

Ok Birim Tailings Storage Facility Project

Environmental and Social Impact Assessment

Chapter 12

Cumulative impact assessment



12. CUMULATIVE IMPACT ASSESSMENT

This chapter presents the cumulative impact assessment for the Ok Birim Tailings Storage Facility (TSF) Project. Unlike other chapters in this environmental and social impact assessment (ESIA), this chapter uses the term 'Ok Birim TSF Project' rather than 'the project' throughout to minimise the potential for confusion with other 'projects'.

Although cumulative impact assessment is not specifically mandated under *Ok Tedi Environment Management Act 2019*, Ok Tedi Mining Limited (OTML) has proactively assessed cumulative impacts from credible and potential projects likely to occur within the same spatial and temporal boundaries as the Ok Birim TSF Project.

The assessment follows guidance provided by the International Finance Corporation (IFC) *Good Practice Handbook: Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets* (IFC 2013). IFC (2013) defines cumulative impacts as:

'... those that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones.'

A cumulative impact is considered possible only if the following three criteria are met: a credible project and spatial and temporal relationship. This assessment identifies credible and potential projects within the project's area of influence, evaluating their spatial and temporal relationships with the Ok Birim TSF Project to determine whether cumulative impacts may occur and to assess their significance. Where significant cumulative impacts are identified, appropriate management strategies are proposed. Effective implementation of these strategies will require collaboration among stakeholders, including other project proponents, provincial governments, and the national government.

Information and data used in this assessment exclude projects beyond the jurisdictional scope of Papua New Guinea (PNG); in particular, it excludes projects in the neighbouring West Papua province of Indonesia as it is beyond the scope of the ESIA to speculate on credible projects there. Sources included existing EISs, relevant project documents, publicly available information, and outcomes from stakeholder consultations conducted described in Chapter 5.

12.1 IMPORTANT ENVIRONMENTAL AND SOCIAL ASPECTS

The important environmental and social aspects of the Ok Birim TSF Project's project area and surrounding region are described in chapters 8 and 9, respectively. The aspects most at risk of cumulative impacts are:

- Common use of transport corridors and facilities. Shared use of road and river transport corridors and road/river user safety. A newly constructed infrastructure corridor will be required to facilitate the movement and use by project specific vehicles and a new tailings pipeline. Transport along the Fly River to Kiunga Port is required to transport some equipment to site, which may lead to increased river traffic and port use.
- Discharges into rivers. The Ok Birim is a prominent river in the project area and it flows into the Ok Tedi southwest of Ningerum. Unlike other developments that may contribute sediment, wastewater, or other materials into the Ok Birim, the TSF is specifically designed to (1) be outside the catchment of the Ok Birim and therefore avoid discharges to it and (2) minimise the direct discharge of tailings to the Ok Tedi system. The amount of tailings entering the system will be significantly reduced, with at least 90% of tailings produced to report to the TSF conservatively allowing for 10% of the time where tailings may still need to be discharged into the Ok Kumiup as per current practice if the pipeline is not operational. While some proportion of sediment may be discharged in the TSF decant water, and from the construction of the

pipeline and associated roads, there will still be an overall significant reduction in sediment, particularly silt, entering the Ok Tedi system. In this sense, the TSF is a significant mitigation measure to address the legacy downriver impacts of the Ok Tedi Mine, rather than a new source of cumulative impact.

- **Habitat loss.** The extent of vegetation clearance for the project could cause a gradual loss of habitat within this region or ecological zone, potentially having a significant impact on endangered fauna and flora species. Habitat loss in this region will contribute to the overall loss of vegetated areas already impacted by dieback due to the mining operations. However, most of the vegetation to be lost is the commonest vegetation type in PNG (low altitude forest on uplands) comprising 31% of the country's forest vegetation. Further, it is anticipated that the Ok Birim TSF Project will reduce the level of dieback stress and peripheral extent in the Lower Ok Tedi and Upper Middle Fly River, offsetting the direct impact of vegetation clearance. Additionally, edge effects and other indirect impacts such as hunting may also contribute to a cumulative impact on a particular habitat or species. Habitat will be lost for conservation-significant fish species with ranges limited to the Ok Birim area.
- **In-migration and access.** The Ok Birim TSF Project will provide road access to areas that were previously difficult to reach or poorly connected. The increased accessibility can lead to an influx of people into an area in search of work (in-migration) and may open up formerly inaccessible areas to hunting and changes in land use. The in-migration of people can impact the health and wellbeing of the existing population and strain service delivery and infrastructure. Improved access can also enhance people's ability to reach education, health and other vital services. Additionally, the potential for in-migration into the general region will extend west towards the Indonesian border as a new PNG-Indonesian border post and associated road network will be constructed at Yetekun within the Ningerum local level government area (OTML 2024).
- **Economic stimulus.** The development of the Ok Birim TSF Project aims to improve the overall performance of the existing mining operations and accommodates the proposed mine life extension from 2033 to 2050. Enabling continued operation of the mine through to 2050 will see economic benefits of the mine continue. Further, through both direct and indirect projects linked to the mine, individuals have opportunities to gain benefits from education, training and employment supported by investments in government and community infrastructure and services.
- **Cultural heritage.** The project has the potential to directly affect a limited number of cultural heritage sites, particularly within the permanent TSF footprint and selected sections of the infrastructure corridor. Loss or disturbance of heritage sites and features due to development of multiple projects in the region can lead to cumulative loss of cultural identity.

These aspects form the basis for identifying and evaluating cumulative impacts that may arise from the Ok Birim TSF Project and other projects. Additionally, Chapter 13 identifies natural environmental and social stressors which may impact the project area and the surrounding region: climate, flooding, terrain, earthquakes and landslips. These stressors provide important context for determining the significance of potential cumulative impacts on environmental and socio-economic and cultural values.

12.2 METHOD FOR IDENTIFYING CREDIBLE PROJECTS

This section explains the method to determine projects that could contribute to a cumulative impact.

12.2.1 Credible projects

Existing projects and their impacts have been considered in the environment and social baseline characterisations described in chapters 8 and 9. For instance, current impacts on terrestrial ecology from construction of the tax credit scheme road to the PNG–Indonesia border and the sealing of the Tabubil–Kiunga Highway with supporting gravel crushing operations on the eastern bank of the Ok Tedi near Alice Pit. These existing projects are only considered in the cumulative impact assessment if their operations are expected to change during the life of the Ok Birim TSF Project.

Credible projects are those that are:

- In operation and seeking approvals for expansion; for example, an existing project that has lodged an application with the PNG Government to expand operation or increase production.
- Under construction or being commissioned; for example, new resource development currently under construction.
- Approved and awaiting final investment decision; for example, a project that has received approval from the PNG Government and is awaiting the proponent's decision on whether to proceed with the investment or not.
- Approved and in detailed engineering design; for example, a project that has received approval from the PNG Government and is currently in detailed design before construction begins.
- In an approvals process and likely to proceed if approval is obtained; for example, a project for which an environmental inception report (EIR) and/or EIS has been lodged with the Conservation and Environment Protection Authority (CEPA), and the company has established a presence in PNG and expressed a desire to proceed with the project if approved.

For a project to be eligible for consideration in the cumulative impact assessment, the important environmental and social aspects need to have been described in an EIS or sufficiently described in an EIR or permit amendment (and these need to be publicly available, which is not always the case) to enable the project's contributions to a cumulative impact to be assessed, either qualitatively or quantitatively. Planned or unplanned activities or infrastructure on the Indonesian side of the border have been excluded from this assessment. The cumulative impact assessment cannot assess potential projects which are speculative and for which there is no verified publicly available information relating to the design, construction and operation of the project.

12.2.2 Spatial relationship

Projects geographically linked (e.g., via a river or road) or located close to one another (e.g., in the same river catchment) may collectively contribute to a cumulative impact. The development of the Ok Birim TSF Project and associated infrastructure will establish new connections to settlements and project sites.

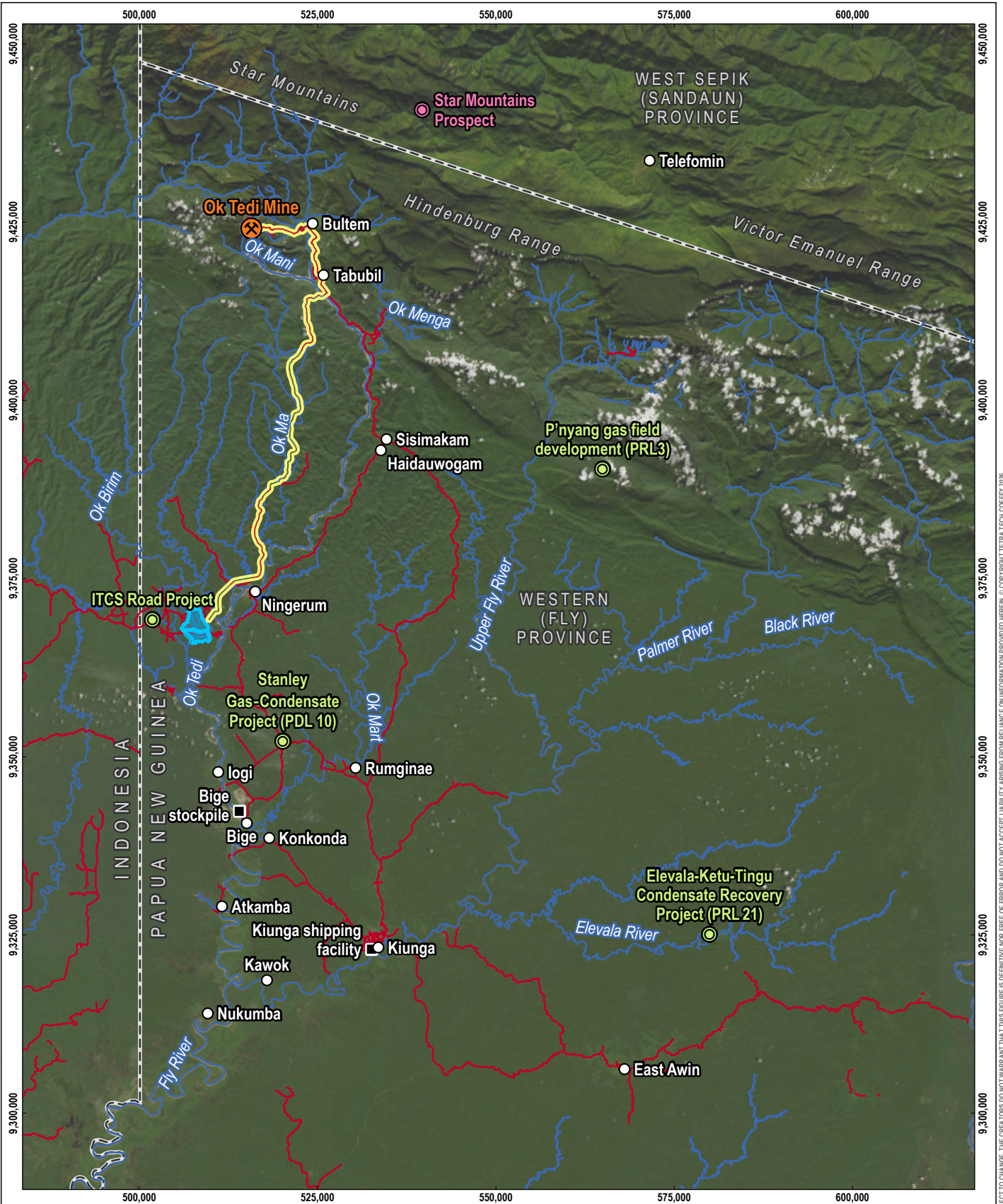
A new infrastructure tax credit scheme (ITCS) road and proposed bridge across the Ok Tedi will provide vehicle access to the eastern bank of the river, where access is currently limited to motorised dinghy or canoe. Projects situated within the same catchments or using the same transport corridors may therefore collectively contribute to cumulative impacts, including further clearing of forested areas, greater human access to remote landscapes, and additional pressure on community, health and education infrastructure. The Ok Birim TSF Project spans the Ok Birim and Lower to Middle Ok Tedi catchments, both of which drain into the Fly River, meaning that proposed and existing projects in these catchments may have added downstream effects.

12.2.3 Temporal relationship

A project's construction, operation and decommissioning activities must overlap with the life of the Ok Birim TSF Project for a cumulative impact to occur. If this is not likely to happen then the project has not been considered in this cumulative impact assessment.

12.3 IDENTIFICATION OF CREDIBLE PROJECTS

Table 12.1 lists projects spatially and temporally connected to the Ok Birim TSF Project along with an evaluation of whether they meet the criteria for a credible project. Figure 12.1 shows these projects. These projects were evaluated for their potential to cause further change to the important environmental and social aspects already predicted to be affected by the Ok Birim TSF Project.



LEGEND

- Credible project
- Potential project
- ⊗ Ok Tedi Mine
- Village
- Key infrastructure
- Road/track
- Watercourse
- Province boundary
- Proposed TSF footprint
- Proposed infrastructure corridor



0 10 20 km
SCALE 1:750,000
PAGE SIZE: A4
PROJECTION: PNG94 PNGMG94 Zone 54

SOURCE
Projects and villages from Tetra Tech Coffey.
Proposed infrastructure from KCB and OTML.
Topographic features from OSM. Admin boundary from NSO.
DEM from SRTM. Imagery from ESRI.

OK TEDI MINING LIMITED

OK BIRIM TAILINGS STORAGE FACILITY PROJECT

FIGURE 12.1

Credible and potential projects



TETRA TECH
COFFEY

DATE: 21.06.26 PROJECT: 754-MELN374244 FILE: 374244C_R08_F12.01_GIS

Table 12.1 Evaluation of projects

Project	Spatial relationship	Temporal relationship	Evaluation
<p>The P'nyang Gas Field Development (P'nyang Project) is a proposed LNG project to be constructed and operated by Esso PNG P'nyang (ExxonMobil affiliate). It holds an estimated 4.36–4.4 trillion cubic feet of gas. A gas agreement was signed in February 2022, followed by a Fiscal Stability Agreement in March 2024.</p>	<p>Petroleum Retention Licence (PRL) 3 is located approximately 50 km northeast of the Ok Birim TSF, with a proposed road access route via Sisimakam Village off the Kiunga–Tabubil Highway.</p>	<p>A final investment decision is expected by 2029; this will be followed with an approximate 2-year construction period. Operations are anticipated to last for approximately 30-years followed by a 2-year decommissioning phase.</p>	<p>This is a credible project for the purposes of this cumulative impact assessment.</p>
<p>The Stanley Gas-Condensate Project (Stanley Project) is an onshore conventional gas and condensate development west of Rumginae, to be constructed and operated by Arran Energy. The project remains in pre-development. Once developed the field will include two production wells (plus reinjection wells) feeding a modular processing plant. There will also be a 43-km-long pipeline that will deliver condensate to a load-out facility on the Fly River near Kiunga, with approximately 40 barged shipments annually. Gas will be primarily injected back underground, with a portion used for regional power.</p> <p>In late 2025, OTML signed a non-binding gas supply agreement with Arran Energy to purchase gas from the Stanley gas field.</p>	<p>Petroleum Development Licence (PDL) 10 is located approximately 18 km southeast of the Ok Birim TSF.</p>	<p>A final investment decision was expected between 2022 and 2023, that aimed for first production between 2023 and 2025. This has not yet happened. Operations are anticipated to last for approximately 25-years.</p>	<p>This is a credible project for the purposes of this cumulative impact assessment.</p>
<p>The Elevala–Ketu–Tingu Condensate Recovery Project (Elevala Project) is an onshore gas-condensate development to be constructed and operated by Arran Energy with minority partner Kina Petroleum. It is located southeast of the Stanley gas field in the Elevala, Ketu and Tingu river catchments. The project concept includes a central gas processing facility, up to six production wells (plus reinjection wells), approximately 90 km of condensate export pipeline to a load-out facility at Drimdenasuk near Kiunga, with approximately 40 barged condensate shipments annually.</p>	<p>PRL 21 is located approximately 50 km southeast of the Ok Birim TSF.</p>	<p>The project remains in the pre-development/concept stage. Front-end engineering design work commenced in 2014 to 2015; however, progress stalled due to regulatory and legal challenges. An application for petroleum development licence (APDL 12) was granted in 2015 but was subsequently challenged in court. As of 2025, the dispute remains unresolved. First production is targeted for approximately 2030; however, the project has not yet advanced to final investment decision.</p>	<p>This is a credible project for the purposes of this cumulative impact assessment.</p>
<p>The Star Mountains Prospect is a copper–gold exploration project, was fully owned by Highlands Pacific Limited, now acquired by Cobalt 27. A major drilling campaign in 2017 confirmed extensive mineralised zones, and the company is currently seeking a partner to advance the project.</p>	<p>The project is located approximately 40 km northeast of the Ok Tedi mine and approximately 80 km northeast of the Ok Birim TSF.</p>	<p>The project remains at an early exploration stage, with no confirmed plans for future development activities</p>	<p>As engineering studies are still in the preliminary phase the potential project is not included in this cumulative impact assessment.</p>

Project	Spatial relationship	Temporal relationship	Evaluation
The Sepik Development Project consists of major and integrated commercial projects: the Frieda River Copper-Gold Project and the Frieda River Hydroelectric Project, which are to be supported by the Sepik Infrastructure Project (SIP) and the Sepik Power Grid Project, owned by PanAust Limited, the Australian subsidiary of China's state-owned Guangdong Rising Holding Group. The project area will span both the East Sepik and Sandaun provinces of PNG.	The Sepik Development Project area is located north of the Star Mountain ranges in the East Sepik Province and expands further north into the Sandaun Province. It is located approximately 120 km northeast of Ok Tedi mine, and 160 km from the Ok Birim TSF.	The project remains in the permitting and approvals phase since the submission of the EIS to CEPA and Proposal for Development to the Mineral Resources Authority in 2018. Six separate environment permits were issued for the project in early 2026.	As the project area is not close to the Ok Birim TSF Project and on the other side of the Star Mountains, it is not included in this cumulative impact assessment.
Gre Drimgas Project involves a 600 km roading development by Epoca Group Limited linking townships of Kiunga to Balimo in the Western Province and extending road networks to connect with the Gulf Province. The Gre Drimgas Project also involves agroforestry with logs harvested to be processed at a facility in the deep-water area of Strickland River.	This project is located approximately 50 km southeast from the Ok Birim TSF site and involves the construction of a 300-km-long road east of Kiunga to the Nomad government station, then south to Balimo and east towards Gulf Province. An additional 300 km of feeder roads will also be constructed.	Little information is publicly available; however, initial information indicates it is expected to be operational by 2028 (Erehe 2024).	Insufficient project information is available for this project to be considered in this cumulative impact assessment.
The West-Agro Fly Vanilla project is based at the Samagos Agro-Industrial Centre in Kiunga, Western Province. The project is facilitated by WestAgro Holdings with support from OK Tedi Development Foundation (OTDF). This supports sustainable livelihood through vanilla farming. This is a pilot project in three different locations in Western Province (Samagos in North Fly, Kaviananga in Middle Fly and Suki in South Fly). Limited information is available about the benefits on livelihoods at this stage in the three pilot project areas.	The agro-industrial centre is located in Kiunga, approximately 50 km southeast of the TSF site.	While production has commenced, it is expected to grow, resulting in greater exports through ports in the Fly River catchment in coming years. The exact timing is unknown.	This is a credible project for the purposes of this cumulative impact assessment.
Kavorabip–Atemkit Road is a roading development funded through OTML as an ITCS project. The development will connect Kavorabip and Atemkit to Tabubil and Indonesia.	The project is located near Mt Bini in the Star Mountains.	Construction commenced in early 2024 and is expected to be completed by the end of 2027.	Insufficient project information is available for this project to be considered in this cumulative impact assessment.
Alice Pit–Border Post Road (the ITCS Road) is a roading development. The project is expected to improve regional accessibility for local communities in the Ningerum Local Level Government area as well as enhance cross-border connectivity at the Yetetkun PNG-Indonesian border post.	Located on the western bank of the Ok Tedi in North Fly District and immediately adjacent the Ok Birim TSF site. This includes a planned bridge over the Ok Tedi to connect to the existing Kiunga-Tabubil Highway near Alice Pit.	Construction of the ITCS road has commenced. Construction of the planned bridge is scheduled to commence in 2027 and is expected to be completed by 2029.	This is a credible project for the purposes of this cumulative impact assessment.

12.4 CUMULATIVE IMPACT ASSESSMENT

Potential cumulative impacts are discussed in the following sections, along with proposed management strategies for the potentially significant cumulative impacts. The impacts are discussed under each of the causes of cumulative impact that could arise from the credible projects in Table 12.1.

12.4.1 Physical disturbance - vegetation clearance

The P'nyang Project and the Stanley Project are situated within an approximate 70 km radius of the Ok Birim TSF Project. Both projects will involve the clearing and conversion of largely undisturbed forest approximately 50 km northeast of the Ok Birim TSF Project for the P'nyang Project and 18 km southeast for the Stanley Project. This will increase the extent of the habitat loss within the region, albeit at different elevations where vegetation type is strongly correlated with elevation.

Habitat loss and associated indirect effects such as edge and barrier effects are expected during construction of the P'nyang Project, while minor vegetation clearance has already been carried out for parts of the Stanley Gas-Condensate Project and Elevala Project. Habitat loss in this context includes the removal of intact vegetation communities, reducing the overall extent of undisturbed forest within the region, as well as the loss or damage to focal sites. This includes important habitat features such as large trees and caves that support biodiversity, particularly at P'nyang.

The approximate area of vegetation clearance required for the P'nyang and Stanley projects are 2,770 ha (Coffey 2015) and 200 ha (Douglas Environmental Services 2012) respectively, as both developments are expected to require substantial land disturbance for well pads, access roads, pipelines, and associated infrastructure. Such disturbance will result in the permanent conversion of intact forest to industrial use, thereby reducing ecological integrity and fragmenting habitats in these locations. Unlike areas cleared for temporary construction activities, land converted for gas production infrastructure has limited potential for progressive rehabilitation during project operations.

To compare the relative scale of vegetation disturbance associated with the credible projects considered in this assessment, Table 12.2 provides the estimated vegetation disturbance footprints for the Ok Birim TSF, P'nyang, Elevala (Horizon Oil Limited 2014) and Stanley projects. While each project contributes to regional vegetation clearance, the magnitude and permanence of disturbance vary considerably.

Table 12.2 Comparison of vegetation clearance associated with credible projects

Project	Estimated vegetation disturbance (ha)	Description
Ok Birim TSF Project*	2,042	Comprises approximately 1,563 ha of intact forest, 318 ha of agricultural land and 132 ha of existing roads and tracks.
P'nyang Project	2,770	Approximately 480 ha associated with permanent facilities and 2,290 ha associated with pipelines and supporting facilities. More than 90% of disturbed areas are expected to regenerate following construction.
Elevala Project	460	Majority of construction footprint in upland forest vegetation. Final operational footprint estimated at approximately 192 ha.
Stanley Gas Project	200	Comprises secondary forest, gardens, sago, cultivated rubber and grassland.
Total	5,472	

* Values based on conservative estimates presented in Appendix G.

Table 12.3 places the cumulative vegetation disturbance associated with the credible projects in the context of the extent of low altitude forest on uplands. While the combined disturbance footprint of the Ok Birim TSF Project and the credible projects is substantial at a local scale, it represents a very small proportion of the overall extent of this vegetation type, the most common forest type in PNG. Consequently, cumulative impacts associated with vegetation clearance are not significant at the national scale. They may be locally important due to habitat fragmentation, edge effects, increased access to previously remote forest areas and the concentration of development activities within northwestern Western Province.

Table 12.3 Context of cumulative vegetation disturbance

Vegetation type	Extent (ha)
Low altitude forest on uplands in PNG	8,524,631
Combined disturbance footprint of credible projects	5,472
Proportion of PNG low altitude forest on uplands potentially disturbed	0.06%

Source Appendix G.

The Ok Birim TSF Project will contribute a similar area of vegetation clearance to the anticipated scale of disturbance from the P'nyang and Stanley projects, albeit mostly in the commonest vegetation type found in PNG. The proximity of these projects means that, when considered together, they represent a cumulative extension of forest clearance across terrain that is largely undisturbed outside towns and villages. This will add to cumulative impacts by increasing edge effects, fragmenting wildlife corridors, and expanding human access to remote forested areas.

Construction of the 14.5-km-long ITCS Road requires vegetation clearance that is already underway, resulting in permanent loss of vegetation. This may contribute to cumulative effects through fragmentation of adjacent forested areas and by causing edge and barrier effects associated with development of a linear road corridor. As the ITCS Road is located adjacent to the Ok Birim TSF Project, impacts from the two projects will spatially overlap, limiting the overall geographic extent of cumulative effects, but leading to more intense local impacts.

Vegetation clearance within the Ok Birim TSF Project footprint will be managed in accordance with measures outlined in Chapter 10, which are designed to limit the project's contribution to cumulative impacts. Further, it is anticipated that the Ok Birim TSF Project will reduce the level of dieback stress and peripheral extent in the Lower Ok Tedi and Upper Middle Fly River, offsetting the direct impact of vegetation clearance. Given the relative scale of disturbance expected from the P'nyang and Stanley projects, no additional mitigation measures are proposed for the Ok Birim TSF Project beyond those already committed.

12.4.2 Physical disturbance - sedimentation

The Ok Birim TSF Project will not deliver fugitive sediment to the Ok Birim as the TSF has deliberately been sited outside its catchment and all drainage ultimately reports to the Ok Tedi. Vegetation and land clearance associated with the TSF will therefore not result in any change of water quality in the Ok Birim, but fugitive sediment not retained in sedimentation ponds will ultimately report to the Lower Middle Ok Tedi. The relative contribution of this additional sediment load to the existing sediment load in the Ok Tedi is negligible. Further, the TSF is deliberately designed to significantly reduce the existing sediment load in the river system due to the Ok Tedi Mine.

In comparison, the Stanley Project is located within both the lower Ok Tedi and Fly River catchments, which are already heavily influenced by elevated sedimentation and legacy contamination from the Ok Tedi Mine. Once in the development and construction phase, the Stanley Project will contribute to sediment loads in the Ok Tedi, primarily through increased erosion and localised run-off during land disturbance and infrastructure development. While these contributions are expected to be localised, they may compound existing sediment pressures in catchments that are already receiving large sediment loads from ongoing Ok Tedi mining operations. This is expected to be limited to the construction phase of that project.

The P'nyang Project is located further upstream and is less directly connected to the Fly River. However, increased erosion and run-off into watercourses and rivers are expected during construction, with sediment loading anticipated to decrease during operations. Sediment inputs from the P'nyang Project will enter the Upper Fly River, with downstream transport adding to cumulative sediment pressures along this part of the river system. However, the contribution of project-related sediment loads is expected to diminish downstream and is unlikely to have a material influence on sedimentation below D'Albertis Junction.

The Elevala Project will also contribute to sediment loads in the Upper Fly River, both at the confluence of the Elevala River and further downstream past Kiunga. These stretches of the Upper Fly River will also receive sediment inputs from the P'nyang Project, which together represent a cumulative increase in sediment loading across the system, particularly during construction.

The Fly River catchment is already subject to substantial and long-term sedimentation resulting from decades of Ok Tedi mining activities. Sediment loading from the Ok Tedi Mine is expected to continue for the life of the mine, albeit significantly reduced once the TSF is operating. Against this background, even localised and project-specific sources of sediment from new developments have the potential to exacerbate cumulative impacts on aquatic ecosystems and downstream communities and counteract to some degree the benefits gained from the TSF.

Management measures outlined in Chapter 10 have been designed to limit fugitive sediment from the Ok Birim TSF Project. However, there will be highly localised impacts in watercourses immediately draining disturbed areas during construction and operation of the TSF. These impacts will be barely detectable once the sediment reports to the Ok Tedi. Given the negligible sedimentation risk to the Ok Tedi and Fly River associated with the TSF and likely benefits, and the relatively greater contributions anticipated from legacy impacts of 40 years of riverine mine waste disposal from Ok Tedi mining activities and new projects located within the Ok Tedi and Fly River catchments, no additional measures are proposed to manage cumulative impacts associated with sedimentation.

12.4.3 Physical disturbance – cultural heritage

Four recorded cultural heritage sites are located within the permanent TSF development footprint and will be directly affected by the Ok Birim TSF Project. Due to the flexibility of the corridor alignment, many potential impacts along the infrastructure development corridor are expected to be avoidable through micro-siting. Most impacts are expected to be manageable through the implementation of management measures.

The majority of known cultural heritage sites relevant to the P'nyang Project are located within or in the vicinity of disturbance areas. The P'nyang Project is expected to limit potential impacts on cultural heritage sites by avoiding disturbance where possible or relocating/salvaging artefacts where avoidance is not possible. Little is known about potential cultural heritage impacts of the Stanley Project and Elevala Project. As these projects focus on linear gas infrastructure, they can likely implement similar measures as the P'nyang Project. These projects and the West-Agro Fly Vanilla project are all expected to require implementation of a cultural heritage management plan that includes focus on avoiding or minimising potential impacts. This will minimise potential cumulative effects on cultural heritage in the region from these projects

Potential cumulative effects associated with the Alice Pit–Border Post Road are more likely due to the proximity to the Ok Birim TSF Project. Cultural heritage sites or features impacted by either project may be important to the same communities, resulting in cumulative loss of cultural identity. OTML will implement measures to avoid impacting heritage sites where practicable and mitigate unavoidable impacts through measures such as minimising disruption or disturbance to cultural heritage sites and vegetation clearance near sacred sites, as detailed in Chapter 11.

12.4.4 Transport - road use

The Kiunga–Tabubil Highway is the principal transport corridor in the project area of influence. Current road users include local commuters, public motor vehicles, Ok Tedi Mine freight transporters, contractors servicing the mine, and road sealing and maintenance contractors. The Ok Birim TSF Project will contribute additional traffic during both the construction and operational phases, primarily associated with the movement of construction materials, equipment, and personnel. Vehicle movements will be greatest during construction, when large volumes of freight and workforce transport are required. Increased traffic will heighten the risk of road accidents and contribute to nuisance effects such as noise, dust, lighting and air emissions, particularly in populated areas along the corridor.

During construction, traffic volumes along the ITCS Road and Kiunga–Tabubil Highway are expected to increase significantly due to the daily movement of the project workforce, construction materials. Chapter 6 presents estimated project traffic volumes, which are cumulatively expected to be approximately 1,700 weekly vehicles during construction, and almost 700 weekly vehicles during operations across the road network.

Additional traffic along the Kiunga–Tabubil Highway is expected to be noticeable compared to baseline commuter and public motor vehicle traffic, with an estimated nine percent increase, relative to the large and regular freight volumes already associated with the Ok Tedi Mine. Vehicle movements will reduce once the project transitions into operations and cell 2 is constructed, with predominantly light vehicle use and periodic maintenance traffic expected thereafter.

The Stanley Project and the P'nyang Project are also expected to contribute to vehicle movements on the Kiunga–Tabubil Highway. Traffic surveys conducted along the corridor for the P'nyang Project (Coffey 2014) indicate that project-related traffic would comprise additional heavy and light vehicle movements during construction phases, on top of the existing baseline dominated by Ok Tedi Mine freight. For example, the P'nyang Project is anticipated to generate daily movements of heavy vehicles carrying equipment and freight, and light vehicles transporting personnel. These contributions will be temporary, with traffic volumes reducing significantly once operations commence. The Stanley Project will result in higher overall construction traffic, expected to contribute to cumulative effects more substantially than the P'nyang Project.

The ITCS Road project is expected to improve regional accessibility for local communities in the Ningerum Local Level Government area as well as enhance cross-border connectivity at the Yetetkun PNG-Indonesian border post. This will also facilitate greater traffic volumes in the region, probably also along the infrastructure corridor, and is likely to result in greater traffic volumes along the Kiunga–Tabubil Highway.

Increased traffic along the highway will heighten the risk of accidents involving other vehicles or pedestrians, with particular concern in areas where roadside walking is common. The cumulative effects of traffic will likely be noticeable if the peak construction phase of the Ok Birim TSF Project coincides with periods of heightened activity for the Stanley and P'nyang projects, as well as with ongoing Ok Tedi Mine freight and highway maintenance. The Elevala Project is not expected to contribute to traffic on the Kiunga–Tabubil Highway.

While the Kiunga–Tabubil Highway will not be sealed as part of this project, primary mine access via the Kiunga–Tabubil Highway is maintained and being progressively upgraded and sealed by OTML. This will contribute to the minimisation of dust generation along the highway, but the Ok Birim TSF Project traffic will add to dust generation in unsealed sections.

Construction impacts will be temporary, only occurring through the construction phase. Management measures outlined in sections 10.8, 10.10 and 11.3 will be implemented to minimise the Ok Birim TSF Project's contribution to road safety risks and nuisance impacts. These include driver awareness programs, strict speed limits through settlements, vehicle maintenance standards, scheduling of freight movements to avoid peak commuting periods, and dust and noise management. Although the road to Ningerum is already in the process of being sealed, if construction of the P'nyang and Stanley projects coincide with the construction of the Ok Birim TSF Project, the additional traffic use along roads would require collaboration between

stakeholders, projects and the State to appropriately manage dust, safety and additional road damage impacts from heavy vehicles.

On the positive side, the presence and expansion of well-maintained road infrastructure provides important socio-economic benefits. Increased vehicle traffic can improve access to markets and services for local communities, create opportunities for roadside businesses, and strengthen the supply chain for small-scale producers.

Despite the potential cumulative effects on increased road use, the credible projects will improve the road network in the region, increasing accessibility of poorly connected communities to the larger hubs of Ningerum and Tabubil. Western Province has lower connectivity than other provinces. Improved road networks and connection generally align with Western Province Integrated Development Plan (2023–2027), PNG's Medium Term Development Plan IV and National Connect PNG Program (2020–2040). Road development is considered as enabling infrastructure, with the ability to contribute to economic development, service access, and regional integration. It is anticipated that the Western Provincial government will play an important role in managing the broader cumulative impacts and benefits of increased traffic movements and improved connectedness arising from the range of credible projects.

12.4.5 Transport – river and port use

The Fly River serves as the primary transportation route vital to the Western Province, where the majority of village communities reside along or close to the river and its tributaries. Local communities rely extensively on the river system for transport, fishing, water supply, subsistence farming and economic activities such as rubber farming and alluvial mining.

The Ok Birim TSF Project is expected to contribute to the cumulative effects of vessel traffic during the construction and operations phases and is likely to increase vessel movements along the river corridor and heighten the risk of accidents. Riverine communities along Fly River south of Kiunga Port may experience impacts during the construction and operations phases due to this increase in traffic.

Kiunga Port is located downstream of the Ok Birim TSF Project site. With the combined gas-condensate projects of P'nyang, Stanley and Elevala, the Fly River will continue to serve as the primary transportation route for barged shipments. These shipments will operate from separate ports that will be developed adjacent to the existing Kiunga Port. The upgrading of these additional load-out facilities is a critical factor that will drive increased vessel traffic through Kiunga's port facilities, supporting overall mining operations and these development projects through importation of freight and fuel and the exportation of gas concentrate. Upon the completion of the port upgrades for these projects, vessel movement and port usage are anticipated to rise significantly, which will elevate the risk of accidents involving other vessels or passengers within and downstream of the Kiunga area.

It is expected that approximately 40 barged shipments per year will be exported from each of the two separate load-out facilities located near Kiunga, for both the Stanley and Elevala projects, totalling 80 shipments annually. The Fly River catchment remains susceptible to increased vessel traffic and congestion around Kiunga Port associated with the Stanley and Elevala projects. This increase in vessel traffic may affect the riverine environment, as well as personnel and vessel safety, during both the construction and operation phases of the Stanley and Elevala projects. If these projects proceed, vessel traffic risks are likely and early collaboration between the project owners and the State is suggested to minimise these risks.

The West-Agro Fly Vanilla Project is expected have limited impact on vessel traffic and port operations at Kiunga. Impacts are likely to be confined to river channels downstream of the Kiunga port, resulting in minimal overall changes. This aligns with the focus of the West-Agro Fly Vanilla Project on sustainable vanilla farming, facilitating vanilla exports through the port.

Overall, the Ok Birim TSF Project's contribution to cumulative impacts is expected to be relatively minor and short-term during its construction. Measures to address potential impacts to the riverine environment are outlined in Chapter 10.

12.4.6 Construction workforce – in-migration and access

Skilled and unskilled workers will be required for each of the credible projects. Competition for employees will be greatest when project construction timeframes coincide or overlap. This may act to increase the attraction for in-migrants seeking work on the projects.

Workforce requirements for the Ok Birim TSF Project will peak during construction, when approximately 300 employees will be needed for vegetation clearance, earthworks, civil works, and tailings dam construction. Numbers will reduce to about 150 once the project transitions into operations, with a smaller workforce focused on facility maintenance, monitoring, and environmental management. Recruitment will prioritise sourcing labour from within local landowner communities then Western Province then PNG more broadly, although expatriate workers may be required for specialist technical and engineering roles that cannot be filled locally.

Improved access, employment and business opportunities associated with the Ok Birim TSF Project are expected to encourage former residents to return to local villages west of the Ok Tedi, while also attracting in-migrants seeking economic opportunities, particularly during the construction phase. Increased activity at project facilities and the establishment of worker and support infrastructure may stimulate small-scale commercial activities and population growth in nearby communities.

Ningerum is expected to become increasingly important as a regional service and transport hub for the Ok Birim TSF Project due to its strategic location, existing services, available government land and OTML plans to expand its presence there (Post Courier 2025). This may further increase in-migration to the area, including movement associated with artisanal and small-scale mining (ASM) activities, which are already a significant driver of population growth in communities such as Alice Pit, Ningerum and settlements along the highway corridor.

The Stanley Project is expected to employ several hundred personnel during peak construction, with workforce numbers reducing once production commences. The P'nyang Project will employ a larger construction workforce, potentially in the thousands, reflecting the scale of upstream gas field development and supporting infrastructure. Workforce numbers will decline considerably during operations but will remain higher than for smaller standalone projects such as the Ok Birim TSF Project. The Elevala Project will also contribute to regional workforce demand, although specific workforce numbers are not available.

The ITCS Road will improve road access to the region, including connecting areas that were previously difficult to reach and providing another road between Ningerum and Tabubil for use by OTML. The increased accessibility may lead to an influx of people into the area in search of work.

The Putmambin, Ambaga, Kungim and Kungembit communities have higher potential for in-migration than other communities near the TSF due to their proximity to the ITCS Road and border with Indonesia; Birimkamba also has a high potential for in-migration given its position along the road closest to Ningerum. These villages may be attractive for people returning and for in-migrants looking to take advantage of potential business opportunities associated with increased traffic on the border road (e.g., trade stores). Alice Pit, Ningerum and Tabubil also have higher potential for in-migration than other communities in the areas as they are important centres proximate to many projects in the region.

The cumulative effects of overlapping construction phases, should they occur, will increase competition for skilled and semi-skilled workers, particularly within Western Province where OTML is already the largest employer. This competition may act as a driver of in-migration, as people move into the project area in search of employment. If not effectively managed, this can create social pressures on local communities, including

increased demand for housing, services, and natural resources. The potential for this workforce competition between large-scale projects is often raised in PNG but history suggests it rarely happens; whether it does or not is outside OTML's control.

Management measures outlined in Chapter 11 will help to reduce the Ok Birim TSF Project's contribution to cumulative impacts associated with in-migration and workforce competition and management measures to mitigate project-induced in-migration. It is also anticipated that the Western Provincial Government will play an important role in managing the broader cumulative impacts of workforce-driven in-migration arising from the range of credible projects.

12.5 SUMMARY OF CUMULATIVE IMPACTS

A total of nine projects were assessed to determine whether they were eligible and would contribute to the cumulative impacts of the Ok Birim TSF Project. From the assessment, five credible projects had spatial and temporal relationships with the Ok Birim TSF Project and were considered to have the potential for a cumulative effect. The potential cumulative impacts likely to arise were considered from the following aspects:

- Vegetation clearance.
- Sedimentation.
- Cultural heritage.
- Road use.
- River and port use.
- Construction workforce and in-migration.

Cumulative impacts from vegetation clearance, sedimentation, road use, and construction workforce are possible. Other proponents are expected to also implement management strategies to manage impacts of their projects to limit the potential for cumulative effects. This will provide an overarching framework to respond to changing conditions. The Western Provincial Government will be encouraged to incorporate these strategies into its development planning to help manage in-migration, workforce demand, and economic change associated with development across the province, while also limiting impacts on the environment.