Technical review of the Environmental Impact Assessment for the Rufiji Hydropower Project in Selous Game Reserve, Tanzania

April 2019

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Executive summary

This rapid technical review assesses the "Updated Environmental Impact Assessment Report for 2100 MW Power Generation from the Rufiji Hydropower Project in Selous Game Reserve, Pwani and Morogoro regions, Tanzania" of 18 October 2018 ("the EIA") that relates to a planned hydropower project to be built at Stiegler's Gorge in the north of Selous Game Reserve ("the Project"). The Project will involve construction of a 130m high dam on the Rufiji river, creation of a 100km long, c.914km^2 reservoir plus a power plant, a transmission line, workers camps and access roads.

The c. 50,000km^2 Selous Game Reserve (SGR) is an IUCN category IV protected area. It has been a natural World Heritage Site since 1982 but has been on the List of World Heritage in Danger since 2014 due to intensive poaching. In 2018, the threat from the Project was added to the justification for the continued inclusion of SGR on the List of World Heritage in Danger.

The review assesses the degree of alignment of the EIA with 1) IUCN guidance on impact assessment in World Heritage sites, and 2) international good practice, as set out in the International Finance Corporation (IFC) Performance Standards and associated technical guidance.

Notwithstanding that recent IFC guidance is that projects in World Heritage sites should in most cases not go ahead at all, the review finds that the EIA falls considerably short of both IUCN guidance on impact assessment and IFC performance standards. The EIA is therefore not appropriate for a large-scale development like the Stiegler's Gorge hydropower project. In particular, the EIA:

- Is based on an inadequately detailed description of the project, notably the planned flow regime (including the possibility of hydropeaking), the expected level of seasonal variation in flows and the expected constraints to flows, for example in cases of prolonged drought.
- Largely lacks baseline data on biodiversity, the social context and the physical environment. The information used does not provide a credible evidence base for assessing impacts or for identifying appropriate mitigation. Fundamental hydrological data is more than 30 years old, which is inappropriate given the scale of land-use change in the Rufiji basin in that period. Some critical information is missing entirely, including information on aquatic biodiversity, a modern environmental flows (eFlows) assessment and an assessment of the effects of land-use and climate change in the Rufiji basin on flow regimes.
- Does not include a systematic, logical, spatially explicit or quantified assessment of ecological, social or physical impacts. Much of the assessment seems to be based on guesswork or wishful thinking rather than careful evidence-based analysis. In particular, the assessment of an overall positive impact of changes in the flood regime on the livelihoods of thousands or tens of thousands of people downstream is not based on credible reasoning or evidence. In addition, some potentially significant impacts are not considered at all, such as the barrier effect to migratory fish which may have significant negative consequences for both biodiversity and for the livelihoods thousands or tens of thousands of people dependent on the fisheries of the Rufiji Basin.
- Includes a piecemeal set of mitigation measures that are 1) not clearly linked to impacts, and/or 2) vague, and/or 3) not demonstrably feasible, and/or 4) insufficiently resourced, while many basic good practice mitigation measures (e.g., fish ladders, fish screens) are not evaluated. The proposed mitigation therefore does not provide confidence that impacts can or will be minimised.
- Appears to have included very limited stakeholder consultation. No Informed Consultation and Participation is documented, a major gap for a project that appears likely to significantly affect critical components of the livelihoods of thousands or tens of thousands of people.

- The EIA contains no serious consideration or justification of how the Project can deliver a net gain or no-net-loss of biodiversity nor how impacted livelihoods will be restored.

The reviewed EIA therefore does not provide a credible evidence base to provide confidence that social and environmental impacts have been assessed with a level of resolution and precision appropriate for the potentially large, long-term and irreversible ecological and social impacts, nor that all feasible and appropriate mitigation has been identified.

In consequence, the EIA does not provide a credible assessment of potential impacts on the Outstanding Universal Value of the SGR. Given the large footprint of the project in the heart of the SGR, the potential barrier effect from a 100km long and 12km wide reservoir, and the need to create and maintain access roads, supporting infrastructure and a permanent human presence it is clear that the undisturbed and wild character of the area will be severely affected. Negative impacts on individual features contributing to the presence of OUV seem inevitable; however, from the information in the EIA it is not possible to determine which specific qualifying features will be compromised nor to what extent.

Over and above the impacts on the SGR itself, the description of the project in the EIA suggests that:

- It is highly likely that the Project will have significant negative impacts on the livelihoods of many thousands or tens of thousands of people dependent on the downstream Rufiji River for agriculture and fishing;
- It is highly likely that there will be significant negative impacts on freshwater biodiversity in the Rufiji River (especially on migratory fish) which may in turn result in potentially significant impacts on the livelihoods of thousands of people dependent on fisheries in the catchment, including the upstream Kilombero Valley Floodplain Ramsar Site;
- Significant and lasting impacts on the physical environment of the downstream Rufiji delta cannot be ruled out, which may in turn result in significant negative impacts on the biodiversity of the Rufiji-Mafia-Kilwa Ramsar site and the ecosystem services it provides.

These potentially highly significant impacts are not credibly evaluated in the EIA. The EIA's conclusion that 'the development of the project should not be a matter of serious concern' is therefore untenable based on the evidence provided.

The numerous gaps and *non-sequiturs* in the EIA, from the scope, through the project description, the baseline characterisation and the impacts assessment itself to the identification of mitigation measures, means that the EIA is far from aligning with IFC performance standards, or with IUCN guidance on impact assessment in World Heritage sites. Under both IFC performance standards and IUCN guidance on impact assessment in World Heritage sites, EIA is a *process* that should be fully integrated into all aspects of project conceptualisation, design and execution. Improving alignment of the EIA for this project with these standards would require starting with a complete and thorough re-assessment of the basic assumptions underpinning the project, informed by an up-to-date and credible set of baseline data on the physical, social and ecological environment.

Background and approach

Scope and context

This rapid technical review assesses the "Updated Environmental Impact Assessment Report for 2100 MW Power Generation from the Rufiji Hydropower Project in Selous Game Reserve, Pwani and Morogoro regions, Tanzania" of 18 October 2018 ("the EIA") that relates to a planned hydropower project to be built at Stiegler's Gorge in the north of Selous Game Reserve ("the Project").

The c. 50,000km^2 Selous Game Reserve (SGR) is one of the oldest protected areas in Africa. It is an IUCN category IV protected area in which managed sport hunting is allowed in certain zones. It has been a natural World Heritage Site since 1982 but has been on the List of sites World Heritage in Danger since 2014 due to intensive poaching. In 2018, the threat from the Project was added to the justification for the continued inclusion of SGR on the List of World Heritage in Danger. World Heritage status for Selous was identified based on Criterion (ix) - outstanding example of ongoing ecological and biological processes and criterion (x) - the most important and significant natural habitats for conservation of in-situ biodiversity.

The review assesses the degree of alignment of the EIA with 1) IUCN guidance on impact assessment in World Heritage sites, and 2) international good practice, as set out in the International Finance Corporation (IFC) Performance Standards and associated technical guidance. The review focuses on Performance Standards 1 and 6 which are the most applicable for a natural World Heritage Site. A recent update to IFC guidance states that projects in natural World Heritage Sites may not be acceptable for financing, with the possible exception of projects specifically designed to contribute to the conservation of the area. The Stiegler's Gorge HPP is not designed to contribute to the conservation of SGR and therefore could never fully align with this recent IFC guidance. Nevertheless, the rest of the provisions of the IFC Performance Standards remain recognised international good practice and so are an appropriate benchmark for reviewing the EIA.

Although no formal assessment has been conducted, the SGR would likely be considered Critical Habitat under Performance Standard 6 due at least to the presence of a significant population of the Endangered African Wild Dog (*Lycaon pictus*) and a remnant population of Critically Endangered Black Rhino (*Diocerus bicornis*). Notwithstanding the SGR's World Heritage status, a project aiming to align with international good practice in this situation would be expected to provide a very high degree of confidence that impacts have been appropriately identified and mitigated.

Documents reviewed

Three documents were provided for this desktop review:

1. "Environmental Impact Assessment for the Stiegler's Gorge Hydropower Project, Tanzania": draft report, 4 May 2018;
2. "Updated Environmental Impact Assessment Report for 2100 MW Power Generation from the Rufiji Hydropower Project in Selous Game Reserve, Pwani and Morogoro regions, Tanzania": 18 October 2018;
3. IUCN's analysis of the draft EIA transmitted to the State Party of Tanzania by the UNESCO World Heritage Centre on 18 July 2018.

In practice, the updated EIA version of 18 October 2018 supersedes the previous version and was therefore the focus of the review.

The documents provided for review did not include all the EIA Annexes, notably Annex D "Signatures of consulted stakeholders" and Annex E "Specialist studies cited in this report"; this review is therefore based on the summaries of these annexes that are presented in the EIA.

The review was complemented by reference to available scientific and third-party literature, which is cited where relevant.

Benchmarks for the review

As set out in the TOR, the benchmarks for the review were:

- IUCN's World Heritage Advice Note on Environmental Assessment.
- The IFC Performance Standards (IFC 2012a) and associated guidance notes (IFC 2012b, 2012c), as relevant for an EIA. The IFC Performance Standards are complex with many nuances, so this rapid review focused on key aspects of PS1 and PS6 which are the most relevant for a natural world heritage site[1].
- Where relevant, the review also considers alignment with sector-specific good practice guidance for hydropower projects, specifically IFC's Good Practice Note on environmental, health and safety approaches for hydropower projects (IFC 2018) and the World Bank Group's Good Practice Handbook on Environmental Flows for Hydropower Projects (World Bank Group 2018)[2].

The approach used was to first review the EIA against key relevant requirements of the IFC Performance Standards, with additional review against sector-specific good practice guidelines where appropriate. This review was then used to assess the EIA against the IUCN World Heritage Advice Note on Environmental Assessment, with additional evaluation of the sections on Outstanding Universal Value.

Review team expertise

The review was conducted by a team of three biodiversity specialists and one social specialist. The biodiversity specialists have extensive recent practical experience of applying international good practice, in particular IFC performance standards, to large-scale hydropower projects in Africa and world-wide, from project-, lender- and government-advisor perspectives. The social specialist is familiar with applying IFC social standards and IUCN's Environmental and Social Management System (ESMS). All the team are familiar with protected area management in Africa, and two have experience of evaluating and managing impacts of large-scale extractives and infrastructure projects on natural world heritage sites in Africa.

[1] IFC's Guidance Note 6 was updated in November 2018 and a final corrected version published in early 2019 (IFC 2019). The majority of changes in GN6 are technical details and would not change the conclusions of this review. However, the updated guidance note does include specific prescriptions for new projects in World Heritage Sites.

[2] Although these specific documents were published during the period the EIA was being prepared and so may not have been available to the EIA team, they are simply compilations of widely-recognised existing good practice that have been applied in many hydropower projects around the world and so it is appropriate to review against the practices included in the documents.

Review against IFC performance standards and good practice guidance

Table 1 below summarises the review findings against key elements of IFC Performance Standards 1 and 6 and where relevant sector-specific good practice guidance.

Table 1 : High-level review of the EIA against relevant key requirements of Performance Standards 1 and 6 and relevant sector-specific good practice guidance

Key PS1 + 6 requirements	Review findings
Establish and maintain an ESMS appropriate to the nature and scale of the project and commensurate with the level of its environmental and social risks and impacts.	• The EIA does not present the Project's ESMS, which is a gap compared to good practice. It was therefore not possible to assess whether the ESMS is 'commensurate with the level of environmental and social risks and impacts'.
Overarching policy defining the environmental and social objectives and principles	• Although there is reference to many external policies, including IFC Performance Standards, no specific policy established by the project is identified in the EIA. • Intended environmental and social objectives are not specified.
Identification of Risks and Impacts based on recent environmental and social baseline data at an appropriate level of detail	• Three 'spatial' areas of the project are defined as; a 'core impact area', 'immediate impact area', and the 'area of influence'. The core impact area includes areas that will be directly impacted by the dam and reservoir - the Stiegler's Gorge area, the reservoir and downstream the Lower Rufiji floodplain and delta. Areas upstream of the reservoir are not considered. • A clearly defined boundary for the 'core impact area' is not provided and there is no ecological justification for the extent of the area making it difficult to determine if all potential impacts to biodiversity, and in particular impacts to mobile species and indirect impacts, are likely to be captured within it. • The immediate impact area is said to be outside the core area and includes villages that will be positively or negatively impacted by the project. However, Affected Communities are not clearly identified and no reference map is provided. • The area of influence is based on the locations of influential stakeholders and is not used further in the EIA.

Key PS1 + 6 requirements	Review findings
	• There is no consideration of potential impacts from associated facilities (notably the transmission line and associated roads).
Assessment of viable alternatives	• Alternatives analysis is limited and focuses on different construction options; it does not consider different project designs, for example, there is no evaluation of the potential to reduce reservoir impacts through alternative heights for the dam.
Identification of priority biodiversity features and ecosystem services	• The EIA reports that scientific secondary data to provide baselines on ecology and flora and fauna of the SGR are limited. However, a rapid internet search turns up freely-available published studies on lions (Spong 2002; Spong *et al.* 2002; Brink *et al.* 2013), elephants (Zafra-Calvo *et al.* 2018) and freshwater species (Darwall *et al.* 2005) that all contain relevant information. There are also numerous studies on the ecosystem services of the Rufiji floodplain, delta and the upstream Kilombero Valley that are of relevance and which are not cited, or only cited in passing (for example: Turpie 2000; Duvail & Hamerlynck 2007; Duvail *et al.* 2017; Kolding *et al.* 2017; Moreau & Garaway 2018). While the TAWIRI aerial surveys are referenced, the only data used appear to be a few maps and overall counts of selected species. • The IUCN Red List (accessible via IBAT) does not seem to have been consulted systematically, and several statements in the EIA contradict IUCN Red List accounts. For example, contrary to the EIA, the ranges of Sanje crested Mangabey and Udzungwa Red Colobus do not overlap SGR, and the fish *Alestes stuhlmannii* is reported on the Red List as being widespread in Tanzanian basins and recorded from Mozambique rather than being endemic to the Rufiji basin. • Annex C provides information on stakeholder groups that were consulted, but consultations (e.g. with the Country Director of WWF and the Minister of Tourism), took place in March/April 2018 after ground surveys (see below) and it is therefore unclear if or how the biodiversity concerns of stakeholder groups were included into the survey phase of work. The African Wildlife Foundation and a Ramsar Site representative are also reported to have been consulted (but the topics, responses and dates of engagement are not reported in annex C). • A Critical Habitat Assessment, or similar assessment to determine global, national and local biodiversity values was not undertaken. A clear list of biodiversity values within an Area of Analysis is not provided. Seven 'key species' are named as buffalo, impala, wildebeest, hippopotamus, zebra, elephant and giraffe - it is not specified why these are considered to be the 'key species' for the Project. The key species do not include terrestrial species that may qualify for Critical Habitat such as the African

Key PS1 + 6 requirements	Review findings
	Wild Dog (*Lycaon pictus*) (EN) or the Black rhino (*Diceros bicornis*) (CR), nor Lion (*Panthera leo*) for which SGR is considered a priority population in the range-wide strategic conservation plan. Sable antelope (*Hippotragus niger*), Lichtenstein's Hartebeest (*Alcelaphus lichtensteinii*), Greater Kudu (*Tragelaphus strepsiceros*), and Eland (*Taurotragus oryx*), are cited in the Statement of OUV but are not specifically considered in the EIA[3]. No aquatic species of conservation importance are referenced. No assessment of the presence of migratory species was undertaken. • Some priority ecosystem services are mentioned, including fisheries and sediment-dependent floodplain agriculture, but a systematic process of identification of ecosystem services incorporating input from Affected Communities is not included in the EIA.
Collection of baseline data for priority features and ecosystem services	• Overall, the EIA is based on very limited social and environmental baseline data. This is an extremely significant gap compared to IFC Performance Standards which require that "The risks and impacts identification process will be based on recent environmental and social baseline data at an appropriate level of detail." (IFC 2012d). Given the large -scale, long-duration and potentially highly significant impacts of this project, an IFC-aligned EIA would be expected to be based on comprehensive and fine-grained baseline data, collected where necessary over multiple seasons. The following points highlight particular issues with the baseline data presented in the EIA: • Data on social context and ecosystem services appear to be based entirely on secondary data sources (such as District- and Ward-level national statistics) with no primary data collection. The Project is described as being located within the most 'extensive and pristine' part of the SGR, which challenged access for biodiversity survey work. Terrestrial surveys undertaken by the Project included key informant interviews, ground transects (by vehicle and boat), pitfall traps, Sherman traps and camera traps. Information is not provided on the level of effort undertaken for each survey method, reference is only made to survey work in January and February 2018 (wet season); it is unclear if any recent surveys were undertaken during the dry season – this is a significant gap as in this landscape many species may make seasonal movements, in particular towards water sources such as the area expected to be impacted. Vehicle surveys (and presumably other types of survey) were only undertaken in 'Matambwe and Kingupira' and not 'Liwale and Msolwa' impact sectors due to accessibility. As secondary

[3] Udzungwa Forest Partridge (*Xenoperdix udzungwensis*) and the Rufous Winged Sunbird (*Nectarinia rufipennis*) are also listed in the Statement of OUV but are in fact unlikely to occur in SGR (IUCN 2018).

Key PS1 + 6 requirements	Review findings
	data are reported to be limited, primary data are important and the lack of survey work in these areas which are less disturbed, and therefore more likely to contain biodiversity values, represents a gap in understanding of the biodiversity values present and their distribution across the Area of Analysis (and a limitation to the assessment of impacts). • Maps of the distribution of six 'key species' are presented from 1994 and 2014 using TAWIRI data – all are present in the area of the Project but distributions of terrestrial species that are likely to qualify for Critical Habitat (e.g., African Wild Dog and Black Rhino) are not presented, although both species are known to be present (although in low numbers). Survey effort for other groups (birds, amphibians, small mammals) appears to be very low and not focused on appropriate habitats or locations; this is inappropriate given for example the SGR's status as an Important Bird Area. There is therefore a risk that particularly rare and/or endemic species with specialised habitat requirements may have been missed from terrestrial survey work. • Data are not presented – and do not seem to have been collected – on the densities of wildlife. Data on wildlife movements are similarly absent. Given the potential barrier effect of the dam and reservoir, this is a significant gap. • Aquatic survey work is not reported in the EIA (apart from boat transects that focused on hippos and crocodiles), no lists of fish species of conservation importance are provided or information on the species that might migrate within the Rufiji river system. This is an extraordinary gap in the understanding of biodiversity risks for a hydropower project, especially since two Ramsar sites, one upstream and one downstream, could be impacted. Without baseline information on the fish species present and their ecological requirements (e.g., if there are migratory species or if there are species associated with fast flowing sections of water (that would not survive a change to lake conditions) an assessment of impacts of the project is not possible. • Vegetation surveys seem to have focused on estimating volumes of timber to be removed and not on assessing species or habitats present. A detailed habitat map is not provided. Aquatic plants (some groups of which show high levels of endemism) do not seem to have been assessed.
Assessment of direct and indirect impacts on	• Identification of impacts to biodiversity is simplistic and generic and the project activity which would generate the impact is not identified e.g. 'loss of wildlife' is listed as an impact but no project related activities that will cause this impact are identified and no justification for the score

Key PS1 + 6 requirements	Review findings
biodiversity and ecosystem services	rating of importance (positive or negative) is provided. As a result, it is unclear if all impacts have been identified e.g. does the assessment of risk of 'loss of wildlife' include increases in poaching rates as a result of in-migration to the area? If the project activities creating the impact are not clearly identified and clearly lined to specific biodiversity features (especially Critical Habitat-qualifying biodiversity), it is unlikely that appropriate mitigation measures will be identified (see below). • In-migration as a result of the development of the Project was considered to be a potential major risk for the Selous Game Reserve when the site was declared a World Heritage Site, however; only direct impacts are identified in the impact section and elsewhere no estimate of the scale of in-migration is provided to assess the scale of the potential impact on land degradation/conversion within the area of the Project and wider landscape. • Barrier effects are not considered as a potential impact (though are included in the table of mitigation measures) despite at least 14 species of migratory fish known to be present in the Rufiji basin (Darwall et al. 2005) and evidence of seasonal movements of elephants. In addition, the Kilombero Valley Floodplain Ramsar Site upstream of the dam is considered to meet Ramsar criterion 8 based on “a crucial breeding and nursery ground for fish for the whole of the Rufiji Basin” (Wilson *et al.* 2017), implying that fish mobility through the basin is important for maintaining that site’s values and warrant assessment. • The risk of fish entrainment (mortality in turbines, etc.) does not appear to have been assessed though it may be significant (fish entrainment can cause mortality rates of up to 20 percent; IFC 2018). • The need for and potential impacts of blasting on wildlife are not assessed. • Downstream impacts on biodiversity and ecosystem services do not appear to have been fully assessed despite recognition of potential impacts due to 1) altered flow rates; 2) change in sedimentation regime; 3) structural changes in the river; and 4) reduced flow due to evapotranspiration from the reservoir. This is a significant gap when there are downstream areas important for biodiversity and people’s livelihoods, including 1) floodplain agriculture, which is dependent upon periodic flood/ sedimentation events; 2) freshwater fisheries, in the river and associated lakes dependent on current seasonal flow regimes; 3) Rufiji Delta fishery, including the estuarine area, mangrove and seagrass artisanal fisheries; and 4) access to freshwater. Since the census data cited in the EIA suggest over 200,000 people live in the downstream

Key PS1 + 6 requirements	Review findings
	area, the overall number of people actually affected could be in the tens of thousands. • The impacts of limited flow during the reservoir filling phase are described as "very deleterious" to fish communities and fisheries and likely to result in disconnection of floodplain lakes. Insufficient data is presented to justify that the proposed 1,500m^3/s peak flow release during the filling period is either 1) feasible to deliver[4] or 2) sufficient to mitigate the potentially "very deleterious" impacts. Third-party studies suggest that much greater peak flow is required to maintain lake connectivity (see Assessment of Impacts to Physical environment section below).Downstream impacts are described as 'positive' in terms of flood control and prevention, but published literature describes the high degree of importance attached by floodplain farmers to the sediments brought by floods (Duvail & Hamerlynck 2007); this discrepancy is not explained in the EIA. • Stakeholder concern over loss of sediment/nutrients that may affect soil fertility is assumed to be compensated for by sediment from other tributaries without any justification for this assessment; for example, no modelling work is presented to assess downstream change in habitat quality based on the change in flow regime and sediment/nutrient load. Downstream impacts that may be important for biodiversity in the floodplain and deltas include sediment trapping and loss of seasonal water flows and nutrients. Hydrological changes are likely to affect breeding success of some aquatic species and impact the ecology of the floodplain and the delta area which in turn will impact the livelihoods of people dependent on agriculture and fishing in these areas. • Cumulative impacts are not fully assessed for biodiversity and ecosystem processes, e.g. the cumulative impact section does not include assessment of the combined impacts of the existing upstream hydropower projects with the Project on sediment flow/nutrients downstream to the floodplains and delta.
Assessment of impacts to the physical environment	• The EIA identifies several potential impacts as a result of changed flow rates and flow regime and changes in water quality, particularly due to reduced sediment load: loss of sand rivers (which we take to mean sections of river that are seasonally dry on the surface), downstream oxbow lakes, flooding regimes on the lower Rufiji floodplain, and changes in salinity and other aspects of water quality in the Rufiji delta. While in several places in the EIA these impacts are mentioned as being

[4] Note that figures on the diagram of the proposed filling regime (p143) are illegible in the version of the EIA reviewed and so could not be evaluated.

Key PS1 + 6 requirements	Review findings
	potentially severe, the overall conclusion is that they will be unlikely or even positive, which is not well-supported by the available evidence. • Given that the Project may have effects on ecosystems other than the river itself, that there are many people dependent on the river for ecosystem services, and that it is the most downstream dam in a cascade (with upstream dams at Mtera and Kidatu on the Great Ruaha) and that the Project is likely in Critical Habitat, good practice would normally require a high-resolution eFlows assessment to inform the impact assessment (World Bank Group 2018). No such study is presented and the cited models of flows are many years old. Details of available data are not presented in the EIA, but a scientific third-party review of the hydrological data available at the time of the cited studies suggests that 1) data were very patchy, and 2) projected peak discharges from the planned dam may not be able to replicate extensive natural flooding of the main agricultural areas of the floodplain. Such replication would require discharges of at least 4,000 m^3/s (Duvail & Hamerlynck 2007), approximately double the maximum discharge from the turbines mentioned in the EIA and close to the maximum discharge from all outlets[5]. The EIA provides no evidence that more recent data or modelling are available that would support a different interpretation; neither does it provide a convincing case that artificial irrigation will be able to mitigate impacts on floodplain agriculture if extensive flooding can no longer occur. Neither does the EIA provide evidence that such high-level discharges are feasible or likely given the planned power regime and design constraints (for example, if a minimum reservoir height is required for dam stability). • Impacts on river structure downstream of the dam, in particular increased river depth due to erosion by discharge of pulses of water at high velocity, are identified as potentially serious and of significant stakeholder concern. The EIA acknowledges that the level of potential impact is unknown. • The EIA acknowledges that sediment trapping behind the dam could significantly affect the Rufiji floodplains and delta since the main source of sediment is now the Kilombero and Luwega catchments as sediment from the Great Ruaha is already reduced due to upstream dams of Mtera and Kidatu. The EIA states 16 M tonnes is the current average annual sediment inflow; of this, 12.8 M m^3 will be trapped annually (i.e. 4.4 M tonnes or 1/4 of yearly sediment). This information is then contradicted on pp. 139/175 where it is stated that 25 M tonnes of sediment will be

[5] The EIA is not explicit that maximum discharge from both turbines and outlets is possible simultaneously, and does not describe the situations in which could be feasible; if this is not the case, a flow of 4,000m^3/s could not be delivered unless the reservoir is full enough to allow spill-over.

Key PS1 + 6 requirements	Review findings
	trapped per year which exceeds the average annual load. The EIA states that reduced sediment will be partially made up from other catchments (Kibanji, Behobeho, Gumba and Mhangoriversa) but provides no indication of why the sediment load of those catchments may change following construction of this dam. • Changes in salinity in the Rufiji delta are identified as a potential impact. The EIA seems to conclude that a more regular flow regime will reduce salinity, which it considers will favour human activities in the delta but would negatively impact biodiversity. Potential negative impacts of changed salinity on biodiversity in the delta are not assessed in any detail. Whether salinity levels will actually be reduced is not clear from the data presented, and the assessment that positive impacts on human uses will outweigh negative impacts on biodiversity is not substantiated by any evidence. • The EIA does not mention whether the dam will operate with hydropeaking and so the potential impacts of peaking flows (such as scouring) are not assessed. This is a highly significant omission compared to good practice guidelines. As well as impacts on the physical environment, this could have safely implications for people as it may mean big fluxes of water that could affect people washing or fishing in the river. • Discharges from the turbines are stated to be from the hypolimnion (lower reservoir depths) but no data is presented on the potential physical parameters of the discharged water or the potential effects on downstream water quality. This is a significant omission because those lower layers are often quite deoxygenated and relatively cold so flushing of those downstream is an additional stress on aquatic life downstream. • The hydrological data cited seems to be at least 30 years old and no consideration appears to have been given to the effects of either land-use change or climate change either since the data was collected and the studies were done or projected into the future This fundamentally calls into question the reliability of any predictions of potential minimum flows or flow regimes.
Impacts on SGRs Outstanding Universal Value	• World Heritage Site status for Selous was identified based on Criterion (ix) - outstanding example of ongoing ecological and biological processes and criterion (x) - the most important and significant natural habitats for conservation of in-situ biodiversity. The integrity of the values was a key component of the justification for Outstanding Universal Value. • The EIA identifies potential negative impacts on key components of the qualifying features for criterion (ix), notably: "… a network of normally

Key PS1 + 6 requirements	Review findings
	dry rivers of sand that become raging torrents during the rains; these sand rivers are one of the most unique features of the Selous landscape. Large parts of the wooded grasslands of the northern Selous are seasonally flooded by the rising water of the Rufiji River, creating a very dynamic ecosystem". Depending on the flow regime adopted, the dam will prevent flooding of wooded grasslands, potentially leading to very significant changes to this key feature. The dam is likely to eliminate significant number and lengths of sand river and their 'raging torrents', either where they are inundated by the reservoir, where dry season flow is maintained downstream, and, depending on the adopted flow regime, where they are scoured due to pulses of high velocity water. Whilst some negative impacts seem inevitable, the EIA does not provide quantification of the proportion of this component of the OUV that will be impacted, so it is impossible to evaluate whether the conclusion that large quantities of sand rivers will persist is warranted. • As discussed above, the EIA does not provide individual assessments on the reference species cited under the justification for meeting World Heritage criterion (x) - contains the most important and significant natural habitats for conservation of in-situ biodiversity based on the diversity of Miombo woodlands vegetation and the diversity and density of fauna supported by it and the aquatic habitats. It this therefore impossible to evaluate the significance of Project impacts on the OUV at an appropriate level of resolution. Some negative effect appears inevitable. However from the information in the EIA it is not possible to determine which qualifying features under criterion (x) will be compromised nor to what extent. • The EIA does not provide a detailed assessment of the consequence of the Project for the integrity of SGR's OUV, which is a core part of the justification for World Heritage status (for example under criterion (ix) 'wilderness' and 'undisturbed' are key aspects: *"The Selous Game Reserve is one of the largest remaining wilderness areas in Africa, with relatively undisturbed ecological and biological processes"*). Given the large footprint of the project in the heart of the SGR, the potential barrier effect from a long and wide reservoir and the need to create and maintain access roads, supporting infrastructure and a permanent human presence it is clear that the undisturbed and wild character of the area will be severely affected, even if individual features can persist. • The EIA considers that the Project will lead to an overall positive impact on the SGR's OUV compared to recent trends, presumably referring principally to recent high levels of poaching. Given the issues with the assessment of impacts on biodiversity and the physical environment described above, and the weak mitigation measures proposed and the

Key PS1 + 6 requirements	Review findings
	absence of a clear plan for delivering net gain (see below), this conclusion is not credible based on the evidence provided.

Application of the mitigation hierarchy, with a focus on avoidance	• Consideration of avoidance measures is very limited. This is the most important step in reducing impacts and therefore this is a significant deviation from good practice. This is particularly the case for projects in natural and mixed World Heritage sites where for example, recent guidance from IFC states that projects should be avoided entirely unless they are specifically designed to bring conservation benefits.
	• Various minimisation measures for social and environmental impacts are suggested but, as impacts are not appropriately identified and prioritised in terms of significance, mitigation measures are not clearly aligned with the most significant potential impacts and lack sufficient detail to assess their feasibility or effectiveness. For example, the mitigation measures include:
	  • measures that are not clearly linked to impacts. For example, it is not clear how the measures 'Designate Oxbow lakes as a fish sanctuary' could actually address the impact 'Impaired fish migration along the Rufiji River'.
	  • measures that are vague, for example 'develop optimum reservoir operation policy to sustain downstream demands' (page 202, enhanced floodplain irrigation agriculture), 'follow weather forecasts' (page 195 River bed/bank Degradation of the Lower Rufiji) or 'ensure controlled fishing and improved market outside' (page 203).
	  • Mitigation measures that are unlikely to be feasible in short time frames, whereas impacts may occur very rapidly once construction begins (e.g., there is evidence that agricultural yields in the floodplain decline significantly even three years after the previous flood ; Duvail & Hamerlynck 2007). For example, 'establish modern community-based irrigation schemes in Lower Rufiji floodplain' (page 202). Shifting farmers from traditional floodplain-based agricultural techniques to modern irrigation schemes is a considerable and time-consuming challenge, and no evidence base is provided for where this has been achieved elsewhere.
	  • The estimates of resources required to implement many of the mitigation measures are unrealistically low. For example, the entire budget for measures to address the impact "Loss of wildlife" is approximately $10,000 (30m TSH) – seemingly as a one-off cost. According to cost estimates from the Ruaha

Key PS1 + 6 requirements	Review findings
	Carnivore Conservation Project, this would only cover the salary and rations (but not equipment, training, management or vehicles) for 4-5 anti-poaching scouts for one year. This would be insufficient to ensure permanent staffing of a single control post, let alone to manage risks of increased poaching during construction and operations, and this budget is also expected to cover land-use planning activities outside the SGR which will also be costly. This budget therefore seems tiny compared to the potential severity of this impact. As a further example, the measure "Improve land use practices in upstream catchment areas" to address reservoir sedimentation is considered a 'no cost' item, which is simply not realistic. • Many mitigation measures, in particular for social impacts, hinge on the evidence base for water release regimes to mimic the conditions in the natural regime/maintain ecosystem services, which is not convincingly demonstrated. The EIA recognises that (for example) timings of releases might not coincide with key agricultural periods, and will be reliant on lake levels rather than downstream user needs, but no detailed alternative measures are provided if this does occur. • Some potential mitigation measures that are widely considered good practice (e.g., IFC 2018) do not seem to have been considered at all, including: fish ladders, mechanical or hydraulic fish lifts, trap and transport programs, mechanisms for downstream fish passage, such as increased spill bypass channel, and trap and transport programs, fish exclusion or guidance devices (such as screens) for both upstream and downstream passage that will prevent entry of fish into dangerous areas and guide them into bypass facilities and "fish friendly" turbine technology. • The EIA does not discuss whether river flow may be stopped completely at any time during construction or operations. If complete cessations of flow are not part of the normal cycle of river levels, this can lead to extinction of species, such as those endemic to riffles or rapids downstream of the dam, so it a is a critical consideration. • Mitigation measures for indirect impacts are particularly vague. For example, there is no discussion of the level of extra anti-poaching effort that will be required to address the risk of increased hunting.
Quantification of significant residual impacts	• The only quantification that is undertaken for biodiversity impacts is to state that the Project footprint of c.914km^2 will be only 1.8% of the area

Key PS1 + 6 requirements	Review findings
	of SGR[6] and hence the impact will be limited. This is an insufficiently detailed level of resolution for a project with such a large footprint in such a sensitive environment and may mask significant impacts to some biodiversity features. For example, the area impacted could well represent a much higher proportion of specific habitat types or of critical seasonal resources for wildlife such as water availability in the dry season. This possibility is supported by available data that show, for example, that 1) lion densities vary by a factor of 5 between different areas of SGR (Brink *et al.* 2013) and that they show a strong preference for riverine areas (Spong *et al.* 2002) and 2) that elephant distribution is seasonally very patchy (Figure 1). • The simplistic quantification that is included only considers footprint impacts – indirect impacts and fragmentation impacts due to the potential barrier effect of a c.12km wide reservoir could make the impacts much larger. • There is no quantification of potential negative or positive social impacts or impacts on ecosystem services.
Establish management programs that identify mitigation and performance improvement measures and actions, including operational procedures, practices, plans, and related supporting documents that are managed in a systematic way	• There is no discussion of the management programmes that will be required to ensure that identified mitigation measures are implemented. A good practice EIA would normally include a list of the management plans that will need to be developed along with their scope and objectives, and an overview of the process and timeline for developing them. • Mitigation measures are assigned to a wide variety of organisations and will cover a very wide geographical area. There is no discussion about how the actions will be co-ordinated to ensure they will be implemented as intended. This is not appropriate for a highly complex project with potentially significant impacts.
Credible plan to deliver no-net-loss or net gain for biodiversity and livelihood restoration for adverse impacts on Affected Communities	• No plan for delivering no-net-loss or net gain is included in the EIA • Livelihood restoration measures are mentioned, but with no reference to scale, scope, and type, and measures seem to be based on the unlikely assumption that farmers/fishers can easily shift to modern/different techniques and areas.

[6] The draft EIA (dated May 2018) states that the reservoir's maximum area will be 1,250km^2 or 3% of the area of SGR, whereas the revised version (October 2018) states that the reservoir's maximum size will be 914km^2 or 1.8% of the area of SGR. No explanation for the different estimates is provided, but presumably the earlier figure (which seems to be 100 km length x 12.5 km average width) is a crude approximation and the 914km^2 is more precise.

Key PS1 + 6 requirements	Review findings
Stakeholder Engagement: Identify the range of stakeholders; Stakeholder Engagement Plan, tailored to the characteristics and interests of the Affected Communities; Disclosure of relevant project information.	• Stakeholder identification emphasises interested parties who stand to gain (primary stakeholders), and secondary stakeholders who can influence decision-making. This approach is not aligned with PS1 which requires direct involvement of the Affected Communities (downstream ecosystem service dependent communities in this case) who are classified as 'other stakeholders' and represented by their District Councils. • While methods are presented, limited information on sampling strategy or representation of Affected Communities, number of meetings or engaged parties is provided. One month of consultation in 'Villages in Lower Rufiji' is reported (Annex C, page 269), with four bullet points of input, and five days of consultation in 'Villagers in the Rufiji Delta'. No village names or locations, or information on participants (village leaders, men, women, youth) is given. • Based on the number of downstream users – likely tens of thousands of people – it appears that Affected Communities have not been adequately consulted as required in PS1. Consultation with potentially Affected Communities in the lower Rufiji area seems to have lasted five days for a population of >100,000 people spread across >50 villages, some of them remote. It is very unlikely that this time would have permitted a consultation process meeting IFC performance standards requirements, especially given the complexity of the issues being discussed and in the absence of an eFlows assessment to inform the consultation. • There is no reference to a Stakeholder Engagement Plan nor about information on how consultation was tailored to local decision-making processes. • At least one existing lodge (Azura / Amara River Lodge) is cited as being under the area to be inundated, but no documentation of engagement with tourism operators is provided.
For projects with potentially significant adverse impacts on Affected Communities - **Informed Consultation and Participation** (ICP)	• No ICP is reported in the EIA. Given the potentially significant impacts downstream this appears to be a significant gap.
External Communications and	• There is no mention of a grievance mechanism nor provision for on-going reporting in the document.

Key PS1 + 6 requirements	Review findings
Grievance Mechanisms, and Ongoing Reporting to Affected Communities	
Monitoring and Review	• An Environmental and Social Monitoring Plan is provided in the EIA but it provides very general indicators only that are not appropriate for tracking impacts and mitigation effectiveness to specific priority biodiversity, OUV or Affected Communities. It is also unclear what pre-project baseline data would be used for the indicators (as noted above, there is a lack of data for the Project) or if it will be collected, when this would happen. It is also unclear which institution listed in the Environmental Monitoring Plan tables is responsible for collecting and reporting each of the monitoring indicators; clear roles and responsibilities and budget lines would be required for each party undertaking monitoring work. • There is no description of the proposed evaluation system so it is unclear how monitoring results would be used to inform adaptive management of mitigation activities.

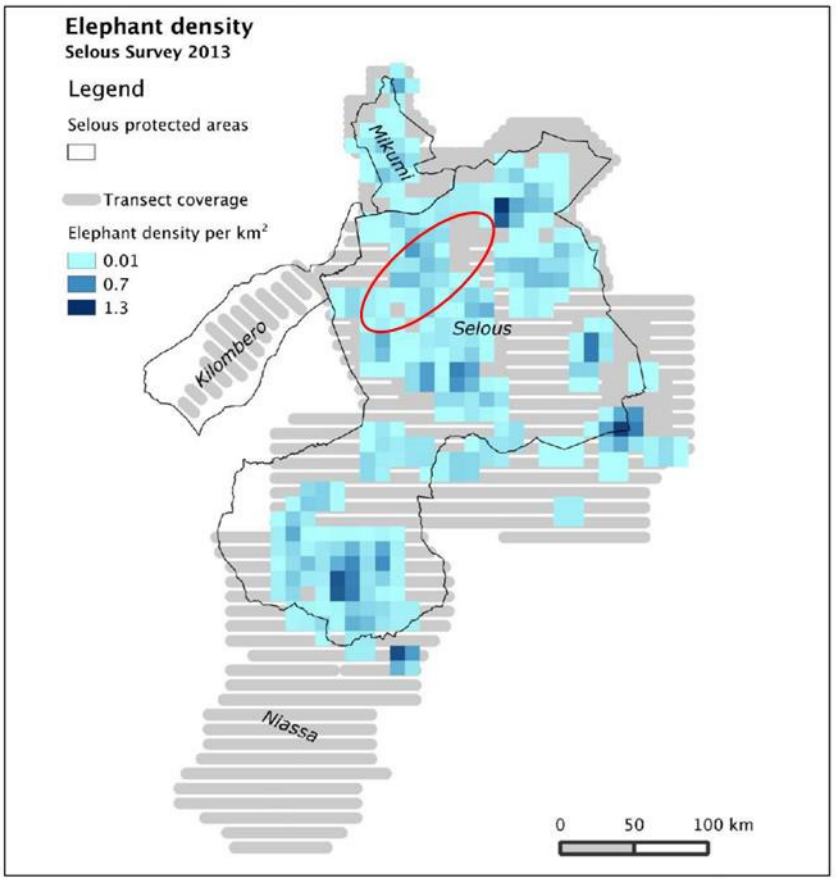

Figure 1 : Results from TAWIRI's aerial surveys show that elephant distribution in the Selous-Mikumi ecosystem is seasonally patchy. This is a dry-season snapshot from 2013. This illustrates why it is not appropriate to simply use surveys from one season, and why the proportion of the area of the entire SGR impacted is not a sensible basis for assessing the significance of reservoir impacts; it also illustrates the rich datasets that are available and which could be used to refine the assessment of impacts. Map from TAWIRI (2013), with approximate reservoir location added in red.

Review against IUCN's World Heritage Advice Note on Environmental Assessment

Table 2 below uses the assessment presented above to summarise the degree of alignment of the project with the principles of IUCN's World Heritage Advice Note on Environmental Assessment.

Table 2 : Review against the principles of IUCN's World Heritage Advice Note on Environmental Assessment. For further details please see Table 1 above.

Principle	Review findings
1: Rigorous EIA early in decision-making process	• As described above, the EIA has too many gaps and inconsistencies in all components to be considered rigorous. It has also not been conducted early in the decision-making process as it appears that construction may already have begun.
2: Appropriate experts	• Although a list of experts is included, insufficient information is provided to assess whether they had appropriate World Heritage, protected area and biodiversity knowledge.

Principle	Review findings
	• For project of this nature, global and regional experts would be expected to be consulted, but no list of such experts is provided.
3: Impacts on OUVs assessed, including direct, indirect and cumulative impacts	• The data used to assess impacts is at an inappropriately low level of resolution. Significant sources of secondary data do not seem to have been used (or not used to an appropriate extent), and primary data is very limited. • Impacts on the OUV are assessed, but not at an appropriate level of resolution: impacts to individual features contributing to the OUV are not assessed individually; neither are they quantified. • Several potential impact types are not assessed at all, including the barrier effect of the dam for migratory fish, and of the reservoir for mobile terrestrial species. • Assessment of indirect and cumulative impacts is limited.
4: Analysis of alternatives	• The analysis of alternatives is weak and focuses principally on different construction options, not on different ways to generate power or design choices that could reduce impacts (such as adjusting the dam height to reduce reservoir size).
5: Mitigation Hierarchy	• As discussed above, the mitigation hierarchy does not seem to have been systematically followed. In particular, there is limited attention to avoidance, and even some basic minimisation measures that are good practice for hydropower projects have not been assessed. • Mitigation measures are generally 1) not clearly linked to impacts, and/or 2) insufficiently detailed, and/or 3) not demonstrably feasible, and/or 4) insufficiently resourced. They therefore do not provide confidence that identified impacts will be avoided and minimised as far as feasible.
6: Chapter on World Heritage with clear conclusions about impacts on OUVs	• A separate chapter on World Heritage status is provided, however the conclusions about impacts on the OUV are vague and in some cases contradict assertions elsewhere in the EIA (for example about impacts on sand rivers). • No quantification of impacts to individual biodiversity features that are cited as contributing to listing under criteria (ix) and (x) is provided, so the overall conclusion of a positive effect cannot be substantiated and is not credible.

Principle	Review findings
7: Public disclosure and thorough public consultation	• No information on public disclosure is available, so this cannot be assessed. • Public consultation was limited, especially given the number of potential Affected Communities, and does not meet international good practice standards. No process of Informed Consultation and Participation was undertaken.
8: Environmental Management Plan	• An environmental management plan is presented but details of how it will be implemented, including the scope of requirement operational management plans is not provided. • No description of the overall monitoring, evaluation and assurance process is provided, and no provision for independent auditing is made.

Conclusions and implications

Key findings

The analysis documented above identifies many significant gaps in terms of project description, baseline information, impact assessment, mitigation design and implementation planning. The reviewed EIA therefore falls considerably short of international standards for a project with potentially significant impacts in an area of such high biodiversity and social sensitivity. It is therefore not appropriate for a large-scale development like the Stiegler's Gorge hydropower project. In particular, the reviewed EIA does not provide confidence that:

- potentially highly significant negative social and environmental impacts have been assessed with a level of resolution and precision appropriate for the nature and scale of the impacts;
- relevant and effective avoidance and minimisation measures have been identified;
- residual impacts will be addressed to ensure that negatively-affected livelihoods will be restored and that an overall net gain or no-net-loss of biodiversity will be delivered.

The most significant areas of divergence from international standards are:

- An inadequately detailed description of the project activities. In particular, there is insufficient detail on the planned flow regime, including both the likelihood or frequency of implementation of a hydropeaking regime, the expected level of seasonal variation in flows and the expected constraints to flows, for example in cases of prolonged drought.
- Insufficient consideration of associated facilities, notably the required transmission line and access roads.
- Baseline data are largely lacking and are frequently based on insufficient, out of date or irrelevant information, with significant gaps.
- Insufficient modelling of downstream flows and the absence of an environmental flows (eFlows) assessment.

- Insufficient justification that no viable alternatives exist: there is very limited consideration of different projects or of technical modifications (such as floating solar) that could be used to reduce project impacts.
- An insufficiently detailed assessment of impacts on the physical environment.
- An overly vague assessment of ecological impacts, with significant gaps in coverage, an insufficiently fine-grained assessment with little primary data, insufficient use of secondary data, and insufficient quantification for the impacts that are considered.
- An overly vague assessment of social impacts, that did not include Informed Consultation and Participation, does not seem to be based on primary data and does not include a quantitative assessment of the number of households or individuals potentially impacted.
- Mitigation measures that are 1) not clearly linked to impacts, and/or 2) vague, and/or 3) not demonstrably feasible, and/or 4) insufficiently resourced and therefore do not provide confidence that ecological or social impacts will be minimised. In addition, many basic good practice mitigation measures (e.g., fish ladders, fish screens) are not evaluated.
- The EIA contains no serious consideration or justification of how the Project can deliver a net gain or no-net-loss of biodiversity nor how impacted livelihoods will be restored.
- Insufficient detail on the proposed Environmental and Social Management System and operational systems that will be required to implement planned mitigation measures.

Implications and impacts on the Outstanding Universal Value of the Selous Game Reserve World Heritage Site was identified based on criterion (ix) - outstanding example of ongoing ecological and biological processes and criterion (x) - the most important and significant natural habitats for conservation of in-situ biodiversity. Given the many deficiencies in the EIA described above, it does not provide a credible assessment of potential impacts on the OUV of the SGR. This applies both to the values and to their integrity:

- The EIA identifies potential negative impacts on key components of the qualifying features for criterion (ix), notably: "… a network of normally dry rivers of sand that become raging torrents during the rains; these sand rivers are one of the most unique features of the Selous landscape. Large parts of the wooded grasslands of the northern Selous are seasonally flooded by the rising water of the Rufiji River, creating a very dynamic ecosystem". Depending on the flow regime adopted, the dam will prevent flooding of wooded grasslands, potentially leading to very significant changes to this key attribute. The dam is likely to eliminate a significant number and length of sand river and their 'raging torrents', either where they are inundated by the reservoir, where dry season flow is maintained downstream, and, depending on the adopted flow regime, where they are scoured due to pulses of high velocity water. Whilst some negative impacts seem inevitable, the EIA does not provide quantification of the proportion of this component of the OUV that will be impacted, so it is impossible to evaluate whether the conclusion that large quantities of sand rivers will persist is warranted.
- As discussed above, the EIA does not provide individual assessments for the species cited under the justification for meeting World Heritage criterion (x). It is therefore impossible to evaluate the significance of Project impacts on the OUV at an appropriate level of resolution. Some negative effect appears inevitable. However, from the information in the EIA it is not possible to determine which qualifying features under criterion (x) will be compromised nor to what extent.
- The EIA does not provide a detailed assessment of the consequence of the Project for the integrity of SGR's OUV, which is a core part of the justification for World Heritage status (for example under criterion (ix) 'wilderness' and 'undisturbed' are key aspects: *"The Selous Game Reserve is one of the largest remaining wilderness areas in Africa, with relatively undisturbed ecological and biological processes"*). Given the large footprint of the project in

the heart of the SGR, the potential barrier effect from a long and wide reservoir and the need to create and maintain access roads, supporting infrastructure and a permanent human presence it is clear that the undisturbed and wild character of the area will be severely affected, even if individual features can persist.

In addition, outside the Selous Game Reserve:

- It is highly likely that the Project will have significant negative impacts on the livelihoods of many thousands or tens of thousands of people dependent on the downstream Rufiji River;
- It is highly likely that there will be significant negative impacts on freshwater biodiversity in the Rufiji River (especially on migratory fish) which may in turn result in potentially significant impacts on the livelihoods of thousands of people dependent on fisheries in the upstream catchment, including the Kilombero Valley;
- Significant and lasting impacts on the physical environment of the downstream Rufiji delta cannot be ruled out, which may in turn result in significant negative impacts on the biodiversity of the Rufiji-Mafia-Kilwa Ramsar site and the ecosystem services it provides.

The EIA's conclusion that 'the development of the project should not be a matter of serious concern' is therefore untenable based on the evidence provided.

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