

# **Panguna Mine Legacy Impact Assessment**

**Phase 1 Assessment Report**  
**Chapter 13 - Recommendations**

Panguna Legacy Assessment Company Limited



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## 13. RECOMMENDATIONS

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This chapter presents recommendations based on the integrated outcomes of the environmental, social and human rights impact assessments presented in chapters 10 to 12. The recommendations outline:

- What needs to be remedied to address or mitigate impacts identified by the impact assessment.
- Further investigations that would address uncertainties in the impact assessments.

Recommendations relating to impact mitigation and management are outside the scope of Phase 1. The Oversight Committee and the Parties to the Complaint will consider the outcomes of this report along with feedback from rightsholders and relevant stakeholders in determining the next steps of the process.

### 13.1 GENERAL APPROACH

#### 13.1.1 Remedy of human rights impacts

The UNGPs state that remedy for impacts to human rights may include “apologies, restitution, rehabilitation, financial or non-financial compensation and punitive sanctions [by the State], as well as the prevention of harm” (UN 2011). In keeping within the scope of the Legacy Impact Assessment, the focus of recommendations relates to restitution, rehabilitation and prevention of harm. The following aspects are relevant when considering remedy of a human rights impact:

- Removing or treating the source of the impact, breaking the pathway of impact or mitigating the end point.
- Involving rightsholders and other stakeholders in remedy considerations, including assessment of remedy options and the impacts of these, implementation processes and follow up monitoring and evaluation processes.
- The role of Free, Prior and Informed Consent with the affected population in determining the preferred option for remedy including communication and consideration of the impacts associated with remedy options.
- The need for procedures relating to remedy to be “impartial, protected from corruption and free from political or other attempts to influence the outcome” (UN 2011).

#### 13.1.2 Recommendations for impacts to be remedied and areas for further investigation

The impacts to be remedied relate directly to the assessed acute actual and potential human rights impacts, as these reflect both the environmental impacts caused by the mine since 1989 and the directly connected impacts to communities and rightsholders. The priority for remedy is based on the salience of the impact to human rights presented in Chapter 12, where impacts of high salience have a higher priority for remedy. This reflects UNGP guidance that while all human rights impacts should be addressed it is not always possible to address them simultaneously.

Given the preliminary nature of Phase 1, there are many impacts that have a high level of uncertainty associated with them. Categories for possible human rights impacts and possible human health risks have been included to address impacts where there is insufficient information to determine if they are an actual impact or not.

A possible human rights impact is a credible impact to a human right that could be directly connected to an actual environmental impact but there is insufficient information to determine this. A possible human health risk is related to potential contaminant exposure from people eating, drinking, or coming into contact with mine-related contaminants in water, food or soil that may impact on the right to health. In this situation, the data collected identifies where further investigations are needed to determine whether there may be an impact on human health.

There are also many impacts that have other contributory factors, such as ASM-related activity impacting land contamination and rights relating to human health and adequate food, housing and standard of living. As noted in the discussions in the impact assessments, this report does not quantify the relative contribution of the mine-related influences and these other factors.

Recommendations have been made based on:

- Progressing to options analysis for the remedy of the acute actual and potential human rights impacts where enough is known.
- Improving understanding of human rights impacts including possible impacts and risks and addressing the main uncertainties in the impact assessments.

In general, recommendations have been made for further work to address main areas of uncertainty as relevant to the understanding and possible remedy of human rights impacts. These investigations draw from the recommendations provided in the technical investigation reports (appendices A to G). However, the technical investigation reports were prepared at the end of the evaluation stage of Phase 1 and before the subsequent impact assessment stage. This means that technical specialists developed technical recommendations for their respective areas of investigation that may not necessarily relate to an aspect which was carried through to formal assessment as an acute actual or potential environmental impact of the Panguna Mine since the cessation of mining in 1989 and the social and human rights impacts directly related to the environmental impact. Because of this, only those recommendations in the technical investigation reports relevant to the assessed human rights impacts are presented in this section, i.e., they must relate to an environmental impact formally assessed and with social and human rights impacts directly connected to it. As a result, not all the recommendations provided in the technical investigation reports (appendices A to G) are included here.

The recommendations are presented by domain. Each section sets out the recommendations for the domain related to:

- Human rights impacts to be remedied, including a summary of whether the impact is actual or potential, its cause, location, impacted right, salience, uncertainty, affected rightsholders and types of analyses needed.
- Areas for further investigation that could form the basis of a more detailed work program developed after the completion of Phase 1. Proposed locations are provided for these investigations, in addition to these there is a need to also investigate relevant control sites.

The output of these further investigations can be used to:

- Determine if possible human rights impacts are actual human rights impacts.
- Assess human health risks and related actual and potential human rights impacts.
- Refine the existing assessment of human rights impacts and risks, particularly related to:
  - Scale and extent of mineralised and non-mineralised contamination.
  - Number of impacted rightsholders.
  - Water security and resource use.
  - Land productivity.

- Identify options and assess the feasibility to remedy and mitigate identified human rights impacts.

In the sections below, actual, potential and possible impacts and risks in Chapter 12 have been summarised for simplicity.

## 13.2 MINE DOMAIN RECOMMENDATIONS

This section sets out the recommendations for the Mine Domain related to:

- Actual and potential human rights impacts to be remedied (Table 13.1).
- Areas for further investigation (Table 13.2).

These recommendations are summarised as follows.

Human rights impacts to be remedied and further investigated relating to:

- Potential impact on right to life, caused by exposure to geotechnical hazard events and structural failure of mine-related structures that may result in fatalities. The recommendation for this impact relates to identifying and assessing options to mitigate the hazards.
- Potential impact to right to health, caused by the geotechnical hazard events which may prevent or change access to healthcare, including hospital level care, for communities in this domain and also the River System Domain. This impact would continue until access is restored. The recommendation for this impact relates to identifying and assessing options to mitigate the hazards or to improve rate of access restoration if events occurred.
- Actual impact to right to water, caused by the presence of mineralised contamination in water sources in the open pit. The recommendation for this impact relates to further investigations to improve understanding of water use and exposure of chemicals to people.
- Actual impact to right to a clean, healthy and sustainable environment, caused by mineralised and non-mineralised contamination from mine-related infrastructure. The recommendation for this impact relates to further investigations to adequately identify the extent of contamination and assess options to remedy or mitigate.

Possible human rights impacts and risks recommended to be further investigated:

- Possible impact to right to adequate food, housing and standard of living, caused by the presence of non-mineralised and mineralised contamination in gardening areas. Recommended areas for further investigation relate to understanding the impact of chemicals and metals on the ability of the land to grow food and crops.
- Possible risks to right to health, caused by exposure to non-mineralised contamination in soils at pit and central workshops and in the processing and milling area; mine-related contaminants in food; and mineralised contamination in surface water in the Kawerong-Jaba River and drinking water sources in the open it. Recommended areas for further investigation relate to:
  - Additional soil and water sampling of contaminants to understand the extent and scale of the area affected by chemicals or metals.
  - Additional surveys to understand household and community use of water.
  - Quantifying exposures to chemicals/metals to better understand risks to human health through a Tier 2 and/or Tier 3 human health risk evaluation, which involves sampling of food sources, soil samples, and how much food and soil people are exposed to. This would also include understanding the risk of dust exposure.

**Table 13.1 Recommended human rights impacts to be remedied in the Mine Domain**

Impacted right	Cause	Location	Saliency rating	Uncertainty rating	Affected rightsholders	Recommendation	Types of analyses
Potential impact to <b>right to life</b>	Exposure to geotechnical hazard events that may result in fatalities	<ul style="list-style-type: none"> <li>• Cut-fill slope above Pirurari.</li> <li>• A section of the Port to Mine Access Road above the western extent of Panguna Town.</li> <li>• A section of the Port to Mine Access Road approaching Panguna Town (1 km from town).</li> <li>• A section of the Port to Mine Access Road 2.8 km north of Panguna Town.</li> <li>• Panguna open pit:               <ul style="list-style-type: none"> <li>○ Eastern slope</li> <li>○ Southeastern slope</li> <li>○ Southern slope</li> </ul> </li> </ul>	Very high to high	Medium	<ul style="list-style-type: none"> <li>• Community – people living or travelling through these areas are at risk.</li> <li>• ASM workers – people undertaking ASM in these areas are at risk.</li> </ul>	Identify options and assess the feasibility for the mitigation of geotechnical hazards at the listed locations.	<p>An options assessment for remedy and mitigation that considers a range of factors, such as safety, geotechnical, geological, environmental, social and economic requirements.</p> <p>Studies to inform the options assessment may include pit slope movement monitoring, additional stability and runout analyses.</p>

Impacted right	Cause	Location	Saliency rating	Uncertainty rating	Affected rightsholders	Recommendation	Types of analyses
Potential impact to <b>right to life</b>	Exposure to structural failure of mine-related structures that may result in fatalities	<ul style="list-style-type: none"> <li>• Integrated mess</li> <li>• Panguna Town concrete walls</li> <li>• Primary crusher</li> <li>• Secondary crusher.</li> </ul>	High	Medium	Community - people living or travelling through these areas are at risk.	Identify options and assess the feasibility for the make-safe of infrastructure.	An options assessment for remedy and mitigation that considers a range of factors, such as safety, structural, environmental, social and economic requirements.
Potential impact to <b>right to life</b>		<ul style="list-style-type: none"> <li>• Fine ore crushing plant.</li> <li>• Screening plant.</li> <li>• Fine ore stockpile.</li> <li>• Milling building.</li> <li>• Substation.</li> <li>• Milling area workshop and storage.</li> </ul>	Very high	Medium	ASM workers - people undertaking ASM in or around these buildings are at risk.		
Potential impact to <b>right to health</b>	Geotechnical hazard events may prevent or change access to healthcare, including hospital level care, for communities in this domain. This impact would continue until access is restored.	<ul style="list-style-type: none"> <li>• Port to Mine Access Road</li> <li>• Pirurari Road (cut-fill slope)</li> </ul>	Medium to High	High	<ul style="list-style-type: none"> <li>• Community: failure at either of these locations would adversely affect access to health care for up to 23,100 people in the Mine, River System and Delta domains who are dependent on this access route.</li> <li>• Women and physically vulnerable individuals: individuals within this group are more vulnerable to changes in access to healthcare than other community members.</li> </ul>	<ul style="list-style-type: none"> <li>• Identify and assess options for the mitigation of geotechnical hazards for the cut-fill slope above Pirurari and Port to Mine Access Road areas.</li> </ul> <p>And/or:</p> <ul style="list-style-type: none"> <li>• Identify and assess options to improve rate of access restoration if events occurred.</li> </ul>	An options assessment for remedy and mitigation that considers a range of factors, such as safety, geotechnical, environmental, social and economic requirements.

Impacted right	Cause	Location	Saliency rating	Uncertainty rating	Affected rightsholders	Recommendation	Types of analyses
Actual impact to <b>right to a clean, healthy and sustainable environment</b>	Mineralised and non-mineralised contamination from mine-related infrastructure has impacted land and water quality in areas of the domain.	<ul style="list-style-type: none"> <li>• Dapera</li> <li>• Processing and milling area</li> <li>• Pit and central workshops</li> <li>• Switchyard</li> <li>• Kawerong-River</li> <li>• Open mine pit</li> </ul>	Medium	Low	Community – People living and working in the areas. This is estimated to be a modelled population of 1,000 people.	Conduct further investigations to identify the extent of contamination and assess options to remedy or mitigate.	<p>An options assessment for remedy and mitigation that considers a range of factors, such as safety, environmental, social and economic requirements.</p> <p>Studies to inform the options assessment may include water and soils sampling to identify the extent of contamination (see 'Detailed contamination investigation' in Table 13.2).</p>
Actual impact to <b>right to water</b>	Presence of mineralised contamination in water sources in the open pit	Open pit	Medium	Medium	ASM community - People living and working in the open pit will be affected. This is estimated to be a modelled residential population of around 210 people.	Conduct further investigations to improve understanding of water use and exposure of chemicals to people and assess options to remedy or mitigate.	<p>An options assessment for remedy and mitigation that considers a range of factors, such as safety, environmental, social and economic requirements.</p> <p>Studies to inform the options assessment may include water sampling to identify the extent of contamination (see 'Detailed contamination investigation' in Table 13.2).</p>



**Table 13.2 Recommended areas for further investigation in the Mine Domain**

Relevant right	Associated hazards	Phase 1 uncertainties and limitations	Study approach	Locations – Mine Domain
<b>Study: Detailed contamination investigation</b>				
<p>Right to water</p> <p>Right to a clean, healthy and sustainable environment</p> <p>Right to health</p> <p>Right to adequate food, housing and standard of living</p>	<ul style="list-style-type: none"> <li>Land with non-mineralised contamination</li> <li>Recreational water with mineralised contamination</li> <li>Drinking water with mineralised contamination</li> </ul>	<p>Phase 1 sampling was limited to collecting preliminary soil and water samples. Some areas were inaccessible.</p> <p>Phase 1 data is not sufficiently detailed to:</p> <ul style="list-style-type: none"> <li>Delineate the extent of contamination</li> <li>Define the detailed transport pathway from contamination to people.</li> <li>Determine if there are any health impacts.</li> <li>Determine effect of contamination on land productivity.</li> </ul>	<p>Collect detailed soil and water sampling of contaminants of concern to improve understanding of extent and scale of contamination.</p> <p>Conduct detailed water resource mapping and refine potential transport pathways identified in Phase 1.</p>	<ul style="list-style-type: none"> <li>Areas of contamination identified in Phase 1:</li> <li>Processing and milling area</li> <li>Pit and central workshops</li> <li>Switchyard</li> <li>Areas of recreational water use identified in Phase 1:</li> <li>The pit lake</li> <li>Kawerong River near Onove with water from seepage streams from the waste rock dump</li> </ul>
<p>Right to health</p>	<p>Contamination in dust</p>	<p>Phase 1 dust sampling results were limited due to some dust gauges being vandalised and some samples being rejected by laboratory due to high water content (from rainfall). Additionally, the sample period did not adequately cover dry conditions.</p>	<p>Collect additional dust samples (metals, particulate matter) during dry season to understand dust levels and composition over time.</p>	<ul style="list-style-type: none"> <li>Dapera</li> <li>Moroni</li> </ul>
<b>Study: Agricultural land use</b>				
<p>Right to a clean, healthy and sustainable environment</p> <p>Right to adequate food, housing, and standard of living</p>	<p>Land with non-mineralised and mineralised contamination</p>	<p>Phase 1 was limited to soil sampling of areas with likely contamination, limited sampling of mine waste and sampling of some garden soils in representative villages Population impacts were estimated from limited survey data and modelling.</p> <p>Phase 1 data is insufficient to:</p> <ul style="list-style-type: none"> <li>Understand dependency on impacted land and severity of impacts at household level</li> </ul>	<p>Conduct social surveys to understand the:</p> <ul style="list-style-type: none"> <li>Use of land for agriculture and gardening (subsistence and livelihoods)</li> <li>Populations dependent on impacted land</li> <li>Severity of impacts at household level.</li> <li>Geographical distribution of impacted rightsholders</li> </ul>	<ul style="list-style-type: none"> <li>Productive land near areas of contamination in:</li> <li>Pit and central workshops</li> <li>Moroni</li> <li>Switchyard</li> <li>West of Panguna Town</li> <li>Dapera</li> <li>Hamlet on waste rock dump</li> </ul>

Relevant right	Associated hazards	Phase 1 uncertainties and limitations	Study approach	Locations – Mine Domain
		<ul style="list-style-type: none"> <li>• Determine effect of contamination on land productivity</li> <li>• Identify affected people and households</li> </ul>	<p>Conduct detailed soil agricultural assessment involving:</p> <ul style="list-style-type: none"> <li>• Establishing baseline soil productivity by collecting and analysing soil samples at variable distances from mine-affected areas</li> <li>• Taking additional targeted co-located soil samples to identify linkages between areas of food growing and areas of contamination</li> <li>• Composite soil sampling at different root zones and where garden beds and soils where poultry or livestock are present</li> </ul>	
<b>Study: human health risk assessment</b>				
<p>Right to a clean, healthy and sustainable environment</p> <p>Right to health</p>	<p>Water and soil with non-mineralised and mineralised contamination</p>	<p>Phase 1 human health data was limited to preliminary social and market basket surveys aimed at identifying areas of risk. Population impacts were estimated from limited survey data and population modelling.</p> <p>Phase 1 data is insufficient to understand detailed exposure pathways and quantify the degree of health impact (if any).</p>	<p>Conduct further investigations into human health using either a Tier 2 and/or Tier 3 approach.</p> <p>A Tier 2 human health risk evaluation would involve:</p> <ul style="list-style-type: none"> <li>• Market basket survey (metals: arsenic, cadmium, mercury, lead, copper, selenium, zinc)</li> <li>• Detailed food frequency survey</li> <li>• Time activity surveys</li> <li>• 24-hour dietary survey</li> <li>• Further soil sampling (see agricultural land use)</li> </ul> <p>A Tier 3 human health risk evaluation would involve:</p> <ul style="list-style-type: none"> <li>• Physical examination and collection of biological samples from willing adult participants.</li> </ul>	<p>Communities living in or around the:</p> <ul style="list-style-type: none"> <li>• Processing and milling area</li> <li>• Pit and central workshops</li> <li>• Switchyard</li> <li>• Moroni, Dapera, Panguna Town, In-pit, Pirurari, Onove</li> <li>• Hamlet on waste rock dump</li> <li>• Communities with recreational and drinking water sources from: <ul style="list-style-type: none"> <li>• Open pit</li> <li>• Seepage from the waste rock dump</li> <li>• Kawerong River near Onove</li> </ul> </li> </ul>

### 13.3 RIVER SYSTEM DOMAIN RECOMMENDATIONS

This section sets out the recommendations for the River System Domain related to:

- Human rights impacts to be remedied (Table 13.3).
- Areas for further investigation (Table 13.4).

These recommendations can be summarised as follows.

Human rights impacts to be remedied and further investigated relating to:

- Potential impacts to right to life, caused by exposure to geotechnical hazard events in the Main/Pump Station Levee. The recommendation for this impact relates to identifying and assessing options to mitigate the hazards and further investigating the rate of deformation and time to failure.
- Potential impact to right to life, caused by exposure to unstable mine-related structures (Jaba Pump Station and Momau River Bridge) that may collapse and result in injury or death. The recommendation for this impact relates to identifying and assessing options to mitigate the hazard.
- Potential impact to the right to life, caused by hazardous river conditions and where there is no bridge to provide safe crossing, which affects the villages of Tempiri, Gold Miners (UT), Gold Miners Camp, Toku, Maton, Pem'ana and Katauli. The recommendation for this impact relates to identifying and assessing options to mitigate the impact or to improve access.
- Actual impact to right to health, caused by riverine hazards high flow and flood events temporarily preventing access to healthcare, including hospital level care, for communities living in an area with no safe access (i.e., a bridge). This temporary impact affects the communities that live more than 2 km from a bridge including Tempiri, Gold Miners (UT), Gold Miners Camp, Toku, Tavampai, Tairomana, Konuku, Maton, Pem'ana, Katauli, Polamato, Kuneka, Maile, Waikeuluma, and Mokerokeroai. Villages that rely on watercourse crossings that are hazardous during flood events include hamlets located southwest of Kuneka Creek along Kuneka Road and villages west of the wet crossing on Tun Creek. The recommendation for this impact relates to identifying and assessing options to mitigate the hazards or to improve rate of access.
- Actual and potential impacts to cultural rights caused by flooding and tailings deposition since 1989 (and potential future flooding) resulting in damage or destruction of cultural heritage sites. Areas affected include flood impacted areas in the Lower tailings area and areas surrounding Kuneka Creek. The recommendation for this impact relates to understanding cultural rights and areas of cultural heritage sensitivity.
- Actual impact to right to adequate food, housing and standard of living and cultural rights, caused by flooding since 1989 that has reduced the value of land and its usability, affecting the rightsholder's capacity to generate food and crops and therefore participate in related components of cultural life. Areas affected include discrete areas of Jaba Pump Station, communities near lower Tun Creek, villages around Kuneka Creek and its tributaries, and villages around the lower Pagana River. The recommendation for this impact relates to identifying and assessing options to mitigate the impact of flooding to productive land in the area. Recommended areas for further investigation relate to:
  - The duration of flood events and periods of inundation.
  - The impact of flooding on the ability of the land to grow food and crops.
  - Identifying impacted rightsholders.
- Actual impact to right to adequate food, housing and standard of living caused by continued effects on aquatic ecology in the Kawerong-Jaba River system. The recommendation for this impact relates to understanding aquatic resource use in the Kawerong-Jaba River System.

- Actual and potential impacts to the right to water, caused by exceedances of drinking water criteria in sections of the Kawerong-Jaba River that may be used by individuals, along with flooding in Tun Creek, Kuneka Creek, and lower Pagana River that reduces acceptability of water. The recommendation for this impact relates to conducting further investigations related to:
  - Use of water and access to alternative water sources for affected rightsholders.
  - Quantifying exposures to chemicals to better understand risks to human health.
  - The duration of flood events and periods of inundation.
  - The impact of flooding on water quality.
- Actual impact to right to education, caused by mine-related flooding. Areas affected include children rightsholders' from Pem'ana, Namunsa, Polamato, Kobalu, Kokore and Kuneka. The recommendation for this impact relates to identifying and assessing options to mitigate the impact of flooding on access to education, including identifying alternative access routes.
- Actual impact to right to a clean, healthy and sustainable environment, caused by mineralised and non-mineralised contamination from mine-related infrastructure. The recommendation for this impact relates to further investigations to adequately identify extent of contamination and assess options to remedy or mitigate.

Possible human rights impacts and risks to be further investigated:

- Possible impact to right to adequate food, housing and standard of living, caused by the presence of tailings with mineralised contamination in agricultural areas. Areas for further investigation relate to understanding the impact of chemicals on the ability of the land to grow food and crops.
- Possible impact to right to adequate food, housing and standard of living caused by the tailings deposition and smothering of the Konaviru Wetland. The recommendation for this impact relates to understanding bush resource use in the Konaviru Wetland and identifying impacted rightsholders.
- Possible risks to right to health, caused by exposure to non-mineralised contamination in soil and mineralised contamination in drinking/recreational water, soil, and by consumption of contaminated food. Concentrations of metals exceeded adopted drinking water and recreational health screening criteria in the sections of the Kawerong-Jaba River. Exceedances of recreational criteria were also identified in seepage from Tailings Basin 1. Areas for further investigation relate to:
  - Further soil and water sampling to understand the extent and scale of areas affected by chemicals and metals.
  - Use of water and access to alternative water sources for affected rightsholders.
  - Quantifying exposures to chemicals to better understand risks to human health through a Tier 2 or Tier 3 human health risk evaluation, which involves sampling of food sources, soil samples, and how much food and soil people are exposed to. This would also include understanding the risk of dust exposure.

**Table 13.3 Recommended human rights impacts to be remedied in the River System Domain**

Impacted right	Cause	Location	Salience rating	Uncertainty rating	Affected rightsholders	Recommendation	Types of analyses
Potential impact to <b>right to life</b>	Exposure to geotechnical hazard events that may result in fatalities	Main/Pump Station levee	Very high	Medium	<ul style="list-style-type: none"> <li>Community – People living, working or travelling through these areas are at risk.</li> <li>ASM workers – people undertaking ASM in these areas are at risk.</li> </ul>	Identify options and assess the feasibility for the mitigation of geotechnical hazards at the listed locations.	An options assessment for remedy and mitigation that considers a range of factors, such as safety, geotechnical, environmental, social and economic requirements. Studies to inform the options assessment may include levee stability analyses such as that described in Table 13.4.
Potential impact to <b>right to life</b>	Exposure to structural hazards events that may result in fatalities	Momau River Bridge	High	Low	People using the bridge.	Identify and assess options to mitigate the hazard.	An options assessment for remedy and mitigation that considers a range of factors, such as safety, structural, environmental, social and economic requirements.
Potential impact to <b>right to life</b>		Jaba Pump Station	Very high	Low	<ul style="list-style-type: none"> <li>Community – people who use the space next to the portal frame building as a place of gathering and worship.</li> <li>Dwellings within 50 m of the Jaba Pump Station.</li> </ul>		

Impacted right	Cause	Location	Salience rating	Uncertainty rating	Affected rightsholders	Recommendation	Types of analyses
Potential impact to <b>right to life</b>	Hazardous river conditions and where there is no bridge to provide safe crossing that may result in fatalities.	Western banks of the Kawerong River and the northern banks of the Jaba River	Very high	Medium	Community - Tempiri, Gold Miners (UT), Gold Miners Camp, Toku, Maton, Pem'ana and Katauli.	Identify and assess options to mitigate the impact or to improve access.	An options assessment for remedy and mitigation that considers a range of factors, such as safety, environmental, social and economic requirements. Studies to inform the options assessment may include riverine hazard analyses (Table 13.4).
Actual impact to <b>right to health</b>	Riverine hazards (high flow and flood events) temporarily preventing access to healthcare, including hospital level care.	<ul style="list-style-type: none"> <li>Western banks of the Kawerong River</li> <li>Northern banks of the Jaba River</li> <li>South of Kuneka Creek</li> <li>West of lower Pagana River</li> <li>Communities that live more than 2 km from a bridge including</li> </ul>	Medium to High	High	Community – Tempiri, Gold Miners (UT), Gold Miners Camp, Toku, Tavampai, Tairomana, Konuku, Maton, Pem'ana, Katauli, Polamato Kuneka, Maile, Waikeuluma, and Mokerokeroai.	Identify and assess options to mitigate the hazards or to improve access.	An options assessment for remedy and mitigation that considers a range of factors, such as safety, environmental, social and economic requirements. Studies to inform the options assessment may include riverine hazards and flooding assessment and water resource use mapping analyses (Table 13.4).
Actual impact to <b>right to adequate food, housing, and standard of living and cultural rights</b>	Flooding effects on land impact the right to adequate food, housing, and standard of living	<ul style="list-style-type: none"> <li>Discrete areas of Jaba Pump Station</li> <li>Lower Tun Creek</li> <li>Some areas of the Kuneka Creek</li> <li>Lower Pagana River</li> </ul>	Medium	High	Community – people living in areas at risk of being impacted by flood effects.	Undertake further investigations to understand use of impacted land for agriculture and gardening (subsistence and livelihoods), the level of impact and population impacted.	An options assessment for remedy and mitigation that considers a range of factors, such as safety, environmental, social and economic requirements. Studies to inform the options assessment may include agricultural land use and flood analyses such as that described in Table 13.4.

Impacted right	Cause	Location	Saliency rating	Uncertainty rating	Affected rightsholders	Recommendation	Types of analyses
Actual impact to <b>right to adequate food, housing, and standard of living</b>	Continued effects on aquatic ecology in the Kawerong-Jaba River system	Kawerong-Jaba River	Medium	High	Community – people living along the Kawerong-Jaba River	Undertake additional studies to understand riverine resource use in the Kawerong-Jaba River system.	An options assessment for remedy and mitigation that considers a range of factors, such as safety, environmental, social and economic requirements. Studies to inform the options assessment may include aquatic and social surveys such as that described in Table 13.4.
Actual and potential impacts to <b>right to water</b>	Mineralised contamination and changed flooding regimes	<ul style="list-style-type: none"> <li>• Areas of the Kawerong-Jaba River</li> <li>• Lower Tun Creek</li> <li>• Kuneka Creek,</li> <li>• Lower Pagana River</li> <li>• Potential future areas of flooding</li> </ul>	Medium	High	<ul style="list-style-type: none"> <li>• Community – people who use the Kawerong-Jaba River, communities around Kuneka Creek, Mokerokeroai, Gold Miners Camp</li> <li>• ASM workers</li> </ul>	Conduct further investigations to improve understanding of water use and exposure of chemicals to people.	An options assessment for remedy and mitigation that considers a range of factors, such as safety, environmental, social and economic requirements. Studies to inform the options assessment may include water sampling and water resource use investigations (see Table 13.4)
Actual impact to <b>right to education</b>	Flooding effects on crossings of the Kawerong-Jaba River system to access schools and education	Children located in and around: <ul style="list-style-type: none"> <li>• Namunsa</li> <li>• Polamato</li> <li>• Kobalu</li> <li>• Kokore</li> <li>• Kuneka (north of the creek).</li> <li>• Pem'ana</li> </ul>	Medium	Medium	Children – people living in areas at risk of being impacted by flood effects	Identify and assess options to mitigate impacts associated with flooding, including identifying alternative access points where required.	An options assessment for remedy and mitigation that considers a range of factors, such as safety, environmental, social and economic requirements. Studies may include riverine hazards and flooding assessment and water resource use mapping analyses (Table 13.4).

Impacted right	Cause	Location	Salience rating	Uncertainty rating	Affected rightsholders	Recommendation	Types of analyses
Actual and potential impacts to <b>cultural rights</b>	Flooding and tailings deposition resulting in damage or destruction of cultural heritage sites.	Flood impacted areas in the Lower tailings and surrounding Kuneka Creek and potential future areas of flooding	Very high	High	Customary groups – in flood affected areas	Conduct further investigations to identify cultural heritage values and sites in impact areas.	An options assessment for remedy and mitigation that considers a range of factors, such as safety, environmental, social and economic requirements. Studies to inform the options assessment may include social surveys and cultural heritage assessments of impacted areas.
Actual impact to <b>right to a clean, healthy and sustainable environment</b>	Mineralised and non-mineralised contamination from mine-related infrastructure.	Extent of tailings	Medium	Low	Community – all villages named in the River System Domain, except Moratona, Maile, and Moirue.	Conduct further investigations to identify extent of contamination and assess options to remedy or mitigate.	An options assessment for remedy or mitigation that considers a range of factors, such as safety, environmental, social and economic requirements. Studies to inform the assessment may include soil sampling to identify extent of contamination.



**Table 13.4 Recommended areas for further investigation in the River System Domain**

Relevant right	Associated hazards	Phase 1 uncertainties and limitations	Study approach	Locations – River System Domain
<b>Study: Detailed contamination investigation</b>				
<ul style="list-style-type: none"> <li>• Right to adequate food, housing and standard of living</li> <li>• Right to a clean, healthy and sustainable environment</li> <li>• Right to health</li> </ul>	Land with non-mineralised and mineralised contamination.	<p>Phase 1 sampling was limited to collecting preliminary soil and water samples. Some areas were inaccessible.</p> <p>Phase 1 data is not sufficiently detailed to:</p> <ul style="list-style-type: none"> <li>• Delineate the extent of contamination</li> <li>• Define the detailed transport pathway from contamination to people.</li> <li>• Determine if any health impacts.</li> <li>• Determine effect of contamination on land productivity.</li> </ul>	Collect detailed soil and water sampling of contaminants of concern to improve understanding of extent and scale of contamination.	<ul style="list-style-type: none"> <li>• Jaba Pump Station</li> <li>• Representative communities along the Kawerong-Jaba River</li> </ul>
<ul style="list-style-type: none"> <li>• Right to health</li> <li>• Right to a clean, healthy and sustainable environment</li> <li>• Right to water</li> </ul>	Drinking water and recreational water containing mineralised contamination	<p>Phase 1 sampling was limited to preliminary water and sediment sampling. Phase 1 sampling was not sufficiently detailed to:</p> <ul style="list-style-type: none"> <li>• Delineate the extent of contamination</li> <li>• Define the detailed transport pathway from contamination to people.</li> <li>• Determine if any health impacts.</li> </ul>	<p>Collect detailed soil and water sampling of contaminants of concern to improve understanding of extent and scale of contamination.</p> <p>Conduct detailed water resource mapping and refine potential transport pathways identified in Phase 1.</p>	Representative sampling along the Kawerong-Jaba River

Relevant right	Associated hazards	Phase 1 uncertainties and limitations	Study approach	Locations – River System Domain
Right to water	Limited availability of acceptable water during periods of flooding	<p>Phase 1 was limited to preliminary water resource mapping. Flood mapping was developed based on limited preliminary river morphology sampling and modelling.</p> <p>Phase 1 sampling was not sufficiently detailed to:</p> <ul style="list-style-type: none"> <li>Quantify the duration and frequencies of high flow events</li> <li>Determine influence of flooding on water quality</li> <li>Understand dependency on water resources, including impacted water sources</li> <li>Identify affected people and households</li> </ul>	<p>Collect information regarding the extent, duration and frequency of flood events.</p> <p>Collect surface water samples (metals, nutrients, physical and aesthetic characteristics) during periods of high flow to understand changes to water quality during flood events and the potential presence of non-mine related contaminants in flood waters.</p> <p>Conduct further detailed detail water resource mapping, including identifying alternative water sources to quantify the population impacted.</p> <p>Conduct social surveys to understand the dependency on impacted water sources and severity of impacts on ASM workers and communities.</p>	<p>Communities around:</p> <ul style="list-style-type: none"> <li>Kuneka Creek</li> <li>Lower Pagana River</li> <li>Lower Tun Creek</li> </ul> <p>ASM workers and communities around Gold Miners Camp.</p>
<b>Study: Riverine resource use</b>				
<ul style="list-style-type: none"> <li>Right to adequate food, housing and standard of living</li> <li>Right to a clean, healthy and sustainable environment</li> </ul>	Affected aquatic ecological resources	The assessment of aquatic ecological resources was excluded in Phase 1. Phase 1 sampling was limited to water quality sampling to identify areas of contamination.	<ul style="list-style-type: none"> <li>Undertake aquatic ecology surveys to determine the abundance and presence of aquatic ecological resources.</li> <li>Conduct a social survey to understand dependency of households on impacted resources and severity of impacts.</li> </ul>	Representative locations along Kawerong-Jaba River System
<ul style="list-style-type: none"> <li>Right to adequate food, housing and standard of living</li> <li>Right to a clean, healthy and sustainable environment</li> </ul>	Affected bush resources in in Konaviru Wetland	The assessment of bush resources was excluded in Phase 1.	<ul style="list-style-type: none"> <li>Conduct a bush resource use survey to determine the extent of resources lost.</li> <li>Conduct a social survey to understand dependency of households and potential alternative resource use areas in Konaviru Wetland.</li> </ul>	<ul style="list-style-type: none"> <li>Konaviru Wetland</li> <li>Communities surrounding Konaviru Wetland</li> </ul>

Relevant right	Associated hazards	Phase 1 uncertainties and limitations	Study approach	Locations – River System Domain
<b>Study: human health risk assessment</b>				
<ul style="list-style-type: none"> <li>Right to health</li> <li>Right to a clean, healthy and sustainable environment</li> </ul>	Water and soil with non-mineralised and mineralised contamination	<p>Phase 1 human health data was limited to preliminary social and market basket surveys aimed at identifying impacts. Population impacts were then estimated from limited survey data and population modelling.</p> <p>Phase 1 data is insufficient to understand detailed exposure pathways and quantify the degree of health impact (if any).</p>	<p>Conduct further investigations into human health using either a Tier 2 and/or Tier 3 approach. A Tier 2 human health risk evaluation would involve:</p> <ul style="list-style-type: none"> <li>Market basket survey (metals: arsenic, cadmium, mercury, lead, copper, selenium, zinc)</li> <li>Detailed food frequency survey</li> <li>Time activity surveys</li> <li>24-hour dietary survey</li> <li>Further soil sampling (see agricultural land use)</li> </ul> <p>A Tier 3 human health risk evaluation would involve:</p> <ul style="list-style-type: none"> <li>Physical examination and collection of biological samples from willing adult participants</li> </ul>	Representative communities along the Kawerong-Jaba River System.
Right to health	Contamination in dust	Phase 1 dust sampling results were limited due to some dust gauges being vandalised and some samples being rejected by laboratory due to high water content (from rainfall). Additionally, the sample period did not adequately cover dry conditions.	Collect additional dust samples (metals, particulate matter) during dry seasons to understand dust levels and composition over time.	Near Tailings Basin 1
<b>Study: Cultural heritage assessment</b>				
Cultural rights	Affected areas of cultural heritage	Phase 1 collected preliminary information on cultural heritage through the social characterisation process. It did not involve inspection of sites and some people/customary groups surveyed were hesitant to provide data regarding sensitive areas of cultural heritage.	Conduct cultural heritage assessment to identify cultural heritage values and where possible, assess impacted areas including engagement with affected rightsholders. Improve understanding of the value of land and participation practices in customary groups.	Lower Tailings and areas surrounding Kuneka Creek

Relevant right	Associated hazards	Phase 1 uncertainties and limitations	Study approach	Locations – River System Domain
<b>Study: Agricultural land use</b>				
Right to adequate food, housing, and standard of living and cultural rights	Productive land in flood-prone areas	Population impacts were estimated from limited survey data and modelling. Phase 1 data is insufficient to: <ul style="list-style-type: none"> <li>Understand dependency on impacted land and severity of impacts at household level</li> <li>Determine influence of flooding on land productivity and identify affected people or households</li> </ul>	Conduct social surveys to understand the: <ul style="list-style-type: none"> <li>Agricultural use of impacted land</li> <li>Populations dependent on impacted land</li> <li>Severity of impacts at household level</li> <li>Geographical distribution of impacted rightsholders</li> </ul>	<ul style="list-style-type: none"> <li>Productive land near flood-prone areas in:</li> <li>Jaba River</li> <li>Lower Tun Creek</li> <li>Lower Tailings, with a focus on areas affected by flooding associated with the Kuneka Creek diversion channel</li> </ul>
<ul style="list-style-type: none"> <li>Right to adequate food, housing and standard of living and cultural rights</li> <li>Right to a clean, healthy and sustainable environment</li> </ul>	Productive land with mineralised contamination due to tailings deposition	Phase 1 was limited to soil sampling of areas with deposited tailings and sampling of some garden soils in representative villages. Population impacts were estimated from limited survey data and modelling. Phase 1 data is insufficient to: <ul style="list-style-type: none"> <li>Understand dependency on impacted land and severity of impacts at household level</li> <li>Determine influence of contamination on land productivity and identify affected people and households</li> </ul>	Conduct social surveys to understand the: <ul style="list-style-type: none"> <li>Agricultural use of impacted land</li> <li>Populations dependent on impacted land</li> <li>Severity of impacts at household level</li> <li>Geographical distribution of impacted rightsholders</li> </ul> Conduct detailed soil agricultural assessment involving: <ul style="list-style-type: none"> <li>Establishing baseline soil productivity by collecting and analysing soil samples at variable distances from mine affected areas</li> <li>Taking additional targeted co-located soil samples to identify linkages between areas of food growing and areas of contamination</li> <li>Composite soil sampling at different root zones and where garden beds and soils where poultry or livestock are present.</li> </ul>	<ul style="list-style-type: none"> <li>Productive land near on areas of deposited tailings in:</li> <li>Gold Miners Camp</li> <li>Pem'ana</li> <li>Mokerokeroai</li> </ul>

Relevant right	Associated hazards	Phase 1 uncertainties and limitations	Study approach	Locations – River System Domain
<b>Study: Levee stability</b>				
Right to life	Geotechnical failure of sections of the Main/Pump Station Levee	<p>Phase 1 was limited to preliminary surface surveys and examinations and no subsurface samples or monitoring was conducted.</p> <p>Phase 1 sampling was not sufficiently detailed to:</p> <ul style="list-style-type: none"> <li>Quantify the condition and rate of deformation for sections of the Main/Pump Station Levee</li> <li>Evaluate the rate and possible effects of ASM activity on the levee face</li> <li>Evaluate the possible failure modes and time to failure</li> </ul>	<ul style="list-style-type: none"> <li>Collection of subsurface samples from soils in and under the levee bank material using intrusive methods such as split spoon sampling, along with collecting further detailed surface LiDAR data.</li> <li>Install long term survey monuments to collect land settlement data and monitor slope movement over time.</li> <li>Use captured data to identify credible failure modes and effects and refine the existing dam breach scenario modelling.</li> </ul>	Sections of the Main/Pump Station Levee.
<b>Study: Riverine hazards</b>				
<ul style="list-style-type: none"> <li>Right to life</li> <li>Right to education</li> </ul>	<ul style="list-style-type: none"> <li>Dangerous river crossings during flooding periods</li> <li>Dangerous river crossings impacting access to education</li> </ul>	<p>Phase 1 was limited to visual inspection of river crossing points and routes during non-flooding conditions. Flood mapping developed in Phase 1 is based on modelling.</p> <p>Phase 1 sampling was not sufficiently detailed to:</p> <ul style="list-style-type: none"> <li>Quantify the duration of high flow events that make crossings unsafe</li> <li>Quantify the impact on attendance levels in affected schools</li> <li>Characterise how people currently cross the river</li> </ul>	<ul style="list-style-type: none"> <li>Collect field data regarding the extent, duration, and frequency of flood events.</li> <li>Collect social survey data to understand the routes people use for river crossings in high flow events.</li> <li>Conduct surveys at villages and schools to quantify impacts to attendance rates during periods of flooding.</li> </ul>	<p>Communities reliant on river crossings near the:</p> <ul style="list-style-type: none"> <li>Upper Tailings: Tempiri, Gold Miners (UT), Gold Miners Camp, Toku</li> <li>Lower Tailings: Maton, Pem'ana, Katuli</li> </ul> <p>Communities with children attending school at:</p> <ul style="list-style-type: none"> <li>Namunsa, Polomato, Kobalu, Kokore,</li> <li>Kuneka (north of the creek), and Pem'ana</li> </ul>

## 13.4 DELTA DOMAIN RECOMMENDATIONS

This section sets out the recommendations for the Delta Domain related to:

- Human rights impacts to be remedied (Table 13.5).
- Areas for further investigation (Table 13.6).

These recommendations are summarised as follows.

Human rights impacts to be remedied and further investigated relating to:

- Actual impact to the right to health, caused by riverine hazards preventing access to healthcare, including hospital level care, for communities living in an area with no safe access during floods. The recommendation for this impact includes identifying and assessing options to mitigate the impact of flooding, including identifying alternative access routes.
- Actual impact to the right to adequate food, housing and standard of living and cultural rights, caused by flooding affecting the value of land and its usability capacity to grow food and crops and also participate in related components of cultural life. Areas affected include land to the north and south of Marau village, and the hamlet west of Marau market. Recommended areas for further investigation relate to:
  - The duration of flood events and periods of inundation.
  - Cultural rights and areas of cultural heritage sensitivity.
  - The impact of flooding on the ability of the land to grow food and crops.
- Actual impact to right to water, caused by continued mine-related flooding affecting households in Marau and the hamlet west of Marau market that rely on water from wells dug next to the Tuju (Marau) River as their primary water source. The recommendation for this impact is to conduct further investigations to understand the duration of flood events and periods of inundation, the impact of flooding on water quality, and use of water and access to alternative water sources for affected rightsholders.
- Actual impact to the right to a clean, healthy and sustainable environment, caused by tailings-related mineralised contamination across the domain. Recommended areas for further investigations include to adequately identify the extent of areas affected and assess options to remedy or mitigate.

Possible human rights impacts to be further investigated:

- Possible impacts to right to adequate food, housing and standard of living, caused by the presence of tailings with mineralised contamination in agricultural areas of the hamlet located west of Marau market. Recommended areas for further investigation relate to:
  - Further soil and water sampling to understand the extent and scale of areas affected by chemicals.
  - The impact of mineralised contamination on agricultural land production.
- Possible impacts to right to adequate food, housing and standard of living caused by mineralised contamination from mine-derived sediment deposited in Empress Augusta Bay. The assessment of marine ecology and resources in Empress Augusta Bay was excluded from Phase 1. Recommended areas for further investigation relate to:
  - The extent of the area affected by chemicals in Empress Augusta Bay.
  - The impact of chemicals on marine resources in Empress Augusta Bay.
  - Level of impact on marine resource use in Empress Augusta Bay.
- Possible risks to the right to health from exposure to contaminated food or soil due to mine-related contaminants. Recommended areas for further investigation include the same as those listed for possible impacts to right to adequate food, housing and standard of living, caused by the presence of tailings with mineralised contamination.

**Table 13.5 Recommended human rights impacts to be remedied in the Delta Domain**

Impacted right	Cause	Location	Salience rating	Uncertainty rating	Affected rightsholders	Recommendation	Types of analyses
Actual impact to <b>right to health</b>	Riverine hazards preventing access to healthcare, including hospital level care, for communities living in an area with no safe access during floods.	Marau and flood affected areas of the delta.	Medium	High	Community – A modelled population of around 40 people	Identify and assess options to mitigate the impact of flooding, including identifying alternative access routes.	An options assessment for remedy and mitigation that considers a range of factors, such as safety, environmental, social and economic requirements. Studies to inform the options assessment may include riverine hazard analyses such as that described in Table 13.6.
Actual impact to <b>right to water</b>	Mine-related flooding affecting households in Marau	Marau and flood affected areas of the delta	Low	Medium	Community – Marau and the hamlet west of Marau market. An estimated population of 40 people.	Conduct further investigations to understand the duration of flood events and periods of inundation, the impact of flooding on water quality, and use of water and access to alternative water sources for affected rightsholders.	An options assessment for remedy and mitigation that considers a range of factors, such as safety, environmental, social and economic requirements. Studies to inform the options assessment may include water security analyses as those described in Table 13.6.
Actual impact to <b>right to a clean, healthy and sustainable environment</b>	Tailings-related chemicals across the domain	Domain wide.	Medium	High	Community – A modelled population of 100 people.	Conduct further investigations to adequately identify the extent of areas affected by chemicals and assess options to remedy or mitigate	An options assessment for remedy and mitigation that considers a range of factors, such as safety, environmental, social and economic requirements. Studies to inform the options assessment may include agricultural land use and marine food sources investigations (Table 13.6).

Impacted right	Cause	Location	Saliene rating	Uncertainty rating	Affected rightsholders	Recommendation	Types of analyses
Actual impact to <b>right to adequate food, housing, and standard of living and cultural rights</b>	Mine-related flooding affecting households in Marau	Marau and flood affected areas of the delta.	Medium	High	Community – Marau and the hamlet west of Marau market. An estimated population of 40 people.	Conduct further investigations to understand the duration of flood events and periods of inundation, the impact of flooding on productive land and the reliance on the affected land and impact on cultural heritage values	An options assessment for remedy and mitigation that considers a range of factors, such as safety, environmental, social and economic requirements. Studies to inform the options assessment may include agricultural investigations, cultural heritage assessments and flood mapping analyses such as that described in Table 13.6.



**Table 13.6 Recommended areas for further investigation in the Delta Domain**

Relevant right	Associated hazards	Phase 1 uncertainties and limitations	Study approach	Locations – Delta Domain
<b>Study: Cultural heritage assessment</b>				
Cultural rights	Affected areas of cultural heritage	Phase 1 collected preliminary information on cultural heritage through the social characterisation process. It did not involve inspection of sites and some people/customary groups surveyed were hesitant to provide data regarding sensitive areas of cultural heritage.	Conduct cultural heritage assessment to identify cultural heritage values and where possible, assess impacted areas including engagement with affected rightsholders. Improve understanding of the value of land and participation practices in customary groups.	Selected communities in the Delta Domain area impacted by tailings deposition.
<b>Study: Agricultural land use</b>				
<ul style="list-style-type: none"> <li>• Right to adequate food, housing and standard of living</li> <li>• Right to adequate food, housing and standard of living</li> <li>• Right to a clean, healthy and sustainable environment</li> <li>• Cultural rights</li> </ul>	<ul style="list-style-type: none"> <li>• Productive land with mineralised contamination due to tailings deposition</li> <li>• Productive land in flood-prone areas</li> </ul>	<p>Phase 1 was limited to soil sampling of areas with deposited tailings and included limited co-located samples taken from garden beds. Population impacts were estimated from limited survey data and modelling.</p> <p>Phase 1 data is insufficient to:</p> <ul style="list-style-type: none"> <li>• Understand dependency on impacted land and severity of impacts at household level</li> <li>• Determine influence of contamination on land productivity and identify affected people and households</li> <li>• Determine influence of flooding on land productivity and identify affected people or households</li> </ul>	<p>Conduct social surveys to understand the:</p> <ul style="list-style-type: none"> <li>• Agricultural use of impacted land</li> <li>• Populations dependent on impacted land</li> <li>• Severity of impacts at household level</li> <li>• Geographical distribution of impacted rightsholders</li> </ul> <p>Conduct detailed soil agricultural assessment involving:</p> <ul style="list-style-type: none"> <li>• Establishing baseline soil productivity by collecting and analysing soil samples at variable distances from mineralised soil zones</li> <li>• Taking additional targeted co-located soil samples to identify linkages between areas of food growing and areas of contamination</li> <li>• Composite soil sampling at different root zones and where garden beds and soils where poultry or livestock are present.</li> </ul>	Marau and the hamlet west of Marau market

Relevant right	Associated hazards	Phase 1 uncertainties and limitations	Study approach	Locations – Delta Domain
<b>Study: Marine food resources</b>				
<ul style="list-style-type: none"> <li>Right to adequate food, housing and standard of living</li> <li>Right to a clean, healthy and sustainable environment</li> </ul>	Affected marine ecological resources	The assessment of marine resources was excluded in Phase 1.	<ul style="list-style-type: none"> <li>Conduct marine ecology surveys to determine the abundance and presence of marine resources. This is expected to involve water and sediment sampling.</li> <li>Conduct a social survey to understand dependency of households on impacted resources and severity of impacts.</li> </ul>	Representative communities and location in Empress Augusta Bay
<b>Study: Water security</b>				
Right to water	Limited availability of clean water during periods of flooding	<p>Phase 1 was limited to preliminary water resource mapping. Flood mapping developed in Phase 1 is based on modelling. Phase 1 sampling was not sufficiently detailed to:</p> <ul style="list-style-type: none"> <li>Quantify the duration and frequencies of high flow events</li> <li>Determine influence of flooding on water quality</li> <li>Identify affected people and households</li> </ul>	<ul style="list-style-type: none"> <li>Collect field data regarding flood frequencies and duration and collect surface water samples (metals, nutrients, physical and aesthetic characteristics) during periods of high rainfall to understand changes to water quality during flood events and the potential presence of non-mine related contaminants in flood waters.</li> <li>Collect additional survey data to further detail water resource mapping, including identifying alternative water sources to quantify the population impacted.</li> </ul>	Marau and the hamlet west of Marau market
<b>Study: Riverine hazards</b>				
Right to health	Dangerous river crossings during flooding periods	<p>Phase 1 was limited to visual inspection of river crossing points and routes during non-flooding conditions. Flood mapping developed in Phase 1 is based on modelling. Phase 1 sampling was not sufficiently detailed to:</p> <ul style="list-style-type: none"> <li>Quantify the duration of high flow events that make crossings unsafe</li> <li>Characterise how people currently cross the river.</li> </ul>	<ul style="list-style-type: none"> <li>Collect field data regarding the extent, duration, and frequency of flood events.</li> <li>Collect social survey data to understand the routes people use for river crossings in high flow events.</li> </ul>	Communities reliant on river crossings near Marau.

Relevant right	Associated hazards	Phase 1 uncertainties and limitations	Study approach	Locations – Delta Domain
<b>Study: Human health risk assessment</b>				
Right to health	Consumption of food affected by mine-related mineralised contamination.	<p>Phase 1 human health data was limited to preliminary social and market basket surveys aimed at identifying impacts. Population impacts were then estimated from limited survey data and population modelling.</p> <p>Phase 1 data is insufficient to understand detailed exposure pathways and quantify the degree of health impact (if any).</p>	<p>Conduct further investigations into human health using either a Tier 2 and/or Tier 3 approach. A Tier 2 human health risk evaluation would involve:</p> <ul style="list-style-type: none"> <li>• Market basket survey (metals: arsenic, cadmium, mercury, lead, copper, selenium, zinc)</li> <li>• Detailed food frequency survey</li> <li>• Time activity surveys</li> <li>• 24-hour dietary survey</li> </ul> <p>A Tier 3 human health risk evaluation would involve:</p> <ul style="list-style-type: none"> <li>• Physical examination and collection of biological samples from willing adult participants.</li> </ul>	<p>Communities living in or around the:</p> <ul style="list-style-type: none"> <li>• Marau village.</li> <li>• Marau market.</li> </ul>

## 13.5 PORT AND TOWN DOMAIN RECOMMENDATIONS

This section sets out the recommendations for the Port and Town Domain related to:

- Human rights impacts to be remedied (Table 13.7).
- Areas for further investigation (Table 13.8).

These recommendations are summarised as follows.

Human rights impacts to be remedied and further investigated relating to:

- Potential impact to right to life and right to health, caused by structural, chemical and explosive hazards that may result in fatalities. The recommendations for these impacts relate to identifying and assessing options to mitigate the hazards, including the make-safe of infrastructure and further investigating options for the safe removal of chemical hazards.
- Actual impact to right to a clean, healthy and sustainable environment, caused by non-mineralised contamination from mine-related infrastructure. The recommendation for this impact relates to further investigations to adequately identify the extent of contamination and assess options to remedy or mitigate.
- Possible human rights impacts and risks to be further investigated:
- Possible impact to right to adequate food, housing and standard of living, caused by non-mineralised contamination from mine-related infrastructure in agricultural areas of Anewa Bay and in sediment in Anewa Bay. Areas for further investigation relate to:
  - Further soil and water sampling to understand the extent and scale of areas affected by chemicals.
  - The impact of chemicals on agricultural land production.
  - Level of impact on marine resources.
  - The extent of the area affected by non-mineralised contamination in Anewa Bay.
  - The impact of non-mineralised contamination on marine resource use in Anewa Bay.
- Possible risks to right to health, caused by exposure to non-mineralised contamination in soil and consumption of contaminated food. Areas for further investigation relate to further soil sampling to understand the extent and scale of area affected by chemicals in soil from mine-related infrastructure in the Anewa Bay area.

**Table 13.7 Recommended human rights impacts to be remedied in the Port and Town Domain**

Impacted right	Cause	Location	Salience rating	Uncertainty rating	Affected rightsholders	Recommendation	Types of analyses
Potential impact to <b>right to life</b>	Exposure to chemical hazards events that may result in fatalities	Camp 11 chemical storage warehouse and former sewage treatment plant at Rorovana 3.	High	High	Community - People working or travelling through these areas are at risk.	Identify and assess options to mitigate the hazards, including the make-safe of infrastructure and options for the safe removal of chemical hazards.	An options assessment for remedy and mitigation that considers a range of factors, such as safety, environmental, social and economic requirements.
Potential impact to <b>right to life</b>	Exposure to structural hazards events that may result in fatalities	Two structures located in Anewa Bay (the power station and the reagent storage tanks)	Medium	Medium	Community - People working or travelling through these areas are at risk.	Identify and assess options for the make-safe of infrastructure.	An options assessment for remedy and mitigation that considers a range of factors, such as safety, environmental, social and economic requirements.
		The weighing station located in Loloho port	Medium	Medium	Loloho port workers		
Potential impact to <b>right to life</b>	Exposure to explosive event from chemical hazards	<ul style="list-style-type: none"> <li>• Above-ground fuel tanks</li> <li>• Reagent storage tanks</li> <li>• Former storage and warehouse</li> </ul>	Medium	High	Community - People living, working or travelling through these areas are at risk.	Identify and assess options to mitigate the hazards, including the make-safe of infrastructure and options for the safe removal of chemical hazards.	An options assessment for remedy and mitigation that considers a range of factors, such as safety, environmental, social and economic requirements.

Impacted right	Cause	Location	Salience rating	Uncertainty rating	Affected rightsholders	Recommendation	Types of analyses
Potential impact to <b>right to health</b>	Exposure to chemical hazards	<ul style="list-style-type: none"> <li>Camp 11 chemical storage warehouse and former sewage treatment plant at Rorovana 3.</li> <li>PAM shipping containers in Anewa Bay</li> </ul>	Very low	High	Community - People living, working or travelling through these areas are at risk.	Identify and assess options to mitigate the hazards, including the make-safe of infrastructure and options for the safe removal of chemical hazards.	An options assessment for remedy and mitigation that considers a range of factors, such as safety, environmental, social and economic requirements.
			Low		Children – Children may not view the substances as a risk.		
Actual impact to <b>right to a clean, healthy and sustainable environment</b>	Non-mineralised contamination from mine-related infrastructure	<ul style="list-style-type: none"> <li>Anewa Bay</li> <li>Camp 11</li> <li>Metonai Elementary School (former Itakaya Waste Disposal).</li> </ul>	Medium	Low	Community - A modelled population of 200 people, may access these areas.	Conduct further investigations to adequately identify the extent of the area affected by chemicals and assess options to remedy or mitigate.	An options assessment for remedy and mitigation that considers a range of factors, such as safety, environmental, social and economic requirements. Studies to inform the options assessment may include analyses listed in Table 13.8.

**Table 13.8 Recommended areas for further investigation in the Port and Town Domain**

Relevant right	Associated hazards	Phase 1 uncertainties and limitations	Study approach	Locations – Port and Town Domain
<b>Study: Detailed contamination investigation</b>				
<ul style="list-style-type: none"> <li>• Right to health</li> <li>• Right to adequate food, housing and standard of living</li> <li>• Right to a clean, healthy and sustainable environment</li> </ul>	Land with non-mineralised contamination	<p>Phase 1 sampling was limited to collecting preliminary, non-intrusive soil samples. Some areas were inaccessible.</p> <p>Phase 1 data is not sufficiently detailed to:</p> <ul style="list-style-type: none"> <li>• Delineate the extent of contamination</li> <li>• Define the detailed transport pathway from contamination to people.</li> </ul>	Collect detailed soil sampling of contaminants of concern to improve understanding of extent and scale of contamination and refine potential transport pathways identified in Phase 1.	<ul style="list-style-type: none"> <li>• Loloho fire station</li> <li>• Areas of bulk fuel storage</li> <li>• Camp 11 chemical storage areas</li> <li>• Former Itakaya Waste Disposal Site</li> </ul>
<b>Study: Marine resources</b>				
<ul style="list-style-type: none"> <li>• Right to adequate food, housing and standard of living</li> <li>• Right to a clean, healthy and sustainable environment</li> </ul>	Affected marine ecological resources	<p>The assessment of marine resources was excluded in Phase 1.</p> <p>Single screening water and sediment samples from shore-based locations were collected in Phase 1 so the quality of water and sediment further offshore is unknown.</p>	<ul style="list-style-type: none"> <li>• Conduct surveys of marine environment to assess contamination. This is expected to involve water and sediment sampling.</li> <li>• Conduct social survey to understand dependency of households on impacted resources and severity of impacts.</li> </ul>	Representative locations in Anewa Bay, including near the former copper concentrate load-out facility at the port.

Relevant right	Associated hazards	Phase 1 uncertainties and limitations	Study approach	Locations – Port and Town Domain
<b>Study: Agricultural land use</b>				
<ul style="list-style-type: none"> <li>Right to adequate food, housing and standard of living</li> <li>Right to a clean, healthy and sustainable environment</li> </ul>	Productive land with non-mineralised contamination	<p>Phase 1 was limited to conducting preliminary surveys, including market basket surveys aimed at identifying impacts. Population impacts were estimated from limited survey data and modelling.</p> <p>Phase 1 data is insufficient to:</p> <ul style="list-style-type: none"> <li>Determine influence of contamination on land productivity and refine understanding of who may be impacted</li> <li>Understand dependency on impacted land and severity of impacts at household level</li> <li>Determine effect of contamination on land productivity</li> </ul>	<p>Conduct social surveys to understand the:</p> <ul style="list-style-type: none"> <li>Agricultural use of impacted land</li> <li>Populations dependent on impacted land</li> <li>Severity of impacts at household level</li> <li>Geographical distribution of impacted rightsholders</li> </ul> <p>Conduct detailed soil agricultural assessment involving:</p> <ul style="list-style-type: none"> <li>Establishing baseline soil productivity by collecting and analysing soil samples at variable distances from mineralised soil zones</li> <li>Taking additional targeted co-located soil samples to identify linkages between areas of food growing and areas of contamination</li> <li>Composite soil sampling at different root zones and where garden beds and soils where poultry or livestock are present</li> </ul>	<ul style="list-style-type: none"> <li>Anewa Bay and Metonai Elementary School</li> <li>Representative garden beds located further from mine infrastructure</li> </ul>
<b>Study: Human health risk assessment</b>				
Right to health	Soil with non-mineralised contamination	<p>Phase 1 human health data was limited to preliminary social and market basket surveys aimed at identifying impacts. Population impacts were then estimated from limited survey data and population modelling.</p> <p>Phase 1 data is insufficient to understand detailed exposure pathways and quantify the degree of health impact (if any).</p>	<p>Conduct further investigations into human health using either a Tier 2 and/or Tier 3 approach. A Tier 2 human health risk evaluation would involve:</p> <ul style="list-style-type: none"> <li>Market basket survey (metals: arsenic, cadmium, mercury, lead, copper, selenium, zinc)</li> <li>Detailed food frequency survey</li> <li>Time activity surveys</li> <li>24-hour dietary survey</li> </ul> <p>A Tier 3 human health risk evaluation would involve:</p> <ul style="list-style-type: none"> <li>Physical examination and collection of biological samples from willing adult participants</li> </ul>	<p>Communities living in or around the:</p> <ul style="list-style-type: none"> <li>Chemical storage areas in Rorovana 3</li> <li>Bulk fuel storage areas and other decaying mine infrastructure in Anewa Bay (Loloho fire station, power station)</li> <li>Former Itakaya Waste Disposal Site</li> </ul>



## 13.6 NEXT STEPS

This chapter has outlined the recommendations for human rights impacts to be remedied and recommendations for further investigation and assessment. It is outside of the scope of Phase 1 to make recommendations about impact mitigation and management.

The Oversight Committee and the Parties to the Complaint will consider the outcomes of this report, particularly these recommendations, along with feedback from rightsholders and relevant stakeholders in determining the next steps of the process.