1 JBS30 (EFR C6: LOWER CALEDON)

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

1.1 SITE DESCRIPTION

EFR C6 is situated in the lower reaches of the Caledon River in MRU D which is delineated from Tussen-Die-Riviere Game Reserve to backup of Gariep Dam. The site is 100 m wide at places and channel substrate includes boulder, bedrock, cobble and sand. The morphology of the site is generally representative of the reach, although such large bedrock riffles are not common. Although this is a bedrock rapid section, fines dominate the bed. Recent floods have deposited several metres of sediment along the banks. In the faster flowing sections of the bedrock rapid section of the channel there are some gravels and cobbles on the bed, but these are all embedded by fines. The condition of the site is probably slightly better than the reach due to location within nature reserve. Flow sensitive habitats for fish (FS and FD) are very well represented at the site and although habitat diversity is moderate. Turbidity is high with extensive sedimentation/siltation. Macroinvertebrate habitat is moderate with limited stones-in-current, marginal vegetation in and out of current and aquatic vegetation habitats.

Location	EFR C6 Lower Caledon	**Altitude**	1270 m
Longitude	26.2708	**Latitude**	-30.4523
EcoRegion	Nama Karoo 26.03	**Quaternary catchment**	D24J
Water Management Area	Upper Orange	**Geomorphological zone**	Lowland River

EFR C6, Upper Caledon River. Channel substrate includes boulder, bedrock, cobble and sand.

1.2 PRESENT ECOLOGICAL STATE (PES)

Geom	High sediment loads (sands and fines) being introduced from the eroding upstream hill slopes and drainage lines, bottom release flushes (from Welbedacht Dam) during low flows. Sedimentation of the lower riparian zone and smothering of the instream habitats through reduction in deep areas and gravels.
WQ	Salinity levels in the system seem to be naturally elevated. Turbidities are particularly high in this stretch of the river, with the impact of the dam shown in changing temperature and oxygen levels. Bloem Water intake data also indicates high toxics. The most likely source of aluminium in the surface water is due to alum or aluminium sulphate used in most water treatment processes as a flocculating agent for suspended solids.
Fish	Loss of some FS and FD habitat as a result of flow modification, loss of SD due to sedimentation of pools, loss of rocky bottom substrates as a result of sedimentation, water quality deterioration (especially increased turbidity levels). Loss of marginal zone overhanging vegetation furthermore reduces cover for *especially B. anoplus* and *B. paludinosus*. The presence of the bottom feeding alien *C. carpio* can especially be detrimental in this reach due to the already altered bottom substrates (sedimentation) and high turbidity. This species can lead to further deterioration in bottom substrates and increased turbidity. Potential presence of predatory alien species (*O.*

	mykiss) may further impact on indigenous fish species. The presence of some complete migratory obstructions (Gariep Dam and Welbedacht Dam) as well as various smaller dams/weirs reduces migration success of species with requirement for movement between reaches.
Inverts	2010 SASS5 score: 52 No of Taxa: 10 ASPT: 5.2 Key taxa expected but not observed included Heptageniidae, Elmidae, Coenagrionidae, Caenidae and Leptophlebiidae. Gomphidae were notably scarce, despite the abundance of suitable sediments. Only one species of hydropsychid caddisflies recorded. Abundance of all taxa very low, with no taxon exceeding 100 specimens per sample (i.e. >B abundance).
Rip veg	**Marginal zone:** Mostly open cobble/boulder and alluvial deposits. Scour damage from recent floods is high. Sedges and *G. virgatum* are sparse and a mix of *P. australis* and *S. mucronata* dominates steeper alluvial banks. **Lower zone:** Extensive new alluvial deposits in the lower zone (clear evidence of smothered existing vegetation), with some open bedrock. Recolonisation by grasses especially prevalent, but sedges also occur). **Upper zone:** Alluvial terraces are similar to the lower zone. Channel banks are dominated by woody vegetation, mainly *D. lycioides, Olea europea africana* and *R. pyroides.*
Diatoms	Diatom results are based on samples taken during 2005, 2008 – 2010 at various sites situated in the MRU D. The diatom assemblage at EFR C6 in MRU D indicated elevated flows and although the SPI score indicated the site was in an A EC, this might not be a true reflection of current conditions. The dominant species is an indicator of anthropogenic disturbance and at an abundance of 88% this site is exposed to high levels of disturbance. Other species present indicated that nutrients, organics and salinity are variables that could impact these sites, but due to releases from Welbedacht Dam these impacts are ameliorated. It is estimated that the biological water quality condition of MRU D is in a C EC, although this is a low confidence determination.

1.3 MAIN IMPACTS AT THE SITE

	PES	Causes	Sources	F/NF
WQ	C	Turbidity levels are highly elevated.	Poor land management.	NF
		Elevated nutrients and potential toxicant loads.	Agriculture. Upstream towns, with industrial/urban activities and poorly functioning STW. The most likely source of aluminium in is due to aluminium sulphate used in most water treatment processes as a flocculating agent for suspended solids.	
		Impact on temperature and oxygen levels.	Bottom releases (Welbedacht Dam).	F
Geom	C/D	Increased sediment yields from catchment.	Agriculture.	NF
		Back up effects of Welbedacht Dam.	Backup of dam.	
		Bottom releases from Welbedacht Dam.	Sediment slugs released during low flow periods.	F
Rip Veg	B	Reduced vegetation cover and abundance.	Sediment deposition (dam flushing & catchment).	NF
		Changes to species composition.	Reduced flows and increased sedimentation.	
		Reduced woody species cover in marginal zone.	Reduced base flows.	F
Fish	D	Decrease in FROC and abundance of fish species with preference for fast habitats.	Decreased base flows.	F
		Decrease in FROC and abundance of fish species with preference for SD habitats.	Loss of SD habitats through sedimentation of pools.	
		Deterioration of spawning habitat.	Bank erosion and extensive overgrazing.	F & NF
		Decreased substrate quality increased benthic growth.	Increased nutrients and organics.	NF
		Decreased overhanging vegetation (cover).	Increased bank erosion.	
		Decreased water quality affect species with requirement for high water quality.	High turbidity and possibly toxins (aluminum).	
		Decreased species diversity and abundance (especially small species)	Aggressive alien predatory species (O. mykiss and *S. trutta*.	
		Increased turbidity and disturbed bottom.	Presence of alien *C. carpio*.	

	PES	Causes	Sources	F/NF
		Reduced migration success (breeding, feeding and dispersal) of some species.	Large dam wall and small dams/weirs.	
Inverts	D	Sediments (high turbidity).	Agriculture (crops).	NF
		Flow cessation.	Regulation.	F
		A-seasonal releases.	Regulation.	

1.4 RESULTS: PRESENT ECOLOGICAL STATE

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

The main reasons for the PES are sedimentation (bank erosion), significantly reduced base flows and alien fish species.

1.5 SUITABILITY AS FUTURE BIOMONITORING SITE

Habitat at the site is moderate to good for biotic monitoring, although it may be influenced by backup from Gariep Dam. The sediment load from this catchment is naturally high, but is elevated due to clearing for cultivation on soils that are naturally easily erodible. As the main landuse around the Caledon River is characterised by extensive agriculture this site may be a good monitoring site to detect agricultural impacts in the river reach between the Welbedacht and Gariep dams.