

Ok Birim Tailings Storage Facility Project

Environmental and Social Impact Assessment

Chapter 7

Assessment of project alternatives



7. ASSESSMENT OF PROJECT ALTERNATIVES

Ok Tedi Mining Limited (OTML) has considered a range of alternatives and options to inform the selection of the proposed design and layout for the Ok Birim Tailings Storage Facility (TSF) Project (the project). This chapter summarises the main alternatives considered for the project, particularly those with the greatest environmental and social implications, and presents the rationale for selecting the preferred arrangement described in Chapter 6, based on an evaluation of technical, environmental, social, and economic factors.

7.1 OVERVIEW AND GENERAL APPROACH

The development of the project from preliminary concept through to pre-feasibility study (PFS) and feasibility study (FS) stage involved the identification and assessment of various alternatives for site selection and project design. These included the alternative scenario of not proceeding with the project, alternatives for tailings storage locations and technologies, and alternatives for associated infrastructure including the access road and tailings pipeline.

As part of the PFS work completed between 2014 and 2024, OTML with support from KCB Australia Pty Ltd (KCB), conducted a series of alternatives and options assessments to identify preferred TSF location, design and layout that meets the operational, environmental, and social objectives of the proposed mine life extension to 2050. This approach applied a systematic multi-criteria alternatives assessment (MAA) process to evaluate a range of options across technical, environmental, social and economic criteria described in Section 7.3.2. A subsequent refinement of TSF location options was completed in 2025.

Feasibility assessments will continue to refine and optimise the project design, with feasibility studies targeted for completion by mid-2026. The final location and configuration of project facilities and infrastructure will be confirmed during detailed design. While further refinements may occur based on the outcomes of ongoing studies, no material changes to the overall project design are anticipated at this stage.

7.2 NOT PROCEEDING WITH THE PROJECT

Development of the proposed TSF is a significant mitigation measure that will provide sufficient tailings storage capacity for the approved Ok Tedi Mine life and largely eliminate OTML's current practice of riverine tailings disposal. While riverine disposal has supported the mine's production since 1984, it is associated with ongoing environmental and social impacts, including downstream sediment aggradation, floodplain inundation, and vegetation dieback along the Ok Tedi and Fly River systems. Constructing the TSF will reduce impacts associated with the current tailings disposal method and align tailings management with international good practice.

An alternative scenario where the proposed TSF does not proceed was considered. Under this scenario, OTML would continue to rely on riverine tailings disposal and the associated environmental and social impacts would continue. If the project does not proceed:

- Continuation of riverine disposal would be inconsistent with international good practice and OTML's commitments to responsible tailings management.
- The opportunity to align with the *Global Industry Standard on Tailings Management* (GISTM) and address long-standing stakeholder concerns would not be achieved.
- The long-term strategic direction and future operations of the Ok Tedi Mine may be constrained by the lack of other viable terrestrial tailings storage and disposal alternatives.

- Anticipated socio-economic benefits of the project at the local and regional levels, as described in Chapter 11, would not be realised. These include:
 - Approximately 300 construction jobs and ongoing employment for about 150 people (including contractors) during operations, most of whom would be locally sourced.
 - Revenue from land lease payments to directly affected villages and landowners.
 - Opportunities for training and skills development, livelihood support, local business and economic development, and investment in community infrastructure.
 - Improved accessibility in the TSF area and surrounding region, particularly via the proposed pipeline access road and associated bridges and water crossings, with potential long-term benefits for local communities during and after TSF closure.
- Long-term environmental improvements associated with transition to a terrestrial TSF would not occur. These include the significant reductions due to the project of mine-derived sediment inputs and transport in the downstream Ok Tedi and Fly River system. These are predicted to lead to lower rates of riverbed aggradation, reduced floodplain inundation frequency and extent of mine-derived sediment deposition onto floodplains and off-river waterbodies, and improved geochemical stability of the river system as well as in fish habitat condition in the lower Ok Tedi and Upper and Middle Fly River (refer to Chapter 10).
- Residual environmental and social impacts associated with project implementation, as described in Chapters 10 and 11, would not occur, such as land clearance and vegetation/habitat loss, noise, fugitive dust emissions, and traffic.
- Potential cumulative impacts as described in Chapter 12, in combination with other developments in the region, would also be avoided.
- Continued tailings discharge to the Ok Tedi could adversely affect OTML's ability to market concentrate or may result in lower prices – and therefore revenue for OTML and the State of Papua New Guinea (PNG) – being realised for such concentrate due to environmental and social concerns.

7.3 KEY ALTERNATIVES FOR THE MANAGEMENT OF TAILINGS

The following subsections outline the key alternatives considered for the management of tailings. These alternatives were assessed to inform the selection of a preferred tailings storage solution that aligns with the project's environmental, social, and operational objectives.

7.3.1 Previous studies

In the 1980s, the original Ok Tedi Mine development plan included a TSF at Ok Ma. However, this site was abandoned due to geotechnical instability following a major landslide during construction.

From the 1990s onwards, OTML conducted extensive work to identify viable TSF site options in the region. Notable TSF sites assessed in early stages but not advanced included (KCB 2013):

- Ningerum (1989, 1995, 2011): Feasible TSF options considered but discounted as these were outside the Ok Tedi catchment and/or were unlikely to gain community approvals.
- Ok Fum (2005): Favourable location but did not have sufficient storage available for the mine life extension at that stage (<100 Mt capacity).
- Bige (2011): Feasible TSF option but the distance required for the tailings pipeline was considered too costly and community support was considered to be unlikely to be forthcoming.

Subsequent TSF work considered the following two main development alternatives and locations between the Ok Tedi Mine and Ningerum (KCB 2023):

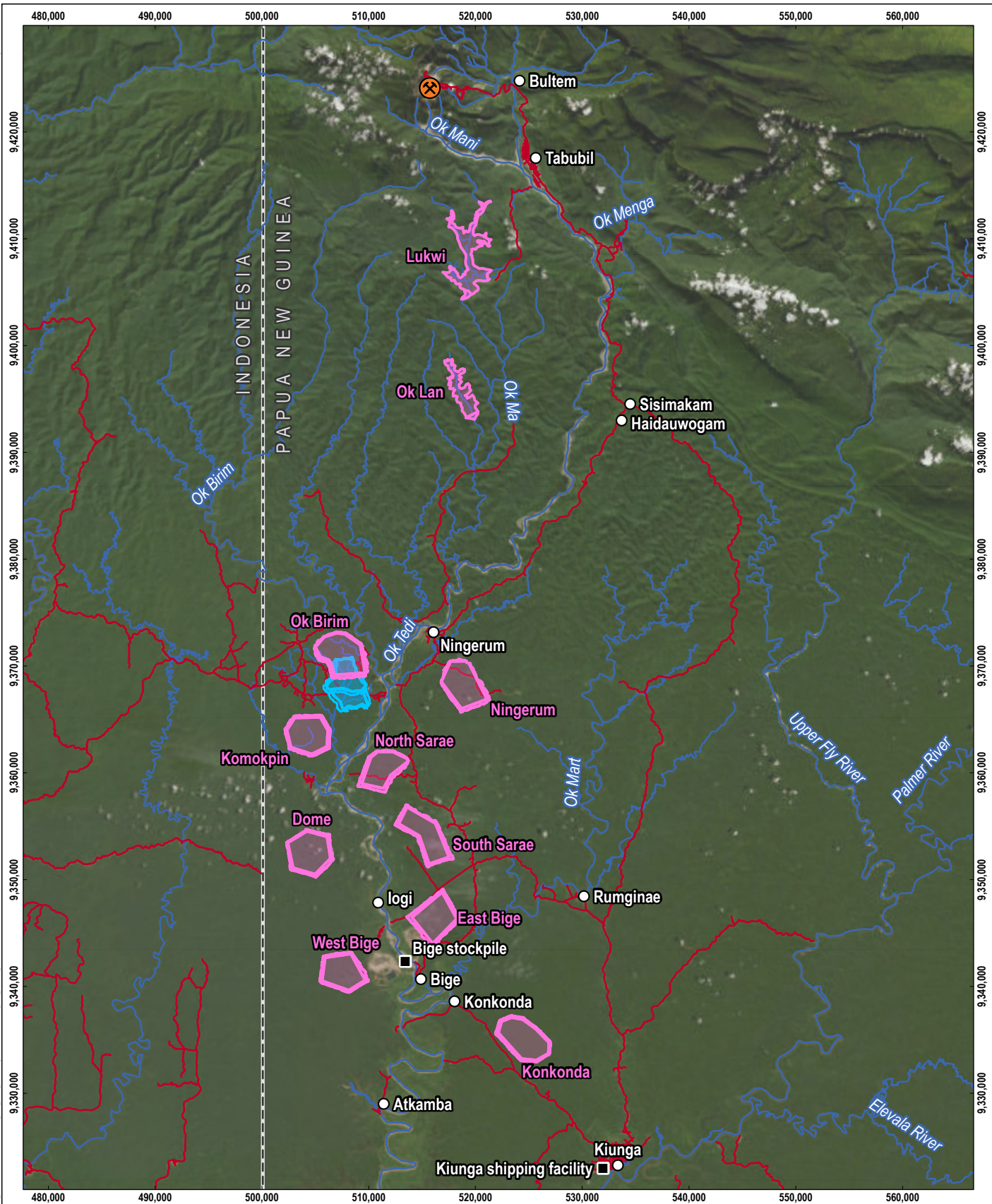
- Valley fill TSF in the highlands, which has key advantages such as a relatively smaller footprint using natural topography for impoundment. However, this alternative also has a greater risk of foundation instability (landslides) and seismicity, particularly in the project region's very high rainfall climate, and larger affected catchments given its location in the highlands, as well as greater challenges with achieving safe closure and constructing associated pipeline and access road infrastructure due to the more challenging terrain. Several site options located within highlands between the Ok Tedi Mine and Ningerum were screened out early due to environmental and social considerations, cost and closure requirements, and non-alignment with GISTM (KCB 2023). These included the Lukwi valley fill TSF site (located on the Ok Ma about 16 km southwest of Tabubil) and the Ok Lan valley fill TSF site (located on a steep narrow valley of Ok Lan, a tributary to the Ok Munga about 25 km south-southwest of Tabubil). Both options were assessed through multi-criterial analysis during the 2014 PFS work and were discounted due to significantly higher risks compared to the Ok Birim TSF site (KCB 2015a).
- Ring-dyke (also known as turkey nest) TSF in the lowlands, which has key advantages including more stable foundations suitable for areas which have lower seismic risk and precipitation, a smaller catchment area, and greater potential to achieve passive closure based on experience from Bige operations. However, this alternative may also involve higher costs associated with a longer tailings pipeline and access road with right-of-way constraints, larger overall footprint, proximity to existing communities, potential for multiple river crossings, and increased flood risk in low lying areas.

Based on a comparative evaluation of these alternatives, OTML decided that a ring-dyke TSF in the lowlands was the preferred alternative for further work.

Figure 7.1 shows the key alternative TSF site options considered across the Ok Tedi highlands and lowlands.

Additional studies included the 2013 TSF Options Scoping Study by KCB, which involved preliminary multi-criteria analysis of 12 potential TSF site options, with preferred sites (including the Ok Birim site) advanced into the Phase II TSF Site Selection study completed in 2014. This study assessed the following sites: Ok Birim, Ningerum, Komopkin, North Sarae, South Sarae, Dome, East Bige, West Bige, and Konkonda. The TSF site selection process was completed using multiple accounts analysis criteria (consistent with GISTM) taking into consideration factors such as maintenance costs, capital costs, community impacts, environmental impacts, flood and erosion controls and geotechnical challenges. Of the sites assessed, the three highest scoring sites (in descending order) were: North Sarae (for shortest pipeline distance), Ok Birim (for fewer community issues) and East Bige (proximity to existing infrastructure). Ok Birim was selected as the preferred location for further PFS studies based on its sufficient storage volume, suitable natural topography, proximity to existing infrastructure, availability of relevant data, and relative distance from nearby communities (and fewer community issues) compared to other high-scoring options. A geotechnical drilling program was also conducted around the same time with recommendations made on sites suitable for further PFS work.

The 2014 TSF PFS study (KCB 2015a) also involved a comparison of three TSF options: Lukwi, Ok Lan, and Ok Birim via multi-criteria analysis. The Ok Birim TSF site option was again recommended as the preferred TSF site and further evaluated in the Ok Birim TSF PFS Design Update (KCB 2024a).



LEGEND

- Ok Tedi Mine
- Key infrastructure
- Community
- Road/track
- Watercourse
- International border
- Proposed TSF footprint
- Alternative TSF site option



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SOURCE
Villages from Tetra Tech Coffey.
Alternative TSF options from KCB and OTML.
Topographic features from OSM. Admin boundary from NSO.
DEM from SRTM. Imagery from ESRI.

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FIGURE 7.1

Alternative TSF site options considered



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COFFEY

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7.3.2 Multi-criteria alternatives assessment

In 2024, OTML re-engaged KCB to undertake the Ok Tedi lowlands TSF MAA study (KCB 2024b) to identify the preferred tailings management strategy to progress to the next phase. In parallel, KCB completed the Ok Birim TSF PFS Design Update (KCB 2024a) to advance the project. KCB used available information from historic reports, studies (e.g., from field and laboratory programs, environmental baseline studies, community engagement), and the Ok Birim PFS TSF Design Update (KCB 2024a) to inform the development of the MAA study. The MAA specifically focused on potential TSF sites located in the Ok Tedi lowlands south of the Ok Tedi Mine towards Ningerum (refer to Figure 7.1).

The MAA was adopted to provide a structured and transparent process that provides a robust rationale for identifying preferred TSF alternatives for further evaluation, incorporating relevant input from OTML, the project design team, technical specialists, and local communities.

The MAA was conducted between January and June 2024 by a multi-disciplinary team led by OTML and supported by technical specialists as needed. A MAA workshop in June 2024 reviewed and confirmed objectives, alternative scoring, weightings, and comparative cost estimates.

The MAA process included:

- Step 1: Confirm the purpose and plan, including appropriate people to be involved and the overarching objective for the study.
- Step 2: Confirm the design basis and battery limits, to set the bounds, parameters and key assumptions of the study, and assess the available waste storage options.
- Step 3: Identify tailings alternatives, including location screening, technology screening and alternative development. This included a systematic and justified screening of various alternatives to identify those to be assessed in subsequent steps, considering TSF locations and technologies.
- Step 4: Pre-screen alternatives based on critical flaws, which are unfavourable attributes that would eliminate the alternative from further consideration. This included if the TSF was likely to be accepted by the regulators or communities, pose an unacceptable risk to local communities, be considered not economically viable or not feasible to achieve closure objectives.
- Step 5: Complete the MAA study, including development of key objectives and scoring criteria to evaluate how well an alternative meets the objective (based on technical, environmental and social merits), alternative characterisation and scoring, objective weightings, comparative cost estimates, and MAA workshop and summary of results.
- Step 6: Develop path forward for preferred alternative(s) for the project for further assessment.

The evaluation of alternatives and options was guided by the following general criteria to assess the relative merits and constraints of each in identifying the preferred project design and layout:

- Economic considerations, such as construction and operational costs.
- Technical and physical constraints, such as proximity to existing infrastructure and right-of-way constraints, topographic conditions (e.g., high ground), availability of borrow material, technology precedents, and geotechnical constraints (avoidance of areas prone to landslide, high seismicity).
- Environmental constraints, such as constraining the project catchment to the Ok Tedi watershed where possible, climatic conditions, avoidance of locations with major channels (increasing external flood risk) or large upstream catchments (greater than 10 km²), proximity to environmentally sensitive areas such as protected areas and species of high conservation value, and extent of disturbance to undeveloped land.
- Social constraints, such as proximity to existing villages and settlements who do not support the project, distance to the Indonesian border, community at risk in a potential inundation zone during a dam breach, potential community benefits and employment opportunities, and other community sensitivities and values.

7.3.2.1 Outcomes of multi-criteria alternatives assessment

After Steps 1 and 2 were completed, the MAA reviewed potential TSF sites and available tailings technologies (Step 3). These were shortlisted to nine sites and two technologies (conventional cycloned sand TSF and filtered stack TSF). Each potential TSF site was assessed with both technologies selected, leading to 18 TSF alternatives for evaluation in the MAA (Step 4). The MAA then proceeded through Step 5 leading up to the MAA workshop and summary of results.

Both the MAA and PFS studies re-confirmed the suitability of the Ok Birim area as the preferred location. The following subsections summarise key outcomes of the MAA leading to the selection of the preferred location and configuration for the project.

7.3.2.2 Location alternatives for the tailings storage facility

The initial location screening during Step 3 of the MAA involved eliminating areas within the study region unsuitable for TSF development. In general, TSF costs were influenced by distance from the mine because southernmost sites have increased costs due to added length of pipelines and which side of the Ok Tedi the site is located because sites on the west side of the Ok Tedi have increased costs due to requiring bridges for access.

The second location screening during Step 4 shortlisted nine potential sites based on critical flaw criteria, which were then assessed with conventional cycloned sand TSF and filtered stack TSF, resulting in 18 alternatives.

The MAA results reviewed during the workshop were considered as the base case. Subsequent optimisations were identified for the cycloned sand TSF alternatives at Ok Birim, North Sarae, and East Bige sites (KCB 2024b). The base case results were updated to reflect these optimisations, which re-confirmed the preferred sites were North Sarae, Ok Birim, and East Bige. These sites were generally preferred due to community considerations, their proximity to existing infrastructure, proximity to the mine site (i.e., shorter pipeline corridor), minimising impacts to previously unimpacted surface water resources, and relative ease of surface water management during operations. The results also indicated that the Ok Birim site could rank highest if the layout was further refined.

Ongoing refinement of the proposed Ok Birim TSF location

Throughout 2025, the proposed location of the Ok Birim TSF was incrementally adjusted and reconfigured towards the southeast, closer to the Ok Tedi, so that the TSF would lie entirely within the Ok Tedi catchment. These refinements were informed by new technical data as they became available and the outcomes of an environmental and social impact assessment (ESIA) workshop held in June 2025.

Table 7.1 summarises the Ok Birim TSF location options considered. Figure 7.2 shows these TSF locations along with the associated infrastructure corridor route alternatives assessed.

Table 7.1 Ok Birim TSF location options

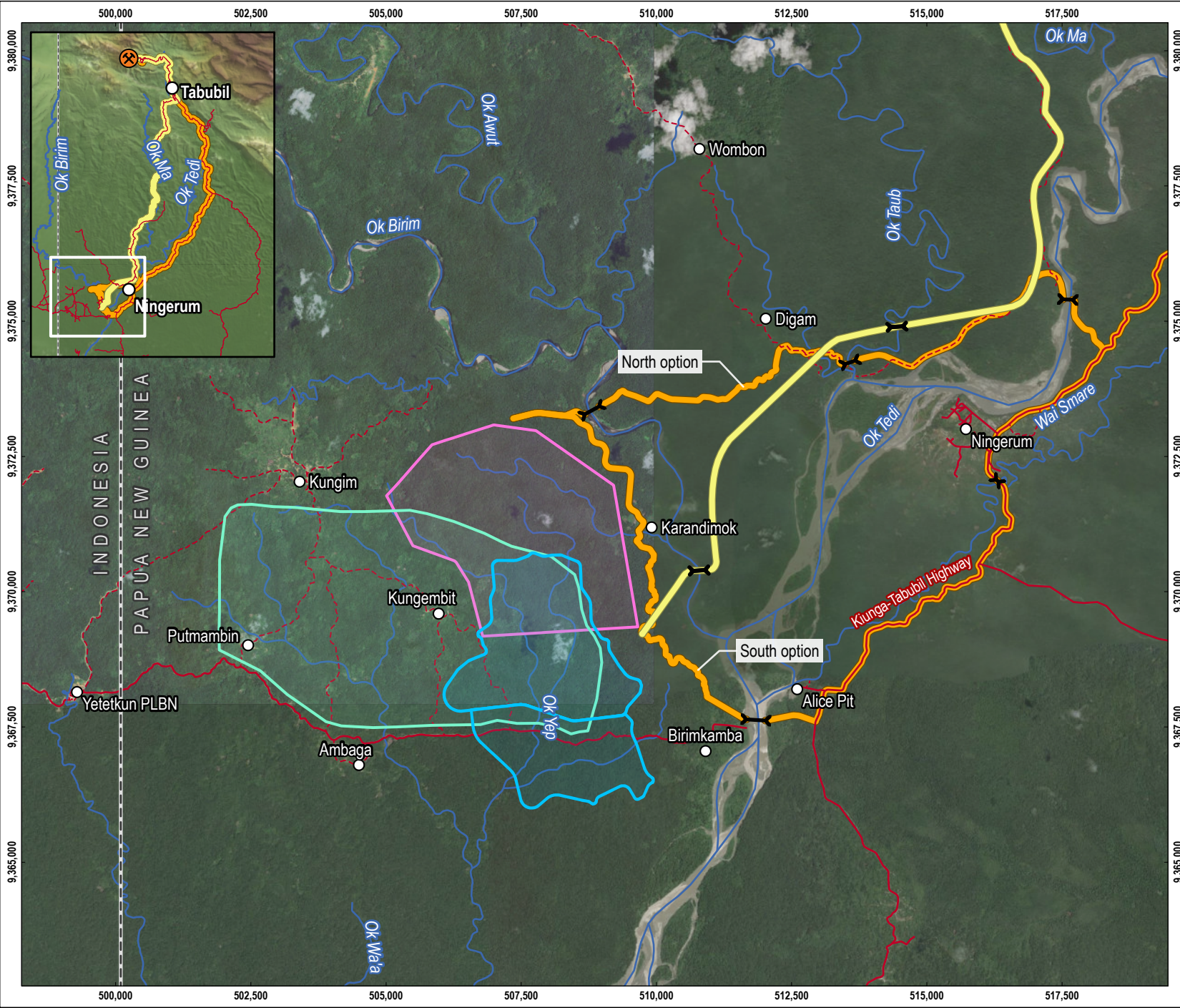
Ok Birim TSF option	Brief description
Option A	Proposed TSF location in the Ok Birim TSF PFS Design Update (KCB 2024b). Straddled across the catchments of Ok Birim and Ok Tedi. No villages or settlements occur within the TSF footprint.
Option B	Revised location identified after completion of the MAA and PFS reports in 2024 following further engagement with local communities by the OTML Community Relations and Sustainability team. OTML agreed to move the TSF outside the Ok Birim catchment so that project runoff and discharges would be confined to the Ok Tedi (an already degraded river system). Located to the south of Ok Birim and Ok Tedi watershed, and to the north of the new Infrastructure Tax Credit Scheme (ITCS) Road under construction. Villages including Kungembit and Putmambin occur within and immediately adjacent to the proposed TSF footprint; requiring relocation of affected households and community infrastructure. Newly discovered Kiunga blue-eye (<i>Kiunga leucozona</i>) recorded within the TSF footprint. No design or modelling completed by KCB for this site.
Option C (currently proposed)	Identified during the ESIA workshop (11 and 12 June 2025). Located south of the Ok Birim catchment and covers the eastern arm of the Ok Yep that drains to the south. No villages or settlements occur within the TSF footprint. Overlaps with the new ITCS Road alignment. Further refinement and modelling were completed by KCB for this site.

Source: Adapted from KCB 2025a.

The ESIA workshop in June 2025 was facilitated by Tetra Tech Coffey and attended by OTML and KCB to review environmental and social risks and sensitivities not previously identified due to limited data. Several critical concerns associated with the initially proposed Options A and B were identified, including the social implications and high cost of relocating existing villages, the risk of TSF seepage crossing the international border into West Papua, and the potential impact to a species of fish new to science known as the Kiunga blue-eye (*Kiunga leucozona*). To address these concerns, an alternative TSF location (Option C) was identified during the workshop, situated south of Option A and east of Option B. As shown in Figure 7.2, this location avoids resettlement of existing villages that would occur for Option B, moves the TSF entirely out of the Ok Birim catchment so that project runoff and TSF discharge would be confined to the Ok Tedi catchment (an already degraded river system), shifts the TSF footprint further away from the Indonesian border to minimise potential TSF seepage across the international border, and was intended to minimise impacts to recorded locations of the newly discovered fish species (KCB 2025a). This location has also been influenced by the new ITCS Road currently under construction, which is expected to serve as the initial access route linking the TSF site to the existing Kiunga–Tabubil Highway.

KCB was subsequently tasked with developing a preliminary configuration to a concept level for Option C. OTML then gave in-principle agreement to progress Option C as the currently proposed TSF location for ongoing feasibility studies (KCB 2025a). The preferred infrastructure corridor for the tailings pipeline and access road was also adjusted to align with the revised TSF location (refer to Section 7.4.2).

Refinement of the final project layout and footprint is ongoing and will continue as further data becomes available during detailed design. This iterative process enables OTML to effectively avoid or minimise social and environmental impacts, such as the need for relocating existing villages/settlements and clearance of high value habitat, where possible.



LEGEND

- Community
- Road
- - - Track
- Watercourse
- - - International border

Ok Birim TSF site option

- TSF Option A - TSF footprint (2024 TSF PFS update)
- TSF Option B - TSF footprint (revised 2024 TSF PFS)
- TSF Option C - TSF footprint (proposed)

Infrastructure corridor option

- TSF Option A
- TSF Option C (proposed)
- Bridge

SOURCE

Villages from Tetra Tech Coffey.
Proposed infrastructure from KCB and OTML.
Topographic features from OSM.
Imagery from ESRI and Google Earth.



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FIGURE 7.2

Ok Birim TSF site options and associated infrastructure corridor route alternatives



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7.3.2.3 Technology alternatives for tailings storage and disposal

The second screening stage in Step 3 of the MAA study involved eliminating technologies not suitable or compatible to the project objectives, local region and climate, and/or tailings properties.

Various alternative technologies for tailings storage and disposal were screened using criteria based on technical feasibility, cost, and compatibility with site-specific conditions such as high rainfall, remoteness, seismic risk, and tailings stream characteristic. These assumed the tailings processing plant (TPP) remains operational and continues to separate the pyrite concentrate (PCon) from the tailings stream as per current practice at the Ok Tedi Mine.

Table 7.2 summarises the outcome of this technology screening process.

Table 7.2 Outcomes of the technology alternatives screening

Technology	Status/comments
Conventional TSF with cycloned sand embankments	Shortlisted for further evaluation.
Filtered (dry-stacked) tailings in TSF	Shortlisted for further evaluation.
Conventional TSF with embankment using borrow materials	Screened-out: discounted due to lack of sufficient suitable borrow material in the region; no particular benefit over cycloned sand alternative.
High-density paste tailings deposition	Screened-out: discounted due to the local high rainfall climate and challenging topography, which makes this option unsuitable and likely to pose geotechnical and operational issues. Likely to result in stability and geochemical issues.
Centrifuge dewatering	Screened-out: considered too costly, power-intensive and unproven at the scale required for the project. The technology can achieve a similar product to filtering but at a higher cost; technology could be considered in the future if there are challenges filtering the tailings.
Downslope/cone	Screened-out: not practical given the available footprint areas and social implications (e.g., management of water and dust, visibility).
Co-disposal of waste rock and tailings	Screened-out: discounted for lowlands sites due to insufficient waste rock generated throughout the mine life for embankment construction and the significant haul distance from the mine making this impractical.
Thickened thin lift	Screened-out: not practical given the available footprint areas and social implications (e.g., dust management, water management).
Hydraulic dewatered stacking	Screened-out: considered too costly, power-intensive and unproven at the scale required for the project. The technology is used to dewater tailings in-situ by layering fine and coarse zones; significant dewatering is alternatively achievable via thickening and underdrains.

Source: Adapted from KCB 2024b.

Following this screening, two tailings technologies were shortlisted for further consideration in the MAA specific to selected lowlands TSF sites (KCB 2024b). Both technologies were selected based on their technical feasibility, performance track record in other large-scale mining operations, potential for adaptation to the local setting, and potential suitability to manage PCon if required. A comparative analysis of the two shortlisted technologies was also carried out based on their cost, constructability, operational complexity, closure performance and alignment with the GISTM (KCB 2024b).

Briefly, the shortlisted technologies were:

- Conventional TSF with cycloned sand embankments, which is suitable for tropical, high-rainfall environments. This alternative was identified as the most technically and economically viable option, particularly at locations such as the Ok Birim TSF site. It involves cyclones to use centrifugal forces to separate tailings into coarse and fine fractions and construct embankments with cycloned underflow sand. Finer material (overflow) is deposited in the central impoundment. Key advantages are that it facilitates progressive construction and staged closure, with potential for integration of passive water management, and it is operationally proven in similar settings.
- Filtered (dry-stacked) tailings in TSF, which involves mechanical dewatering of tailings to a low-moisture content and stacking in compacted layers. Typically used in arid or temperate climates where water recovery and reduced dam risk are key drivers. A key advantage of this alternative is that it does not involve a pond during operations. However, this technology was eventually discounted due to its significantly higher cost, operational complexity, and lack of precedent at the required throughput in high-rainfall conditions such as in PNG, where transporting and placing the tailings at the TSF via truck or conveyor would be challenging in the typical wet and rainy conditions.

Overall, the cycloned sand TSF technology was preferred over the filtered TSF technology for both technical and economic reasons. Monte Carlo sensitivity modelling confirmed the robustness of these results. While a filtered TSF offers advantages such as the absence of an impounded water pond and a generally drier facility, these advantages are outweighed by the challenges of operating and constructing such a facility in a high-rainfall environment. The use of filtered tailings at this scale and in this climate remains unproven (KCB 2024b).

7.3.3 Disposal alternatives for tailings

As part of developing OTML's long-term integrated mine waste management strategy, various alternatives for tailings, waste rock and PCon management have been investigated since 1984. These studies have considered options including disposal of tailings within a proposed TSF either alone or in combination with waste rock and PCon.

At present, OTML's current practices for tailings management consist of:

- Riverine disposal of tailings with waste rock at the Ok Tedi Mine: Tailings are discharged into the headwaters of the Ok Kumiup valley along with waste rock. This results in the release of large volumes of tailings fines, sand and waste rock into the downstream receiving environment. While some material accumulates in the valley floor, most is transported further downstream into the Ok Tedi due to high rainfall, with coarser material settling within a dredged slot near Bige. Although riverine disposal has supported mine production since 1984, it is associated with significant ongoing environmental and social impacts, which underpin the case for the proposed TSF at Ok Birim as a significant mitigation measure.
- Dredging and stockpiling of coarse sediment (comprised of coarse tailings and waste rock) at Bige with subaqueous storage of PCon: OTML undertakes dredging of coarse sediment from the Ok Tedi for storage in engineered stockpiles on both banks of the river, together with subaqueous storage of PCon on the west bank of the Ok Tedi. This is a key environmental mitigation measure to reduce ongoing impacts from riverine disposal. However, while dredging recovers coarse sediment derived from tailings and waste rock, it does not capture fine tailings which represents up to 50% of the tailings. Accordingly, dredging alone does not address the broader impacts associated with riverine tailings disposal.

The 2024 PFS Design Update (KCB 2024b) evaluated the alternative of disposing PCon with tailings in separate cells at the proposed Ok Birim TSF. This alternative would involve construction of a dedicated PCon pipeline from the existing pipeline near Ningerum and the development of separate subaqueous PCon cells within the TSF footprint, with PCon storage at Bige ceasing.

However, OTML decided not to proceed with the PFS concept of storing PCon at the proposed TSF following a subsequent high-level review of the relative costs, benefits, risks and opportunities compared with continued storing PCon at Bige (OTML 2025c). This alternative was discounted primarily due to a lack of community support driven by higher perceived environmental and social risks associated with storing PCon on-site as well as technical challenges related to geochemistry, water management, deposition control and long-term closure planning.

On this basis, this alternative was not considered further for the project.

7.3.3.1 Continued dredging and PCon storage at Bige

Continued dredging and PCon storage at Bige is expected to remain necessary even without the project to recover the significant volumes of mine-derived sediment that continue to be transported in the Ok Tedi and Fly River systems.

Key advantages provided through this mitigation initiative include (OTML 2025c):

- Significant environmental benefits from continued removal of coarse sediment that would otherwise deposit and contribute to further riverbed aggradation and associated floodplain impacts in the Ok Tedi and Fly River systems downstream of Bige. Without dredging, a rebound in riverbed elevations and associated vegetation dieback of regrowth in the reaches below would be expected.
- Ongoing employment opportunities, land lease and compensation payments, and community development and economic benefits to the local community associated with the Bige operations.
- Retention of all PCon in a single location, which provides the potential option for future reprocessing of PCon for mineral extraction, if technically and economically feasible at a future stage depending on market conditions.

As part of ongoing operational and environmental improvements, OTML will continue to periodically review its dredging practices to identify opportunities to optimise dredging solutions at Bige or elsewhere within the mine-affected river systems.

7.3.4 Transportation alternatives for tailings

The location of the proposed TSF relative to the existing Ok Tedi Mine requires tailings to be transported over a considerable distance. Key alternatives considered at a high level for overland transport of tailings included:

- Slurry pipeline to the TSF site.
- Truck haulage by road to the TSF site.
- A combination of truck haulage by road and slurry pipeline to the TSF site.

Truck haulage by road was discounted early in project planning due to its potential to generate significant environmental and social impacts on the local and regional road network. Key concerns included significant increases in heavy vehicle traffic resulting in increased road safety risks for local communities and other road users, as well as the need for costly upgrades to existing road infrastructure. Based on these considerations, the slurry pipeline to the TSF site was selected as the preferred alternative.

7.4 KEY ALTERNATIVES FOR ASSOCIATED INFRASTRUCTURE

This section outlines the key alternatives considered for infrastructure required to support the proposed Ok Birim TSF, including for the hydro-cyclone house, infrastructure corridor, power and water supply.

7.4.1 Hydro-cyclone house

A site selection study undertaken as part of feasibility studies identified two main feasible alternative hydro-cyclone house locations: a northeastern option located adjacent to Cell 1 embankments; and an eastern option located further south near the planned ITCS Road. The study considered factors such as topography, operational efficiency, pipeline reticulation, hydraulic performance and proximity to key infrastructure including the TSF embankment construction areas.

Based on this evaluation, the northeastern location was selected primarily due to its relatively higher elevation and more favourable topography compared to the alternative. This site provides an elevated, centrally located position within the proposed TSF development area, enabling efficient distribution of cyclone underflow and overflow pipelines across the staged embankment construction areas. The location also supports improved pipeline hydraulic optimisation, reducing long-term pumping requirements and associated operational costs and greenhouse gas emissions over the life of the project. It also has minimal elevation variations compared to surrounding areas, thus minimising the need for extensive earthworks.

7.4.2 Infrastructure corridor

A number of infrastructure corridor route alternatives were assessed to identify the preferred alignment for the tailings pipeline and associated access road between the Ok Tedi Mine and the proposed Ok Birim TSF site. Figure 7.2 shows the main infrastructure corridor alternatives considered.

The 2024 PFS studies (KCB 2024a) initially identified a north and south corridor option to the TSF, each comprising an access road, major bridge crossings and tailings pipeline infrastructure while maximising use of the existing Kiunga–Tabubil Highway for most of their length. The north option followed approximately 80 km of the existing highway before branching west towards the TSF north of Ningerum via a new access road approximately 14 km long. The south option followed approximately 91 km of the existing highway before turning west towards the TSF near Alice Pit, south of Ningerum, via a new access road approximately 11 km long. However, both options were eventually discounted primarily due to major operational constraints associated with accommodating a tailings pipeline within the available highway corridor right-of-way (including existing pipelines within it), as well as social considerations such as encroachment of community infrastructure restricting access.

A third alternative corridor route was subsequently investigated as part of ongoing feasibility studies to provide an alternative regional access route with a more direct connection approaching from the north. This option involves following the existing Kiunga–Tabubil Highway from the Ok Tedi Mine to Tabubil for about 22 km before crossing the Ok Tedi south of Tabubil and turning south near Kumkit Village and the construction and upgrade of approximately 65 km of new road through rural areas, with three permanent bridges and several minor crossings.

A comparative assessment of the three corridor route alternatives was undertaken considering construction and operational costs, hydraulic and geotechnical performance, constructability, flood and erosion risks, and potential environmental and community impacts and benefits. The third alternative corridor route was ultimately selected as the preferred route.

This corridor route is preferred based on its overall balance of operational efficiency, reduced pipeline length and lower construction costs, and improved hydraulic efficiency, while also enhancing long-term regional accessibility benefits for nearby communities along the corridor. Importantly, this route will also provide a key alternative regional access road for OTML and local communities to transport fuel, goods and supplies,

including from nearby Indonesia, during periods when access via the Kiunga–Tabubil Highway or Kiunga Port may be disrupted.

Following selection of the preferred corridor route, several alignment options were assessed to further refine the finalised proposed route with the aim to reduce earthworks and trenching requirements, minimise the need for major crossings, and avoid passing directly through villages and settlement areas and potentially environmentally significant sites such as the Lukwi caves.

7.4.3 Power supply

There is currently no existing power generation or distribution network near the proposed TSF site. OTML's preferred power supply option for the project is on-site diesel generation. Another option investigated involved constructing a powerline along the planned ITCS Road to connect the TSF site to diesel power generators located at Ningerum. At this stage, no additional alternatives are being considered. Given the region's consistently overcast weather conditions, solar power was deemed unviable.

7.4.4 Water supply

Various water supply options were considered to meet the project's construction and operational needs:

- Existing water supply: such as from the Ok Tedi Mine operations, considered for potable water supply (e.g., bottled drinking water for the workforce) and make-up water for the tailings slurry transported via the proposed tailings pipeline.
- TSF reclaim decant water: preferred source for process water for the hydro-cyclone and associated flush water systems, as it enables water recycling and significantly reduces overall operational water demand.
- Surface water: from on-site rainfall runoff collected and stored within the TSF footprint, suitable as raw water for dust suppression, vehicle washdown and rehabilitation activities.
- Abstraction from nearby watercourses: as alternative source to supplement potable water for the workforce, camp, kitchens and ablutions. Potential sources include the Ok Birim, Ok Taub, Ok Yep or nearby upstream tributaries (see Figure 6.12). This option would require installation of water intake and pump infrastructure.
- Groundwater from boreholes: as alternative source to supplement potable water for the workforce, camp, kitchens and ablutions. This would require installation of bore and pump infrastructure (see Figure 6.12).

Based on technical, cost and environmental considerations, the preferred water supply strategy for the project will involve a combination of the following sources:

- Initial construction water may be sourced from construction sediment trap ponds (after decanting), existing water supply or nearby watercourses, subject to confirmation by ongoing studies.
- Operational water will be primarily sourced from recycling of TSF decant water for the hydro-cyclone and associated flush water systems. Given the significant surplus of this water in the TSF water balance, surface water abstraction from the Ok Tedi or nearby watercourses for the hydro-cyclone systems is not anticipated.
- Raw water for dust suppression, vehicle washdown and progressive rehabilitation may be sourced from suitable clean water such as from TSF decant water (if deemed adequate) or on-site rainfall collected and stored within the TSF footprint.
- Potable water for the workforce, camp, kitchens and ablutions will either be trucked to site or sourced from groundwater borehole or nearby upstream watercourse after adequate treatment to meet drinking water quality standards.

Ongoing studies will confirm the project's water supply strategy for construction and operations. Chapter 6 provides further detail on water supply and management.