

<u>Specialist Reports</u>	<u>Recommendations</u>	<u>Inclusion in BAR/EMP</u>
Freshwater Assessment	Limit the extent of the construction footprint, including the bridge footprint, access tracks to either side of the causeway and any sandbag coffer dams / berms, to that which is absolutely essential.	Annexure 2 of the EMP.
Freshwater Assessment	Limit construction activities within the river to the dry winter months (June to September).	Annexure 2 of the EMP under <i>Minimise the potential for ground and surface water pollution.</i>
Freshwater Assessment	A maximum construction working servitude of 3m should be allowed to either side of proposed bridge footprint.	Annexure 2 of the EMP under <i>Construction and Construction Camp setup.</i>
Freshwater Assessment	Demarcate the construction footprint, including the working servitudes clearly: <ul style="list-style-type: none"> o Allow only essential construction related activities within the demarcated areas and strictly prohibit any construction related activity outside the demarcated areas; o Confine construction vehicles to designated roadways and strictly prohibit the indiscriminate movement of construction vehicles and personnel through areas falling outside of the demarcated construction footprint; o No temporary storage of building material or soil is allowed within areas falling outside of the demarcated construction footprint area; and o All material used for demarcation purposes should be removed after construction has been completed. 	Annexure 2 of the EMP under <i>Construction and Construction Camp setup.</i>
Freshwater Assessment	Limit the movement of construction personnel and construction vehicles through the river during the construction of the proposed bridge to that which is absolutely necessary.	Annexure 2 of the EMP under <i>Causeway development in the White Umfolozi River.</i>

Freshwater Assessment	Minimise the extent of infilling within the instream habitat as far as possible.	Annexure 2 of the EMP under <i>Causeway development in the White Umfolozi River</i> .
Freshwater Assessment	Prevent excessive disturbance of the bed and banks during culvert and abutment development.	Annexure 2 of the EMP under <i>Causeway development in the White Umfolozi River</i> .
Freshwater Assessment	An environmental control officer (ECO) must inspect the bridge works on a weekly basis (at least) and must take measures to address unforeseen disturbances to the river.	Section 5 of the EMP.
Freshwater Assessment	Immediately rehabilitate any accidental disturbance to freshwater habitat falling outside of the demarcated construction footprint area (refer to rehabilitation measures listed below).	Annexure 2 of the EMP under <i>Causeway development in the White Umfolozi River</i> .
Freshwater Assessment	Construction camps, storage areas, soil stockpile areas and laydown areas must be located outside of the riparian areas and 17m buffer or the 1: 100 year floodline, whichever is greatest.	Annexure 2 of the EMP under <i>Construction and Construction Camp setup</i> .
Freshwater Assessment	Prohibit the dumping of excavated material within the riparian area, the river channel or within the buffer area. Spoil material must be appropriately disposed of at a registered waste disposal facility.	Annexure 2 of the EMP under <i>Causeway development in the White Umfolozi River and Waste Management</i> .
Freshwater Assessment	Store topsoil and vegetation removed from the construction footprint at designated stockpile areas, preferably within already disturbed areas, for use in rehabilitation activities. Vegetation should be cut rather than uprooted in order to make way for stockpile areas. This will prevent further disturbance of soils.	Annexure 2 of the EMP under <i>Conservation of topsoil and Erosion prevention</i> .

Freshwater Assessment	Topsoil and subsoil removed during construction must be stockpiled separately and the height of stockpiles must be limited to 2m in order to avoid the compaction of soils.	Annexure 2 of the EMP under <i>Conservation of topsoil and Erosion prevention.</i>
Freshwater Assessment	Once construction has been completed all construction waste, rubble, and equipment must be removed from the site.	Annexure 2 of the EMP under <i>Conservation of topsoil and Erosion prevention.</i>
Freshwater Assessment	<p>Alien and Invasive species control:</p> <ul style="list-style-type: none"> o The construction footprint and any bare areas must be checked by the ECO for alien and invasive species once every two weeks and alien species noted must be removed; o Alien species removal is to take place manually, by hand as far as possible. The use of herbicides should be avoided. Should the use of herbicides be required, only herbicides which have been certified safe for use in aquatic environments by an independent testing authority may be considered. The ECO must be consulted in this regard; o Dispose of removed alien plant material at a registered waste disposal site or burn on a bunded surface where no stormwater runoff is expected; o Remove vegetation before seed is set and released; and o Cover removed alien plant material properly when transported, to prevent it from being blown from vehicles. 	Annexure 2 of the EMP under <i>Limit the disturbance and destruction of vegetation.</i>
Freshwater Assessment	Rehabilitate any areas outside of the direct construction footprint which have been disturbed as a result of construction related activities Rehabilitation must take place as soon as possible after construction is completed. A rehabilitation plan must be developed including rehabilitation measures such as:	Annexure 2 of the EMP under <i>Limit the disturbance and destruction of vegetation.</i>

	<ul style="list-style-type: none"> o Reshape and reprofile the banks of the river to either side of the bridge so that they tie in with the surrounding channel banks both longitudinally and perpendicularly (height, slope and structure); o Rip and loosen compacted soils to a depth of 30cm in order to aid in the establishment of vegetation; o Redistribute stockpiled topsoil across exposed banks and slopes; o Prevent erosion of the channel banks by covering and stabilizing any steep or unstable reshaped channel banks with a geotextile such as Geojute or BioJute, or with the use of sandbags or silt fences at the break in slope; o Disturbed areas must be revegetated with vegetation assemblages reflecting the general species composition of the area as soon as possible after the application of topsoil and stabilizing of soils; o Strictly prohibit the use of alien and invasive species during the revegetation of disturbed areas; and o Revegetated areas must be audited by an ECO once a week for six weeks after construction in order to monitor revegetation success. Thereafter, revegetation must be monitored every three months for a period of six months and the need for further revegetation, alien species removal and erosion control measures must be determined. After six months the ECO should assess whether any further revegetation or actions are required or whether revegetation can be considered a success. 	
Freshwater Assessment	The clearing of vegetation and excavation of soils must only be undertaken during agreed times and under suitable weather conditions. Should heavy rains be forecast, clearing activities must be put on hold.	Annexure 2 of the EMP under <i>Limit the disturbance and destruction of vegetation.</i>
Freshwater Assessment	Minimise the duration of construction activities within the river and associated riparian area as far as possible.	Annexure 2 of the EMP.

Freshwater Assessment	Implement erosion control measures where required (e.g. covering exposed river banks with geotextiles, utilising sand bags in order to support river banks and prevent bank slump, covering disturbed, bare areas with brush packing, mulch etc).	Annexure 2 of the EMP under <i>Conservation of topsoil and Erosion prevention.</i>
Freshwater Assessment	If possible, use excavators instead of bulldozers during the construction of the causeway in order to reduce sedimentation, and consolidate the entry and exit points to reduce scouring.	Annexure 2 of the EMP under <i>Causeway development in the White Umfolozi River and Waste Management.</i>
Freshwater Assessment	Strategically divert stormwater away from the construction footprint area (including the construction camp, cleared areas, storage areas, soil stockpile areas and laydown areas). Stormwater must not be discharged directly into the river or its buffer. Stormwater should rather be discharged as diffuse flow at multiple discharge points into well vegetated areas outside of the buffer, and energy dissipaters (such as areas of rock riprap grassed with indigenous vegetation or similar structures) must be constructed where stormwater is released in order to reduce the runoff velocity and therefore erosion.	Annexure 2 of the EMP under <i>Stormwater Management.</i>
Freshwater Assessment	Install many small, shallow mitre type drains, cut off drains or berms at regular intervals along access roads. Drains should be protected from erosion with the use of riprap grassed with indigenous vegetation or similar structures. These drains/berms will direct surface water off the access roads and will prevent the concentration of flows and the erosion of the road surface and the river during both the construction phase and the operational phase.	Annexure 2 of the EMP under <i>Stormwater Management.</i>
Freshwater Assessment	Stockpiles must be located in a stockpile area outside of the river and buffer area or the 1: 100 year floodline, whichever is greatest. Stockpiles should preferably be located within previously disturbed areas.	Annexure 2 of the EMP under <i>Conservation of topsoil and Erosion prevention.</i>

Freshwater Assessment	Where necessary, stockpiles must be stabilised with geotextiles in order to prevent erosion.	Annexure 2 of the EMP under <i>Conservation of topsoil and Erosion prevention.</i>
Freshwater Assessment	<p>Construct silt fences / traps in areas prone to erosion, to retain sediment-laden runoff:</p> <ul style="list-style-type: none"> o Silt fences / traps must be developed prior to the start of construction activities within the river; o Place silt fences / traps strategically on the periphery of the construction footprint area including the construction camp, cleared areas, storage areas, soil stockpile areas and laydown areas; o Silt fences/traps must be installed downstream of the bridge during construction activities to trap any sediment produced during construction activities. The ECO must be consulted on the number and location of silt fences, and silt fences must not result in any unnecessary disturbance to the channels and banks of the river; o All sediment trapping devices should be checked weekly by the appointed ECO and cleared as needed; o Ensure silt fences / traps are adequately maintained; and o Sediment traps should not be removed immediately after the completion of construction activities. Sediment traps should only be removed once at least 70% vegetation cover has re-established on disturbed, bare soils on the banks of the river. 	Annexure 2 of the EMP under <i>Stormwater Management and Causeway development in the White Umfolozi River and Waste Management.</i>
Freshwater Assessment	Turbidity curtains must be erected downstream of the proposed bridge during high risk activities such as the development and removal of sandbag coffer dams / berms and the dredging of the river bed.	Annexure 2 of the EMP under <i>Causeway development in the White Umfolozi River and Waste Management.</i>
Freshwater Assessment	Should pumps be required, the pump inlet must be located at a sufficient height above the sediment which accumulates on the river bed so as to reduce the amount of sediment captured. A suitable sediment filter	Annexure 2 of the EMP under <i>Causeway development in the White Umfolozi River and Waste Management.</i>

	should also be installed in front of the pump inlet in order to remove any sediment or debris from the pumped water.	
Freshwater Assessment	Any water pumped from the dry working space within the river must be pumped into a retention dam (or similar structure) in order to ensure that sediment settles out of suspension before the water is pumped back into the river downstream. Energy dissipation and erosion protection measures must be implemented at the discharge points.	Annexure 2 of the EMP under <i>Causeway development in the White Umfolozi River</i> .
Freshwater Assessment	The ECO must check the river and associated riparian area for erosion damage once a week and after every heavy rainfall event. Should erosion or sedimentation be noted immediate corrective measures must be undertaken. Rehabilitation measures may include filling of erosion gullies and rills and the stabilization of gullies with silt fences; the use of sandbags, rock packs, gabion baskets or similar structures in order to stabilize bank slump or eroded banks etc. Care must be taken to prevent additional disturbance to the river during the implementation of these measures. Additional erosion control measures must then be applied in order to avoid any further disturbance. Erosion measures will need to be adapted according to each concern	Annexure 2 of the EMP under <i>Causeway development in the White Umfolozi River</i> .
Freshwater Assessment	The bed and the banks of the river must be rehabilitated to as close to their original condition as possible. Ensure that the bed of the river is restored to its natural base level in order to prevent erosion or upstream ponding (i.e. the base of culverts/pipes must tie in with the natural base level of the river bed).	Annexure 2 of the EMP under <i>Causeway development in the White Umfolozi River</i> .
Freshwater Assessment	The natural flow of the river must not be permanently diverted or blocked.	Annexure 2 of the EMP under <i>Causeway development in the White Umfolozi River</i> .

Freshwater Assessment	Strictly prohibit the excavation of a new channel or drainage canals for the diversion of water away from the construction area.	Annexure 2 of the EMP under <i>Causeway development in the White Umfolozi River</i> .
Freshwater Assessment	A method statement guiding the flow diversion method must be developed and signed off by a suitably qualified specialist. This method statement must be approved by the ECO.	Annexure 2 of the EMP.
Freshwater Assessment	Throughflow to downstream freshwater habitats must be maintained during construction. This can be achieved by the development of flume pipes through dry work areas, which divert water away from the direct construction works area. Alternatively, water can be pumped from areas upstream of the impoundment to a suitable area downstream of the impoundment. An ECO should be consulted in this regard.	Annexure 2 of the EMP under <i>Causeway development in the White Umfolozi River</i> .
Freshwater Assessment	Sandbags utilised for the diversion of the river must be in good condition so as to avoid the bursting of the bags and sedimentation of downstream areas.	Annexure 2 of the EMP under <i>Causeway development in the White Umfolozi River</i> .
Freshwater Assessment	Any debris which collects above the sandbag coffer dams / berms during the construction phase must be removed and disposed of at a registered waste disposal facility.	Section 2.4.5 of the BAR.
Freshwater Assessment	Once construction is completed the sandbag coffer dams / berms must be removed and the original flow patterns re-instated.	Annexure 2 of the EMP under <i>Causeway development in the White Umfolozi River</i> .
Freshwater Assessment	Any disturbance to the river bed and banks as a result of the diversion must be immediately rehabilitated upon completion of construction.	Annexure 2 of the EMP under <i>Causeway development in the White Umfolozi River</i> .

Freshwater Assessment	Inspect all storage facilities, machinery and vehicles daily for the early detection of deterioration or leaks;	Annexure 2 of the EMP under <i>Minimise the potential for ground and surface water pollution.</i>
Freshwater Assessment	Servicing of vehicles and refuelling should preferably take place off site. However, if this is not possible, use a bunded surface (with an oil filter trap) within designated areas outside of the river and its buffer area or the 1:100 year floodline, whichever is greatest, for servicing and re-fuelling vehicles.	Annexure 2 of the EMP under <i>Minimise the potential for ground and surface water pollution.</i>
Freshwater Assessment	Store fuel, chemicals and other hazardous substances in suitable secure weather-proof containers and within an area with impermeable and bunded floors, the surface of bunded areas must be graded to the centre in order to ensure the collection and disposal of any spillages.	Annexure 2 of the EMP under <i>Chemical storage and spill treatment.</i>
Freshwater Assessment	Avoid the use of infill material or construction material with pollution / leaching potential when constructing the causeway.	Annexure 2 of the EMP under <i>Chemical storage and spill treatment.</i>
Freshwater Assessment	Dispose of used oils, wash water from cement and other pollutants at an appropriate licensed landfill site	Annexure 2 of the EMP under <i>Chemical storage and spill treatment.</i>
Freshwater Assessment	Where practical, prefabricated elements and pre-cast concrete must be used during construction. This will minimise the duration of the construction period and will aid in the prevention of impacts as a result of fabrication activities on site.	Annexure 2 of the EMP under <i>Construction and Construction Camp setup.</i>
Freshwater Assessment	Ready-mix concrete is to be preferred should concrete be utilised during construction. Concrete must not be mixed on exposed soils. Concrete must be mixed on an impermeable surface in an area of low environmental sensitivity identified by the ECO outside of the buffer area or the 1: 100 year floodline, whichever is greatest.	Annexure 2 of the EMP under <i>Construction and Construction Camp setup.</i>

Freshwater Assessment	Dispose of slurry, concrete and cement-related mortars in an environmental sensitive manner (can be toxic to aquatic life). Washout should not be discharged into the river. A washout area should be designated, and wash water should be treated on-site.	Annexure 2 of the EMP under <i>Construction and Construction Camp setup</i> .
Freshwater Assessment	Utilise an impermeable surface, trays or shutter boards for the mixing or pouring of hazardous substances or chemicals. Areas in which the substances are mixed must be isolated from stormwater movement.	Annexure 2 of the EMP under <i>Construction and Construction Camp setup</i> .
Freshwater Assessment	Should a water pump be utilised, it must be placed on a drip tray lined with absorbent pads in order to prevent the contamination of river water or soils by spilled fuel.	Annexure 2 of the EMP under <i>Construction and Construction Camp setup</i> .
Freshwater Assessment	Place debris catch netting under the causeway structure during construction in order to ensure that any debris which accidentally falls into the river is captured and does not contaminate downstream areas.	Annexure 2 of the EMP under <i>Causeway development in the White Umfolozi River</i> .
Freshwater Assessment	Train employees and contractors in spillage management and provide them with absorbent spill kits and disposal containers to handle spillages.	Section 1.3.5 of the EMP.
Freshwater Assessment	Clean up any spillages (e.g. concrete, slurry, oil, fuel), immediately. Remove contaminated soil and dispose of it at a registered waste disposal facility.	Annexure 2 of the EMP under <i>Chemical storage and spill treatment</i> .
Freshwater Assessment	Provide portable toilets where work is being done. These toilets must be located outside of the buffer zones of the river or outside of the 1:100 year floodline, whichever is greatest.	Annexure 2 of the EMP under <i>Chemical storage and spill treatment</i> .
Freshwater Assessment	Do not remove natural vegetation from the banks and channels of the river during maintenance.	Annexure 2 of the EMP under <i>Causeway Operation and Maintenance</i> .
Freshwater Assessment	Confine maintenance vehicles to the existing roadway and strictly prohibit the indiscriminate movement of vehicles and personnel through riparian and instream areas.	Annexure 2 of the EMP under <i>Vehicle access and Movement</i> .

Freshwater Assessment	<p>The following design related mitigation measures will reduce impact to the river during the operational phase:</p> <ul style="list-style-type: none"> o The bridge must be stable and must be appropriately protected so as to withstand major flood events; o As far as possible, the bridge should be designed in such a way as to prevent the alteration of the natural flow patterns through the river and the extent of the floodlines of the river; o The bridge design must allow for natural dispersion of water through the river channel to prevent the concentration of flow and the resultant scouring and incision of the river. In this regard it must be ensured that the culverts span the entire width of the river channel; o Appropriate design measures must be put in place in order to dissipate flow velocity below the bridge and around culvert structures, and in order to prevent turbulent flow; o It is recommended that a local ichthyologist¹⁸ is consulted in order to ensure that the design of the proposed bridge structure will not impede the movement of fish species through the river; o Stormwater from the gravel access roads and hardened bridge surface traversing the river must be directed to the outer edges of the bridge and must be passed through filter strips / energy dissipaters (e.g. areas of rock riprap grassed with indigenous vegetation) before being released into the river. 	Incorporated into the designs of the causeway construction. Please see Engineering designs of the causeway.
Freshwater Assessment	Implement all construction phase flow / stormwater control related mitigation measures in order to prevent operational phase impacts.	Annexure 2 of the EMP under <i>Stormwater Management</i> .
Freshwater Assessment	Appoint an ECO / suitable contractor to inspect the crossing bi-annually for the remainder of the operational phase as well as after heavy rainfall events for the build-up of debris. Any debris noted must be removed.	Section 2.4.5 of the BAR.

Freshwater Assessment	Appoint an ECO / suitable contractor to inspect the crossing bi-annually as well as after heavy rainfall events for two years following construction in order to determine whether any additional erosion control measures are required. Should erosion or sedimentation be noted immediate corrective measures must be undertaken. Rehabilitation measures may include filling of erosion gullies and rills and the stabilization of gullies with silt fences; the use of sandbags, rock packs, gabion baskets or similar structures in order to stabilize bank slump or eroded banks etc. Care must be taken to prevent additional disturbance to the river during the implementation of these measures. Additional erosion control measures must then be applied in order to avoid any further disturbance. Erosion measures will need to be adapted according to each concern and, where possible, only soft engineering techniques should be implemented.	Annexure 2 of the EMP under <i>Conservation of topsoil and Erosion prevention</i> .
Botanical Assessment	A suitably qualified specialist must undertake a 'walk through' of the final bridge alignment prior to construction in order to identify and mark individuals of protected species which will be removed. A floral permit application will have to be made to EKZN Wildlife for the removal of individuals of <i>Aloe marlothii</i> and <i>Aloe cf parvebracteata</i> .	Annexure 2 of the EMP under <i>Limit the disturbance and destruction of vegetation</i> .
Botanical Assessment	An attempt must be made to rescue and relocate individuals of <i>Aloe marlothii</i> and <i>Aloe cf parvebracteata</i> . These individuals should be relocated to rehabilitated areas within the designated 3m construction working servitude.	Annexure 2 of the EMP under <i>Limit the disturbance and destruction of vegetation</i> .
Botanical Assessment	Vegetation should only be cut where it is creating a safety hazard or restricting vision.	Annexure 2 of the EMP under <i>Limit the disturbance and destruction of vegetation</i> .
Botanical Assessment	Confine maintenance vehicles to the proposed gravel access roads and bridge and strictly prohibit the indiscriminate movement of maintenance vehicles and personnel through natural vegetation to either side of the roads and causeway.	Annexure 2 of the EMP under <i>Limit the disturbance and destruction of vegetation</i> .

Botanical Assessment	Follow up alien vegetation clearing must be undertaken every 6 months for the first 12 months after construction (refer to alien control methods as listed for Impact 1 above). The ECO should monitor the site after a year in order to determine whether any additional alien vegetation control measures will be required.	Annexure 2 of the EMP under <i>Limit the disturbance and destruction of vegetation</i> .
Botanical Assessment	Care must be taken in order to avoid the disturbance of indigenous species during the removal of alien plants.	Annexure 2 of the EMP under <i>Limit the disturbance and destruction of vegetation</i> .
Ichthyofaunal Assessment (Fish)	The proposed low level crossing must allow for the free flow of water beneath the structure.	Section 2.1.2 of the BAR.
Ichthyofaunal Assessment (Fish)	The proposed low level bridge should not block flow or create a barrier to fish movement and migration. Fish should be able to pass freely beneath the structure, or jump and swim over the top when overtopping occurs.	Annexure 2 of the EMP under <i>Causeway Operation and Maintenance</i> .
Ichthyofaunal Assessment (Fish)	In order for the low level crossing to not be a hindrance, sufficient water volume must be able to pass beneath the crossing. The widest possible gaps between supports must be provided. The use of numerous small diameter pipes must be avoided.	Annexure 2 of the EMP under <i>Causeway Operation and Maintenance</i> .
Ichthyofaunal Assessment (Fish)	If pipes or culverts are to be used, these must be the maximum allowable diameter.	Annexure 2 of the EMP under <i>Causeway Operation and Maintenance</i> .
Ichthyofaunal Assessment (Fish)	Construction activities be undertaken during the low flow period when fish are less likely to move and conditions for construction will be more manageable.	Annexure 2 of the EMP under <i>Causeway Operation and Maintenance</i> .
Geotechnical Assessment	Cut slopes in the sandy and gravelly alluvial soils overlying the weathered bedrock should not exceed a batter of 1:2 (26°). Where cuts are taken into the granite bedrock, may be increased to a batter of 1:1,5 (33°) or steeper at the discretion of the Engineer.	Section 2.4.3 of the BAR.

Geotechnical Assessment	The construction must be performed in the drier winter months to minimise the effects of groundwater seepage in the alluvial soils in the riverbed. Stream diversion and sump pumps may be necessary to deal with the seepage.	Annexure 2 of the EMP under <i>Minimise the potential for ground and surface water pollution</i> .
Geotechnical Assessment	Founding of the proposed structure, comprising portal culverts overlain by a concrete slab surface with bollards, should be by means of concrete footings founded into the granite bedrock. The maximum allowable bearing pressures for the portal culvert foundations should be restricted to a maximum of not more than 500kPa. Dowels or equivalent anchoring might be required at the discretion of the Engineer.	Section 2.4.3 of the BAR.