

Panguna Mine Legacy Impact Assessment

Phase 1 Assessment Report Chapter 8 – Impacts and Scope of Issues Assessed

Panguna Legacy Assessment Company Limited



CONTENTS

8.	IMPACTS AND SCOPE OF ISSUES ASSESSED	8-1
8.1	Whole of study area	8-2
8.2	Mine Domain.....	8-4
8.2.1	Scope of Work and focus limitations of Phase 1	8-4
8.2.2	Concerns that are not supported by information gathered during Phase 1.....	8-6
8.3	River System Domain	8-6
8.3.1	Scope of Work and focus limitations of Phase 1	8-6
8.3.2	Concerns that are not supported by information gathered during Phase 1.....	8-8
8.4	Delta Domain.....	8-9
8.4.1	Scope of Work and focus limitations for Phase 1	8-9
8.5	Port and Town Domain.....	8-10
8.5.1	Scope of Work and focus limitations of Phase 1	8-10
8.5.2	Concerns that are not supported by information gathered during Phase 1.....	8-11
8.6	Conclusion.....	8-12

LIST OF TABLES

Table 8.1	Community concerns raised – whole of study area.....	8-2
Table 8.2	Community concerns raised – Mine Domain.....	8-4
Table 8.3	Concerns compared with information gathered during Phase 1 – Mine Domain	8-6
Table 8.4	Community concerns raised – River System Domain.....	8-7
Table 8.5	Concerns compared with information gathered during Phase 1 – River System Domain	8-8
Table 8.6	Community concerns raised – Delta Domain	8-9
Table 8.7	Community concerns raised – Port and Town Domain.....	8-10
Table 8.8	Concerns compared with information gathered during Phase 1 – Port and Town Domain	8-11
Table 8.9	Focus of impact assessments and key issues in Complaint	8-13

8. IMPACTS AND SCOPE OF ISSUES ASSESSED

Individuals and communities feel strongly about how the Panguna Mine has impacted them. Many stakeholders have hopes and expectations that the Legacy Impact Assessment will specifically address those issues of greatest importance to them and that this will lead to tangible outcomes for them, at an individual and community level. Engagement during fieldwork to inform the social and human rights characterisation process, and the Complaint, raised a range of environmental, social and human rights issues, some of which are able to be assessed in this report and some of which are not. These issues have been considered, and this chapter explains why some could be formally assessed and some could not.

Those issues that have not been assessed in this report can be broadly grouped as:

- Issues that are outside the Scope of Work and focus for Phase 1
- Concerns that are not supported by information gathered during Phase 1.

Context related to this is provided below, followed by specific details. Aspects that are relevant to the whole of the study area (i.e., the entire Legacy Impact Assessment) are described first in Section 8.1 and not repeated in subsequent sections to avoid repetition. Aspects that are relevant to particular domains, such as where communities had particular concerns about specific issues in specific places, are discussed after this in sections 8.2 to 8.5. These are not in-depth discussions of all issues raised; rather, they focus on key community concerns raised in social surveys during Phase 1 and/or the Complaint. For completeness, the tables also identify those community concerns that have been carried into formal assessment in the following chapters because they are in scope and/or supported by information gathered during Phase 1.

Issues that are outside the Scope of Work and focus for Phase 1

It is not possible within the Scope of Work and timeframe of Phase 1 to identify, investigate and assess all issues people and communities have with the Panguna Mine.

A key part of the Scope of Work for Phase 1 that fundamentally limits the aspects that Tetra Tech Coffey can assess and make recommendations on is that Phase 1 is limited to focussing on the acute environmental impacts caused by the Panguna Mine since the cessation of mining in 1989, or that have continued post 1989, and the acute social and human rights impacts directly connected to them. In the context of this restriction:

- An environmental impact caused by the mine means adverse mine-related effects on the environment for which there is a complete pathway between the source and the end point in the conceptual site model. Environmental impacts caused by the mine are within the scope of the Legacy Impact Assessment; other environmental impacts that are not caused by the mine are not within the scope and while they may be noted, cannot be assessed.
- Acute in this context is used to refer to extreme, severe or very serious actual and potential impacts.
- Directly connected means actual and potential social and human rights impacts resulting straight (without intervening or intermediary factors) from environmental impacts caused by the mine. Directly connected social and human rights impacts are within the scope of the Legacy Impact Assessment; other social and human rights impacts that are not directly connected are not within the scope and while they may be noted, they are not to be assessed. The identification of the directly connected impacts in some cases may not be clear-cut and in these cases a conservative approach has been taken.
- Post-1989 means the timeframe of the scope of the Legacy Impact Assessment. In practice, this means that the environmental impacts associated with the physical changes that occurred as a result of the construction and operation of the mine up until 1989, are not in scope, for example impacts associated with the establishment of infrastructure (e.g., road, port, Arawa and Panguna towns), creation of the open pit, deposition of waste rock and riverine disposal of tailings. Ongoing or new emissions from these

features (e.g., dust, seepage, runoff) are, however, in scope. Regarding riverine disposal of tailings, environmental impacts from changes in the spatial distribution of tailing since 1989 and the associated flooding regime are in scope. From a social and human rights perspective this means that resettlement and displacement associated with the original development of the mine, establishment of infrastructure, placement of the waste rock dumps, open pit and 1989 tailings footprint are not in scope, nor are the distribution of social benefits during the mine’s operation.

This means that issues that may be of particular importance to an individual or community which arose prior to 1989, are not directly connected to an environmental impact post-1989, or are not acute in the context of the Legacy Impact Assessment cannot be formally assessed here. Where this is the case, the issue has been discussed in this chapter to demonstrate that concerns have been heard, considered and communicated to the Parties.

Concerns that are not supported by information gathered during Phase 1

While people and communities hold strong views on how the Panguna Mine has impacted them, there are a range of situations where the results from Phase 1 provide evidence for alternative scenarios.

8.1 WHOLE OF STUDY AREA

This section largely discusses those issues which apply across the study area that are outside the Scope of Work and focus of Phase 1 and therefore cannot be carried into formal assessment. Table 8.1 discusses these in more detail. No concerns that are not supported by information gathered during Phase 1 have been identified that apply across the study area. Where a community concern has been discussed in Table 8.1 as applying across the study area this has not been repeated in the subsequent tables specific to each domain.

Table 8.1 Community concerns raised – whole of study area

Community concern	Discussion	In scope?
The conflict, which was inextricably linked to the environmental and social impacts of the mine.	While sensitive to the conflict and the enduring impacts that this has caused, the Legacy Impact Assessment cannot address impacts to people arising from the conflict.	No.
Communities surveyed commonly reported that mine-related activities had destroyed sacred sites.	<p>Sacred sites in the Mine Domain were destroyed during construction of Panguna Mine to develop infrastructure, such as the open pit, waste rock dumps and processing plant.</p> <p>In the River System and Delta domains, communities reported that mine-related activities, including the deposition of mine tailings in the Kawerong-Jaba River system and flooding, had destroyed or put the sacred sites at risk.</p> <p>In the Port and Town Domain, impacts to sacred sites were identified in the Complaint for a site within the Aneva River (known locally as Dodoko Creek), and on land where the Loloho Port is situated.</p> <p>Notwithstanding the enduring effect of the loss of sacred sites, the majority of these sites were damaged or destroyed prior to 1989.</p> <p>Sacred sites that have been damaged or destroyed since 1989 that are associated with new areas of physical disturbance have been assessed.</p>	Yes, for areas of new physical disturbance post-1989.
Land boundaries and landownership, including villages relocated by BCL and impacts associated with flooding.	Comprehensive social mapping and landowner identification studies for the purposes of determining customary rights, land boundaries and land ownership is explicitly out of scope for Phase 1.	No.

Community concern	Discussion	In scope?
<p>Enduring issues associated with resettlement for the establishment of the mine. These include but were not limited to:</p> <ul style="list-style-type: none"> • Land issues, such as security of tenure, and the poor quality of land, and poor availability of land. • Community identity issues, such as connection to customary land, and the dispersion of communities and subsequent loss of social capital and ties following resettlement. 	<p>While recognising that formal resettlement has affected a range of social attributes and contributes to ongoing community concerns, resettlement of these villages occurred prior to 1989 and concerns relating to formal resettlement are explicitly excluded from the Scope of Work.</p>	<p>No.</p>
<p>Health effects of the mine. The Complaint describes poor general health, skin diseases, respiratory problems, gastrointestinal problems, women's health and malaria.</p>	<p>The Phase 1 Human Health Risk Assessment focussed on mine-related contamination in environmental media (soil, water, dust) and food and the resultant exposure risk to people from this. The Scope of Work for Phase 1 did not include any invasive sampling of people or medical examinations and available data on health conditions in the communities maintained by the health centres and hospitals is very limited.</p> <p>The health risks identified in Phase 1 are outlined in the report. However, no health impacts could be determined based on the information available as part of Phase 1. Many of the health concerns reported are common elsewhere in PNG and are influenced by numerous factors such as poverty, malnutrition, overcrowding, immunisation rates and health service availability. Further investigation would be needed to investigate areas of possible health risk.</p>	<p>Yes, focussed on mine-related contamination. No for other aspects.</p>
<p>Mental health impacts associated with not knowing if the environment is safe was raised by some community members during field investigations and highlighted in the Complaint.</p>	<p>Mental health impacts were not assessed as part of the Phase 1 investigations. The focus of Phase 1 was to better understand community safety and health risks associated with mine contamination.</p>	<p>No. However, the report provides information that will help improve understanding of uncertainties associated with the environment.</p>
<p>Health effects of ASM, including the use of mercury for processing were raised by some community members during field investigations.</p>	<p>The use of mercury by artisanal miners and associated health risk is not directly connected to the environmental impacts of the mine. Literature supports that ASM use of mercury can pose a health risk. During the field investigations mercury was reported in garden soils below the residential in agricultural setting screening criteria in each of the domains apart from the Delta Domain. Mercury was also observed in ASM tailing samples (again below the screening criteria) and in some of the industrial areas of the Mine Domain (below the agricultural screening criteria). It was not observed in water samples. Mercury levels were elevated above the market basket survey control database maximum ranges in plant-based foods in three villages (Moroni, Pirurari and Barako). There was also one food standard exceedance of mercury reported. The evaluation of dietary consumption and contaminant intake in foods in the low altitude coastal area indicated the intakes of methylmercury in aquatic meats as a possible health risk for children in coastal communities. However, the total mercury concentrations measured in the aquatic foods sampled as part of Phase 1 were relatively low and were well below the food standards.</p>	<p>No.</p>

Community concern	Discussion	In scope?
Environmental impacts of ASM. The Complaint stated that a number of residents interviewed noted the recent appearance of new brown sedimentation into the rivers which they described as resulting from ASM.	<p>Some people have migrated to the study area to conduct ASM, others say their diminished gardening capacity is a reason why they conduct ASM (by and large ASM is undertaken in upper and mid tailings, upper mine and lower mine sub-domain areas). In these areas the diminished gardening capacity is largely due to physical impacts of the mine that are pre-1989, e.g., loss of customary lands used for gardening due to mine, waste rock dump, tailings and associated infrastructure. ASM is not directly connected to a post-1989 environmental impact and therefore it is out of scope.</p> <p>Environmental impacts associated with ASM are not mine-related and therefore outside the Scope of Work. However, where ASM has had an influence on water quality this has been noted but cannot be quantified.</p> <p>Additionally, in some areas it is not possible to separate the ASM-related environmental impacts to the mine-related impacts. In these situations, the observed impacts to the environment are assessed and the potential contribution of ASM are noted.</p>	No.
Impacts to freshwater and marine ecosystems and resource use.	Studies to specifically investigate the freshwater and marine environment were excluded from the Phase 1 Scope of Work. This means that the characterisation and evaluation of the freshwater and marine environment was based on limited water, sediment and food samples and not ecology surveys of these environments. Impacts to resource use have been assessed based on this information.	Partially.
In-migration and over-population.	Population estimates derived for Phase 1 show there has been a substantive population increase in the study area. The main reasons people provided for relocating into the study area were marriage, ASM, family connections and employment opportunities unrelated to ASM. As these are not directly connected to the environmental impacts of the mine post-1989, impacts associated with them are not in scope.	No.

8.2 MINE DOMAIN

8.2.1 Scope of Work and focus limitations of Phase 1

Table 8.2 lists community concerns raised which apply in the Mine Domain and discusses those that are outside the Scope of Work and focus of Phase 1 and therefore cannot be carried into formal assessment. It also identifies those that have been carried into formal assessment in the following chapters.

Table 8.2 Community concerns raised – Mine Domain

Community concern	Discussion	In scope?
Landslides were identified as an environmental hazard in Dapera and Pirurari.	<p>Landslides were attributed by participants to clearing of land during mine construction and operation, along with impacts associated with dynamite use. These impacts to land quality are related to environmental effects prior to 1989.</p> <p>The geotechnical hazard associated with a potential large-scale landslide due to slope instability associated with the road near Pirurari has been assessed.</p>	Yes.
Communities in the Mine Domain reported injuries from ASM activities in an area of the open pit where they were actively working.	The Investigation Report: Geotechnical (Appendix C) identified areas of ASM excavation within the open pit as a high risk geotechnical hazard; however, this risk is driven by ASM activity in both areas, not mine-related infrastructure or activities.	No.

Community concern	Discussion	In scope?
Fatalities from tunnel collapse were reported in an ASM area on the Port to Mine Access Road.	The Investigation Report: Geotechnical (Appendix C) identified an area on the Port to Mine Access Road as an extreme landslide hazard risk. Within this area there is significant ASM disturbance and tunnelling, where past fatalities were reported. The risk of ASM tunnel collapse in this area is driven by ASM disturbances, and not mine-related infrastructure or activities. The risk of slope failure at this location has been assessed as there is partial contribution from both ASM and slope instability associated the Port to Mine Access Road.	Yes.
Rockfall and stability hazards within the open pit.	This has been assessed as acute areas of geotechnical hazard are in scope.	Yes.
Enduring issues from resettlement were raised in Dapera specifically related to the poor quality of land and poor availability of land.	Impacts to land quality in the Mine Domain have been assessed as they relate to ongoing contamination by the mine, e.g., gardens on waste rock in Dapera. The resettlement itself is out of scope as described in Section 8.1.	Yes, as they relate to ongoing contamination.
Communities in the Mine Domain reported that the establishment of the Panguna Mine affected the availability and quality of gardening land.	Construction and operation of Panguna Mine resulted in large areas of land becoming unsuitable for gardening, as the land was developed and used for mine-related infrastructure and activities. These impacts occurred pre-1989.	No.
Communities raised concerns regarding the loss of riverine resources in the Kawerong River.	<p>The Kawerong River was fundamentally altered during the construction and operation of Panguna Mine, including construction of the Northern Diversion Channel. These activities resulted in the loss of customary habits and rights related to fishing in and general use of and enjoyment of rivers.</p> <p>The ongoing levels of sedimentation in the Kawerong River is likely a result of ASM activities near the headwaters of the river and throughout mine area.</p> <p>Impacts possibly associated with ongoing poor water quality in the Kawerong River have been assessed as ongoing contamination from the mine is in scope.</p>	Yes, as they relate to ongoing contamination.
Communities reported concerns about the effects of mine related contamination on their health, including exposure to contaminated water, food, and soil.	This has been assessed as ongoing contamination from the mine is in scope.	Yes.
Some community members raised concerns about the health effects of ASM, including the use of mercury for processing.	<p>The Investigation Report: Human Health Risk Assessment (Appendix G) reported elevated mercury levels in plant-based foods in Moroni and Pirurari, possibly associated with ASM activities.</p> <p>Notwithstanding the potentially serious nature of mercury use, no mine-related source of mercury was identified during Phase 1 despite extensive testing for it.</p>	No.
Communities raised concerns that their drinking water sources were contaminated by mine-related chemicals.	This has been assessed as ongoing contamination from the mine is in scope.	Yes.

8.2.2 Concerns that are not supported by information gathered during Phase 1

Table 8.3 lists community concerns raised in the Mine Domain that are not supported by information gathered during Phase 1 that therefore cannot be carried into formal assessment.

Table 8.3 Concerns compared with information gathered during Phase 1 – Mine Domain

Community concern	Discussion
<p>Dapera and Pirurari community members reported flooding as a community hazard.</p>	<p>The diversion channel around the relocated Dapera village is in good condition and there is little sedimentation in the channel that would reduce conveyance capacity. The 2023 aerial imagery shows that the high-water lines in the channel are about one-quarter the way up from the channel bed. The DEM indicates that Dapera is at least 15 m higher than the channel, and the channel would overtop to the south and not to the north. The channel poses no flooding risk to Dapera.</p> <p>Most houses in Pirurari are built uphill of the road, but there are a few miners' huts on the lower elevation floodplain. These huts were not there in 1989. The houses along the road are about 10 m higher than the channel. There is a relatively large drainage basin uphill (southeast) of the village that is not mine-impacted and there has been no significant change in the land use within it that would increase flooding.</p>
<p>Communities reported the loss of bush resources, including timbers, affecting their ability to build houses.</p>	<p>The Panguna Mine site was developed in Montane Rainforest which inevitably involved large scale vegetation clearing and habitat loss. This would have reduced bush resources available for local people at this time. There is no credible mine-related source for ongoing loss of Montane Rainforest since 1989 and therefore impacts to this vegetation community were not formally assessed in the environmental impact assessment. Impacts are readily attributable to population increase and associated reduction in availability of bush resources.</p>
<p>Communities raised concerns regarding contamination in dust from mine-related areas.</p>	<p>Dust samples were collected from one monitoring location in Moroni. However, due to vandalism of a second monitoring location and some samples not being able to be analysed due to high rainfall conditions, the data was not sufficient to inform the Legacy Impact Assessment.</p> <p>Additional dust samples are required to understand dust levels and composition (see Chapter 13).</p>
<p>Communities reported the loss of bush resources, including the loss of animals that were people's primary protein source, such as cuscus and bush kangaroo.</p>	<p>There is no credible mine-related source for ongoing loss of Montane Rainforest since 1989 and therefore impacts to this habitat were not formally assessed in the environmental impact assessment. Impacts are readily attributable to population increase and associated reduction in availability of bush resources.</p>

8.3 RIVER SYSTEM DOMAIN

8.3.1 Scope of Work and focus limitations of Phase 1

Table 8.4 lists community concerns raised which apply in the River System Domain and discusses those that are outside the Scope of Work and focus of Phase 1 and therefore cannot be carried into formal assessment. It also identifies those that have been carried into formal assessment in the following chapters.

Table 8.4 Community concerns raised – River System Domain

Community concern	Discussion	In scope?
<p>Hazardous river crossings were raised in the Complaint and during field investigations. Communities reported that areas of quicksand make crossing the river hazardous, particularly during flooding. Similarly, there are areas where waters are either too deep or fast (or both) to cross safely during high flow events.</p>	<p>The hazards associated with changes in river conditions and the movement of sediment since 1989 have been assessed as they are associated with an ongoing environmental impact.</p> <p>Changed access during high flow events such as floods has also been assessed as it is associated with an ongoing environmental impact.</p>	<p>Yes.</p>
<p>Concerns about the safety of mine-related infrastructure such as the levee and its potential failure have been reported in the Complaint and raised by communities during the field investigation.</p>	<p>Potential impacts relating to failure of mine-related infrastructure have been assessed as they are an ongoing acute hazard. The potential flow-on effect from geotechnical failure to community access to infrastructure and services has also been assessed.</p>	<p>Yes.</p>
<p>Flooding and destruction of land were raised in the Complaint. Communities along the Jaba and Kawerong rivers expressed concerns about the effects of flooding, causing landlessness and eroded land boundaries, and in turn, leading to social tensions between landowners.</p>	<p>The impacts of flooding and the destruction of land have been assessed as it is associated with an ongoing environmental impact. Regarding riverine disposal of tailings, environmental impacts from changes in the spatial distribution of tailings since 1989 and the associated flooding regime are in scope.</p> <p>Similarly, the effects of flooding on social ties within and between people (social capital) have been assessed. However, consideration of land boundaries and landownership is explicitly out of scope for Phase 1.</p>	<p>Partially.</p>
<p>Flooding restricts community access to and from their village, and limits people's access to health and education services. This concern was raised in the Complaint and during field investigations.</p>	<p>Regarding riverine disposal of tailings, environmental impacts from changes in the spatial distribution of tailings since 1989 and the associated flooding regime are in scope. High flow events, including floods, make river crossing hazardous and affects access to community infrastructure and services. The overall social effect of this has been identified and assessed for communities where a community does not have access to a bridge to enable safe crossing as it is associated with an ongoing environmental impact.</p>	<p>Yes.</p>
<p>Flooding and destruction of resource areas were raised in the Complaint and during field investigations. Communities reported the loss of bush resources, including timbers, affecting their ability to build houses, and access the area for other livelihood purposes.</p>	<p>Regarding riverine disposal of tailings, environmental impacts from changes in the spatial distribution of tailings since 1989 and the associated flooding regime are in scope. Impacts of flooding on resource use, including areas such as the Konaviru Wetland, have been assessed as they are associated with an ongoing environmental impact.</p>	<p>Yes.</p>
<p>Flooding impacts on land availability/productivity for gardening and cash cropping were raised in the Complaint and field investigations.</p>	<p>Regarding riverine disposal of tailings, environmental impacts from changes in the spatial distribution of tailings since 1989 and the associated flooding regime are in scope. Effects to gardening and cash cropping, and in turn food security and livelihoods have been assessed as they are associated with an ongoing environmental impact.</p>	<p>Yes.</p>
<p>Pollution in the Kawerong-Jaba River system was raised in the Complaint, as well as during field investigations. Communities attributed the absence of fish and aquatic life in the river system to contaminated water as a result of mine-related activities.</p>	<p>Effects due to ongoing impacts to aquatic life and fishing in the Kawerong-Jaba River system, and in turn livelihoods and food security have been assessed as ongoing contamination is within scope.</p>	<p>Yes.</p>

Community concern	Discussion	In scope?
Contamination from tailings impacting the quantity and quality of food was raised in the Complaint and during field investigations.	The deposition of tailings during mining had a substantial effect on gardening land. Mineralised contamination associated with tailings has continued to effect the productivity of gardening land. The effect of this on livelihoods and food security has been assessed as ongoing contamination is within scope.	Yes.
Health effects from mine-related contamination were raised in the Complaint and during field investigations. Communities reported concerns about the effects of mine related contamination on their health, including exposure to contaminated water, food, soil and dust.	Health risks from mine-related contamination of land and water have been assessed. Two different types of contamination have occurred in areas of the River System Domain: mineralised contamination associated with tailings deposition and waste rock drainage, and non-mineralised contamination in small areas associated with mine-related infrastructure. No exceedances of the adopted drinking water criteria were detected in drinking water samples collected from River System Domain communities. Some communities reported that they use water from the Kawerong-Jaba River for consumption during the dry season and as such the health risks associated with this have been assessed as ongoing contamination is within scope.	Yes.
Lack of access to clean drinking water was raised in the Complaint and during field investigations. Communities living along the Jaba and Kawerong rivers expressed concerns about the effects of flooding on drinking water security.	Impacts to water security as a result of mine-related impacts to flooding regimes have been assessed as they are related to an ongoing environmental impact. Water security issues were identified for communities along Kuneka Creek, Pagana River and Tun Creek.	Yes.

8.3.2 Concerns that are not supported by information gathered during Phase 1

Table 8.5 lists community concerns raised in the River System Domain that are not supported by information gathered during Phase 1 that therefore cannot be carried into formal assessment.

Table 8.5 Concerns compared with information gathered during Phase 1 – River System Domain

Community concern	Discussion
Health effects from mine-related contamination were raised in the Complaint and during field investigations. Communities reported concerns about the effects of mine related contamination on their health, including exposure to contaminated water, food and soil.	No exceedances of the adopted drinking water criteria were detected in drinking water samples collected from River System Domain communities. However, drinking water collected from the Kawerong-Jaba River during the dry season or periods of extended drought may exceed the adopted drinking water criteria. No exceedances of the residential setting direct contact pathway criteria were detected in soil samples collected from the River System Domain communities. Eight of 62 food samples analysed exceeded the food standard screening criteria for one or more metals/metalloids in the River System Domain.
Communities on the north side of the Kawerong-Jaba River in the River System Domain (e.g., Konuku) reported impacts due to flooding caused by the mine, which affects cash cropping areas, gardening areas and water sources.	Villages on the north side of the Kawerong-Jaba River in the River System Domain are generally situated along the margins of the 1989 maximum extent of tailings deposition. This maximum extent of tailings deposition in this area logically follows the maximum extent of flooding in 1989. While still a braided river system, the main flow channel of the Jaba River has typically retreated to the south since 1989. This means that some of these villages are now distant to the Jaba River, such as Maton (500 m away) and Konuku (800 m away). Analysis of 2023 aerial imagery and flood modelling of the conservative 1-in-100 year flood event shows that villages on the north of the Jaba River are not inundated by flooding from the Jaba River. Several villages are located adjacent to flooded areas, including Gold Miners, Toku, Pem'ana and Katauli, and these areas were also adjacent to flooding in 1989. This means that there has been no change in flooding extent for villages north of the Jaba River since 1989 associated with mine-related changes to the environment.

Community concern	Discussion
Communities raised concerns regarding contamination in dust from mine-related areas.	Dust samples were collected from two monitoring locations in Gold Miners Camp and Pem'ana. However, due to vandalism of a third monitoring location and some samples not being able to be analysed due to high rainfall conditions, the data was not sufficient to inform the Legacy Impact Assessment. Additional dust samples are required to understand dust levels and composition (see Chapter 13).

8.4 DELTA DOMAIN

8.4.1 Scope of Work and focus limitations for Phase 1

Table 8.6 lists community concerns raised which apply in the Delta Domain and discusses those that are outside the Scope of Work and focus of Phase 1 and therefore cannot be carried into formal assessment. It also identifies those that have been carried into formal assessment in the following chapters.

Table 8.6 Community concerns raised – Delta Domain

Community concern	Discussion	In scope?
Flooding restricts community access to and from their village, and limits people's access to health and education services. This concern was raised in the Complaint and during field investigations.	Regarding riverine disposal of tailings, environmental impacts from changes in the spatial distribution of tailings since 1989 and the associated flooding regime are in scope. This has been assessed as it is associated with an ongoing environmental impact.	Yes.
Flooding impacts on land availability/productivity for gardening and cash cropping were raised in the Complaint and field investigations.	Regarding riverine disposal of tailings, environmental impacts from changes in the spatial distribution of tailings since 1989 and the associated flooding regime are in scope. This has been assessed as it is associated with an ongoing environmental impact.	Yes.
Communities reported that the absence of fish and aquatic life in the river system was due to contaminated water from mine-related activities.	This has been assessed as it is associated with an ongoing environmental impact.	Yes.
Communities raised concerns relating to reductions in fish stock in Empress Augusta Bay and loss of reefs due to mine-related activities.	Marine investigations were excluded from the Scope of Work for Phase 1 and only limited sampling of the marine environment was conducted. Nevertheless, this has been assessed using available information as it may relate to an ongoing environmental impact.	Yes.
Health effects from mine-related contamination were raised in the Complaint and during field investigations. Communities reported concerns about the effects of mine related contamination on their health, including exposure to contaminated water and soil.	This has been assessed as it is associated with an ongoing environmental impact.	Yes.
Health effects from consumption of fish contaminated by mine-related chemicals.	This has been assessed as it may relate to an ongoing environmental impact.	Yes.
Communities raised concerns regarding the impact of flooding on access to water during field investigations. Concerns related to access to water for drinking, laundering and sanitation.	Regarding riverine disposal of tailings, environmental impacts from changes in the spatial distribution of tailing since 1989 and the associated flooding regime are in scope. This has been assessed as it is associated with an ongoing environmental impact.	Yes.
Communities raised community safety concerns regarding the presence of crocodiles in watercourses near villages.	Studies to specifically investigate the freshwater and marine environment were excluded from the Phase 1 Scope of Work. This means that ecology surveys of the freshwater and marine environments were not undertaken.	No.

8.5 PORT AND TOWN DOMAIN

8.5.1 Scope of Work and focus limitations of Phase 1

Table 8.7 lists community concerns raised which apply in the Port and Town Domain and discusses those that are outside the Scope of Work and focus of Phase 1 and therefore cannot be carried into formal assessment. It also identifies those that have been carried into formal assessment in the following chapters.

Table 8.7 Community concerns raised – Port and Town Domain

Community concern	Discussion	In scope?
Landslides were the most common environmental hazard identified by communities in the Port and Town Domain.	Landslides in this domain, as reported by the community, primarily occur in the slopes to the west of the Loloho Road, particularly during the rainy season. These landslides were reported to affect gardening, which is also undertaken on these slopes. Landslide risk in the Port and Town Domain was not a focus of Phase 1; the Investigation Report: Geotechnical (Appendix C) did not target this area in Phase 1 because it focussed on areas of greatest risk in the Mine and River System domains. Further work would be required to assess landslide risk in the Port and Town Domain.	No.
Acute hazards associated with historic chemical storage facilities. Some sites were also reported to generate smells, particularly when it rains.	This has been assessed as they are an ongoing acute hazard.	Yes.
Land availability for gardening.	This has been assessed as it relates to ongoing and potential contamination.	Yes.
Contamination of gardening land from mine-related infrastructure and historic chemical storage has caused or contributed to poor yields and plant growth.	This has been assessed as ongoing contamination is within scope.	Yes.
Health impacts due to exposure to contaminated food and soil.	This has been assessed as ongoing contamination is within scope.	Yes.
Contamination of marine water in Arawa Bay by mine-related chemicals, and related impacts to human health, including women's reproductive health.	Marine investigations were excluded from the Scope of Work for Phase 1 and only limited sampling of the marine environment was conducted. Nevertheless, this has been assessed as ongoing contamination is within scope.	Yes.
Arawa drinking water supply	The legacy infrastructure in Arawa town was not a focus of Phase 1. This includes aspects such as housing, water and power supply	No.
The Complaint states that diversion of the Dodoko River reduced aquatic resources in the river including prawns, fish and crabs.	Diversion of the Dodoko River occurred prior to 1989 and therefore impacts associated with the diversion are not in scope.	No.
Reductions in fish stock in Anewa Bay due to mine-related contamination.	Marine investigations were excluded from the Scope of Work for Phase 1 and only limited sampling of the marine environment was conducted. Nevertheless, and as noted above, contaminants in samples collected in Anewa Bay during Phase 1 are not at concentrations expected to lead to changes in fish stock.	No.

Community concern	Discussion	In scope?
Health effects from consumption of fish contaminated by mine-related chemicals.	Marine investigations were excluded from the Scope of Work for Phase 1 and only limited sampling of the marine environment was conducted. As detailed in the Investigation Report: Human Health Risk Assessment (Appendix G), marine fish collected from Anewa Bay were below the adopted health screening criteria. However, only a small number of fish were collected and tested. Further sampling would expand the dataset related to this.	No.
Nightmares due to consumption of fish contaminated by mine-related chemicals.	There is no plausible connection between the mine-related contaminants in this area and dream disturbance or hallucinations. A possible explanation of the nightmares may be Ciguatera fish poisoning ¹ .	No.

8.5.2 Concerns that are not supported by information gathered during Phase 1

Table 8.8 lists community concerns raised in the Port and Town Domain that are not supported by information gathered during Phase 1 that therefore cannot be carried into formal assessment.

Table 8.8 Concerns compared with information gathered during Phase 1 – Port and Town Domain

Community concern	Discussion
The Complaint notes that communities attribute flooding of food gardens to the diversion of the Pinei River during the construction of the Port to Mine Access Road, which has resulted in ongoing impacts to food security.	<p>The Investigation Report: Hydrology and Fluvial Geomorphology (Appendix D) did not identify any hydrological changes or flooding of the Pinei River attributable to the Panguna Mine since 1989. Environmental impacts associated with the physical changes that occurred as a result of construction and operation of the mine up until 1989 are not in scope. Locations of flooding nominated by the communities were investigated as follows:</p> <ul style="list-style-type: none"> Near the Metonai Vocational School, where flooding is consistent with natural riverine processes. Areas near Rorovana 2, where nuisance flooding occurs at blocked road culverts that convey runoff from the steeper ground to the east of Rorovana 2. These flooding locations are not hydraulically connected to the Pinei River and therefore have no hydraulic connection to the Panguna Mine. General flooding near Rorovana 2 where flooding is associated with a lagoon that is fed by the connection channel and a series of small creeks. There is a weak flow connection between the Pinei River and the lagoon but no mine-related impacts to the Pinei River since 1989 were identified.

¹ Nightmares and hallucinations have been linked to ciguatera fish poisoning, although ciguatera incidence is reported to very low in Papua New Guinea, cases occur intermittently (Dalzell 1994). Ciguatera poisoning is a naturally occurring process that is caused by a poison produced by small organisms (dinoflagellates) that get consumed by marine finfish along with algae, which are then eaten by humans.

Community concern	Discussion
<p>The Complaint states that silt build-up during the operation of the mine continues to effect marine fish stocks at the mouth of the Pinei River.</p>	<p>Substantial earthworks in the headwaters of the Pinei Valley caused heavy sedimentation in the river during the mine’s construction and operation, with an estimated 13 Mt of volcanic ash and weathered material side-cast into the upper reaches of the river. Concerns about the effect of sedimentation buildup affecting fishing in areas close to the mouth of the Pinei River were raised prior to 1989. BCL paid compensation for these impacts.</p> <p>Although heavily impacted the Pinei River recovered relatively quickly. Regular monitoring of fish populations was undertaken, with post-construction recovery of the Pinei River documented by 1985 and fish assemblages (diversity and biomass) comparable to reference sites prior to the cessation of mining in 1989. It was concluded that fish stocks in the river and marine area had returned to normal levels, and compensation ceased in 1984 based on a decision undertaken by the independent Warden’s Court process (Minenco 1996).</p> <p>It was therefore inferred that construction of the Port to Mine Access Road had only a minor, short-term effect on fish populations of the Pinei River. This was disputed by the people of Rorovana and was raised as a continued matter of dispute in 1989 by AGA (1989).</p> <p>No evidence was found during Phase 1 to indicate that the ecological condition of the Pinei River has been further impacted by this mine-related construction activity after 1989. Therefore, there is no credible impact to aquatic ecology in the Pinei River to be assessed associated with construction of the Port to Mine Access Road and subsequent sedimentation or metal contamination.</p> <p>Environmental impacts associated with the physical changes that occurred from construction and operation of the mine up until 1989 are not in scope. This includes the build-up of silt which may have occurred during operation of the mine which, as noted above, was determined to no longer be impacting fish stocks in the mid-1980s, some forty years ago.</p> <p>ASM has occurred and reports indicate that this likely persists in the Pinei River headwaters. Increased turbidity, suspended solids concentrations and chemical spills from this activity have the potential to adversely affect the aquatic ecological condition of the Pinei River, resulting in deterioration from 1989 to the present.</p> <p>As only social impacts directly connected to an environmental impact of the Panguna Mine persisting or occurring since 1989 are within the scope of this assessment, this impact has not been assessed further.</p>
<p>Contamination of marine water in Anewa Bay by mine-related chemicals, and related impacts to human health, including women’s reproductive health.</p>	<p>Marine water samples collected from Anewa Bay were below the adopted health screening criteria, indicating that the health risks are low. No exceedances of the adopted health food standards were detected in marine fish samples collected.</p> <p>However, only a small number of marine water samples and fish were collected and tested. Further sampling would expand the dataset related to this.</p>
<p>Contamination of Rorovana 3 drinking water source by mine-related chemicals.</p>	<p>Drinking water samples collected from Rorovana 3 and other water sources in the domain, including the Pinei River, were below the adopted health screening criteria.</p>

8.6 CONCLUSION

The discussion in sections 8.1 to 8.5 demonstrates there are a range of community concerns that cannot be carried into formal assessment. Many of these relate to concerns regarding the original establishment of the Panguna Mine, which are outside the Scope of Work for Phase 1 of the Legacy Impact Assessment. Notwithstanding this, the environmental, social and human rights impact assessments that follow in Volume II, Part B Impact Assessments focus on the most serious known likely impact areas for local communities, and the identification of potentially affected communities as identified in the Complaint. Table 8.9 lists these key issues in the Complaint to set the scene for the following impact assessments.

Table 8.9 Focus of impact assessments and key issues in Complaint

Key issue in Complaint	Carried to formal assessment?
Polluted rivers	Yes
Treacherous river crossings	Yes
Lack of access to clean water	Yes
Flooding and destruction of land and sacred sites	Yes, where impacts to sacred sites are limited to those that have occurred since 1989.
Landslides and collapsing levees	Yes
Food shortages	Yes
Disease and illness	Partially, noting Phase 1 comprised a human health screening assessment, and that invasive sampling (e.g., anthropomorphic measurements, blood, tissue and hair sampling) was excluded from the Scope of Work. This limits the degree to which disease and illness can be assessed.
Human rights <ul style="list-style-type: none"> • Right to life • Right to health • Right to water • Cultural rights • Rights of women and girls • Childrens' rights 	Yes, and including other internationally recognised human rights.