ANNEXURE A

SURFACE-WATER - QUANTITY COMPONENT FOR RIVERS

Proposed results for the Reserve determination and ecological categorisation for the Usuthu-Mhlathuze catchment, where the Reserve amounts are expressed as a percentage of the NMAR for the respective catchments (cumulative) in terms of section (16)(1).

Table 1: Reserve determination for the quantity component for the rivers which include the EWR & BHN for the priority sites.

RU Number/Name: Integrated Unit of Analysis	Sub-quaternary catchments	River	PES	EIS	REC	[2] Ecological Reserve (%NMAR)	[1] NMAR (MCM)
W1 catchment (main river: Mhlathuze)							
IUA W11: Matigulu							
W11-1	W11A-03597	Matigulu	B	High	B	31.4	22.78
	W11A-03748	uMngwenya					
	W11A-03776	kuMnyameni					
W11-2	W11A-03599	Ngoje					
	W11A-03612 (EWR MA1)	**Matigulu**	**B/C**	**High**	**B/C**	**34**	**55.17**
	W11C-03713	Nyezane					
W11-3	W11C-03917	Nyoni					
IUA: W12-a: Upper Mhlathuze							
W12-1	W12A-03086	Gologodo					
	W12A-03104	Mhlatuze					
	W12A-03153	Mhlatuze	B	High	B	39.8	32.15
	W12A-03226	Mhlathuze					
W12-2	W12B-03334	Mhlatuze					
	W12B-03356	Mhlatuze	B	High	B	39.8	95.13
	W12B-03398	Mavungwini					
W12-3	W12B-03471	Nyawushane					
	W12B-03479	Mhlatuze	C	High	C	41.3	125.08
W12-4	W12B-03336	KwaMazula	C	High	B/C	47.6	12.87
IUA: W12-b: Mfule, Mhlatuzane, Nseleni Tributary systems							
W12-5	W12C-03189	Mfule					
	W12C-03225	Mfule					
	W12C-03232	Nhlozane					

RU Number/Name: Integrated Unit of Analysis	Sub-quaternary catchments	River	PES	EIS	REC	[2] Ecological Reserve (%NMAR)	[1] NMAR (MCM)
	W12C-03263	Mfulazane					
	W12C-03303	Mfule	C	High	C	40.4	50.80
W12-7	W12E-03526	Mhlatuzana	B	High	B	37.9	23.13
	W12E-03530	Mateku					
	W12E-03558	Mhlatuzana					
W12-8	**W12G-03229 (EWR NS1)**	**Nseleni**	**C**	**High**	**C**	**21.9**	**31.23**
	W12H-03289	Mbabe					
	W12H-03316	Mposa					
	W12H-03401	Okula					
	W12H-03418	Nseleni					
	W12H-03428	Mbabe					
	W12H-03459	Nseleni	C	High	C	20.27	133.782
IUA: W12-c: Lower Mhlathuze							
W12-6	W12D-03346	Ntambanana					
	W12D-03375	Mhlatuze					
	W12D-03388	Mhlatuze	C	High	C	30.51	177.90
	W12E-03475	Mhlatuze					
IUA: W13: Mlalazi							
W13-1	W13A-03583	Mlalazi					
	W13A-03609	Mlalazi	C	High	C	`38.4	107.19
	W13A-03641	Mkukuze					
	W13B-03593	KwaGugushe					
W13-2	W13B-03774	Manzamnyama	B/C	High	B/C	18.8	42.57
W2 catchment (main river: Umfolozi)							
IUA: W21: Upper and Middle White Umfolozi							
W21-1	W21A-02527	White Mfolozi					
	W21A-02512	aMagoda					
	W21B-02539	iShoba					
	W21B-02546	White Mfolozi	C	High	B/C	46.8	53.41
W21-2	W21B-02603	Lenjane					
	W21B-02652	White Mfolozi					
	W21B-02670	White Mfolozi	B	High	B	46.4	63.55
W21-3	W21C-02599	Sandspruit					

RU Number/Name: Integrated Unit of Analysis	Sub-quaternary catchments	River	PES	EIS	REC	[2] Ecological Reserve (%NMAR)	[1] NMAR (MCM)
	W21F-02727	White Mfolozi	C	High	C	39.5	103.29
W21-4	W21D-02676	Mvunyane					
	W21D-02788	Vumankala					
	W21D-02832	Jojosi					
	W21D-02848	Jojosi					
	W21D-02815	Mvunyane	D	Moderate	D	30.1	66.0
	W21E-02934	Vuwankala					
	W21E-02963	Nondweni					
	W21E-02953	Ngwebini					
	W21E-02912	Nondweni					
	W21E-02873	Nondweni					
W21-5	W21F-02840	Mvunyane					
	W21G-03085	Ntinini					
	W21G-03067	White Mfolozi					
	W21G-02929	Nsubeni					
	W21G-02914	Ntinini					
	W21G-02885	White Mfolozi					
	W21G-02851	White Mfolozi					
	W21H-02889	Mhlahlane					
	W21H-02897 (EWR WM1)	**White Mfolozi**	**B/C**	**Moderate**	**B/C**	**40.1**	**222.51**
	W21H-03004	White Mfolozi					
W21-6	W21J-03112	Mzinhlanga					
	W21J-03036	Mpembeni					
	W21J-03018	Maphophoma					
	W21J-03075	Mkumbane					
	W21J-03066	Mpembeni					
	W21J-03050	Mpembeni					
	W21J-03030	White Mfolozi	B	High	B	35.03	412.569
W21-7	W21K-02976	Mbilane					
	W21K-03019	Nhlungwane					
	W21K-02981	White Mfolozi					
	W21K-03080	White Mfolozi	B	High	B	35.60	460.103
IUA: W22: Upper Black Umfolozi							

RU Number/Name: Integrated Unit of Analysis	Sub-quaternary catchments	River	PES	EIS	REC	[2] Ecological Reserve (%NMAR)	[1] NMAR (MCM)
W22-1	W22A-02587	Mgobhozi					
	W22A-02591	0					
	W22A-02586	Black Mfolozi					
	W22A-02596	Black Mfolozi					
	W22A-02610 (EWR BM1)	**Black Mfolozi**	**C**	**Moderate**	**C**	**26.1**	**166.72**
	W22B-02662	KwaMbizankulu					
	W22B-02773	Hlangabende					
	W22B-02661	Hlonyana					
	W22B-02728	Hlonyane					
	W22B-02706	Hlonyane					
W22-2	W22C-02688	Black Mfolozi	B	Moderate	B	40.42	78.371
	W22D-02795	iThaka					
	W22F-02722	Black Mfolozi					
W22-3	W22E-02601	Bululwana					
	W22E-02605	Sikwebezi					
	W22E-02595	Sikwebezi					
	W22E-02702	Sikwebezi					
	W22F-02726	Sikwebezi	C	High	C	37.9	69.08
W22-4	W22F-02748	Black Mfolozi					
	W22G-02624	Black Mfolozi					
	W22H-02846	Black Mfolozi					
IUA: W23: Umfolozi Hluhluwe Game Reserve							
W21-8	W21L-03161	Munywana					
	W21L-03176	Mayayeni					
	W21L-03163	Munywana					
	W21L-03059	White Mfolozi					
	W21L-03041	White Mfolozi	C	Moderate	C	44.61	416.687
W22-5	W22H-02844	Mbhekamuzi					
	W22J-02942	Mvalo					
	W22J-02918	Wela					
	W22J-02807	Black Mfolozi					
	W22J-02910	Black Mfolozi					
	W22J-02817	Black Mfolozi	B	Moderate	B	55.86	288.623

RU Number/Name: Integrated Unit of Analysis	Sub-quaternary catchments	River	PES	EIS	REC	[2] Ecological Reserve (%NMAR)	[1] NMAR (MCM)
	W22K-02761	Mapopoma					
	W22K-02636	Manzimakhulu					
	W22K-02629	Mona	B	Moderate	B	55.86	24.716
	W22K-02783	Mona					
	W22L-02916	Black Mfolozi	B	Moderate	B	55.86	325.787
W23-1	W23A-03098	Nkatha					
	W23A-03160	Mvamanzi					
	W23A-03058	Mbukwini					
	W23A-03083	Mfolozi					
	W23A-03149	Mfolozi					
	W23A-03113	Mfolozi	B	High	B	43.7	808.98
W23-2	W23B-03250	Ntobozi	B	High	B	43.2	19.38
	W23B-03222	Msunduzi					
W3 catchment (main river: Mkuze)							
IUA: W31-a: Upper Mkuze							
W31-1	W31A-02494	Nkongolwana					
	W31A-02534	Mkuze					
	W31B-02477	Mkuze	C	High	B/C	41.5	56.17
W31-2	W31C-02556	Sihlengeni					
	W31D-02436	Manzimhlope					
	W31D-02450	Ntutshe					
	W31D-02495	Mkuze					
	W31D-02500	Mkuze	B	High	B	44.7	99.66
W31-3	W31E-02456	Mkuze					
	W31F-02573	Mphiphisi					
	W31F-02555	Nkunzana					
	W31F-02530	Nkunzana					
	W31G-02455	Mtiki					
	W31G-02506	Mkuze	C	High	B/C	44.53	209.887
IUA: W31-b: Lower Mkuze							
W31-4	W31G-02425	Mkuze					
	W31H-02514	KwaSekane					
	W31J-02501	Nhlohlela					

RU Number/Name: Integrated Unit of Analysis	Sub-quaternary catchments	River	PES	EIS	REC	[2] Ecological Reserve (%NMAR)	[1] NMAR (MCM)
	W31J-02469	Mkuze	B	High	B	28.52	17.873
W31-5	W31J-02343	Mthambalala					
	W31J-02406	Ndlamyane					
	W31J-02480 (EWR MK1)	**Mkuze**	**C**	**High**	**B/C**	**37.1**	**158.75**
	W31J-02509	Mkuze					
W31-6	W31K-02617	Mduna					
	W31K-02611	Msebe					
	W31K-02582	Ntweni					
	W31K-02568	Msunduzi					
	W31L-02553	Nsumu					
	W31L-02525	Nsumu					
	W31L-02528	Masundwini					
	W31L-02551	Nsumu					
	W31L-02563	Nsumu					
	W31L-02569	Msunduzi	B	High	B	59.3	20.16
W32-1	W32A-02345	Neshe					
	W32A-02557	Mkuze					
	W32B-02476	Khobeyane					
	W32B-02547	Mkuze	B	High	B	30.53	236.811
IUA: W32-a: Upper Hluhluwe							
W32-2	W32D-02811	Nzimane					
	W32D-02720	Wela					
	W32E-02887	Hluhluwe					
	W32E-02797	Manzabomvu					
	W32E-02765	Mansiya					
	W32E-02779	Nzimane					
	W32E-02859	Nzimane					
	W32E-02865	Hluhluwe	B	High	B	30.2	23.90
IUA: W32-b: Nyalazi and Mzinene Tributaries							
W32-3	W32G-02946	Sikhathula					
	W32G-02973	Nyalazi	B	High	B	32.9	11.80
W32-4	W32G-03102	Nsane					
	W32G-02943	Hlazane					

RU Number/Name: Integrated Unit of Analysis	Sub-quaternary catchments	River	PES	EIS	REC	[2] Ecological Reserve (%NMAR)	[1] NMAR (MCM)
	W32G-02980	Mnyaba					
	W32G-03006	Nyalazi					
	W32G-03055	Nyalazi	C	High	C	29.6	25.92
	W32G-02986	Hlazane					
W32-5	W32C-02684	Ngweni					
	W32C-02749	Mzinene					
	W32C-02721	Mzinene					
	W32C-02671	Mzinene	C	High	C	34.8	20.80
W32-6	W32C-02634	Mhlosinga					
	W32C-02612	Munywana	B	High	B	44.1	3.72
W4 catchment (main river: Pongola)							
IUA: W41: Bivane River							
W41-1	W41A-02372	Bivane					
	W41B-02401	uBivanyana					
	W41B-02427	Bivane					
	W41B-02431	Bivane					
	W41B-02434	Soetmelks					
	W41C-02437	Mpemvana					
	W41D-02373	Bivane					
	W41D-02435	iNxwayi					
	W41E-02359	Bivane	C	High	B/C	38.7	221.53
W41-2	W41F-02433	Manzana	B	High	B	37.0	45.09
	W41F-02454	Manzana					
	W41F-02461	KwaCeba					
	W41F-02481	Manzana					
	W41F-02502	Manzana					
IUA: W42-a: Upper Pongola							
W42-1	W42A-02261	Phongolo					
	W42A-02328	Pandana					
	W42B-02268	Phongolo					
	W42B-02271	Phongolo	C	High	B/C	38.9	264.38
	W42B-02315	Tsakwe					
	W42B-02325	Tsakwe					

RU Number/Name: Integrated Unit of Analysis	Sub-quaternary catchments	River	PES	EIS	REC	[2] Ecological Reserve (%NMAR)	[1] NMAR (MCM)
	W42B-02331	Bazangoma					
	W42C-02205	Ntombe					
W42-2	W42D-02251	Phongolo					
	W42D-02327	Phongolo					
	W42E-02221 (EWR UP1)	**Phongolo**	**C**	**Moderate**	**C**	**27.3**	**356.84**
	W42F-02185	Wit					
	W42G-02317	Phongolo					
IUA: W42-b: Middle Pongola (Ithala)							
W41-3	W41G-02379	Bivane	B	High	A/B	73.85	299.057
W42-3	W42H-02382	Phongolo					
	W42H-02394	iThalu					
	W42H-02411	iThalu					
	W42H-02428	Mbizane					
	W42J-02353	Phongolo					
	W42J-02378	Phongolo	B	High	B	73.85	780.98
	W42J-02397	Mhulumbela					
W42-4	W42K-02148	Mozana					
	W42K-02242	Mozana					
	W42K-02270	Mozana					
	W42L-02272	Mozana	B	Moderate	B	42.4	52.70
W42-5	W42M-02269	Mtokotshwala					
	W42M-02294	Spekboom					
	W42M-02352	Phongolo	B	High	B	37.2	901.99
IUA: W44: Middle Pongola (Grootdraai)							
W44-1	W44A-02332	Phongolo					
	W44A-02386	Phongolo					
	W44A-02389	Voyizana					
	W44A-02410	Mdlavenga					
	W44B-02248	Manzawakho					
	W44B-02351	Phongolo					
	W44C-02338	Phongolo					
	W44D-02304	Phongolo	D	Moderate	D	26.7	942.03
IUA: W45: Lower Pongola (Floodplain)							

RU Number/Name: Integrated Unit of Analysis	Sub-quaternary catchments	River	PES	EIS	REC	[2] Ecological Reserve (%NMAR)	[1] NMAR (MCM)
W43-1	W43F-02013	Msunduzi					
	W43F-02053	Ngwavuma					
	W43F-02072	Ngwavuma	C	Moderate	C	33.4	26.95
	W43F-02076	Msunduzi					
	W43F-02089	Ngwavuma					
	W43F-02099	Ngwavuma					
	W43F-02104	Mnvoni					
	W43F-02107	Mnvoni					
	W43F-02113	Ngwavuma					
	W43F-02142	Ngwavuma					
	W43F-02159	Ngwavuma					
W45-1	W45A-02216	Zibayeni					
	W45A-02245	Zibayeni					
	W45A-02246	Phongolo					
	W45A-02256	Lubambo					
	W45A-02275	Mpontshane					
	W45A-02282	Phongolo					
	W45A-02285	Mpontshane					
	W45A-02310	Mangqwashi					
	W45A-02316	Mfongosi					
	W45A-02356	Mlambo					
	W45A-02367	Phongolo					
	W45A-02368	Phongolo					
	W45B-02029	Phongolo					
	W45B-02105	Phongolo	C	Very high	B	31.63	1151.202
W5 catchment (main river: Usutu)							
IUA: W51-a: W5 Upstream major dams (Assegaai)							
W51-1	W51A-02082	Assegai	C/D	High	C	41.1	99.61
W53-1	W53A-01804	Ngwempisi	D	Moderate	D	33.1	38.66
W53-2	W53B-01694	Mpama	B/C	Moderate	B/C	42.4	5.05
W54-1	W54B-01569	Usuthu	B	Moderate	B	46.0	32.77
IUA: W52: W5 Downstream major dams & Hlelo River							
W51-2	W51C-01981	Assegaai	B	Moderate	B	43.59	212.841

RU Number/Name: Integrated Unit of Analysis	Sub-quaternary catchments	River	PES	EIS	REC	[2] Ecological Reserve (%NMAR)	[1] NMAR (MCM)
W51-3	**W51E-02049 (EWR AS1)**	**Assegaai**	**C**	**Moderate**	**C**	**21.6**	**328.61**
W51-4	W51F-01986	Blesbokspruit	C	Moderate	C	41.5	43.36
W52-1	W52D-01862	Hlelo	B/C	High	B/C	44.1	97.06
W53-3	**W53E-01790 (EWR NG1)**	**Ngwempisi**	**B/C**	**Moderate**	**B/C**	**32.5**	**156.33**
W54-2	W54D-01593	Usuthu	C	Moderate	C	35.0	79.46
IUA: W55: Mpuluzi & Lusushwana River systems							
W55-1	W55E-01477	Mpuluzi	B/C	High	B/C	49.9	128.96
W55-2	W56A-01372	Lusushwana	C	High	C	46.1	39.48
IUA: W57: Lower Usutu River							
W57-1	W57K-01929	Usuthu	B/C	High	B	40.3	2289.46

1) NMAR is the Natural Mean Annual Runoff.
2) This amount represents the long-term mean based on the NMAR. If the NMAR changes, this % of Ecological Reserve will also change

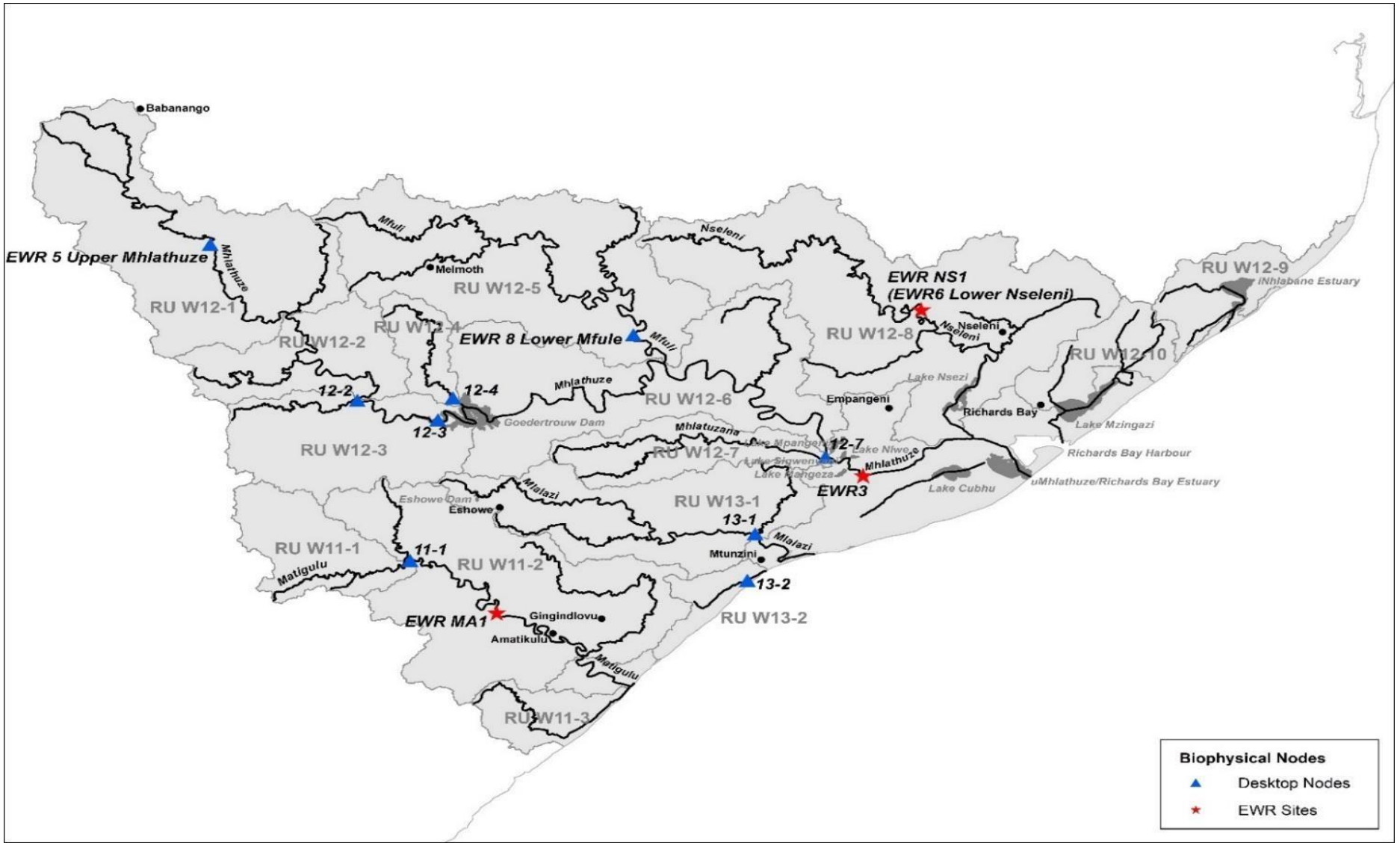

Figure 1: Resource Units of the W1 catchment (main river: Mhlathuze)

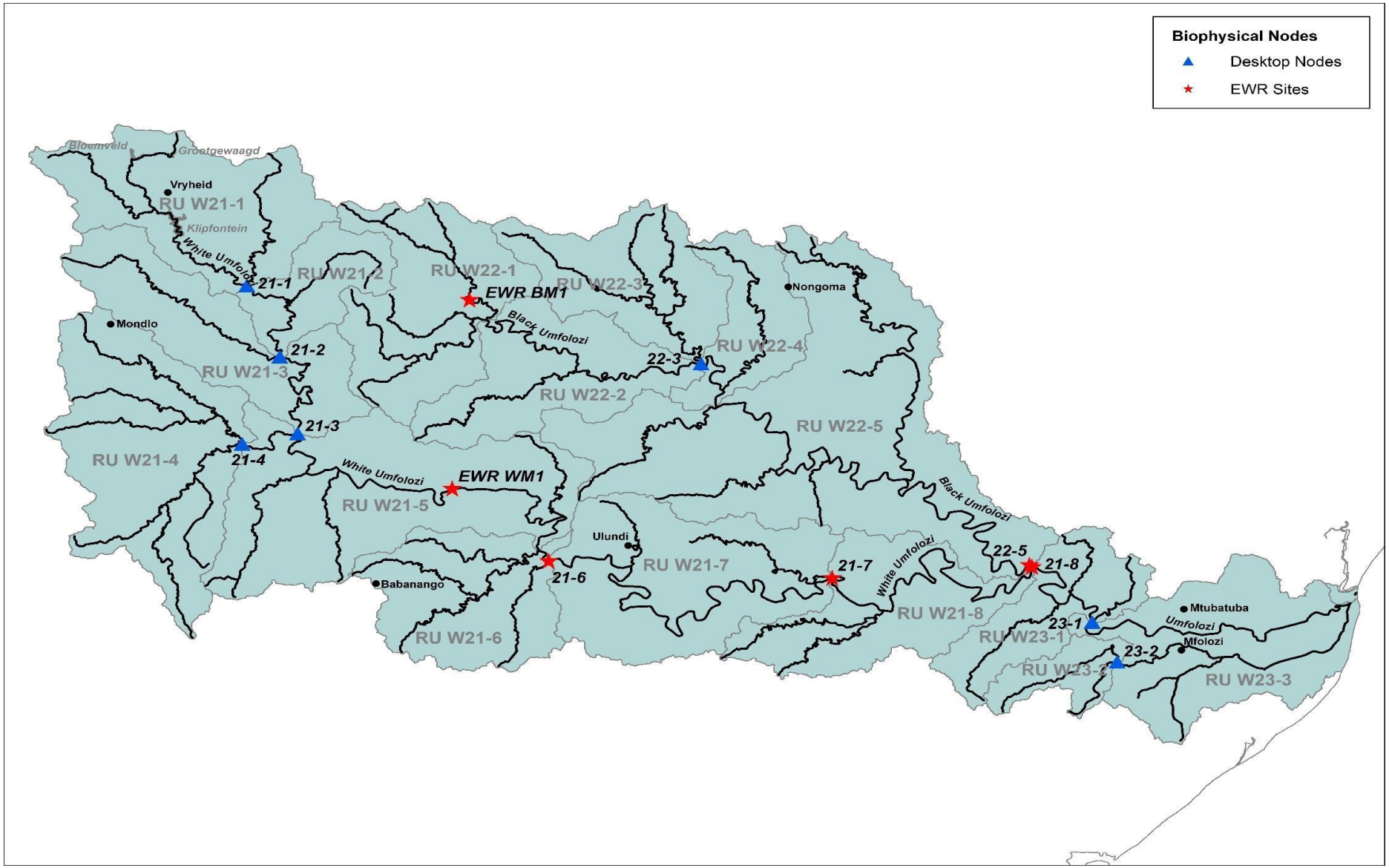

Figure 2: Resource Units of the W2 catchment (main river: UMfolozi)

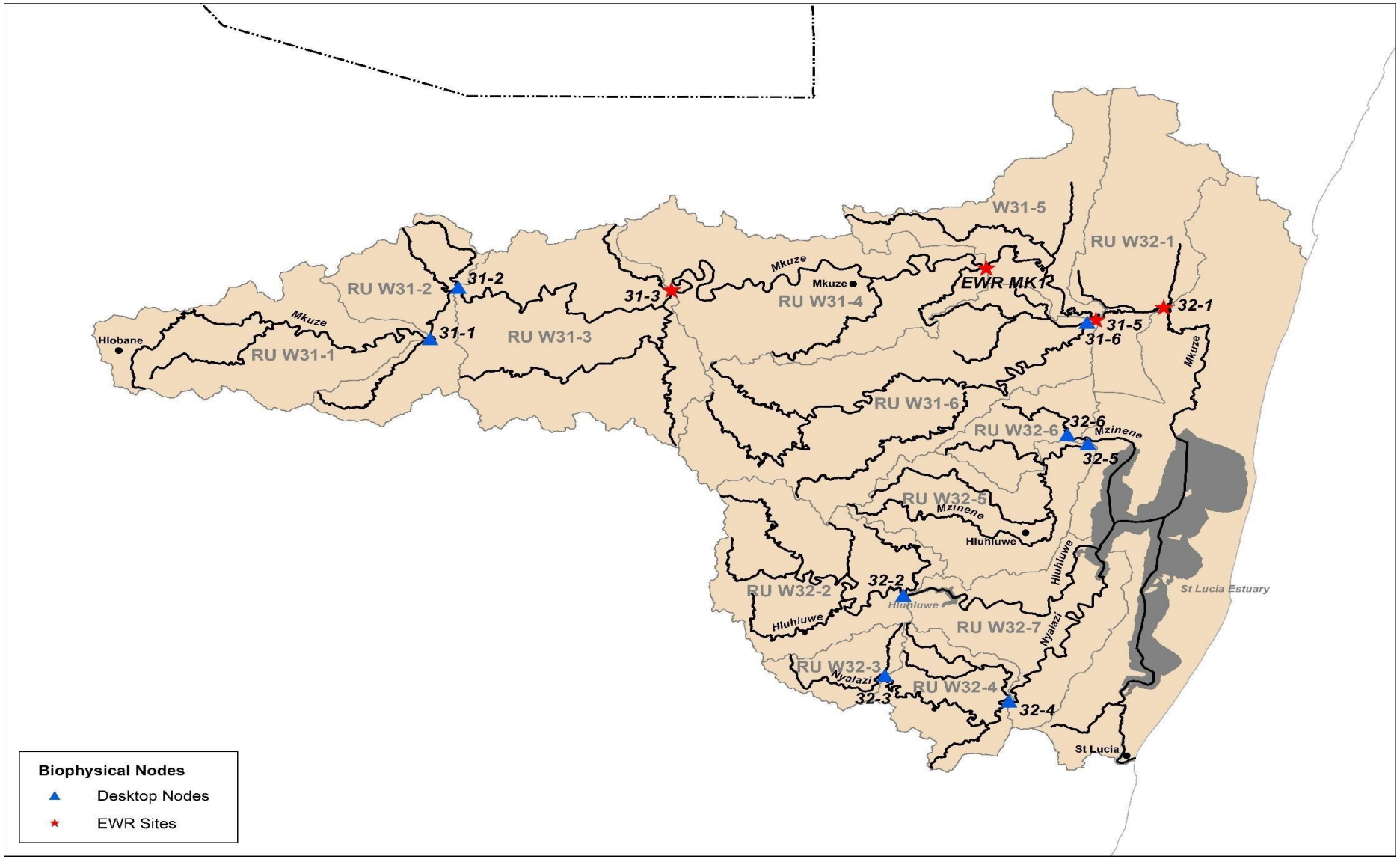

Figure 3: Resource Units of the W3 catchment (main river: Mkuze)

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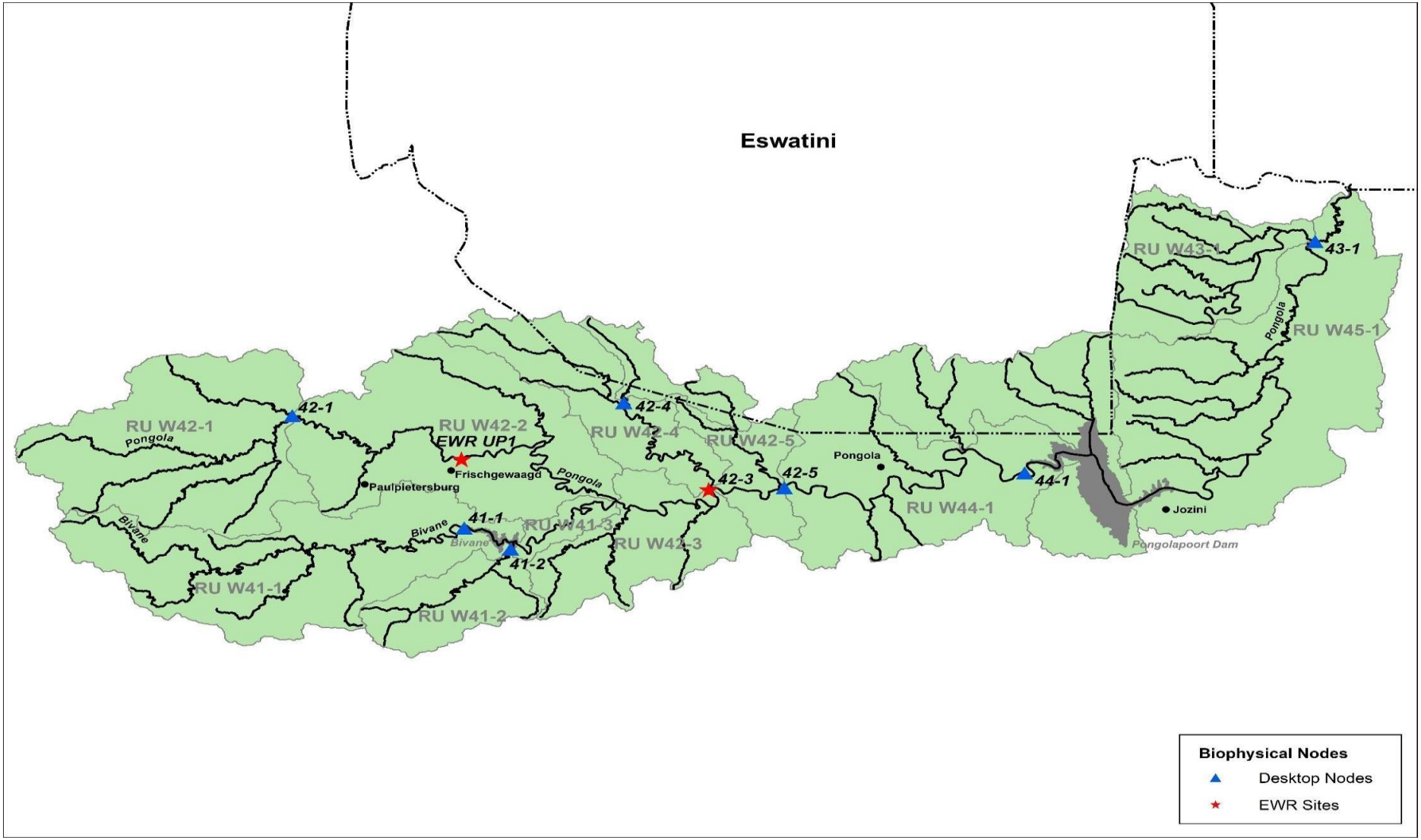

Figure 4: Resource Units of the W4 catchment (main river: Pongola)

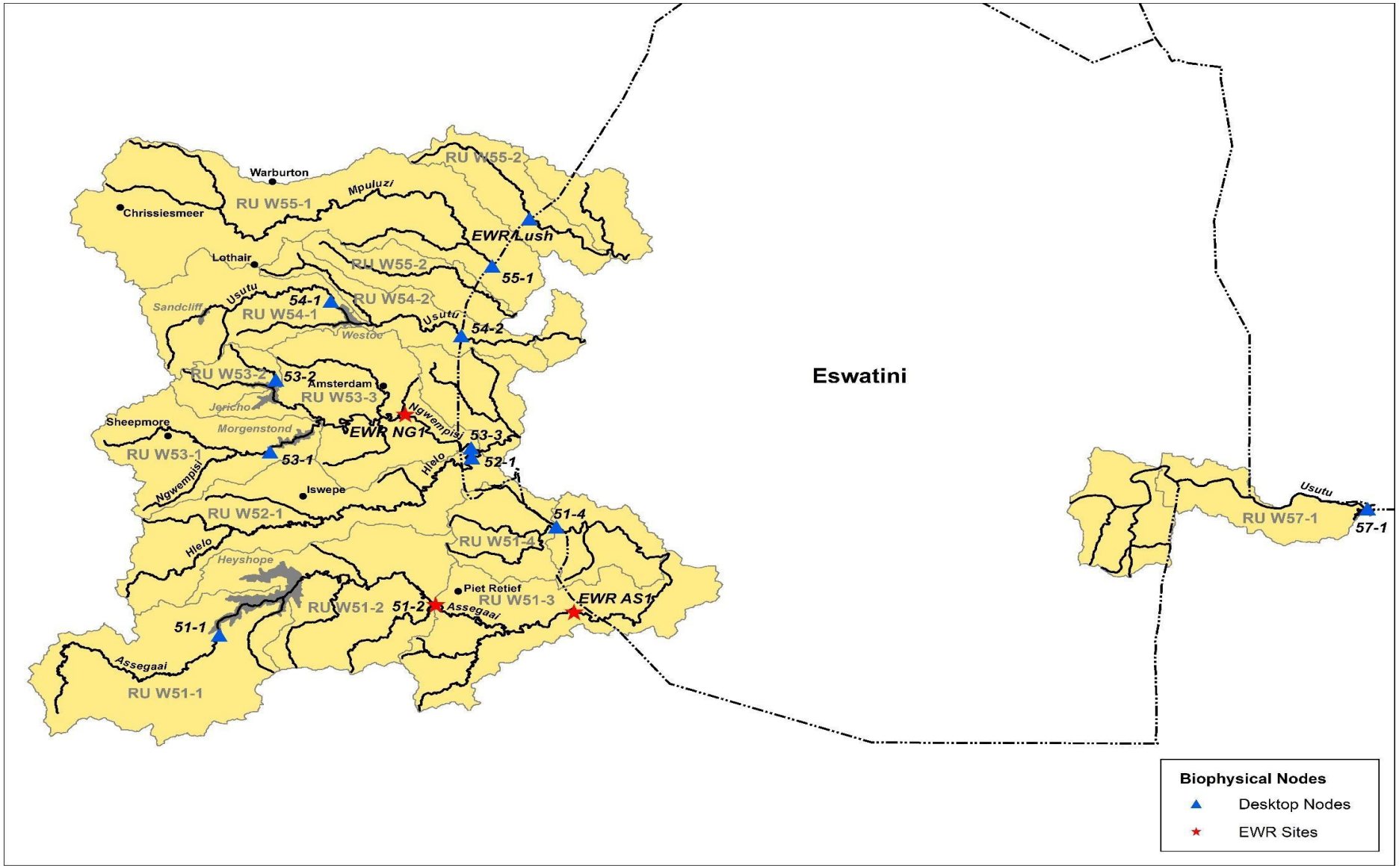

Figure 5: Resource Units of the W5 catchment (main river: Usutu)

Basic Human Needs Reserve (BHNR)

Communities likely to be reliant on direct abstraction from run off river and surface water were identified in the study area using Geographic Information System (GIS) mapping and the 2016 population Census. A series of steps were undertaken to determine the population within each quaternary catchment dependant on the water resource. The method follows the approach revised by DWS (DWA, 2008a), with additional steps to improve projections. In this method, the BHNR only applies to the areas in which informal water sources are the means by which communities obtain water. The method adopted is summarized below:

- Quaternary catchments falling within the Usutu to Mhlathuze Catchment were determined, and the area of each catchment was calculated based on GIS information.
- Data from the 2016 Statistics South Africa Community Survey (Stats SA, 2016) was used to determine the number of people within Local Municipalities that fall either entirely or partially within the Usutu to Mhlathuze Catchment. Some quaternary catchments fall within more than one Local Municipality. Local Municipality data is provided with a statistical analysis of the level of service with respect to provision and access to water resources.
- The 2016 Statistics South Africa Community Survey (Stats SA, 2016) is the most recent comprehensive national data set. The 2011 Census is out of date as a reliable source of water service information and the current Census (2022) was unavailable.
- The number of people within the Local Municipality was apportioned to the quaternary catchment based on the size of the quaternary relative to the total Municipal Population.
- Based on the level of service provided by the Local Municipality, the number of people estimated to be directly dependent on the various water sources were calculated per quaternary catchment. Areas falling completely or partially in each quaternary catchment were used to determine households with access to formal and informal water supplies. The former included all households with access to piped water in any configuration, while the latter covers all households without access to piped water and therefore would be reliant on other informal sources such as run-off rivers, springs, dams, lakes, vendors and tankers. It should be noted that in the 2016 Statistics South Africa Community Survey (Stats SA, 2016) water supply was determined by household and therefore the method needed adjustment to account for individuals. Total qualifying households multiplied by the average number of individuals was used to determine the total population qualifying under the BHNR. Those who receive water from formal schemes and mechanized groundwater extraction were excluded (see the DWS directive (DWA, 2008a) relating to formal scheme exclusion). Those who use buckets to collect from wells are included. According to the results of the 2016 Statistics South Africa Community Survey, approximately 77% of the overall Water Management Area (WMA) population has access to formal water supply schemes or abstract groundwater via boreholes.
- Having calculated the qualifying population per quaternary catchment the next step in determining the BHNR is to project the population to a target date. The average growth for the applicable Local Municipalities between 2011 Census and 2016 Community survey of 1.7% per annum was used.
- The BHNR provides for the essential needs of individuals served directly by the water resource in question and includes water for drinking, food preparation and for personal hygiene. To calculate the quantity of water for the BHNR, the daily normative allowance of 60 litres per person per day was used for eligible individuals in the population. The figure of 60 litres is used from guidelines as set out in DWAF (1999; 2007 and 2008a; b).

Table 2: BHNR by quaternary catchment in Million cubic metres per annum

Quaternary catchment	Population BHN Reserve Dependent excluding boreholes and formal schemes	BHN Reserve (1 000 000 m^3/annum)		
		2022	2025	2030
W11A	1 041	0.023	0.024	0.027
W11A	10 849	0.238	0.254	0.277
W11B	4 827	0.106	0.113	0.123
W11B	686	0.015	0.016	0.017
W11C	8 404	0.184	0.197	0.214
W11C	6 610	0.145	0.155	0.168
W12A	2 766	0.061	0.065	0.070
W12A	2 349	0.051	0.055	0.060
W12A	2 909	0.064	0.068	0.074
W12B	3 540	0.078	0.083	0.090
W12B	1 518	0.033	0.036	0.039
W12B	7 618	0.167	0.178	0.194
W12C	8 984	0.197	0.210	0.229
W12D	2 643	0.058	0.062	0.067
W12D	1 408	0.031	0.033	0.036
W12D	7 846	0.172	0.184	0.200
W12E	372	0.008	0.009	0.009
W12E	6 833	0.150	0.160	0.174
W12F	3 230	0.071	0.076	0.082
W12F	109	0.002	0.003	0.003
W12G	883	0.019	0.021	0.023
W12G	833	0.018	0.020	0.021
W12G	1 734	0.038	0.041	0.044
W12H	2 894	0.063	0.068	0.074
W12H	2 198	0.048	0.051	0.056
W12J	3 372	0.074	0.079	0.086
W12J	595	0.013	0.014	0.015
W13A	8	0.000	0.000	0.000
W13A	9 180	0.201	0.215	0.234
W13B	248	0.005	0.006	0.006
W13B	688	0.015	0.016	0.018
W13B	4 511	0.099	0.106	0.115
W21A	2 665	0.058	0.062	0.068
W21A	24	0.001	0.001	0.001
W21A	124	0.003	0.003	0.003
W21B	5 136	0.112	0.120	0.131
W21C	3 271	0.072	0.077	0.083
W21D	2 915	0.064	0.068	0.074
W21D	2 679	0.059	0.063	0.068
W21E	8 001	0.175	0.187	0.204
W21F	1 118	0.024	0.026	0.028
W21F	165	0.004	0.004	0.004
W21F	2 365	0.052	0.055	0.060
W21G	5 250	0.115	0.123	0.134
W21G	6 359	0.139	0.149	0.162
W21H	9 494	0.208	0.222	0.242
W21J	744	0.016	0.017	0.019
W21J	10 590	0.232	0.248	0.270
W21K	33	0.001	0.001	0.001
W21K	3 201	0.070	0.075	0.082
W21K	12 973	0.284	0.304	0.331
W21L	3 042	0.067	0.071	0.078
W21L	815	0.018	0.019	0.021
W21L	3 113	0.068	0.073	0.079

Quaternary catchment	Population BHN Reserve Dependent excluding boreholes and formal schemes	BHN Reserve (1 000 000 m^3/annum)		
		2022	2025	2030
W21L	81	0.002	0.002	0.002
W22A	2 112	0.046	0.049	0.054
W22B	1 691	0.037	0.040	0.043
W22B	3 084	0.068	0.072	0.079
W22C	1 361	0.030	0.032	0.035
W22C	697	0.015	0.016	0.018
W22D	5	0.000	0.000	0.000
W22D	4 319	0.095	0.101	0.110
W22E	2 210	0.048	0.052	0.056
W22E	3 594	0.079	0.084	0.092
W22E	1 523	0.033	0.036	0.039
W22E	2	0.000	0.000	0.000
W22F	21	0.000	0.000	0.001
W22F	5 326	0.117	0.125	0.136
W22F	4 642	0.102	0.109	0.118
W22G	13 547	0.297	0.317	0.345
W22H	2 079	0.046	0.049	0.053
W22H	5 875	0.129	0.138	0.150
W22J	652	0.014	0.015	0.017
W22J	13 995	0.306	0.328	0.357
W22J	6 385	0.140	0.150	0.163
W22K	629	0.014	0.015	0.016
W22K	22 888	0.501	0.536	0.583
W22L	3 220	0.071	0.075	0.082
W22L	0	0.000	0.000	0.000
W22L	65	0.001	0.002	0.002
W22L	0	0.000	0.000	0.000
W23A	4	0.000	0.000	0.000
W23A	2 912	0.064	0.068	0.074
W23A	7 548	0.165	0.177	0.192
W23B	2 481	0.054	0.058	0.063
W23C	3 178	0.070	0.074	0.081
W23C	2 649	0.058	0.062	0.068
W23D	159	0.003	0.004	0.004
W23D	9 500	0.208	0.223	0.242
W31A	3 272	0.072	0.077	0.083
W31B	2 679	0.059	0.063	0.068
W31B	25	0.001	0.001	0.001
W31C	1 518	0.033	0.036	0.039
W31D	1 527	0.033	0.036	0.039
W31D	1 972	0.043	0.046	0.050
W31E	520	0.011	0.012	0.013
W31E	4 454	0.098	0.104	0.114
W31F	322	0.007	0.008	0.008
W31F	17 834	0.391	0.418	0.455
W31F	3 536	0.077	0.083	0.090
W31G	503	0.011	0.012	0.013
W31G	10 939	0.240	0.256	0.279
W31G	4 773	0.105	0.112	0.122
W31H	4 571	0.100	0.107	0.117
W31H	1 570	0.034	0.037	0.040
W31H	1 332	0.029	0.031	0.034
W31J	9 394	0.206	0.220	0.239
W31J	847	0.019	0.020	0.022
W31K	1 356	0.030	0.032	0.035

Quaternary catchment	Population BHN Reserve Dependent excluding boreholes and formal schemes	BHN Reserve (1 000 000 m^3/annum)		
		2022	2025	2030
W31K	7 541	0.165	0.177	0.192
W31K	21 175	0.464	0.496	0.540
W31L	396	0.009	0.009	0.010
W31L	6 214	0.136	0.146	0.158
W32A	0	0.000	0.000	0.000
W32A	2 573	0.056	0.060	0.066
W32A	2 135	0.047	0.050	0.054
W32B	2 853	0.062	0.067	0.073
W32B	267	0.006	0.006	0.007
W32B	4 835	0.106	0.113	0.123
W32C	8 390	0.184	0.197	0.214
W32C	99	0.002	0.002	0.003
W32D	1 903	0.042	0.045	0.049
W32D	5 601	0.123	0.131	0.143
W32E	4 846	0.106	0.114	0.124
W32E	1 531	0.034	0.036	0.039
W32F	1 099	0.024	0.026	0.028
W32F	3 733	0.082	0.087	0.095
W32G	961	0.021	0.023	0.025
W32G	22 780	0.499	0.534	0.581
W32H	8 370	0.183	0.196	0.213
W32H	22 353	0.490	0.524	0.570
W41A	627	0.014	0.015	0.016
W41B	1 334	0.029	0.031	0.034
W41B	682	0.015	0.016	0.017
W41C	121	0.003	0.003	0.003
W41C	1 995	0.044	0.047	0.051
W41C	173	0.004	0.004	0.004
W41D	71	0.002	0.002	0.002
W41D	3 020	0.066	0.071	0.077
W41E	21	0.000	0.000	0.001
W41E	3 950	0.087	0.093	0.101
W41F	1 745	0.038	0.041	0.044
W41F	1 920	0.042	0.045	0.049
W41G	410	0.009	0.010	0.010
W41G	574	0.013	0.013	0.015
W41G	94	0.002	0.002	0.002
W42A	19	0.000	0.000	0.000
W42A	1 342	0.029	0.031	0.034
W42A	959	0.021	0.022	0.024
W42A	6	0.000	0.000	0.000
W42B	4 391	0.096	0.103	0.112
W42B	135	0.003	0.003	0.003
W42B	213	0.005	0.005	0.005
W42C	366	0.008	0.009	0.009
W42C	9	0.000	0.000	0.000
W42C	1	0.000	0.000	0.000
W42C	1 209	0.026	0.028	0.031
W42D	3 048	0.067	0.071	0.078
W42D	1 312	0.029	0.031	0.033
W42E	1 768	0.039	0.041	0.045
W42E	495	0.011	0.012	0.013
W42F	1 558	0.034	0.036	0.040
W42G	2 141	0.047	0.050	0.055
W42G	106	0.002	0.002	0.003

Quaternary catchment	Population BHN Reserve Dependent excluding boreholes and formal schemes	BHN Reserve (1 000 000 m^3/annum)		
		2022	2025	2030
W42G	1 041	0.023	0.024	0.027
W42H	1 508	0.033	0.035	0.038
W42H	1 656	0.036	0.039	0.042
W42J	494	0.011	0.012	0.013
W42J	3 794	0.083	0.089	0.097
W42K	1 120	0.025	0.026	0.029
W42K	27	0.001	0.001	0.001
W42L	241	0.005	0.006	0.006
W42L	3 287	0.072	0.077	0.084
W42M	4 984	0.109	0.117	0.127
W43C	79	0.002	0.002	0.002
W43E	9	0.000	0.000	0.000
W43F	13 636	0.299	0.319	0.348
W44A	4 119	0.090	0.096	0.105
W44B	5 567	0.122	0.130	0.142
W44C	1 085	0.024	0.025	0.028
W44D	3 451	0.076	0.081	0.088
W44E	1 227	0.027	0.029	0.031
W44E	5 002	0.110	0.117	0.127
W45A	20 726	0.454	0.486	0.528
W45A	2 362	0.052	0.055	0.060
W45A	9	0.000	0.000	0.000
W45B	2 793	0.061	0.065	0.071
W45B	2 711	0.059	0.064	0.069
W51A	1 446	0.032	0.034	0.037
W51A	8	0.000	0.000	0.000
W51A	377	0.008	0.009	0.010
W51B	461	0.010	0.011	0.012
W51B	1 642	0.036	0.038	0.042
W51C	0	0.000	0.000	0.000
W51C	3 455	0.076	0.081	0.088
W51D	2 687	0.059	0.063	0.068
W51E	96	0.002	0.002	0.002
W51F	1 560	0.034	0.037	0.040
W52A	249	0.005	0.006	0.006
W52A	994	0.022	0.023	0.025
W52B	1 714	0.038	0.040	0.044
W52C	907	0.020	0.021	0.023
W52D	366	0.008	0.009	0.009
W53A	3	0.000	0.000	0.000
W53A	761	0.017	0.018	0.019
W53A	1 255	0.027	0.029	0.032
W53B	4	0.000	0.000	0.000
W53B	690	0.015	0.016	0.018
W53C	1 487	0.033	0.035	0.038
W53C	76	0.002	0.002	0.002
W53D	1 343	0.029	0.031	0.034
W53D	163	0.004	0.004	0.004
W53E	904	0.020	0.021	0.023
W53F	6	0.000	0.000	0.000
W54A	796	0.017	0.019	0.020
W54B	34	0.001	0.001	0.001
W54B	873	0.019	0.020	0.022
W54C	341	0.007	0.008	0.009
W54D	167	0.004	0.004	0.004

Quaternary catchment	Population BHN Reserve Dependent excluding boreholes and formal schemes	BHN Reserve (1 000 000 m^3/annum)		
		2022	2025	2030
W54D	215	0.005	0.005	0.005
W54D	201	0.004	0.005	0.005
W54E	15	0.000	0.000	0.000
W54E	74	0.002	0.002	0.002
W55A	437	0.010	0.010	0.011
W55A	1 909	0.042	0.045	0.049
W55B	2	0.000	0.000	0.000
W55B	689	0.015	0.016	0.018
W55C	2 057	0.045	0.048	0.052
W55C	384	0.008	0.009	0.010
W55D	367	0.008	0.009	0.009
W55D	487	0.011	0.011	0.012
W55E	14	0.000	0.000	0.000
W56A	1 191	0.026	0.028	0.030
W56B	217	0.005	0.005	0.006
W57J	1 915	0.042	0.045	0.049
W57K	2 962	0.065	0.069	0.076
W70A	18 427	0.404	0.432	0.470
Total		**15.329**	**16.412**	**17.855**

SURFACE-WATER - QUALITY COMPONENT FOR RIVERS

Reserve determination for the Quality component at EWR sites

Table 3.1: EWR MA1- Water quality EcoSpecs and TPCs (PES and TEC: B)

Water quality metrics	EcoSpecs	TPC
Inorganic salts		
$MgSO_4$	The 95th percentile of the data must be ≤23 mg/L.	The 95th percentile of the data is 19 - 23 mg/L.
Na_2SO_4	The 95th percentile of the data must be ≤33 mg/L.	The 95th percentile of the data is 27 - 33 mg/L.
$MgCl_2$	The 95th percentile of the data must be ≤30 mg/L.	The 95th percentile of the data is 24 - 30 mg/L.
$CaCl_2$	The 95th percentile of the data must be ≤57 mg/L.	The 95th percentile of the data is 46 - 57 mg/L.
NaCl	The 95th percentile of the data must be ≤191 mg/L.	The 95th percentile of the data is 153 - 191 mg/L.
$CaSO_4$	The 95th percentile of the data must be ≤351 mg/L.	The 95th percentile of the data is 280 - 351 mg/L.
Physical variables		
Electrical Conductivity	The 95th percentile of the data must be ≤55 mS/m.	The 95th percentile of the data is 44 - 55 mS/m.
pH	The 5th percentile of the data must range from 6.5 to 8.0, and the 95th percentile from 6.5 to 8.4.	The 5th percentile of the data is <6.7 and >7.8, and the 95th percentile is <6.7 and >8.2.
Temperature	Largely natural temperature range is expected.	Abundance and frequency of occurrence of temperature sensitive species are lower than expected for reference.
Dissolved oxygen	The 5th percentile of the data must be ≥7.5 mg/L.	The 5th percentile of the data is ≤7.7 mg/L.
Turbidity	Moderate impact expected due to land–use and sediment deposits at the site.	Unnaturally high sediment loads and turbidity during runoff events. Impacts are mostly temporary, but some sediment deposits are evident. Check biotic response for habitat-related changes.
Nutrients		
Total Inorganic Nitrogen (TIN-N)	The 50th percentile of the data must be <0.25 mg/L.	The 50th percentile of the data is 0.2 - 0.25 mg/L
PO_4-P	The 50th percentile of the data must be ≤0.015 mg/L.	The 50th percentile of the data is 0.012 - 0.015 mg/L
Response variables		
Chl-*a* phytoplankton	The 50th percentile of the data must be ≤15 mg/L	The 50th percentile of the data is 12 - 15 µg/L.
Chl-*a* periphyton	The 50th percentile of the data must be ≤12 mg/m^2	The 50th percentile of the data is 10 - 12 mg/m^2.
Toxics		
Ammonia (NH_3-N)	The 95th percentile of the data must be ≤0.1 mg/L	The 95th percentile of the data is 0.08 - 0.1 mg/L.
Other variables	The 95th percentile of the data must be within the A (or 0) category in DWAF (2008a), or within the Acute Effects Value (AEV) as stated in DWAF (1996a) for those variables not in DWAF (2008a).	An impact is expected if the 95th percentile of the data exceeds the A Category range in DWAF (2008a), or the Target Water Quality Range (TWQR) as stated in DWAF (1996a).

Table 3.2: EWR NS1- Water quality EcoSpecs and TPCs (PES and TEC: B)

Water quality metrics	EcoSpecs	TPC
Inorganic salts		
$MgSO_4$	The 95th percentile of the data must be ≤37 mg/L.	The 95th percentile of the data is 30 - 37 mg/L.
Na_2SO_4	The 95th percentile of the data must be ≤51 mg/L.	The 95th percentile of the data is 41 - 51 mg/L.
$MgCl_2$	The 95th percentile of the data must be ≤51 mg/L.	The 95th percentile of the data is 41 - 51 mg/L.
$CaCl_2$	The 95th percentile of the data must be ≤105 mg/L.	The 95th percentile of the data is 84 - 105 mg/L.
NaCl	The 95th percentile of the data must be ≤389 mg/L.	The 95th percentile of the data is 311 - 389 mg/L.
$CaSO_4$	The 95th percentile of the data must be ≤1105 mg/L.	The 95th percentile of the data is 884 - 1105 mg/L.
Physical variables		
Electrical Conductivity	The 95th percentile of the data must be ≤85 mS/m.	The 95th percentile of the data is 68 - 85 mS/m.
pH	The 5th percentile of the data must range from 6.5 to 8.0, and the 95th percentile from 6.5 to 8.8.	The 5th percentile of the data is <6.7 and >7.8, and the 95th percentile is <6.7 and >8.6.
Temperature	Largely natural temperature range is expected.	Abundance and frequency of occurrence of temperature sensitive species are lower than expected for reference.
Dissolved oxygen	The 5th percentile of the data must be ≥7.5 mg/L.	The 5th percentile of the data is ≤7.7 mg/L.
Turbidity	Moderate impact expected due to land–use and sediment deposits at the site.	Unnaturally high sediment loads and turbidity during runoff events. Impacts are mostly temporary, but some sediment deposits are evident. Check biotic response for habitat-related changes.
Nutrients		
Total Inorganic Nitrogen (TIN-N)	The 50th percentile of the data must be <0.25 mg/L.	The 50th percentile of the data is 0.2 - 0.25 mg/L.
PO_4-P	The 50th percentile of the data must be ≤0.015 mg/L.	The 50th percentile of the data is 0.012 - 0.015 mg/L.
Response variables		
Chl-*a* phytoplankton	The 50th percentile of the data must be ≤15 mg/L	The 50th percentile of the data is 12 - 15 µg/L.
Chl-*a* periphyton	The 50th percentile of the data must be ≤12 mg/m^2	The 50th percentile of the data is 10 - 12 mg/m^2.
Toxics		
Other variables	The 95th percentile of the data must be within the A (or 0) category in DWAF (2008a), or within the AEV as stated in DWAF (1996a) for those variables not in DWAF (2008a).	An impact is expected if the 95th percentile of the data exceeds the A Category range in DWAF (2008a), or the TWQR as stated in DWAF (1996a).

Table 3.3: EWR WM1- Water quality EcoSpecs and TPCs (PES and TEC: B)

Water quality metrics	EcoSpecs	TPC
Inorganic salts		
$MgSO_4$	The 95th percentile of the data must be ≤23 mg/L.	The 95th percentile of the data is 19 - 23 mg/L.
Na_2SO_4	The 95th percentile of the data must be ≤33 mg/L.	The 95th percentile of the data is 27 - 33 mg/L.
$MgCl_2$	The 95th percentile of the data must be ≤30 mg/L.	The 95th percentile of the data is 24 - 30 mg/L.
$CaCl_2$	The 95th percentile of the data must be ≤57 mg/L.	The 95th percentile of the data is 46 - 57 mg/L.
NaCl	The 95th percentile of the data must be ≤191 mg/L.	The 95th percentile of the data is 153 - 191 mg/L.
$CaSO_4$	The 95th percentile of the data must be ≤351 mg/L.	The 95th percentile of the data is 280 - 351 mg/L.
Physical variables		
Electrical Conductivity	The 95th percentile of the data must be ≤55 mS/m.	The 95th percentile of the data is 44 - 55 mS/m.
pH	The 5th percentile of the data must range from 6.5 to 8.0, and the 95th percentile from 6.5 to 8.8.	The 5th percentile of the data is <6.7 and >7.8, and the 95th percentile is <6.7 and >8.6.
Temperature	Largely natural temperature range is expected.	Abundance and frequency of occurrence of temperature sensitive species are lower than expected for reference.
Dissolved oxygen	The 5th percentile of the data must be ≥7.5 mg/L.	The 5th percentile of the data is ≤7.7 mg/L.
Turbidity	Moderate impact expected due to land–use and sediment deposits at the site.	Unnaturally high sediment loads and turbidity during runoff events. Impacts are mostly temporary, but some sediment deposits are evident. Check biotic response for habitat-related changes.
Nutrients		
Total Inorganic Nitrogen (TIN-N)	The 50th percentile of the data must be <0.25 mg/L.	The 50th percentile of the data is 0.2 - 0.25 mg/L.
PO_4-P	The 50th percentile of the data must be ≤0.015 mg/L.	The 50th percentile of the data is 0.012 - 0.015 mg/L.
Response variables		
Chl-*a* phytoplankton	The 50th percentile of the data must be ≤15 mg/L.	The 50th percentile of the data is 12 - 15 µg/L.
Chl-*a* periphyton	The 50th percentile of the data must be ≤12 mg/m^2.	The 50th percentile of the data is 10 - 12 mg/m^2.
Toxics		
Ammonia (NH_3-N)	The 95th percentile of the data must be ≤0.02 mg/L.	The 95th percentile of the data is 0.016 - 0.02 mg/L
Other variables	The 95th percentile of the data must be within the A (or 0) category in DWAF (2008a), or within the AEV as stated in DWAF (1996a) for those variables not in DWAF (2008a).	An impact is expected if the 95th percentile of the data exceeds the A Category range in DWAF (2008a), or the TWQR as stated in DWAF (1996a).

Table 3.4: EWR BM1- Water quality EcoSpecs and TPCs (PES and TEC: B/C)

Water quality metrics	EcoSpecs	TPC
Inorganic salts		
$MgSO_4$	The 95th percentile of the data must be ≤23 mg/L.	The 95th percentile of the data is 19 - 23 mg/L.
Na_2SO_4	The 95th percentile of the data must be ≤33 mg/L.	The 95th percentile of the data is 27 - 33 mg/L.
$MgCl_2$	The 95th percentile of the data must be ≤30 mg/L.	The 95th percentile of the data is 24 - 30 mg/L.
$CaCl_2$	The 95th percentile of the data must be ≤57 mg/L.	The 95th percentile of the data is 46 - 57 mg/L.
NaCl	The 95th percentile of the data must be ≤191 mg/L.	The 95th percentile of the data is 153 - 191 mg/L.
$CaSO_4$	The 95th percentile of the data must be ≤773 mg/L.	The 95th percentile of the data is 618 - 773 mg/L.
Inorganic salts ions		
Sulphate as SO_4	The 95th percentile of the data must be ≤30 mg/L[2].	The 95th percentile of the data is 24 - 30 mg/L.
Physical variables		
Electrical Conductivity	The 95th percentile of the data must be ≤55 mS/m.	The 95th percentile of the data is 44 - 55 mS/m.
pH	The 5th percentile of the data must range from 6.5 to 8.0, and the 95th percentile from 6.5 to 8.8.	The 5th percentile of the data is <6.7 and >7.8, and the 95th percentile is <6.7 and >8.6.
Temperature	Largely natural temperature range is expected.	Abundance and frequency of occurrence of temperature sensitive species are lower than expected for reference.
Dissolved oxygen	The 5th percentile of the data must be >8.0 mg/L.	The 5th percentile of the data is ≤8.2 mg/L.
Turbidity	Small changes expected.	Some localized erosion at the site due to land use.
Nutrients		
Total Inorganic Nitrogen (TIN-N)	The 50th percentile of the data must be <0.25 mg/L.	The 50th percentile of the data is 0.2 - 0.25 mg/L
PO_4-P	The 50th percentile of the data must be ≤0.015 mg/L.	The 50th percentile of the data is 0.012 - 0.015 mg/L.
Response variables		
Chl-*a* phytoplankton	The 50th percentile of the data must be ≤15 mg/L.	The 50th percentile of the data is 12 - 15 µg/L
Chl-*a* periphyton	The 50th percentile of the data must be ≤12 mg/m^2	The 50th percentile of the data is 10 - 12 mg/m^2
Toxics		
Ammonia (NH_3-N)	The 95th percentile of the data must be ≤0.02 mg/L	The 95th percentile of the data is 0.016 - 0.02 mg/L
Other variables	The 95th percentile of the data must be within the A (or 0) category in DWAF (2008a), or within the AEV as stated in DWAF (1996a) for those variables not in DWAF (2008a).	An impact is expected if the 95th percentile of the data exceeds the A Category range in DWAF (2008a), or the TWQR as stated in DWAF (1996a).

Table 3.5: EWR MK1- Water quality EcoSpecs and TPCs (PES and TEC: B/C)

Water quality metrics	EcoSpecs	TPC
Inorganic salts		
$MgSO_4$	The 95th percentile of the data must be ≤37 mg/L, *as indicated for a D Category river*.	The 95th percentile of the data is 30 - 37 mg/L.
Na_2SO_4	The 95th percentile of the data must be ≤51 mg/L, *as indicated for a D Category river*.	The 95th percentile of the data is 41 - 51 mg/L.
MgCl2	The 95th percentile of the data must be ≤51 mg/L, as indicated for a D Category river.	The 95th percentile of the data is 41 - 51 mg/L.
CaCl2	The 95th percentile of the data must be ≤105 mg/L, as indicated for a D Category river.	The 95th percentile of the data is 84 - 105 mg/L.
NaCl	The 95th percentile of the data must be ≤389 mg/L, as indicated for a D Category river.	The 95th percentile of the data is 311 - 389 mg/L.
CaSO4	The 95th percentile of the data must be ≤1105 mg/L, as indicated for a D Category river.	The 95th percentile of the data is 884 - 1105 mg/L.
Inorganic salts ions		
Sulphate as SO_4	The 95th percentile of the data must be ≤100 mg/L.	The 95th percentile of the data is 80 - 100 mg/L.
Physical variables		
Electrical Conductivity	The 95th percentile of the data must be ≤85 mS/m, *as indicated for a D Category river*.	The 95th percentile of the data is 68 - 85 mS/m.
pH	The 5th percentile of the data must range from 6.5 to 8.0, and the 95th percentile from 6.5 to 8.8.	The 5th percentile of the data is <6.7 and >7.8, and the 95th percentile is <6.7 and >8.6.
Temperature	Largely natural temperature range is expected.	Abundance and frequency of occurrence of highly temperature sensitive species are lower than expected for reference.
Dissolved oxygen	The 5th percentile of the data must be ≥7.0 mg/L.	The 5th percentile of the data is <7.2 mg/L.
Turbidity	Small to moderate changes linked to some erosion in upper and middle catchments.	Check biotic response for habitat-related changes. Continue turbidity monitoring.
Nutrients		
Total Inorganic Nitrogen (TIN-N)	The 50th percentile of the data must be ≤0.25 mg/L.	The 50th percentile of the data is 0.2 - 0.25 mg/L.
PO_4-P	The 50th percentile of the data must be ≤0.015 mg/L.	The 50th percentile of the data is 0.012 - 0.015 mg/L.
Response variables		
Chl-*a* phytoplankton	The 50th percentile of the data must be ≤15 mg/L.	The 50th percentile of the data is 12 - 15 µg/L.
Chl-*a* periphyton	The 50th percentile of the data must be ≤12 mg/m^2.	The 50th percentile of the data is 10 - 12 mg/m^2.
Toxics		
Ammonia (NH_3-N)	The 95th percentile of the data must be ≤0.043 mg/L.	The 95th percentile of the data is 0.034 - 0.043 mg/L.
Fe	The Fe concentration should not vary more than 10% of the background dissolved Fe concentration (TWQR; DWAF, 1996a).	The Fe concentration is varying ≥8% of the background dissolved Fe concentration.
Al	The 95th percentile of the data must be ≤0.055 mg/L (ANZ, 2000 - 2023).	The 95th percentile of the data is 0.044 - 0.055 mg/L.
Pb	The 95th percentile of the data must be ≤0.003 mg/L (ANZ, 2000 - 2023).	The 95th percentile of the data is 0.002 - 0.003 mg/L.
Zn	The 95th percentile of the data must be ≤0.008 mg/L (ANZ, 2000 - 2023).	The 95th percentile of the data is 0.006 - 0.008 mg/L.
Other variables	The 95th percentile of the data must be within the A (or 0) category in DWAF (2008a), or within the AEV as stated in DWAF (1996a) for those variables not in DWAF (2008a).	An impact is expected if the 95th percentile of the data exceeds the A Category range in DWAF (2008a), or the TWQR as stated in DWAF (1996a).

Table 3.6: EWR UP1- Water quality EcoSpecs and TPCs (PES and TEC: A/B)

Water quality metrics	EcoSpecs	TPC
Inorganic salts		
$MgSO_4$	The 95th percentile of the data must be ≤16 mg/L.	The 95th percentile of the data is 13-16 mg/L.
Na_2SO_4	The 95th percentile of the data must be ≤20 mg/L.	The 95th percentile of the data is 16 - 20 mg/L.
$MgCl_2$	The 95th percentile of the data must be ≤15 mg/L.	The 95th percentile of the data is 12 - 15 mg/L.
$CaCl_2$	The 95th percentile of the data must be ≤21 mg/L.	The 95th percentile of the data is 17 - 21 mg/L.
NaCl	The 95th percentile of the data must be ≤45 mg/L.	The 95th percentile of the data is 36 - 45 mg/L.
$CaSO_4$	The 95th percentile of the data must be ≤351 mg/L.	The 95th percentile of the data is 280 - 351 mg/L.
Physical variables		
Electrical Conductivity	The 95th percentile of the data must be ≤30 mS/m.	The 95th percentile of the data is 24 - 30 mS/m.
pH	The 5th percentile of the data must range from 6.5 to 8.0, and the 95th percentile from 6.5 to 8.8.	The 5th percentile of the data is <6.7 and >7.8, and the 95th percentile is <6.7 and >8.6.
Temperature	Largely natural temperature range is expected.	Abundance and frequency of occurrence of temperature sensitive species are lower than expected for reference.
Dissolved oxygen	The 5th percentile of the data must be ≥7.5 mg/L.	The 5th percentile of the data is ≤7.7 mg/L.
Turbidity	Small changes expected.	Some localized gully erosion in the area.
Nutrients		
Total Inorganic Nitrogen (TIN-N)	The 50th percentile of the data must be <0.25 mg/L.	The 50th percentile of the data is 0.2 - 0.25 mg/L
PO_4-P	The 50th percentile of the data must be ≤0.01 mg/L.	The 50th percentile of the data is 0.008 - 0.01 mg/L
Response variables		
Chl-*a* phytoplankton	The 50th percentile of the data must be <10 mg/L.	The 50th percentile of the data is 8 - 10 µg/L
Chl-*a* periphyton	The 50th percentile of the data must be <1.7 mg/m^2.	The 50th percentile of the data is 1.4 - 1.7 mg/m^2
Toxics		
All variables	The 95th percentile of the data must be within the A (or 0) Category in DWAF (2008a), or within the AEV as stated in DWAF (1996a) for those variables not in DWAF (2008a).	An impact is expected if the 95th percentile of the data exceeds the A Category range in DWAF (2008a), or the TWQR as stated in DWAF (1996a).

Table 3.7: EWR AS1- Water quality EcoSpecs and TPCs (PES and TEC: B/C)

Water quality metrics	EcoSpecs	TPC
Inorganic salts		
$MgSO_4$	The 95th percentile of the data must be ≤16 mg/L.	The 95th percentile of the data is 13 - 16 mg/L.
Na_2SO_4	The 95th percentile of the data must be ≤20 mg/L.	The 95th percentile of the data is 16 - 20 mg/L.
$MgCl_2$	The 95th percentile of the data must be ≤15 mg/L.	The 95th percentile of the data is 12 - 15 mg/L.
CaCl2	The 95th percentile of the data must be ≤21 mg/L.	The 95th percentile of the data is 17 - 21 mg/L.
NaCl	The 95th percentile of the data must be ≤45 mg/L.	The 95th percentile of the data is 36 - 45 mg/L.
CaSO4	The 95th percentile of the data must be ≤351 mg/L.	The 95th percentile of the data is 280 - 351 mg/L.
Physical variables		
Electrical Conductivity	The 95th percentile of the data must be ≤30 mS/m.	The 95th percentile of the data is 24 - 30 mS/m.
pH	The 5th percentile of the data must range from 6.5 to 8.0, and the 95th percentile from 6.5 to 8.8.	The 5th percentile of the data is <6.7 and >7.8, and the 95th percentile is <6.7 and >8.6.
Temperature	Largely natural temperature range is expected.	Some temperature sensitive species at lower abundance and frequency of occurrence than expected for reference.
Dissolved oxygen	The 5th percentile of the data must be >7.0 mg/L.	The 5th percentile of the data is ≤7.2 mg/L.
Turbidity	Small changes expected.	Maintain within current range (median: 14.0 NTU).
Nutrients		
Total Inorganic Nitrogen (TIN-N)	The 50th percentile of the data must be ≤0.7 mg/L.	The 50th percentile of the data is 0.6 - 0.7 mg/L
PO_4-P	The 50th percentile of the data must be ≤0.075 mg/L.	The 50th percentile of the data is 0.06 - 0.075 mg/L.
Response variables		
Chl-*a* phytoplankton	The 50th percentile of the data must be ≤20 mg/L.	The 50th percentile of the data is 16 - 20 µg/L
Chl-*a* periphyton	The 50th percentile of the data must be ≤21 mg/m^2.	The 50th percentile of the data is 17 - 21 mg/m^2
Toxics		
Other variables	The 95th percentile of the data must be within the A (or 0) Category in DWAF (2008a), or within the AEV as stated in DWAF (1996a) for those variables not in DWAF (2008a).	An impact is expected if the 95th percentile of the data exceeds the A Category range in DWAF (2008a), or the TWQR as stated in DWAF (1996a).

Table 3.8: EWR NG1- Water quality EcoSpecs and TPCs (PES and TEC: B)

Water quality metrics	EcoSpecs	TPC
Inorganic salts		
$MgSO_4$	The 95th percentile of the data must be ≤16 mg/L.	The 95th percentile of the data is 13 - 16 mg/L.
Na_2SO_4	The 95th percentile of the data must be ≤20 mg/L.	The 95th percentile of the data is 16 - 20 mg/L.
$MgCl_2$	The 95th percentile of the data must be ≤15 mg/L.	The 95th percentile of the data is 12 - 15 mg/L.
CaCl2	The 95th percentile of the data must be ≤21 mg/L.	The 95th percentile of the data is 17 - 21 mg/L.
NaCl	The 95th percentile of the data must be ≤45 mg/L.	The 95th percentile of the data is 36 - 45 mg/L.
CaSO4	The 95th percentile of the data must be ≤351 mg/L.	The 95th percentile of the data is 280 - 351 mg/L.
Physical variables		
Electrical Conductivity	The 95th percentile of the data must be ≤30 mS/m.	The 95th percentile of the data is 24 - 30 mS/m.
pH	The 5th percentile of the data must range from 6.5 to 8.0, and the 95th percentile from 6.5 to 8.4.	The 5th percentile of the data is <6.7 and >7.8, and the 95th percentile is <6.7 and >8.2.
Temperature	Largely natural temperature range is expected.	Some temperature sensitive species at lower abundance and frequency of occurrence than expected for reference.
Dissolved oxygen	The 5th percentile of the data must be >7.0 mg/L.	The 5th percentile of the data is ≤7.2 mg/L.
Turbidity	Small changes expected.	Small increase in sediment supply from cultivated lands and forestry. Maintain within current range (median: 10.7 NTU).
Nutrients		
Total Inorganic Nitrogen (TIN-N)	The 50th percentile of the data must be ≤0.5 mg/L.	The 50th percentile of the data is 0.4 - 0.5 mg/L
PO_4-P	The 50th percentile of the data must be ≤0.075 mg/L.	The 50th percentile of the data is 0.06 - 0.075 mg/L.
Response variables		
Chl-*a* phytoplankton	The 50th percentile of the data must be ≤20 mg/L.	The 50th percentile of the data is 16 - 20 µg/L
Chl-*a* periphyton	The 50th percentile of the data must be ≤21 mg/m^2.	The 50th percentile of the data is 17 - 21 mg/m^2
Toxics		
Other variables	The 95th percentile of the data must be within the A (or 0) Category in DWAF (2008a), or within the AEV as stated in DWAF (1996a) for those variables not in DWAF (2008a).	An impact is expected if the 95th percentile of the data exceeds the A Category range in DWAF (2008a), or the TWQR as stated in DWAF (1996a).

Desktop Ecoclassification and Summary of Wetland Priority

The desktop Ecoclassification for wetlands was conducted for the Delineation and Status Quo Report. Summary results of the PES assessment and wetland prioritization are repeated here to serve as background information, and are shown in Tables in sections below for each secondary catchment where Table headings are as follows:

- **SQ:** The SQ number from the PES/EI/ES study (DWS, 2014a) representing the sub-quaternary catchment.
- **Name:** Name of the River in the SQ if it exists.
- **Wetland PES:** The dominant PES Category of the wetlands within the sub-quaternary catchment.
- **Wetland Ecological Importance (EI):** Obtained from an integration of RAMSAR status, wetland FEPA status, provision of habitats for rare and endangered species (birds, frogs, plants), critical biodiversity areas (Berliner & Desmet, 2007), and wetland extent (area).
- **Wetland Ecological Sensitivity (ES):** Based on natural land cover data within wetlands and within a 100m buffer around wetlands (data from NFEPA; Nel *et al*., 2011 and National Biodiversity Assessment (NBA); Van Deventer *et al.*, 2018).
- **Integrated Environmental Importance (IEI):** Based on a rating from 1 – 5 where 1 is Very Low and 5 is Very High. The IEI considers both the ES and the PES.
- **Water Resource Use Importance (WRUI):** Based on a rating from 0 – 4 where 0 is Very Low and 4 is Very High.
- **Wetland Priority:** This is based on a rating from 1 – 4 where 1 is Low, 2 is Moderate, 3 is High and 4 is Very High, and considers both the IEI and the WRUI. At the SQ level, the wetland priority represents the combined priority of all wetlands in the quinary catchment.

The following Wetland HGM abbreviations are applicable to maps in this Chapter:

- CVB - Channeled valley bottoms.
- DEPR – Depressions.
- FLOOD – Floodplains.
- RIVER – Riverine.
- SEEP – Seeps.
- UVB - Unchanneled valley bottoms.
- EST – Estuary.

W1 Catchment (Main River: Mhlathuze)

The Mhlathuze catchment has roughly 124 000 Ha of wetlands including estuaries and nearly 20 000 Ha if estuaries are excluded. **Figure 4.1** shows the spatial distribution of different wetland HGMs within the catchment. Floodplain wetlands dominate the catchment with a combined area of over 6700 Ha, but unchanneled valley bottoms and riverine and seepage wetlands are also notable in extent covering 3078, 3882 and 4490 Ha respectively. Wetlands named in the National Spatial Biodiversity Assessment (NSBA) within this catchment include the floodplain and swamp system, Umlalazi, Cubhu, Nsezi, Thulazihleka and Mzingazi.

Mzingazi was historically part of the Richard's Bay estuary, but a weir was built between the lake and the connection to the ocean which results in the lake being a freshwater system. The priority of wetlands within the Mhlathuze Catchment, as well as the data which are considered in its determination, are summarised at the sub-quaternary catchment scales in **Table 4.1**. The SQs that have a Very High wetland priority include W12E-03475 (Mhlathuze leading into the Mhlathuze swamp system), W12H-03459 (mostly lower reaches of Nseleni, including Nsezi and portions of the Mhlathuze floodplain), W12J-03450 (Nundwane, mainly Mzingazi), W12J-03392 (Mpisini) and W12J-03403 (extensive channelled valley bottom wetlands leading into Richard's Bay Estuary, and W12J-03411 (Depressions and seeps near the Nlabane estuary).

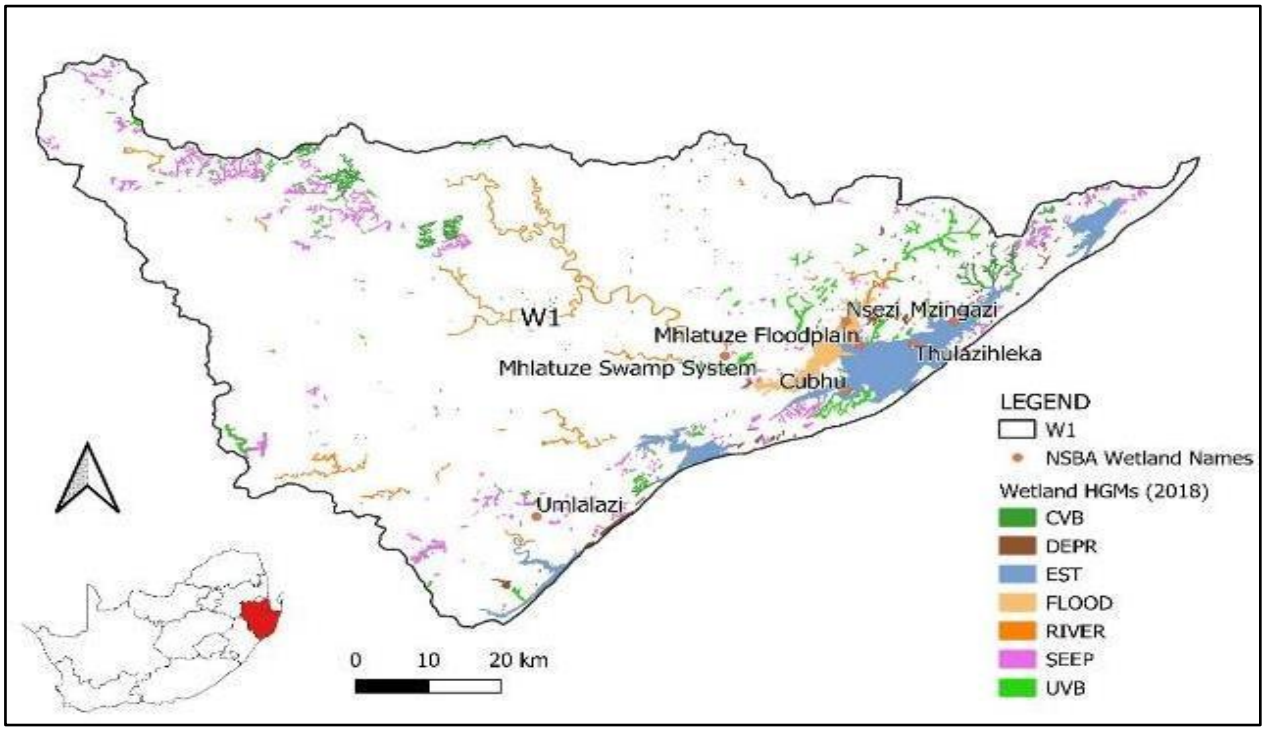

Figure 4.1: The spatial distribution of different HGMs (2018 updated wetland map 5; van Deventer *et al.*, 2018) in the Mhlathuze Catchment (W1) and NSBA named wetlands (data from the NSBA, Driver *et al.*, 2005)

Table 4.1: Summary of wetland PES, EI, ES and IEI, along with WRUI and wetland priority per SQ in the Mhlathuze catchment

SQ	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W11A-03597	Matigulu	**C/D**	VERY HIGH	VERY HIGH	MODERATE	1	1
W11A-03748	uMngwenya	**C**	MODERATE	MODERATE	MODERATE	1	1
W11A-03776	kuMnyameni	**C**	MODERATE	MODERATE	MODERATE	1	1
W11A-03599	Ngoje	**D/E**	HIGH	VERY HIGH	MODERATE	2	2
W11A-03612	Matigulu	**C**	VERY HIGH	HIGH	MODERATE	2	2
W11C-03713	Nyezane	**D**	VERY HIGH	HIGH	MODERATE	2	3
W11C-03917	Nyoni	**D/E**	VERY HIGH	LOW	MODERATE	2	3
W12A-03086	Gologodo	**C**	VERY HIGH	VERY HIGH	HIGH	2	2
W12A-03104	Mhlatuze	**D**	VERY HIGH	VERY HIGH	MODERATE	2	2
W12A-03153	Mhlatuze	**C/D**	VERY HIGH	VERY HIGH	MODERATE	2	2

SQ	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W12A-03226		**D**	VERY HIGH	VERY HIGH	MODERATE	2	2
W12B-03334	Mhlatuze	**C**	VERY HIGH	VERY HIGH	HIGH	1	2
W12B-03356	Mhlatuze	**B/C**	VERY HIGH	VERY HIGH	VERY HIGH	1	2
W12B-03398	Mavungwini	**B/C**	VERY HIGH	VERY HIGH	VERY HIGH	1	2
W12B-03471	Nyawushane	**B/C**	VERY HIGH	VERY HIGH	VERY HIGH		3
W12B-03479	Mhlatuze	**D/E**	VERY HIGH	VERY HIGH	MODERATE	4	3
W12B-03336	KwaMazula	**D/E**	VERY HIGH	VERY HIGH	MODERATE	1	1
W12C-03189	Mfule	**D**	VERY HIGH	HIGH	MODERATE	2	2
W12C-03225	Mfule	**C**	VERY HIGH	VERY HIGH	HIGH	2	2
W12C-03232	Nhlozane	**B**	VERY HIGH	LOW	HIGH	2	2
W12C-03263	Mfulazane	**C/D**	VERY HIGH	VERY HIGH	MODERATE	2	2
W12C-03303	Mfule	**B/C**	VERY HIGH	LOW	MODERATE	2	2
W12D-03346	Ntambanana	**C**	VERY HIGH	VERY HIGH	HIGH		3
W12D-03375	Mhlatuze	**C/D**	VERY HIGH	VERY HIGH	MODERATE	4	3
W12D-03388	Mhlatuze	**E**	VERY HIGH	VERY HIGH	MODERATE	4	3
W12E-03475	Mhlatuze	**C**	VERY HIGH	VERY HIGH	HIGH	4	4
W12E-03526	Mhtatuzana	**C**	VERY HIGH	VERY HIGH	HIGH		1
W12E-03530	Mateku	**D**	VERY HIGH	VERY HIGH	MODERATE		1
W12E-03558	Mhlatuzana	**B**	VERY HIGH	VERY HIGH	VERY HIGH		2
W12G-03229	Nseleni	**D**	HIGH	VERY HIGH	MODERATE	4	3
W12H-03289	Mbabe	**C/D**	VERY HIGH	VERY HIGH	MODERATE	4	3
W12H-03316	Mposa	**D**	VERY HIGH	VERY HIGH	MODERATE	4	3
W12H-03401	Okula	**E**	VERY HIGH	VERY HIGH	MODERATE	4	3
W12H-03418	Nseleni	**C**	VERY HIGH	VERY HIGH	HIGH	4	3
W12H-03428	Mbabe	**D**	VERY HIGH	VERY HIGH	MODERATE	4	3
W12H-03459	Nseleni	**C**	VERY HIGH	VERY HIGH	HIGH	4	4
W12F-03611	Mzingwenya	**D**	VERY HIGH	VERY HIGH	MODERATE	4	3
W12J-03290	Nhlabane	**C/D**	VERY HIGH	VERY HIGH	MODERATE	4	3
W12J-03411		**C**	VERY HIGH	VERY HIGH	HIGH	4	4
W12J-03493		**C**	VERY HIGH	VERY HIGH	HIGH	4	3
W12J-03501	Kondweni	**C/D**	VERY HIGH	VERY HIGH	MODERATE	4	3
W12J-03392	Mpisini	**C**	VERY HIGH	VERY HIGH	HIGH	4	4
W12J-03403		**C**	VERY HIGH	VERY HIGH	HIGH	4	4
W12J-03450	Nundwane	**C**	VERY HIGH	VERY HIGH	HIGH	4	4
W13A-03583	Mlalazi	**C**	HIGH	VERY HIGH	MODERATE	2	2
W13A-03609	Mlalazi	**C/D**	VERY HIGH	VERY HIGH	MODERATE	2	3
W13A-03641	Mkukuze	**C**	VERY HIGH	VERY HIGH	HIGH	2	2
W13B-03593	KwaGugushe	**C**	VERY HIGH	VERY HIGH	HIGH	2	3
W13B-03774	Manzamnyama	**B**	VERY HIGH	VERY HIGH	VERY HIGH	1	2
W12F-03494	Mhlatuze	**D/E**	VERY HIGH	VERY HIGH	MODERATE		1

W2 Catchment (Main River: UMfolozi)

The UMfolozi catchment has roughly 90 000 Ha of wetlands including estuaries and just over 66 100 Ha, if estuaries are excluded. **Figure 4.2** shows the spatial distribution of different wetland HGMs within the catchment. Riverine and seepage wetlands dominate the catchment

with a total area each of nearly 32300 Ha and 26072 Ha respectively. Wetlands named in the NSBA within this catchment include the Bloemveld Vlei, Stilwater Vlei, Grootgewaagd Vlei, Lenjani Vlei, Aloeboom Vlei, the Fuyeni Reedbed, Mvamazi Pan, UMfolozi, Lake Teza, Collin's Lake, Mavuya Pan, Mfuthululu and the Umfolozi Swamp. The SQs that have a Very High wetland priority include W21G-02885, W21H-02897 and W21H-03004 (mainly the White Mfolozi, and mainly because PES is B and WRUI is high) (**Table 4.2**).

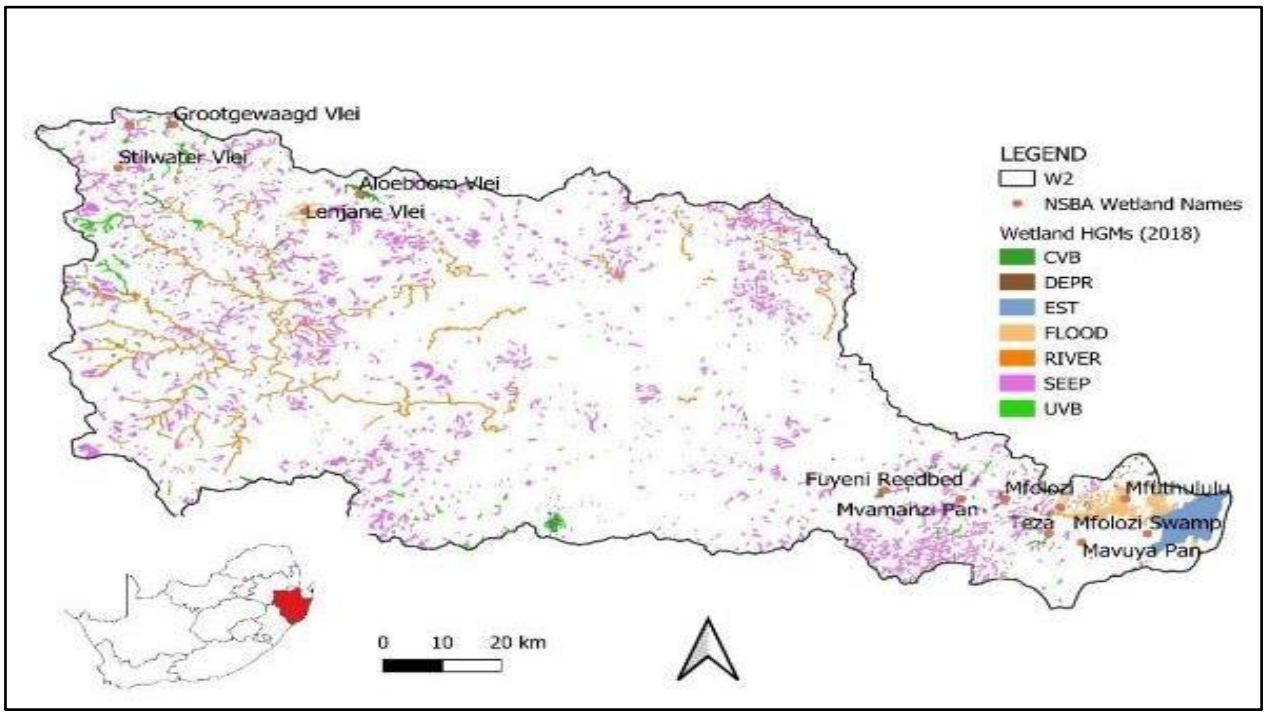

Figure 4.2: The spatial distribution of different HGMs (2018 updated wetland map 5; van Deventer *et al.*, 2018) in the UMfolozi Catchment (W2) and NSBA named wetlands (data from the NSBA, Driver *et al.*, 2005)

Table 4.2: Summary of wetland PES, EI, ES and IEI, along with WRUI and wetland priority per SQ in the UMfolozi catchment

SQ / RU	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W21A-02512	aMagoda	**C/D**	VERY HIGH	VERY HIGH	MODERATE	2	3
W21A-02527	White Mfolozi	**C/D**	VERY HIGH	HIGH	MODERATE	2	3
W21B-02539	iShoba	**C**	VERY HIGH	HIGH	MODERATE	2	3
W21B-02546	White Mfolozi	**B/C**	VERY HIGH	MODERATE	MODERATE	2	3
W21B-02603	Lenjane	**B/C**	VERY HIGH	HIGH	HIGH	2	3
W21B-02652	White Mfolozi	**B**	VERY HIGH	HIGH	VERY HIGH	2	3
W21B-02670	White Mfolozi	**B**	VERY HIGH	HIGH	VERY HIGH	2	3
W21C-02599	Sandspruit	**B**	VERY HIGH	VERY HIGH	VERY HIGH	1	3
W21F-02727	White Mfolozi	**B/C**	VERY HIGH	HIGH	HIGH	1	2
W21D-02676	Mvunyane	**C/D**	VERY HIGH	HIGH	MODERATE	1	1
W21D-02788	Vumankala	**C/D**	VERY HIGH	HIGH	MODERATE	1	1
W21D-02815	Mvunyane	**B/C**	VERY HIGH	HIGH	HIGH	1	2
W21D-02832	Jojosi	**C/D**	VERY HIGH	HIGH	MODERATE	1	1
W21D-02848	Jojosi	**C/D**	VERY HIGH	HIGH	MODERATE	1	1
W21E-02873	Nondweni	**B/C**	VERY HIGH	HIGH	HIGH	1	2

SQ / RU	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W21E-02912	Nondweni	**C/D**	VERY HIGH	VERY HIGH	MODERATE	1	1
W21E-02934	Vuwankala	**C**	VERY HIGH	MODERATE	MODERATE	1	1
W21E-02953	Ngwebini	**D**	VERY HIGH	VERY HIGH	MODERATE	1	1
W21E-02963	Nondweni	**C/D**	VERY HIGH	VERY HIGH	MODERATE	1	1
W21F-02840	Mvunyane	**B/C**	VERY HIGH	HIGH	HIGH	3	3
W21G-02851	White Mfolozi	**B/C**	VERY HIGH	HIGH	HIGH	3	3
W21G-02885	White Mfolozi	**B**	VERY HIGH	HIGH	VERY HIGH	3	4
W21G-02914	Ntinini	**B/C**	VERY HIGH	MODERATE	HIGH	3	3
W21G-02929	Nsubeni	**B/C**	VERY HIGH	MODERATE	HIGH	3	3
W21G-03067		**E**	VERY HIGH	HIGH	MODERATE	3	3
W21G-03085	Ntinini	**D**	VERY HIGH	HIGH	MODERATE	3	3
W21H-02889	Mhlahlane	**C**	VERY HIGH	HIGH	MODERATE	3	3
W21H-02897	White Mfolozi	**B**	VERY HIGH	MODERATE	VERY HIGH	3	4
W21H-03004	White Mfolozi	**B**	VERY HIGH	MODERATE	VERY HIGH	3	4
W21J-03018	Maphophoma	**D**	VERY HIGH	MODERATE	LOW	1	1
W21J-03030	White Mfolozi	**C**	VERY HIGH	MODERATE	MODERATE	1	1
W21J-03036	Mpembeni	**B**	VERY HIGH	MODERATE	HIGH	1	2
W21J-03050	Mpembeni	**B**	VERY HIGH	LOW	HIGH	1	2
W21J-03066	Mpembeni	**B/C**	VERY HIGH	MODERATE	MODERATE	1	1
W21J-03075	Mkumbane	**B**	VERY HIGH	HIGH	VERY HIGH	1	2
W21J-03112	Mzinhlanga	**C**	VERY HIGH	MODERATE	MODERATE	1	1
W21K-02976	Mbilane	**C/D**	VERY HIGH	MODERATE	MODERATE	1	1
W21K-02981	White Mfolozi	**C**	VERY HIGH	MODERATE	MODERATE	1	1
W21K-03019	Nhlungwane	**B**	VERY HIGH	MODERATE	VERY HIGH	1	2
W21K-03080	White Mfolozi	**C**	VERY HIGH	HIGH	MODERATE	1	1
W21L-03041	White Mfolozi	**B**	VERY HIGH	MODERATE	HIGH	1	2
W21L-03059	White Mfolozi	**B**	HIGH	MODERATE	HIGH	1	2
W21L-03161	Munywana	**B/C**	HIGH	MODERATE	MODERATE	1	1
W21L-03163	Munywana	**B**	HIGH	LOW	HIGH	1	2
W21L-03176	Mayayeni	**B**	VERY HIGH	MODERATE	HIGH	1	2
W22A-02586	Black Mfolozi	**C**	VERY HIGH	VERY HIGH	HIGH	2	3
W22A-02587	Mgobhozi	**C**	VERY HIGH	VERY HIGH	HIGH	2	3
W22A-02591		**C/D**	VERY HIGH	VERY HIGH	MODERATE	2	3
W22A-02596	Black Mfolozi	**C**	VERY HIGH	VERY HIGH	HIGH	2	3
W22A-02610	Black Mfolozi	**C**	VERY HIGH	HIGH	MODERATE	2	2
W22B-02661	Hlonyana	**C**	VERY HIGH	HIGH	MODERATE	2	2
W22B-02662	KwaMbizankulu	**C**	VERY HIGH	HIGH	MODERATE	2	2
W22B-02706	Hlonyane	**B/C**	VERY HIGH	MODERATE	MODERATE	2	2
W22B-02728	Hlonyane	**B**	VERY HIGH	MODERATE	HIGH	2	2
W22B-02773	Hlangabende	**C**	VERY HIGH	VERY HIGH	HIGH	2	2
W22C-02688	Black Mfolozi	**C**	VERY HIGH	HIGH	MODERATE	1	1
W22D-02795	iThaka	**C**	VERY HIGH	HIGH	MODERATE	1	1
W22F-02722	Black Mfolozi	**C/D**	VERY HIGH	HIGH	MODERATE	0	1
W22E-02595		**C**	VERY HIGH	HIGH	MODERATE	2	2
W22E-02601	Bululwana	**C/D**	VERY HIGH	HIGH	MODERATE	2	2
W22E-02605	Sikwebezi	**C**	VERY HIGH	HIGH	MODERATE	2	2
W22E-02702	Sikwebezi	**C/D**	VERY HIGH	HIGH	MODERATE	2	2
W22F-02726	Sikwebezi	**C**	VERY HIGH	HIGH	MODERATE	2	2
W22F-02748	Black Mfolozi	**C**	VERY HIGH	MODERATE	MODERATE	2	2
W22G-02624	Vuna	**B/C**	VERY HIGH	MODERATE	HIGH	2	2

SQ / RU	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W22H-02846	Black Mfolozi	**B/C**	VERY HIGH	LOW	HIGH	2	2
W22H-02844	Mbhekamuzi	**C**	VERY HIGH	MODERATE	MODERATE	1	1
W22J-02807	Black Mfolozi	**C/D**	VERY HIGH	MODERATE	MODERATE	1	1
W22J-02817	Black Mfolozi	**B/C**	VERY HIGH	MODERATE	HIGH	1	2
W22J-02910	Black Mfolozi	**B/C**	VERY HIGH	MODERATE	HIGH	1	2
W22J-02918	Wela	**C**	VERY HIGH	MODERATE	MODERATE	1	1
W22J-02942	Mvalo	**C/D**	VERY HIGH	MODERATE	MODERATE	1	1
W22K-02622		**C**	VERY HIGH	MODERATE	MODERATE		1
W22K-02629	Mona	**C**	VERY HIGH	MODERATE	MODERATE	1	1
W22K-02636	Manzimakulu	**C**	VERY HIGH	MODERATE	MODERATE	1	1
W22K-02761	Mapopoma	**B**	VERY HIGH	MODERATE	VERY HIGH	1	2
W22K-02783	Mona	**B**	VERY HIGH	LOW	VERY HIGH	1	2
W22L-02916	Black Mfolozi	**B**	VERY HIGH	HIGH	VERY HIGH	1	2
W23A-03058	Mbukwini	**C/D**	VERY HIGH	VERY HIGH	MODERATE	1	1
W23A-03083	Mfolozi	**C**	VERY HIGH	VERY HIGH	HIGH	1	2
W23A-03098	Nkatha	**C/D**	VERY HIGH	VERY HIGH	MODERATE	1	1
W23A-03113	Mfolozi	**C/D**	VERY HIGH	VERY HIGH	MODERATE	1	1
W23A-03149	Mfolozi	**B/C**	MODERATE	VERY HIGH	MODERATE	1	1
W23A-03160	Mvamanzi	**C/D**	VERY HIGH	VERY HIGH	MODERATE	1	3
W23B-03222	Msunduzi	**C**	VERY HIGH	VERY HIGH	HIGH	0	1
W23B-03250	Ntobozi	**D**	VERY HIGH	VERY HIGH	MODERATE	0	1
W23B-03231	Msunduzi	**D**	VERY HIGH	VERY HIGH	MODERATE	4	3
W23C-03180	Msunduzi	**E**	VERY HIGH	VERY HIGH	MODERATE	4	3
W23C-03254	Mavuya	**D**	VERY HIGH	VERY HIGH	MODERATE	4	3
W23C-03272	Ntenja	**E**	VERY HIGH	VERY HIGH	MODERATE	4	3
W23C-03287	Mavuya	**D**	VERY HIGH	VERY HIGH	MODERATE	4	3
W23D-03108	Mfolozi	**E**	VERY HIGH	VERY HIGH	MODERATE	4	3

W3 Catchment (Main River: Mkuze)

The Mkuze catchment has over 1 000 000 Ha of wetlands including estuaries but almost 33 000 Ha if estuaries are excluded. **Figure 4.3** shows the spatial distribution of different wetland HGMs within the catchment. Floodplains and depressional wetlands dominate the catchment with a total area each of 11844 Ha and 9484 Ha respectively. Wetlands named in the NSBA within this catchment include Enseleni, Nyalazi, the Makhakathana Flats, Hluhluwe River Vlei, Bushlands Pan, the Hluhluwe Floodplain, the Mkuze Floodplain and Swamp System, Ku Ndlebeni, Nhlonhlela Pan, Hlonhlela, Mkuze Airstrip Pans, Nsumo Pan, Neshe, Muzi (South), Tshanetshe, Ntshangwe Lake, Mpanze Pan, Yengweni, Mdlaze Pan, StLucia-Manzibomvu, Mhlazi Pan, St Lucia-Siphudwini, Siphudwini, Mfula Pan and St Lucia-Mbazwana. The RUs that have a Very High wetland priority include W31-1 (Mkuze), W31-4 (Mkuze including Nhlnhlela Pan), W31-5 (Mkuze), W31-6 (Nsumu), W32-1 (Mkuze), W33-7 (Hluhluwe, Nyalazi and Mpate, including Nyalazi, Bushlands Pan and Hluhluwe River Vlei) and the St Lucia RU (**Table 4.3**).

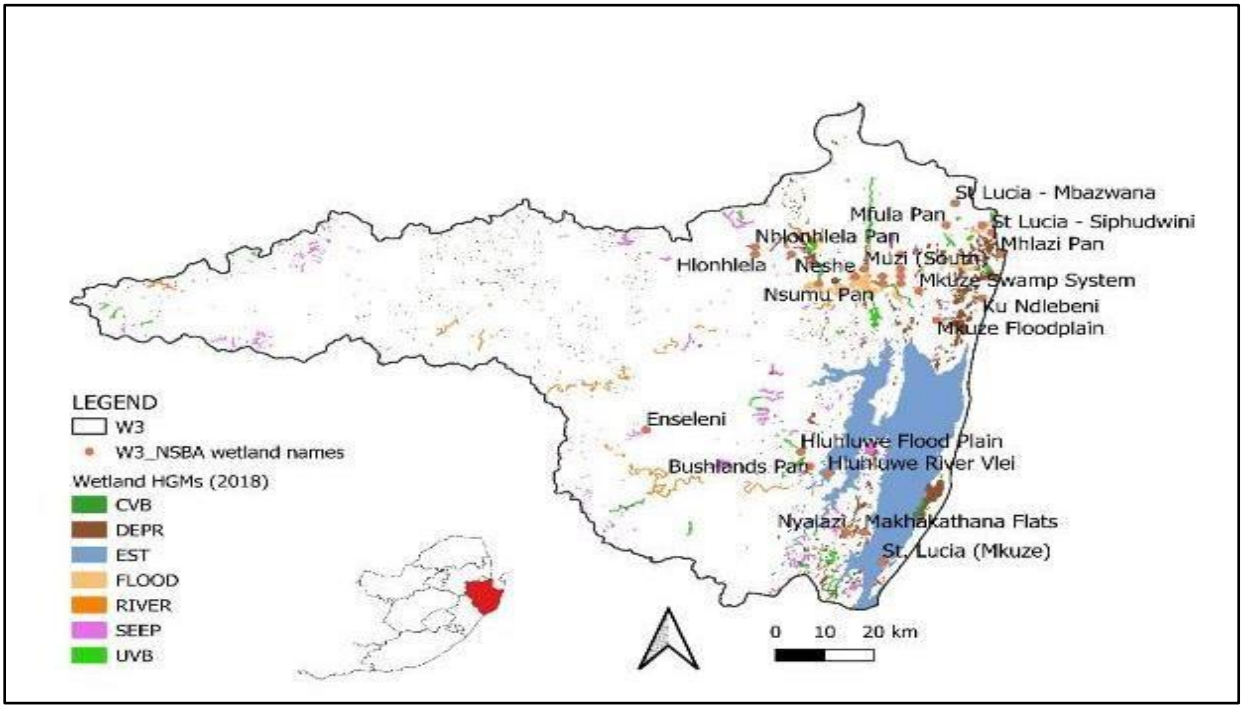

Figure 4.3: The spatial distribution of different HGMs (2018 updated wetland map 5; van Deventer *et al.*, 2018) in the Mkuze Catchment (W3) and NSBA named wetlands (data from the NSBA, Driver *et al.*, 2005)

Table 4.3: Summary of wetland PES, EI, ES and IEI, along with WRUI and wetland priority per SQ in the Mkuze catchment

SQ	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W31A-02494	Nkongolwana	**E**	VERY HIGH	VERY HIGH	MODERATE	2	2
W31A-02534	Mkuze	**B/C**	VERY HIGH	VERY HIGH	VERY HIGH	2	3
W31B-02477	Mkuze	**C**	VERY HIGH	HIGH	MODERATE	2	2
W31C-02556	Sihlengeni	**C**	VERY HIGH	VERY HIGH	HIGH	2	2
W31D-02436	Manzimhlope	**C/D**	VERY HIGH	HIGH	MODERATE	2	2
W31D-02450	Ntutshe	**C/D**	VERY HIGH	HIGH	MODERATE	2	2
W31D-02495	Mkuze	**C/D**	VERY HIGH	LOW	LOW	2	1
W31D-02500	Mkuze	**B**	VERY HIGH	LOW	HIGH	2	2
W31E-02456	Mkuze	**C/D**	VERY HIGH	LOW	LOW	3	2
W31F-02530	Nkunzana	**C/D**	VERY HIGH	LOW	LOW	3	2
W31F-02555	Nkunzana	**D/E**	VERY HIGH	HIGH	MODERATE	3	3
W31F-02573	Mpuphisi	**B**	VERY HIGH	LOW	HIGH	3	3
W31G-02455	Mtiki	**C/D**	MODERATE	LOW	LOW	3	2
W31G-02506	Mkuze	**C/D**	MODERATE	LOW	LOW	3	2
W31G-02425	Mkuze	**C**	VERY HIGH	MODERATE	MODERATE	3	3
W31H-02514	KwaSekane	**B/C**	MODERATE	HIGH	MODERATE	3	3
W31J-02469	Mkuze	**B**	HIGH	HIGH	VERY HIGH	3	4
W31J-02501	Nhlohlela	**B**	HIGH	LOW	HIGH	3	3
W31J-02343	Mthambalala	**C**	VERY HIGH	MODERATE	MODERATE	0	1
W31J-02406	Ndlamyane	**C/D**	VERY HIGH	HIGH	MODERATE	0	1
W31J-02480	Mkuze	**B/C**	VERY HIGH	MODERATE	HIGH	0	1
W31J-02509	Mkuze	**B**	VERY HIGH	HIGH	VERY HIGH	0	2
W31K-02568	Msunduzi	**C**	VERY HIGH	MODERATE	MODERATE	0	1

SQ	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W31K-02582	Ntweni	**C/D**	VERY HIGH	LOW	MODERATE	0	1
W31K-02611	Msebe	**B**	VERY HIGH	LOW	VERY HIGH	0	2
W31K-02617	Mduna	**D**	VERY HIGH	LOW	MODERATE	0	1
W31L-02525		**B**	VERY HIGH	HIGH	VERY HIGH	0	2
W31L-02528	Masundwini	**B**	VERY HIGH	MODERATE	VERY HIGH	0	2
W31L-02551	Nsumu	**B**	VERY HIGH	HIGH	VERY HIGH	0	2
W31L-02553	Nsumu	**D**	VERY HIGH	MODERATE	MODERATE	0	1
W31L-02563	Nsumu	**B**	VERY HIGH	HIGH	VERY HIGH	0	2
W31L-02569	Msunduzi	**B**	VERY HIGH	HIGH	VERY HIGH	0	2
W32A-02345	Neshe	**C**	VERY HIGH	HIGH	MODERATE	0	1
W32A-02557	Mkuze	**B/C**	VERY HIGH	HIGH	HIGH	0	1
W32B-02476	Khobeyane	**B**	VERY HIGH	HIGH	VERY HIGH	0	2
W32B-02535	Mkuze	**C**	VERY HIGH	MODERATE	MODERATE	0	3
W32D-02720	Wela	**B/C**	VERY HIGH	LOW	HIGH	1	2
W32D-02811	Nzimane	**C**	VERY HIGH	MODERATE	MODERATE	1	1
W32E-02765	Mansiya	**C**	VERY HIGH	LOW	MODERATE	1	1
W32E-02779	Nzimane	**B/C**	VERY HIGH	LOW	HIGH	1	2
W32E-02797	Manzabomvu	**D**	VERY HIGH	MODERATE	MODERATE	1	1
W32E-02859	Nzimane	**B**	VERY HIGH	LOW	VERY HIGH	1	2
W32E-02865	Hluhluwe	**B**	VERY HIGH	LOW	VERY HIGH	1	2
W32E-02887	Hluhluwe	**B/C**	VERY HIGH	LOW	HIGH	1	2
W32G-02946	Sikhathula	**C/D**	VERY HIGH	VERY HIGH	MODERATE	0	1
W32G-02973	Nyalazi	**B**	VERY HIGH	VERY HIGH	VERY HIGH	0	2
W32G-02943	Hlazane	**C**	VERY HIGH	VERY HIGH	HIGH	2	2
W32G-02980	Mnyaba	**D**	VERY HIGH	VERY HIGH	MODERATE	2	2
W32G-02986	Hlazane	**D**	VERY HIGH	VERY HIGH	MODERATE	2	2
W32G-03006	Nyalazi	**D/E**	VERY HIGH	VERY HIGH	MODERATE	2	2
W32G-03055	Nyalazi	**C**	VERY HIGH	VERY HIGH	HIGH	2	2
W32G-03102	Nsane	**D**	VERY HIGH	VERY HIGH	MODERATE	2	2
W32C-02671	Mzinene	**B**	VERY HIGH	MODERATE	HIGH	2	3
W32C-02684	Ngweni	**C/D**	VERY HIGH	HIGH	MODERATE	2	2
W32C-02721	Mzinene	**C**	VERY HIGH	MODERATE	MODERATE	2	2
W32C-02749	Mzinene	**C**	VERY HIGH	HIGH	MODERATE	2	3
W32C-02612	Munywana	**B**	VERY HIGH	MODERATE	HIGH	0	1
W32C-02634	Mhlosinga	**C**	VERY HIGH	MODERATE	MODERATE	0	1
W32F-02835	Hluhluwe	**D/E**	VERY HIGH	VERY HIGH	MODERATE	3	3
W32H-02854	Nyalazi	**C/D**	VERY HIGH	VERY HIGH	MODERATE	3	3
W32H-02998	Mpate	**B**	VERY HIGH	VERY HIGH	VERY HIGH	3	4
W31J-02497	Ndlamyane	**B**	VERY HIGH	MODERATE	VERY HIGH		2
W32B-02429	Mbazwana	**C**	VERY HIGH	HIGH	MODERATE		1
W32B-02462	Siphudwini	**C**	VERY HIGH	HIGH	MODERATE		3
W32B-02467	Mbazwana	**B**	VERY HIGH	HIGH	VERY HIGH		2
W32B-02489		**B/C**	VERY HIGH	HIGH	HIGH		1

W4 Catchment (Main River: Pongola - excluding Eswatini)

The Pongola catchment has over 113 000 Ha of wetlands. **Figure 4.4** shows the spatial distribution of different wetland HGMs within the catchment. Riverine wetlands dominate the catchment with a total area of 61752 Ha, but channelled valley bottoms and floodplains are also high with 20759 Ha and 17660 Ha respectively. Wetlands named in the NSBA within this catchment include Balamhlanga, the Pongola Floodplain, Msenyeni Pan, Mtoti Pan, Tete Pan, Khanganzeni Pan, Shalala Pans, Nhlole Pan, Bumbe Pan, Mandlankunzi Pan and the Ndumo Game Reserve wetlands (a Ramsar site). The Pongola catchment also contains two thermal springs, Natal Spa and Swaelfontein, a sulphur spring. The RUs that have a Very High wetland priority include W41-1 (Bivane) and W43-1 (Ngwavuma [Ndumo]). An unexpected outcome of the process is that the Pongola floodplain has a High priority and not Very High. This is mainly due to poor ecological state (PES is mainly C/D, D or worse) even though ecological importance and WRUI are high (**Table 4.4**).

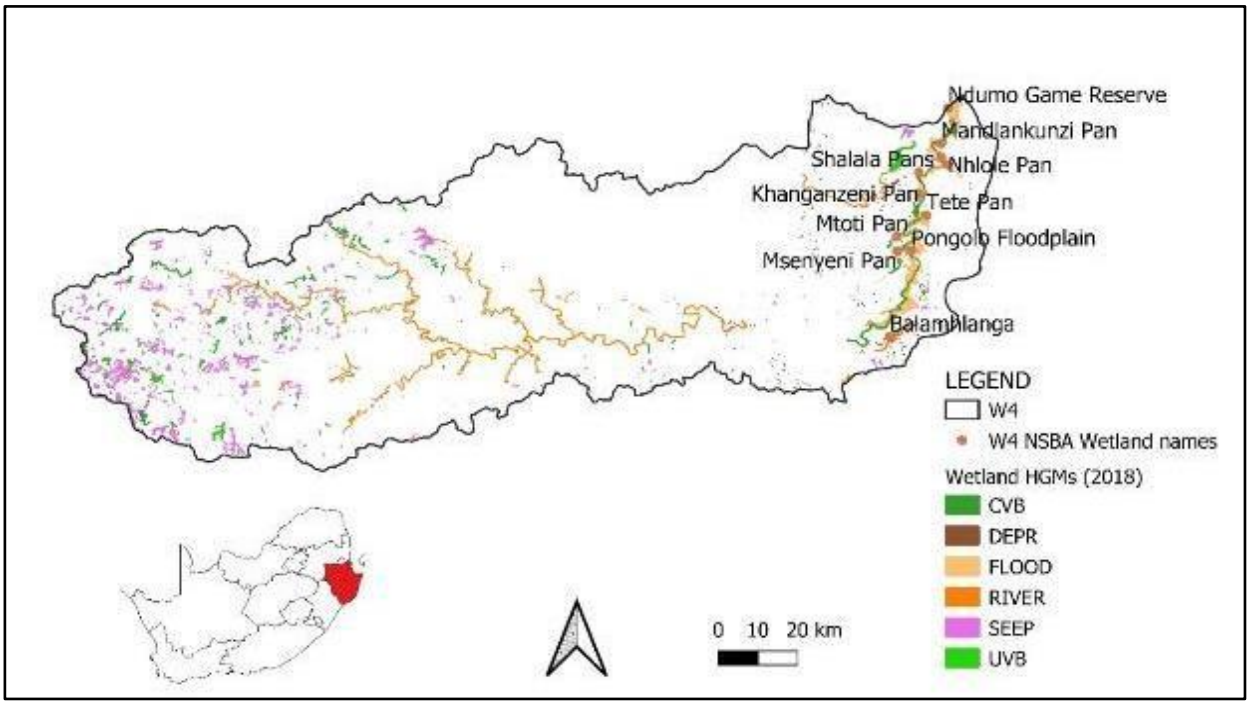

Figure 4.4: The spatial distribution of different HGMs (2018 updated wetland map 5; van Deventer *et al.*, 2018) in the Pongola Catchment (W4) and NSBA named wetlands (data from the NSBA, Driver *et al.*, 2005)

Table 4.4: Summary of wetland PES, EI, ES and IEI, along with WRUI and wetland priority per SQ in the Pongola catchment

SQ	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W41A-02372	Bivane	**B/C**	VERY HIGH	HIGH	HIGH	3	3
W41B-02401	uBivanyana	**C/D**	HIGH	HIGH	MODERATE	3	3
W41B-02427	Bivane	**D**	VERY HIGH	HIGH	MODERATE	3	3
W41B-02431	Bivane	**B**	MODERATE	HIGH	VERY HIGH	3	4
W41B-02434	Soetmelks	**C/D**	VERY HIGH	HIGH	MODERATE	3	3
W41C-02437	Mpemvana	**C/D**	VERY HIGH	VERY HIGH	MODERATE	3	3
W41D-02373	Bivane	**D/E**	VERY HIGH	HIGH	MODERATE	3	3

SQ	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W41D-02435	iNxwayi	**C**	HIGH	HIGH	MODERATE	3	3
W41E-02359	Bivane	**D/E**	VERY HIGH	MODERATE	MODERATE	3	3
W41F-02433	Manzana	**D**	HIGH	MODERATE	LOW	1	1
W41F-02454	Manzana	**D**	VERY HIGH	HIGH	MODERATE	1	1
W41F-02461	KwaCeba	**C**	HIGH	HIGH	MODERATE	1	1
W41F-02481	Manzana	**C/D**	MODERATE	HIGH	LOW	1	1
W41F-02502		**D**	MODERATE	HIGH	LOW	1	1
W42A-02261	Phongolo	**B/C**	VERY HIGH	HIGH	HIGH	3	3
W42A-02328	Pandana	**C/D**	VERY HIGH	HIGH	MODERATE	3	3
W42B-02268	Phongolo	**C/D**	VERY HIGH	HIGH	MODERATE	3	3
W42B-02271	Phongolo	**C/D**	VERY HIGH	VERY HIGH	MODERATE	3	3
W42B-02315	Tsakwe	**C**	HIGH	HIGH	MODERATE	3	3
W42B-02325	Tsakwe	**D**	VERY HIGH	HIGH	MODERATE	3	3
W42B-02331	Bazangoma	**D**	VERY HIGH	HIGH	MODERATE	3	3
W42C-02205	Ntombe	**C/D**	VERY HIGH	HIGH	MODERATE	3	3
W42D-02251	Phongolo	**C/D**	VERY HIGH	HIGH	MODERATE	2	2
W42D-02327		**C**	VERY HIGH	HIGH	MODERATE	2	2
W42E-02221	Phongolo	**C**	VERY HIGH	HIGH	MODERATE	2	2
W42F-02185	Wit	**D**	VERY HIGH	HIGH	MODERATE	2	2
W42G-02317	Phongolo	**B**	VERY HIGH	HIGH	VERY HIGH	2	3
W41G-02379	Bivane	**D**	VERY HIGH	MODERATE	LOW	2	1
W42H-02382	Phongolo	**B**	VERY HIGH	VERY HIGH	VERY HIGH	2	3
W42H-02394	iThalu	**B**	VERY HIGH	VERY HIGH	VERY HIGH	2	3
W42H-02411	iThalu	**B/C**	VERY HIGH	VERY HIGH	VERY HIGH	2	3
W42H-02428	Mbizane	**B**	VERY HIGH	VERY HIGH	VERY HIGH	2	3
W42J-02353	Phongolo	**B**	VERY HIGH	VERY HIGH	VERY HIGH	2	3
W42J-02378	Phongolo	**B**	VERY HIGH	VERY HIGH	VERY HIGH	2	3
W42J-02397	Mhulumbela	**B/C**	VERY HIGH	VERY HIGH	VERY HIGH	2	3
W42K-02148	Mozana	**C**	VERY HIGH	HIGH	MODERATE	2	2
W42K-02242		**B/C**	VERY HIGH	HIGH	HIGH	2	2
W42K-02272	Mozana	**B**	HIGH	LOW	HIGH	2	2
W42L-02270	Mozana	**B**	VERY HIGH	MODERATE	HIGH	2	2
W42M-02269	Mtokotshwala	**D/E**	VERY HIGH	MODERATE	LOW	2	1
W42M-02294	Spekboom	**D**	VERY HIGH	MODERATE	LOW	2	1
W42M-02352	Phongolo	**B**	VERY HIGH	MODERATE	HIGH	2	2
W43F-02013	uMsunduzi	**D**	VERY HIGH	HIGH	MODERATE	0	1
W43F-02053		**D/E**	VERY HIGH	HIGH	MODERATE	0	3
W43F-02072	Ngwavuma	**C/D**	VERY HIGH	HIGH	MODERATE	0	1
W43F-02076	Msunduzi	**E/F**	VERY HIGH	HIGH	MODERATE	0	1
W43F-02089	Ngwavuma	**D**	VERY HIGH	HIGH	MODERATE	0	1
W43F-02099	Ngwavuma	**C**	VERY HIGH	HIGH	MODERATE	0	1
W43F-02104	Mnvoni	**B/C**	VERY HIGH	HIGH	HIGH	0	1
W43F-02107		**C/D**	VERY HIGH	HIGH	MODERATE	0	1
W43F-02113	Ngwavuma	**D**	VERY HIGH	HIGH	MODERATE	0	1
W43F-02142		**B**	VERY HIGH	HIGH	VERY HIGH	0	2
W43F-02159	Ngwavuma	**C**	VERY HIGH	HIGH	MODERATE	0	1
W44A-02332	Phongolo	**C**	VERY HIGH	MODERATE	MODERATE	4	3
W44A-02386	Phongolo	**D/E**	VERY HIGH	MODERATE	LOW	4	3

SQ	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W44A-02389	Voyizana	**E**	VERY HIGH	HIGH	MODERATE	4	3
W44A-02410	Mdlavenga	**D**	VERY HIGH	MODERATE	LOW	4	3
W44B-02248	Manzawakho	**E**	VERY HIGH	MODERATE	LOW	4	3
W44B-02351	Phongolo	**E**	VERY HIGH	MODERATE	LOW	4	3
W44C-02338	Phongolo	**E**	VERY HIGH	MODERATE	LOW	4	3
W44D-02304	Phongolo	**D**	VERY HIGH	MODERATE	LOW	4	3
W45A-02216	Zibayeni	**C/D**	VERY HIGH	HIGH	MODERATE	4	3
W45A-02245	Zibayeni	**D**	VERY HIGH	HIGH	MODERATE	4	3
W45A-02246	Phongolo	**D**	VERY HIGH	HIGH	MODERATE	4	3
W45A-02256	Lubambo	**C/D**	VERY HIGH	HIGH	MODERATE	4	3
W45A-02275	Mpontshane	**D**	VERY HIGH	HIGH	MODERATE	4	3
W45A-02282	Phongolo	**D**	VERY HIGH	HIGH	MODERATE	4	3
W45A-02285	Mpontshane	**C/D**	VERY HIGH	HIGH	MODERATE	4	3
W45A-02310	Mangqwashi	**D/E**	VERY HIGH	HIGH	MODERATE	4	3
W45A-02316	Mfongosi	**C**	VERY HIGH	HIGH	MODERATE	4	3
W45A-02356	Mlambo	**C**	VERY HIGH	HIGH	MODERATE	4	3
W45A-02367	Phongolo	**C/D**	VERY HIGH	HIGH	MODERATE	4	3
W45A-02368	Phongolo	**D/E**	VERY HIGH	HIGH	MODERATE	4	3
W45B-02029	Phongolo	**D**	VERY HIGH	HIGH	MODERATE	4	3
W45B-02105	Phongolo	**D**	VERY HIGH	HIGH	MODERATE	4	3

W5 Catchment (Main River: Usutu - excluding Eswatini)

The Usutu catchment has roughly 80 100 Ha of wetlands. **Figure 4.5** shows the spatial distribution of different wetland HGMs within the catchment. Channelled valley bottoms dominate the catchment with a total area of over 33081 Ha, but seepage wetlands, depressions and floodplains are also notable in extent covering 16814, 11266 and 12934 Ha respectively. Wetlands named in the NSBA within this catchment include Banzi Pan, Shokwe Pan, Upper Black Umfolozi, Langfontein Pan 3, Coalbank, Liefgekozen, Lake Chrissie and several other Lake Chrissie pans, Tweelingpan, Wets Tweelingpan, Lake Banagher and several other Lake Banagher pans, Van Aardt Kaalpan, Blinkpan, Hamilton, Neethlingpan, Grasdal, Florence, Blaauwater, Lusthop Pan 18, Tevreden and Tevrede se pan 16. The RUs that have a Very High wetland priority include W51-2 (Boesmanspruit and Assegaai), W51-3 (Swartwater and Mhkondvo), W53-1 (Sandspruit and Ngwempisi), W54-1 (uSuthu, including Coalbank and Liefgekozen, and Seganagana) and W55-1 (Mpumalanga pan district around Chrissiesmeer, Majosie se Vlei and Mpuluzi) and W57-1 (uSuthu, Banzi Pan Ndumo, Shokwe Pan) (**Table 4.5**).

From a regional perspective, Chrissiesmeer (Mpumalanga Lake District) has been classified as being an irreplaceable Critical Biodiversity Area in the Mpumalanga Biodiversity Sector Plan 2013. The majority of this ecosystem falls within the Chrissiesmeer Panveld Ecosystem which has been listed as Endangered in the National List of Ecosystems that are Threatened and in Need of Protection (GN1002 of 9 December 2011). In terms of the Mpumalanga Provincial Gazette Extraordinary (Notice 19 of 2014) the Mpumalanga Lake District forms part of the Chrissiesmeer Protected Environment (CPE). This area is unique due to the high density of pans, several of which are permanently saturated (DWA, 2014a). The pans range

in size from less than a hectare to over a thousand hectares (Lake Chrissie). According to McCarthy *et al*. (2007), Tevreden Pan, along with other pans in the Mpumalanga Lakes District should be nominated/proposed for Listing as Wetlands of International Importance in terms of the Ramsar Convention, given the uniqueness of the area, which includes its status as an important bird area (Global IBA: SA019 Chrissie Pans of approximately 62500 Ha), as well as its geomorphological and hydrological uniqueness.

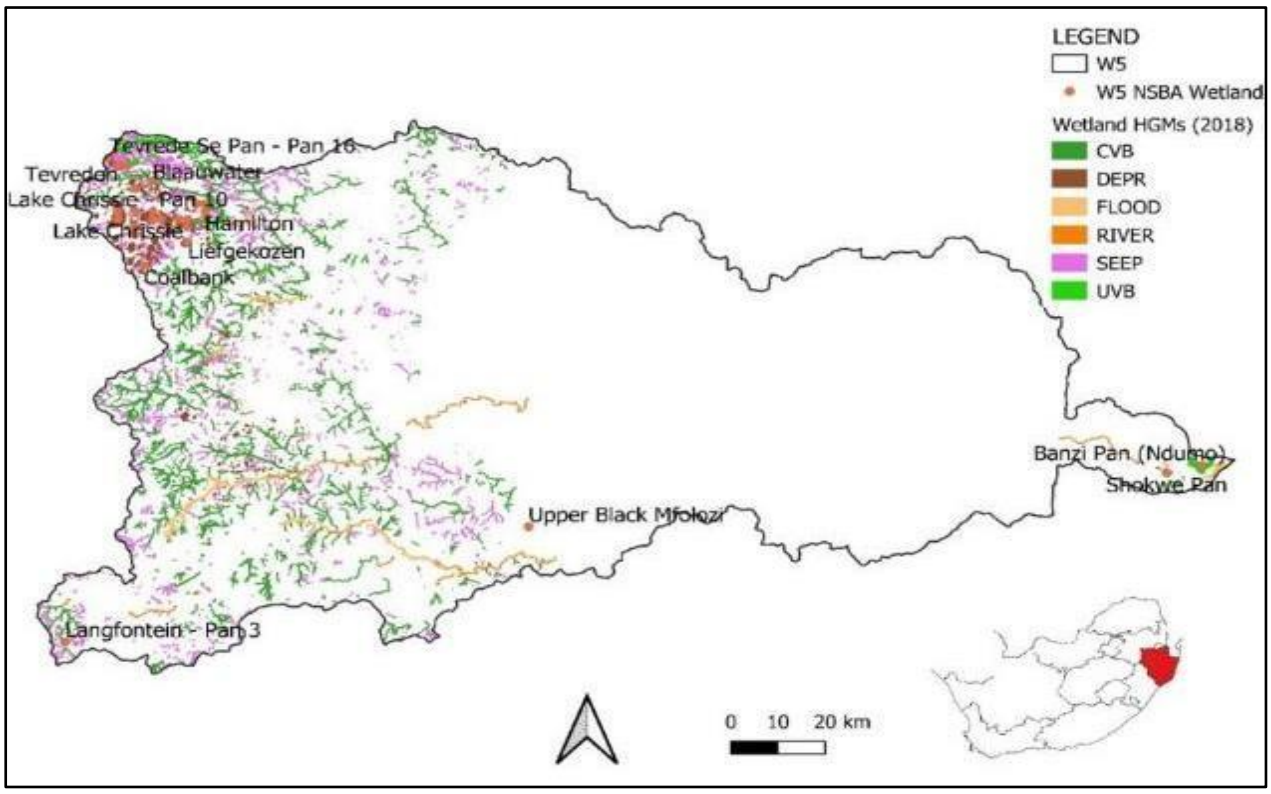

Figure 4.5: The spatial distribution of different HGMs (2018 updated wetland map 5; van Deventer *et al.*, 2018) in the Usutu Catchment (W5) and NSBA named wetlands (data from the NSBA, Driver *et al.*, 2005)

Table 4.5: Summary of wetland PES, EI, ES and IEI, along with WRUI and wetland priority per SQ in the Usutu catchment

SQ	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W51A-02082	Assegaai	**D/E**	VERY HIGH	HIGH	MODERATE	1	3
W51B-02101	Ngulane	**E**	VERY HIGH	VERY HIGH	MODERATE	1	3
W51C-01981	Assegaai	**C/D**	VERY HIGH	VERY HIGH	MODERATE	4	3
W51C-02011		**C**	VERY HIGH	VERY HIGH	HIGH	4	4
W51C-02022	Assegaai	**E**	VERY HIGH	VERY HIGH	MODERATE	4	3
W51C-02067	Assegaai	**C/D**	VERY HIGH	VERY HIGH	MODERATE	4	3
W51C-02074	Anysspruit	**C/D**	VERY HIGH	VERY HIGH	MODERATE	4	3
W51C-02109	Boesmanspruit	**C**	VERY HIGH	VERY HIGH	HIGH	4	4
W51D-02044	Assegaai	**C/D**	VERY HIGH	VERY HIGH	MODERATE	4	3
W51D-02151	Swartwater	**D**	VERY HIGH	MODERATE	LOW	4	3
W51D-02160		**C**	HIGH	VERY HIGH	MODERATE	4	3
W51D-02171	Klein-Assegaai	**D**	HIGH	VERY HIGH	MODERATE	4	3
W51D-02177	Klein-Assegaai	**C**	HIGH	VERY HIGH	MODERATE	4	3
W51D-02193	Swartwater	**C**	VERY HIGH	VERY HIGH	HIGH	4	4

SQ	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W51E-02049	Mhkondvo	**B**	VERY HIGH	VERY HIGH	VERY HIGH	4	4
W51F-01919	Ndlozane	**D**	MODERATE	VERY HIGH	LOW	1	1
W51F-01951		**D**	VERY HIGH	HIGH	MODERATE	1	1
W51F-01986	Blesbokspruit	**D**	HIGH	VERY HIGH	MODERATE	1	1
W51F-02019	Blesbokspruit	**D**	VERY HIGH	VERY HIGH	MODERATE	1	1
W52A-01934		**C/D**	VERY HIGH	VERY HIGH	MODERATE	2	3
W52A-01983	Hlelo	**C/D**	VERY HIGH	VERY HIGH	MODERATE	2	3
W52B-01890		**D**	VERY HIGH	VERY HIGH	MODERATE	2	2
W52B-01964	Hlelo	**D**	VERY HIGH	VERY HIGH	MODERATE	2	2
W52C-01867	Hlelo	**C/D**	VERY HIGH	VERY HIGH	MODERATE	2	2
W52C-01888	Tweelingspruit	**C**	VERY HIGH	VERY HIGH	HIGH	2	2
W52D-01862	Hlelo	**C/D**	VERY HIGH	VERY HIGH	MODERATE	2	2
W53A-01757	Sandspruit	**C**	VERY HIGH	VERY HIGH	HIGH	4	4
W53A-01804	Ngwempisi	**E**	VERY HIGH	VERY HIGH	MODERATE	4	3
W53A-01853	Ngwempisi	**C/D**	VERY HIGH	HIGH	MODERATE	4	3
W53B-01694		**D/E**	VERY HIGH	VERY HIGH	MODERATE	4	3
W53B-01710	Mpama	**D/E**	VERY HIGH	VERY HIGH	MODERATE	4	3
W53C-01679	Thole	**B/C**	VERY HIGH	VERY HIGH	VERY HIGH	2	3
W53D-01751		**B/C**	HIGH	HIGH	HIGH	2	2
W53D-01764	Mpama	**D/E**	VERY HIGH	VERY HIGH	MODERATE	2	2
W53D-01773	Ngwempisi	**D/E**	VERY HIGH	VERY HIGH	MODERATE	2	2
W53D-01801	Ngwempisi	**D**	VERY LOW	LOW	VERY LOW	2	1
W53D-01809	Ngwempisi	**C**	VERY HIGH	VERY HIGH	HIGH	2	2
W53D-01814	Swartwaterspruit	**C/D**	VERY HIGH	VERY HIGH	MODERATE	2	2
W53E-01790	Ngwempisi	**D/E**	VERY HIGH	MODERATE	LOW	2	1
W54A-01534	uSuthu	**C**	VERY HIGH	VERY HIGH	HIGH	4	4
W54A-01630		**C**	VERY HIGH	VERY HIGH	HIGH	4	4
W54B-01569	uSuthu	**D**	VERY HIGH	VERY HIGH	MODERATE	4	3
W54B-01623	Seganagana	**C**	VERY HIGH	VERY HIGH	HIGH	4	4
W54C-01512	Bonnie Brook	**B/C**	VERY HIGH	VERY HIGH	VERY HIGH	1	2
W54C-01552	Bonnie Brook	**C**	VERY HIGH	VERY HIGH	HIGH	1	2
W54C-01556	Bonnie Brook	**C**	VERY HIGH	VERY HIGH	HIGH	1	2
W54D-01593	uSuthu	**C/D**	VERY HIGH	HIGH	MODERATE	1	1
W55A-01375	Mpuluzi	**C**	VERY HIGH	VERY HIGH	HIGH	2	4
W55A-01423	Majosie se Vlei	**C**	VERY HIGH	HIGH	MODERATE	2	4
W55C-01395	Mpuluzi	**C/D**	VERY HIGH	HIGH	MODERATE	2	4
W55C-01489	Swartwater	**C/D**	VERY HIGH	VERY HIGH	MODERATE	2	2
W55E-01477	Mpuluzi	**C**	VERY HIGH	VERY HIGH	HIGH	2	2
W55D-01506	Metula	**C/D**	VERY HIGH	VERY HIGH	MODERATE	1	1
W56A-01372	Lusushwana	**C/D**	VERY HIGH	VERY HIGH	MODERATE	1	1
W57J-01923	uSuthu	**A/B**	VERY HIGH	MODERATE	VERY HIGH	0	2
W57K-01929	uSuthu	**B**	VERY HIGH	HIGH	VERY HIGH	0	2
W57K-02025		**B/C**	VERY HIGH	HIGH	HIGH	0	1

W7 Catchment (Kosi Estuary and Sibaya Lake)

The Lake Sibaya and Kosi catchment has roughly 82 200 Ha of wetlands including estuaries and 59 500 Ha of wetlands excluding estuaries. **Figure 4.6** shows the spatial distribution of

different wetland HGMs within the catchment. Depressions and floodplains dominate the catchment with a total area each of 33191 Ha and 21991 Ha respectively. Wetlands named in the National Spatial Biodiversity Assessment within this catchment include Mgobozeleni – Shazibe, KuMzingwane, KuMzinganwane, Siyadla, Mvelabusha, Muzi Swamps, Sileza Vlei, Nlangu mire complex, Kosi – Siyadla, KuShengeza, Kozi – aManzamnyama, Sihadla, Enkathweni, Kosi – Swamanzi, KuNkanini, Matitimane, Apiesdraai, Mtando, Kosi – Ngweve, KuZilonde, Kukalwe, Cele, Nlovu, Gazini and Mloli. The Vazi Pan peatlands near the town of Manguzi is also within this catchment. The Resource Units (RUs) that have a Very High wetland priority include W70-1 (Swamanzi) and W70-3 (Lake Sibaya, Muzi swamps) (**Table 4.6**).

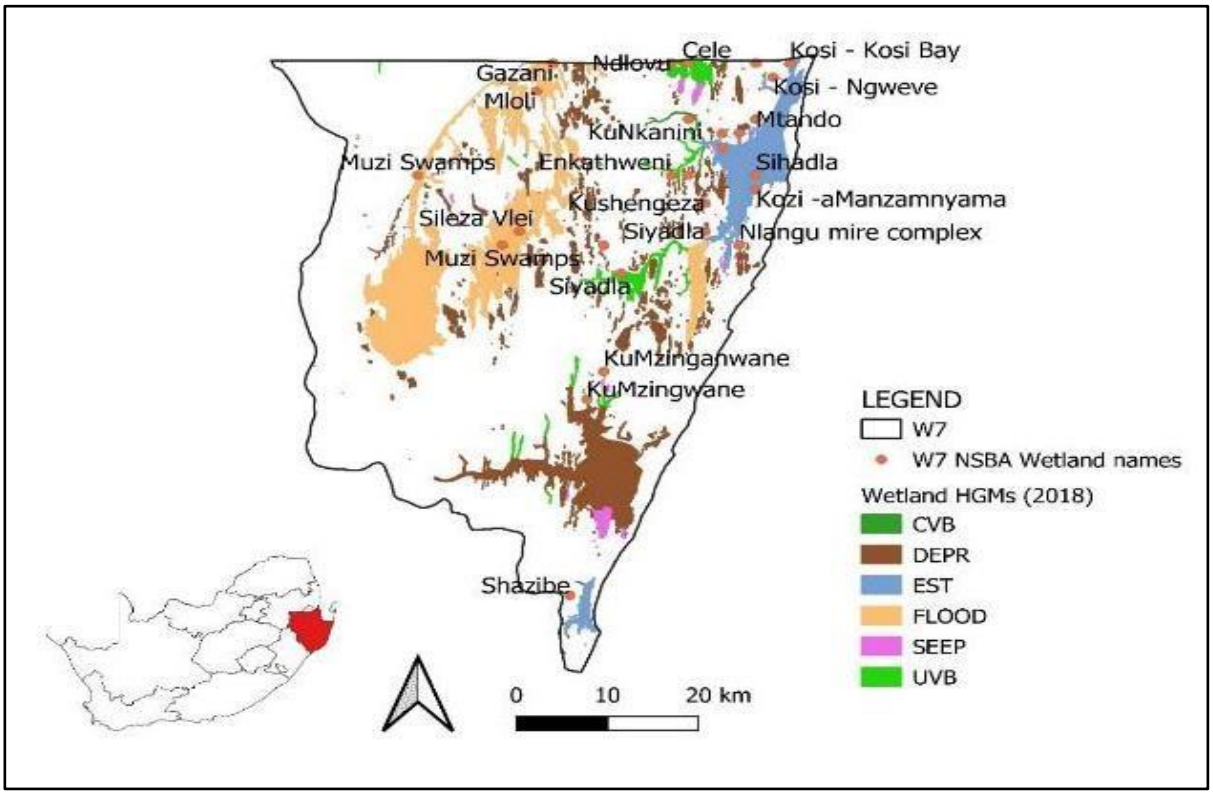

Figure 4.6: The spatial distribution of different HGMs (2018 updated wetland map 5; van Deventer *et al.*, 2018) in Lake Sibaya and Kosi Catchment (W7) and NSBA named wetlands (data from the NSBA, Driver *et al.*, 2005)

Table 4.6: Summary of wetland PES, EI, ES and IEI, along with WRUI and wetland priority per SQ in the Kosi and Lake Sibaya catchment

SQ	Name	Wetland PES	Wetland EI	Wetland ES	Wetland IEI	WRUI	Priority
W70A-02046	Kosi Lakes	**Estuary**					2
W70A-02079	Swamanzi	**E**	VERY HIGH	HIGH	MODERATE	0	1
W70A-02112	Malangeni	**B/C**	VERY HIGH	HIGH	HIGH	0	1
W70A-02030	Muzi Swamps	**N/A**	VERY HIGH	HIGH	VERY HIGH		4
W70A-02278	Lake Sibaya	**B/C***	VERY HIGH	HIGH	VERY HIGH		4
W70A-02301		**D**	VERY HIGH	VERY HIGH	MODERATE	2	2
W70A-02381		**C**	VERY HIGH	HIGH	MODERATE		1

* DWS (2015).

Table 4.7: Summary of high priority wetland PES, EI, ES, trends, REC, TEC and methods for improvement or maintenance

RU	Wetland Name	Wetland Type	Includes SQs	PES	EI	ES	Trend	REC	How to achieve the REC	TEC
W1 Mhlathuze										
W12-8	Mhlathuze Floodplain	Floodplain	W12H-03459 W12F-03494	E	VERY HIGH	VERY HIGH	↓	D	Reduce / control sugarcane cultivation.	D
W12-9	Nhlabane Wetlands	Depressional & Seepage wetlands	W12J-03411	D	VERY HIGH	VERY HIGH	↓	C/D	Prevent encroachment of the wetland by forestry species.	C/D
W12-10	Lake Mzingazi	Lake (excluding surrounding channelled valley bottom wetlands)	W12J-03489	D/E	VERY HIGH	VERY HIGH	↓	D	Control expansion of forestry and residential development, improve water quality, reduce / control gill netting (fish & birds), mitigate upstream / downstream connectivity (fish ladder).	D
W12-10	Mzingazi	Valley bottoms with a channel, excluding the lake	W12J-03392 W12J-03493 W12J-03403 W12J-03450	C	VERY HIGH	VERY HIGH	→	C	Prevent encroachment of the wetland by forestry species. Control expansion of forestry and residential development.	C
W2 UMfolozi										
W22-1	Aloeboom Vlei	Hillslope seeps linked to the channel, and channelled valley bottom wetlands along the Black Mfolozi River	W22A-02586 W22A-02591 W22A-02596	C	VERY HIGH	VERY HIGH	↓	B/C	Prevent encroachment of the wetland by forestry species, control formal residential expansion.	B/C
W23-1	Mvamanzi Pan	Unchanneled valley bottom wetland leading depressional wetland, along the Mvamanzi River	W23A-03160	B/C	VERY HIGH	VERY HIGH	→	B/C	Control expansion of subsistence / small-scale crops and formal residential areas.	B/C
W23-3	Mfolozi Swamps	The Mfolozi and Msunduzi rivers both form part of the Mfolozi swamp in their	W23C-03180 W23D-03108	D	VERY HIGH	VERY HIGH	→	D	Reduce / control sugarcane cultivation.	D

RU	Wetland Name	Wetland Type	Includes SQs	PES	EI	ES	Trend	REC	How to achieve the REC	TEC
		lower reaches with extensive floodplains connecting the two rivers								
W3 Mkuze										
W31-4	Nhlonhlela Pan	The Mkuze River and the Nhlonhlela River confluence area including Nhlonhlela Pan, a depressional wetland	W31J-02469 W31J-02501	A	HIGH	MODERATE	→	A	Preventative conservation: prevent expansion of surrounding forestry.	A
W32-7	Hluhluwe Floodplain	The Hluhluwe River and its floodplain before entering the St Lucia estuary	W32F-02835	C/D	VERY HIGH	VERY HIGH	↓	C	Reduce / control cultivation of commercial and emerging farmer sugarcane.	C
W32-7	Nyalazi Pan	Depressional wetlands with swamp forest in the Nyalazi River catchment	W32H-02854	C	VERY HIGH	VERY HIGH	→	C	Control existing forestry extent.	C
W32-7	Mpate Wetlands	Channelled valley-bottom and depressional wetlands in the Mpate River catchment that leads into St Lucia	W32H-02998	A	VERY HIGH	HIGH	→	A	Preventative conservation: prevent expansion of forestry and small-scale subsistence farming.	A
N/A	Mkuze Floodplain	Mkuze River including the Mkuze swamp system and	W32B-02535	B	VERY HIGH	HIGH	→	B	Control extent of subsistence / small-scale annual crops.	B

RU	Wetland Name	Wetland Type	Includes SQs	PES	EI	ES	Trend	REC	How to achieve the REC	TEC
		the Mkuze floodplain								
W4 Pongola										
W45-1	Pongola Floodplain	Floodplain and valley bottoms with a channel	W45A-02216 W45A-02245 W45A-02246 W45A-02256 W45A-02275 W45A-02282 W45A-02285 W45A-02310 W45A-02316 W45A-02356 W45A-02367 W45A-02368 W45B-02029 W45B-02105	D	VERY HIGH	HIGH	↓	C	Reduce / control subsistence and small-scale annual crops.	D
W5 Usutu										
W51-2	Assegaai Floodplain	Floodplains along the Assegaai River and channelled valley-bottom wetlands along tributaries	W51C-01981 W51C-02011 W51C-02022 W51C-02067 W51C-02074 W51C-02109 W51D-02044 W51D-02151 W51D-02160 W51D-02171 W51D-02177 W51D-02193	C	VERY HIGH	VERY HIGH	→	C	Prevent encroachment of the wetland by forestry species. Control expansion of forestry and informal farming.	C
W53-1	Sandspruit Wetlands	Channelled valley bottom wetlands along the Sandspruit towards the headwaters	W53A-01757 W53A-01804 W53A-01853	C	VERY HIGH	VERY HIGH	→	C	Control expansion of commercial annual crops and dry-land agriculture.	C
W54-1	Upper Usuthu Wetlands	Extensive channelled valley bottom wetlands	W54A-01534 W54A-01630	B/C	VERY HIGH	VERY HIGH	→	B/C	Control expansion of commercial annual crops and dry-land agriculture.	B/C

RU	Wetland Name	Wetland Type	Includes SQs	PES	EI	ES	Trend	REC	How to achieve the REC	TEC
		upstream of the Sandcliff Dam but not along an official SQ, rather a tributary of the Usutu								
W54-1	Seganagana Wetlands	Floodplain and channelled valley-bottom wetlands along the Seganagana upstream of the Westoe Dam	W54B-01569 W54B-01623	A	VERY HIGH	VERY HIGH	→	A	Preventative conservation: Control expansion of forestry and dry-land agriculture.	A
W55-1	Pans District	Most of the pans are not directly associated with an official SQ. The area has a high density of pans, extensive seepage wetlands and large areas of channelled valley-bottoms	W55A-01375 W55A-01423 W55C-01395	A/B	VERY HIGH	HIGH	→	A/B	Preventative conservation: Control expansion of forestry and commercial annual crops, rain-fed.	A/B
W57-1	Lower Usuthu (Ndumo)	Floodplains along W57K-02025 (tributary of the Usutu River) form part of the Pongola floodplains in the Ndumo	W57J-01923 W57K-01929 W57K-02025	A	VERY HIGH	HIGH	→	A	Preventative conservation: prevent expansion of nearby slash & burn agricultural activities.	A

RU	Wetland Name	Wetland Type	Includes SQs	PES	EI	ES	Trend	REC	How to achieve the REC	TEC
		Game Reserve area and Banzi Pan occurs along the Usutu River (W57K-01929), both are part of the RAMSAR site								
W7 Kosi & Sibaya										
W70-3	Lake Sibaya	Lake Sibaya and surrounding wetlands comprised of seepage wetlands (650 Ha) and channelled valley-bottoms	W70A-02278 W70A-02301 W70A-02381	B/C	VERY HIGH	HIGH	→	B	Prevent expansion of surrounding forestry, residence and dry-land agriculture, where reasonably possible prevent water levels low enough to isolate basins.	B/C
W70-	Muzi Swamps	Depressional and floodplain wetlands that comprise the Muzi swamps	None	C			↓	C	Prevent expansion of surrounding forestry, residence and dry-land agriculture, where reasonably possible prevent water levels low enough to isolate basins.	C

** Wetland delineations were taken from the NWM5 of 2018 (van Deventer et al., 2018) as part of the National Biodiversity Assessment (NBA) 2018* (Van Deventer, H., Smith-Adao, L., Mbona, N., Petersen, C., Skowno, A., Collins, N.B., Grenfell, M., Job, N., Lötter, M., Ollis, D., Scherman, P., Sieben, E. & Snaddon, K. 2018. South African National Biodiversity Assessment 2018: Technical Report. Volume 2a: South African Inventory of Inland Aquatic Ecosystems (SAIIAE). Version 3, final released on 3 October 2019. Council for Scientific and Industrial Research (CSIR) and South African National Biodiversity Institute (SANBI): Pretoria, South Africa. Report Number: CSIR report number CSIR/NRE/ECOS/IR/2018/0001/A; SANBI report number http://hdl.handle.net/20.500.12143/5847).

SURFACE-WATER - ESTUARIES COMPONENT

Ecological Categories for the eight estuaries represented below summarise the PES, REC and TEC in **Table 5.1** (as per DWS estuarine methods).

Table 5.1: Water Quality Ecological Specifications (Estuaries in the Usuthu-Mhlathuze Catchment)

	aMatigulu/iNyoni	iSiyaya	uMlalazi	uMhlathuze	iNhlabane	uMgobezeleni	Kosi	St Lucia/ uMfolozi
PES (trajectory)	B/C ↓	D/E↓	B/C ↓	D↓	E↓	B↓	A/B↓	D ↓↑
REC	B	C	B	D	D	A	A	B
TEC	B	D (short term) C (long term)	B	D	D	A/B	A	C (short term) B (long term)
Hydrology	C	B/C↑	C	C	D	B	A	C
Hydrodynamics	B	D ↑	B/C	D/E	C/D	B	A	C
Physical habitat (sediments)	B	B	B	D	E→D	A/B	A	C
Water quality (salinity)	A	B	B	C/D	E→D	A/B	A	D ↑
Water quality (general)	C	D ↑	C	D	D	B	A/B	D ↑
Microalgae	B	C	C	D	D	B	A	D ↑
Macrophytes	B	D→C	B/C	D	C/D	B	A/B	B
Invertebrates	B	D→C	B	E→D	E→D	A/B	B↑	D
Fish	B/C	D→C	B	D	E→D	B	B↑	C
Birds	B	D→C	B	C	D	A	A/B	C

X (short term; <5 years)→Y (long term; 5-10 years) - indicates the expected long-term trajectory of change to meet long- term TEC.
↓↑ - indicate that the trajectory of change is not stable.
↑ - indicate an improvement within a category (mostly associated with degraded components) and thus a focus for restoration.

Ecological Specifications

Thresholds of potential concern (TPC) are defined as measurable end points related to specific abiotic or biotic indicators that if reached (or when modelling predicts that such points will be reached) prompt management action. In essence, TPCs should provide early warning signals of potential non-compliance to ecological specifications (i.e. not the point of 'no return'). This implies that the indicators (or monitoring activities) selected as part of a long-term monitoring programme need to include biotic and abiotic components that are particularly sensitive to changes in river inflow. The TPCs associated with each of the ecological specifications are also provided in **Table 5.2 to Table 5.9**.

Table 5.2: W1-Amatigulu/Inyoni Estuary

PES:	B/C ↓	REC:	B	TEC:	B

The following non-flow interventions will result in halting the negative trajectory and achieving the TEC:

- Undertake restoration of estuarine floodplain (Estuary Functional Zone - EFZ) and reduce agriculture impacts in the supratidal area of the system.
- Control/manage the harvesting of Juncus and Phragmites to prevent over-exploitation (management plan in place).
- Curb/control illegal fishing activities (e.g., gill netting) to improve nursery function and prawn abundance (bycatch) and increase community education and awareness.
- Control recreational activities in the lower reaches through zonation and improve compliance (e.g. development of an Estuary Management Plan and estuary zonation map).
- Improve protection levels through Contracted Conservation on the North Bank - part of the DFFE 30 x 30 Estuary Protection Priorities which include expanding uThukela Marine Protected Area (MPA).
- Promote tourism (e.g., bird guides) to reduce impacts and provide benefits to the community.
- Implement interventions (e.g., agricultural best practices, development of farm plans) within the catchment and institute a buffer of natural vegetation along the length of the river to improve the nutrient status and help with sedimentation issues.
- Remove invasive aliens to improve baseflows.

Component/ indicator	TEC	TPC
Hydrology	C	Maintain TEC (>63%). Protect the flow regime to create the required habitat for birds, fish, macrophytes, microalgae and water quality: ▪ River inflow distribution patterns (flood components) should not differ by more than 10% (in terms of magnitude, timing and variability) from that of the Present State – (MAR = 113.77 x10^6 m^3)(DWS, 2023a). ▪ River inflow distribution patterns should not differ by more than 5% from that of the Present State (i.e. approved flow scenario for the aMatigulu/iNyoni). ▪ Monthly river inflow should not be < 0.75 m^3/s for more than 17% of the time. ▪ Monthly river inflow should not be < 10.0 m^3/s for more than 65% of the time.
Hydrodynamics	B	Maintain Target EC (>78%). Maintain mouth conditions to protect estuarine ecosystems and the associated habitat for birds, fish, macrophytes, microalgae and water quality (DWS, 2015a; 2023a): ▪ Mouth closure occurs less than 6 - 8 weeks in a year. ▪ Mouth closure occurs for less than 3 - 4 years out of ten. ▪ Mouth closure occurs between September and March. ▪ Changes in tidal amplitude at the tidal amplitude should be <20% from Present State (DWS, 2015a) (mouth in the northern position, if mouth moves south the average tidal amplitude is expected to increase by 30 - 50%.
Physical habitat (sediments)	B	Maintain the TEC (>78%). Protect estuarine sediment distributions suitable habitat for estuarine biota: ▪ River inflow distribution patterns (flood components) are <20% (in terms of magnitude, timing and variability) from that simulated for the present state (refer to DWS, 2015a). ▪ Suspended sediment concentration in river inflow should not deviate by more than 20% of sediment load-discharge relationship of the present state (refer to DWS, 2015). ▪ No deviation in sedimentation and erosion patterns in the estuary should occur from the present baseline (refer to DWS, 2015).
		Changes in sediment grain size distribution patterns not to cause exceedance tolerance of benthic invertebrates: ▪ Median bed sediment diameter should not deviate by more than a factor of two from levels of the present baseline (refer to DWS, 2015a). ▪ Sand/mud distribution in middle and upper reaches should change <20% from the present baseline (refer to DWS, 2015). ▪ Changes in tidal amplitude at the tidal gauge should change <20% from the present baseline (refer to DWS, 2015) as a result of sediment processes.

Water quality (salinity)	**A**	Maintain TEC (>93%). Salinity regime to maintain TEC for dependent biotic components (DWS 2015a; 2023a). ▪ Salinity values >5 in the upper reaches (End of Zone B/ beginning of Zone C) of the estuary. ▪ Salinity values >10 in middle reaches (Zone B) during the low flow season. ▪ Salinity values <5 in middle reaches (Zone B) and <15 in the lower reaches (Zone A) during closed mouth periods. ▪ Salinity values >5 in the iNyoni Arm about 1 km from the confluence. ▪ Salinities should not decrease by >20% in each of the reaches except during high flow freshwater dominated conditions. Salinities should not drop below 10 in the lower and middle reaches, except for short periods during the high flow freshwater state, to allow macrocrustacea larval development.
Water quality (general)	**C**	Maintain the TEC (>63%). Water quality to be suitable for maintaining the TEC for dependent biotic components (DWS, 2023a). River inflow: ▪ 7.5 < pH > 8.5 consistently over 2 months. ▪ DO >6 mg/l. ▪ Turbidity <15 NTU (low flow). ▪ Turbidity high flows naturally turbid ▪ Flows <5 m^3/s: NO_x-N <200 µg/l over 2 months (NO_x-N refers to Nitrate-N + Nitrite-N); NH_3-N<30 µg/l over 2 months; PO_4-P <50 µg/l over 2 months. ▪ Flows >5 m^3/s: Average DIN <300 µg/ℓ; Average DIP <50 µg/ℓ. ▪ Toxic substances (water): See **Table A1** in **Appendix A**. ▪ Toxic substances (sediment): See **Table A2 in Appendix A**. Estuary: ▪ Average turbidity <10 NTU (low flow). ▪ Turbidity high flow, naturally turbid. ▪ 6.0 < pH > 8.5 in a sampling survey (to be verified by sampling) ▪ Average DO >6 mg/ℓ in a sampling survey. ▪ River flow <5 m^3/s): Average NOx-N <200 µg/l; Average NH_3-N <30 µg/l; Average PO_4-P <50 µg/l in a sampling survey. ▪ River flow >5m^3/s): Average NOx-N <300 µg/l; Average NH_3-N <20 µg/l; Average PO_4-P <50 µg/l in a sampling survey. ▪ Toxic substances (water): See **Table A1** in **Appendix A**. ▪ Toxic substances (sediment): See **Table A2** in **Appendix A**. For recreational use areas in estuary (see details in DEA, 2012): ▪ Enterococci <185 counts per 100 ml (90 percentile), and ▪ *E. coli* <500 counts per 100 ml (90 percentile).
Microalgae	**B**	Maintain the TEC (>78%) through: Maintain the current composition, richness, and abundance of phytoplankton and benthic microalgal assemblages. No harmful algal bloom (HAB) species, unless constrained to Zone A during open mouth conditions (i.e., marine origin) (DWS, 2023a). **Phytoplankton:** ▪ 90^{th} percentile value (i.e., entire estuary) for phytoplankton biomass <10 µg Chl-*a* l^{-1}. ▪ No bloom conditions (represented by values >20 µg Chl-*a* l^{-1}); even isolated instances. ▪ No presence of potentially HAB-forming taxa. **Benthic Microalgae:** ▪ Average Microphytobenthos (MPB) biomass <50 mg Chl-*a* m^{-2}. ▪ Average benthic diatom diversity (H') >3. (Based on average values recorded throughout estuary).

Macrophytes	**B**	Maintain the TEC (>78%) through: ▪ Maintain the distribution of macrophyte habitats to present baseline, particularly the large Swamp Forest stands (>300 ha) and presence of submerged macrophytes (refer to **Appendix B** and DWS, 2023a). ▪ <10% change in the area covered by different macrophyte habitats, especially swamp forest and submerged macrophytes. ▪ Invasive plants (e.g. syringa berry, Brazilian pepper tree, lantana, *Chromolaena*, *Opuntia*) should be largely absent from the riparian zone. ▪ No unvegetated, cleared areas along the banks. ▪ Floating invasive aquatics should not be observed in the upper estuary reaches. ▪ Macroalgae cover should be <20% of estuarine water surface area. ▪ Sugarcane should not be present in the estuarine functional zone. ▪ There should not be extensive land cover change of natural land in the iNyoni and aMatigulu EFZ – less than 5% change from 2023.
Invertebrates	**B**	Maintain the TEC (>78%) through (DWS 2015a, 2023a): ▪ Maintain current zooplankton, zoobenthic and macrocrustacea abundance (including seasonal variation) and species richness in each of the estuary regions. <10% decrease in macrobenthic densities in terms of numbers per m^{-2} over estuarine area (at least Zones A - C). ▪ Polychaetes, amphipods and tanaids should numerically dominate during all seasons. However, abundance of all taxon groups should be higher during spring before summer high flow and decline during the winter, low flow periods. ▪ No increase in distribution and relative abundance of invertebrate alien species currently present. Invasive snail *Tarebia granifera* distribution should be limited to Zones C and D and present <20% of the abundance in any sample. No new alien species (especially molluscs in any reach, in any sample). ▪ No shift in prawn community from current balanced marine-freshwater assemblage in the middle reaches towards freshwater dominated assemblage. i.e. Carid prawns should not dominate in the Zone A and migrating species (e.g., *Macrobrachium* and *Varuna* should be present in Zones B - D). ▪ <20% decrease in abundance of zooplankton in terms of numbers per m^{-2} over entire estuarine area (from at least 3 sites) over 3 years ▪ Regionally endemic species to be retained; *Paratylodiplax blephariskios* present in annual samples from Zones A and B.
Fish	**B/C**	Maintain the TEC (>73%) through (DWS 2015a, 2023a): ▪ <20% decline in abundance (to be defined as an average with prediction limits) of marine estuarine-opportunist species and estuarine-dependent species as juveniles. ▪ Marine estuarine-opportunist species should occur throughout Zone A and into the lower reaches at least of Zones B and D. *Sillago sihama, Platycephalus indicus* and *Stolephorus* spp. should always occur. *Hilsa kelee, Bothus pantherinus* (or *Pseudorhombus arsius*), *Sphyraena* spp., *Thryssa* spp. *Amblyrhynchotes honckenii* should occur in at least one sampling session over a two consecutive year period. ▪ All zones of the estuary should function as high value nursery habitat to a diversity of marine estuarine-dependent species with all of the following species occurring in the estuary in two consecutive years: *Leiognathus equula, Acanthopagrus vagus, Pommadasys commersonnii, Terapon jarbua, Rhabdosargus sarba, Rhabdosargus holubi, Caranx* spp. Mullet should occur throughout the system (all zones) every year. *Pseudomyxus capensis, Mugil cephalus, Osteomugil cunnesius, Planiliza macrolepis, Chelon dumerilii* occur in all zones of the estuary at a full array of size classes. ▪ Permanent populations of estuarine resident species should occur throughout the system. *Ambassis ambassis* (or *Ambassis natalensis*) and *Glossogobius callidus* are all present and abundant in the estuary (except during floods). *Croilia mossambica* occurs in the estuary, being sampled at least once every two consecutive years. ▪ A good trophic basis must exist for predatory (piscivorous) marine estuarine-dependant and opportunist species. Piscivorous fishes (e.g. *Agyrosomus japonicus*, *Caranx* spp.) occur in the estuary. ▪ Freshwater fishes should be limited in their distribution through the system. *Oreochromis mossambicus* is the most abundantly occurring freshwater species and is limited to the Zone C and the upper reaches of Zones B and D in the low flow period. ▪ The species assemblage should comprise indigenous species only. No non-indigenous fishes should occur.

Birds	**B**	Maintain the TEC (>78%). Maintaining avifaunal community that includes representatives of all original groups as per present baseline (refer to DWS, 2015; 2023a). ▪ Resident pair of African Fish Eagle present and breed successfully. ▪ Cormorants and/or herons/egrets: No significant reduction in numbers (<20%). ▪ Migratory waders, especially of estuarine-dependent species: No significant reduction in numbers (<20%). ▪ Waterfowl (ducks and geese): No significant reduction in numbers (<20%). ▪ Whole waterbird community: No significant reduction in numbers (<20%). ▪ Tern and gull roost at mouth: No significant reduction in numbers (<20%).

Table 5.3: W13-Isiyaya Estuary

PES:	**D/E↓**	**REC:**	**C**	**TEC:**	**D (Short term)** **C (Long-term)**

The following interventions will result in halting the negative trajectory and achieving TEC:

An Ecosystem-based adaptation restoration project embedded in an Estuary Management Plan is needed to restore the iSiyaya Estuary's functionality. In the short term (<5 years) several mechanical interventions are needed to restore estuarine functionality:

- Remove accumulated organic sludge through dredging of the bottom substrate to improve water quality, i.e., increase oxygen in the water column. This is a once-off intervention but may need to be repeated every 10 - 20 years if marine connectivity and water quality do not improve.
- Mechanical removal of reeds in lower reaches to increase open water area (once-off).
- When the mouth has been closed for long periods, it may require mechanical removal of sediment that build up at the mouth to allow for overwash recruitment and breaching. This may also require deepening the estuarine channel and /or bringing the openwater area forward by removing marine sand at the mouth. Given that the removal of 5 m^3 of sediment at an estuary triggers the Environmental Impact process (National Environmental Management Act No. 107 of 1998), removal of organic sludge and skimming/reshaping of the berm will require the development of an Estuary Mouth/Maintenance Plan to guide the management authority on when such an action is needed. The plan also needs to consider the location of submarine cable to the north of the system.
- Revegetate the dune at the mouth.

In the long-term (5 - 10 years), a "catchment-to-coast" approach needs to be taken given this is a small river basin including:

- Mitigate the impacts of mining by ensuring a 1 km buffer zone of riparian vegetation around the estuary to reduce the turbidity signal and sediment input from mining. Note: Forestry in and around the EFZ has removed the natural buffer capacity riparian vegetation provides.
- Reduce the direct impact of forestry on the estuary by instituting buffer zones around the estuary (e.g., 1 km zone), while over longer time scales baseflows should be restored by an overall reduction in forested areas in the catchment.
- Pioneer different footpaths to the beach further north to reduce the disturbance of birds.
- Increase fishing compliance as fishing pressure will escalate if fish communities recover under restoration actions.
- Restore the upstream riparian zone and remove alien vegetation to assist with restoring baseflows and act as turbidity and nutrient filters.
- Develop a groundwater-surface water model to direct the use of groundwater resources and ensure the protection of estuary functionality and guide management of the plantations and woodlots. Note that a reduction of community woodlots may require the establishment of alternative livelihoods.

Component/ indicator	**TEC**	**TPC**
Hydrology	**B/C↑**	Maintain TEC (>63%). Protect the flow regime to create the required habitat for birds, fish, macrophytes, microalgae and water quality: River inflow patterns should not: ▪ Differ by more than 5% from that of Present State - (MAR = 3.39 x10^6 m^3) (2022) (DWS, 2023b). ▪ Monthly river inflow <0.05 m^3/s for more than 10% of the time. ▪ Monthly river inflow <0.5 m^3/s for more than 87% of the time.

Hydrodynamics	**D↑**	Maintain TEC (>43%). Maintain an open mouth conditions to protect estuarine ecosystems and the associated habitat for birds, fish, macrophytes, microalgae and water quality: ▪ Mouth closure occurs for <3%. ▪ Changes in tidal amplitude at the tidal amplitude of <20% from Present State (2022) (DWS, 2023b).
Physical habitat (sediments)	**B**	Maintain the TEC (>78%). Protect estuarine sediment distribution suitable habitat for estuarine biota (DWS, 2023b): ▪ River inflow distribution patterns (flood components) should differ by <20% (in terms of magnitude, timing and variability) from that of the Present State (2021). ▪ Suspended sediment concentration from river inflow should deviates by <20% of the sediment load-discharge relationship to be determined as part of baseline studies (Present State 2015). ▪ Findings from the bathymetric surveys undertaken as part of a monitoring programme should not indicate changes in the sedimentation and erosion patterns in the estuary have occurred (± 0.5 m).
		Changes in sediment grain size distribution patterns not to cause exceedance tolerance of benthic invertebrates (DWS, 2023b): ▪ The median bed sediment diameter should deviate by less than a factor of two from levels to be determined as part of baseline studies (Present State 2021). ▪ Sand/mud distribution in the middle and upper reaches change should be <20% from Present State (2022). ▪ Changes in tidal amplitude at the tidal gauge should be <20% from Present State (2022).
Water quality (salinity)	**B**	Maintain TEC (>78%). Salinity regime to maintain TEC for dependent biotic components (DWS, 2023b). ▪ Surface Salinity values >4 in the Lower reaches (Zone A) for more than 90% of the time (develop under persistent close mouth conditions). ▪ Bottom Salinity values between 5 - 10 should not occur in the Lower reaches (Zone A) for more than 90% of the time (develop under persistent close mouth conditions).
Water quality (general)	**D↑**	Maintain the TEC (>43%). Water quality to be suitable for maintaining the TEC for dependent biotic components (DWS, 2023b). **River Inflow and Estuary:** ▪ 7.5< pH >8.5. ▪ Turbidity <5 NTU. ▪ DO >6 mg/l (surface), >4 mg/l (bottom, when stratified). ▪ DIN <100 ug/l. ▪ DIP <10 ug/l. ▪ Toxic substances (water): See **Table A1** in **Appendix A**. ▪ Toxic substances (sediment): See **Table A2** in **Appendix A**. **For recreational use areas in estuary (see details in DEA, 2012):** ▪ Enterococci <185 counts per 100 ml (90 percentile), and ▪ *E. coli* <500 counts per 100 ml (90 percentile).
Microalgae	**C**	Maintain the TEC (>63%). Maintain phytoplankton and benthic microalgal assemblages and ensure no harmful algal bloom (HAB) species. **Phytoplankton:** ▪ 90th percentile value (i.e., entire estuary) for phytoplankton biomass <15 µg Chl-a l^{-1}. ▪ No presence of bloom conditions (represented by values >20 µg Chl-a l^{-1}); even isolated instances. ▪ No presence of potentially HAB-forming taxa. **Benthic Microalgae**: ▪ Average MPB biomass & <50 mg Chl-a m^{2}. ▪ Average benthic diatom diversity (H') >2.5. (*Based on average values recorded throughout estuary.

Macrophytes	**D➔C**	Maintain the TEC (>43%) through (DWS 2023b): ▪ Maintain the distribution of macrophyte habitats. Less than 10% change in the area covered by different macrophyte habitats (**Appendix B**; DWS (2023b)). ▪ Maintain the integrity of the riparian zone. No development in estuarine functional zone. No plantations or agriculture (e.g. sugarcane) in the estuarine functional zone. ▪ Invasive plants (e.g. syringa berry, Brazilian pepper tree, lantana, *Chromolaena*, *Opuntia*) are largely absent from the riparian zone. ▪ No invasive floating aquatic species present in the estuary e.g. water hyacinth.
Invertebrates	**D➔C**	Maintain the TEC category (>43%) through: ▪ Species richness and invertebrate diversity should not decline further from site and seasonal averages: <10% change in plankton or benthic invertebrate community metrics in Zones A and B. ▪ A minimum of ten core of estuarine taxa should always be present in the system including Peracarida and Mollusca representatives, especially *Ceratonereis, Grandidierella, Americorophium, Iphinoe, Halmrapseudes, Melanoides* spp. In Zone A. ▪ Macrocrustacea (*Macrobrachium* and *Kraussillichirus*) reproduction occurs (salinities >5 in the lower and middle reaches, Zone A) and both taxa are consistently present. ▪ The open mouth state allows for recruitment of larger macrocrustaceans into the system and importantly adult *Varuna* emigration during summer and larval immigration in autumn (April/May). ▪ Chironomidae and Oligochaeta should not dominate a site (tolerant of low oxygen, especially <4 mg/l). ▪ Invasive snail *Tarebia granifera* distribution limited to Zone B, with no increase in distribution and relative abundance of invertebrate alien species. *T. granifera* to not outnumber collective abundance of resident estuarine species.
Fish	**D➔C**	Maintain the TEC category (>43%) through: ▪ <20% decline in abundance (to be defined as an average with prediction limits) of estuarine-dependent species as juveniles. ▪ All zones of the estuary should function as nursery habitat for a diversity of marine estuarine-dependent species. The greatest diversity and abundance of marine estuarine-dependent species occurs in the lower reaches of Zone A. *Rhabdosargus holubi* and several species of *Mugillidae* dominate the assemblage. All of the following species occurring in the estuary in two consecutive years: *Planiliza alata*, *Planiliza macrolepis* and *Pseudomyxus capensis*, *Mugil cephalus*, *Osteomugil cunnesius*, *Rhabdosargus holubi*, *Terapon jarbua*. ▪ Connectivity down the full length of the historic estuary and into the marine environment is maintained. Three species of mullet occur throughout the whole system (all zones) in all size classes. ▪ Permanent populations of estuarine resident species should occur throughout the system. *Ambassis* spp. *Gilchristella aestuaria and Glossogobius callidus* are all present in the estuary (except during floods). ▪ Freshwater species should be dominated by euryhaline forms. Freshwater estuarine-opportunist species also occur throughout, dominated by *Oreochromis mossambicus*. Freshwater stenohaline fishes are restricted to the upper reaches of Zone B. ▪ The species assemblage should comprise indigenous species only. No non-indigenous fishes should occur.
Birds	**D➔C**	Maintain the TEC (>43%) through: ▪ Given limited species richness and abundance of waterbirds, all species should be present and assessed. ▪ Tern/gull should be roosting at the mouth and threatened specialized waterbirds, e.g. African Finfoot and White-backed Night Heron, present in the system. ▪ No sustained loss of key species, especially any threatened specialized waterbird species.

Table 5.4: W13-Umlalazi Estuary

PES:	B/C↓	REC:	B	TEC:	B

Components that require interventions to halt the negative trajectory and achieve TEC:

- Deteriorating water quality represents a significant threat to the ecological functioning of the system, the risk is especially high during the closed state. No wastewater should be discharged into the system RP and agricultural best practices should be implemented through farm plans to reduce nutrient-rich agriculture return flow. Address diffuse runoff from housing not on formal reticulation systems (supported through the Provincial Growth and Development Strategy). Look into innovative ways to manage wastewater in this area, e.g., artificial reed beds.
- Where possible, i.e. not build up, create interventions (e.g. replanting of natural vegetation, artificial wetlands, managing grazing) within a 500 m buffer zone around the EFZ to improve the nutrient status and reduce sediment inputs.
- Curb illegal fishing (i.e. gill netting) impacting nursery function and prawns (part of the bycatch).
- Undertake restoration of the uMlalazi EFZ and reduce agriculture impacts in the supratidal area of the system. Rewild banks and restore gentle slopes where possible along the banks of the estuary (investigate the option to remove hard structures of aquaculture facilities).
- Manage/control the harvesting of *Juncus* and *Phragmites* (refinement of existing plan).
- Curb recreational activities in the lower reaches through zonation and improved compliance (i.e. development of an Estuary Management Plan).
- Realign the protected area delineation with the EFZ to increase protection levels, including options for Stewardship/Contracted Conservation being undertaken on the North Bank. The system is a DFFE 30 x 30 priority targeted as part of uThukela MPA expansion.
- Manage disturbance to birds (e.g. closed areas, boating controls such as speed zones), including control of vehicle access at the mouth and promoting tourism (bird guides etc.) to reduce impacts and ensure the flow of benefits to the community.
- Remove/prevent sand-mining in the upper reaches of the system.
- Maintain hydrological connectivity by ensuring that roads and bridges do not impact tidal and river flows.
- Manage and control fires of riparian vegetation to protect mangroves.
- Remove invasive alien plants in the catchment to safeguard base flows to prevent mouth closure for periods longer than six to eight weeks and also prevent the water levels from going beyond 4m mean sea level (indicative of long closures).

Component/ indicator	TEC	TPC
Hydrology	C↑	Maintain TEC (>63%). Protect the flow regime to create the required habitat for birds, fish, macrophytes, microalgae and water quality (DWS, 2023c). River inflow patterns should not: ▪ Differ by more than 5% from that of Present State (MAR = 99.55 x10^6 m^3) (2022). ▪ Monthly river inflow <0.25 m^3/s for more than 1% of the time. ▪ Monthly river inflow between 0.25 - 0.5 m^3/s for more than 2% of the time. ▪ Monthly river inflow between 0.5 - 1.0 m^3/s for more than 29% of the time. ▪ Monthly river inflow between 1.0 - 15.0 m^3/s for less than 64% of the time. ▪ Monthly river inflow >15.0 m^3/s for less than 3% of the time.
Hydrodynamics	B/C	Maintain TEC (>73%). Maintain open mouth conditions to protect estuarine ecosystems and the associated habitat for birds, fish, macrophytes, microalgae and water quality (DWS 2015b; 2023c): ▪ Mouth closure occurs less than 2 - 4 weeks at a water level > 1.5 m mean sea level. ▪ Mouth closure occurs for less than 2 years out of ten. ▪ Mouth closure occurs between September and March. ▪ No changes in tidal amplitude at the tidal gauge of more than 20% from Present State (2015).
Physical habitat		Maintain the Target EC (>78%). Protect estuarine sediment distribution suitable habitat for estuarine biota: ▪ River inflow distribution patterns (flood components) should differ by <20% (in terms of magnitude, timing and variability) from that simulated for the present state (refer to DWS, 2015b). ▪ Suspended sediment concentration in river inflow should deviate by <20% of the sediment load-discharge relationship of the present state (refer to DWS, 2015b). ▪ No deviation in sedimentation and erosion patterns in the estuary to occur from the present baseline (refer to DWS, 2015b).

(sediments)	**B**	Changes in sediment grain size distribution patterns not to cause exceedance tolerance of benthic invertebrates: ▪ Median bed sediment diameter should not deviate by more than a factor of two from levels of the present baseline (refer to DWS, 2015b). ▪ Sand/mud distribution in the middle and upper reaches should change by <20% from the present baseline (refer to DWS, 2015b). ▪ Changes in tidal amplitude at the tidal gauge should be <20% from the present baseline (refer to DWS, 2015b) as a result of sediment processes.
Water quality (salinity)	**B**	Maintain TEC (>78%). Salinity regime to maintain TEC for dependent biotic components (DWS, 2023c). **Estuary open:** ▪ Salinity values <5 in the upper reaches (End of Zone C / beginning of Zone D) of the estuary. ▪ Salinity values <30 in middle reaches (Zone C) during the low flow season. **Estuary Closed:** ▪ Salinity values <10 in the upper reaches (End of Zone C/ beginning of Zone D) of the estuary. ▪ Salinity values >10 in middle reaches (Zone C). ▪ Salinity values >15 in the lower reaches (Zone A & B). **Average estuary salinity:** ▪ Salinity values >23 in Zone A. ▪ Salinity values <16 in Zone B. ▪ Salinity values <11 in Zone C. ▪ Salinity values <3 in Zone D.
Water quality (general)	**C**	Maintain the TEC (>63%). Water quality to be suitable for maintaining the TEC for dependent biotic components (DWS, 2023c). **River inflow:** ▪ 6 < pH > 8.5 consistently over 2 months. ▪ DO >6 mg/l. ▪ Turbidity: <15 NTU (low flow). ▪ Turbidity: High flows naturally turbid. ▪ Flow <5 m^3/s (closed states): Measured DIN <100 µg/l; Measured DIP <20 µg/l. ▪ Flow >5 m^3/s (open states): Measured DIN <130 µg/l; Measured DIP <20 µg/l. ▪ Toxic substances (water): See **Table A1** in **Appendix A**. ▪ Toxic substances (sediment): See **Table A2** in **Appendix A**. **Estuary:** ▪ Average turbidity <10 NTU (low flow). ▪ Turbidity high flow, naturally turbid. ▪ 6.0 < pH > 8.5. ▪ Average DO >5 mg/l in a sampling survey in surface water. ▪ Flow <5 m^3/s (closed states): Measured DIN <20 µg/l (should be depleted as limiting nutrient); Measured DIP <50 µg/ℓ (may reflect some accumulation). ▪ Flow >5 m^3/s (open states): Measured DIN <100 µg/l; Measured DIP <20 µg/l. ▪ Toxic substances (water): See **Table A1** in **Appendix A**. ▪ Toxic substances (sediment): See **Table A2** in **Appendix A**. **For recreational use areas in estuary (see details in DEA, 2012):** ▪ Enterococci <185 counts per 100 ml (90 percentile), and ▪ *E. coli* <500 counts per 100 ml (90 percentile).
Microalgae	**C**	Maintain the TEC (>63%) through (DWS, 2023b): Maintaining the current composition, richness, and abundance of phytoplankton and benthic microalgal assemblages. No harmful algal bloom (HAB) species, unless constrained to Zone A during open mouth conditions (i.e., marine origin). **Phytoplankton:** ▪ 90^{th} percentile value (i.e., entire estuary) for phytoplankton biomass <15 µg Chl-*a* l^{-1}. ▪ No presence of bloom conditions (represented by values >20 µg Chl-*a* l^{-1}); even in isolated instances. ▪ No presence of potentially HAB-forming taxa (except during open mouth conditions and constrained to Zone A?). **Benthic Microalgae:** ▪ Average MPB biomass <50 mg Chl-*a* m^2. ▪ Average benthic diatom diversity (H') >3.

		(Based on average values recorded throughout estuary)
Macrophytes	**B/C**	Maintain the TEC (>73%) through: ▪ Maintain the distribution of macrophyte habitats to present baseline, particularly the large Swamp Forest stands (> 159 ha) and the presence of submerged macrophytes. (refer to **Appendix B** and DWS, 2023c). ▪ Less than 10% change in the area covered by different macrophyte habitats, especially mangroves, Swamp Forest and submerged macrophytes. ▪ Invasive plants (e.g. syringa berry, Spanish reed, black wattle, Brazilian pepper tree) are largely absent from the riparian zone. ▪ No unvegetated, cleared areas along the banks. ▪ Floating invasive aquatics observed in the upper estuary reaches. Macroalgae cover <20% of estuarine water surface area. ▪ No extensive land cover change in EFZ. ▪ **No additional** Sugarcane is present in the EFZ (2022) (Appendix A).
Invertebrates	**B**	Maintain the TEC (>78%) through (DWS, 2015b; 2023c): ▪ Maintain current zooplankton, zoobenthic and macrocrustacea abundance (including seasonal variation) and species richness in each of the Zones A - D. No decrease in abundance of zooplankton (<20%) in terms of numbers per m^2 from at least 3 sample sites, over 3 years, or for macrobenthos <15% change in numbers per m^2 from at least 5 sample sites, over 2 years. ▪ Species to include primarily estuarine affiliates but also freshwater representatives in the upper reaches and marine species at the mouth. ▪ Endemic or species with limited biogeographical distribution are maintained. No decrease in densities of *Paratylodiplax blephariskios* (<15% change in annual sample). To be targeted in Zone B, which is the limited habitat of this species. ▪ Abundance of all taxon groups are higher during spring before summer high flow periods and decline during the winter, low flow period. Macrofauna diversity seasonal ranges are 15 species (summer) to 40 species (winter). Zooplankton diversity ranges are 12 species (summer) to 20 (winter). Macrocrustaceans species ranges 8 - 15, indicating seasonal changes and recruitment to appropriate zones. ▪ Mouth to be open during peak recruitment periods for species with a life cycle dependent on an annual estuarine-marine link for larval and postlarval recruitment (mostly spring) for Penaeidae prawns and multiple Decapoda. ▪ Invasive snail *Tarebia granifera* distribution is limited to upper reaches with no occurrence outside of Zone D and <20% increase in abundance at any time of year. ▪ No shift in prawn community from marine dominated towards freshwater dominated assemblage. <20% decrease in relative abundance of estuarine dependent marine macrocrustaceans in Zones B - C, and no loss of marine species.
Fish	**B**	Maintain the TEC (>78%) through (DWS, 2015b; 2023c): ▪ Declines of <20% abundance (to be defined as an average with prediction limits) of marine estuarine-opportunist species and estuarine species as juveniles. ▪ Healthy transitional marine-estuary waters are maintained with good connectivity down the full length of the historic estuary and into the marine environment. Mullet do not occur throughout the system (all zones). All of the following mullet species occur in the system, *Pseudomyxus capensis, Mugil cephalus, Planiliza alata* (dominant in the upper reaches), *Osteomugil cunnesius, Planiliza macrolepis, Chelon dumerilii* (dominant in the lower reaches) at a full array of size classes. ▪ Marine estuarine-opportunist species should occur throughout Zone A and into the lower reaches at least of Zones B. The following species occur in these reaches: *Bothus pantherinus* (or *Pseudorhombus arsius*), *Caranx* spp., *Chelonodon laticeps, Drepane longimana, Hilsa kelee, Platycephalus indicus, Pomadasys kaakan, Sillago sihama, Sphyraena jello, Stolephorus* spp, *Thryssa* spp. ▪ All zones (A - D) of the estuary should function as high value nursery habitat to a diversity of marine estuarine-dependent species. All of the following species (in addition to the mullet above) occur in the estuary in under normal (non-flood) flow conditions: *Leiognathus equula, Acanthopagrus vagus, Pommadasys commersonnii, Terapon jarbua, Rhabdosargus holubi, Caranx* spp., *Gerres filamentosus, Gerres methueni. Monodactylus argenteus, Pegusa nasuta.* ▪ Permanent populations of estuarine resident species should occur throughout the system. All three species of Ambassid occur (*Ambassis ambassis, Ambassis natalensis* and *Ambassis dussumieri*). At least three species of estuarine goby occur excluding mudskipper *Periophthalmus* spp. *Gilchristella aestuaria* occurs. ▪ Freshwater species are limited in their distribution to the upper reaches of the estuary. *Oreochromis mossambicus* distribution does not extend into Zone B and A for more than two consecutive years. ▪ A good trophic basis must exist for zooplanktivores (including several Clupeid

		species), benthivores, fishes that specialise in feeding on larger crustaceans and piscivores. Shifts if relative abundance of <20% (to be defined as an average with prediction limits) of *Gilchristella aestuaria* and other zooplanktivorous species (*Thryssa* spp. and *Stolephorus* spp.), benthivores (e.g. *Gerres* spp. and *Leiognathus equula*), fishes that specialise in feeding on larger crustaceans (e.g. *Pomadasys commersonnii*) and piscivores (*Agyrosomus japonicus*, *Caranx* spp.). ▪ The species assemblage should comprise indigenous species only. No non-indigenous fishes occur.
Birds	**B**	Maintain the TEC (>78%). Maintaining avifaunal community that includes representatives of all original groups as per present baseline (refer to DWS, 2015b; 2023c): ▪ Resident pair of African Fish Eagle present and breed successfully. ▪ Rare and highly specialized species, i.e. White-backed Night Heron, African Finfoot and Mangrove Kingfisher: No significant reduction in numbers (<20%). ▪ Cormorants and/or herons/egrets: No significant reduction in numbers (<20%). ▪ Migratory waders, especially of estuarine-dependent species: No significant reduction in numbers (20%). ▪ Waterfowl (ducks and geese): No significant reduction in numbers (<20%). ▪ Whole waterbird community: No significant reduction in numbers (<20%). ▪ Tern and gull roost at mouth: No significant reduction in numbers (<20%).

Table 5.5: W12-Umhlathuze Estuary

PES:	D	REC:	D	TEC:	D

The following non-flow interventions will result in halting the negative trajectory and maintaining TEC:

Short term (<5 years): key interventions needed to restore/protect this important nursery area (e.g., sharks, rays and economically important fish species):

- Reduce very high fishing pressure (poaching and illegal gillnetting) by increasing compliance.
- Increase connectivity between lakes and downstream waters by reinstalling/installing functional fishways.
- Identify and protect areas in which the seagrass *Zostera capensis* reestablishment is occurring and reestablish/restore this important habitat near the yacht terminal.
- Improve access to uMhlathuze Estuary to allow for increased compliance, monitoring and research. Lack of access (through Port) leads to no oversight and results in no awareness of the high level of illegal activities.

Long term (5 - 10 years):

- Increase protection of mangrove areas by formal including in Sanctuary Protected Area (currently excluded from formal protection)
- Develop bird tourism (which will also improve access) that could provide livelihoods for local communities (e.g. Zululand Birding Route).
- Halt/restore declining water quality by instituting formal reticulation for urban development (supported through the Provincial Growth and Development Strategy) and implementing the best agricultural practices (through the implementation of farm plans) to reduce nutrient enrichment to the estuary, lakes and port.

Component/ indicator	TEC	TPC
Hydrology	**C**	Maintain TEC (>63%). Protect the flow regime to create the required habitat for birds, fish, macrophytes, microalgae and water quality (DWS, 2023d): ▪ River inflow patterns should not: Differ by more than 5% from that of Present State 2022 (MAR = 289.59 x10^6 m^3) ▪ Monthly river inflow >0.5 m^3/s for more than 60% of the time. ▪ Monthly river inflow >20.0 m^3/s for more than 30% of the time. ▪ River inflow distribution patterns (flood components) differ by more than 10% (in terms of magnitude, timing and variability) from that of the Present State (2022) (DWS, 2023d).
Hydrodynamics	**D/E**	Maintain TEC (>38%). Maintain mouth conditions to protect estuarine ecosystems and the associated habitat for birds, fish, macrophytes, microalgae and water quality: The mouth should remain permanently open through an artificial mouth.

Physical habitat (sediments)	**D**	Maintain the TEC (>43%). Protect estuarine sediment distributions suitable habitat for estuarine biota: ▪ River inflow distribution patterns (flood components) should differ by <10% (in terms of magnitude, timing and variability) from that of the Present State (2022) (DWS, 2023d). ▪ Suspended sediment concentration from river inflow should deviate by less than 20% of the sediment load-discharge relationship to be determined as part of baseline studies (Present State 2022) (DWS, 2023d). ▪ Findings from the bathymetric surveys undertaken as part of a monitoring programme should not indicate changes in the sedimentation and erosion patterns in the estuary have occurred (± 0.5 m).
		Changes in sediment grain size distribution patterns not to cause exceedance tolerance of benthic invertebrates: ▪ The median bed sediment diameter should deviate by less than a factor of two from levels to be determined as part of baseline studies (Present State 2022) (DWS, 2023d). ▪ Sand/mud distribution in the middle and upper reaches should change by <20% from Present State (2022) (DWS, 2023d). ▪ Changes in tidal amplitude at the tidal gauge should be <20% from the Present State (2022) (DWS, 2023d).
Water quality (salinity)	**C/D**	Maintain TEC (>58%). Salinity regime to maintain TEC for dependent biotic components (DWS, 2023d). **Average flow condition:** ▪ Zone C1: <30 (Lower reaches). ▪ Zone C2: <25 (Middle reaches). ▪ Zone C3: <15 (Upper reaches). **Droughts:** ▪ Zone C1: 35 (Lower reaches). ▪ Zone C2: <30 (Middle reaches). ▪ Zone C3: <20 (Upper reaches).
Water quality (general)	**D**	Maintain the TEC (>43%). Water quality to be suitable for maintaining the TEC for dependent biotic components (DWS, 2023d). **Mhlathuze River inflow:** ▪ 7.5 < pH > 8.5. ▪ DO >6 mg/l. ▪ Turbidity <15 NTU (low flow). ▪ Turbidity high flows: Naturally turbid. ▪ DIN <200 µg/l. ▪ DIP <20 µg/l ▪ Toxic substances (water): See **Table A1** in **Appendix A**. ▪ Toxic substances (sediment): See **Table A2** in **Appendix A**.A **Mhlathuze Estuary:** ▪ Average turbidity <10 NTU (low flow). ▪ Turbidity high flow: naturally turbid. ▪ 7.5 < pH > 8.5. ▪ DO >6 mg/l. ▪ Zone C1: DIN <50 µg/ℓ; DIP <10 µg/l. ▪ Zone C2: DIN <100 µg/ℓ; DIP <15 µg/l. ▪ Zone C3: DIN < 200 µg/ℓ; DIP <20 µg/l. ▪ Toxic substances (water): See Table A.1 in Appendix A ▪ Toxic substances (sediment): See Table A.2 in Appendix A **For recreational use areas in estuary (see details in DEA, 2012):** ▪ Enterococci < 185 counts per 100 ml (90 percentile), and ▪ *E. coli* < 500 counts per 100 ml (90 percentile).

Microalgae	**D**	Maintain the TEC (>43%). Maintain the current microalgal assemblages, with a view to improvement where possible. Specifically, the loss of connectivity between the Zones has markedly reduced species richness (loss of salinity gradient) and abundance (habitat loss) (DWS, 2023d). **Phytoplankton:** ▪ Richards Bay (Zone B): 90th percentile value for phytoplankton biomass <5 µg Chl-a l^{-1}. ▪ uMhlathuze Estuary (Zone C): 90th percentile value for phytoplankton biomass <10 µg Chl-a l^{-1}. ▪ Lakes (Zone A and D): 90th percentile value for phytoplankton biomass <15 µg Chl-a l^{-1}. ▪ No presence of bloom conditions (represented by values >20 µg Chl-a l^{-1}); even isolated instances. ▪ No presence of potentially HAB-forming taxa. **Benthic Microalgae:** ▪ Richards Bay (Zone B): Basin (Zone B2): Average MPB biomass <50 mg Chl-a m^2; and Mouth (Zone B1): Average MPB biomass >10 mg Chl-a m^2 (i.e., to prevent further loss of available habitat). ▪ uMhlathuze Estuary (Zone C) and Lakes (Zone A and D): Average MPB biomass <50 mg Chl-a m^2. ▪ Entire system: Benthic diatom diversity (H') >3.
Macrophytes	**D**	Maintain the TEC (>43%) through: ▪ Maintaining the distribution of macrophyte habitats, for example, the small Zostera bed in Zone B2. Less than 10 % change in the area covered by different macrophyte habitats, particularly mangroves, Swamp Forest and *Zostera capensis* beds (see **Appendix B** and DWS, 2023d). ▪ Maintaining the integrity of the riparian zone. No invasive plants within the EFZ, from terrestrial to floating aquatic invasives, particularly in the Lakes. No unvegetated, cleared areas along the banks. ▪ No invasive floating aquatic species present in the estuary e.g. water hyacinth.
Invertebrates	**E➔D**	Maintain the TEC (>23%) through: ▪ Macrobenthic and macrocrustacea abundance (including seasonal variation) and species richness in each estuary zones to not decrease by >20% and/or number of overall taxa not to decline to <100 in any sampling event. ▪ Macrobenthos to be represented by multiple taxa (from at least four phyla, including Annelida, Crustacea and Mollusca). ▪ Taxa indicative of stressed and/or organically enriched sediments should not dominate benthic abundance in all zones including A, C3 and D and whereby *Capitella capitata, Prionospio sexoculata* or *Oligochaeta* spp. represent <40% abundance at any site, during any season. ▪ Retain southern African and regionally endemic benthic species with no loss of any one of the core estuarine species for KZN estuaries (e.g., *Ceratonereis keiskama, Desdemona ornata, Dendronereides zululandica, Hymenosoma* sp.) during any survey. ▪ No loss of estuarine or marine macrocrustacea from Zones C2 and C1. *Penaeidae* prawns (at least 4 species) and crabs from *Portunidae* (at least 2 species) and *Grapsidae* (at least 2 species) to be present in all samples. ▪ Zone C3 should have consistent representation by catadromous prawns (*Macrobrachium, Varuna litterata*) and freshwater or freshwater tolerant carids (e.g., *Palaemon*). *Macrobrachium* and *Varuna* adults present in lower estuary in summer and *Varuna megalopae* are present in the estuarine channel during late autumn/early winter surveys. ▪ No shift in prawn community from balanced marine-freshwater assemblage towards freshwater or marine dominated assemblage. *Paratylodiplax blephariskios* to be present every year.

Fish	D	Maintain the TEC (>43%) through: ▪ Declines of <20% abundance (to be defined as an average with prediction limits) of marine estuarine-opportunist species and estuarine species as juveniles. ▪ Healthy transitional marine-estuary waters are maintained with good connectivity down the full length of the historic estuary and into the marine environment. Mullet do not occur throughout the system (all zones). All of the following mullet species occur in the system, *Pseudomyxus capensis, Mugil cephalus, Planiliza alata* (dominant in the upper reaches), *Osteomugil cunnesius, Planiliza macrolepis, Chelon dumerilii* (dominant in the lower reaches) at a full array of size classes. ▪ Functional connectivity is restored with Lakes Cubhu and Mzingazi. *Pseudomyxus capensis* occurs in Lakes Cubhu and Mzingazi. ▪ Marine estuarine-opportunist species should occur throughout Zone C1 and C2. The following species occur in these reaches: *Bothus pantherinus* (or *Pseudorhombus arsius*), *Caranx* spp., *Chelonodon laticeps, Amblyrhynchotes honckenii, Hilsa kelee, Platycephalus indicus, Pomadasys kaakan, Sillago sihama, Sphyraena jello, Stolephorus* spp, *Thryssa* spp. ▪ All zones of the estuary should function as high value nursery habitat to a diversity of marine estuarine-dependent species. All of the following species (in addition to the mullet above) occur in the estuary under normal (non-flood) flow conditions: *Leiognathus equula, Acanthopagrus vagus, Pommadasys commersonnii, Terapon jarbua, Rhabdosargus holubi, Caranx* spp., *Gerres filamentosus, Gerres methueni. Monodactylus argenteus, Pegusa nasuta.* ▪ Permanent populations of estuarine resident species should occur throughout the system. All three species of Ambassid occur (*Ambassis ambassis, Ambassis natalensis* and *Ambassis dussumieri*). At least three species of estuarine goby occur excluding mudskipper *Periophthalmus* spp. *Gilchristella aestuaria* occurs. ▪ Freshwater species are limited in their distribution to the upper reaches of the estuary. *Oreochromis mossambicus* distribution does not extend into Zone C2 or C1. ▪ A good trophic basis must exist for zooplanktivores (including several Clupeid species), benthivores, fishes that specialise in feeding on larger crustaceans and piscivores. Shifts in relative abundance of <20% (to be defined as an average with prediction limits) of *Gilchristella aestuaria* and other zooplanktivorous species (*Thryssa* spp. and *Stolephorus* spp.), benthivores (e.g. *Gerres* spp. and *Leiognathus equula*), fishes that specialise in feeding on larger crustaceans (e.g. *Pomadasys commersonnii*) and piscivores (*Agyrosomus japonicus*, *Caranx* spp.). ▪ The species assemblage should comprise indigenous species only. No non-indigenous fishes occur.
Birds	C	Maintain the TEC (>63%) by sustaining avifaunal community that includes representatives of all groups. ▪ Resident pair of African Fish Eagle present and breed successfully. ▪ Rare and highly specialized species, e.g. White-backed Night Heron, African Finfoot, Mangrove Kingfisher and Pels' Fishing-Owl: No significant reduction in numbers (<20%). ▪ Cormorants and/or herons/egrets: No significant reduction in numbers (<20%). ▪ Migratory Palearctic waders, especially of estuarine-dependent species: No significant reduction in numbers (<20%). ▪ Waterfowl (ducks and geese): No significant reduction in numbers (<20%). ▪ Whole waterbird community: No significant reduction in numbers (<20%). ▪ Tern and gull roost at mouth: No significant reduction in numbers (<20%). ▪ No loss of piscivores, especially swimming species, due to entanglement in gill-netting.

Table 5.6: W12-Inhlabane Estuary

PES:	E↓	REC:	D	TEC:	D

The following non-flow interventions will result in halting the negative trajectory and maintaining TEC:

- Develop an Estuary Management Plan (requirement of the Integrated Coastal Management Act) for the iNhlabane Estuarine Lake System to identify key actions and coordinate restoration efforts.
- Develop an Estuary Mouth/Maintenance Management Plan to facilitate skimming of the berm at the mouth (>3.0 m mean sea level) and/or artificial breaching of the estuary. Note: Removal of 5 m^3 of sediment at the estuary triggers the need for EIA approval.
- Remove accumulated organic sludge with earth-moving equipment/dredging from the bottom strata to improve water quality (i.e., oxygen levels) in the system. This is a once-off intervention if water quality and marine connectivity improve, else may need to be repeated every 10 to 20 years.
- Ensure connectivity between the estuary and the various parts of the lakes. The current fishways are not functional. Increase connectivity between the estuary and various parts of the lakes by flow releases from the weir and possible reengineering of the fishway.
- Prevent disturbance of riparian vegetation, including trampling, cattle, fire, and removal of alien vegetation.
- Deteriorating water quality represents a significant threat, the risk is especially high during the closed state. Address diffuse runoff from housing not on formal reticulation systems. Look into innovative ways to manage wastewater in this area, e.g., artificial reed beds. No wastewater discharges (sewage or industrial) should be discharged into the lakes or estuary. Proactive regional strategic planning (e.g. in Provincial Growth and Development Strategy) is needed in the area to reduce the impact of future developments, for example, the disposal of waste is a key issue -waste cannot run into closed estuaries and lakes. Institute agricultural best practices (through the development of farm plans) to reduce nutrient-rich agriculture return flow.
- Increase freshwater runoff to estuaries and lakes through management/removal of unauthorised wood lots/plantations and removal of invasive alien vegetation species.

Component/ indicator	TEC	TPC
Hydrology	D	Maintain TEC (>43%). Protect the flow regime to create the required habitat for birds, fish, macrophytes, microalgae and water quality (DWS, 2023e): ▪ River inflow distribution patterns should not differ by <5% from that of restoration scenario (MAR = 26.35 x106 m^3). ▪ Historical EWR: Fishway continuous discharges 0.1 m^3/s. To improve marine connectivity the estuary requires 175 000 m^3 to fill up and breach, historical EWR specifies 33 m^3/s for 9 hours every 2 years. Such flow release will also result in variable lake levels which will also benefit water birds in the lakes. Drawdown of the lakes should not be at levels that could separate North and South Lakes.
Hydrodynamics	C/D	Maintain TEC (>58%). Maintain mouth conditions to protect estuarine ecosystems and the associated habitat for birds, fish, macrophytes, microalgae and water quality: ▪ Mouth closure occurs for 25% of the time.
Physical habitat (sediments)	E→D	Maintain the TEC (>23%). Protect estuarine sediment distributions suitable habitat for estuarine biota (DWS, 2023e): ▪ River inflow distribution patterns (flood components) should differ by <20% (in terms of magnitude, timing and variability) from that of the Restoration scenario (2022). ▪ Suspended sediment concentration from river inflow should deviate by <20% of the sediment load-discharge relationship to be determined as part of baseline studies (Present State 2022). ▪ Findings from the bathymetric surveys undertaken as part of a monitoring programme should not indicate no changes in the sedimentation and erosion patterns in the estuary have occurred (± 0.5 m).
		Changes in sediment grain size distribution patterns not to cause exceedance tolerance of benthic invertebrates: ▪ Median bed sediment diameter deviates by less than a factor of two from levels of the present baseline (to be determined). ▪ Sand/mud distribution in the middle and upper reaches changed by <20% from the present baseline (to be determined). ▪ Changes in tidal amplitude at the tidal gauge change less than 20% from the present baseline (to be determined) as a result of sediment processes.

Water quality (salinity)	**E➔D**	Maintain TEC (>23%). Salinity regime to maintain TEC for dependent biotic components (DWS, 2023e). ▪ Bottom Salinity values >5 in the lower reaches (Zone A) of the estuary for 20% of the time.
Water quality (general)	**D**	Maintain the TEC (>43%). Water quality to be suitable for maintaining the TEC for dependent biotic components. **River inflow:** ▪ 7.5 < pH > 8.5 consistently over 2 months. ▪ DO >6 mg/l. ▪ Turbidity <15NTU (low flow). ▪ Turbidity high flows naturally turbid. ▪ Inflow <5 m3/s: NOx-N <200 µg/l over 2 months; NH3-N <30 µg/l over 2 months; PO4-P <50 µg/l over 2 months. ▪ Inflow >5 m3/s): Average DIN <300 µg/l; Average DIP <50 µg/l. ▪ Toxic substances (water): See Table A.1 in Appendix A ▪ Toxic substances (sediment): See Table A.2 in Appendix A Estuary: ▪ Average turbidity <10 NTU (low flow). ▪ Turbidity high flow, naturally turbid. ▪ 6.0 < pH > 8.5 in a sampling survey (to be verified by sampling). ▪ Average DO >6 mg/l in a sampling survey. ▪ Inflow <5 m3/s: Average NOx-N <200 µg/ℓ; Average NH3-N <30 µg/l; Average PO4-P <50 µg/l in a sampling survey. ▪ Inflows >5 m3/s: Average NOx-N <300 µg/ℓ; Average NH3-N <20 µg/ℓ; Average PO4-P <50 µg/ℓ in a sampling survey. ▪ Toxic substances (water): See Table A1 in Appendix A. ▪ Toxic substances (sediment): See Table A2 in Appendix A. For recreational use areas in the estuary (see details in DEA, 2012): ▪ Enterococci <185 counts per 100 ml (90 percentile), and ▪ E. coli <500 counts per 100 ml (90 percentile).
Microalgae	**D**	Maintain the TEC (>43%). Maintain the current microalgal assemblages, with a view to improvement. Specifically, the loss of marine connectivity in Zone A, as well as the loss of connectivity between the estuary and lakes, has markedly reduced species richness (mouth predominantly closed) and abundance (habitat loss) (DWS, 2023e). Phytoplankton: ▪ Estuary (Zone A): 90th percentile value for phytoplankton biomass <15 µg Chl-a l-1. ▪ Lakes (Zone B and C): 90th percentile value for phytoplankton biomass <10 µg Chl-a l-1. ▪ No presence of bloom conditions (represented by values >20 µg Chl-a l-1); even in isolated instances. ▪ No presence of potentially HAB-forming taxa. Benthic Microalgae: ▪ Estuary: Average MPB biomass <50 mg Chl-a m-2 and benthic diatom diversity (H') > 2.5. ▪ Lakes: Average MPB biomass <10 mg Chl-a m-2 (i.e., to prevent further loss of available habitat) and benthic diatom diversity (H') >2. (*Based on average values recorded throughout estuary)
Macrophytes	**C/D**	Maintain the TEC (>58%) through: ▪ Maintain the distribution of macrophyte habitats with less than 10% change in the area covered by different macrophyte habitats – Appendix B and DWS (2023e). ▪ Maintain the integrity of the riparian zone by flooding and low nutrient levels: No unvegetated, cleared areas along the banks. No invasive plants (e.g. syringa berry, Brazilian pepper tree, lantana, Chromolaena, Opuntia) are largely absent from the riparian zone. ▪ No invasive floating aquatic species present in the estuary e.g. water hyacinth. ▪ No sugarcane in the EFZ (estuarine functional zone). ▪ No development or land cover change (e.g. mining, agriculture, plantations) in EFZ.

Invertebrates	**E➔D**	Maintain the TEC category (>23%) through: ▪ Invertebrate taxon components or community attributes should not decline further at any site, in any season. Thresholds are >5% change in plankton or benthic invertebrate community metrics (e.g., richness, diversity and evenness) and decline in macrobenthic densities by >5% (no.m-2) in Zones A - C. ▪ Core of estuarine taxa to return to the system through over wash or open mouth conditions (Zone A), this is a potential recruitment pool for the remainder of the estuary and should be further present in at least the lower reaches of Zone A. ▪ A minimum of four core of estuarine taxa should always be present in Zone A with at least representatives from Mollusca. ▪ Distribution and relative abundance of invertebrate alien species (e.g., Tarebia granifera) to be < 25% of abundance at any site in Zones A - C. Invasive snails are limited to littoral margins of Zones B/C. ▪ Hypoxia tolerant Chironomidae and Oligochaeta should not dominate any site (DO <4 mg/l in >40% of the estuary). ▪ Freshwater prawns present in the estuary and lakes, and represented by multispecies communities, particularly in Zones B - C. ▪ Relict estuarine peracarids always found in Zones B-C with Halmrapseudes, Grandidierella and Americorophium >70% of site abundance. ▪ Species with the propensity to harbour organisms that are harmful to humans should not be the dominant macrofauna community.
Fish	**E➔D**	Maintain the TEC category (>23%) through: ▪ Declines of <20% abundance (to be defined as an average with prediction limits) of marine estuarine-opportunist species and estuarine species as juveniles. ▪ Zone A should function as an estuary and provide viable nursery habitat to a diversity of marine estuarine-dependent species. Rhabdosargus holubi and several species of Mugillidae dominate the assemblage. Ambassis ambassis, Ambassis natalensis, Glossogobius callidus, Planiliza alata, Planiliza macrolepis and Pseudomyxus capensis, Mugil cephalus, Osteomugil cunnesius, Rhabdosargus holubi, Terapon jarbua all occur in Zone A, and each of these species is sampled at least every second year. ▪ Connectivity between the lake and estuary should be restored and retained by a functional fishway. Several marine estuarine-dependent species including Planiliza alata, Planiliza macrolepis, Pseudomyxus capensis, Acanthopagrus vagus, Monodactylus argenteus occur in the lake (Zones B and C). ▪ The full length of the system (Zones A, B and C) should support permanent populations of estuarine species comprising a mix of zooplankton feeders as well as benthivores. Gilchristella aestuaria and Glossogobius callidus occur in all zones of the system ▪ Freshwater estuarine-opportunist species should not dominate the fish assemblage (by abundance) in the estuary (Zone A). ▪ Freshwater stenohaline fishes should mostly be restricted to the upper reaches above the weir (Zones B and C), but could occur infrequently, in low abundances in the upper reaches of the estuary (Zone A). They should not occur near the estuary mouth. ▪ The species assemblage should comprise indigenous species only. No non-indigenous fishes occur.
Birds	**D**	Maintain the TEC (>43%) through: ▪ No significant reduction in bird numbers (<20%), including breeding numbers, of any of three main waterbird guilds: swimming piscivores (cormorant and darters), large wading carnivores (e.g. herons and egrets) and swimming herbivorous waterfowl (ducks and geese). ▪ Maintain colonial breeding sites of swimming piscivores.

Table 5.7: W70-Umgobezeleni Estuary

PES:	B↓	REC:	A	TEC:	A/B

The following non-flow interventions will result in halting the negative trajectory and maintaining TEC:

- Urgent action is needed to create awareness of the importance of mangroves and protect these threatened ecosystem types (e.g., road through mangroves).
- Ensure protection of swamp forest that acts as critical habitat and ensure estuary water quality (black water system).
- Eradicate illegal gillnets in the lakes to enhance nursery function and support coastal fisheries.
- Eradicate and monitor the occurrence of alien invasive species, e.g., spotted bass *Micropterus punctulatus*.
- Increasing the protection of the lakes (e.g. Other Effective Conservation Measures, Stewardship, adjusting park boundaries) as part of it is excluded from formal protection.
- Prevent land use clearing in the estuary functional zone.
- Create interventions (e.g. restoring natural bank vegetation, artificial wetlands, reduce the impact of grazing) within a 500 m buffer zone around the estuary functional zone, where no buildup infrastructure, to improve the nutrient status and reduce sediment inputs to the estuary and lakes.
- Deteriorating water quality represents a significant threat; the risk is especially high during the closed state. Address diffuse runoff from housing not on formal reticulation systems. Look into innovative ways to manage wastewater in this area, e.g., artificial reed beds. No wastewater discharges (sewage or industrial) should be discharged into the lakes or estuary. Proactive regional strategic planning (e.g. Provincial Growth and Development Strategy) is needed in the area to reduce the impact of future developments, for example, the disposal of waste is a key issue -waste cannot run into closed estuaries and lakes. Institute agricultural best practices (through the development of farm plans) to reduce nutrient-rich agriculture return flow.
- Maintain hydrological connectivity by ensuring that roads and bridges, e.g. crossing the estuary near the mouth, do not impact tidal and river flows.
- Prevent removal of bark from mangroves and other trees.
- Prevent undue disturbance of birds.

Component/ indicator	TEC	TPC
Hydrology	B	Maintain TEC (>93%). Protect the flow regime to create the required habitat for birds, fish, macrophytes, microalgae and water quality: ▪ Maintain groundwater resources within 15% of natural levels. ▪ Groundwater stress index: 0.15.
Hydrodynamics	B	Maintain TEC (>78%). Maintain open mouth conditions to protect estuarine ecosystems and the associated habitat for birds, fish, macrophytes, microalgae and water quality: ▪ Maintain a permanent connection to the sea (with the exception of drought conditions). ▪ Ensure connectivity between all parts of the Estuarine Lakes system (e.g. no construction of weirs, no blockages of bridges, ensure adequate culverts/trough flow under existing bridges).
Physical habitat (sediments)	A/B	Maintain the TEC (>88%). Protect estuarine sediment distributions suitable habitat for estuarine biota: ▪ River inflow distribution patterns (flood components) should differ by <20% (in terms of magnitude, timing and variability) from that of the Present State (2022). ▪ Suspended sediment concentration from river inflow should deviate by <20% of the sediment load-discharge relationship to be determined as part of baseline studies (Present State 2022). ▪ Findings from the bathymetric surveys undertaken as part of a monitoring programme should indicate no changes in the sedimentation and erosion patterns in the estuary have occurred (± 0.5 m).
		Changes in sediment grain size distribution patterns not to cause exceedance tolerance of benthic invertebrates: ▪ The median bed sediment diameter should deviate by less than a factor of two from levels to be determined as part of baseline studies (Present State 2022). ▪ Sand/mud distribution in the middle and upper reaches should change by <10% from Present State (2022).
Water quality (salinity)	A/B	Maintain TEC (>88%). Salinity regime to maintain TEC for dependent biotic components. ▪ Estuary 5 - 20. ▪ Lakes <1.

Water quality (general)	**B**	Maintain the TEC (>78%). Water quality to be suitable for maintaining the TEC for dependent biotic components. **River Inflow and Estuary:** ▪ Average turbidity <10 NTU (low flow). ▪ 6.0 < pH > 8.5 in a sampling survey (to be verified by sampling). ▪ Average DO >6 mg/l in a sampling survey. ▪ DIN <100 µg/l. ▪ DIP < 30 µg/l. ▪ Toxic substances (water): See **Table A1** in **Appendix A**. ▪ Toxic substances (sediment): See **Table A1** in **Appendix A**. **For recreational use areas in estuary (see details in DEA, 2012):** ▪ Enterococci <185 counts per 100 ml (90 percentile), and ▪ *E. coli* <500 counts per 100 ml (90 percentile).
Microalgae	**B**	Maintain the TEC (>78%) through: **Phytoplankton:** ▪ Estuary: 90th percentile value for phytoplankton biomass <10 µg Chl-a l^{-1}. ▪ Lakes: 90th percentile value for phytoplankton biomass <15 µg Chl-a l^{-1}. ▪ No presence of bloom conditions (represented by values >20 µg Chl-a l^{-1}); even isolated instances. ▪ No presence of potentially HAB-forming taxa. **Benthic Microalgae:** ▪ Average MPB biomass <50 mg Chl-a m^{-2} and benthic diatom diversity (H') > 2.5.
Macrophytes	**B**	Maintain the TEC (>78%) through: ▪ Maintain the distribution of macrophyte habitats with less than 10% change in the area covered by different macrophyte habitats (**Appendix B**). ▪ Maintain the integrity of the riparian zone by flooding and low nutrient levels: No unvegetated, cleared areas along the banks. No invasive plants (e.g. syringa berry, Brazilian pepper tree, lantana, *Chromolaena*, *Opuntia*) are largely absent from the riparian zone. ▪ No invasive floating aquatic species present in the estuary e.g. water hyacinth. ▪ No sugarcane in the EFZ (estuarine functional zone). ▪ No development or land cover change (e.g. mining, agriculture, plantations) in EFZ.
Invertebrates	**A/B**	Maintain the TEC (>88%) through: ▪ Ensure the protection of full biodiversity, all functional groups in the estuarine and freshwater habitats. Endemic species are of special importance. ▪ No substantial reduction of populations of endemic species (falling below 50% of average abundance in estuary or lake). ▪ Declines of <10% in abundance of ingressing marine opportunistic species at the mouth (e.g., burrowing Urothoe spp.). ▪ uMgobezeleni Lake to support permanent populations of estuarine relict peracarid species (e.g., Halmrapseudes digitalis, Grandidierella lignorum). ▪ No additional alien invasive species (e.g., Meretrix or Corbicula spp.). ▪ No further ingression of invasive Tarebia granifera into estuarine reaches with the potential to outcompete native species. T. granifera to remain <20% of macrofauna abundance, especially at estuary head. ▪ Chironomidae spp. do not form the majority of macrofauna biomass and abundance. Equally, native Assimineidae should not form monospecific communities at any estuary site.
		Maintain the TEC (>78%) through: ▪ Declines of <20% abundance (to be defined as an average with prediction limits) of marine estuarine-opportunist species and estuarine species as juveniles. ▪ The estuary provides viable nursery habitat to a diversity of marine estuarine-dependent species. Several species of Mugillidae dominate the assemblage. Planiliza alata, Planiliza macrolepis, Pseudomyxus capensis, Mugil cephalus, Osteomugil cunnesius, Rhabdosargus holubi, Terapon jarbua all occur in the estuary. ▪ The estuary supports permanent populations of estuarine species. Ambassis ambassis, Ambassis natalensis, Glossogobius callidus occur in the estuary. ▪ Connectivity between the lake and estuary is maintained. Planiliza alata, Planiliza macrolepis, Pseudomyxus capensis, Acanthopagrus vagus, Monodactylus argenteus occur in the uMgobezeleni Lake. ▪ uMgobezeleni Lake supports permanent populations of estuarine species.

Fish	**B**	Gilchristella aestuaria and Glossogobius callidus occur in the lake. ▪ All trophic levels are represented in the fish assemblage. Detritivores (mullet) zooplanktivores (Ambassis spp., Gilchristella aestuaria), benthivores (Gerres spp., Pomadasys commersonnii) and piscovores (Caranx spp.) occur in the estuary. ▪ Freshwater stenohaline fishes are restricted to the upper reaches above the system. Enteromius and Lacustricola do not occur near the estuary mouth. ▪ The species assemblage should comprise indigenous species only. No non-indigenous fishes occur.
Birds	**A**	Maintain the TEC (>93%). Maintaining avifaunal community that includes representatives of all original groups as per present baseline: ▪ Resident pair of African Fish Eagle present and breed successfully. ▪ Rare and highly specialized species, e.g. White-backed Night Heron, Mangrove Kingfisher: No significant reduction in numbers (<20%). ▪ Cormorants and/or herons/egrets: No significant reduction in numbers (<20%). ▪ Waterfowl (ducks and geese): No significant reduction in numbers (<20%). ▪ Whole waterbird community: No significant reduction in numbers (<20%).

Table 5.8: W70-KOSI

PES:	A/B↓	REC:	A	TEC:	A

The following non-flow interventions will result in halting the negative trajectory and maintaining TEC (DWS 2016a):

- In line with existing fisheries management guidelines for the Kosi Lakes maintain the traditional subsistence fishery using traditional methods at sustainable levels (traditional methods refer to the back-facing traps and exclude gear such as diving masks and spear guns, augmented baskets (lined with nets / gill nets).
- Control and monitor crab harvesting (presently uncontrolled and sold in Durban).
- Control resource utilisation of reeds, sedges, and mangroves through the introduction of rest areas (refinement of existing plan).
- Control the burning of the floodplain vegetation, swamp forest and mangroves, e.g., through the development of an education programme.
- Prevent land-use change and control the clearing and draining of the peatlands and swamp forests for gardening.
- Control the usage of DDT, herbicides and pesticides in the catchment (a growing concern that the use of DDT and organic phosphates is having an impact because of their long resident time and vulnerability of the lake system); and
- Where not presently built-up (e.g. housing, roads), create a 2 km buffer around the estuary functional zone to protect groundwater from the impact of woodlots and commercial plantations.
- Capping the groundwater utilisation and reducing plantations – to be guided by a groundwater study that sets the level of restrictions on plantations and woodlots in the wider catchment to not impact the groundwater input into Kosi Estuarine Lake system.

Component/ indicator	TEC	TPC
Hydrology	**A**	Maintain TEC (>93%). Protect the flow regime to create the required habitat for birds, fish, macrophytes, microalgae and water quality: ▪ River and groundwater inflow distribution patterns should not differ by no more than 5% from that of from natural (DWS, 2016a). ▪ Groundwater stress index: 0.15.
Hydrodynamics	**A**	Maintain TEC (>93%) (DWS, 2016a). ▪ Maintain open mouth conditions to protect estuarine ecosystems and the associated habitat for birds, fish, macrophytes, microalgae and water quality. ▪ No mouth closure should occur. ▪ Tidal variation observed in Lake 1 and Lake 2 Changes in tidal amplitude at the tidal gauge of less than 10% from Present State (2015). ▪ Water level in the system is not above 1.3 m MSL for longer than a few days (not related to a flood).
Physical habitat	**A**	Maintain the TEC (>93%): ▪ Protect estuarine sediment distributions suitable habitat for estuarine biota. Changes in sediment grain size distribution patterns should not cause exceedance tolerance of benthic invertebrates with median bed sediment diameter deviates by no more than a factor of two from levels to be determined as part of baseline studies (Present State 2015). ▪ No change to the grain size distribution and individual organic content relationships within each lake compartment. Lake 4 and the Estuary must typically

(sediments)		support an average of 30% coarse sand, and Lakes 1 - 3 supporting fine to medium-grained sands with little to no mud (<3%). ▪ Findings from the bathymetric surveys undertaken as part of a monitoring programme should indicate no changes in the sedimentation and erosion patterns in the estuary have occurred (± 0.5 m). ▪ Suspended sediment concentration from river inflow should deviate by less than 20% of the sediment load-discharge relationship to be determined as part of baseline studies (Present State 2015) (DWS, 2016a)
Water quality (salinity)	**A**	Maintain TEC (>93%). Salinity regime to maintain TEC for dependent biotic components and should maintain a well-defined and typical gradient of (DWS, 2016a): ▪ Polyhaline/euhaline in the lower reaches of the mouth (typically marine and never less than 20). ▪ Mesohaline to euhaline in the mid/lower reaches to reflect the influence of the uKhalwe River. ▪ Lakes 1 and 2 should remain typically mesohaline, occasionally slightly polyhaline but for limited periods. ▪ Lake 3: Oligohaline state with salinity <5. ▪ Lake 4: Limnetic/oligohaline with salinity <1.
Water quality (general)	**A/B**	Maintain the TEC category (>88%) (DWS, 2016a). Water quality to be suitable for maintaining the TEC for dependent biotic components. River inflow: ▪ 7.0 < pH > 8 in any survey. ▪ DO >6 mg/l. ▪ Turbidity <10 NTU (low flow). ▪ Turbidity <15 NTU (higher flow – State 1). ▪ DIN <100 µg/l in 2 consecutive monthly sampling. ▪ DIP <10 µg/l in 2 consecutive monthly sampling. ▪ Toxic substances (water): See Table A1 in Appendix A. ▪ Toxic substances (sediment): See Table A2 in Appendix A. Estuary and Lakes: ▪ Average turbidity <5 NTU. ▪ 7.0 < pH > 8.5 at any station. ▪ DO >6 mg/l in surface samples (up to ~5 m water depth). ▪ Average DIN <100 µg/l in a sampling survey. ▪ Average PO4-P <10 µg/l in a sampling survey. ▪ No nuisance matter (plastics) is present in estuary, channels and lakes. ▪ Toxic substances (water): See Table A1 in Appendix A. ▪ Toxic substances (sediment): See Table A2 in Appendix A. For recreational use areas in estuary (see details in DEA, 2012): ▪ Enterococci <185 counts per 100 ml (90 percentile), and ▪ E. coli <500 counts per 100 ml (90 percentile).
Microalgae	**A**	Maintain the TEC (>93%) through: Phytoplankton: ▪ Estuary and Lake 1 - 2: 90th percentile value for phytoplankton biomass <5 µg Chl-a l-1. ▪ Lakes 3 - 4: 90th percentile value for phytoplankton biomass <10 µg Chl-a l-1. ▪ No presence of bloom conditions (represented by values >20 µg Chl-a l-1); even in isolated instances. ▪ No presence of potentially HAB-forming taxa; particularly in brackish regions. Benthic Microalgae: ▪ Estuary and Lake 1: Average MPB biomass <50 mg Chl-a m-2 and benthic diatom diversity (H') >3. ▪ Lake 2 - 4: Average MPB biomass <100 mg Chl-a m-2 and benthic diatom diversity (H') >2.5.

Macrophytes	**A/B**	Maintain the TEC (>88%) through (DWS, 2016a): ▪ Maintain the distribution and diversity of macrophyte habitats from the estuary to Lake 4. Lake 4 with a fringe of emergent reeds and sedges, large swamp forest areas on the west bank with Raphia australis (raphia palm) present. ▪ No greater than 10% change in the area covered by different macrophyte habitats due to salinity changes of greater than 5 in Lake 3 and greater than 1 in Lake 4 (Appendix B). ▪ Extensive submerged macrophyte beds in Lake 3 with a diversity of species such as Ceratophyllum demersum, Potamogeton sweinfurthii and Najas marina. ▪ No loss of any of the dominant / characteristics species listed under ecological specifications. For example - loss of mangroves and raphia palms due to inundation (i.e. water depth greater than 60 cm for three months). ▪ Dominant species throughout the lakes include Hibiscus tilieaceus (lagoon hibiscus) and Acrostichum aureum (mangrove fern). ▪ Six mangrove species present with Lumnitzera racemosa and Bruguiera gymnnorhiza as far upstream from the mouth as Lake 2. ▪ No Loss of mangroves from Lake 2 due to prolonged freshwater conditions (>1 year in Lake 2). ▪ No Loss of freshwater reeds, sedges and swamp forest species due to groundwater inflow reduction. ▪ No invasive floating aquatic species present in the estuarine lake e.g. water hyacinth, Azolla, Hydrilla, Pistia.
Invertebrates	**B↑**	Maintain the TEC category (>78%) through (DWS, 2016a): ▪ Maintain current zooplankton, macrobenthic and macrocrustacea abundance (including seasonal variation) and species richness in each of the estuary and four lake regions. ▪ <50% contribution by abundance and biomass of any individual non-invasive taxon that suggests a shift in ecological balance. ▪ No disappearance of any group or indicator taxon for each sediment and salinity habitat combinations (as generally depicted by different lake and channel environments). ▪ A highly diverse complement of invertebrates from multiple Phyla, Classes and other groups, including congenerics in the Copepoda, Isopoda, Amphipoda. All invertebrate surveys (across the benthos and plankton) should include species from a minimum of 7 Phyla and particularly the Annelida, Arthropoda and Mollusca. ▪ Maintain present day (2016/2022) ratios of fewer polychaetes to more crustaceans (Amphipoda, Isopoda) in the sediments of Lakes 1and 2. Shifts to a dominance of Amphipoda/Crustacea elsewhere indicates an abundance of microalgae or where existing prey-eating polychaetes increase suggests a loss of microphytobenthos for amphipods. ▪ Fossorial species and suspension feeders, algal grazers, detritus feeders, carnivores and omnivores should dominate guild types in the estuary and lakes 1 - 3. A switch to surface/sub-surface deposit feeders indicates a change in habitat (grain size distribution and/or food source). ▪ Kraussicallichirus kraussi biomass should remain stable and dominate shallow subtidal habitat of Lakes 1 and 2, only. Ingression of sand prawn into Lake 3 suggests a prolonged ingression of saline water into Lake 3. ▪ The open mouth conditions during peak recruitment periods for crabs and larval stages of other macrocrustacea and macroinvertebrate species (generally spring) will support life cycle requirements for species dependent on an annual estuarine-marine link for larval and post larval recruitment. ▪ Salinity states within each lake compartment are important for invertebrate diversity and function to retain a full complement and range of freshwater to marine. Fauna should range from polyhaline species in the lower reaches, mesohaline species in Lakes 1 and 2, brackish tolerant fauna in Lake 3 and oligohaline freshwater species only in Lake 4. ▪ Catadromous crustaceans e.g., Varuna litterata should be always found and particularly in Lake 1 and the estuary, during reproductive periods. ▪ The invertebrate community should comprise indigenous species only. No spread of Tarebia granifera to areas inside the system beyond Lakes 3 and 4, or to surrounding pans, streams or wetlands.

Fish	**B↑**	Maintain the TEC category (>78%) through (DWS, 2016a): ▪ Declines of <20% abundance (to be defined as an average with prediction limits) of marine estuarine-opportunist species and estuarine species as juveniles. ▪ Lake 4, freshwater seep areas and inflowing streams support a diversity of primary freshwater fishes, along with secondary freshwater species. These should include Hypseleotris dayi, several Enteromius and Lacustricola species. At least one species of stenohaline freshwater fishes (Enteromius spp., Lacustricola spp.) is sampled in Lake 4. No lower lower than average abundance (to be defined as a mean with prediction limits) of freshwater fishes. ▪ The system retains functionality and health as habitat for a diversity of estuarine resident species which includes pelagic and demersal groups, as well as species with a high degree of dependence on specific vegetation habitats. Estuarine resident species should comprise both pelagic and demersal groups. The former dominated
		by Gilchristella aestuaria, Ambassis spp., and to a lesser degree Hyporhamphus capensis. These fishes should occur in abundance and 100% frequency in Lakes 4, 3 and Mtando Channel at least. Benthic groups should include goby species (Croilia mossambica, Silhouettea sibayi, Glossogobius callidus with 100% frequency, but also other species such as Redigobius dewaali, Glossogobius giuris, Psammogobius biocellatus), as well as Eleotris spp. Hippichthys spp. should occur in suitable habitat (submerged aquatic vegetation). The average abundance should not be lower (to be defined as a mean with prediction limits) of any of the main estuarine resident species (Gilchristella aestuaria, Ambassis spp., Hyporhamphus capensis, Croilia mossambica, Silhouettea sibayi, Glossogobius callidus). Hippichthys spp. should always be present. ▪ The system acts as a nursery and feeding habitat to a diversity of benthic feeding estuarine dependent marine fishes. Marine estuarine-dependent species (Whitfield category IIa, IIb, Vb) should dominate fishes sampled in estuarine habitats (i.e., excluding reef areas near the system mouth). Thus, the benthic feeding estuarine dependant marine species should occur throughout the linked lakes system as in all size classes (juveniles, sub-adults and adults). Abundances should be greatest in Lakes 1 and 2. Species should include mullet (to Lake 4), Pomadasys commersonnii, Acanthopagrus vagus, Lutjanus argentimaculatus and Rhabdosargus sarba (to Lake 2 at least). Gerres spp. should occur to Lake 3 at least as juveniles. All of these fishes should occur with 100% frequency. Size distributions should reflect those that would be expected under reference conditions. ▪ Piscivorous species, including Sphyraena spp., Caranx spp. and Scomberoides spp. should occur as juveniles and sub-adults to Lake 2 at least, and juveniles of the former two species should penetrate into Lake 3. ▪ Alien fish species should not occur.
Birds	**A/B**	Maintain the TEC (>88%) through (DWS, 2016a): ▪ Maintain the abundance of birds using the system, with overall bird abundance – excluding terns - not less than 1000 in three consecutive counts (the terns are excluded as their numbers show huge inter-annual variability.) ▪ Maintain the existing composition of feeding guilds (2016). The proportion of each of the guilds should be about 30% and none should deviate by more than 20% for more than three consecutive counts (i.e. the guilds should each be within 10 and 50 %). The guilds are: (i) the birds that feed on large (>10 cm) fish; (ii) the birds that feed on small (<10 cm) fish; and (iii) the combined abundance of the vegetation feeders and the invertebrate feeders. ▪ Ensure the continued presence of specified habitat-specialist species (i.e. use them as indicators of health of the system). No loss of any of the following sensitive species from the system: Pel's Fishing owl; African Pygmy Goose; African Finfoot; Palmnut Vulture.

Table 5.9: St Lucia/UMfolozi

PES:	D ↓↑	REC:	B	TEC:	C (Short term) B (long term)

The following non-flow interventions will result in halting the negative trajectory and improving the system to reach the TEC (DWS, 2016b; DFFE, 2022):

- St Lucia/iMfolozi should have a single mouth and with manipulation of the mouth (artificial breaching or closing) kept to a minimum as it increases drought/climate change vulnerability.
- Restore low-lying areas of the iMfolozi floodplain to natural vegetation to allow for natural processes (e.g., carbon sequestration, mouth closure). A detailed remote sensing study is needed to identify these low-lying areas that are inundated during the wetter cycle.
- Remove alien vegetation around the Lake, estuaries, and rivers.
- Limit further natural deforestation such as in the Dukuduku Forest.
- Eradicate illegal gillnetting from the system.
- Eradicate and monitor the occurrence of alien invasive species (plants, inverts and fish).
- Strategic planning is needed to prevent urbanization in the catchments feeding directly into the Lake and the Narrows.
- Reduce commercial forestation in the lake catchments to increase low flows as much as possible.
- In the uMfolozi River catchment, land care practices should focus on the most critical sub-catchment areas to limit future erosion and land degradation which could further reduce low flows.
- Unauthorised river abstractions especially the Mkuze and uMfolozi Rivers must be eliminated. DWS will need to undertake further investigations into limiting further forestry applications in St Lucia and uMfolozi catchments and review license conditions in relation to buffer zones. Validation and verification of water use is required and possibly leading to compulsory licensing.

Component/ indicator	TEC	TPC
Hydrology	C	Maintain TEC (>63%). Protect the flow regime to create the required habitat for birds, fish, macrophytes, microalgae and water quality (DWS, 2016b). **Maintain freshwater inflow from all influent rivers at a level that is as close to natural as possible but not less than under present-day conditions.** Runoff from the uMfolozi is particularly important for ensuring that the estuary mouth functions in a manner that resembles natural conditions, while runoff from the smaller rivers that discharge directly into the St Lucia lakes (Mkuse, Hluhluwe, Msinene, Nyalazi, Mpate River) and groundwater inputs are important for maintaining water level, preventing an increase in the occurrence of hypersaline conditions, and for mouth dynamics ▪ Minimum discharge at DWS gauging station W2H032 in the uMfolozi at 3 m^3/s to maintain an open mouth (outside of a defined drought period).
Hydrodynamics	C	Maintain TEC (>63%). Maintain open mouth conditions to protect estuarine ecosystems and the associated habitat for birds, fish, macrophytes, microalgae and water quality (DWS, 2016b): ▪ Phases not alternating at regular intervals, i.e. decadal shifts, as this could compromise the survival of sensitive stages. ▪ Maintain the water level in Lake at Charters Creek > 0.35 m mean sea level (to be confirmed with surveys). ▪ The estuary mouth should not be breached artificially except in an emergency or when exceptional circumstances prevail. This will allow more river flow to the lake during droughts and when breaching occurs it will open up a large mouth with a large tidal flow. ▪ Variations in water level in the Lakes should correspond as closely as possible to natural. Mean water level in the Lakes under natural conditions is estimated to be around 0.55 m mean sea level (MSL) and dropped below 0.1 m MSL less than 16% of the time. ▪ Mean water level in the lakes should not drop below 0.1 m MSL for more than 20% of the time outside of a defined drought period
		Maintain the TEC (>63%). Protect estuarine sediment distributions suitable habitat for estuarine biota (DWS, 2016b): ▪ Channel morphology and bed level in the Lakes, Narrows and iMfolozi should resemble those under natural condition as far as possible, or where these have been substantially modified from natural, should not diverge further than Present Day. ▪ Change in bed level anywhere in the estuary by more than 10 cm away from natural or present-day conditions, as applicable, except following a major (>1:20 year flood).

Physical habitat (sediments)	**C**	Changes in sediment grain size distribution patterns not to cause exceedance tolerance of benthic invertebrates (DWS, 2016b): ▪ No change should occur to the grain size distribution and individual organic content relationships within the Narrows and each lake compartment. ▪ Findings from bathymetric surveys undertaken as part of a long-term monitoring programme should not indicate changes in the sedimentation and erosion patterns in the estuary have occurred (± 0.5 m).
		▪ Suspended sediment concentration from river inflow should deviate by less than 20% of the sediment load-discharge relationship to be determined as part of baseline studies (Present State 2023).
Water quality (salinity)	**D ↑**	Maintain TEC (>43%). Salinity regime to maintain TEC for dependent biotic components (DWS, 2016b). ▪ Salinity structure in the Lakes, Narrows and iMfolozi should correspond as closely as possible with the natural condition. Average salinity in the Lakes under natural conditions ranged from 6.5 - 9.6, and exceeded 20 less than 10% of the time. ▪ Salinity levels in the Lakes outside of a defined drought period, and averaged over an extended period do not exceeds 20. ▪ Hypersaline conditions (salinity >35) are recorded outside of a defined drought period.
Water quality (general)	**D ↑**	Maintain the TEC (>43%). Water quality to be suitable for maintaining the TEC for dependent biotic components. Water quality in the influent rivers and in the estuary itself should approximate natural conditions as closely as possible. Important risk factors include elevated pH and nutrient levels in the influent waters and low oxygen levels in the estuary, especially at night (DWS 2016b). **River Inflow (DWS 2016a):** ▪ DIN <100 µg/l. ▪ DIP <30 µg/l. ▪ Toxic substances (water): See **Table A1** in **Appendix A**. ▪ Toxic substances (sediment): See **Table A2** in **Appendix A**. **Estuary (DWS 2016a):** ▪ DO >4 mg/l. ▪ Average TSS <50 mg/l levels (in the Narrows over a period of one year). ▪ Toxic substances (water): See **Table A1** in **Appendix A**. ▪ Toxic substances (sediment): See **Table A2** in **Appendix A**. **For recreational use areas in estuary (see details in DEA, 2012):** ▪ Enterococci < 185 counts per 100 ml (90 percentile), and ▪ *E. coli* < 500 counts per 100 ml (90 percentile).
Microalgae	**D ↑**	Maintain the TEC (>43%) through: ▪ Maintain low phytoplankton biomass throughout the estuarine lake. Phytoplankton biomass: <5 µg Chl-a l^{-1} in the estuary and <15 µg Chl-a l^{-1} in the lake. ▪ The system must be free of algal blooms or floating algal scum. ▪ Maintain the distribution of phytoplankton groups throughout the estuary. ▪ *Cyanophyceae* and *Chlorophyceae* dominant when the estuary is fresher and flagellated-taxa are dominant when the system is in a brackish/marine state. Blooms of *Cyanobacteria* can also form under hypersaline conditions.
Macrophytes	**B**	Maintain the TEC (>78%) through: ▪ Maintain the distribution and diversity of macrophyte habitats throughout the estuarine lake system with a less than 20% change in the area covered by different macrophyte habitats due to salinity changes (See **Appendix B**). ▪ Extensive submerged macrophyte beds can form in the south lake around Catalina Bay and Makakatana. No loss of dominant / characteristic submerged macrophyte species should occur. ▪ No loss of freshwater reeds, sedges and swamp forest species due to groundwater inflow reduction. ▪ No invasive floating aquatic species present in the estuarine lake e.g. water hyacinth, *Azolla*, *Hydrilla* and *Pistia*.

Invertebrates	**D**	Maintain the TEC category (>43%) through (DWS, 2016b and unpublished data): ▪ Ensure protection of full biodiversity, at least four salinity -derived functional groups in the estuarine, marine, freshwater and hypersaline habitats. Endemic species are of special importance, particularly when restricted to the Lake St Lucia System. ▪ Endemic or species with limited biogeographical distribution are maintained (<50% of average). No decrease in densities of *Paratylodiplax blephariskios* (<25% change in annual sample). To be targeted in the Narrows, which is the limited habitat of this species and requires an open mouth for larval exchange. ▪ Maintain zooplankton, zoobenthic and macrocrustacea abundance (including seasonal variation) and species richness in each of the Lakes, Narrows and iMfolozi System. No decrease in abundance of zooplankton (<20%) in terms of numbers per m^{-2} from at least 3 sample sites per zone, over 2 years, or for macrobenthos <15% change in numbers per m^{-2} from at least 5 sample sites, per zone, per year. ▪ No alien invasive species with potential to outcompete native species. Especially those with fresh/brackish water affiliations e.g., *Tarebia, Corbicula*. ▪ *Tarebia granifera* distribution is limited to iMfolozi system and higher salinity of the lower narrows should prevent penetration into St Lucia.
		▪ Species to include primarily estuarine affiliates (lakes and False Bay) but also freshwater representatives in the iMfolozi reaches and marine species at the mouth. ▪ Characteristic micro-crustaceans to be always found especially Eriopisa chilkensis, Bolttsia minuta, Halmrapseudes cooperi and Afrochiltonia capensis in the Narrows and lower South Lake. ▪ Abundance of all taxon groups are higher during spring before summer high flow periods and decline during the winter, low flow period. Considering seasonality, macrofauna diversity should not decline to <50 taxa in the system, with South Lake showing the greatest diversity (<25 taxa). ▪ Mouth to be open during peak recruitment periods for species with a life cycle dependent on an annual estuarine-marine link for larval and postlarval recruitment (mostly spring) for a diversity of Penaeidae prawns and multiple Decapoda. ▪ No shift in prawn community from marine dominated (Penaidea) towards freshwater dominated assemblage (Caridea). <20% decrease in relative abundance of estuarine dependent marine macrocrustaceans in estuary and lakes, and no loss of marine species. ▪ No dominance of Insecta in zooplankton or sediment macrofauna, especially with species tolerant of poor environmental conditions (e.g., Chironomidae).
Fish	**C**	Maintain the TEC category (>63%) through (DWS, 2016b): ▪ 75% or more of the estuarine lakes system acts as a nursery to a diversity of EDCII species but particularly EDCIIa species. An abundance (to be defined as an average with prediction limits) of EDCIIa species present as young juveniles in spring and early summer (Acanthopagrus vagus, Agyrosomus japonicas, Elops machnata, Pommadasys comerssonnii, Rhabdosargus holubi, Terapon jarbua) is not reached. ▪ A good trophic basis exists for predatory estuarine dependant marine species (e.g. Agyrosomus japonicus, Elops machnata, Caranx spp.). ▪ Estuarine resident species are represented by a core group (Glossogobius spp., Oligolepis spp. Ambassis spp. and Gilchistella aestuaria). The four dominant mullet species (Mugil cephalus, Liza macrolepis, L. dumerelii and Valamugil cunnesius) occur throughout the system represented by a full array of size classes and present in all samples. ▪ Oreochromis mossambicus limited to the upper reaches under estuarine conditions. ▪ Species assemblage comprises indigenous species only. ▪ Connectivity to a healthy transitional marine-estuary-freshwater system is maintained for 75% of the time. ▪ Connectivity between the iMfolozi and St Lucia is maintained even during dry cycles. ▪ No decline in nearshore linefish catches (e.g. Rhabdosargus sarba) occurs (not related to gear changes or bag limit restrictions).

Birds	**C**	Maintain the TEC (>63%) (DWS, 2016b). ▪ The estuarine lake system should contain a diverse avifaunal community that includes representatives of all the original groups, and that sustains the populations for which the system has acquired its conservation status. ▪ Numbers of waterbirds on the entire system, other than those that have or are increasing regionally such as Egyptian Goose, should not decline below 50 species or below 8000 birds for three consecutive counts. ▪ Dramatic reduction (<20%) in numbers of any of the colonially-breeding waterbirds, especially if not balanced by the establishment/growth of colonies elsewhere in the region ▪ Dramatic reduction in the diversity (evenness) of the avifaunal community, e.g. due to dominance by a few species.

Table A1: Recommended water quality limits for water metal concentrations (as derived from DWAF, 1995)

Metal	Recommended water quality limits
Arsenic (As)	12 µg/ℓ
Cadmium (Cd)	4 µg/ℓ
Chromium (Cr)	8 µg/ℓ
Copper (Cu)	5 µg/ℓ
Lead (Pb)	12 µg/ℓ
Mercury (Hg)	0.3 µg/ℓ
Nickel (Ni)	25 µg/ℓ
Silver (Ag)	5 µg/ℓ
Zinc (Zn)	25 µg/ℓ

Table A2: Recommended water quality limits for sediment metal and DDT concentrations (as derived from UNEP/Nairobi Convention Secretariat and CSIR, 2009)

Metal	Recommended water quality limits (mg/kg dry weight)
Arsenic	7.24
Cadmium	0.68
Chromium	52.3
Copper	18.7
Lead	30.2
Mercury	0.13
Nickel	15.9
Silver	0.73
Tin as Tributyltin-Sn	0.005
Zinc	124
Pesticide	**Recommended water quality limits** (µg/kg dry weight normalized to 1% organic carbon)
Total DDT	3.89

GROUNDWATER - QUANTITY COMPONENT

GROUNDWATER RESERVE – WATER QUANTITY COMPONENT

The Usuthu-Mhlathuze catchment consists of 118 quaternary catchments as outlined in **Table 6.1**. The groundwater quantity component was determined using values obtained during the Classification of significant Water Resources and determination of Resource Quality Objectives for water resources in the Usuthu-Mhlathuze. Population values were obtained from the Directorate Water Services and were adjusted from the 2023 census data. To calculate the quantity of water for the BHN, the daily normative allowance of 25 litres per person per day, as set out in the Census 2023 dataset.

*Population was estimated from the average of the Tertiary Catchments W41, W42, W51, W52, W53, W54 and W55.

Table 6.1: Groundwater Quantity Component of the Reserve for the Usuthu-Mhlathuze catchment.

QUATERNARY	POPULATION	AREA (Km^2)	RECHARGE (Mm^3/a)	BHN (Mm^3/a)	GROUNDWATER BASEFLOW (Mm^3/a)	RESERVE (Mm^3/a)
W11A	48 967	445.15	39.56	0.45	8.53	8.98
W11B	18 593	126.82	11	0.17	2.44	2.61
W11C	46 204	383.02	40.52	0.42	7.26	7.68
W12A	34 459	623.31	27.23	0.31	9.05	9.36
W12B	36 434	656.33	35.93	0.33	9.6	9.93
W12C	33 008	570.07	23.38	0.30	8.53	8.83
W12D	44 983	568.94	25.02	0.41	8.7	9.11
W12E	30 947	248.59	20.45	0.28	3.76	4.04
W12F	239 741	387.31	53.37	2.19	13.92	16.11
W12G	33 560	326.36	14.24	0.31	4.92	5.23
W12H	82 637	484.57	44.68	0.75	7.34	8.09
W12J	126 703	332.85	46.59	1.16	11.95	13.11
W13A	40 043	275.84	28.35	0.37	3.95	4.32
W13B	24 470	222.76	31	0.22	3.03	3.25

QUATERNARY	POPULATION	AREA (Km^2)	RECHARGE (Mm^3/a)	BHN (Mm^3/a)	GROUNDWATER BASEFLOW (Mm^3/a)	RESERVE (Mm^3/a)
W21A	72 935	340.14	19.37	0.67	17.85	18.52
W21B	9 147	580.39	26.67	0.08	23.08	23.16
W21C	865	369.64	10.63	0.01	9.93	9.94
W21D	104 674	468.7	13.33	0.96	12.33	13.29
W21E	46 371	415.98	12.85	0.42	11.08	11.50
W21F	2 603	242.75	7.43	0.02	5.68	5.70
W21G	15 439	562.85	22.6	0.14	14.33	14.47
W21H	21 239	432.82	17.79	0.19	13.52	13.71
W21J	16 604	530.05	21.19	0.15	19.49	19.64
W21K	94 453	797.46	26.27	0.86	26.37	27.23
W21L	14 639	532.82	17.41	0.13	17.28	17.41
W22A	2 874	238.71	13.45	0.03	12.95	12.98
W22B	3 513	331.69	13.58	0.03	13.39	13.42
W22C	9 336	185.61	9.91	0.09	9.1	9.19
W22D	3 994	197.48	8.15	0.04	6.04	6.08
W22E	18 679	385.42	30.34	0.17	29.61	29.78
W22F	38 695	312.04	11.67	0.35	10.43	10.78
W22G	30 875	249.36	8.37	0.28	7.55	7.83
W22H	27 373	306.12	10.81	0.25	8.4	8.65
W22J	38 422	604.95	16.85	0.35	15.54	15.89
W22K	66 340	475.54	13.81	0.61	13.63	14.24
W22L	8 828	279.3	8.4	0.08	8.38	8.46
W23A	51 790	413.72	17.15	0.47	16.87	17.34
W23B	30 409	192.79	11.44	0.28	10.52	10.80
W23C	11 033	312.69	37.46	0.10	27.83	27.93

QUATERNARY	POPULATION	AREA (Km^2)	RECHARGE (Mm^3/a)	BHN (Mm^3/a)	GROUNDWATER BASEFLOW (Mm^3/a)	RESERVE (Mm^3/a)
W23D	58 944	247.88	26.32	0.54	17.63	18.17
W31A	22 943	369.72	16.76	0.21	14.16	14.37
W31B	13 610	304.28	12.66	0.12	11.32	11.44
W31C	1 313	171.56	9.1	0.01	8.6	8.61
W31D	2 456	294.57	12.49	0.02	10.64	10.66
W31E	3 724	334.19	9.65	0.03	3.23	3.26
W31F	38 271	583.35	14.01	0.35	5.17	5.52
W31G	11 461	519.77	11.26	0.10	3.76	3.86
W31H	12 642	322.59	6.94	0.12	2.8	2.92
W31J	21 632	552.6	12.78	0.20	5.13	5.33
W31K	35 883	855.31	18.77	0.33	7.68	8.01
W31L	2 447	321.38	8.03	0.02	3.25	3.27
W32A	13 270	417.4	18.75	0.12	9.31	9.43
W32B	31 090	934.44	89.22	0.28	38.24	38.52
W32C	35 282	728.23	21.55	0.32	8.06	8.38
W32D	39 467	267.22	8.67	0.36	4.6	4.96
W32E	18 577	455.92	16.99	0.17	7.74	7.91
W32F	17 625	187.34	9.56	0.16	3.53	3.69
W32G	94 793	647.5	36.63	0.86	15.43	16.29
W32H	36 207	1276.01	113.79	0.33	65.72	66.05
W41A*	4587	187.61	20.57	0.04	2.63	2.67
W41B	6 576	305.61	29.37	0.06	4.42	4.48
W41C	4 100	217.31	20.67	0.04	3.16	3.20
W41D	1 061	238.02	20.33	0.01	4.03	4.04
W41E	10 893	303.17	23.74	0.10	3.06	3.16

QUATERNARY	POPULATION	AREA (Km^2)	RECHARGE (Mm^3/a)	BHN (Mm^3/a)	GROUNDWATER BASEFLOW (Mm^3/a)	RESERVE (Mm^3/a)
W41F	3 489	343.46	25.49	0.03	3.51	3.54
W41G	1 402	95.8	6.39	0.01	0.99	1.00
W42A	4 381	397.37	46.75	0.04	5.43	5.47
W42B	2 992	416.55	39.21	0.03	6.95	6.98
W42C*	15292	376.56	41.61	0.14	6.14	6.28
W42D	18 212	489.41	41.79	0.17	8.29	8.46
W42E	34 671	231.74	18	0.32	3.97	4.29
W42F	2 817	305.53	23.96	0.03	5.24	5.27
W42G	24 599	248.17	18.34	0.22	2.51	2.73
W42H	4 163	272.9	17.99	0.04	2.82	2.86
W42J	11 346	290.46	17.61	0.10	3.02	3.12
W42K*	15292	415.98	30.16	0.14	4.23	4.37
W42L	19 842	250.66	16.23	0.18	2.59	2.77
W42M	29 894	391.57	23.11	0.27	6.77	7.04
W43C	878	395.08	26.24	0.01	6.49	6.50
W43F	48 213	631.45	14.33	0.44	4.09	4.53
W44A	5 811	254.71	7.45	0.05	1.34	1.39
W44B	60 527	486.09	11.96	0.55	2.45	3.00
W44C	105	314.3	6.29	0.00	1.51	1.51
W44D	1 896	236.43	4.38	0.02	0.96	0.98
W44E	3 843	711.45	13.68	0.04	3.02	3.06
W45A	104 879	1289.09	23.41	0.96	7.78	8.74
W45B	49 859	508.13	13.09	0.45	3.17	3.62
W51A	822	624.64	41.11	0.01	8.27	8.28
W51B	49 393	496.45	31.29	0.45	6.59	7.04

QUATERNARY	POPULATION	AREA (Km^2)	RECHARGE (Mm^3/a)	BHN (Mm^3/a)	GROUNDWATER BASEFLOW (Mm^3/a)	RESERVE (Mm^3/a)
W51C	7 546	677.71	47.7	0.07	9.99	10.06
W51D	62 528	527.43	36.12	0.57	7	7.57
W51E*	25739	274.28	21.47	0.23	4.2	4.43
W51F	8 408	589.36	49.1	0.08	10.16	10.24
W52A	23 668	289.44	17.79	0.22	3.85	4.07
W52B	24 717	336.19	20.6	0.23	4.92	5.15
W52C	1 276	177.84	10.71	0.01	2.59	2.60
W52D*	16554	119.29	9.37	0.15	1.8	1.95
W53A	5 321	547.48	34.42	0.05	7.95	8.00
W53B*	8194	218.54	15.48	0.07	3.2	3.27
W53C	18 945	315.62	24.97	0.17	4.66	4.83
W53D	317	314.71	21.45	0.00	4.61	4.61
W53E*	8194	421.87	36.96	0.07	7.2	7.27
W53F*	8194	447.34	39.19	0.07	7.64	7.71
W54A*	2762	251.08	15.73	0.03	3.33	3.36
W54B	1 276	281.94	19.73	0.01	3.74	3.75
W54C*	2762	107.45	7.72	0.03	1.58	1.61
W54D	2 783	138.75	12.2	0.03	2.38	2.41
W54E	4 226	194.12	19.62	0.04	3.28	3.32
W55A	4 680	688.7	39.75	0.04	9.82	9.86
W55B	13 560	217.83	14.66	0.12	3.11	3.23
W55C	18 688	532.2	48.66	0.17	13.9	14.07
W55D	27 719	270.86	24.39	0.25	7.08	7.33
W55E*	16162	161.23	15.43	0.15	4.16	4.31
W56A	31 536	359.72	65.68	0.29	12.8	13.09

QUATERNARY	POPULATION	AREA (Km^2)	RECHARGE (Mm^3/a)	BHN (Mm^3/a)	GROUNDWATER BASEFLOW (Mm^3/a)	RESERVE (Mm^3/a)
W56B	2 434	224.66	45.02	0.02	9.31	9.33
W57J	1 004	519.42	12.87	0.01	2.9	2.91
W57K	2 297	137.42	2.42	0.02	0.79	0.81
W70A	104 133	2577.95	205.55	0.95	63.61	64.56

GROUNDWATER RESERVE – WATER QUALITY COMPONENT

The groundwater quality of quaternary catchments with available hydrochemistry data was assessed against the domestic water target water quality ranges (Upper limit of Class I Water Quality [Drinking]) as shown in **Table 7.1.** A summary of the results for the groundwater quality classification at quaternary level in the terms of basic human needs requirements is outlined in **Tables 7.2 to 7.8. Table 7.9** shows the parameters of concern for groundwater quality**.**

Table 7.1: Physical and chemical water quality

Parameter	Target Water Quality Ranges [1)]				
	Units	Class 0	Class I	Class II	Class III
pH	pH units	6 – 9	5 – 6 & 9 – 9.5	4 – 5 & > 9.5 – 10	<4 & > 10
Electrical Conductivity	mS/m	< 70	70 - 150	150 – 370	> 370
Calcium as Ca	mg/l	< 80	80 - 150	150 – 300	> 300
Magnesium as Mg	mg/l	< 70	70 - 100	100 – 200	> 200
Sodium as Na	mg/l	< 100	100 - 200	200 – 400	> 400
Chloride as Cl	mg/l	< 100	100 - 200	200 – 600	> 600
Sulphate as SO_4	mg/l	< 200	200 - 400	400 – 600	> 600
Nitrate as NO_x-N	mg/l	< 6	6 - 10	10 – 20	> 20
Fluoride as F	mg/l	<0.7	0.7 – 1.0	1.0 – 1.5	> 1.5

1) Reference: Classification Systems in terms of – Water Research Commission: Quality of Domestic Water Supplies – Volume 1. Report No. TT 101/98. Second Edition. 1998.

Class 0: Water is classed as ideal drinking water, suitable for lifetime use. The values are essentially the same as the target water guideline in the South African Water Quality Guideline for Domestic Use.

Class I: Water is still safe for lifetime use; however, some mild health effects may, in very rare cases occur. They may also be some aesthetic effects.

Class II: Water allowable for limited short term or emergency use. Health effects may be felt more commonly. as compared to Class I, especially by those who are long term users of the water. Therefore. it is not recommended that the water be used continuously for life. This is only class in the guideline which is not specific in terms of the exact duration that the water can be used for. It states that it can be used for short term use; but does not define what length of time “short term” refers to.

Class III: Class III water will cause serious health effects, particular in infants and elderly people. Use of this water is not recommended for drinking purposes.

The following quaternary catchments with limited water quality data (dataset < 7) were excluded from the analysis, and no Groundwater Quality Component has been established:

- W11B, W12A
- W21B, W21C, W21F, W21G, W21J, W22A, W22B, W22C, W22D, W22E, W22G, W22H, W22J, W22L
- W31B, W31C, W31D, W31E, W31G
- W41A, W41B, W41C, W41E, W41F, W41G, W42A, W42C, W42E, W42F, W42G, W42H, W42J, W42K, W42L, W42M, W43C, W44A, W44C, W44D, W45B
- W51A, W51B, W51C, W51D, W51E, W51F, W52A, W52B, W52C, W52D, W53A, W53B, W53D, W53E, W53F, W54A, W54B, W54C, W54D, W54E, W55B, W55D, W55E, W56B, W57K, W57K

Table 7.2 Groundwater Quality Reserve: W11A, W11C, W12B, W12C, W12D, W12E, W12F, W12G

Chemical Parameter	Unit	Quaternary Catchments W11A, W11C, W12B, W12C											
		No. of Samples				Ambient GW quality or median[1)]				BHN Threshold[2)]	Groundwater Quality Reserve[3)]		
		W11A	W11C	W12B	W12C	W11A	W11C	W12B	W12C		W11A	W11C	W12B	W12C
pH		93	21	26	46	8.05	8.06	8.16	7.87	5.0 – 9.5	8.86	8.87	8.97	8.66
Electrical Conductivity	mS/m	93	21	26	46	45.00	104.30	46.70	37.55	<150	49.50	114.73	51.37	41.31
Calcium as Ca	mg/l	93	21	26	46	21.70	29.00	25.90	25.05	<150	23.87	31.90	28.49	27.56
Magnesium as Mg	mg/l	93	21	26	46	11.90	25.70	9.45	9.35	<100	13.09	28.27	10.40	10.29
Sodium as Na	mg/l	93	21	26	46	42.80	172.80	45.10	35.15	<200	47.08	190.08	49.61	38.67
Chloride as Cl	mg/l	93	21	26	46	37.60	**243.40**	33.40	39.35	<200	41.36	**243.40**	36.74	43.29
Sulphate as SO_4	mg/l	93	21	26	46	8.60	16.90	9.15	10.50	<400	9.46	18.59	10.07	11.55
Nitrate as NO_x-N	mg/l	93	21	26	46	0.96	0.58	0.42	0.37	<10	1.05	0.64	0.46	0.40
Fluoride as F	mg/l	93	21	26	46	0.38	0.44	0.29	0.33	<1.0	0.42	0.48	0.31	0.36
										GW Quality Class	Class 0	Class II	Class 0	Class 0
Chemical Parameter	**Unit**	**Quaternary Catchments W12D, W12E, W12F, W12G**											
		No. of Samples				**Ambient GW quality or median[1)]**				**BHN Threshold[2)]**	**Groundwater Quality Reserve[3)]**		
		W12D	**W12E**	**W12F**	**W12G**	**W12D**	**W12E**	**W12F**	**W12G**		**W12D**	**W12E**	**W12F**	**W12G**
pH		70	9	52	55	7.85	8.10	7.52	8.07	5.0 – 9.5	8.63	8.91	8.27	8.88
Electrical Conductivity	mS/m	70	9	52	55	31.55	**201.00**	59.80	**237.00**	<150	34.71	**201.00**	65.78	**237.00**
Calcium as Ca	mg/l	70	9	45	55	14.45	43.80	48.60	63.60	<150	15.90	48.18	53.46	69.96
Magnesium as Mg	mg/l	70	9	45	55	8.70	50.20	9.70	42.80	<100	9.57	55.22	10.67	47.08
Sodium as Na	mg/l	70	9	41	55	41.90	**333.50**	58.30	**400.10**	<200	46.09	**333.50**	64.13	**400.10**
Chloride as Cl	mg/l	70	9	52	55	23.00	**438.40**	107.70	**539.80**	<200	25.30	**438.40**	118.47	**539.80**
Sulphate as SO_4	mg/l	70	9	47	55	10.05	48.00	6.30	34.20	<400	11.06	52.80	6.93	37.62
Nitrate as NO_x-N	mg/l	70	9	52	55	0.51	0.40	0.05	0.22	<10	0.56	0.44	0.05	0.25
Fluoride as F	Mg/l	70	9	52	55	0.43	0.53	0.16	0.71	<1.0	0.47	0.58	0.18	0.78
										GW Quality Class	Class 0	Class II	Class I	Class III

[1)] Based on long term groundwater quality datasets (DWS Water Management System). Minimum number of analyses used for the statistical evaluation is seven (7).
[2)] Upper limit of Class I water quality [Drinking] (WRC *et al.* 2nd Edition. 1998. Volume 1: Assessment Guide); and
[3)] Median value plus 10%. 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 7.3 Groundwater Quality Reserve: W12H, W12J, W13A, W13B, W21A, W21D, W21E, W21H

Chemical Parameter	Unit	Quaternary Catchments W12H, W12J, W13A, W13B											
		No. of Samples				Ambient GW quality or median[1)]				BHN Threshold[2)]	Groundwater Quality Reserve[3)]		
		W12H	W12J	W13A	W13B	W12H	W12J	W13A	W13B		W12H	W12J	W13A	W13B
pH		82	27	30	16	8.11	7.93	7.93	7.65	5.0 – 9.5	8.92	8.72	8.72	8.42
Electrical Conductivity	mS/m	82	27	30	16	105.80	54.00	61.65	49.45	<150	116.38	59.40	67.82	54.40
Calcium as Ca	mg/l	82	27	30	16	35.20	47.30	22.65	11.05	<150	38.72	52.03	24.92	12.16
Magnesium as Mg	mg/l	82	27	30	16	15.05	8.10	19.85	9.35	<100	16.56	8.91	21.84	10.29
Sodium as Na	mg/l	82	27	30	16	165.30	49.40	75.90	57.70	<200	181.83	54.34	83.49	63.47
Chloride as Cl	mg/l	82	27	30	16	198.15	83.90	70.10	71.80	<200	217.97	92.29	77.11	78.98
Sulphate as SO_4	mg/l	82	27	29	16	28.25	11.90	17.80	13.25	<400	31.08	13.09	19.58	14.58
Nitrate as NO_x-N	mg/l	82	27	30	16	3.31	0.02	0.85	0.81	<10	3.64	0.02	0.93	0.90
Fluoride as F	mg/l	82	27	30	16	0.28	0.15	0.47	0.28	<1.0	0.30	0.17	0.51	0.30
										GW Quality Class	Class I	Class 0	Class 0	Class 0
Chemical Parameter	**Unit**	**Quaternary Catchments W21A, W21D, W21E, W21H**											
		No. of Samples				**Ambient GW quality or median[1)]**				**BHN Threshold[2)]**	**Groundwater Quality Reserve[3)]**		
		W21A	**W21D**	**W21E**	**W21H**	**W21A**	**W21D**	**W21E**	**W21H**		**W21A**	**W21D**	**W21E**	**W21H**
pH		8	10	7	7	7.80	7.33	7.96	7.93	5.0 – 9.5	8.57	8.06	8.76	8.72
Electrical Conductivity	mS/m	8	10	7	7	36.60	40.15	29.80	21.90	<150	40.26	44.17	32.78	24.09
Calcium as Ca	mg/l	8	10	7	7	25.50	7.50	22.70	10.90	<150	28.05	8.25	24.97	11.99
Magnesium as Mg	mg/l	8	10	7	7	9.75	4.90	10.50	8.40	<100	10.73	5.39	11.55	9.24
Sodium as Na	mg/l	-	10	7	7	-	59.20	25.40	15.50	<200	-	65.12	27.94	17.05
Chloride as Cl	mg/l	8	10	7	7	17.05	25.30	17.00	10.70	<200	18.76	27.83	18.70	11.77
Sulphate as SO_4	mg/l	-	10	7	7	-	10.30	5.40	8.50	<400	-	11.33	5.94	9.35
Nitrate as NO_x-N	mg/l	8	10	7	7	0.19	0.09	0.64	0.17	<10	0.21	0.10	0.70	0.19
Fluoride as F	mg/l	8	10	7	7	0.24	0.52	0.26	0.40	<1.0	0.26	0.57	0.29	0.44
										GW Quality Class	Class 0	Class 0	Class 0	Class 0

[1)] Based on long term groundwater quality datasets (DWS Water Management System). Minimum number of analyses used for the statistical evaluation is seven (7).
[2)] Upper limit of Class I water quality [Drinking] (WRC *et al.* 2nd Edition. 1998. Volume 1: Assessment Guide); and
[3)] Median value plus 10%. 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 7.4 Groundwater Quality Reserve: W21K, W21L, W22F, W22K, W23A, W23B, W23C, W23D

Chemical Parameter	Unit	Quaternary Catchments W21K, W21L, W22F, W22K												
		No. of Samples				Ambient GW quality or median[1)]				BHN Threshold[2)]	Groundwater Quality Reserve[3)]			
		W21K	W21L	W22F	W22K	W21K	W21L	W22F	W22K		W21K	W21L	W22F	W22K
pH		9	26	10	30	8.37	8.15	7.89	7.96	5.0 – 9.5	9.21	8.97	8.67	8.76
Electrical Conductivity	mS/m	9	26	10	29	128.00	**252.50**	65.25	**217.00**	<150	140.80	**252.50**	71.78	**217.00**
Calcium as Ca	mg/l	9	26	10	26	60.40	80.00	34.95	50.66	<150	66.44	88.00	38.45	55.73
Magnesium as Mg	mg/l	9	26	10	26	56.80	67.80	26.45	62.70	<100	62.48	74.58	29.10	68.97
Sodium as Na	mg/l	9	26	10	27	137.90	**363.90**	66.80	**321.46**	<200	151.69	**363.90**	73.48	**321.46**
Chloride as Cl	mg/l	9	26	10	25	176.80	**534.70**	61.55	**384.12**	<200	194.48	**534.70**	67.71	**384.12**
Sulphate as SO_4	mg/l	9	26	10	26	18.40	39.45	15.00	164.53	<400	20.24	43.40	16.50	180.98
Nitrate as NO_x-N	mg/l	9	26	10	25	4.84	1.07	0.72	3.69	<10	5.32	1.18	0.80	4.05
Fluoride as F	mg/l	9	26	10	24	0.96	0.89	0.68	0.54	<1.0	1.0	0.98	0.75	0.59
										GW Quality Class	Class I	Class II	Class 0	Class II
Chemical Parameter	**Unit**	**Quaternary Catchments W23A, W23B, W23C, W23D**												
		No. of Samples				**Ambient GW quality or median[1)]**				**BHN Threshold[2)]**	**Groundwater Quality Reserve[3)]**			
		W23A	**W23B**	**W23C**	**W23D**	**W23A**	**W23B**	**W23C**	**W23D**		**W23A**	**W23B**	**W23C**	**W23D**
pH		56	56	9	13	8.04	8.01	8.14	7.99	5.0 – 9.5	8.84	8.81	8.95	8.79
Electrical Conductivity	mS/m	56	56	9	13	**234.50**	**171.50**	55.10	64.80	<150	**234.50**	**171.50**	60.61	71.28
Calcium as Ca	mg/l	56	56	9	13	48.70	54.80	44.70	30.90	<150	53.57	60.28	49.17	33.99
Magnesium as Mg	mg/l	56	56	9	13	26.45	18.35	7.10	16.30	<100	29.10	20.19	7.81	17.93
Sodium as Na	mg/l	56	56	9	13	**388.95**	**252.70**	109.60	66.20	<200	**388.95**	**252.70**	120.56	72.82
Chloride as Cl	mg/l	56	56	9	13	**580.20**	**297.45**	59.60	91.00	<200	**580.20**	**297.45**	65.56	100.10
Sulphate as SO_4	mg/l	56	56	9	13	73.30	41.65	10.50	16.41	<400	80.63	45.82	11.55	18.05
Nitrate as NO_x-N	mg/l	56	56	9	13	0.11	0.43	0.70	0.28	<10	0.13	0.47	0.77	0.31
Fluoride as F	mg/l	56	56	9	13	0.46	0.37	0.26	0.22	<1.0	0.51	0.41	0.29	0.24
										GW Quality Class	Class II	Class II	Class I	Class 0

[1)] Based on long term groundwater quality datasets (DWS Water Management System). Minimum number of analyses used for the statistical evaluation is seven (7).
[2)] Upper limit of Class I water quality [Drinking] (WRC *et al.* 2nd Edition. 1998. Volume 1: Assessment Guide); and
[3)] Median value plus 10%. 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 7.5 Groundwater Quality Reserve: W31A, W31F, W31H, W31J, W31K, W31L, W32A, W32B

Chemical Parameter	Unit	Quaternary Catchments W31A, W31F, W31H, W31J											
		No. of Samples				Ambient GW quality or median[1)]				BHN Threshold[2)]	Groundwater Quality Reserve[3)]		
		W31A	W31F	W31H	W31J	W31A	W31F	W31H	W31J		W31A	W31F	W31H	W31J
pH		8	12	11	22	7.59	7.96	7.96	7.98	5.0 – 9.5	8.35	8.76	8.76	8.78
Electrical Conductivity	mS/m	8	12	11	22	55.30	**205.50**	**160.00**	**263.50**	<150	60.83	**205.50**	**160.00**	**263.50**
Calcium as Ca	mg/l	8	12	11	22	46.75	67.80	68.10	78.05	<150	51.43	74.58	74.91	85.86
Magnesium as Mg	mg/l	8	12	11	22	13.75	**108.85**	19.00	66.80	<100	15.13	**108.85**	20.90	73.48
Sodium as Na	mg/l	8	12	11	22	62.55	**289.00**	188.10	**337.00**	<200	68.81	**289.00**	200	**337.00**
Chloride as Cl	mg/l	8	12	11	22	15.05	**434.65**	**284.00**	**695.90**	<200	16.56	**434.65**	**284.00**	**695.90**
Sulphate as SO_4	mg/l	8	12	11	22	25.85	122.75	20.50	92.85	<400	28.44	135.03	22.55	102.14
Nitrate as NO_x-N	mg/l	8	12	11	22	0.06	0.31	0.36	0.25	<10	0.06	0.34	0.40	0.28
Fluoride as F	mg/l	8	12	11	22	0.47	0.65	0.60	**1.11**	<1.0	0.52	0.71	0.66	**1.11**
										GW Quality Class	Class 0	Class II	Class II	Class III
Chemical Parameter	**Unit**	**Quaternary Catchments W31K, W31L, W32A, W32B**											
		No. of Samples				**Ambient GW quality or median[1)]**				**BHN Threshold[2)]**	**Groundwater Quality Reserve[3)]**		
		W31K	**W31L**	**W32A**	**W32B**	**W31K**	**W31L**	**W32A**	**W32B**		**W31K**	**W31L**	**W32A**	**W32B**
pH		86	17	8	44	8.04	8.04	6.96	7.71	5.0 – 9.5	8.84	8.84	7.66	8.48
Electrical Conductivity	mS/m	16	17	8	43	**178.50**	134.00	112.10	**1014.00**	<150	**178.50**	147.40	123.31	**1014.00**
Calcium as Ca	mg/l	13	17	8	38	64.90	43.30	73.25	**381.89**	<150	71.39	47.63	80.58	**381.89**
Magnesium as Mg	mg/l	13	17	8	39	80.20	24.40	23.55	**318.05**	<100	88.22	26.84	25.91	**318.05**
Sodium as Na	mg/l	13	17	8	38	**294.30**	199.50	129.90	**1239.72**	<200	**294.30**	200	142.89	**1239.72**
Chloride as Cl	mg/l	13	17	8	37	**350.50**	**225.90**	177.00	**2579.91**	<200	**350.50**	**225.90**	194.70	**2579.91**
Sulphate as SO_4	mg/l	13	17	8	39	41.70	22.00	32.45	**443.20**	<400	45.87	24.20	35.70	**443.20**
Nitrate as NO_x-N	mg/l	13	17	8	38	1.72	0.17	0.31	0.05	<10	1.89	0.18	0.34	0.06
Fluoride as F	mg/l	13	17	8	36	0.38	0.78	0.36	0.06	<1.0	0.42	0.86	0.39	0.07
										GW Quality Class	Class II	Class II	Class I	Class III

[1)] Based on long term groundwater quality datasets (DWS Water Management System). Minimum number of analyses used for the statistical evaluation is seven (7).
[2)] Upper limit of Class I water quality [Drinking] (WRC *et al.* 2nd Edition. 1998. Volume 1: Assessment Guide); and
[3)] Median value plus 10%. 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 7.6 Groundwater Quality Reserve: W32C, W32D, W32E, W32F, W32G, W32H, W41D, W42B

Chemical Parameter	Unit	Quaternary Catchments W32C, W32D, W32E, W32F												
		No. of Samples				Ambient GW quality or median[1)]				BHN Threshold[2)]	Groundwater Quality Reserve[3)]			
		W32C	W32D	W32E	W32F	W32C	W32D	W32E	W32F		W32C	W32D	W32E	W32F
pH		16	18	9	23	7.86	7.90	7.90	8.28	5.0 – 9.5	8.64	8.69	8.69	9.11
Electrical Conductivity	mS/m	16	18	9	23	**228.00**	68.45	41.30	**175.00**	<150	**228.00**	75.30	45.43	**175.00**
Calcium as Ca	mg/l	16	18	9	23	64.85	20.05	17.40	45.90	<150	71.34	22.06	19.14	50.49
Magnesium as Mg	mg/l	16	18	9	23	69.60	13.40	13.60	46.80	<100	76.56	14.74	14.96	51.48
Sodium as Na	mg/l	16	18	9	23	**303.26**	62.40	41.30	**232.00**	<200	**303.26**	68.64	45.43	**232.00**
Chloride as Cl	mg/l	16	18	9	23	**434.39**	89.89	33.00	**296.10**	<200	**434.39**	98.88	36.30	**296.10**
Sulphate as SO_4	mg/l	16	18	9	23	39.95	9.35	11.10	17.40	<400	43.95	10.29	12.21	19.14
Nitrate as NO_x-N	mg/l	16	18	9	23	6.27	0.24	0.73	6.38	<10	6.89	0.27	0.81	7.02
Fluoride as F	mg/l	16	18	9	23	0.21	0.35	0.61	0.23	<1.0	0.23	0.38	0.67	0.25
										GW Quality Class	Class II	Class 0	Class 0	Class II
Chemical Parameter	**Unit**	**Quaternary Catchments W32G, W32H, W41D, W42B**												
		No. of Samples				**Ambient GW quality or median[1)]**				**BHN Threshold[2)]**	**Groundwater Quality Reserve[3)]**			
		W32G	**W32H**	**W41D**	**W42B**	**W32G**	**W32H**	**W41D**	**W42B**		**W32G**	**W32H**	**W41D**	**W42B**
pH		46	24	27	80	8.20	7.90	7.25	7.12	5.0 – 9.5	9.01	8.69	7.98	7.83
Electrical Conductivity	mS/m	46	24	27	80	**157.00**	46.40	13.90	36.95	<150	**157.00**	51.04	15.29	40.65
Calcium as Ca	mg/l	44	21	27	80	45.25	26.38	9.80	33.70	<150	49.78	29.02	10.78	37.07
Magnesium as Mg	mg/l	44	21	27	80	35.45	8.70	5.50	11.50	<100	39.00	9.57	6.05	12.65
Sodium as Na	mg/l	44	21	27	80	**251.70**	48.06	5.40	14.35	<200	**251.70**	52.86	5.94	15.79
Chloride as Cl	mg/l	46	24	27	80	**313.85**	80.50	3.90	3.65	<200	**313.85**	88.55	4.29	4.02
Sulphate as SO_4	mg/l	44	23	27	80	21.00	9.70	8.30	81.55	<400	23.10	10.67	9.13	89.71
Nitrate as NO_x-N	mg/l	46	24	27	80	0.72	0.18	0.21	0.10	<10	0.80	0.20	0.23	0.11
Fluoride as F	mg/l	44	23	27	80	0.40	0.18	0.16	0.18	<1.0	0.44	0.20	0.18	0.20
										GW Quality Class	Class II	Class 0	Class 0	Class 0

[1)] Based on long term groundwater quality datasets (DWS Water Management System). Minimum number of analyses used for the statistical evaluation is seven (7).
[2)] Upper limit of Class I water quality [Drinking] (WRC *et al.* 2nd Edition. 1998. Volume 1: Assessment Guide); and
[3)] Median value plus 10%. 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 7.7 Groundwater Quality Reserve: W42D, W43F, W44B, W44E, W45A, W53C, W55A, W55C

Chemical Parameter	Unit	Quaternary Catchments W42D, W43F, W44B, W44E												
		No. of Samples				Ambient GW quality or median[1)]				BHN Threshold[2)]	Groundwater Quality Reserve[3)]			
		W42D	W43F	W44B	W44E	W42D	W43F	W44B	W44E		W42D	W43F	W44B	W44E
pH		22	23	8	14	7.48	7.96	8.22	8.39	5.0 – 9.5	8.23	8.76	9.04	9.22
Electrical Conductivity	mS/m	22	23	8	14	14.05	138.00	97.30	140.00	<150	15.46	150	107.03	150
Calcium as Ca	mg/l	21	23	8	14	10.40	34.90	41.40	20.00	<150	11.44	38.39	45.54	22.00
Magnesium as Mg	mg/l	21	23	8	14	5.40	11.50	39.25	7.50	<100	5.94	12.65	43.18	8.25
Sodium as Na	mg/l	21	23	8	14	7.70	195.80	67.35	**244.70**	<200	8.47	200	74.09	**244.70**
Chloride as Cl	mg/l	22	23	8	14	3.50	**228.70**	26.95	**267.65**	<200	3.85	**228.70**	29.65	**267.65**
Sulphate as SO_4	mg/l	21	23	8	14	2.00	16.60	43.00	9.50	<400	2.20	18.26	47.30	10.45
Nitrate as NO_x-N	mg/l	22	23	8	14	0.55	0.02	4.11	0.05	<10	0.61	0.02	4.52	0.06
Fluoride as F	mg/l	21	23	-	14	0.10	**1.43**	-	**2.59**	<1.0	0.11	**1.43**	-	**2.59**
										GW Quality Class	Class 0	Class II	Class I	Class II
Chemical Parameter	**Unit**	**Quaternary Catchments W45A, W53C, W55A, W55C**												
		No. of Samples				**Ambient GW quality or median[1)]**				**BHN Threshold[2)]**	**Groundwater Quality Reserve[3)]**			
		W45A	**W53C**	**W55A**	**W55C**	**W45A**	**W53C**	**W55A**	**W55C**		**W45A**	**W53C**	**W55A**	**W55C**
pH		62	10	10	7	8.06	8.92	7.22	7.97	5.0 – 9.5	8.87	9.81	7.94	8.77
Electrical Conductivity	mS/m	62	10	10	7	132.25	24.70	13.00	22.10	<150	145.48	27.17	14.30	24.31
Calcium as Ca	mg/l	62	10	10	7	37.40	2.65	5.85	12.60	<150	41.14	2.92	6.44	13.86
Magnesium as Mg	mg/l	62	10	10	7	15.20	0.50	2.80	2.20	<100	16.72	0.55	3.08	2.42
Sodium as Na	mg/l	62	10	10	7	**218.00**	49.35	9.85	15.70	<200	**218.00**	54.29	10.84	17.27
Chloride as Cl	mg/l	62	10	10	7	**211.55**	24.10	3.55	6.50	<200	**211.55**	26.51	3.91	7.15
Sulphate as SO_4	mg/l	62	10	10	7	21.10	6.35	4.60	5.90	<400	23.21	6.99	5.06	6.49
Nitrate as NO_x-N	mg/l	62	10	10	7	0.08	0.17	0.23	0.48	<10	0.09	0.19	0.25	0.53
Fluoride as F	mg/l	62	10	10	7	**1.11**	**4.47**	0.13	0.43	<1.0	**1.11**	**4.47**	0.14	0.47
										GW Quality Class	Class II	Class III	Class 0	Class 0

[1)] Based on long term groundwater quality datasets (DWS Water Management System). Minimum number of analyses used for the statistical evaluation is seven (7).
[2)] Upper limit of Class I water quality [Drinking] (WRC *et al.* 2nd Edition. 1998. Volume 1: Assessment Guide); and
[3)] Median value plus 10%. 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 7.8 Groundwater Quality Reserve: W56A, W70A

Chemical Parameter	Unit	Quaternary Catchment W56A, W70A						
		No. of Samples		Ambient GW quality or median[1)]		BHN Threshold[2)]	Groundwater Quality Reserve[3)]	
		W56A	W70A	W56A	W70A		W56A	W70A
pH		9	117	7.75	7.54	5.0 – 9.5	8.53	8.29
Electrical Conductivity	mS/m	9	116	9.00	37.05	<150	9.90	40.76
Calcium as Ca	mg/l	9	102	5.10	17.43	<150	5.61	19.17
Magnesium as Mg	mg/l	9	98	2.00	5.86	<100	2.20	6.45
Sodium as Na	mg/l	9	103	7.50	21.50	<200	8.25	23.65
Chloride as Cl	mg/l	9	99	5.30	34.37	<200	5.83	37.81
Sulphate as SO_4	mg/l	9	103	5.20	4.80	<400	5.72	5.28
Nitrate as NO_x-N	mg/l	9	102	0.35	0.05	<10	0.38	0.06
Fluoride as F	mg/l	9	101	0.17	0.10	<1.0	0.19	0.11
						GW Quality Class	Class 0	Class 0

[1)] Based on long term groundwater quality datasets (DWS Water Management System). Minimum number of analyses used for the statistical evaluation is seven (7).
[2)] Upper limit of Class I water quality [Drinking] (WRC *et al.* 2nd Edition. 1998. Volume 1: Assessment Guide); and
[3)] Median value plus 10%. 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 7.9 Parameters of Concern for groundwater quality

Quaternary	Parameters of Concern
W11C	Chloride
W12E	Electrical Conductivity, Sodium, Chloride
W12F	Chloride
W12G	Electrical Conductivity, Sodium, Chloride
W12H	Electrical Conductivity, Sodium, Chloride
W21K	Electrical Conductivity, Sodium, Chloride
W21L	Electrical Conductivity, Sodium, Chloride
W22K	Electrical Conductivity, Sodium, Chloride

W23A	Electrical Conductivity, Sodium, Chloride
W23B	Electrical Conductivity, Sodium, Chloride
W23C	Sodium
W31F	Electrical Conductivity, Magnesium, Sodium, Chloride
W31H	Electrical Conductivity, Chloride
W31J	Electrical Conductivity, Sodium, Chloride, Fluoride
W31K	Electrical Conductivity, Sodium, Chloride
W31L	Chloride
W32A	Electrical Conductivity, Sodium, Chloride
W32B	Electrical Conductivity, Calcium, Magnesium, Sodium, Chloride, Sulphate
W32C	Electrical Conductivity, Sodium, Chloride
W32F	Electrical Conductivity, Sodium, Chloride
W32G	Electrical Conductivity, Sodium, Chloride
W43F	Chloride, Fluoride
W44B	Electrical Conductivity
W44E	Sodium, Chloride, Fluoride
W45A	Sodium, Chloride, Fluoride
W53C	Fluoride

The Secondary Catchments making up the Usuthu-Mhlathuze Catchment are shown below in Figure 1.

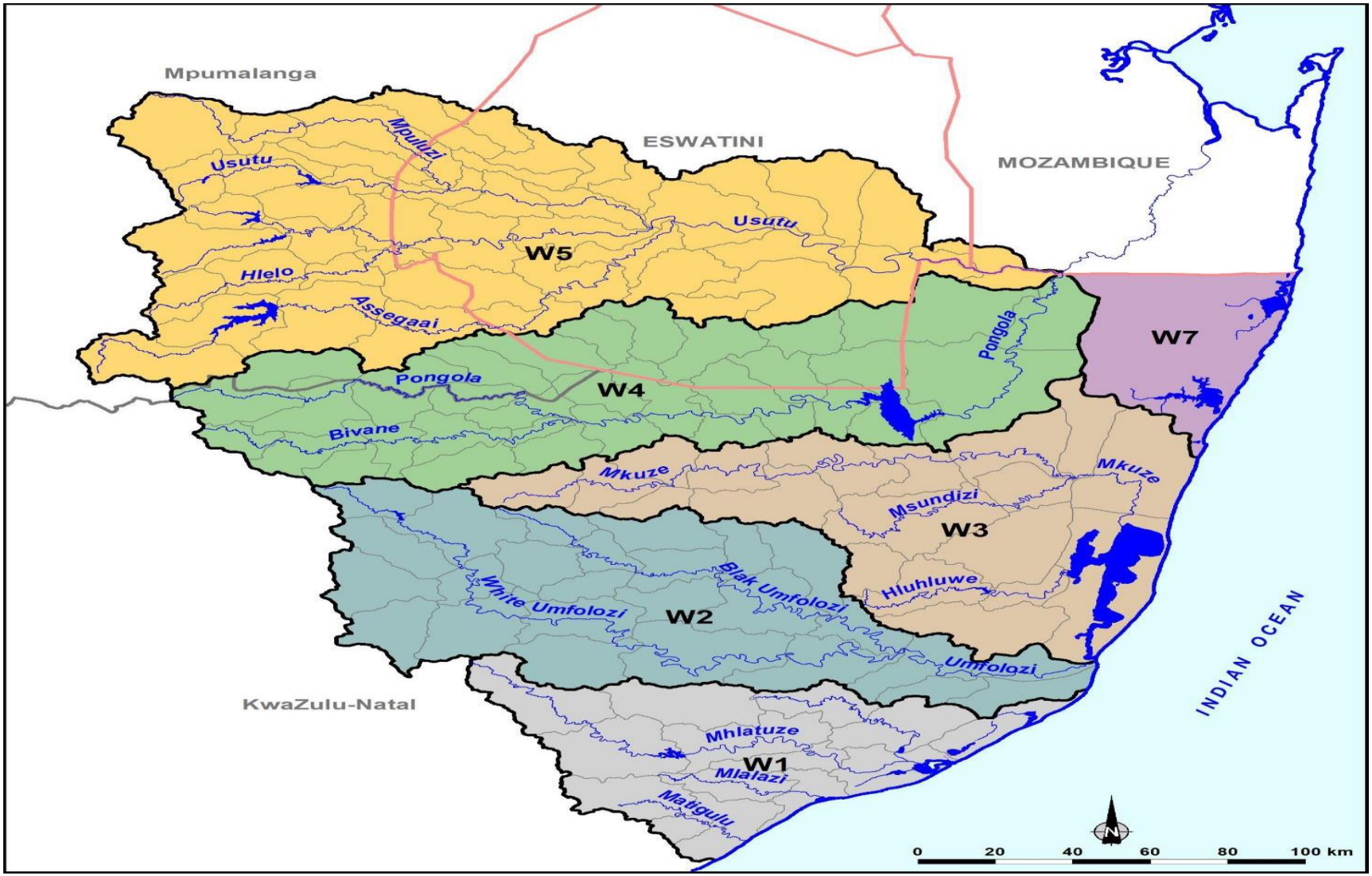

Figure 1: Locality map for the Usuthu-Mhlathuze catchment showing the Secondary Catchments.