


1 JBS34 (EFR O3: AUGRABIES (ORANGE RIVER))

The information is summarised from WFA (2010a;b).

1.1 SITE DESCRIPTION

The site is situated at Blouputs and falls within MRU E which is delineated as the river reach from Augrabies Waterfall up to Vioolsdrift weir. This reach is less disturbed with no cultivation in the riparian zone and a canal is present on the left bank. This is a bedrock anastomosing reach, with well-vegetated bedrock core bars and islands between the distributary channels, and large bedrock riffle areas in the active channels. Flow sensitive habitats for fish (FS and FD) are very well represented at site. Moderate habitat diversity is present with various secondary canals. The loss of the floodplains to agriculture removed a very important component of the riparian habitat. Alluvial floodplain channels and associated vegetation) is presented in the upper and lower riparian zone.

Location	EFR O3 Augrabies	Altitude	425
Longitude	19.9983	Latitude	-28.4287
EcoRegion	Orange River Gorge 28.01	Quaternary catchment	D81B
Water Management Area	Lower Orange River	Geomorphological zone	Lowland River
			
EFR O3, Lower Orange River. Large cobble bars and small fines deposits are present.			

1.2 PRESENT ECOLOGICAL STATE

Geom	Critically reduced flows at the site constrain channel maintenance. However, despite the lower flows, the PES is ameliorated by concomitant declines in sediment loads (since much is trapped in upstream dams), although some sediment replenishment occurs from tributary inputs. The site has some bedrock control and therefore is not very sensitive to the impacts of base flow and small flood changes. Cobbles, boulders and gravels in the channel and along the margins are generally not embedded, although they are slightly armoured. This suggests that scouring of the bed is occurring frequently enough that the bed is remaining mobile.
WQ	Salt concentrations are similar for the PES, except for sulphate, sodium and chloride which show increases from the RC, particularly sulphate and chloride. Little impact is expected on temperature and oxygen, although temperature less variable than natural. Impacts from toxicants are expected due to intensive farming-related pesticides and fertilizer use. There is some indication of elevated nutrient levels throughout the reach; probably due to intensive agricultural activities in the area. The presence of toxic algae has been reported in the Lower Orange River passing Upington. Toxics from herbicide and pesticide use are also expected. Data collected from WMS and that collected by the diatom component do not support the reported intermittent high concentrations of some metals, i.e. Al, Cd, Cu and Pb, in the Upington and Neusberg weir area. Temperature levels are probably less variable than under natural conditions, as the system was naturally more variable than at present (despite the system now being more manipulated).

Fish	<p>All the expected fish species are still present in this river reach albeit in a slight to moderately reduced FROC. The species that are thought to have been impacted the most are <i>Barbus hospes</i>, <i>L. umbratus</i>, <i>Labeobarbus aeneus</i>, <i>L. kimberleyensis</i>, <i>Labeo capensis</i>, <i>B. paludinosus</i>, <i>P. philander</i> and <i>T. Sparrmanii</i>. The primary changes responsible for deterioration in the fish assemblage are primarily associated with altered hydrology/flow modifications (due to large dams and flow regulation), causing habitat deterioration and loss; and water quality alterations. Other impacts are related to water quality deterioration, some loss of marginal zone overhanging vegetation which may also be associated with the fluctuating flows and altered hydrological regime. The presence of alien and introduced indigenous fish species (trans-located <i>Oreochromis mossambicus</i>) furthermore have a potential negative impact on the fish assemblage of this river reach (in terms of competition for habitat, feeding, and predation pressure).</p>
Inverts	<p>2010 SASS5 score: 135 No of Taxa: 20 ASPT: 6.8</p> <p>Taxa that were abundant during the site-visit included the mayflies <i>Tricorythus discolor</i> and <i>Baetis glaucus</i>, and the blackfly <i>S. chutteri</i>. The most obvious change from natural has been outbreaks of pest blackflies (mainly <i>S. chutteri</i>) following impoundment. The site experienced a flood of 700 m³/s six weeks before the site visit. The threatened blackfly <i>S. garipeense</i> was recorded during the site visit, reflecting the post-flood conditions suitable for this species. The invertebrate fauna at this site is similar to that expected at EFR O2, so the description presented under Section 44. is applicable to this site.</p>
Rip veg	<p>Marginal Zone: Sparse cover, with recent flood scour observed. LB mostly open <i>C. dactylon</i> and <i>C. marginatus</i>. Cobble areas have a vibrant population of <i>G. virgatum</i>. Other dominants are <i>S. mucronata</i> and <i>P. australis</i> and features well on RB, but have almost completely been removed on LB by high grazing pressure. <i>C. dactylon</i> also shows evidence of grazing and form lawns where it occurs.</p> <p>Lower Zone: LB dominated by open cobble with <i>T. usneoides</i>. RB is mainly reed dominated (<i>P. australis</i>) alluvium with <i>S. mucronata</i>.</p> <p>Upper Zone: LB has extensive open areas (cobble or alluvium) as a result of grazing and physical removal, with vegetation mainly comprised of riparian thickets (common species are <i>T. usneoides</i>, <i>A. karoo</i>, <i>R. pendulina</i>, <i>Z. mucronata</i>, <i>D. lycioides</i>, <i>Euclea pseudobenus</i>, <i>Lycium bosciifolium</i>, <i>A. erioloba</i>, <i>M. linearis</i>, <i>Prsopis glandulosa</i>, <i>P. velutina</i>). RB mainly reeds as lower, but also with open bedrock areas and a cobble/alluvium mixed ephemeral channel. Annual and bi-annual exotic species are abundant.</p> <p>Macro channel bank: Same as upper zone, with <i>Schotia affra</i> on the RB. Floodplain: Only occurs on LB and has been removed and transformed into agricultural land for grapes and vegetables.</p>
Diatoms	<p>Diatom results are based on samples taken during 2005, 2008 – 2010 at various sites situated in the reach delineated as MRU E. During July 2005 chloride concentrations were problematic. Although elevated at times organic pollution does not seem to be a major problem in this reach, although during 2009 organic pollution increased drastically at Pella. Nutrients were elevated for all sampling years (except at OR 21 during 2005) indicating continuous impact, while salinity may be problematic at times. The EC for this reach is a C.</p>

1.3 MAIN IMPACTS AT THE SITE

	PES	Causes	Sources	F ¹ /NF ²
WQ	C	Elevated nutrients and potential toxicant loads due to fertilizer and pesticide use from agricultural activities.	Agricultural activities.	NF
		Less variability in temperatures than under the natural state.	Operation for irrigation and other users.	F
Geom	C	Reduced sediment loads.	Large dams upstream trap sediment loads, but this is in some ways ameliorated by tributary inputs downstream of the dams. The impact of reduced sediment is also ameliorated by the concomitant reduction of floods.	NF
Rip Veg	B/C	Altered species composition and loss of indigenous riparian cover.	Invasions of alien vegetation.	NF
		Increased reed density.	Frequent fires (unnatural).	
		Altered non-woody vegetation structure (forming of lawns) and increased cover.	High grazing pressure, especially LB.	
		Increased reed and other non-woody cover in marginal and lower zones.	Reduced base flows, especially in the wet season. Reduced small and moderate floods.	F

	PES	Causes	Sources	F ¹ /NF ²
Fish	C	Decreased overhanging vegetation as cover.	Erosion, change in flow, agriculture.	F/NF
		Decrease in FROC and abundance of fish species with preference for fast habitats.	Decreased base flows.	F
		Decreased water quality affect species with requirement for high water quality.	Presence of toxics, farming, changes hydrology, dams trapping silt.	NF
		Decreased FROC of species with preference for substrate as preferred cover and habitat for spawning, feeding etc.	Increased algal growth on substrates (increased nutrients from farming).	F/NF
		Decreased species diversity and abundance.	Presence of alien predatory species.	NF
		Increased turbidity and disturbed bottom substrates (impact on <i>L. umbratus</i> breeding habitats)	Presence of alien <i>C. carpio</i> .	
		Decreased abundance and FROC of detritus feeders (esp. <i>L. umbratus</i>)	Competition by introduced indigenous (<i>O. mossambicus</i>).	
		Decreased abundance, and therefore FROC.	Poaching and over-fishing using nets (gill and seine nets, often home-made).	F
		Reduced spawning success resulting in decreased FROC of many species.	Flow modification: Absence or lag effect of spring flushes.	
		Reduced migration success (breeding, feeding and dispersal) of some species.	Some small dams/weirs.	NF
Macroinvertebrates	C	Elevated low flows.	Discharges to meet demands for winter power generation and irrigation demands.	F
		Water quality deterioration.	Agricultural return flows.	
		Aseasonal releases.	Operation of Vanderkloof Dam.	
		Toxic algal blooms, such as <i>Microcystis</i> .	Annual overturn of Vanderkloof Dam plus inputs from Harts River (Spitzkop Dam) as well as Upton, WWTW and agro-chemicals.	NF
		Pesticides.	Blackfly Control Programme.	NF/F

1.4 RESULTS: PRESENT ECOLOGICAL STATE

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

The main reasons for the PES are decreased frequency of large floods as well as agricultural return flows, agricultural activities and associated water quality impacts. Higher low flows than

natural in the dry season, drought and dry periods occurs while decreased low flows occur at other times. The presence of alien fish species, alien vegetation and barrier effects of dams as well as decreased sedimentation impact this site. The site has a high degree of physical disturbance (vegetation removal, grazing, trampling and lighting fires) which has already and will continue to promote pioneer species, especially exotic riparian species such as *Prosopis glandulosa*. *P. glandulosa* recruitment was extensive at the site, and cover of perennial exotics will increase over time. If the structure of the riparian zone is altered, this will change the habitat from a patch mosaic to dense woodland, uncommon for these areas.

1.5 SUITABILITY AS FUTURE BIOMONITORING SITE

Habitat at the site is good for biotic monitoring. The site represents the delineated reach (MRU E) and is less disturbed than the rest of the MRU, with no cultivation in the riparian zone and a canal is present on the left bank. The site is downstream of Augrabies Waterfall and is suitable for detecting impacts relating to an altered hydrological regime and agricultural activities, which seems to be the biggest problem in this reach. It is also an important transboundary site, situated just upstream of the border with Namibia.
