Sepik Development Project Review
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Introduction

I was asked by the Centre for Environmental Law and Community Rights (CELCOR), to provide expert advice on the environmental impact statement (EIS) of the proposed Sepik Development Project. I have prepared this report in accordance with Division 23.12 of Part 23 of the Australian Federal Court Rules and the Expert Evidence Practice Note including the associated Annexures (Practice Note). I have read the Practice Note and agree to be bound by it.

a) A plain English summary of the key issues raised by the Project EIS.

The main issues in the EIS involve:

Species in danger of extinction

The most severe categories of threat in the International Union for the Conservation of Nature (IUCN) global Red List of threatened species are Critically Endangered (CR) and Endangered (EN). The threshold to meet these criteria is high. For example, criteria for a species to be classified 'Critically Endangered' include that the species has been assessed to have more than 50% chance of global extinction within three generation based on evidence from monitoring, it has actually declined more than 80% in population in the last three generations, or there are fewer than 250 known individuals and it is still declining. The EIS found that there are between eight (confirmed) and sixteen (confirmed plus potential) Critically Endangered or Endangered species in the project area, and the first section of the infrastructure corridor and Bewani region. Another twenty-six to fifty-three species are in a less severe category of imperilment (Vulnerable or Near-threatened). This is a lot of threatened species for an area of this size; similar to the highest densities of threatened species anywhere in Australia. This demonstrates the importance of this site as a refuge for species that have been heavily hunted elsewhere, that has relatively low human population density, and high-quality intact forest.

Most of the highly threatened species in the study area are mammals. Some are plants and insects, but no birds, reptiles or frogs in the area are classified CR or EN. The Critically Endangered and Endangered mammals identified are listed mainly because of over-hunting, and also some due to habitat loss. These include a Critically Endangered Long-beaked Echidna (possibly present), black-spotted cuscus (present), Telefomin cuscus (possibly present), Bulmer's Fruit Bat (possibly present in or near the site), and the Endangered Goodfellow's Tree Kangaroo (present). These species are at very high risk of extinction

because they have been hunted out in most of their world-wide range. Remains of the Critically Endangered Black-spotted Cuscus were found in a village on the Sepik Floodplain during the surveys. This is an extremely rare animal that was recorded in the region in the 19th century, and at the time of the EIS had been recorded only twice anywhere in the last 20 years. Information from hunters and the jaw bone in Nekiei Village suggest that it survives in the area, possibly more in the Hill Zone than the often-inundated areas of the Lowland Zone. The area is likely to be a critical stronghold for its persistence due to the good condition of Hill forest and low human population in this region (thus low pressure from hunting). The Goodfellow's tree kangaroo is in the Nena Limestone Plateau area. Bulmer's fruit bat is a very rare species (known definitely from only two sites) that is also likely to roost in a limestone cave or sinkhole in the Nena Limestone Plateau area, if present. It's survival depends on protecting roost caves from disturbance including hunting, and preserving forest around them. The range of the Telefomin cuscus is very small and only in this region. The Telefomin cuscus is only known from 5 specimens ~ 50 km from the study area, and has been considered to be possibly extinct, as its only known site was burned.

The Critically Endangered and Endangered plants and insects identified are listed because of habitat loss. The plant species are at high risk of extinction because so much of their known distribution has been and continues to be logged or cleared for palm oil or pine plantations, and there are no conservation actions to protect them. Red List coverage of mammals is more thorough and frequently updated than that of plants, because of the much larger number of plant species and scarcity of researchers in relation to number of species in plants.

Species new to science

According to the EIS, more than 85 species discovered during Project surveys were probably new to science. Several species were also rediscovered (they might have been considered potentially extinct, or this was unknown), and several were recently discovered and in the process of being scientifically named and described; for example a Feather-tailed Possum endemic to the Sepik region, which was captured in the peat forest as well as disturbed forest along a river. The surveys found 26 new plants, two new mammals (tree mouse species at the Malia Site and Kaugumi swamp forest site), 26 new frogs, five new reptiles, 17 new odonates (dragonflies) and nine new butterflies. There are also several bats possibly new to science, assessed by their calls. One undescribed plant, one of the species of tree mouse, one reptile (a forest dragon only recorded at one site (called HI site in the EIS) and two dragonflies were only found in the project disturbance area (which is Malia, HI, Frieda Base, Ubiame, Frieda Strip, Frieda Bend, or Wario locations). The EIS points out that it is possible that some species new to science are restricted or have a large or crucial part of their population in the study area, but they consider it unlikely because their habitat extends beyond the study area (except possibly for a new butterfly in the peat forest). This is probably correct, although some of these species are probably endemic to Sepik region. Because habitat loss in the surrounding area is expected in the next few years when development increases outside the project area itself, clearing and flooding at this site added to surrounding habitat loss might affect much of the range of at least some of the new species endemic to the Sepik region in the near future. Most of the plant species new to science were only in Hill Forest or Montane forest (the highest areas, mainly not in the

footprint of the project disturbance area), and the plant assessment concludes that these areas are of the highest conservation value for plants. Most of the new frog species were tree frogs that breed in clear, flowing streams, in the limestone karst area.

Special species, types of forest, and landscape features that are valuable at a world scale for scientific reasons

This area is valuable not only to reduce the chance of extinction of threatened species and to protect poorly-known species new to science, but it is also important as an intact tropical forest landscape. Intact biodiversity is itself a globally 'rare natural resource'. There are areas of particular importance here, due to their high biodiversity together with this intactness. The Lowland and Hill Zone habitats in the project area have very high species diversity of mammals. The Hill Zone is especially important for threatened and newly discovered plants, and for threatened mammals. The Hill and Montane zones have high biodiversity and threatened species, and the lowlands also have unique birds, reptiles and butterflies, as well as being crucial for ecosystem services such as locally useful plants.

In the North Coast Ranges, the eastern Bewani Mountains, especially Mount Menawa is a 'Biologically Important Area' for reptiles and frogs. The Critically Endangered mammals the northern glider, tenkile, and Endangered northern water rat occur in this region.

The upper Sepik was already highlighted by scientists as an area needing urgent conservation action because of its many endemic, distinctive and threatened species, intactness, and its scientific value. The EIS reports of taxonomic experts confirm this. The region contains 'more than 1,354 species of vascular plants, 81 mammals, 220 birds, 58 frogs, 41 reptiles, 107 odonates and 359 butterflies (plus potentially 59 more mammals and 195 more birds)'. Around two-thirds of mammal species recorded are endemic to mainland New Guinea.

There are several species important to science in the study area because they don't have living close relatives - there is nothing else like them. These include Long-beaked echidnas (confirmed in the area, may be one of two species - one of which has not been seen by scientists as a living animal and is known only from one specimen in the Cyclops mountains) and Bulmer's fruit bat (occurs 50km away and is likely to occur in the study area, which has good habitat for it - limestone sinkholes and caves surrounded by intact forest). For bats, particular roosting caves are important for persistence in the region, and the Critically Endangered Bulmer's fruit bat is concentrated in only two known caves. The domed peat forest is also a rare ecosystem in New Guinea, and has been very little studied.

Species that have exceptional value because they maintain other species, and the health of the environment.

Both fruit and nectar-eating birds and bats are likely to be important for plant pollination and seed dispersal, regenerating forests after disturbance. Small and large bats are likely to affect different sets of plants. There is an exceptionally high number of species of small fruit and nectar eating bats, and also a high population density of individuals of these bats. Swamp forest and Nena limestone sites are particularly important for these small blossom

bats and fruit bats. A larger species, the Great Fruit Bat occupies several large camps of around 100,000 in the area, and these are likely to be main camps where they gather to mate and give birth at the same place each year. This includes the Wogamush flying fox camp ~30 km northeast from the Frieda River Port. A camp this size will be a high proportion of breeding females in a large area, no other similar breeding aggregations of this species are known outside the Sepik Basin. The maternity camp near Wogamush site is probably important for the species.

b) Whether the assessment of impacts on the terrestrial environment is appropriate and sufficient.

Adequacy of the surveys to document species

The species surveys are thorough and competent. World experts in locating and identifying these species did the field surveys over several years, using appropriate methods, including documenting local knowledge. The region was previously poorly known scientifically, for example there was no past systematic mammal survey, only a brief visit in 1983 by one Australian researcher. The EIS survey team found 60-75% of mammals that are likely to occur in the sites.

Is interpretation of the impacts identified in the EIS appropriate and sufficient?

There are three main causes of species declines and extinctions; over-hunting/harvesting, habitat loss, and interactions with invasive species.[1] The EIS has discussed how these might affect species persistence and larger-scale biodiversity. However, there are gaps, and it has not highlighted both the relative magnitude of these impacts and the probability of being able to reduce each impact. The EIS has not discussed how these impacts have affected species at other large gold and copper mines in Melanesia, for example. I think it would be valuable to report how severe these impacts have been in other similar projects, how well they were mitigated in these and other cases (how big is the effect of each remedial measure), and lessons learned to improve the mitigation of each of these in this proposed project, and have a larger positive effect on species persistence and biodiversity values (what will work best based on past experience?). The following summaries are in order of importance (magnitude of impact for the species at most risk) in my opinion.

Hunting and harvesting

Increased population density, more people arriving who do not have cultural connections to this area, access to roads, access to firearms and money are very likely to combine to increase hunting in and beyond the project sites, and this will especially put pressure on larger mammals, including bats congregating in caves and maternity camps, and some birds that are hunted for their ornamental feathers. This has happened before in the case of Bulmer's fruit bat; this species was only known from a single cave near Ok Tedi, and the development of Ok Tedi mine enabled the near-extermination of this colony when hunters

[1] Diamond, J.M. (1989) Overview of recent extinctions. In Conservation for the Twenty-First Century (Western, D. and Pearl, M.C., eds), pp. 37–41, Oxford University Press.

obtained guns (http://www.batcon.org/resources/media-education/bats-magazine/bat_article/626). It is now known from one additional cave system.

Immigration of mine workers and others is likely to be concentrated in the Hill and Montane forests where the most threatened mammals are. The EIS states that indirect impacts to montane forests from immigration are predicted to have a major residual impact, i.e. people moving to these forests will hunt threatened species, endangering their survival, and this can't be entirely controlled. This risk will particularly affect the Critically Endangered black-spotted cuscus, Vulnerable western montane tree kangaroo, Endangered Goodfellow's tree kangaroo, as well as the culturally significant northern cassowary and dwarf cassowary. The EIS assessment and IUCN Red List species assessments agree that If present, the Critically Endangered Telefomin cuscus, Sir David's long-beaked echidna and Bulmer's fruit bat are at high risk from this increased hunting. Hunting losses of the lesser bird-of-paradise, Pesquet's parrot (Vulnerable and declining due to over-hunting for its red feathers), palm cockatoo, Blyth's hornbill and New Guinea eagle will probably be moderate after mitigation measures, according to the EIS. Risk to other birds of paradise is assessed as minor. The EIS considers that immigrants are not expected to settle near the large flying fox maternity camp (although this camp may move year-to-year), and although there will be some hunting of bats, the residual impact on bats will be moderate including at the landscape scale.

Hunting is the reason why the severely threatened species in the project area have declined, and why they are now restricted to areas with few people such as this location. Increasing the number of people might well result in the extinction of black-spotted cuscus, and hasten the extinction of the other Critically Endangered and Endangered species here, unless strict measures are taken to prevent hunting. The suggested mitigation measures are to prohibit hunting, bushmeat consumption and removal of wildlife by staff, training and enforcement of wildlife harvesting rules, limit weapons, ensure that workers report sightings of the Critically Endangered and Endangered mammals: echidna, cuscus and tree kangaroos, a conservation programme and fauna relocation if these species are found in clearing zones, and further surveys for Bulmer's fruit bat to enable avoidance of any roosts of this species. These are appropriate measures, but there is a risk that measures of banning hunting and periodic checks of compliance only in project area staff won't be enough. The Tenkile Conservation Alliance project in the Torricelli mountains is a relevant example of successful mitigation of threats to restricted-range tree kangaroos using a holistic community development approach to stop hunting. This approach had a huge effect on people's behaviour, it is more likely to be effective long-term, and it involves a lot more than simply banning some activities and local education initiatives (https://www.tenkile.com/our-strategy.html).

Habitat loss

According to the EIS, over sixteen thousand hectares will be cleared or inundated. Around 70% will be hill forest and 20% lowland forest. There will be substantially more clearing than this overall, due to resettlement of four villages, and clearing for housing and gardens for an influx of people working on the project, and on subsequent developments. In future there will be more clearing along the infrastructure corridor, it is likely that this will include

forestry enabled by increased access. This will be a much greater area than the initial project. Loss of Montane forest will be 'medium' according to the EIS. It states that less than six hectares of montane forest (above 1000m above sea level) will be directly affected next to the open pit, however immigration of people from Telefomin will cause more impact. The location of resettled villages is not yet known. If resettled villages and roads to access them are established above 1000 m above sea level, then impacts on the Montane forest will be even greater. The EIS predicts 'moderate' impact of habitat loss on the Critically Endangered black-spotted cuscus and Sir David's long-beaked echidna (if present), and the Endangered Goodfellow's tree kangaroo.

For the most threatened animals in the project area including these Critically Endangered species, habitat loss due to this project will not be the mechanism that causes their extinction, but it will compound the effects of hunting, increasing the chance that hunting pushes them over the edge. Habitat loss has the greatest effect on species with small ranges (restricted distributions) by overlapping with most of their range or critical parts of their range. Assuming that project participants do follow the suggestions of the EIS to minimise the amount of clearing, then loss of intact habitats will be 8% of the area, and there will be 'moderate' impact on the biodiversity value of the site overall, potentially species new to science (as we do not know their distributions), and flying foxes in camps (as habitat loss could affect the critical roost). If maternity camps are damaged or cleared, or bats have to fly further for food, this would increase mortality and susceptibility to hunting. Substantial habitat of the Critically Endangered and Endangered plants will not be cleared. Most or all of the riparian (river-side) gallery forests in the project area will be cleared or flooded, and this will affect habitat of the only listed threatened aquatic species; the Vulnerable dragonfly *Bironides teuchestes*. The peat forest, Nena karst, and the North Coastal Ranges will either be avoided by Project infrastructure or have minimal disturbance according to the EIS, so the residual impact of habitat loss will not harm these ecosystems or species restricted to these areas (provided that mine workers follow the suggestions of the EIS below). These discussions assume that the cause of habitat loss is clearing and not fire. Uncontrolled fire might affect all of these areas. Fire is a relatively rare cause of habitat loss of restricted-range species in PNG, however in the case of the Telefomin cuscus, its only known location was destroyed by fire.

According to the EIS, suggested mitigation measures to limit the amount of clearing in the actual project area are: comply with planned minimal areas of clearing, clear in already-degraded areas where possible, keep habitat trees and trees with canopy above roads, avoid disturbing drainage in lowland swamp forest, do not put infrastructure (buildings, tracks etc including temporary ones) in peat forest, montane forest, the Nena limestone karst area, or intact forest of the North Coastal Ranges, enforce fire bans in drought times, cultivate new species of plants (i.e. use ex-situ propagation to increase the number of individuals so more can be planted), identify and cultivate new butterfly species' food plants, and use these cultivated plants in revegetation, and minimise stream bank disturbance. These are appropriate measures, and are likely to decrease the chance that species' conservation status will deteriorate as a result of the project work, but most of them will have minimal or modest-sized effects. In my opinion, the most important (highest magnitude effect, benefitting the most individuals in the largest area) is probably avoiding inadvertently draining swamp forest, and not disturbing peat forest, montane forest, the

Nena limestone karst areas (including Bulmer's fruit bat roosts if located), or intact forest of the North Coastal Ranges (as this might well lead to further damage, especially via tracks or road access). Wildfire avoidance is also crucial.

The other two main suggestions are to relocate individuals of any threatened species found in the project disturbance area and establish a system of offsets (comments on these below). These two suggestions are the only ones that will address the serious issue of habitat loss outside the immediate project area.

Invasive species

In several places in the EIS, the authors emphasise the threat of invasive pests and diseases, state that they can cause landscape-wide effects, and say that quarantine measures are 'key mitigation measures'. With a few exceptions, I think that invasive species are not as serious risks to biodiversity of this site and particular threatened species and ecosystems as is over-hunting and habitat loss. This is because areas of intact forest on large land masses such as PNG are resistant to most (but not all) invaders, and the relevant harmful invasive species are already in PNG, they are not arriving from other countries or islands, but expected to travel into the project area from other parts of PNG. The EIS documents invasive species in disturbed areas only. The species that they give as examples are all serious invaders of small islands in the Pacific, that arrived over water from other invaded islands accidentally or were introduced in misguided biocontrol attempts 'small Indian mongoose, rosy wolf snail, slider turtle, crazy ant' (and cane toad, which is already established in PNG). Small islands are most vulnerable. In my opinion, the risk to a newly-disturbed inland area of PNG is most likely to be from invasive species already present in the country but previously inhibited from establishing in intact forest or not transported to water bodies due to the previous lack of roads and access, or else a new exotic organism brought to the site directly from another country by fly-in fly-out workers and other staff. I think that the largest such threat is chytrid fungus (*Batrachochytrium dendrobatidis*), which wasn't mentioned in the EIS. This disease has decimated frogs world-wide and caused many extinctions. It is not in PNG, but it is present in Australia. Conservation scientists are very concerned that chytrid fungus must be kept out of PNG, which has 6% of the world's frog species (https://theconversation.com/a-deadly-fungus-threatens-to-wipe-out-100-frog-species-heres-how-it-can-be-stopped-117842). The reason that the EIS did not record highly threatened frogs, but did record many species of frogs, is largely because PNG does not have this disease.

Suggested mitigation measures are chemical washing down points to prevent weeds and pathogens. This is an appropriate measure. In my opinion, inspections of materials brought by people arriving from other countries, limiting roads and tracks, and limiting visits to sites where there are endemic frogs would also be appropriate.

c) Concerns about the environmental impacts of the project, considering mitigation measures proposed

The most concerning aspect of the project impact to me is the limitation of mitigation to staff doing project activities in the lease area. Most of the mitigation ideas are appropriate, but small scale and fragmented rather than holistic. Limiting mitigation to the project site

might well result in extinction of the black-spotted cuscus, possibly other Critically Endangered species or restricted-range Montane zone species, and degradation of the world-class biodiversity values of intact forest in the region. The EIS states that the project will not be able to control immigration and behaviour of people beyond the lease area. However, I think that leaders of the project could improve the chance of retaining biodiversity values with a 'bigger picture' approach. Offsets is one such approach. Another is to engage with the Tenkile Conservation Alliance and other civil society holistic conservation organisations who have experience building long-term conservation partnerships in this region, such as UNDP and WCS (as well as CEPA). Although there is no mining / hydroelectric development where TCA works, they know from experience how to do conservation education and local development that is effective in the long term, and their methods could be integrated into mitigation. This project as a whole could engage much better with conservation and local development organisations to improve the biodiversity outcomes in the short and long term.

Offsets

The EIS suggests that the project is in a good position to start a biodiversity offset program that offsets biodiversity losses by strengthening existing protected areas or making new protected areas, or both. I agree that this is a good idea if done properly. This program can go beyond this project to establish a planned conservation system for PNG as a whole, together with CEPA. There are many examples of poor offset protocols (such as just replanting grass on mine sites). If this project is to effectively strengthen existing protected areas or make new protected areas, this should involve prior community consultation and consent, and a form of community protected area that is appropriate for PNG. For example, this might be an area of complete or periodic hunting and clearing closure (plus complete bans on the threatened species), in exchange for agreed benefits to communities such as schools, well-supported clinics, water tanks etc. This could also engage with immigrants to the area, as well as local villages. There have been examples of inadvertent benefits to hunted species in PNG of mining, because large areas around mine sites were closed off or fenced. A study of the ecologist Jared Diamond in the PNG highlands in the 1980s documented a large increase in density of wildlife near a mine site over a few years.

Enforcement and performance measures

Details of the measures, responsibilities and frequencies in the 'Biodiversity Management Sub-plan' (Table 3-1 onwards) appear to be appropriate and feasible. There are some actions with insufficient detail to assess if they are likely to work, especially the plan to relocate species of conservation concern, the aim of developing a management plan for Bulmer's flying fox if surveys find colonies of this Critically Endangered species, and the plan to prohibit bush meat and firearms / bows and arrows for project workers during project activities - the performance measure is 'regular inspection' but what will the response to non-compliance be? Several measures have this problem of not explicitly stating the threshold and the response to non-compliance, including 'monitoring of forest condition at road and facility edges' annually, targeting reduction in diversity <50% and cover <75%, and 'analysis of imagery to monitor habitat cover and condition' biennially, 'monitoring of amphibious fauna' annually targeting 'no loss of species new to science', and 'aerial surveys

of waterbirds and flying fox colonies' annually targeting no evidence of colonies being abandoned.

Relocation

The EIS suggests relocating any threatened species found in the lease area. I don't think this plan is very well developed. Many studies have shown that relocating wildlife is usually simply killing them (either they are moved to poor habitat where there are no others of the same species, or if it is good habitat, it is usually already saturated with competitors. Tree kangaroos are highly territorial and aggressive to intruders for example). A better idea would be to engage the Port Moresby Fauna Park to take any threatened tree kangaroos, cuscus, or other threatened species. They have active conservation programmes for these types of species, captive breeding, husbandry, research and they are also members of the IUCN Species Specialist Group for marsupials and monotremes. Additionally, there should be a dedicated holding pen for any animals located on the lease site, designed with advice from them. The project leaders should help the fauna park to fund this.