

1 JBS04 (EWR 5: SCANDINAVIA (VAAL RIVER))

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

1.1 SITE DESCRIPTION

MRU Vaal E is delineated from the Vaal Barrage to the end of the Water Management Area (WMA). The site is 10 km upstream of the Mooi River confluence and the lowest EWR site situated in the Vaal River. The cross-section runs across a bedrock/boulder riffle area, but the reach characterised by generally long pools. Well developed alluvial terraces are present with minor landscaping and boulder piling. There is a high incidence of exotic species in some places with some landscaping occurring on the RB. Fish habitat, flow-depth categories and cover is well represented at site although fast habitats were limited and was supplemented by sampling another site. Macroinvertebrate habitat is moderate.

Location	EWR 5	Altitude	1309 m
Longitude	27.01367	Latitude	-26.93243
EcoRegion	Highveld/Southern Central Kalahari 11.08	Quaternary catchment	C23L
Water Management Area	Upper Vaal	Geomorphological zone	Lowland
			
EWR 5, Scandinavia, August 2007			

1.2 PRESENT ECOLOGICAL STATE (PES)

Geom	The site is a bedrock/boulder riffle area, but the reach is characterised by generally long pools. There are limited impacts at the site. Although flow regulation effects from Vaal Dam and the Vaal Barrage are still prominent, these are ameliorated by tributaries. Islands are still common in the reach, suggesting that sediment supply is not critically reduced. The site has pronounced alluvial terraces on the north bank.
WQ	Data records from water quality station C2H018Q01 (1979 – 2008; n = 1227) and Rand Water data from V17: Barrage outlet (2003 – 2008; n = 226) were used for the physico-chemical PES assessment. Turbidity is variable due to releases from the Vaal Barrage but the Barrage also allows for settlement. There are seasonal water quality changes due to high flushes from the Vaal Dam which negate the return flows from the WWTWs. It is suspected that the town of Parys is also a major point source polluter in this reach due to the uncompliant WWTW.
Fish	All the expected fish species is still present within this RU. The FROC of both <i>A. sclateri</i> and <i>L. kimberleyensis</i> have been reduced from reference conditions, probably related to deteriorated substrate condition (increased siltation and algal growth) as well as decreased flows (loss of fast habitats) and fluctuations and deteriorated water quality. The FROC of <i>L. umbratus</i> has been reduced, potentially related to loss of SD habitats (siltation and decreased flows). The FROC of <i>B. anoplus</i> , <i>B. trimaculatus</i> and <i>B. paludinosus</i> have also been reduced, potentially related

	<p>to the presence of the aggressive alien predator <i>M. salmoides</i> and other alien fish species contributes to the deterioration in habitat quality (<i>C. carpio</i> and <i>C. idella</i>). Alterations in slow habitats as a result of flow modification as well as loss of cover (vegetation as result of bank erosion and sedimentation of substrates) may also have contributed to their decline as well as the presence of hyacinth. Predation on indigenous fish larvae by <i>G. affinis</i> may also have an impact on the occurrence of smaller fish species.</p>
Inverts	<p>Aug 07: SASS5 score: 103 No of Taxa: 19 ASPT: 5.4 Apr 08: SASS5 score: 102 No of Taxa: 17 ASPT: 6</p> <p>The most notable taxa that were absent from this site were those that are sensitive to water quality changes. These included Perlidae, Ancylidae, Heptageniidae and Prosopistomatidae. The SASS scores are extremely low in relation to the quality of biotopes available. Overall the data indicate that the macroinvertebrate composition is driven mainly by deterioration in water quality, and elevated winter base flows. The abundance of water hyacinth is likely to have a major influence on oxygen levels, and this could partly explain why sensitive macroinvertebrates are absent from or scarce at this site. Physidae were recorded at the site in August 2007. The species was not recorded but it was presumably <i>Physa acuta</i>, which is an exotic species that could impact on local snail species. Elevated base flows during winter allow pest blackfly populations to overwinter, and this leads to major problems with outbreaks of blackflies, particularly in spring.</p>
Rip veg	<p>The current vegetation type is Rand Highveld Grassland, which is endangered with only 0.9% of the vegetation type protected and 58.5% remaining. There is reduced cover, abundance and species composition throughout all zones due to the presence of exotic species. Increased low flows facilitate more exotic woody species in lower zone and increased terrestrialization (<i>Acacia karoo</i>).</p>
Diatoms	<p>Three diatom samples were taken at this site (August 2007, January and April 2008) and 2003 diatom data was also available (Taylor, 2004). The data indicates high salinity levels due to mine water decants from Witwatersrand and high nutrient levels due to waste water treatment works discharges and informal settlement runoff. This has led to seasonal algal growth (rooted macrophytes, filamentous, exotic and floating). Diffuse runoff from un-sewered areas leads to seasonally high microbiological contamination. Chlorophyll-a values are seasonally high. High ammonia values are evident as well as occasional high metal values due to mining and industrial discharges into and directly downstream of the Vaal River Barrage. Water temperature is elevated due to warming due to weirs while there are diurnal fluctuations in DO due to algal growth and releases from the Vaal Barrage. SPI scores ranged between 6.9 – 9.9 for samples taken during 2007 – 2008 (moderate – bad water quality) and the overall biological water quality EC is a C/D. All samples indicated deteriorated water quality due to highly urbanised industrialised and intensely mined areas of Southern Gauteng. The 2003 data shows that water quality conditions deteriorate alarmingly to unacceptable levels for survival of biota, and general recreational activities (E/F EC) at Goosebay canyon and Schoemansdrift. Metal contamination is evident and the diatom communities of all three samples have a dominance of species that are tolerant of high to critical levels of pollution indicate industrially impacted waters.</p>

1.3 MAIN IMPACTS AT THE SITE

	PES	Causes	Sources	F/NF
Water Quality	E	High salinity. High nutrients which has led to seasonal algal growth – rooted macrophytes, filamentous, exotic and floating. Chlorophyll-a values seasonally high.	Mine water decants from Witwatersrand. WWTW treatment works discharges and informal settlement runoff. Mining and industrial discharges into and directly downstream of the Vaal River Barrage.	NF
		High microbiological contamination.	Diffuse runoff from unsewered areas leads to seasonally dense algal blooms and diurnal oxygen fluctuations. Input from Klip River and Rietspruit that are a combination of microbial input from uncompliant WWTW such as Sebokeng works and Parys and Vereeniging works as well as diffuse runoff from unserved areas.	
		High ammonia values.	Seasonal water quality changes due to high	
				F

	PES	Causes	Sources	F/NF
		Occasional high metal values.	flushes from Vaal dam which negate the return flows from the waste water treatment works.	
Geomorphology	C	Decreased transport capacity. Moderate floods are very reduced and prolonged elevated base flows.	Upstream dams (Vaal Dam and farm dams).	F
		Connectivity – loss of floods has reduced connectivity between active channel and upper islands/riparian zones.	Vaal Dam.	
		Sediment supply is altered due to dams and catchment erosion.	Erosion from the agricultural areas has increased sediment supply, and this might offset the effects of the Vaal Barrage and Vaal Dam.	NF
Rip veg	D	Reduced vegetation cover in marginal zone.	Increased low flows – Vaal Dam and Barrage.	F
		Facilitates more exotic woody species in lower zone and increased terrestrialization (<i>Acacia karoo</i>).		
		Reduced cover, abundance and species composition throughout all zones.	Exotic species.	NF
Fish	C	Altered habitat diversity (fluctuation from natural composition) as a result of flow modification.	Flow modification by Vaal Barrage, other sources of 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 substrate quality related to increased benthic growth.	Increased nutrients from point and diffuse sources.	
		Decreased water quality affect species with requirement for high water quality.	Diffuse effluent from industrial activities and agriculture. Excessive exotic macrophytes contribute to oxygen fluctuation.	
		Decreased species diversity and abundance (especially small species) as result of presence of aggressive alien predator (<i>M. salmoides</i>) and <i>G. affinis</i> .	Presence of aggressive alien predatory species (<i>M. salmoides</i>) naturally spreading and introduced for recreation/angling.	
		Increased turbidity reduces predatory success (<i>L. kimberleyensis</i> , <i>Clarias gariepinus</i>).	Erosion and presence of bottom feeding alien <i>C. carpio</i> .	
		Decreased bottom substrate quality.	Impact of bottom feeding alien <i>C. carpio</i> and siltation.	
		Loss of AV and MV as cover for fish.	Presence of herbivorous alien <i>C. idella</i> (grass carp).	
Presence of migration barriers reduces migration success (breeding, feeding and dispersal) of some species.	Vaal Barrage upstream and Goosebay weir, as well as other major dams and various weirs. Also farm dams in tributaries reduce refuge areas.			
Inverts	C	Water quality.	Agriculture, and urban sewage and industrial waste (high metals).	NF
		Low oxygen.	Water hyacinth.	
		Elevated base flows in winter.	Releases from the Barrage, comprising mainly return flows from sewer works and mines.	F

1.4 RESULTS: PRESENT ECOLOGICAL STATE

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

The PES EcoStatus is a C mostly due to a combination of flow and non-flow related impacts. Flow related impacts include increased base flows and reduced frequency of moderate floods due to Vaal Dam and Barrage and releases to regulate TDS levels. Non-flow related impacts include agriculture, and urban sewage and industrial waste and the occurrence of gauges, weirs and dams in the system.

1.5 SUITABILITY AS FUTURE BIOMONITORING SITE

This site is situated at the end of the WMA and is impacted by major anthropogenic activities upstream. This site is situated within the Vredefort Dome World Heritage area and is therefore a very high priority monitoring site.
