.g. guidelines, legislation; access to on-line help; and information about the software version.

■ Tabs

The 'Tabs' provide an overview of each of the working screens in the Model, namely:

- Introduction
- Input
- Best AEMC
- References
- Monthly-Flow
- End-of-Pipe
- Report

■ Introduction

The 'Introduction' tab provides users with a brief overview and background to the Model.

■ Input

The 'Input' tab is the main input screen in the Model. Here users are required to:

- 1) Select (or enter) the Recommended Ecological Category (Best AEMC) for the water resource management unit;
- 2) Select the desired management class for the water resource management unit;
- 3) Set the spatial extent of the water resource management unit;
- 4) Select the desired target flows to support the determination of loads;
- 5) Select the desired water user categories (current and future); and
- 6) Enter present and reference water quality for selected parameters of concern.

Resource Water Quality Objectives Beta

File Tools Help

Introduction **Input** BestAEMC References Monthly-Flow End-of-Pipe Report

Project Name:
Study Unit Name:

Recommended Ecological Category: **(1) Select Best AEMC**
☒ Use to set the Ecological Reserve Category

Management class: **(2) Select management class** ☒ Use to set the Category for other users

Spatial extent: **(3) Select spatial extent**

Temporal extent:
Flow assurance: %
Target flow: m³/sec **(4) Select flow**

Report created by:

User	Existing?	Future?	Category
International obligations	<input type="checkbox"/>	<input type="checkbox"/>	Ideal
Strategic use	<input type="checkbox"/>	<input type="checkbox"/>	Ideal
Ecological Reserve	<input type="checkbox"/>	<input type="checkbox"/>	A
Ecological Requirements	<input type="checkbox"/>	<input type="checkbox"/>	Nat...
Basic Human Needs	<input type="checkbox"/>	<input type="checkbox"/>	Ideal
Agriculture - Aquaculture	<input type="checkbox"/>	<input type="checkbox"/>	Ideal
Industrial - Category 1	<input type="checkbox"/>	<input type="checkbox"/>	Ideal
Industrial - Category 2	<input type="checkbox"/>	<input type="checkbox"/>	Ideal
Industrial - Category 3	<input type="checkbox"/>	<input type="checkbox"/>	Ideal
Industrial - Category 4	<input type="checkbox"/>	<input type="checkbox"/>	Ideal
Recreation - Full contact	<input type="checkbox"/>	<input type="checkbox"/>	Ideal
Recreation - Intermediate contact	<input type="checkbox"/>	<input type="checkbox"/>	Ideal
Recreation - Non-contact	<input type="checkbox"/>	<input type="checkbox"/>	Ideal

Category	Variable	NT	Present State		Ref
			Value	Percentile	
Physical	Clarity	NT	<input type="text"/>	<input type="text"/>	<input type="text"/>
Physical	Colour	Pt	<input type="text"/>	<input type="text"/>	<input type="text"/>

(6) Present and Reference water quality

Each of these steps is briefly unpacked below and in more detail in the worked example in Annexure A.

❖ Recommended ecological category

The Recommended ecological category (REC) (sourced from the Best AEMC) provides the starting default category for the ecological Reserve category [under Users]. To select the REC the user should go to the BestAEMC tab and select the appropriate quaternary catchment. By doing so, the Best AEMC will automatically be filled into the Input screen.

Recommended ecological category

Select

A22F

☒ Use to set the Ecological Reserve Category

The user can choose to keep the REC or deselect, to allow a different ecological Reserve category to be entered.

Select REC

Best AEMC and default ecological Reserve category

❖ Desired management class

The Management Class, for the water resource management unit, provides the starting or default category for the other Water Users [under Users] - [Natural=Ideal; Moderately used/impacted=Acceptable; Heavily used/impacted=Tolerable]. The Management Class can be selected from the available drop down menu.

Management class

Moderately used/impacted

☒ Use to set the Category for other users

The user can choose to keep the Management Class or deselect this, to allow different Water User categories to be selected.

Select Management Class

❖ Spatial extent of the water resource management unit

The spatial extent defines the water resource management unit for the study. This is used for supporting information and is not used in any of the calculations to determine the RWQOs.

Spatial extent

Water management area

Select Spatial Extent

❖ Target flows and flow assurance

The flow is used in the Model to determine the allocatable load and the end-of-pipe discharges. Once flows have been entered in the Monthly-Flow tab, the desired temporal extent and flow assurance should be selected. This will automatically insert the target flow into the required field. Flows may be edited by clicking on the Edit Flow Table button.

Edit Flow Table

Select

Temporal extent

Annual

Flow assurance

10 %

Target flow

0.18 m³/sec

Select Temporal Extent

❖ Desired water user categories (current and future)

The desired water user categories, both existing and future are fundamental to determining the RWQOs.

User	Existing?	Future?	Category
International obligations	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Acc...
Strategic use	<input type="checkbox"/>	<input type="checkbox"/>	Acc...
<input type="radio"/> Ecological Reserve	<input type="checkbox"/>	<input type="checkbox"/>	C
<input checked="" type="radio"/> Ecological Requirements	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Good
Basic Human Needs	<input type="checkbox"/>	<input type="checkbox"/>	Acc...
Domestic use	<input type="checkbox"/>	<input type="checkbox"/>	Acc...
Agriculture - Stock watering	<input type="checkbox"/>	<input type="checkbox"/>	Acc...
Agriculture - Irrigation	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Acc...
Agriculture - Aquaculture	<input type="checkbox"/>	<input type="checkbox"/>	Acc...
Industrial - Category 1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Acc...
Industrial - Category 2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Acc...
Industrial - Category 3	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Acc...
Industrial - Category 4	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Acc...
Recreation -	<input type="checkbox"/>	<input type="checkbox"/>	Acc...
Recreation -	<input type="checkbox"/>	<input type="checkbox"/>	Acc...
Recreation -	<input type="checkbox"/>	<input type="checkbox"/>	Acc...

Buttons: Select All, Select None, Apply

Annotations:

- Ecological Reserve category may be changed from default
- Water User categories may be changed from default
- Existing and future water users should be selected

❖ Present and reference water quality for selected parameters of concern

The present water quality is used to determine the water resource stress [See Reports], while the reference water quality provides data to assess the feasibility of the determined RWQOs.

Category	Variable	Units	Bound	Present State		Reference	
				Value	Percentile	Value	Percentile
Physical	Clarity	NTU	Lower				
Physical	Colour	Pt-Co	Upper				
Physical	Odour	TON	Upper				
Physical	Temperature	°C	Upper				
Physical	Hardness (CaCO ₃)	mg/l	Lower				
Physical	TSS	mg/l	Upper				
Physical	Turbidity	NTU	Upper				
Chemical	Alkalinity (CaCO ₃)	mg/l	Upper				
Chemical	Ammonia (NH ₃ -N)	mg/l	Upper				
Chemical	Calcium	mg/l	Upper				
Chemical	Chloride	mg/l	Upper				
Chemical	Chlorine (OCl)	µg/l	Upper				
Chemical	Conductivity	mS/m	Lower				
Chemical	Fluoride	mg/l	Upper				
Chemical	Magnesium	mg/l	Upper				
Chemical	NO ₂ and NO ₃	mg/l	Upper				
Chemical	NO ₃ (NO ₃ -N)	mg/l	Upper				
Chemical	NO ₃	mg/l	Upper				
Chemical	NO ₂	mg/l	Upper				
Chemical	TIN	mg/l	Upper				

Annotation: Present and reference water quality can be entered by the user

■ Best AEMC

The 'Best Achievable Ecological Management Category (Best AEMC)' tab allows users to automatically select the *Recommended Ecological Category* for a given quaternary catchment. The Best AEMC was determined by specialists with local knowledge of the various catchments (Kleynhans, 1999).

Best AEMC for the selected quaternary catchment is used to set the default recommended ecological category

Order by: ☒ Quaternary ☐ Stream Name

Quaternary	Rivers	EISC	PESC	Best AEMC
A10A	LEBENIA	HIGH	CLASS C: MODERATELY ...	CLASS B
A10B		NAL	CLASS C: MODERATELY ...	CLASS B
A10C		NAL	CLASS B: LARGELY NATU...	CLASS A
A21A		NAL	CLASS C: MODERATELY ...	CLASS B
A21B			CLASS C: MODERATELY ...	CLASS B
A21C			CLASS D: LARGELY MODI...	CLASS C
A21D	BLOUBANKSPRUIT	MODERATE	CLASS C: MODERATELY ...	CLASS B
A21E	CROCODILE	MODERATE	CLASS C: MODERATELY ...	CLASS B
A21F	MAGALIES	MODERATE	CLASS C: MODERATELY ...	CLASS B
A21G	SKEERPOORT	MODERATE	CLASS C: MODERATELY ...	CLASS B
A21H	CROCODILE	MODERATE	CLASS C: MODERATELY ...	CLASS B
A21J	CROCODILE	MODERATE	CLASS C: MODERATELY ...	CLASS B
A21K	STERKSTROOM	MODERATE	CLASS C: MODERATELY ...	CLASS B
A21L	CROCODILE	MODERATE	CLASS C: MODERATELY ...	CLASS B
A22A	HEX RIVER	MODERATE	CLASS C: MODERATELY ...	CLASS B
A22B	HEX RIVER	MODERATE	CLASS C: MODERATELY ...	CLASS B
A22C	HEX RIVER	MODERATE	CLASS C: MODERATELY ...	CLASS B
A22D	SELONS	MODERATE	CLASS C: MODERATELY ...	CLASS B
A22E	ELANDS R	MODERATE	CLASS C: MODERATELY ...	CLASS B
A22F	ELANDS	MODERATE	CLASS D: LARGELY MODI...	CLASS C
A22G	HEX RIVER	MODERATE	CLASS C: MODERATELY ...	CLASS B
A22H	HEX RIVER	MODERATE	CLASS D: LARGELY MODI...	CLASS B
A22J	HEX	MODERATE	CLASS C: MODERATELY ...	CLASS B
A23A	PIENAARS	MODERATE	CLASS C: MODERATELY ...	CLASS B

Users can sort alphabetically by quaternary catchment or by stream name

Select desired quaternary catchment

Category selected provides the default Ecological Reserve Category

■ References

The 'Reference tab' provides the input water quality data for various water user types, and is used to determine the RWQOs. For certain water users, the water quality data are automatically provided in the Model [Reference tab], based on the South African Water Quality Guidelines (DWAF, 1996) (e.g. Domestic Use, Agriculture, Industrial, and Recreation) – these are accessible under Help > Supporting Documents. In addition, default water quality data are provided for Ecological Requirements (in the absence of an ecological reserve) (Palmer *et al.*, 2005) and Basic Human Needs (Class 1) (WRC, 1998).

If applicable to the catchment, users are required to enter the water quality in the 'Reference' tab for:

- International obligations;
- Strategic use; and
- Ecological Reserve.

Resource Water Quality Objectives									
File Tools Help									
Introduction Input BestAEMC References Monthly-Flow End-of-Pipe Report									
Category	Variable	Units	Bound	Domestic use			Agriculture - Stock water		
				Ideal	Acceptable	Tolerable	Ideal	Acceptable	Tolerable
Physical	Clarity	NTU	Lower						
Physical	Colour	Pt-Co	Upper						
Physical	Odour	TON	Upper						
Physical	Temperature	°C	Upper						
Physical	Hardness (CaCO ₃)	mg/l	Upper	200	300	600			
Physical	TSS	mg/l	Upper						
Physical	Turbidity	NTU	Upper	0.1	1	20			
Chemical	Alkalinity (CaCO ₃)	mg/l	Upper						
Chemical	Ammonia (NH ₃ -N)	mg/l	Upper						
Chemical	Calcium	mg/l	Upper	80.00	150.00	300.00	1000.00	1500.00	
Chemical	Chloride	mg/l	Upper	100.00	200.00	600.00	1000.00	1750.00	
Chemical	Chlorine (OCl ₂)	µg/l	Upper	0.60	0.80	1.00			
			Lower	0.30	0.20	0.10			
Chemical	Conductivity	mS/m	Upper	70.00	150.00	370.00			
Chemical	Fluoride	mg/l	Upper	0.70	1.00	1.50	2.00	4.00	
Chemical	Magnesium	mg/l	Upper	70.00	100.00	200.00	500.00	750.00	
Chemical	NO ₂ and NO ₃	mg/l	Upper	6.00	10.00	20.00			

The ecological Reserve water quality data are entered for the selected ecological Reserve category, as determined from the Reserve process.

Resource Water Quality Objectives									
File Tools Help									
Introduction Input BestAEMC References Monthly-Flow End-of-Pipe Report									
Category	Variable	Units	Bound	Ecological Reserve				Natural	
				A	B	C	D		
Physical	Clarity	NTU	Lower						
Physical	Colour	Pt-Co	Upper						
Physical	Odour	TON	Upper						
Physical	Temperature	°C	Upper						
			Lower						
Physical	Hardness (CaCO ₃)	mg/l	Upper						
Physical	TSS	mg/l	Upper						
Physical	Turbidity	NTU	Upper						
Chemical	Alkalinity (CaCO ₃)	mg/l	Upper						
Chemical	Ammonia (NH ₃ -N)	mg/l	Upper					0.015	
Chemical	Calcium	mg/l	Upper						
Chemical	Chloride	mg/l	Upper						
Chemical	Chlorine (OCl ₂)	µg/l	Upper						
			Lower						
Chemical	Conductivity	mS/m	Upper						
Chemical	Fluoride	mg/l	Upper				2.183		1.500
Chemical	Magnesium	mg/l	Upper				147		
Chemical	NO ₂ and NO ₃	mg/l	Upper						
Chemical	NO ₃ (NO ₃ -N)	mg/l	Upper				1.21		
Chemical	NO ₃	mg/l	Upper						
Chemical	NO ₃	mg/l	Upper						
Chemical	TIN	mg/l	Upper					0.25	
Chemical	pH						7.6		8.0
							5.8		6.50
Chemical	Potassium	mg/l	Upper						



There is no ecological Reserve?

If an Ecological Reserve has not been set for the water resource management unit, the Model will automatically use the 'Ecological Requirements' (Palmer *et al.*, 2005) for the default Ecological Reserve Category, as determined from the Best AEMC.

■ Monthly Flow

Target flows and flow assurances are used to set the 'Allocatable Load', i.e. the water quality over and above that required for the RWQOs, i.e. that which can be allocated for use.

The flows are entered into the 'Monthly Flow' tab. This can be done in two possible ways, either by:

- Typing the monthly flows into a given flow assurance column, e.g. 10%, or
- Importing the monthly flows as derived from the SPATSIM database (*.rul file), i.e. the output of the Reserve process.



What units should the flows be in?

The monthly flows can be imported as either m³/s or Mm³/month. If the SPATSIM *.rul file is being imported, it is important that the header rows remain in the file. The Model will read these lines, to determine the import flow units.

R30E_mcm.rul - WordPad

File Edit View Insert Format Help

Desktop Version 2, Printed on 2006/06/20
Summary of IFR rule curves for : R30E WR90 Incr.
Determination based on site specific parameters from SPATSIM database.
Regional Type : E.Cape ERC = B

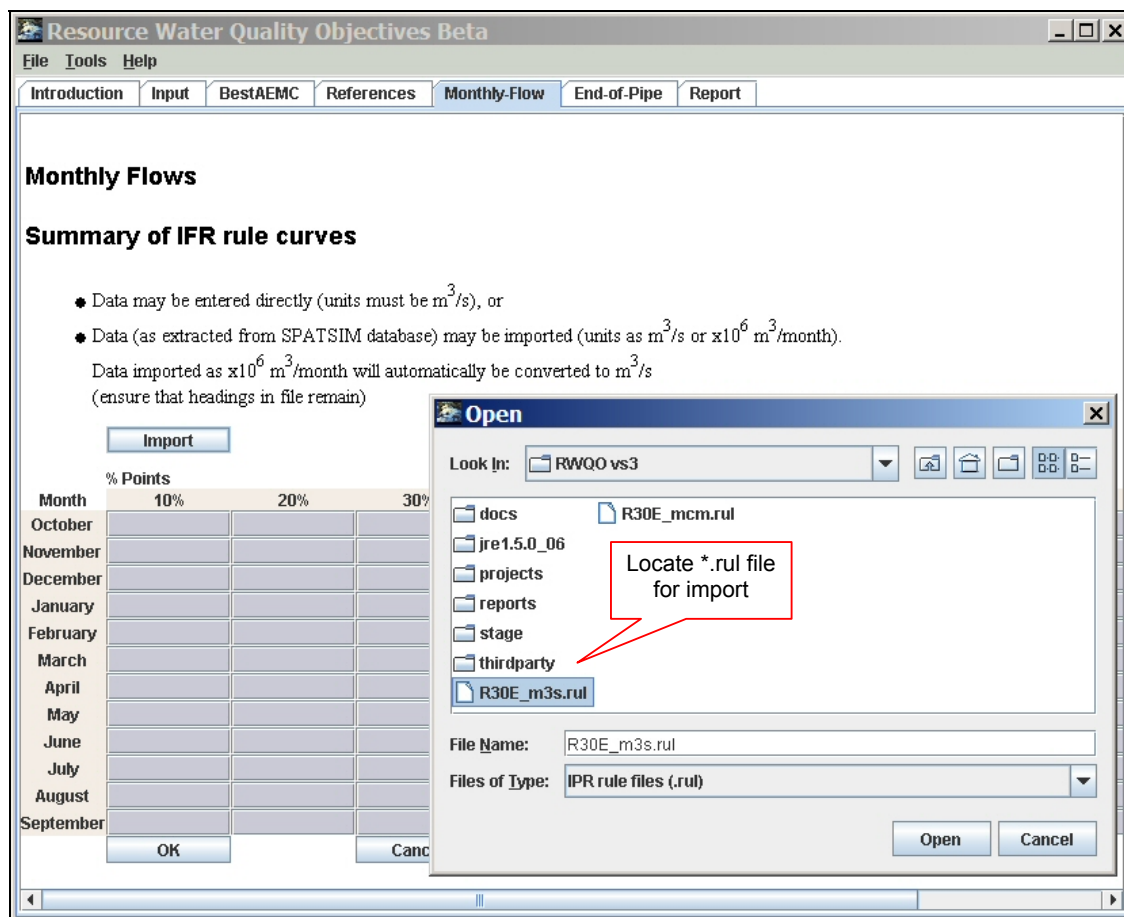
Data are given in m³ * 10⁶ monthly flow volume

Month	10%	20%	30%	40%	50%	60%	70%	80%	90%	99%
Oct	1.083	1.041	0.953	0.805	0.609	0.410	0.255	0.165	0.127	0.122
Nov	4.965	3.931	2.460	1.730	1.130	0.854	0.529	0.346	0.272	0.110
Dec	1.167	1.005	0.853	0.692	0.465	0.321	0.197	0.119	0.086	0.070
Jan	0.675	0.651	0.601	0.514	0.391	0.255	0.140	0.069	0.040	0.020
Feb	0.831	0.803	0.744	0.640	0.492	0.327	0.184	0.094	0.055	0.010
Mar	2.019	1.654	1.329	1.012	0.600	0.384	0.219	0.127	0.089	0.020
Apr	1.024	0.985	0.900	0.758	0.571	0.380	0.231	0.145	0.090	0.070
May	0.386	0.371	0.341	0.290	0.222	0.153	0.100	0.069	0.056	0.054
Jun	0.289	0.277	0.249	0.205	0.152	0.103	0.069	0.051	0.044	0.043
Jul	0.341	0.326	0.294	0.244	0.182	0.124	0.082	0.060	0.051	0.049
Aug	1.048	0.670	0.460	0.360	0.290	0.240	0.210	0.150	0.123	0.100
Sep	0.888	0.854	0.782	0.660	0.440	0.330	0.211	0.137	0.107	0.100

For Help, press F1

These header rows should not be deleted from the import *.rul file

To import flow data, click the **Import** Monthly-Flow' tab. This will take users to an 'Open' screen where you can locate the file for import.



Once imported, the 'Monthly-Flow' tab will be populated with flow assurance values to be used in the Input Tab.

The screenshot shows the 'Resource Water Quality Objectives Beta' application window with the 'Monthly-Flow' tab selected. The 'Edit' button is visible. The table displays flow assurance values for various time frames and percentages.

Time frame	10%	20%	30%	40%	50%	60%	70%	80%	90%	99%
Annual	0.467	0.399	0.316	0.251	0.176	0.123	0.077	0.048	0.036	0.024
Annual - Le...	0.466	0.398	0.316	0.251	0.176	0.123	0.077	0.048	0.036	0.024
October	0.404	0.389	0.356	0.300	0.227	0.153	0.095	0.061	0.047	0.045
November	1.916	1.517	0.949	0.667	0.436	0.330	0.204	0.133	0.105	0.042
December	0.436	0.375	0.319	0.258	0.174	0.120	0.074	0.044	0.032	0.026
January	0.252	0.243	0.225	0.192	0.146	0.095	0.052	0.026	0.015	0.007
February	0.343	0.332	0.307	0.264	0.204	0.135	0.076	0.039	0.023	0.004
February - ...	0.343	0.332	0.307	0.264	0.204	0.135	0.076	0.039	0.023	0.004
March	0.754	0.618	0.496	0.378	0.224	0.143	0.082	0.047	0.033	0.007
April	0.395	0.380	0.347	0.292	0.220	0.146	0.089	0.056	0.035	0.027
May	0.144	0.139	0.127	0.108	0.083	0.057	0.037	0.026	0.021	0.020
June	0.112	0.107	0.096	0.079	0.059	0.040	0.027	0.020	0.017	0.016
July	0.127	0.122	0.110	0.091	0.068	0.046	0.031	0.022	0.019	0.018
August	0.391	0.250	0.172	0.134	0.108	0.090	0.078	0.056	0.046	0.037
September	0.343	0.329	0.302	0.255	0.170	0.127	0.081	0.053	0.041	0.039
Autumn	0.577	0.501	0.423	0.336	0.222	0.144	0.085	0.051	0.034	0.017
Winter	0.194	0.155	0.126	0.103	0.080	0.058	0.043	0.031	0.026	0.023
Spring	0.374	0.359	0.329	0.278	0.199	0.140	0.088	0.057	0.044	0.042
Summer	0.737	0.616	0.449	0.345	0.239	0.170	0.101	0.060	0.044	0.020
Summer - ...	0.734	0.614	0.448	0.344	0.239	0.169	0.101	0.060	0.044	0.020



Where do I
get monthly
flows?

Monthly flow data are sourced from the SPATSIM database, obtainable from the Directorate RDM. Flows should be requested for the point or catchment for which the RWQOs are being set.



How do I edit
flows after I
have imported
them?

If you need to edit the monthly flows after having imported the *.rul file, you can do this by clicking on the **Edit Flow Table** button in the 'Input' tab or the **Edit** button in the Monthly-Flow tab.



■ End-of-pipe

The 'End-of-Pipe' tab, allows users to work back to point source effluent discharges, to determine the end-of-pipe discharge(s) that may be allowed in order to achieve the RWQOs. The 'End-of-Pipe' tab makes use largely of data that have already been entered within the other tabs. The only data to be entered in the 'End-of-Pipe' tab are the data for 'Effluent Flow'.

Resource Water Quality Objectives

File Tools Help

Introduction Input BestAEMC References Monthly-Flow **End-of-Pipe** Report

Upriver Flow (Qs) 0.399
Effluent Flow (Qw) 0.013

Automatically filled from target flow (Input tab)

To be entered by user

	Upriver Concentration (Cs)	Effluent Concentration (Cw)	Downriver Flow (Qr)	Downriver Concentration (Cr)	Mixing Ratio
Hardness (CaCO3) mg/l			0.412	100.000	0.033
TSS mg/l			0.412	25.000	0.033
Alkalinity (CaCO3) mg/l			0.412	300.000	0.033
Ammonia (NH3-N) mg/l			0.412		0.033
Calcium mg/l	93.8	6,628.754	0.412	300.000	0.033
Chloride mg/l	102.1	669.392	0.412	120.000	0.033
Chlorine (OHCl) µg/l			0.412	1.000	0.033
Fluoride mg/l	2.3	0.000	0.412	1.500	0.033
Magnesium mg/l	68.7	4,229.900	0.412	200.000	0.033
NO2 and NO3 mg/l			0.412	20.000	0.033
NO3 (NO3-N) mg/l					
NO3 mg/l					
NO2 mg/l					
TIN mg/l					0.033
Potassium mg/l			0.412	100.000	0.033
PO4 mg/l			0.412		0.033
SAR mmol/l			0.412	15.000	0.033
Sodium mg/l			0.412	115.000	0.033
SO4 mg/l			0.412	90.000	0.033
Sulphide (H2S) mg/l			0.412		0.033
TDS mg/l			0.412	450.000	0.033
Al mg/l			0.412	20.000	0.033

Automatically filled from present water quality (Input tab)

Calculated by Model based on input data

Automatically filled from calculated RWQOs (Report tab)



Effluent Concentration (Cw)

The Effluent Concentration (Cw) calculated in the Model is the total allocatable effluent quality – this may be assigned to a single user or to multiple users. It is up to the user to determine how the effluent concentration will be assigned within a catchment or river reach.

■ Report

Having entered all of the necessary data into the input screen, the user may view the results in the 'Report' tab. The report provides a:

- (1) review of the present and reference water quality, and
- (2) results of:

- RWQOs;
- Resource stress;
- The allocatable water quality and associated confidence; and
- The allocatable loads.

Resource Water Quality Objectives

File Tools Help

Introduction Input BestAEMC References Monthly-Flow End-of-Pipe **Report**

Project: Blesbokspruit RWQOs
Study Unit: Blesbokspruit - C21D
Best AEMC:
Management Class: Fair
Spatial Extent: Quaternary catchment
Temporal Extent: Annual
Flow Assurance: 20 %
Target Flow: 0.399 m³/sec = 12.583Mm³/annum
Prepared on 2006/07/03
using version Beta

Water Use

Water Use	Existing?	Future?	Quality
International obligations	<input type="checkbox"/>	<input type="checkbox"/>	Tolerable
Strategic use	<input type="checkbox"/>	<input type="checkbox"/>	Tolerable
Ecological Reserve	<input type="checkbox"/>	<input type="checkbox"/>	D
Ecological Requirements	<input type="checkbox"/>	<input type="checkbox"/>	Fair
Basic Human Needs	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Tolerable
Domestic use	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Tolerable
Agriculture - Stock watering	<input type="checkbox"/>	<input type="checkbox"/>	Tolerable
Agriculture - Irrigation	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Tolerable
Agriculture - Aquaculture	<input type="checkbox"/>	<input type="checkbox"/>	Tolerable
Industrial - Category 1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Tolerable
Industrial - Category 2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Tolerable
Industrial - Category 3	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Tolerable
Industrial - Category 4	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Tolerable
Recreation - Full contact	<input type="checkbox"/>	<input type="checkbox"/>	Tolerable
Recreation - Intermediate contact	<input type="checkbox"/>	<input type="checkbox"/>	Tolerable
Recreation - Non-contact	<input type="checkbox"/>	<input type="checkbox"/>	Tolerable

Water Quality Variable

Category	Variable	Units	Bound	Present State Value	Present State Percentile	Reference Value	Reference Percentile	RWQO	Stressed?	Allocatable Water Quality Value	Allocatable Water Quality Confidence	Allocatable Loads Tonnes/annum	Allocatable Loads Percentile
Chemical	Calcium	mg/l	Upper	93.8	95.0	62.6	95.0	300.000	No	206.200	95.0	2,594.587	
Chemical	Chloride	mg/l	Upper	102.1	95.0	49.1	95.0	120.000	No	17.900	95.0	225.233	
Chemical	Conductivity	mS/m	Upper	134.5	95.0	68	95.0	70.000	Yes	-64.500	95.0		
Chemical	Fluoride	mg/l	Upper	2.3	95.0	0.8	95.0	1.500	Yes	-0.800	95.0	-10.066	
Chemical	Magnesium	mg/l	Upper	68.7	95.0	47.3	95.0	200.000	No	131.300	95.0	1,652.130	



Parameters of Concern

For the RWQOs of a particular variable to appear in the 'Report' tab, that variable must have been selected in the 'Input' tab as a parameter of concern. This should be done by ☐ the required variable. ☒



*How are the
RWQO
determined by
the Model?*

The Model determines the RWQOs by selecting the lowest or most sensitive water quality, for each variable of concern, for each selected water user (existing and future). The water quality requirements are extracted from entered water quality data (Reserve, International Obligations, Strategic Use) and default SA Water Quality Guideline data.



*How is Stress
determined by
the Model?*

The stress of the resource is the difference between the proposed RWQOs and the present water quality.

RWQOs > Present = unstressed (water quality available for allocation)

RWQOs < Present = stressed (no water quality available for allocation)

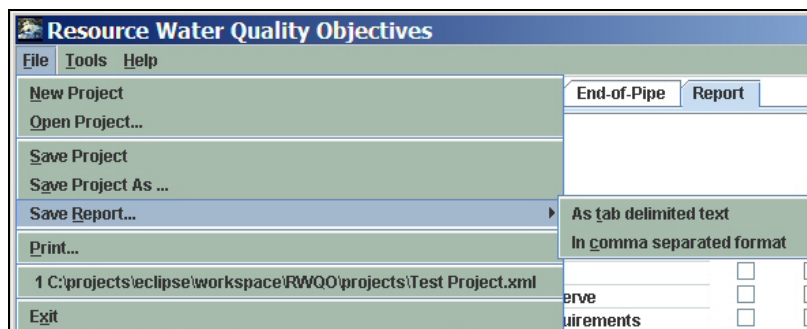


Saving and Exporting the results

Reports that have been generated for a project can be saved or printed, allowing users to modify input criteria and assess the impact of these changes on the resultant RWQOs.

The results can be exported as either '*tab delimited text*' or in '*comma separated format*'. The '*tab delimited text*' option allows users to open the report in e.g. Notepad, MS Word, WordPerfect, while the '*comma separated format*' allows users to open the report in e.g. MS Excel.

To export or save the report, go to >> File >> Save Report. Select either 'As tab delimited text' or 'In comma separated format'.



7. Data requirements

To determine RWQOs, the Model requires the following input data:

- Ecological category – from a Reserve or Best AEMC
- Management Class – from a catchment visioning exercise
- Target flows – from Reserve output - *.rul files
- Existing and future water users within the water resource management unit
- Present water quality – 5th and 95th percentiles
- Reference water quality – 5th and 95th percentiles

8. References

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- Palmer, C.G., Rossouw, N., Muller, W.J. and Scherman, P-A. 2005. *The development of water quality methods within ecological Reserve assessments, and links to environmental flows*. *Water SA*, **31** (2): 161-170.
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