1 JBS35 (EFR O4: VIOOLSDRIF (ORANGE RIVER))

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

1.1 SITE DESCRIPTION

The site is situated below Vioolsdrift weir and falls within MRU F which is delineated as the river reach from Vioolsdrift weir to the Fish River confluence. The site is bedrock dominated with rapid and riffle sections. There is some bedrock exposed at the site, but angular boulders, cobbles and sands are present. The LB is completely artificial to facilitate a canal and road. Flow sensitive habitats for fish (FS and FD) well represented at the site. There is low diversity of habitats for macroinvertebrates especially stones-out-of-current and mud while marginal vegetation habitats were moderate and instream aquatic vegetation was present.

Location	EFR O4 Vioolsdrif	**Altitude**	167 m
Longitude	17.71696	**Latitude**	-28.7553
EcoRegion	Orange River Gorge 28.01	**Quaternary catchment**	D82F
Water Management Area	Lower Orange River	**Geomorphological zone**	Lowland River

EFR O4, Lower Orange River. There is a mix of cobbles, gravels and fine sediment deposits within the bedrock-controlled reach.

1.2 PRESENT ECOLOGICAL STATE (PES)

Geom	The reduced sediment loads (since much is trapped in upstream dams) is being increasingly replenished by tributary inputs. The critically reduced flows at the site and lack of moderate and large floods continue to constrain channel and habitat maintenance. The key issue for this site is the loss of floods that scour and maintain the channel bed and bars.
WQ	PES data show significant elevations for all ions as compared to the natural state. Impacts on temperature and oxygen is expected due to the extreme reductions of flow for large parts of the year, although now more similar to natural. Impacts from toxicants are expected due to farming activities and large abstractions. References suggest mining

	impacts There is an increase in electrical conductivity from Prieska to Vioolsdrift along the reaches of the lower Orange River. This is due to a cumulative effect of irrigation return flows (although limited agriculture in the immediate area) and evaporative losses along the river. The last significant volume of water is abstracted and return flows form the bulk of the flow in the river during dry periods. Elevations in nutrient levels are also evidence of this trend. The concentration of some metals was reported to be intermittently high at Pella and Vioolsdrift – some evidence of these elevations was seen, although data is very limited. A health incident (blisters and skin rashes after rafting in the Orange River) and fish kills were reported in the Richtersveld (De Hoop camp and Grasdrif respectively) upstream of EFR O4 during April 2008, with an additional fish kill incident in May 2008. Causes are unknown although fish kills might be related to seasonal temperature changes and human skin conditions due to toxic blue-green algae or *Schistosome cercarial*. The latter is also known as swimmer's itch, duck itch or cercarial dermatitis. It is a short-term, immune reaction occurring in the skin of humans that have been infected by water-borne schistosomatidae.
Fish	All the expected fish species are still present in this river reach albeit in a moderately reduced FROC. The species that are thought to have been impacted the most (due to the catchment changes) are *B. hospes*, *L. umbratus*, *A. sclateri*, *L. aeneus*, and *L. kimberleyensis*.
Inverts	2010 SASS5 score: 147 No of Taxa: 24 ASPT: 6.1 The only taxon that was abundant during the site visit was the blackfly *S. chutteri*. Empty shells of freshwater limpets (*Burnupia* sp) and bivalves (Unionidae) were found. Instream conditions at these sites are much the same as found further upstream at EFR O2 and EFR O3, except that water temperatures are significantly warmer, so life-cycles of invertebrates are faster. Outbreaks of pest blackflies (mainly *S. chutteri)*. The most obvious change from natural has been outbreaks of pest blackflies (mainly *S. chutteri)* following flow regulation. The site experienced a flood of 700 m^3/s six weeks before the site visit. The threatened blackfly *S. gariepense* was recorded as an empty pupal case during the site-visit, reflecting the post-flood conditions suitable for this species.
Rip veg	**Marginal Zone:** Mostly open bedrock with some alluvium. *P. australis*, *S. mucronata* and *G. virgatum* are dominants. **Lower Zone:** Predominantly reeds (*P. australis*) or open unconsolidated alluvium with some woody vegetation. Both *A. karoo* and *Prosopis glandulosa* are recruiting. **Upper Zone:** Open alluvia or dominated by woody vegetation. Extensive mortality of *P. glandulosa* due to recent flooding. **Macro channel bank:** Dominated by woody vegetation. RB is artificial with boulder rubble, road and canal. LB vegetation with distinct browse line except for *P. glandulosa*. Extensive *P. glandulosa* recruitment. The site has a high degree of physical disturbance (vegetation removal, grazing and trampling) which has already and will continue to promote pioneer species, especially exotic riparian species such as *Prosopis glandulosa* and other perennial and annual species. The site has a high abundance of invasive weeds on the LB and extreme overutilization on the RB. The change in riparian structure due to the exotic riparian influx will impact adversely on the riverine fauna assemblage.
Diatoms	Diatom results are based on samples taken during 2005, 2008 – 2010 at various sites situated in MRU F which is delineated as the river reach from Vioolsdrift weir to the Fish River confluence. The biological water quality of this reach is a C EC. Elevated nutrient levels are of concern as well as salinity. Although still to be verified the presence of *Coscinodiscus devius* indicates that salinity levels have increased drastically since 2009 and is of major concern.

1.3 MAIN IMPACTS AT THE SITE

	PES	Causes	Sources	F/NF
WQ	C/D	Toxicant levels elevated, possibly from upstream pesticide use (agriculture) and mining activities.	Results in increased toxicant levels.	NF
		Lower flows cause elevated temperatures and drops in oxygen levels.	Abstractions are fewer in this area but evaporation concentrates salts.	F
Geom	C	Reduced sediment loads due to loss of floods.	Upstream dams.	NF
Riparian vegetation	C	Altered species composition and loss of indigenous vegetation cover.	Exotic vegetation invasion.	NF
		Reduced non-woody cover and absence of woody recruitment.	Intense grazing and trampling pressure, especially on RB.	
		Reduced riparian woody cover and abundance.	Physical disturbance and removal, especially due to road and canal construction and maintenance (LB).	
		Increased reed and non-woody riparian vegetation cover in the marginal and lower zones.	Reduced base flows and floods.	F
Fish	C	Decreased overhanging vegetation as cover.	Erosion, change in flow, agriculture.	F/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)	
		Decrease in FROC and abundance of fish species with preference for fast habitats.	Decreased base flows.	F
		Reduced spawning success resulting in decreased FROC of many species.	Flow modification: Absence or lag effect of spring flushes.	
		Decreased water quality affect species with requirement for high water quality.	Presence of toxics, farming, changes hydrology, dams trapping sit.	NF
		Decreased species diversity and abundance.	Presence of alien predatory species.	
		Increased turbidity and disturbed bottom substrates (impact on *L. umbratus* breeding habitats).	Presence of alien *C. carpio*.	
		Decreased abundance and FROC of detritus feeders (esp. *L. umbratus*).	Competition by introduced indigenous *O. mossambicus*).	
		Decreased abundance, and therefore FROC.	.Poaching and over-fishing using nets (gill and seine nets, often home-made).	
		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 *Microcystis.*	Annual overturn of Vanderkloof Dam plus inputs from Harts River (Spitzkop Dam).	NF
		Deteriorate marginal habitat for waders.	Loss of floods (dams) and lack of zero flows.	F

1.4 RESULTS: PRESENT ECOLOGICAL STATE

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

The main reasons for the PES are decreased frequency of large floods. Agricultural return flows and mining activities are impacting on water. 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 and barrier effects of dams impact on fish. There is decreased sedimentation due to a lack of large floods and upstream dams.

1.5 SUITABILITY AS A FUTURE BIOMONITORING SITE

Habitat at the site is moderate for macroinvertebrates while fish habitats are well represented. There is a high occurrence of alien vegetation species and the river banks are modified. However, there is good data availability for this site and is adequate as a biomonitoring site.