

1 JBS06 (EWR 7: UPPER WILGE (WILGE RIVER))

The information is summarised from DWA (2008a,b; 2009a; 2010a).

1.1 SITE DESCRIPTION

MRU Wilge A extends from the origin of Wilge River to the confluence with the Nuwejaarspruit and EWR 7 is located in this reach. The site is a meandering floodplain area within an extensive reach, and generally little impacts are present, but Braamhoek pumped storage scheme is under construction in the upper reaches - approx 17 km upstream from the site. The meandering alluvial floodplain system has good morphological cues (ox-bows etc.) Only natural undercutting and slumping was observed on cutting bends of main channel and no channel manipulation was observed at site. Fish habitat, flow-depth categories and cover is well represented at site although very limited stable flow-sensitive habitats are available, although the site is representative of this reach. Non-flow related impacts may have a negative impact on fish species (alien predatory bass) which may reduce the ability of site to sustain these species, and therefore reflect adequate flow conditions. While the channel was sufficient for sampling the floodplain was too extensive. Macroinvertebrate habitat is very poor.

Location	EWR 7	Altitude	1692 m
Longitude	29.55827	Latitude	-28.20185
EcoRegion	Highveld/Southern Central Kalahari 11.03	Quaternary catchment	C81A
Water Management Area	Upper Vaal	Geomorphological zone	Lowland
			
EWR 7, Upper Wilge, April 2008			

1.2 PRESENT ECOLOGICAL STATE (PES)

Geom	This is a meandering floodplain area – representative of the whole reach. The system is a suspended load (fine silts and clays) dominated system and the site is near reference condition.
WQ	Data records from water quality station WMW (Wilge on Bethlehem Warden road) 2000 – 2002 were used for the physico-chemical PES assessment. There are elevated turbidity levels due to highly erodable soils and nutrient levels may be slightly elevated due to agriculture in the area.
Fish	It is perceived that all the expected fish species is still present within this RU. <i>L. aeneus</i> was the only indigenous species sampled at the site, but in very low abundance. The other two expected species (<i>B. anoplus</i> and <i>B. pallidus</i>) were absent, but have been sampled in the area previously. It is thought that their absence from the site and general low abundance in this reach is not habitat related (as habitat was optimal) but rather as a result of the presence of the

	predatory alien <i>M. salmoides</i> . The PES is D considering the impact of alien species. The habitat is however still optimal, and if alien species are not considered, a PES of B is calculated for this reach.
Inverts	<p>Apr 08: SASS5 score: 108 No of Taxa: 19 ASPT: 5.7</p> <p>The available instream aquatic biotopes were poor and limited to a small riffle upstream of a road bridge. As such, the site was not suitable for the application of SASS5. The riffle was made up mainly by wood debris that had accumulated upstream of the bridge, plus small stones and gravels in current that provided reasonable habitat for flow-dependent species. The site provides the best available sampling instream biotopes, although it is unrepresentative of the type of stream, which is a meandering lowland system that is naturally devoid of fast-flowing water. Oxbow lakes were abundant in the area, and although the diversity of invertebrates in each of these lakes was low, each lake supported a different biota, so the invertebrate diversity of the combined lakes was high.</p> <p>The diversity of aquatic invertebrates was good, although the standard method of assessment (SASS5) could not be used because of the limited riffle habitats available, so the confidence in the assessment is low. The presence of the mayfly <i>Adenophlebia auriculata</i> indicates excellent quality water. Taxa expected but not found were Turbellaria, Hydracarina, Hydraenidae and Hydrophilidae.</p>
Rip veg	The site falls within the Eastern Free State Sandy Grassland vegetation type which has a conservation status of "Endangered", with 55.3% remaining and only 1.8% protected. Reduced cover and changed species composition is present due to minor exotic species component.
Diatoms	Three diatom samples were taken during the site visit. One sample was taken upstream of the cross section at a roadbridge the other at the cross section one in an oxbow lake adjacent to EWR 7. The diatom samples indicate that there is minimal impact on this site, with the water being generally circumneutral, and oxygen rich.

1.3 MAIN IMPACTS AT THE SITE

	PES	Causes	Sources	F/NF
WQ	B	Elevated turbidity.	Erodable soils.	NF
		Slightly elevated nutrient levels.	Agriculture.	
Geom	A	System connectivity.	A few small farm dams are very slightly reducing connectivity.	NF
		Sediment supply.	Small change in sediment supply from the catchment due to a few small farm dams as well as fire and grazing in the upper catchment areas.	
Rip veg	A/B	Some reduced cover and changed species composition.	Minor exotic species component. Presence of roads in the wetland. Mowing of wetland grasses.	NF
Fish	B (D)	Decreased species diversity and abundance (especially small species) as result of presence of aggressive alien predator (<i>M. salmoides</i>).	Presence of aggressive alien predatory species (<i>M. salmoides</i>) naturally spreading and introduced for recreation/angling.	NF
Inverts	B	Predation by exotic fish.	<i>M. salmoides</i> .	NF
		Periodic elevated levels of ammonia.	Cattle Farming.	

1.4 RESULTS: PRESENT ECOLOGICAL STATE

Driver Components	PES	Trend
GEOMORPHOLOGY	A	Negative (B/C)
WATER QUALITY	B	Negative (B/C)
DIATOMS	B	
Response Components	PES	Trend
FISH	B (D)	Negative (D/E)
MACRO INVERTEBRATES	B	Stable
INSTREAM	B	
RIPARIAN VEGETATION	A/B	Stable
ECOSTATUS	A/B	

The PES EcoStatus of an A/B is mainly due to non-flow related impacts that include small dams for agriculture and exotic fish species (*M. salmoides*). It must however be noted that in lieu of the Braamhoek pump storage scheme development the trend is negative for Driver components. New dams (Eskom pumped storage scheme) coming online and will cause reductions in baseflows, as well as likely changes to moderate floods which will impact geomorphology while water quality may deteriorate due to increased turbidity and nutrient loading. It is estimated that the predatory alien *M. salmoides* may over the long term eradicate the indigenous barbs from the system, which would lead to a further decrease in ecological integrity.

1.5 SUITABILITY AS FUTURE BIOMONITORING SITE

EWR 7 is situated in the upper reaches of the Wilge River. As the Braamhoek pump storage scheme is under development this will impact the Wilge River and this site has a good location for detecting these impacts although suitable habitat for sampling is limited. It was noted during a field visit in 2009 to the Braamhoek pump storage scheme that biomonitoring is being conducted by Eskom as part of the Environmental Management Programme (EMP) requirements.

2 EWR 8: BAVARIA (WILGE RIVER)

The information is summarised from DWA (2008a,b; 2009a; 2010a).

2.1 SITE DESCRIPTION

EWR 8 in the Wilge occurs in MRU Wilge B which extends from Nuwejaarspruit to the Holspruit. The site is at the beginning of a bedrock gorge and not representative of most of the reach. The bedrock nature of the channel makes the banks insensitive to flow changes, and therefore not a good area for obtaining information on the condition of the river. There are no morphological cues in this predominantly fixed boulder dominated area. There are less than 10% exotic species at the site, and poplars are aggressive invaders locally. No channel manipulation was observed at site. Fish habitat, flow-depth categories and cover is well represented at site, but macroinvertebrate habitat is poor.

Location	EWR 8	Altitude	1573 m
Longitude	28.76778	Latitude	-27.80017
EcoRegion	Highveld/Southern Central Kalahari 11.03	Quaternary catchment	C82C
Water Management Area	Upper Vaal	Geomorphological zone	Lowland
			
EWR 8, Bavaria, December 2007			

2.2 PRESENT ECOLOGICAL STATE (PES)

Geom	The moderate floods have been reduced and high (although infrequent) flush releases are made from Sterkfontein Dam. The banks are cut extensively on both sides upstream of the site (but at the site, which is near a gorge, the banks are largely bedrock and not sensitive to flow changes). This condition is probably in response to the infrequent releases from Sterkfontein Dam. Large volumes of exotic woody debris at the site suggest that bank erosion is accelerating and eroding the trees from the bank.
WQ	Data records from water quality station C8H014Q01 (1984 – 1992; n = 93) and Rand Water data from C-WH: Harrismith (2003 – 2008; n = 56) were used for the physico-chemical PES assessment. The site is impacted by WWTWs (Harrismith, Industriqwa, Warden and Tshiane) and receives diffuse runoff from agricultural, urban (Harrismith) and industrial activities (Industriqwa). Weirs occur in the system for the purposes of abstraction for purification purposes, fish dams and tankers. Sterkfontein Dam releases potentially have an impact on turbidity levels, habitat loss, decreased temperature and oxygen levels. Physico-chemical data indicates that nitrogen and phosphate concentrations are relatively low. There are indications that EC and sulphate levels reach seasonal winter highs and metal contamination is below detection limits.
Fish	All of the expected fish species are still present within this Resource Unit although the FROC of some species have been reduced from reference conditions. The most prominent reduction in FROC is evident in the small barb species (<i>B. anoplus</i> , <i>Barbus pallidus</i> and <i>B. paludinosus</i>), most

	probably related to the impact of the predatory alien <i>M. salmoides</i> . Some deterioration in habitats due to decreased flows and sedimentation has also impacted the overall ecological integrity slightly.
Inverts	<p>Sep 07: SASS5 score: 118 No of Taxa: 22 ASPT: 5.4 Apr 08: SASS5 score: 115 No of Taxa: 23 ASPT: 5.0</p> <p>Biotopes were highly suitable for assessing the PES, particularly the stones-in-current (SIC) and stones-out-of-current (SOOC). However, flows were very low in September 2007, and there was limited habitat available. Biotopes that were notably scarce were sand and aquatic vegetation. The diversity of macroinvertebrates was relatively high, but most taxa were low scoring, so the ASPT was lower than expected. Taxa that were notably absent were high-scoring taxa that are sensitive to changes in water quality (Perlidae, Heptageniidae, Leptophlebiidae and Baetidae >2spp). Three species of Hydropsychidae were present.</p>
Rip veg	<p>The site occurs in the Eastern Free State Clay Grassland vegetation type which has a conservation status of Endangered (44.5% remaining and only 0.1% under protection).</p> <p>Marginal zone: Is dominated by non-woody vegetation (<i>C. marginatus</i> mainly), but exotic woody debris is abundant and reduces zone habitat.</p> <p>Upper zone: Is a mix of terrestrial grasses (soils) and grass/shrub mix where it is rocky and steeper. Extensive grazing occurs in this zone leading to vegetation loss.</p>
Diatoms	<p>Two diatom samples were taken at this site (August 2007 and April 2008) and 2003 diatom data was also available (Taylor, 2004).</p> <p>Both diatom samples indicate alkaline waters with low oxygen saturation and sodium based salinity (presence of <i>A. coffaeiformis</i>) problems. The 2003 diatom data shows that water quality fluctuated between a C and D EC during the year. The biological water quality is overall of poor quality and the current biological water quality is a C/D.</p>

2.3 MAIN IMPACTS AT THE SITE

	PES	Causes	Sources	F/NF
WQ	C	Elevated turbidity, habitat loss, cold water and low oxygen levels.	Sterkfontein Dam releases.	F
		Elevated N and P at times. Seasonal increase in salts.	WWTW, diffuse runoff from urban and industrial activities (Harrismith and Warden). Abstraction for water purification, tankers, fish dams and agriculture.	NF
Geom	C	Decreased transport capacity.	Moderate floods are smaller, but there are occasional high releases from Stekfontein Dam.	F
		Increased sediment supply.	Erosion of upstream tributaries and channel banks has increased the sediment load.	F/NF
		Slight reduction in connectivity and change in sediment structure.	High releases (specifically occasional high releases from Stekfontein Dam) have caused cut banks and probably coarsened/armoured channel beds, thus reducing connectivity.	
Rip veg	C	Vegetation removal.	Extensive grazing on upper zone.	NF
		Exotic species invasion.	< 10% low impact, but exotic woody debris is unnatural.	
		Water quantity changes.	Non-woody cover increased by reduced low flows and increased fine sediments.	F
Fish	C	Slightly altered habitat diversity (fluctuation from natural composition) as a result of flow modification.	Abstraction.	F
		Decreased overhanging vegetation as cover for fish.	Increased bank erosion related to agricultural and livestock farming and recreational activities.	NF
		Increased sedimentation result in deterioration of substrate as habitat (clogging interstitial spaces, loss of important spawning habitats, etc.).	Bank erosion and vegetation removal (grazing) contribute to increased sedimentation.	
		Decreased species diversity and abundance (especially small species) as result of presence of aggressive alien predator (<i>M. salmoides</i>).	Presence of aggressive alien predatory species (<i>M. salmoides</i>) naturally spreading and introduced for recreation / angling.	
		Decreased bottom substrate quality.	Impact of bottom feeding alien CCAR and siltation.	

	PES	Causes	Sources	F/NF
		Presence of migration barriers reduces migration success (breeding, feeding and dispersal) of some species.	Dams and various weirs. Also farm dams in tributaries reduce refuge areas.	
Inverts	C/D	Water quality.	WWTW, diffuse runoff from urban and industrial activities (Harrismith and Warden).	NF
		Decreased low flows.	Abstraction for irrigation.	F

2.4 RESULTS: PRESENT ECOLOGICAL STATE

Driver Components	PES	Trend
GEOMORPHOLOGY	C	Positive
WATER QUALITY	C	Stable
DIATOMS	C/D	
Response Components	PES	Trend
FISH	C	Stable)
MACRO INVERTEBRATES	C/D	Stable
INSTREAM	C	
RIPARIAN VEGETATION	C	Stable
ECOSTATUS	C	

The C PES EcoStatus is due to flow related impacts include alteration of hydrological regime due to interbasin transfers from Sterkfontein Dam, the LHWP, abstraction and agriculture. Non-flow related impacts include water quality problems, erosion and exotic species invasion. The improved management of Sterkfontein Dam releases has resulted in the cut banks on site becoming increasingly vegetated and therefore geomorphology has a positive trend.

2.5 SUITABILITY AS FUTURE BIOMONITORING SITE

The lower reaches of the Wilge is largely unregulated with only small dams for water supply to local users. Water users within this catchment comprise of both urban and irrigation user groups. EWR 8 is situated upstream of the Liebenbergsvlei confluence downstream of Warden. This site could be valuable for detecting upstream anthropogenic activities. As Sterkfontein releases and the LHWP impact on turbidity levels, habitat loss, temperature and oxygen levels this site should be monitored.
