

DEPARTMENT OF WATER AND SANITATION

NO. 1009

18 SEPTEMBER 2020

NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998)

PROPOSED RESERVE DETERMINATION FOR WATER RESOURCES OF THE MOKOLO AND MATLABAS CATCHMENTS

I Lindiwe Sisulu, in my capacity as Minister of Human Settlements, Water and Sanitation, having complied with section 13 of the National Water Act, 1998 (Act No. 36 of 1998) ("the Act"), and Regulation 3 of the Regulations for the Establishment of Water Resource Classification System (No. R. 810 *Gazette* No. 33541, 17 September 2010), and duly authorised in terms of section 16(1) of the Act, hereby publish for public comment, the proposed Reserve for water resources of the Mokolo and Matlabas catchments, as set out in the Schedule to this Notice.

Any person who wishes to submit written comments with regards to the proposed Reserve should submit the comments within 60 days from the date of publication of this Notice to:

Director: Reserve Determination
Attention: Mr Yakeen Atwaru
Department of Water and Sanitation
Ndinaye Building 185 Francis Baard Street
Private Bag X313
Pretoria
0001
Email: atwaruy@dws.gov.za


MS LINDIWE SISULU
MINISTER OF HUMAN SETTLEMENT, WATER AND SANITATION

**PROPOSED RESERVE FOR WATER RESOURCES OF THE MOKOLO AND
MATLABAS CATCHMENTS TO BE DETERMINED IN TERMS OF SECTION 16(1) AND
(2) OF THE NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998)**

SCHEDULE

DESCRIPTION OF WATER RESOURCE

1. (1) The proposed Reserve is determined for all or part of every significant water resource within the Mokolo and Matlabas catchments as set out below:

- Water Management Area: Limpopo
- Drainage Regions: A Primary Drainage Region (A41 and A42)
- Rivers: Mokolo, Mamba and Matlabas

(2) The Minister has in terms of section 12 of the National Water Act, 1998 (Act No.36 of 1998) ("the Act"), prescribed a system for classifying water resources by issuing Government Notice No. R. 810, published in *Gazette* No. 33541 dated 17 September 2010. In terms of section 16(1) of the Act, the Minister must, as soon as reasonably practicable after the class of all or part of a water resource has been determined, by Notice in the *Gazette*, determine the Reserve for all or part of that water resource.

(3) The Minister, in terms of section 16(3) of the Act, proposes, for the purpose of section 16(1) of the Act, the following Reserve determination for the Mokolo and Matlabas catchments.

2. ACRONYMS AND DEFINITIONS

2.1 Acronyms

BAS	Best attainable state
BHN	Basic Human Needs
CAWC	Co-ordinated Water Bird Counts
CBA	Critical Biodiversity Areas
EC	Ecological Category
EcoSpecs	Ecological Specifications
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
ESA	Ecological Support Areas
EWR	Ecological Water Requirement
EWR Site	Ecological Water Requirement Site
GRAII	Groundwater Resource Assessment Phase II
GRDM	Groundwater Resource Directed Measures
GRUs	Groundwater Resource Units
MAR	Mean Annual Runoff
MCM	Million Cubic Metres
MLF	Maintenance Low Flow
NMAR	Natural Mean Annual Runoff
PES	Present Ecological Status
RC	Reference conditions
REC	Recommended Ecological Category
TEACHA	Tools for Ecological Aquatic Chemical Habitat Assessment
TEC	Target Ecological Category
TPCs	Thresholds of Potential Concern
WUL	Water Use Licence
WQSU	Water quality sub-unit

2.2 Definitions

In this Notice, unless the context otherwise indicates—

“**Act**” means the National Water Act, 1998 (Act No. 36 of 1998).

“**Baseflow**” means a sustained low flow in rivers during dry or fair weather conditions, but not necessarily all contributed by groundwater; includes contribution from delayed interflow and groundwater discharge.

“**Biophysical Node**” means the modelling point's which is a representative of an upstream reach or area of an aquatic eco-system such as rivers, wetlands, estuaries and groundwater for which a suite of relationships apply.

“**Ecological Importance and Sensitivity**” means key indicators in the ecological classification of water resources. Ecological importance relates to the presence, representativeness and diversity of species of biota and habitat. Ecological sensitivity relates to the vulnerability of the habitat and biota to modifications that may occur in flows, water levels and physico-chemical conditions.

“**Ecological Water Requirements**” means the flow patterns such as the magnitude, timing and duration, and water quality needed to maintain a riverine ecosystem in a particular condition. This term refers to both the quantity and the quality of the components.

“**Ecological Water Requirement Sites**” means specific points on the river as determined through the site selection process which consists of a length of a river of various cross-sections for both hydraulic and ecological purposes. These sites provide sufficient indicators to assess environmental flows and assess the condition of biophysical components drivers such as hydrology, geomorphology and physico-chemical and biological responses such as fish, invertebrates and riparian vegetation.

“**Present Ecological Status**” means a category indicating the current health or integrity of various biological attributes of the water resource, compared to the natural or close to

natural reference conditions. The results of the process are provided as Ecological Categories ranging from a (near natural) to F (completely modified) for the PES.

“Recharge” means the addition of water to the zone of saturation, either by downward percolation of precipitation or surface water or the lateral migration of groundwater from adjacent aquifers.

“Recommended Ecological Category” means an ecological category indicating the ecological management target for a water resource based on its ecological classification that should be attained. Categories range from Category A which refers to unmodified, natural to Category D which refers to largely modified.

“Reserve” means the quantity and quality of the water required to satisfy the basic human needs by securing a basic water supply and to protect the aquatic ecosystem in order to secure ecologically sustainable development and use of the relevant water resource.

“Target Ecological Category” means the assigned ecological condition by the Minister to a water resource that reflects the ecological condition of that water resource in terms of the deviation of its biophysical components from the natural reference condition. The ultimate target to achieve a sustainable system both ecologically and economically taking into account the PES and REC.

**PROPOSED RESERVE DETERMINATION IN TERMS OF SECTION 16(1) AND (2) OF
THE ACT**

3. (1) The proposed Reserve which includes the Ecological Water Requirements and the Basic Human Needs Reserve for the Rivers at EWR sites and selected biophysical nodes in the Mokolo and Matlabas catchments are set out in Paragraph 4.
- (2) The Mokolo and Matlabas catchments locality and EWR sites are indicated in Figure 1.
- (3) The water quality component of the proposed Reserve for the Rivers at the EWR sites in Mokolo and Matlabas catchments in terms of section 16(1) of the Act is set out in Paragraph 5.
- (4) The proposed Groundwater Reserve for Water Quantity in terms of section 16(1) of the Act for the Mokolo and Matlabas catchments are set out in Paragraph 6.
- (5) The proposed Groundwater Reserve for Water Quality in terms of section 16(1) of the Act for the Mokolo and Matlabas catchments are set out in Paragraph 6.
- (6) The Reserve will apply from the date signed off as determined in terms of section 16(1) of the Act, unless otherwise specified by the Minister.

4. SURFACE WATER QUANTITY COMPONENT FOR RIVERS

Proposed results for the Reserve determination and ecological categorisation for the Mokolo and Matlabas Catchments, where the Reserve amounts are expressed as a percentage of the NMAR for the respective catchments (cumulative) in terms of section (16)(1) of the Act .

Table 1: Summary of the quantity component for the Rivers which include the EWR & BHN for the priority sites

Node Name	Quaternary Catchment	River Name	PES	EIS	NMAR (MCM) ¹	EWR % NMAR ²	BHN Reserve ³ (%NMAR)	Total Reserve ⁴ (%NMAR)
HN51	A42B	Grootspruit (source) to confluence with Sand	D	Moderate	27.8	21.73	0	21.73
EWR Site MOK_EWR1 A	A42C	Mokolo to confluence with Dwars	C/D	High	84.84	16.7	0.048	16.748
EWR Site MOK_EWR1 B	A42E	Mokolo to confluence with Sterkstroom	B/C	High	135.03	13.6	0.090	13.69
HN54	A42D	Sterkstroom (source) to confluence with Mokolo,	B	Very high	43.45	52.63	0	52.63
EWR Site MOK_EWR2	A42F	Mokolo River in A42F to inflow Mokolo Dam,	B/C	Very high	196.2	11.7	0.103	11.803
EWR Site MOK_EWR3	A42G	Mokolo Dam to upper portion of A42G (10km downstream of dam)	B/C	Very high	214.5	8.9	0.111	9.011
EWR Site MOK_EWR4	A42G	Mokolo main stem	C	Very high	253.3	12.3	0.111	12.411
HN59	A41A	Headwaters Mothlabatsi (Matlabas-Zyn-Kloof, peatlands)	A	Very high	5.23	57.07	0	57.07
MAT Rapid_EWR 3	A41B	Mamba to confluence with Mothlabatsi	B/C	High	9.54	35.49	0	35.49
MAT Rapid_EWR 2	A41B	Matlabas/Motlhabatsi confluence (outlet of IUA)	B/C	High	32.80	33.23	0	33.23
MAT Rapid_EWR 4	A41C	Matlabas	B	Moderate	35.58	33.42	0	33.42

- (1) These amounts represent the long term mean based on the NMAR. If the NMAR changes, this volume will also change.
- (2) Represents the percentage of BHN.
- (3) The total Reserve amount accounts for both the Ecological Reserve and the BHN.

The REC has not been recommended for approval for this preliminary Reserve but the maintenance of the current operating of the system was recommended.

SURFACE-WATER - QUALITY COMPONENT FOR RIVERS

5. Summary of the Quality component at EWR sites

Table 5.1: PES categories and overall site assessment for EWR 1A in the Mokolo River- WQSU1 4

RIVER	Mokolo River	Water Quality Monitoring Points		
WQSU	4	RC	A4H002Q01, '77-'79, n = 68	
EWR SITE	1A	PES	A4H002Q01, '02-'07 (with 1 point in 2007), n = 48 (but 37 for F and SO4)	
Confidence assessment	Confidence in the assessment is moderate, as little DO, temp., turbidity or toxics data, although the gauging weir is close to the EWR site.			
Water Quality Constituents		RC Value	PES Value	Category (Rating) / Comment
Inorganic Salts* (mg/L)	MgSO4		-	TEACHA could not be used and EC used as surrogate
	Na2SO4		-	
	MgCl2		-	
	CaCl2		-	
	NaCl		-	
	CaSO4		-	
Nutrients (mg/L)	SRP	0.011	0.0165	B (1): Benchmark category was recalibrated
	TIN	0.080	0.123	A (0)
Physical variables	pH (5th and 95th percentiles)	6.68 - 7.70	6.92 - 7.83	A (0)
	Temperature		-	No data, but few impacts expected. Catchment not pristine, so A/B (0.5) – qualitative assessment only
	Dissolved oxygen		-	
	Turbidity (NTU)		-	No data, but loads not expected to be high. B (1) – qualitative assessment only
	Electrical conductivity (mS/m)	12.28	12.05	A (0)
Response variables	Chl-a: periphyton		EWR 1A: 21.58	C/D (2.5) (n=1)
	Chl-a: phytoplankton		-	-

RIVER	Mokolo River		Water Quality Monitoring Points	
WQSU	4		RC	A4H002Q01, '77-'79, n = 68
EWR SITE	1A		PES	A4H002Q01, '02-'07 (with 1 point in 2007), n = 48 (but 37 for F and SO4)
Confidence assessment		Confidence in the assessment is moderate, as little DO, temp., turbidity or toxics data, although the gauging weir is close to the EWR site.		
Water Quality Constituents		RC Value	PES Value	Category (Rating) / Comment
	Biotic community composition: macroinvertebrate (ASPT) score		SASS: 127 ASPT: 5.3	C (62.3)
	Fish		70.3	C - largely flow-related
	Diatoms		EWR 1A: SPI = 17.3 and 16.8	A/B (0.5) (n = 2)
Toxics (mg/L)	Fluoride	0.10	0.18	A (0)
	Ammonia		0.001	A (0)
OVERALL SITE CLASSIFICATION (from PAI)			B/C (80 %)	

* To be generated using TEACHA when the TPC for EC is exceeded or salt pollution is expected

Table 5.2: Ecospecs relating to physico-chemical data: PES

River: Mokolo		EWR Site: 1A	Monitoring site: A4H002Q01
Water quality metrics		ECOSPEC: PES	
Inorganic salts*	MgSO4	The 95th percentile of the data must be ≤ 16 mg/L.	
	Na2SO4	The 95th percentile of the data must be ≤ 20 mg/L.	
	MgCl2	The 95th percentile of the data must be ≤ 15 mg/L.	
	CaCl2	The 95th percentile of the data must be ≤ 21 mg/L.	
	NaCl	The 95th percentile of the data must be ≤ 45 mg/L.	
	CaSO4	The 95th percentile of the data must be ≤ 351 mg/L.	
Physical variables	EC	The 95th percentile of the data must be ≤ 30 mS/m.	
	pH	The 5th and 95th percentiles of the data must range from 6.5 to 8.0.	
	Temperature	Small deviation from the natural temperature range.	
	Dissolved oxygen	The 5th percentile of the data must be ≥ 7.5 mg/L.	
	Turbidity	Vary by a small amount from the natural turbidity range; minor silting of instream habitats acceptable.	
Nutrients (mg/L)	TIN	The 50th percentile of the data must be ≤ 0.25 mg/L.	
	PO4-P	The 50th percentile of the data must be ≤ 0.025 mg/L.	
Response variables	Chl-a phytoplankton	The 50th percentile of the data must be < 10 µg/L.**	
	Chl-a periphyton	The 50th percentile of the data must be ≤ 52.5 mg/m2.***	
	Toxics	The 95th percentile of the data must be within the Chronic Effects Value (CEV) as stated in DWAF (1996).	

* To be generated using TEACHA when the TPC for EC is exceeded or salt pollution is expected

** No phytoplankton data were available for this assessment. All EcoSpecs and TPCs need verification as range is based on expert judgement.

*** Periphyton (21.58 mg/m2) is actually in a C/D category (C = 12 - 21 mg/m2 and D = 21 - 84 mg/m2; DWAF, 2008), so therefore the upper boundary of a C/D has been defined as the EcoSpec for the PES.

Table 5.3: PES categories and overall site assessment for EWR 1B in the Mokolo River- WQSU 4

RIVER	Mokolo River		Water Quality Monitoring Points	
WQSU	4		RC	A4H002Q01, '77 - '79, n = 68
EWR SITE	1B		PES	A4H002Q01, '02-'07 (with 1 point in 2007), n = 48 (but 37 for F and SO4)
Confidence assessment		Confidence in the assessment is moderate, as little DO, temp., turbidity or toxics data. Data from A4H002Q01 is used for EWR 1A and B, with modifications to the PAI table – particularly based on on-site indicators.		
Water Quality Constituents		RC Value	PES Value	Category (Rating) / Comment
Inorganic* salts (mg/L)	MgSO4		-	TEACHA could not be used and EC used as surrogate
	Na2SO4		-	
	MgCl2		-	
	CaCl2		-	
	NaCl		-	
	CaSO4		-	
Nutrients (mg/L)	SRP	0.011	0.0165	B (1): Benchmark category was recalibrated
	TIN	0.080	0.123	A (0)
Physical variables	pH (5th and 95th percentiles)	6.68 and 7.70	6.92 – 7.83	A (0)
	Temperature		-	No data, but few impacts expected. Catchment not pristine, so B (1) due to the impact of zero flows – qualitative assessment only
	Dissolved oxygen		-	
	Turbidity (NTU)		-	No data, but loads not expected to be high. B (1) – qualitative assessment only
	Electrical conductivity (mS/m)	12.28	12.05	A (0)
Response variables	Chl-a: periphyton		WQ site 3 (Dwars): 19.04 (high SD)	C (2) (n=1)

RIVER	Mokolo River		Water Quality Monitoring Points	
WQSU	4		RC	A4H002Q01, '77 - '79, n = 68
EWR SITE	1B		PES	A4H002Q01, '02-'07 (with 1 point in 2007), n = 48 (but 37 for F and SO4)
Confidence assessment		Confidence in the assessment is moderate, as little DO, temp., turbidity or toxics data. Data from A4H002Q01 is used for EWR 1A and B, with modifications to the PAI table – particularly based on on-site indicators.		
Water Quality Constituents		RC Value	PES Value	Category (Rating) / Comment
	Chl-a: phytoplankton		-	-
	Biotic community composition: macroinvertebrate (ASPT) score		SASS: 130 ASPT: 5.4 (Jan '08) SASS: 188 ASPT: 6.1 (June '08)	B/C
	Fish		72.4	C
	Diatoms		EWR 1B: SPI = 18.8 WQ site 3 (Dwars): 15.9	A (0) (n=1) B (1) (n=2)
Toxics (mg/L)	Fluoride	0.10	0.18	A (0)
	Ammonia		0.001	A (0)
OVERALL SITE CLASSIFICATION (from PAI)			B/C (80.8%)	

* To be generated using TEACHA when the TPC for EC is exceeded or salt pollution is expected

Table 5.4: EcoSpecs relating to physico-chemical data: PES

River: Mokolo		EWR Site: 1B	Monitoring site: A4H002Q01
Water quality metrics		ECOSPEC: PES	
Inorganic salts* (mg/L)	MgSO ₄	The 95th percentile of the data must be ≤ 16 mg/L.	
	Na ₂ SO ₄	The 95th percentile of the data must be ≤ 20 mg/L.	
	MgCl ₂	The 95th percentile of the data must be ≤ 15 mg/L.	
	CaCl ₂	The 95th percentile of the data must be ≤ 21 mg/L.	
	NaCl	The 95th percentile of the data must be ≤ 45 mg/L.	
	CaSO ₄	The 95th percentile of the data must be ≤ 351 mg/L.	
Physical variables	EC	The 95th percentile of the data must be ≤ 30 mS/m.	
	pH	The 5th and 95th percentiles of the data must range from 6.5 to 8.0.	
	Temperature	Small deviation from the natural temperature range.	
	Dissolved oxygen	The 5th percentile of the data must be ≥ 7.0 mg/L.	
	Turbidity	Vary by a small amount from the natural turbidity range; minor silting of instream habitats acceptable.	
Nutrients (mg/L)	TIN	The 50th percentile of the data must be ≤ 0.25 mg/L.	
	PO ₄ -P	The 50th percentile of the data must be ≤ 0.025 mg/L.	
Response variables	Chl-a phytoplankton	The 50th percentile of the data must be < 10 µg/L.**.	
	Chl-a periphyton	The 50th percentile of the data must be ≤ 21 mg/m ² .	
	Toxics	The 95th percentile of the data must be within the CEV as stated in DWAF (1996).	

* To be generated using TEACHA when the TPC for EC is exceeded or salt pollution is expected

** No phytoplankton data were available for this assessment. All EcoSpecs and TPCs need verification as range is based on expert judgement.

Table 5.5: PES categories and overall site assessment for EWR 2 in the Mokolo River- WQSU 4

RIVER	Mokolo River		Water Quality Monitoring Points	
WQSU	4		RC	A4H005Q01, '77 - '80, n = 85 (but 163 for EC)
EWR SITE	2		PES	A4H005Q01, '98 - '01, n = 39 (but 47 for TIN)
Confidence assessment		Confidence in the assessment is low. Little DO, temp., turbidity or toxics data are available, and although the gauging weir is close to the EWR site, present state data is only available up until 2001.		
Water Quality Constituents		RC Value	PES Value	Category (Rating) / Comment
Inorganic Salts (mg/L)	MgSO4		-	TEACHA could not be used and EC used as surrogate
	Na2SO4		-	
	MgCl2		-	
	CaCl2		-	
	NaCl		-	
	CaSO4		-	
Nutrients (mg/L)	SRP	0.011	0.0059	A (0): Benchmark category was recalibrated – RC data very variable
	TIN	0.06	0.02	A (0). RC data very variable
Physical variables	pH (5th and 95th percentiles)	6.00 and 7.25	7.46 - 7.87	A (0): Benchmark category recalibrated for lower A category
	Temperature		-	No data, but few impacts expected. Some temperature and DO fluctuations may occur at low flows - B (1) – qualitative assessment only
	Dissolved oxygen		-	
	Turbidity (NTU)		-	No data, but loads not expected to be high. A/B (0.5) – qualitative assessment only

RIVER	Mokolo River		Water Quality Monitoring Points	
WQSU	4		RC	A4H005Q01, '77 - '80, n = 85 (but 163 for EC)
EWR SITE	2		PES	A4H005Q01, '98 - '01, n = 39 (but 47 for TIN)
Confidence assessment		Confidence in the assessment is low. Little DO, temp., turbidity or toxics data are available, and although the gauging weir is close to the EWR site, present state data is only available up until 2001.		
Water Quality Constituents		RC Value	PES Value	Category (Rating) / Comment
	Electrical conductivity (mS/m)	9.09	9.4	A (0)
Response variables	Chl-a: periphyton		EWR 2: 25.54 WQ site 4: 18.68 (high SD)	D (3) (n=1). SD high across 3 replicates C (2) (n=1)
	Chl-a: phytoplankton		-	-
	Biotic community composition: macro-invertebrate (ASPT) score		Jan '08: SASS - 82; ASPT - 5.1 March '08: SASS - 126 ; ASPT - 6.6	C
	Fish		65.1	C
	Diatoms		EWR 2: SPI=16.1 WQ site 4: 18.8	B (1) (n=2) A (0) (n=1)
Toxics (mg/L)	Fluoride	0.19	0.15	A (0)
	Ammonia		0.002	A (0)
OVERALL SITE CLASSIFICATION (from PAI)			B (84.2)	

Table 5.6: EcoSpecs relating to physico-chemical data: PES

River: Mokolo		EWR: 2	Monitoring site: A4H002Q01
Water quality metrics		ECOSPEC: PES	
Inorganic salts* (mg/L)	MgSO ₄	The 95th percentile of the data must be ≤ 16 mg/L.	
	Na ₂ SO ₄	The 95th percentile of the data must be ≤ 20 mg/L.	
	MgCl ₂	The 95th percentile of the data must be ≤ 15 mg/L.	
	CaCl ₂	The 95th percentile of the data must be ≤ 21 mg/L.	
	NaCl	The 95th percentile of the data must be ≤ 45 mg/L.	
	CaSO ₄	The 95th percentile of the data must be ≤ 351 mg/L.	
Physical variables	EC	The 95th percentile of the data must be ≤ 30 mS/m.	
	pH	The 5th and 95th percentiles of the data must range from 6.5 to 8.0.	
	Temperature	Small deviation from the natural temperature range.	
	Dissolved oxygen	The 5th percentile of the data must be ≥ 7 mg/L.	
	Turbidity	Vary by a small amount from the natural turbidity range; minor silting of instream habitats acceptable.	
Nutrients (mg/L)	TIN	The 50th percentile of the data must be ≤ 0.25 mg/L.	
	PO ₄ -P	The 50th percentile of the data must be ≤ 0.015 mg/L.	
Response variables	Chl-a phytoplankton	The 50th percentile of the data must be < 10 µg/L.**	
	Chl-a periphyton	The 50th percentile of the data must be ≤ 52.5 mg/m ² . ***	
	Toxics	The 95th percentile of the data must be within the TWQR as stated in DWAF (1996).	

* To be generated using TEACHA when the TPC for EC is exceeded or salt pollution expected.

** No phytoplankton data were available for this assessment. All EcoSpecs and TPCs need verification as based on expert judgement.

*** Periphyton (25.54 mg/m²) is actually in a C/D category (C= 12 - 21 and D= 21 - 84 mg/m², DWAF 2008), so have defined the upper boundary of a C/D as the EcoSpec for PES.

Table 5.7: PES categories and overall site assessment for EWR 3 in the Mokolo River- WQSU 5

RIVER	Mokolo River		Water Quality Monitoring Points	
WQSU	5		RC	A4H007Q01, '77 - '80, n = 82
EWR SITE	3		PES	A4H010Q01, '92 - '96, n = 27 (but 19 for temp. and 6 for NH3)
Confidence assessment		Confidence in the assessment is low as little DO, temp., turbidity or toxics data are available. Although the gauging weir is close to the EWR site, present state data only until 1996. RC data sourced from A4H007Q01 on the Tambotie River (same EcoRegion level II).		
Water Quality Constituents		RC Value	PES Value	Category (Rating) / Comment
Inorganic salts (mg/L)	MgSO4		-	TEACHA could not be used and EC used as surrogate
	Na2SO4		-	
	MgCl2		-	
	CaCl2		-	
	NaCl		-	
	CaSO4		-	
Nutrients (mg/L)	SRP	0.007	0.015	A (0): Benchmark category was recalibrated – Data very variable
	TIN	0.065	0.067	A (0). Data very variable
Physical variables	pH (5th and 95th percentiles)	5.14 and 6.70	7.2 and 7.76	B (1): RC data 5.14 (5th percentile) and 6.7 (95th percentile) – reliability?
	Temperature (10th and 90th percentiles)		12 – 25	Little data, but site downstream Mokolo Dam (even if multi-level off take, probably bottom release due to low flows in the dam), so dam impacts on temperature and DO expected. C (2)
	Dissolved oxygen		-	
	Turbidity (NTU)		-	No data, but loads not expected to be high. A/B (0.5) – qualitative assessment only

RIVER	Mokolo River		Water Quality Monitoring Points	
WQSU	5		RC	A4H007Q01, '77 - '80, n = 82
EWR SITE	3		PES	A4H010Q01, '92 - '96, n = 27 (but 19 for temp. and 6 for NH3)
Confidence assessment		Confidence in the assessment is low as little DO, temp., turbidity or toxics data are available. Although the gauging weir is close to the EWR site, present state data only until 1996. RC data sourced from A4H007Q01 on the Tambotie River (same EcoRegion level II).		
Water Quality Constituents		RC Value	PES Value	Category (Rating) / Comment
	Electrical conductivity (mS/m)	15 and 24	10.87	A (0)
Response variable	Chl-a: periphyton		17.28	C (2) (n=1)
	Chl-a: phytoplankton		-	-
	Biotic community composition: macroinvertebrate (ASPT) score		SASS:130 ASPT: 5.0 SASS: 149 ASPT: 5.7	C
	Fish		65.8	C
	Diatoms		SPI=16.6 (Sept 07) SPI=17.4 (Jan 08) SPI=18.4 (Mar 08)	B (1) (n=3) A (0) A (0)
Toxics (mg/L)	Fluoride	6.77	0.278	A (0)
	Ammonia	0.160	0.001	A (0)
OVERALL SITE CLASSIFICATION (from PAI)			B/C (79.2)	

Table 5.8: EcoSpecs relating to physico-chemical data: PES

River: Mokolo		EWR: 3	Monitoring site: A4H010Q01
Water quality metrics		ECOSPEC: PES	
Inorganic salts* (mg/L)	MgSO ₄	The 95th percentile of the data must be ≤ 16 mg/L.	
	Na ₂ SO ₄	The 95th percentile of the data must be ≤ 20 mg/L.	
	MgCl ₂	The 95th percentile of the data must be ≤ 15 mg/L.	
	CaCl ₂	The 95th percentile of the data must be ≤ 21 mg/L.	
	NaCl	The 95th percentile of the data must be ≤ 45 mg/L.	
	CaSO ₄	The 95th percentile of the data must be ≤ 351 mg/L.	
Physical variables (mg/L)	EC	The 95th percentile of the data must be ≤ 30 mS/m.	
	pH	The 5th and 95th percentiles of the data must range from 6.5 to 8.0.	
	Temperature	Vary by more than 2°C, i.e. a large change to the temperature regime occurs often. Most moderately temperature sensitive species would be in lower abundances and frequency of occurrence than expected for reference. Biological assessments therefore recommended and initiate baseline monitoring for this variable if Level II or higher of the DSS.	
	Dissolved oxygen	The 5th percentile of the data must be ≥ 6 mg/L.	
	Turbidity	Vary by a small amount from the natural turbidity range; minor silting of instream habitats acceptable.	
Nutrients	TIN	The 50th percentile of the data must be ≤ 0.25 mg/L.	
	PO ₄ -P	The 50th percentile of the data must be ≤ 0.015 mg/L.	
Response variables	Chl-a phytoplankton	The 50th percentile of the data must be < 10 µg/L.**	
	Chl-a periphyton	The 50th percentile of the data must be ≤ 21 mg/m ² .	
	Toxics	The 95th percentile of the data must be within the TWQR as stated in DWAF (1996).	

* To be generated using TEACHA when the TPC for EC is exceeded or salt pollution expected

** No phytoplankton data were available for this assessment. All EcoSpecs and TPCs need verification as based on expert judgement.

Table 5.9: PES categories and overall site assessment for EWR 4 in the Mokolo River- WQSU 5

RIVER	Mokolo River		Water Quality Monitoring Points	
WQSU	5		RC	A4H007Q01, '77 - '80, n = 82
EWR SITE	4		PES	A4H010Q01, '92-'96, n = 27 (but 19 for temp. and 6 for NH3)
Confidence assessment		Confidence in the assessment is low as little DO, temp., turbidity or toxics data are available. Data from A4H010Q01 is used for EWR 3 and 4, with modifications to the PAI table – particularly based on on-site indicators and the influence of Poer-se-loop tributary joining the Mokolo River between the two sites. Present state data only until 1996 and RC data sourced from A4H007Q01 on the Tambotie River (same EcoRegion level II).		
Water Quality Constituents		RC Value	PES Value	Category (Rating) / Comment
Inorganic salts (mg/L)	MgSO4		-	TEACHA could not be used and EC used as surrogate
	Na2SO4		-	
	MgCl2		-	
	CaCl2		-	
	NaCl		-	
	CaSO4		-	
Nutrients (mg/L)	SRP	0.007	0.015	A (0): Benchmark category was recalibrated – Data very variable
	TIN	0.065	0.067	A (0). Data very variable
Physical variables	pH (5th and 95th percentiles)	5.14 and 6.70	7.2 - 7.76	B (1): RC data 5.14 (5th percentile) and 6.7 (95th percentile) – reliability?
	Temperature		-	No data, but no impacts expected. Small temperature and DO fluctuations may occur - B (1) – qualitative assessment only
	Dissolved oxygen		-	

RIVER	Mokolo River		Water Quality Monitoring Points	
WQSU	5		RC	A4H007Q01, '77 - '80, n = 82
EWR SITE	4		PES	A4H010Q01, '92-'96, n = 27 (but 19 for temp. and 6 for NH3)
Confidence assessment		Confidence in the assessment is low as little DO, temp., turbidity or toxics data are available. Data from A4H010Q01 is used for EWR 3 and 4, with modifications to the PAI table – particularly based on on-site indicators and the influence of Poer-se-loop tributary joining the Mokolo River between the two sites. Present state data only until 1996 and RC data sourced from A4H007Q01 on the Tambotie River (same EcoRegion level II).		
Water Quality Constituents		RC Value	PES Value	Category (Rating) / Comment
	Turbidity (NTU)		-	No data, but loads not expected to be too high and river generally clear. A (0) – qualitative assessment only
	Electrical conductivity (mS/m)	15 and 24	10.87	A (0)
Response variable	Chl-a: periphyton		-	-
	Chl-a: phytoplankton		-	-
	Biotic community composition: macroinvertebrate (ASPT) score		SASS: 126 ASPT: 4.8	C
	Fish		63.73	C
	Diatoms		Sept '07: SPI=17.8 March '08: SPI=17.4	A (0) (n=2)
Toxics (mg/L)	Fluoride	6.77	0.278	A (0)
	Ammonia	0.160	0.001	A (0)
OVERALL SITE CLASSIFICATION (from PAI)				B (86.8)

Table 5.10: EcoSpecs relating to physico-chemical data: PES

River: Mokolo		EWR: 4	Monitoring site: A4H010Q01
Water quality metrics		ECOSPEC: PES	
Inorganic salts* (mg/L)	MgSO4	The 95th percentile of the data must be ≤ 16 mg/L.	
	Na2SO4	The 95th percentile of the data must be ≤ 20 mg/L.	
	MgCl2	The 95th percentile of the data must be ≤ 15 mg/L.	
	CaCl2	The 95th percentile of the data must be ≤ 21 mg/L.	
	NaCl	The 95th percentile of the data must be ≤ 45 mg/L.	
	CaSO4	The 95th percentile of the data must be ≤ 351 mg/L.	
Physical variables	EC	The 95th percentile of the data must be ≤ 30 mS/m.	
	pH	The 5th and 95th percentiles of the data must range from 6.5 to 8.0.	
	Temperature	Small to moderate deviation from the natural temperature range. Some highly temperature sensitive species in lower abundances and frequency of occurrence than expected for reference.	
	Dissolved oxygen	The 5th percentile of the data must be ≥ 7 mg/L.	
	Turbidity	No known concerns about turbidity; changes in turbidity appear to be natural.	
Nutrients (mg/L)	TIN	The 50th percentile of the data must be ≤ 0.25 mg/L.	
	PO4-P	The 50th percentile of the data must be ≤ 0.015 mg/L.	
Response variables	Chl-a phytoplankton	The 50th percentile of the data must be < 10 µg/L.**	
	Chl-a periphyton	The 50th percentile of the data must be ≤ 21 mg/m2 .	
	Toxics	An impact is expected if the 95th percentile of the data exceeds the TWQR as stated in DWAF (1996).	

*: To be generated using TEACHA when the TPC for EC is exceeded or salt pollution is expected

** : No phytoplankton data were available for this assessment. All EcoSpecs and TPCs need verification as range is based on expert judgement.

6. GROUNDWATER-QUANTITY COMPONENT

The groundwater quantity component was determined using values such as recharge, baseflow, and stress index, obtained during the determination of water resource classes and associated resource quality objectives in the Mokolo and Matlabas catchments, DWS 2015, shown in Table 6.1. The average annual groundwater recharge for the entire catchment based on the GRA II dataset is estimated to be more than 16.25 Mm³/a. The EWR MLF values were obtained from the Intermediate groundwater Reserve determination study for the Limpopo catchment (Water Geosciences Consulting, 2011).

Population values were obtained from the Water Services dataset of 2011. BHN provides for the essential needs of individuals served by the water resource in question and includes water for drinking, food preparation and for personal hygiene. A life-line amount of 25 litres per person per day was used. The current study approach also took cognisance of the GRA II and WARMS 2013 datasets to achieve a more balanced estimate of groundwater use. The groundwater stress index reflects groundwater used versus recharge.

Table 6.1: Mokolo and Matlabas Groundwater Reserve

Quat	Area (km)	Recharge (Mm3/a)	Population (Water services) 2011)	Baseflow (Mm3/a)	EWR_MLF (Mm3/a)	BHN Reserve (Mm3/a)	Reserve (Mm3/a)	Reserve as % of Recharge	Current Groundwater Use (Mm3/a)	Stress Index
A41A	692	17.66	6785	5.06	3.18	0.06	3.24	18.34	1.22	0.07
A41B	358	7.86	5175	1.79	0.75	0.05	0.80	10.18	0.15	0.02
A41C	1111	13.23	7749	0.85	0.39	0.07	0.46	3.48	0.25	0.02
A41D	1913	16.71	5483	0.54	0.54	0.05	0.59	3.53	2.76	0.16
A41E	1940	12.41	7886	0.17	0.53	0.07	0.60	4.83	1.79	0.14
A42A	573	18.19	3793	9.46	4.07	0.03	4.10	22.54	4.56	0.25
A42B	522	15.77	3443	8.93	4.05	0.03	4.08	26.90	4.47	0.28
A42C	698	27.02	6031	11.56	2.83	0.06	2.89	10.69	5.51	0.20
A42D	497	16.86	2662	6.49	9.19	0.02	9.21	54.62	2.93	0.17
A42E	1007	32.98	13391	11.87	8.18	0.12	8.30	25.17	8.10	0.24
A42F	1022	22.46	1958	4.23	2.48	0.02	2.50	11.13	2.66	0.12
A42G	1207	26.40	2188	2.53	2.70	0.02	2.72	10.30	0.13	0.004
A42H	1057	18.15	17266	2.02	0.63	0.16	0.79	4.35	0.09	0.004
A42J	1 812	12.81	2812	0.74	0.36	0.03	0.39	3.04	2.12	0.16

Table 6.2: Groundwater quality per Quaternary Catchments (Mokolo and Matlabas)

Chemical Parameter	Unit	Quaternary Catchmentss A41A, A41B, A41C & A41D												
		No. of Samples				Ambient GW quality or median ¹⁾				BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾			
		A41 A	A41 B	A41C	A41D	A41A	A41B	A41C	A41D		A41A	A41B	A41C	A41D
pH		70	259	70	259	7.51	7.61	7.51	7.61	5.0 – 9.5	8.26	8.37	8.26	8.37
Electrical Conductivity	mS/m	70	259	70	259	97.50	130.00	97.50	130.00	<150	107.25	143.00	107.25	143.00
Calcium as Ca	mg/l	70	259	70	259	49.90	76.50	49.90	76.50	<150	54.89	84.15	54.89	84.15
Magnesium as Mg	mg/l	70	259	70	259	37.55	52.80	37.55	52.80	<100	41.31	58.08	41.31	58.08
Sodium as Na	mg/l	70	259	70	259	105.70	129.10	105.70	129.10	<200	116.27	142.01	116.27	142.01
Chloride as Cl	mg/l	70	259	70	259	78.30	143.10	78.30	143.10	<200	86.13	157.41	86.13	157.41
Sulphate as SO ₄	mg/l	70	259	70	259	21.65	38.87	21.65	38.87	<400	23.82	42.76	23.82	42.76
Nitrate as NO _x -N	mg/l	70	259	70	259	3.90	4.53	3.90	4.53	<10	4.29	4.98	4.29	4.98
Fluoride as F	mg/l	70	259	70	259	1.28	0.85	1.28	0.85	<1.0	1.28	0.94	1.28	0.94

- (1) Based on data obtained from the National Groundwater Archive. Values reported are the statistical median of each parameter.
- (2) Ref: *Quality of Domestic Water Supplies, Volume 1: Assessment Guide, 2nd Ed.* 1998. Water Research Commission Report No: TT 101/98. Pretoria, South Africa (Set for a Class 1).
- (3) Where a difference in the water quality values for the ambient groundwater quality and basic human needs was found, the lesser or more protective value was selected for the groundwater quality Reserve. Where the ambient groundwater quality was selected as the groundwater quality Reserve, the value was scaled up by 10 per cent provided that the value does not exceed the BHN Reserve.

Table 6.3: Groundwater quality per Quaternary Catchments (Mokolo and Matlabas)

Chemical Parameter	Unit	Quaternary Catchmentss A41E, A42A, A42B & A42C												
		No. of Samples				Ambient GW quality or median ¹⁾				BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾			
		A41 E	A42 A	A42B	A42C	A41E	A42A	A42B	A42C		A41E	A42A	A42B	A42C
pH		99	4	4	47	7.70	6.88	7.55	8.10	5.0 – 9.5	8.47	7.57	8.30	8.91
Electrical Conductivity	mS/m	99	4	4	47	163.20	14.10	23.75	33.30	<150	163.20	15.51	26.13	36.63
Calcium as Ca	mg/l	96	3	4	41	79.50	3.40	18.85	17.70	<150	87.45	3.74	20.74	19.47
Magnesium as Mg	mg/l	96	3	4	41	47.20	6.10	9.75	5.61	<100	51.92	6.71	10.73	6.17
Sodium as Na	mg/l	96	3	4	41	213.05	5.60	12.30	52.50	<200	213.05	6.16	13.53	57.75
Chloride as Cl	mg/l	97	4	4	41	280.00	14.10	7.25	11.00	<200	280.00	15.51	7.98	12.10
Sulphate as SO ₄	mg/l	96	3	4	41	76.50	10.20	8.60	7.78	<400	84.15	11.22	9.46	8.55
Nitrate as NO _x -N	mg/l	97	4	4	42	6.70	0.07	0.19	1.64	<10	7.37	0.07	0.20	1.80
Fluoride as F	mg/l	97	3	4	41	1.10	0.38	0.57	0.42	<1.0	1.10	0.42	0.62	0.46

- (1) Based on data obtained from the National Groundwater Archive. Values reported are the statistical median of each parameter.
- (2) Ref: *Quality of Domestic Water Supplies, Volume 1: Assessment Guide, 2nd Ed.* 1998. Water Research Commission Report No: TT 101/98. Pretoria, South Africa (Set for a Class 1).
- (3) Where a difference in the water quality values for the ambient groundwater quality and basic human needs was found, the lesser or more protective value was selected for the groundwater quality Reserve. Where the ambient groundwater quality was selected as

the groundwater quality Reserve, the value was scaled up by 10 per cent provided that the value does not exceed the BHN Reserve.

Table 6.4: Groundwater quality per Quaternary Catchment (A42D, A42E, and A42F & A42G)

Chemical Parameter	Unit	Quaternary Catchments A42D, A42E, A42F & A42G												
		No. of Samples				Ambient GW quality or median ¹⁾				BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾			
		A42 D	A42 E	A42F	A42G	A42D	A42E	A42F	A42G		A42D	A42E	A42F	A42G
pH		3	12	3	20	7.07	7.56	7.93	7.34	5.0 – 9.5	7.78	8.31	8.72	8.07
Electrical Conductivity	mS/m	3	12	3	20	42.10	58.85	25.50	27.60	<150	46.31	64.74	28.05	30.36
Calcium as Ca	mg/l	3	12	2	20	41.60	30.25	10.25	8.35	<150	45.76	33.28	11.28	9.19
Magnesium as Mg	mg/l	3	12	2	20	8.30	17.10	7.55	5.60	<100	9.13	18.81	8.31	6.16
Sodium as Na	mg/l	2	12	2	20	26.20	24.35	17.10	15.40	<200	28.82	26.79	18.81	16.94
Chloride as Cl	mg/l	3	12	3	20	17.00	33.70	6.85	10.90	<200	18.70	37.07	7.54	11.99
Sulphate as SO ₄	mg/l	3	12	2	20	14.00	8.55	5.30	6.65	<400	15.40	9.41	5.83	7.32
Nitrate as NO _x -N	mg/l	2	12	2	20	0.22	0.06	0.16	0.09	<10	0.24	0.06	0.18	0.10
Fluoride as F	mg/l	3	12	3	20	0.12	0.35	0.50	0.22	<1.0	0.13	0.39	0.55	0.24

(1) Based on data obtained from the National Groundwater Archive. Values reported are the statistical median of each parameter.

(2) Ref: *Quality of Domestic Water Supplies, Volume 1: Assessment Guide, 2nd Ed.* 1998. Water Research Commission Report No: TT 101/98. Pretoria, South Africa (Set for a Class 1).

- (3) Where a difference in the water quality values for the ambient groundwater quality and basic human needs was found, the lesser or more protective value was selected for the groundwater quality Reserve. Where the ambient groundwater quality was selected as the groundwater quality Reserve, the value was scaled up by 10 per cent provided that the value does not exceed the BHN Reserve.

Table 6.5: Groundwater quality per Quaternary Catchment (A42H & A42J)

Chemical Parameter	Unit	Quaternary Catchments A42H & A42J						
		No. of Samples		Ambient GW quality or median ¹⁾		BHN Reserve ²⁾	Groundwater Quality Reserve ³⁾	
		A42H	A42J	A42H	A42J		A42H	A42J
pH		48	54	8.23	7.44	5.0 – 9.5	9.06	8.18
Electrical Conductivity	mS/m	48	54	159.50	199.85	<150	159.50	199.85
Calcium as Ca	mg/l	47	54	7.50	71.00	<150	8.25	78.10
Magnesium as Mg	mg/l	47	54	1.20	40.35	<100	1.32	44.39
Sodium as Na	mg/l	47	54	313.56	196.45	<200	313.56	200
Chloride as Cl	mg/l	47	54	284.00	302.60	<200	284.00	302.60
Sulphate as SO ₄	mg/l	47	54	135.33	129.05	<400	148.86	141.96
Nitrate as NO _x -N	mg/l	47	54	0.08	7.50	<10	0.09	8.25
Fluoride as F	mg/l	43	54	12.62	1.21	<1.0	12.62	1.21

- (1) Based on data obtained from the National Groundwater Archive. Values reported are the statistical median of each parameter.
- (2) Ref: *Quality of Domestic Water Supplies, Volume 1: Assessment Guide, 2nd Ed.* 1998. Water Research Commission Report No: TT 101/98. Pretoria, South Africa (Set for a Class 1).

- (3) Where a difference in the water quality values for the ambient groundwater quality and basic human needs was found, the lesser or more protective value was selected for the groundwater quality Reserve. Where the ambient groundwater quality was selected as the groundwater quality Reserve, the value was scaled up by 10 per cent provided that the value does not exceed the BHN Reserve.

A total of 2 quaternary catchmentss (A41A and A41B) do not have adequate groundwater chemistry data for comprehensive analysis of the ambient status. Therefore the ambient groundwater quality for A41A and A41B was extrapolated from neighbouring quaternary catchments (A41C and A41D) with a similar geology because geology has a huge bearing on the water quality of an area.

Table 6.6: Summary of the water quality class and parameters of concern

Quaternary catchment	Water quality class (WRC, 1998)	Water quality parameters of concern
A41A	II	Fluoride
A41B	I	Electrical Conductivity, Chloride and Sodium
A41C	II	Fluoride
A41D	I	Electrical Conductivity, Chloride and Sodium
A41E	II	Chloride, Electrical Conductivity and sodium
A42A	0	None
A42B	0	None
A42C	0	None
A42D	0	None
A42E	0	None
A42F	0	None
A42G	0	None
A42H	III	Fluoride
A42J	III	Chloride, Electrical Conductivity and fluoride

Figure 1: Locality map for the Crocodile (West), Marico, Mokolo and Matlabas catchments illustrating the Water Resource class and EWR sites.

