Solomon Islands Resources Company Limited.

Environment Impact Statement Report

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ACRONYMS

AP	Affected Person
ACOM	Anglican Church of Melanisia
AIDS	Acquired Immuno Deficiency Syndrome
BMP	Building Materials Permit
CITES	Convention on International Trade on Endangered Species
CLO	Community Liaison Officer
ECD	Environment Conservation Division
EFO	Exportable Fine Ore
EIA	Environment Impact Assessment
EIS	Environment Impact Statement
EMP	Environment Management Plan
ESIA	Environment Social Impact Assessment
ESO	Environment Safety Officer
ETO	Exportable Transit Ore
GRM	Grievance Redress Mechanism
HIV	Human Immuno Virus
IUCN	International Union for Conservation of Nature
MD	Mine's Division
MECDM	Ministry of Environment, Climate Change, Disaster Management and Meteorology
MIA	Mining Area of Influence
MID	Ministry of Infrastructure Development
ML	Mining License
MMERE	Ministry of Mines Energy Rural Electrification
NAPA	National Adaptation Plan of Action
NDS	National Development Strategy
NEMS	National Environment Management Strategy
NWMPCS	Waste Management and Pollution Control Strategy
PER	Public Environment Report
PGA	Provincial Government Act
PL	Prospecting License
RSIPF	Royal Solomon Islands Police Force
SIG	Solomon Islands Government
SINDS	Solomon Islands National Development Strategy 2011-2020
SIRC	Solomon Islands Resources Company
SMM	Tsumitomo Metal Mining
SOP	Standard Operating Procedures
UXO	Unexploded Ordinance
WHO	World Health Organisation

NON TECHNICAL SUMMARY

E 1. Location

The proposed mining tenement area is located south east of Isabel Island in the Takata area, east of San Jorge Island. It is the current Solomon Islands Resource Company (SIRC)'s Prospecting License (PL) area. The coordinates are supplied in the table below.

Points	X coordinates	Y coordinates
0	581743.427591	9071868.80605
1	583016.416784	9070932.76999
2	580480.85317	9066768.96543
3	578147.840318	9065578.92533
4	576074.383946	9067909.76394
5	581743.427591	9071868.80605

E 2. The Mining Project

SIRC acquired its business license to operate in the Solomon Islands in 2018. SIRC interest is to mine the Takata laterite nickel deposits. In early 2019, the company was granted prospecting license to further explore the deposit in Takata. Takata area was subjected to prospecting by Axiom Mining Limited in 2015, Solex in the1980s and INCO. Prospecting Company in the 1960s. The initial and corresponding SIRC prospecting findings of the Takata nickel deposits were considered to be economically viable. These have increased investment confidence among SIRC shareholders to pursue mining application for the tenement.

The proposed mining lease area covers an area of approximately 19.7 square kilometer in size currently held under a Prospecting License (PL 02/19).

E 3. Basis for Environmental and Social Impact Assessment

Following requirements of the Mines and Minerals Act and Environmental Act 1998, SIRC is required to prepare an Environmental Impact Statement (EIS) Report as part of the company's application for the mining lease/agreement. Mining is classified under Non Metallic industries in the second schedule of the Environment Act 1998. EIS are undertaken for activities that are likely to have significant impact on the environment and are subjected to decision of the national authority, the Environment Conservation Division (ECD) under the Ministry of Environment, Climate Change, Disaster Management and Meteorology (MECDM). The EIS will be approved by the Director ECD who will then issue a development consent for the mining project to proceed.

E 4. Analysis of Alternatives

The mining methodology for extraction of the ore is an open cut strip mining. This method normally used when the minerals are found over a large area and relatively close to the surface. Since, the Saprolitic layer where nickel can be found extend 10-12m below the ground surface, vertical extraction would require an open cut strip mining as the feasible option. The mining here at Takata will not involve processing of the ores since the economic viability for establishing such plant is uneconomical at this stage. All ores will be transported offshore for processing. Offshore processing reduces further impacts to the environment.

The Takata area had been investigated over sometime now and the results indicate majority of the ores are located on the ridges and hills. As a result there is no option for alternative locations but to mine potential sites identified to have ore deposits. Open cut strip mining requires removal and stockpile of top soils and the limolitic layer.

The company will build and upgrade existing roads to access deposits and site relevant to the mining operations. The current wharf facility is shallow and restrict movements due to offshore reefs. The port area would only allow landing craft with minimum load capacity. All ores will be loaded into a landing craft which will then be trans-loaded to larger vessels. Decking of ships at the current facility is restricted and not allowed.

The no mining alternatives eliminates all benefits from the mining to the SIG, province and landowners. It is important to consider the positive benefits of the mining and consider collective efforts to avoid the potential negative environmental and social effects.

E 5. Baseline Conditions

This section discusses the environment baseline of the proposed Takata Tenement Area. The baseline information are based on literature review and on site field work in June 2019. The objective of the environmental social baseline is to assess the present state of the environmental conditions in the tenement area, and to provide a basis for evaluating environmental social impacts and issues related to mining construction, operations, decommissioning and rehabilitation.

E.5.1 Physical Environment

The proposed mining tenement area partially cuts through two physiographic regions, the San Jorge Saikile and Mbughotu regions. The Mbughotu peninsula facing east is mostly underlain by pyroclastic rocks and lavas of basaltic composition forming sharp topped hills and ridges. The San Jorge –Saikile region comprise the San Jorge Island and mainland area directly east of the San Jorge. This region consists of distinctive low, rounded hills, radial ridges of low amplitude, terraces and swamps. According to Hansel and Wall the soil in the area are unsuitable for agriculture purpose because it contain high levels of heavy metal, notably chromium, nickel and to the extent accumulation magnesium to levels of 18% in derived alluvial soil.

Average annual rainfall ranges from 3,500 mm in low areas, to more than 6,000 mm on the mountain peaks, with most areas receiving around 4,000 mm. Isabel has not been severely affected by natural disasters in the last 30 years. The island fairly lies on a cyclonic region and is a seismically active area, placing it at risk to natural disasters such as earthquakes and cyclones. There are 11 cyclones occurred within 200km from the tenement area in the last 60 years. According to Tsumitomo's weather station in the Lelegia area (IWS01) over 4 years 2008-2012, the minimum temperatures range from 20.39^{0}C to 23.35^{0}C while maximum temperatures ranged from 31.53^{0}C to 35.83^{0}C. According to the monthly rainfall data for Buala station directly north of the tenement area, receives more rainfall between February and December. The data recorded at ISW01 indicates that there is similar trend in rainfall patterns in Isabel. Solomon Islands is geologically located in the ring of fire. The highest occurrence in this area is 6.4 on the Richter scale, at a depth of 29 km, of the Coast of Isabel Island. Air quality is generally excellent in the tenement area and there are no air quality non-attainment areas in the vicinity.

The water quality assessments provide understanding of how diverse the water environment and its link to land use activities. In the absence of national water quality standards, the WHO standards are used as a basis for comparison. The water quality results confirmed changes in water chemistry approaching the ocean and at location expose to runoffs. The causes are both natural and anthropogenic.

E.5.2 Terrestrial Environment (Flora and Fauna)

There are two major vegetation type observed in the tenement area and this include the Lowland Forest and the Ultramafic Forest. The survey has categorized the sites sampled according to habitat types which include old growths and secondary forest, Fernlands (that includes Fern Shrublands, Fern Woodlands, ridge and ridge slopes and valleys of fern areas), ultramafic forest habitats, combination of lowland hilly and ultramafic habitats, Lowland Riparian Forest, mangroves forest habitat, Coastal Fernland and Shrubland, and coastal rocky habitat. The survey confirmed that *Xanthostemon melanoxylon* (Ironwood) is the majority species that occur within the tenement. In most sites the understory and ground level species is mostly composed of *Dicranopterus linearis.* As such it was influenced by the geology of the area (ultrabasic/ultramafic rocks). Hence, limiting the occurrence of other plant species except for an abundance of the ironwood trees. Common species that occurring in the area are recorded and identified.

During the survey, only the frog *Buffo marinus*, millipedes and several bird species were sighted and observed due to limitations of time availability for the survey. No large mammals and reptiles were observed. However, Solomon Islands including Isabel Island are known to have a diverse species of fauna, and endemism within islands is remarkable and distinctive. These are capture in the literature review section of the report.

E.5.3 Aquatic Environment

Inland waterways at Kolosori (Takata) Tenement are very healthy as they are endowed with a diversity of biological life. As was depicted by an abundance of biological life at the two sample sites, it is important to note that the inland waterways in the area requires some sort of protection. The proposed mining operation in the area will need to apply site specific mitigation measures and techniques to ensure the potential negative impacts on the freshwater ecosystem is avoided or should it happen it must be reduced to acceptable level. The presence of diverse fish species and macrocrustacean species only signifies the intactness of the freshwater ecosystem which is important to maintaining life in the area.

E.5.4 Marine Environment

Most of the corals surveyed within the tenement area during the first visit are hard corals which is consistence with the coral survey done by Tsumitomo in 2012. The main hard corals found within the tenement area on the southern end at three different sites are branching, massive and sub-massive growth and these are from the families:

- Acroporidae (Acropora spp.)
- Poritidae (Porites spp.)
- Faviidae (Favia spp.)

Coral families found within three (3) of the sites visited are typical of the coral reef communities in Solomon Islands. Hard corals are common but the soft corals are uncommon especially within the reefs of the tenement area. From the survey through diving and identification of fish Familia, it was discovered that the dominant fish family found within the tenement area are: Pomacentridae (common name: damselfish), Labridae (common name: wrasses), Chaetodontidae (common name: butterflyfish) and Scaridae (common name: parrotfish). This finding is consistence with the survey done by Tsumitomo in 2012.

The hydrodynamic of both at Thousand's Ships bay and Huali Bay have different behaviors. The differences in their physical hydrodynamic behavior is depended entirely on the location, orientation of the bay, coastal structures, depth of each bay, and island barriers of these separate bays. Addition to these factors are the external factors that also contributes to the variation in the behavior of waters within each bay and these are the easterly trade wind, wind stress, tidal variation and climatology.

E.5.4 Social Environment

People within and surrounding the Tenement area including the land and resource owners express support towards the development considering the direct or indirect benefits of the development both in the short and long term. There are also people who have express concern over the environment and social impacts of the mining project. The mining is expected to contribute to the country's economic growth and livelihoods by improving accessibility to market opportunities and economic and social services, as well as generating employment opportunities and income.

E 6. Environment Social Management Plan

	Impact Management				**Impact Monitoring**		
Project activities	**Potential Impacts**	**Mitigation approaches**	**Responsibility**	**Mitigation cost**	**Parameter to monitor**	**Means of verification and frequency**	**Responsibility**
CONSTRUCTION PHASE							
Surveying, demarcation, clearing for mining camp set up, stoke plie areas, workshops and offices.	• Felling of forest and coastal plants causing loss to important plant species and or wild life.	• Minimize clearance to relevant areas of activities; • Unnecessary clearance avoided; • Acquire land clearing permit from the Ministry of Forestry if necessary; • Build campsites on existing space provided by and in agreement with the local community; • ***(Biodiversity Management Manual applies).***	• SIRC	• Part of mining cost	• Area of vegetation; area of felled trees/vegetation removal	• During survey and activities - visual inspection before, during and after	• SIRC
Mobilisation of SIRC company and presence of construction workers	• Poaching of terrestrial and marine fauna, unnecessary felling of trees for cooking.	• SIRC company responsible for information and sanctions regarding harm to wildlife and felling of trees (not requiring to be cleared) • SIRC company to supply sufficient cooking fuel to avoid use of local timber or felling of trees • ***(Biodiversity Management Manual applies)***	SIRC	Part of construction cost	Check for poaching and unnecessary vegetation clearance; Progress of re-vegetation of work areas; Adequate fuel supplies in camp; Training of workers in information	Spot inspections; monthly - visual inspection of camp and work sites; Re-vegetation activities as per EMP; Consultations with villagers and workers	SIRC and ECD
	• Community exposure to campsites Spread of STIs and HIV/AIDS	• Village protocols discussed. Worker awareness as part of mobilization; • Signage and security at camp i.e. prohibition on unauthorised people (esp. Children and women) entering camp;	SIRC	Part of Construction cost	STI/HIV/AIDS prevalence Increased awareness about transmission and prevention	Prior to construction - check SIRC company records, consultation with employees,	SIRC and ECD.

		• Workers to respect village and landowner boundaries • STIs and HIV/AIDS awareness program for workers and villages; • A communications and complaints plan will be used for liaison and correction among stakeholders; • SIRC company to provide health facilities and First Aid post in camps and provide safety equipment for workers; • ***(Health and Safety Manuals applies).***					
	• Increase social disruptions	• SIRC company to ensure worker's actions are controlled and village rules, code of conduct observed; • Educate workers to respect village protocols; • Such that if the situation is beyond the capacity of the community leaders, police will be informed to investigate problem.	SIRC, ECD and RSIPF	Part of construction cost	Complaints of incidents between workers and villagers; No. of children & WOMEN entering camp; Number and effectiveness of signs	During activities - checking records for complaints, consultation with workers about protocols; Issues raised with CLO or ESO	SIRC, ECD and RSIPF
	• Generation of Solid and Sanitary waste impacting coastal and water quality	• Collect and dispose of solid waste regularly at designated dump site; • Install waste collection and temporary storage facilities fully label; • Awareness and educated construction workers on waste management system; • Establish sanitary latrines for workers; • ***(Waste Management Manual applies)***	SIRC	Part of Constructio n cost	Waste management - visual inspection that solid waste is disposed of as per EMP; Provision of sanitary facilities; No direct discharges to local streams or rivers; Regularity of waste removal	Monthly, as required and spot checks - visual inspection; Review of waste management manual	SIRC and ECD
Operation of construction machinery	• Emission of exhaust from vehicles and machinery	• Maintain construction equipment; • Prohibit use of equipment that causes excessive pollution (e.g. generates smoke);	• SIRC	• Inc. in construct ion cost	• Air quality, emissions,	• Weekly or after complaint - periodic visual inspection;	• SIRC

generating emissions		• ***(Traffic Management Manual applies).***				• Any particulate matter and smoke	
	• Dust caused by vehicles running at high velocity	• Thorough watering to avoid dust.	• SIRC	• Inc. in construction cost	• dust, particulate matter; • Use of tarpaulins and loading of vehicles; • Stockpiles.	• Weekly or after complaint - periodic visual inspection	• SIRC
Operation of construction machinery creating noise	• Noise to communities (Riudede)	• Construction machine exhaust systems and noisy equipment will be maintained to minimise noise; • SIRC will develop a schedule of operations with village chiefs to identify days of no work and hours for certain activities; • Limit noisy construction activities to day time hours, i.e. construction activities prohibited between 9pm and 6am; • ***(Health and safety manual applies).***	• SIRC	• Inc. in construction cost	• Adherence to agreed schedule; • Complaints (no. logged with resolution).	• Weekly or after complaint - review schedule • Consultation (ensure schedule being adhered to)	• SIRC • ECD
	• Impacts on construction workers	• Workers limit of exposure to noise will be strictly below 70decibels per 8 hour shift; • Provide workers with noise abatement equipment (ear-muffs etc); • Complaints will be addressed by SIRC company; • ***(Health and safety manual applies).***	• SIRC	• Inc. in construction cost	• Workers safety equipment.	• Weekly • Workers are provided with safety equipment	• SIRC • ECD
Stockpile of Construction Materials or Soil	• Construction materials washed out into coast or water bodies.	• Construction materials will be stockpiled 20m away from coastline or water bodies; • Stockpile areas properly bunded; • Placement of diversion ditches around stockpiles; • ***(Erosion management Manual applies).***	• SIRC	• Inc. in construction cost	• No stockpiling close to water bodies.	• Weekly-Visual Inspection	• SIRC • ECD

	• Dust from exposed stockpiles	• Material stockpiles located in sheltered areas and to be covered	• SIRC	• Inc. in construction cost	• dust, particulate matter; • Stockpile covered.	• Weekly or after complaint - periodic visual inspection	• SIRC
Construction of causeway-wharf, cut and fill activities for the road and stockpile areas, quarrying and construction of campsite/offices.	• Changes to coastal processes as a result of wharf construction.	• Coastal protection to avoid littoral drift effects; • Avoid tipping soil; • Construction works undertaken with extreme care.	• SIRC	• Inc. in construction cost	• Erosion	• Weekly	• SIRC
	• Silt generation	• Construction works especially at the coast or rivers to be undertaken with extreme care; • Use of silt control devices and sediment traps/fences Construction of sediment settling ponds and bunds. Diverting turbid water to sediment settling ponds; • ***(health and safety manual applies) & (health and safety manual applies)& Surface and ground water manuals***	• SIRC	• Include in construction cost	• Reduced soil erosion and sedimentation • Vegetation clearance minimized • No dump sites near waterways	• Weekly - visual inspection •	• SIRC and ECD
	• Accidental release of hydrocarbon from construction machines impacting soil and water and frequent machine exposure to sea or water releases hydrocarbons	• Ensure all construction machines are well maintained; • A prestart on construction machine carried out every morning; • Oil/fuel remediation agents, oil pads, oil booms and geo-fabric clothes are ready for usage as ***per emergency response plan;*** • ***(Hazardous material management manual).***	• SIRC	• Include in construction cost	• Construction machineries maintain in good working order • Spot check for visible oil • Water quality	• Weekly - visual inspection	• SIRC and ECD

	• Direct discharge to adjacent creeks or streams	• Development footprint will be provided with effective drainage systems which will avoid direct discharge to creeks or streams	• SIRC	• Include in construction cost	• No direct discharge to water bodies	• Weekly - visual •	• SIRC and ECD
	• Access and Mobility restricted	• SIRC Company to allow areas within the tenement to be continuously accessed by affected communities and public.	• SIRC •	• Include in construction cost	• Maintenance of access; • Signage; • Road free of materials and debris; • Haulage routes rehabilitated	• During activities - Visual inspection; • Consultations; • Review of traffic management plan	• SIRC and ECD
	• Barrow pits exposed water table	• Avoid Barrow pits exposing water table • Barrow pit immediately covered when water tables are exposed	• SIRC	• Inc in cont cost	Barrow pits	• Weekly	• SIRC
Fuelling construction machines and storage of	• Hydrocarbon leakage / spills from construction camps / workshops	• ***Detailed Emergency Response Plan*** (as part of EMP) prepared by SIRC company to cover hazardous materials/oil storage, spills and accidents;	• SIRC	• Include in construction cost	• Ensure storage sites are using existing concrete base;	• Weekly inspection	• SIRC and ECD

Hydrocarbons		• Chemicals will be stored in secure containers 20m away from the coastline; • Chemicals stored in area or compound with concrete floor and weatherproof roof and fire extinguishers; • Spills will be cleaned up as per emergency response plan; • Ensure all construction machines are well maintained; • Accidents reported to police and MMERE and MECDM within 24 hours; • ***(Hazardous material management manual)***					
	• Smoking near storage and workshop areas causing fire.	• Prohibit smoking close to fuel storage areas; • Put up signs of no go smoking zones; • Provide extinguishers and train workers on their use; • ***(Health and Safety Manuals applies).***	• SIRC	• Include in construction cost	• Signs and fire extinguishes	• Code of conduct and housekeeping rules being adhered to. • Verify records of accidents	• SIRC and ECD
OPERATION PHASE							
Encroachment into precious ecology	• Workers poach animals • Protected areas affected	• SIRC Company responsible for information and sanctions regarding harm to wildlife. • ***(Biodiversity Management Manual)***	• SIRC and ECD	• Part of operational cost	• Check for unnecessary vegetation clearance; • Progress of re-vegetation of work areas; • Adequate fuel supplies in camp; • Training of workers in information	• Monthly	• SIRC and ECD

	• Runoffs carrying turbid water impacting corals and aquatic organisms	• Use of silt control devices and sediment traps/fences including Construction of embankments and replanting to avoid direct runoffs; • ***(Biodiversity Management Manual)&*** (***Erosion management Manual applies) & Surface and ground water manuals.***	• SIRC and ECD	• Part of operational cost	• Water quality along coast and water bodies; • Suspended solids from road or areas of erosion, if identified • Visual inspection- signs of stress to corals • • Water quality samplings and testing including field parameters	• Monthly or after complaint - periodic visual inspection	• SIRC and ECD
	• Impact on terrestrial habitats	• SIRC company responsible for information and sanctions regarding felling of trees (not requiring to be cleared); • Provision for plant collection and plant nursery to be later used in the rehabilitation work; • ***(Biodiversity Management Manual).***	SIRC and ECD	• Part of operational cost	• Check for unnecessary vegetation clearance; • Progress of re-vegetation of work areas; • Adequate fuel supplies in camp; • Training of workers in information	• Monthly	• SIRC and ECD
Encroachment into archaeological and cultural sites	• Damage to archaeological and cultural sites	• The mining is not going to impact any cultural or archaeological sites; • Such that during the operation a site is accidently exposed, clearing will be stopped and National Museum officers will be informed to assess site.	SIRC and ECD	Part of operational cost	Check for Complaints	Monthly	SIRC and ECD

Presence of mining workers	• Public are exposed to sexual exploitation in camps	• Village protocols discussed. Worker awareness as part of mobilization; • Signage and security at camp i.e. prohibition on unauthorised people (esp. children) entering camp; • Workers to respect village and landowner boundaries; • STIs and HIV/AIDS awareness program for workers and villages; • A communications and complaints plan will be used for liaison and correction among stakeholders; • SIRC Company to provide health facilities in camps and provide safety equipment for workers.	SIRC and ECD	Part of operational cost	STI/HIV/AIDS prevalence Increased awareness about transmission and prevention	Prior to construction - check SIRC company records, consultation with employees, discussions with NGO	SIRC and ECD

	• Waste generated at campsites and operational sites causing nuisance and potential contamination to coastal waters and or ground water.	• Septic tanks and garbage receptacles will be set up at construction camp sites which will be regularly cleared by the SIRC company; • SIRC company to prepare waste management manual as part of EMP; • All wastes from work sites and camps to be disposed of in approved landfill / areas; • SIRC company will provide sufficient training in appropriate waste disposal methods; • ***Waste Management Manual (Hazardous material management manual).*** • No wastes to be dumped in waterways or close to the coast; • SIRC company ensures wastes not discharged to rivers or coastal waters and that all wastes disposed of in proper areas; • Construction camps will have sanitary latrines; • SIRC company to provide adequate and safe drinking water in camp; • SIRC Company will provide sufficient training in appropriate waste disposal methods.	SIRC and ECD	• Part of operational cost	Waste management - visual inspection that solid waste is disposed of as per EMP; Provision of sanitary facilities; No direct discharges to local streams or rivers; Regularity of waste removal	Monthly, as required and spot checks - visual inspection; Review of waste management plan	SIRC and ECD
	• Possibility of conflicts or antagonism between residents and SIRC Company.	• Facilitate reconciliation between parties- Chiefs, SIRC Company and ECD to involve in resolving the issue.	• SIRC and ECD	• Operational cost	• Construction workers to be drawn from the communities • Important to involve community chiefs through all the project phase	• Monthly and when conflict arises	• SIRC and ECD

Mining, quarrying, stockpile of ore and waste rocks/soils, , transporting and loading ore.	• Siltation to water bodies/Stockpile materials washed out to adjacent water bodies.	• Mining works especially near coast or rivers to be undertaken with extreme care; • Use of silt control devices and sediment traps/fences and sediment settling ponds; • Water quality monitoring undertaken regularly for compliance levels ***(Surface and Ground water operating manuals).***	• SIRC and ECD	• Part of operational cost	Water quality in streams, rivers and coast; Suspended solids from road or areas of erosion, if identified • Visual inspection- effectiveness of drainage system	Monthly or after complaint - periodic visual inspection	SIRC and ECD
	• Increase in acid drainage from in appropriate management of waste rock/soil and top soil	• Manage waste rock site in such as a way the acidity are kept at reasonably levels; • (***Waste Rock/Soil Management Manual as part of the EMP).***	• SIRC and ECD	• Part of operational cost	Water quality in streams, rivers and coast; Suspended solids from road or areas of erosion, if identified • Visual inspection- effectiveness of drainage system	Monthly or after complaint - periodic visual inspection	SIRC and ECD
	• Accidental spills associated with loading of the ores	• Workers are trained in SOPs for loading of ores; • Avoid loading during bad weather; • Acquire weather forecast of the site 2 months before loading; • SIRC will develop an emergency response plan to manage any accidents; • SIRC will procure relevant materials to ensure readiness during spills.	• SIRC	• Part of operational cost	• Workers are trained in loading SOPs and emergency procedures	• Daily inspection	• SIRC
Fueling mining machineries and storage of Hydrocarbons	• Hydrocarbon leakage / spills from construction camps / workshops/operational sites	• ***Detailed Emergency Response Plan (as part of EMP***) prepared by SIRC company to cover hazardous materials/oil storage, spills and accidents; • Chemicals will be stored in secure containers away from the rivers and coastline;	SIRC and ECD	Part of operational cost	EMP and emergency response plan; Ensure storage sites are using existing concrete base; Spills cleaned and area rehabilitated	Monthly or after event or as required - review and approval of emergency response plan; Visual Inspection of storage facilities;	SIRC and ECD

		• Chemicals stored in area or compound with concrete floor and weatherproof roof and fire extinguishers; • Spills will be cleaned up as per emergency response plan; • Ensure all construction machines are well maintained; • Accidents reported to police and ECD within 24 hours; • ***(Hazardous material management manual).***					
Waste Management	• Waste generated at campsites, offices, and operational site causing nuisance to public and villages.	• Septic tanks and garbage receptacles will be set up at operational camp sites, which will be regularly cleared by the SIRC company; • Construction camps will have sanitary latrines; • SIRC company ensures wastes not discharged to rivers or coastal waters and that all wastes; disposed of in proper areas • SIRC company to provide adequate and safe drinking water in camp; • SIRC company to prepare waste management plan (as part of EMP); • All wastes from work sites and camps to be disposed of in approved landfill / areas; • SIRC company will provide sufficient training in appropriate waste disposal methods; • ***Waste Management Manual.***	SIRC and ECD	Part of Constructio n cost •	Waste management - visual inspection that solid waste is disposed of as per EMP; Provision of sanitary facilities; No direct discharges to local streams or rivers; Regularity of waste removal	Monthly, as required and spot checks - visual inspection; Review of waste management plan	SIRC and ECD
Operation of construction machinery	• Emission of exhaust from vehicles and machinery	• Maintain construction equipment; • Prohibit use of equipment that causes excessive pollution (e.g. generates smoke);	SIRC and ECD	Part of operational cost	Air quality, emissions,	Monthly or after complaint - periodic visual inspection; Any particulate matter and smoke managed as per EMP	SIRC and ECD

generating emissions		• ***Air quality management manual.***					
	• Dust caused by vehicles running at high velocity	• Thorough watering to avoid dust.	SIRC and ECD	Part of operational cost	Air quality, dust, particulate matter; Use of tarpaulins and loading of vehicles; Stockpiles	Monthly or after complaint - periodic visual inspection; Any particulate matter and smoke managed as per EMP	SIRC and ECD
Operation of machinery creating noise	• Noise to communities	• Construction machine exhaust systems and noisy equipment will be maintained to minimise noise; • SIRC company will develop a schedule of operations with village chiefs and Engineer to identify days of no work and hours for certain activities; • Limit noisy construction activities to day time hours, i.e. construction activities prohibited between 9pm and 6am.	SIRC and ECD	Part of operational cost	Adherence to agreed schedule; Complaints (no. logged with resolution); Workers safety equipment	Monthly or after complaint - review schedule Consultation (ensure schedule being adhered to)	SIRC and ECD
	• Impacts on construction workers	• Workers limit of exposure to noise will be strictly below 70 decibels per 8 hour shift; • Provide workers with noise abatement equipment (ear-muffs etc.); • Complaints will be addressed by SIRC Company.	SIRC and ECD	Operational cost	Visual inspection – construction workers worn safety abatement equipment (ear-muffs etc Consultation with workers if safety standards have been provided	Monthly or after complaint - review schedule Consultation (ensure schedule being adhered to)	SIRC and ECD
DECOMMISSIONING IMPACTS							

Waste	• Decommissioning will result in numerous waste and recycled materials including stockpile materials, oil and fuel, batteries, steel, to name a few	• At the mine closure, campsites and associated facilities can be dismantled using minimal impact approach and recycled or disposed of safely. SIRC will ensure waste due to the mine closure does not eventuate into negative impacts. Relevant authorities including ECD and MD will inspect tenement area at the mine closure to ensure no impacts remain or generated due to decommissioning	• SIRC,	• Decommissioning cost	• No waste remain at the site	Decommission stage	SIRC and MECDM, MMERE
Storage	• The scope of the current mine is to extract and export the ore. So there is no need for storage unless it requires the company do so.	• All wastes whether is it is solid, liquid or gas stored at any location in the tenement will be removed by SIRC in the first instance during operation. The SIRC Company will make arrangement for recycling with oversea companies together with ECD once it is necessary. The storage site will have concreate platform, weather proof roofs and secure. The company is liable for any storage onsite including any impacts that may arise due to the storage.	• SIRC,	• Decommissioning cost	• No waste remain at the site	Decommission stage	SIRC and MECDM, MMERE
Access and Mobility	• Disruption due access	• The company will agree work schedule with the community before decommissioning activities commences.	• SIRC,	• Decommissioning cost	• No waste remain at the site	Decommission stage	SIRC and MECDM, MMERE
Decommissioning causing exposure of soil surfaces	• Erosion due to exposure of soil	• All ore pockets and sites exposed will be rehabilitated with local indigenous and economical trees. •	• SIRC,	• Decommissioning cost	• No waste remain at the site	Decommission stage	SIRC and MECDM, MMERE

1. INTRODUCTION

1.1 Background

Solomon Islands Resources Company (SIRC) acquired its business license to operate in the Solomon Islands in 2018. SIRC interest is to mine the Takata laterite nickel deposits. In early 2019, the company was granted prospecting license to further explore the deposit in Takata. Takata area was subjected to prospecting by Axiom Mining Ltd in 2015, by Solex in 1980 and INCO. Prospecting Company 1960. The initial and corresponding SIRC prospecting findings of the Takata nickel deposits were considered to be economically viable. These have increased investment confidence among SIRC shareholders to pursue mining application for the tenement.

The proposed mining lease area covers an area of approximately 19.7 square kilometer in size (refer to Fig 1) currently held under a Prospecting License (PL 02/19).Following requirements of the Mines and Minerals Act and Environmental Act 1998, SIRC is required to prepare an EIS Report as part of the company's application for the mining lease.

The proposed nickel mining is indeed can be seen as a large scale activity with impacts can be felt starting from the construction stage till operation and decommissioning. Nevertheless, this mining operation would be a medium scale mining within a small land area of 19.7 square kilometers only. The mine will operate using strip-mining method that will involve vegetation and top soil clearance and then peeling the nickel ore deposit. Processing plant will be offshore, in China.

While it is true that the construction, operation and decommissioning works of the mining are expected to have high disturbance to natural environment, appropriate mitigation measures will be applied so as to minimize and/or avoid the impacts. Potential environmental and social impacts from the mining construction, operation and decommissioning phases will be highly localised and with the implementation of good mining practice and well proven mitigation measures, all the predicted impacts will be minimized to acceptable levels. It is envisaged that the mining company will comply to standard health, safety and environment practices, adhere to code of conduct at all times and ensure good mining practice so that the positive impacts will offset the predicted negative impacts.

1.2 Mining Proponent

Address: Solomon Islands Resources Company Limited

Contact Person: Peter Zheng

Official Designation: General Manager

Tel: 7928887

Email: siresources1353@gmail.com

1.3 Parties Responsible For Preparing The ESIA

1.3.1 ESIA Preparation

This EIS was prepared by a group of consultant who have wide experience in environmental impact assessment in the Solomon Islands. The EIS team had worked on a number of SIG and Donor Projects. The EIS team leader is Winston Lapo and operates under the business name W.L Consultancy Services.

1.3.2 ESIA Quality Review and Final Edit

The EIS was reviewed together with the SIRC.

1.4 Objectives of the ESIA Study

The main objective of this assessment is to establish the baseline information, identify the potential environmental and social impacts of the mining, and formulate an Environmental Management Plan to ensure the proposed mining takes into consideration appropriate measures to mitigate any adverse impacts during construction, operation and decommissioning.

The assessment was undertaken in full compliance with the Solomon Islands environment impact assessment guideline. Appropriate sectorial legal provisions relevant to such mining project have also been referred to for the necessary considerations during the construction, operation and decommissioning of the mining.

Specific objectives of the study include the following:

- Comply with Solomon Islands legal requirements for the formulation of an Environment Impact Statement under the Environment Act 1998 since the proposed mining is a prescribed development under schedule 2 (section 16);
- Establish the environmental social baseline conditions of the tenement area and review available information and data related to the mining project;

- Identify key areas for environmental and social concerns as well as the anticipated impacts associated with the mining project implementation;
- Establish a comprehensive environmental social management plan for the construction, operation and decommissioning phases of the mining project; and
- Preparation of an EIS and submission to ECD for approval.

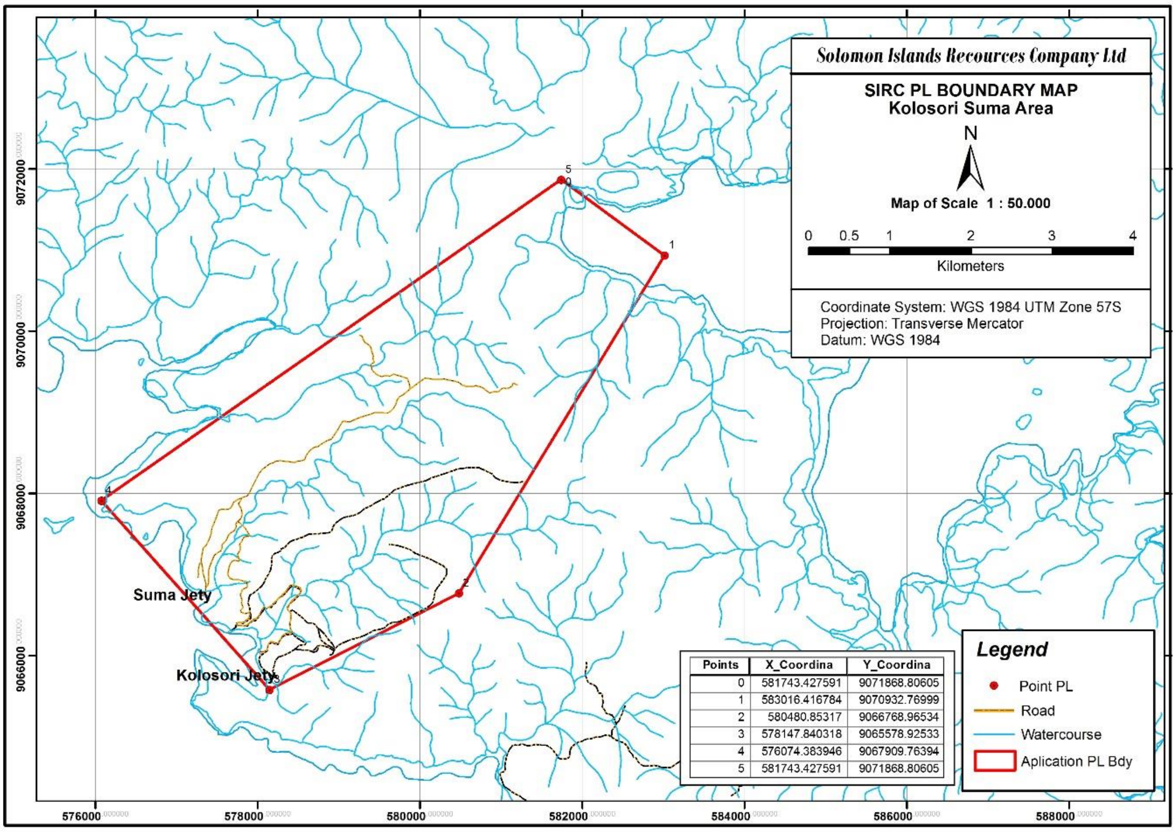
1.5 ESIA Study Methodology

1.5.1 Area of Influence and Study Area

1.5.1.1 Mining area of influence

The Mining Area of Influence (MAI) is defined as the geographical area likely to be affected by the mining's construction, operation and decommissioning activities. This can also be called the Mining Tenement area. This area excludes the wider area which may be affected by cumulative impacts. The MAI includes the direct impact area, upstream areas and downstream areas of rivers, terrestrial and marine habitats, stockpile areas, ore locations, quarry and the camp area.

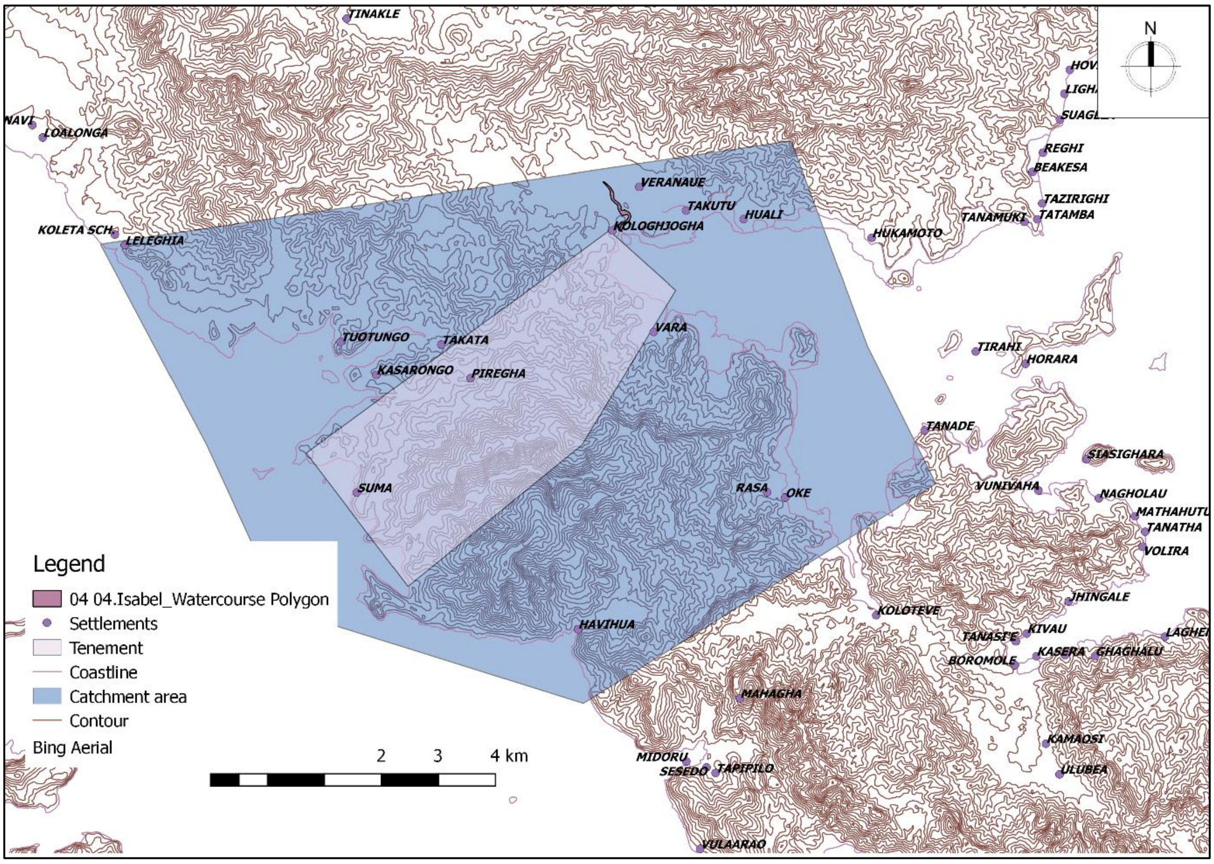
Figure 1: Takata Tenement Area



1.5.1.2 Study Area

The social perspective of the study is made up of a wide area of communities stretching for over 2 km along the Huali Bay on the North east coast and 4km on the Takata/Medoru south east coastline, Isabel Islands. These neighborhood communities may not be direct beneficiaries in terms of royalties and as such but are likely to have effects due to the mining operation. This also include those that have ownership rights but do not reside in the tenement area.

Figure 2: Mining Area of Influence



1.5.2 Identification of Baseline Conditions

1.5.2.1 Literature Review

In preparing the EIS report, information were obtained from secondary data sources through a literature review process. The materials below were reviewed and integrated into the EIS:

- EIS document published by various companies on the same tenement;
- Scientific Journals; and

- Solomon Islands Government publications e.g. statistical data, maps.

1.6.2.2 Field Studies and Surveys

Secondary data obtained through literature review were complemented by primary data collected through field studies and surveys. The team of consultant made two separate visits to the tenement area. The initial field visit took place on the 29th July to 4th August and the second field visit on the 9th to 12th August 2019. The initial visit comprises of marine, terrestrial, and social survey consultants and the second visit the soil, water quality and hydrology consultants.

1.5.3 Identification of Impacts and Mitigation Measures

1.5.3.1 Impact Assessment Methodology

This EIS assesses the potential negative impacts of the mining on the biophysical, ecological and social environments and it identifies measures for addressing any potential impacts that may have been identified. The following steps were considered for this report:

- **Define Mine Area of influence (MAIs)** – identify the boundary within which a mining action or activity could potentially affect a given environmental or social resource or attribute. These will include the use of the proposed mining plans and location of ores.
- **Identify Impact Sources** - identify the mining actions or activities (impact sources) likely to affect environmental or social attributes within the MAI and Study area. An impact identification matrix was used for this purpose.
- **Assess Impacts** – assess each impact according to a set of impact criteria, including: duration (temporary vs permanent); reversibility (reversible vs irreversible); extent (site specific vs local vs regional); magnitude or intensity (minor, moderate, major), and probability of occurrence (low, moderate, high).
- **Assess Impact Significance** - assess significance of each identified impact. Impacts can be both positive and negative. Negative or adverse impacts are rated using the criteria of duration, extent, magnitude/intensity (major, moderate or minor) and probability of occurrence.
- **Application of identified mitigation measures –** identify measures to avoid or reduce negative or adverse impacts. The cost associated with the measures are part of the mining operation and so there will be provision for it in the mining budget.
- **Identify Residual Impacts** identify residual effects of the impact after mitigation (significant or not significant).

- **Cumulative impacts**-identify cumulative impacts and management measure to mitigate the impacts.

1.6.3.2 Environmental Impact Analysis

Impacts on the following valued physical and natural environmental attributes / components were assessed:

- Physical assets;
- Small-scale logging, forest and timber milling;
- Gravel extraction;
- Water supplies, availability and quality;
- Livelihoods and key resources;
- Natural capital;
- Cultural heritage;
- Terrestrial flora;
- Terrestrial fauna and terrestrial fauna habitats;
- Marine ecosystem; and
- Aquatic ecosystems.

1.6.3.3 Social Impact Analysis

Impacts on the following valued social attributes / components were assessed:

- Health, safety and well-being;
- Women and vulnerable groups;
- Social relations;
- Social organisation;
- Local customs and way of life;
- Employment;
- Education;
- Livelihood ; and
- Local financial capital and economic development, royalties, resource rents.

2. MINING DESCRIPTION

2.1 Mining tenement area

The proposed mining tenement area is located south east of Isabel Island in the Takata area, east of San Jorge Island. It is the current SIRC's Prospecting License (PL) area. The coordinates are supplied in the table below. Refer to figure above for map.

Table 1: Coordinates of Tenement Area

Points	**X coordinates**	**Y coordinates**
0	581743.427591	9071868.80605
1	583016.416784	9070932.76999
2	580480.85317	9066768.96543
3	578147.840318	9065578.92533
4	576074.383946	9067909.76394
5	581743.427591	9071868.80605

2.2 Objective of proposed development

Solomon Islands is categorized as a middle income country with a GDP of 1.202 billion USD in 2016 that is expected to grow 3% every year. In 2015, a national survey shows that almost one quarter of the population lived under poverty line and this cannot be measured in terms of hunger but primarily due to lack of income.

With the economy of the Solomon Islands is predominantly based on agriculture and forestry, it faces a major challenge of climate change and can be dictated by external forces of the global market. Therefore, the Solomon Islands government decided to establish alternative export industries such as mining, tourism and fishing to compensate for the expected decline in the forestry industry.

The main objective for establishing the mine in the area is to sustainably extract the much coveted nickel laterite deposit and associated minerals within the Takata Tenement in Isabel Province. This will help boost the local and national economy, improve standard of living and create employment for locals that will further improve their rural-based incomes.

2.3 Project Justification

2.3.1 Direct Economic Benefits

The proposed mining project will contribute significant revenues directly to the SIG over the life of the mining. It is anticipated that a proportion of taxes and royalty benefits will be used for local social infrastructure and social development such as education, healthcare and among others long term community projects in the southern part of Isabel Province. Not only that, more local people in the area and elsewhere in the country will be employed during the construction phase and operation phase of the mine. SIRC Ltd.'s workforce strategy will see increase in employment and training of locals which means improved skills and income earnings for locals in Isabel Province and the country.

2.3.2 Indirect Economic Benefits

The operation of the mine will contribute significantly to the Solomon Islands economy through the purchasing of goods and services from local suppliers in Isabel and other parts of the country. Also it will help to increase the transfer of important skills that can be utilized to build, repair, maintain and develop homes and other local infrastructures in Isabel Province. Finally, the mining operation will help diversify the Solomon Islands economy through the exports of mineral resources which means it will reduce the country's significant reliance on the forestry and agriculture exports.

2.4 Proposed Works – Mining Plan

The mine development in Takata, Isabel Province will go through the normal mine life-cycle; pre-constructions/development stages, construction, operational, decommissioning and rehabilitation stages.

2.4.1 The preconstruction stage

The company's specialists will develop the initial design of the mine coupled with feasibility studies. Further detailed engineering design will also take place at this stage to ensure the mine will be constructed and operated in a well-planned manner. The company will also mobilize its workforce who have experience in the fields of business assessment and development, law, accounting, management, resource, finance and associated skills. It will also engage mineral exploration/development experts and qualified and experienced trainers to train up local personnel.

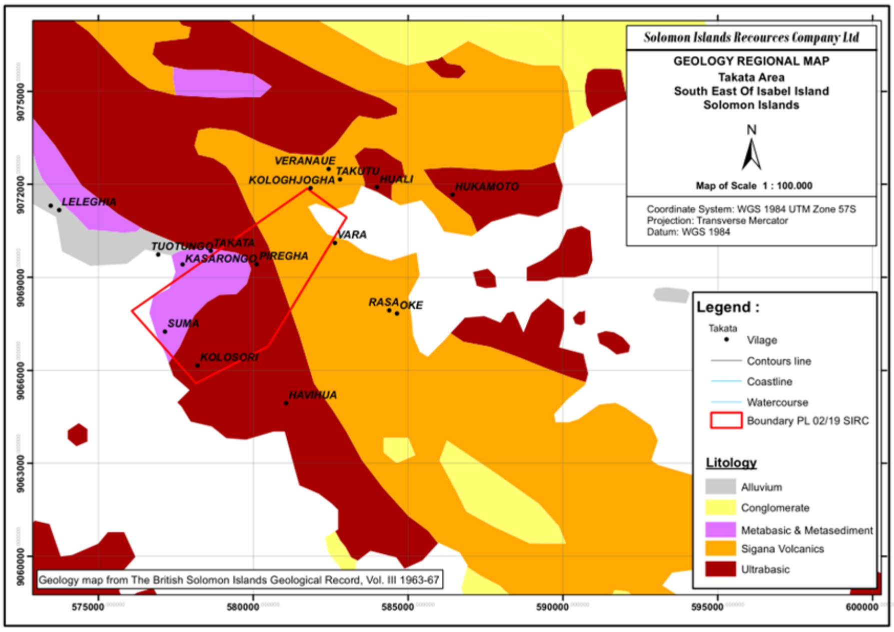
The company has also established its camp site in Honiara in preparation for the mining operation in Takata. The campsite in Honiara consists of office, dormitory, restaurant, equipment maintenance and repairing house, security post and office, which are of a building area over 1500 square meters.

Of all the equipment, there are over 50 units of heavy equipment being imported and standby in Honiara. These include 22 units of dump truck, 6 units of wheel loader, 8 units of excavator, 5 units of bulldozer, 1 unit of water truck, 1 unit of fuel truck, 1 unit of motor grader, 1 unit of soil compactor, 1 unit of crane truck, 1 unit of prime mover for heavy equipment transportation, and 4 fuel tanks. The biggest heavy equipment manufacturer in China, XCMG, offers great support towards SIRC Ltd through the supply of equipment and technical expertise.

2.4.2 Construction stage

This will involve the construction of a campsite, infrastructure and related facilities in Suma (Figure 3 & 4), including office, dormitory, restaurant, a workshop, and security post and office. Roadways and drainage will be constructed in order to access the laterite deposits in the area including landing sites for stockpiling of the ores. A port will be constructed for loading and unloading of cargoes and ores.

Figure 3: Map of Block Takata Prospecting



Key infrastructure that will be required by the Project prior to production will include:

- Roads
- Water infrastructure
- Power station
- Labour quarters and staff housing (120-person capacity)
- Storage house
- Company head office
- Loading port and dock
- Constructing Stockpile
- Preparing of the front mine
- Waste disposal site/Landfill.

Figure 4: Layout of Infrastructure Plans and supporting facilities

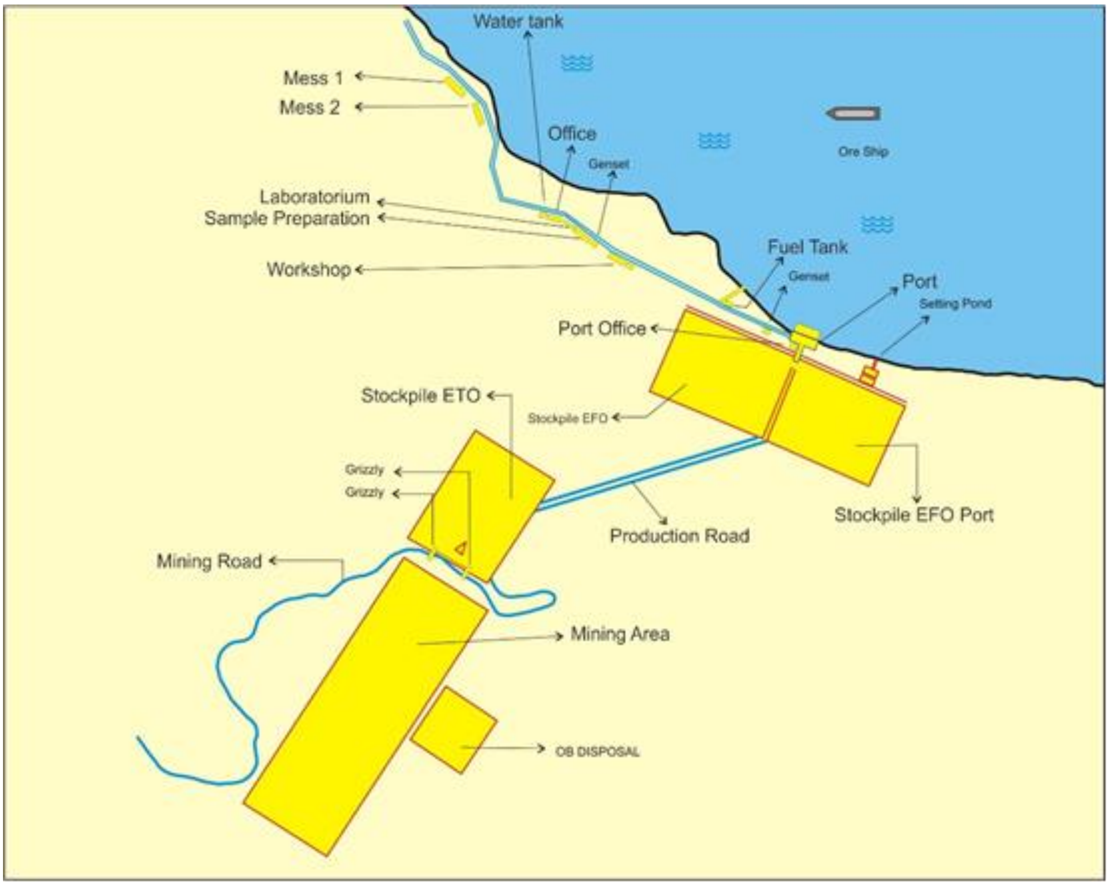
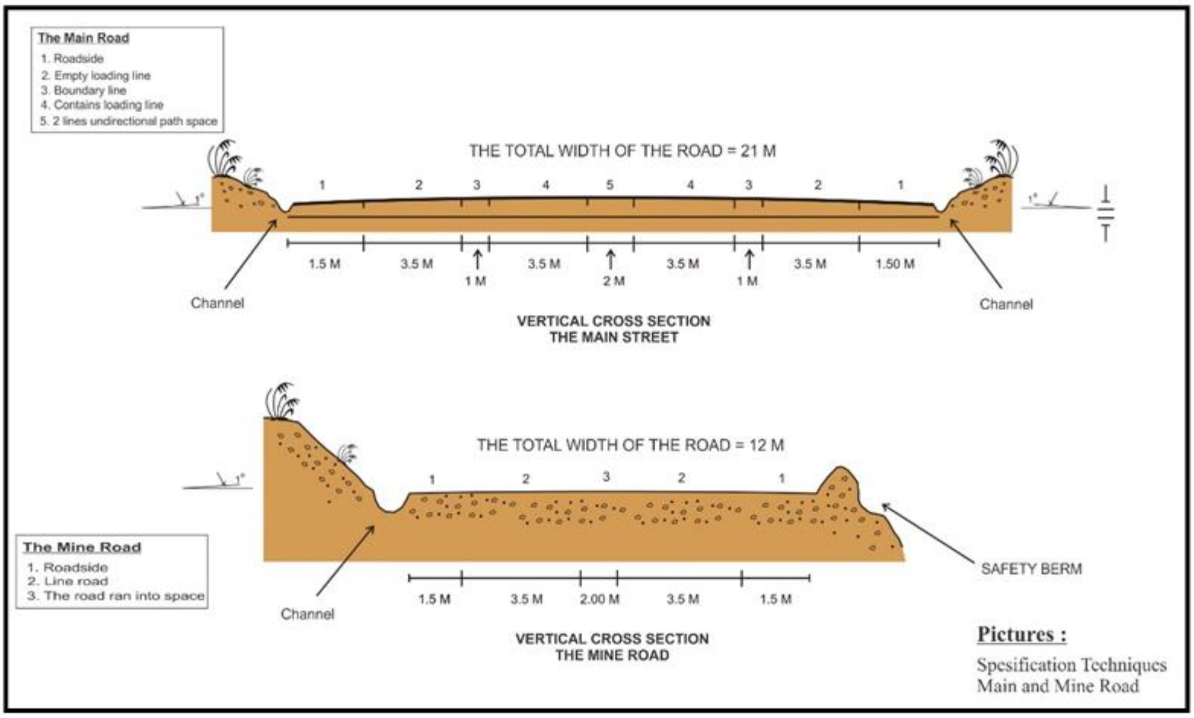


Table 2: Construction Phase Schedule

ACTIVITY		MONTHS				
		1	2	3	4	5
A	Making Road					
B	Labour quarters and staff housing					
C	Power Station					
D	Making Water infrastructur					
E	Company head office					
F	Storage house					
G	Constructing Stockpile					
H	Preparing of the front mine					
I	Loading port and dock					

- SIRC will construct production roads (21 meters) and mine roads (12 meters). Front mine - ETO (Exportable Transite Ore) stockpile – EFO (Exportable Fine Ore) stockpile is a production road, total distance of approximately 4.5 kilometers. Roads inside mining area are called mine roads. The construction of the mine road is adjusted to the mining progress, estimated construction of the mining road per year along 1 km. (Figure 5).
- SIRC will also construct the entrance road from the production roads to the office, workshop area, laboratory, employee's house and polyclinics with distance ± 1 km.

Figure 5: Specification of Production Road and Mine Road



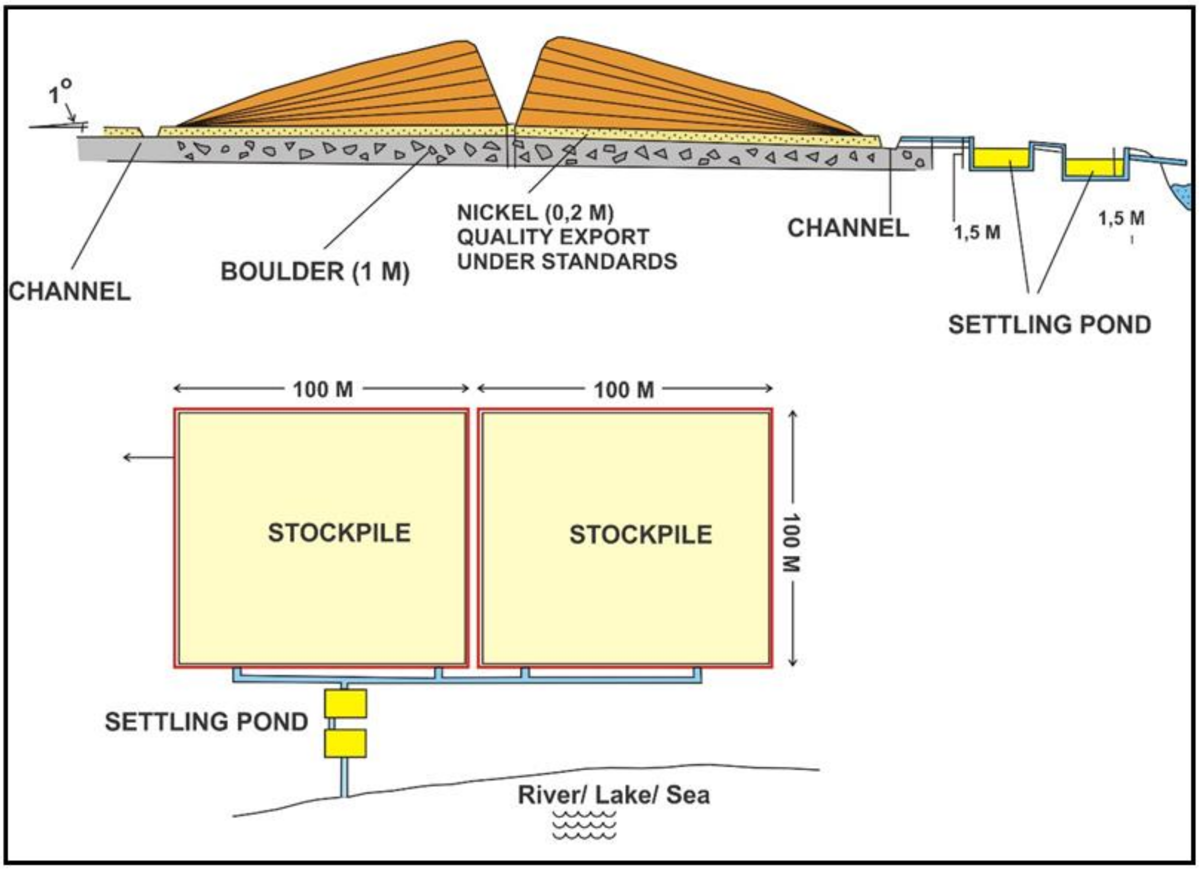
Construction of the Stockpile ETO in Mining Area

The stockpile ETO will be constructed on 2 hectares, to accommodate a pile of nickel ore as much as 100,000 wet metric tons (Figure 6). The location of grizzly and jaw crusher in the stockpile ETO is selected in the reserve center but in the place that does not contain nickel ore or low grade nickel area. The benefit of the stockpile ETO is to accommodate and control the grade of daily nickel ore production. If the grade of nickel ore falls, then when transported to the stockpile EFO at the port there is still a chance of fixing by blending with the nickel ore high grade.

Construction of the Stockpile EFO in Port Area

The stockpile EFO in the port will require approximately 2 hectares, for storing nickel ore 100,000 wet metric tons (Figure 6). The proposed location is on the south coast of the Suma block, 3 kilometers from the stockpile ETO in the mine area. To get a flat location around the port, there must be a hoarding and ground leveling. The hoarding materials will be taken from around the same location. Approximately 20,000 x 3 meters^3 = 60,000 meter^3 is required.

Figure 6: Technical Specification of Stockpile



Construction of the Barge Port

Barge Ramp door to be used requires area of 80 meters x 50 meters for 270 ft x 72 ft x 18 ft or 82. 2 meters x 21. 9 meters x 5, 4 meters for approximately 5,500 – 6,000 DWT. The port will cater for 2 barges, at a loading rate of 5,000 tons per day. Export target will be 2 times delivery in a month at 50,000 tons. This loading Target is expected to be served by this port even with a sufficiently dense delivery frequency.

Manpower Requirements

The estimated amount of labor needed during the construction phase is as follows**:**

Table 3: Manpower Requirements in construction phase

Job Description		No. Of Employees
1	Site Manager	1
2	Geologist	2
3	Mining Engineer	1
4	Operators	13
5	Foreman	4
6	Technician	3
7	Work shop Manager	1
8	General Worker	20
9	Cook	1
	Total	46

Equipment

The following section discusses equipment selection and fleet requirements for use during the construction phase

a. Bulldozer

Used for stripping, stacking ore and making production roads

Type: Shantui/XCMGSD 22, 190 Hp;

Blade capacity 4,2 m^3

Dozing distance 40 m.

Blade factor 0,70 (average dozing)

Production per cycle ;

q = (blade height)^2 x blade width x blade factor

= $(1,21)^2$ x 3,978 x 0,70 = 4,077 m^3.

Forward speed = 0 - 4 km/h. Backwards speed= 0 – 6 km/h.

Average forward speed = 4 x 0,75 = 3 km/h = 50 m/min.

Average backwards speed= 6x0,85= 5,1 km/h = 85 m/min.

The time it takes to move the transmission= 0,05 minutes.

Cycle time (Cm)= 40/50 + 40/85 + 0,05 = 1,32 minutes.

Job Efficiency = 0,60

Earth Volume Conversion Factor = 1,0 (clay).

Bulldozer capacity =

Q = 4,077 x 60/1,32 x 0,60 x 1,0 = 111,2 m^3/h.

Needs: Land clearing, Stockpile ETO, making and maintenance of road, total requirement of equipment are 2 units.

b. Motor Grader

For making road and Maintenance, required 1 unit.

Type: XCMG GR215, 160 HP, Blade 3965 x 610 x 19 mm.

c. Hydraulic Excavator (Backhoe)

Type: XCMG XE 215 D, 0.8 m3 bucket capacity.

Used to dig and load OB, required 4 units

d. Vibratory Roller

Type : XCMG XS203, working mass 20.000 kg, engine power 140 HP, compacting width 2.1 m, centrifugal force 370/255 kN, frequency 28/33 Hz.

Use for making and maintenance road, required 1 unit.

e. Dump Truck

Type: XCMG NXG5430DT Dump Truck capacity of 20 ton.

Table 4: Equipment to be used in Construction Phase

Equipment	Type	Units
Bulldozer	Shantui/XCMGSD 22, 190 Hp	2
Motor Grader	XCMG GR215, 160 HP	1
Hydraulic Excavator	XCMG XE 215 D	4
Vibratory Roller	XCMG XS203	1
Dump Truck	XCMG NXG5430DT	5
	Total	13

2.4.3 Operation stage

This will involve the actual extraction of the ore deposits, transportation to port site and transferring ore to large vessels for shipment. The extraction will involve strip mining method that includes clearing of top soil and peeling of ore deposit. These nickel laterite are located near the surface, with an average depth overburden of 2 meter and saprolite 1 – 2 meter. For such an approach, vegetation and top soil are first removed, and ore is extracted and transported by trucks to stockpile locations.

2.4.3.1 Plans of Mining and Blending

The exploration drilling will require 50 meters x 50 meters area 25 meters x 25 meters for some areas with a very heterogeneous deposit condition before the exploitation stage begins. This is done so that the result of mixing of nickel ore levels is not different than desired. Good quality of nickel ore is generally determined by high Ni elements. To obtain the quality of nickel ore according to the sales contract, blending of the low grade nickel ore with a high grade will be required and done in accordance with the formula of specific tonnage comparison.

$$\text{Blending Grade} = \boxed{\frac{\Sigma\ (\text{Nickel Ore Tonnage from Mine x Grade})}{\Sigma\ (\text{Nickel Ore Tonnage from Mine})}}$$

A grade control supervisor will ensure there are evidence of high grade ores before actual mixing or even extraction are conducted. Production samples will be collected from the mine front and in the stockpile area and from the drilled samples. Production samples will be analyzed using X-ray analysis and the results will be known to the supervisor every day prior to mixing and extraction.

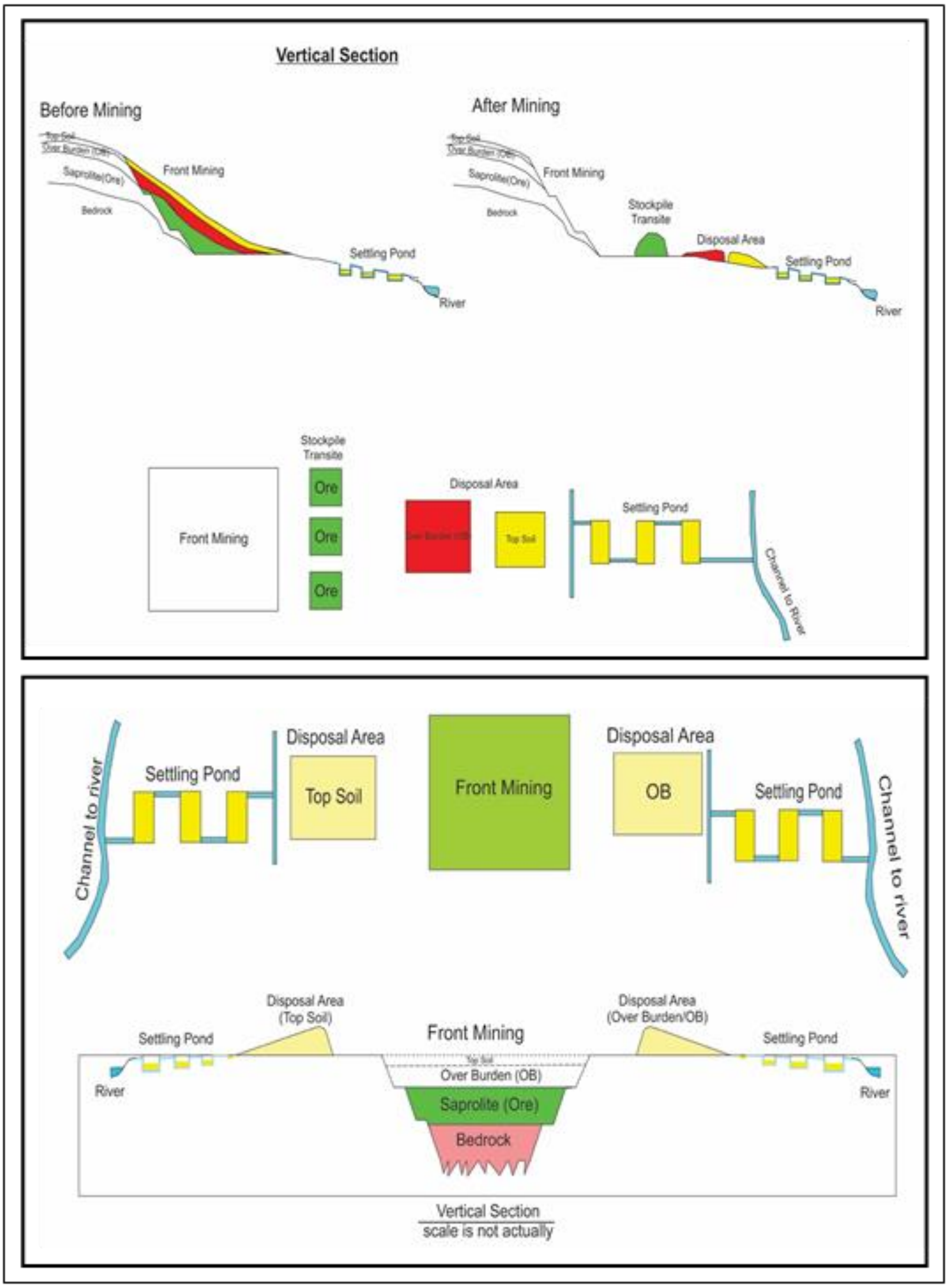
2.4.3.2 Stripping of The Overburden

The thickness of the overburden is likely to be between 0 – 6.0 meters. To reach the nickel ore lining required stripping with the bulldozer. The overburden is pushed and collected at the edge of the reserve boundary. If overburden is thicker or above 1 meter then it will be peeled using excavator (backhoe) and transported to the disposal by using a dump truck. After the mine is completed for a site, the mine will rehabilitate using the overburden (back filling). With the production of 1.2 million tons per year for the average thickness of nickel ore over 2 meters, the land area is expected to be peeled 40 hectares per year.

2.4.3.3 Mining Process

The next stage is mining the nickel ore that has been stripped (unwrapped). Mining is carried out with an open pit system (Figure 7), using dump trucks and excavators, starting from the top elevation, done bench system with a height in accordance with the safety regulations which is general a maximum of 6 meters. Nickel ores are transported and deposited in the stockpile ETO mining. From the stockpile ETO, nickel ore are transported to the stockpile EFO port. Nickel ore in both stockpiles will be arranged based on the grade of Ni. The nickel ore piles at the stockpile ETO and the port stockpile EFO will be managed by the use of survey tools.

Figure 7: Overview of open pit system in slope and flat areas



Manpower Requirements

To save running costs, a very efficient work formation must be made at an early stage. Core staffs who already have expertise drawn from former employees who have worked in the nickel ore mine, accepted as employees through selection/tests. Non-skilled workers drawn from residents around the area. Gradually through a proper training process, non-skilled workers from residents who deemed to have competence are recommended to fill the quota of employees who have the expertise (skills) following the required field of work. The scope of work includes reclamation and rehabilitation of ex-mining land, exploration, mining planning, licensing, technical administration-staffing, coordinator of transportation of nickel ore mines - stockyard transport, stockyard harbour - barges for shipping, and quality control.

The estimated amount of labor needed during the operation phase is as follows**:**

Table 5: Manpower requirements during operation phase

Position	Quota	Country			
		China	Solomon	Indonesia	Malaysia
President	1	1			
Vice President	1	1			
Central Office Staff	3	3			
Heads of Production	1	1			
Senior Geologists	2		1	1	
Geologist	2			1	
Heads of Exploration and mining	1			1	
Shipping Head	1				
Head of Laboratory	1				
Drilling Power	5			1	
Preparation and analysis	4				
Procurement & Logistics	3		1	2	
Finance	1	1			
Human Resources	2		2		2
Dump truck driver	20			3	
Excavator operators	8			8	

Wheel loader operators	6			1	
Bulldozer operator	3			2	
grader operators	1			1	
Operator vessel crane	10				
Stockpile	20		20		
Boat Operators	2		2		
Mechanics	8	7		1	
Cook	3	2		1	
Security	22		22		
Office Boy/Office Girl	10		10		
Environment Officers	2		2		
Community relation officers	2		2		
Safety Officer	1		1		
Total	146	16	63	23	2

Equipment:

The following section discusses equipment selection and fleet requirements for use during the operation phase

Bulldozer

Used for stripping, stacking ore and making production roads

Type: Shantui/XCMGSD 22, 190 Hp;

Blade capacity 4,2 m^3

Dozing distance 40 m.

Blade factor 0,70 (average dozing)

Production per cycle ;

q = (blade height)^2 x blade width x blade factor

= $(1,21)^2$ x 3,978 x 0,70 = 4,077 m^3.

Forward speed = 0 - 4 km/h. Backwards speed = 0 – 6 km/h.

Average forward speed = 4 x 0,75 = 3 km/h = 50 m/min.

Average backwards speed= 6x0,85= 5,1 km/h = 85 m/min.

The time it takes to move the transmission= 0,05 minutes.

Cycle time (Cm)= 40/50 + 40/85 + 0,05 = 1,32 minutes.

Job Efficiency = 0,60

Earth Volume Conversion Factor = 1,0 (clay).

Bulldozer capacity =

$$Q = 4{,}077 \times 60/1{,}32 \times 0{,}60 \times 1{,}0 = 111{,}2 \text{ m}^3/\text{h}.$$

Needs: Land clearing 1 unit, Stockpile ETO mine 1 unit, making and maintenance of road 1 unit, total requirement of equipment are 3 units.

Motor Grader

For making road and Maintenance, required 1 unit.

Type: XCMG GR215, 160 HP, Blade 3965 x 610 x 19 mm.

Hydraulic Excavator (Backhoe)

Type: XCMG XE 215 D, 0.8 m3 bucket capacity.

Used to dig and load nickel ore in mines, required 10 units

Wheel Loader

Prepared for the purpose of assisting loading and trimming in the barge. Required 1 unit, XCMG ZL50GN, 162 HP, bucket capacity 3.5 – 3.8 m3.

Vibratory Roller

Type : XCMG XS203, working mass 20.000 kg, engine power 140 HP, compacting width 2.1 m, centrifugal force 370/255 kN, frequency 28/33 Hz.

Use for making and maintenance road, required 1 unit.

Dump Truck

Type: XCMG NXG5430DT Dump Truck capacity of 20 ton.

- Mine Over burden

Shift I, II: Required excavator 1 unit and dump truck 3 units

- Mine and hauling nickel ore to stockpile ETO

Shift I, II: Required excavator 4 units and dump truck 11 units

- Hauling nickel ore : Stockpile ETO – Stockpile EFO port

Shift I, II: Required 2 Unit excavator and dump truck 10 units.

- Shipment

Hauling nickel ore from the stockpile EFO of the port to the barge

Shift I, II, III: Required excavator 2 unit and dump truck 6 units.

Ship 40,000 – 60,000 tons. : In one year 24 shipping or

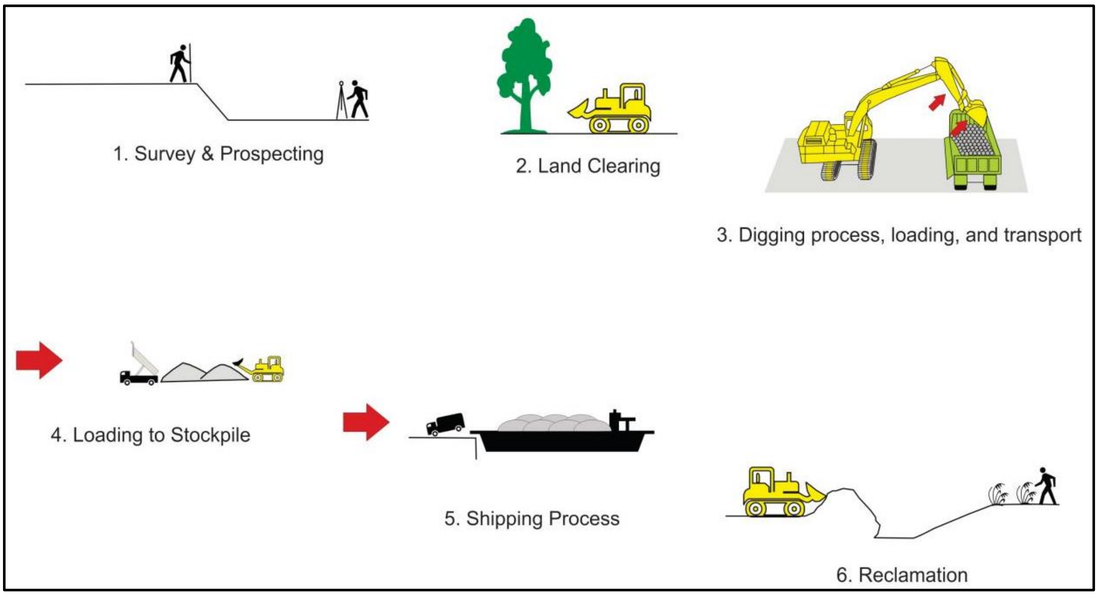
2 times a month. (2 x 50,000/5,000) = 20 days per month.

- Barge loading:
  Required: 1 unit wheel loader for trimming on the barge.

Table 6: Equipment requirements in the Operation Phase

Equipment	Type	Units
Bulldozer	Shantui/XCMGSD 22, 190 Hp	3
Motor Grader	XCMG GR215, 160 HP	1
Hydraulic Excavator	XCMG XE 215 D	8
Vibratory Roller	XCMG XS203	1
Dump Truck	XCMG NXG5430DT	20
Whell Loader	XCMG ZL50GN	6
	Total	39

Figure 8: Nickel laterite mining process scheme



2.4.4 Loading of ore

Ore will be transported directly into the awaiting barge at the port area. All ores will be loaded into a landing craft which will then be trans-loaded to larger vessels. Loading will be carefully assessed and monitored to avoid any risk of accidents for example, ore spillages on the coastline. SIRC had already identified a sheltered anchorage pending Solomon Islands Maritime Safety Agency (SIMSA) approval.

2.4.4.1 Shipment

SIRC plans to transport ore using export vessel with the capacity of 40,000 – 60,000 metric tons. Loading to vessel will be conducted in the middle of the sea at a minimum sea depth of

15 meters. Distance of jetty to vessel will be approximately 1.5 km. Facilities to be prepared are: the pier loading Ramp door to barge, barge type Ramp door with capacity of 5,000 tons and a tug 2 x 8100 HP. Export vessels are equipped with cranes and bucket for use during loading. Nickel ore at the stockpile EFO will be loaded onto the dump truck using excavators, then transported and loaded into barges. The barge is then, pulled by the tug boat to the export vessel in the middle of the sea. The ore will be trans-loaded into the export vessel by the use of the vessel's cranes. The export vessel will calculate the volume of ore required ensuring it does not exceed the loading capacity of the vessel. The result will be made known to relevant authorities every day by the loading master.

Figure 9: Loading point of SIRC

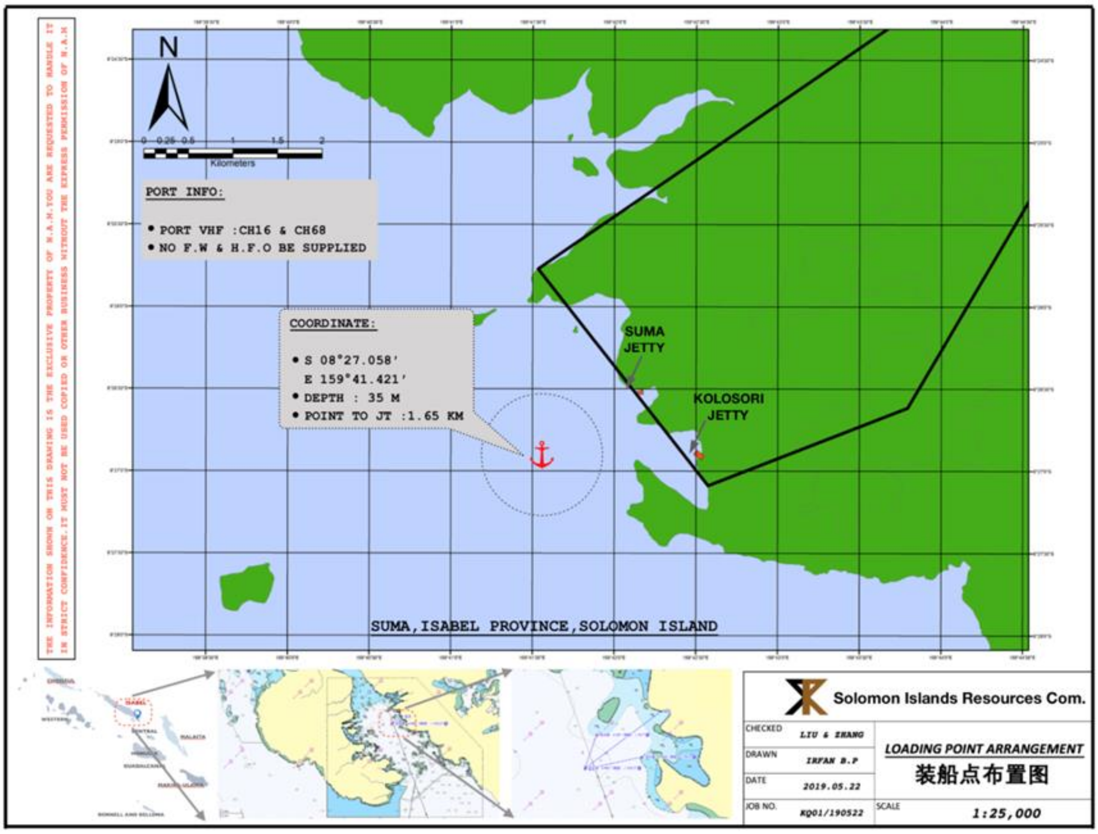


Table 7: Loading point coordinates

Coordinate	S 08^{0} 27,058'
	E 159^{0} 41,421'
Depth	35 m
Point to JT	1,65 Km

2.4.5. Mining Closure Phase

At the end of the mine life, preparations are needed to anticipate the negative impacts of mine closure, with intensive land exploitation causing the irregular landscaping of ex-mines. Topsoil is difficult to obtain, soil density increases, soil fertility and microbial activity are low. Landscape management on ex-mining land is inseparable from soil conservation measures including erosion and surface runoff which is one of the negative impacts of the mining process. One approach to landscape management is to improve soil quality in an environmentally friendly and sustainable manner:

1. Prior to the mining activities begin, an inventory of native plant species will be carried out. The aim is to establish nurseries by collecting local plant seeds to rehabilitate disturbed site and bring the site to its original condition.
2. At the mining stage, top soil, will be collected and stored at designated locations and will be used again during the reforestation process.
3. The rehabilitation process will include consultation with the landowners and can be used as a community development program.
4. Soil erosion and surface runoff is one of the negative impacts on the environment due to open mining activities, therefore it is necessary to take action to prevent this. One way to do this is by constructing terraces on areas of land that have a slope 5 -40%. The terrace will be equipped with a drainage system. This serves as a device to control surface runoff and soil erosion including organic material from being washed away.
5. Furthermore, all mined pits will be progressively backfilled with mine waste rock or overburden during mining operations.
6. The mined area will be replanted after spreading the top soil stockpiled.
7. The replanting process can be done naturally, i.e. after the formation of topsoil on the surface or with special treatment in certain areas to be able to accelerate the process of plant growth because the soil on the surface has undergone a compaction process and cannot absorb water properly.
8. Remodelling the mined land by adjusting the mined area to the surrounding landform, this reduces the possibility of erosion, by reducing the slope angle and length, and allowing the natural drainage pattern to be rebuilt.

2.5 Rehabilitation

For purpose of rehabilitation, the company proposes to engage locals to involve in the rehabilitation plan. The rehabilitation scope will include natural revegetation and the use of local species and economical species to rehabilitate disturbed sites. The Mine Rehabilitation

Plan will be developed as part of the Environmental Management Plan (EMP) at the mining stage. SIRC rehabilitation strategy will include:

- Top Soil Management (recovery and reapplication);
- Establishing a natural vegetation community (natural revegetation and enrichments plantings);
- Agro-forestry systems;
- Establishment of a nursery; and
- Conserve patches of forests.

2.6 Feasibility studies and plans

The company has engaged consultants to undertake feasibility studies including port, engineering and economic studies to establish the economic viability market supply of the ore resources. This will also include the Environment Impact Assessment (EIA) studies for purpose of identifying the potential impacts and the possible mitigation measures to reduce the impacts to acceptable levels.

The Plans for the mine design will be made available soon and will be submitted with the mining application in due course. Currently, the company is undertaking prospecting activities that involve;

- Soils and rock chips sampling;
- Pitting and augering and trenching;
- Drilling;
- And employed locals that involve and engaged to do other works in relation to mineral exploration.

The company is planning to train and employ as many locals as possible for skills transfer so that they can be able to do jobs that will enable the company achieves its goals. At the same time enable them to do other important jobs to develop their local communities and the country as a whole.

2.7 Mining components

The main mine site infrastructures and facilities that will support the mining includes:

- Port Area Infrastructer and Facilities;
- Ore Handling systems and transportation facilities;

- Temporary Stockpile Area, sediments and erosion control structures and bench access;
- Accomodation and Camp facilities;
- Power supply and Reticulation;
- Water Supply;
- Landfill;
- Workshop facilities;
- Core storage and Laboratories;
- Communications systems;
- Fuel oil and other hazardous storages; and
- Fire protection and emergency response facilities.

2.8 Existing land use and development activities

Much of the land cultivation are evident 3-4 kilometers northwest and southeast from the tenement area, where villages, settlements and hamlets are located. Logging activities occurs on the mainland northwest towards Kaevanga, southeast towards Midoru and westward on San Jorge Island. Axiom's campsite is located 5 kilometres southeast and the former Tsumitomo Metal Mining main camp on Santa Isabel is located on the island of Kokatoo, 5 kilometers further southeast from Kolosori. See section on cumulative impacts for details.

3. LEGAL AND POLICY FRAMEWORK

Environmental impact assessment in the Solomon Islands is provided for under the Environment Act of 1998 and the accompanying regulatory instrument, the Environment Regulation, 2008. The Act and regulations are administered by the MECDM.

3.1 Solomon Islands Environment Impact Assessment Process

The Environment Impact Assessment guideline is design to administer the schedule 16 of the Environment Act 1998. The guideline comprise of EIA procedural descriptions, stakeholders in the EIA process and fees required for development type. “The guideline was prepared by the ECD with the aim of simplifying the procedures in the Act, provide basic advice and guidance to government officers, planners, developers, resource owners on the environment impact assessment process” (MECM, 2010). The EIA guideline was recently reviewed by a Technical Assistance under the Asian Development Bank (ADB) in 2015. This guideline is used to provide guidance on the preparation of this EIS.

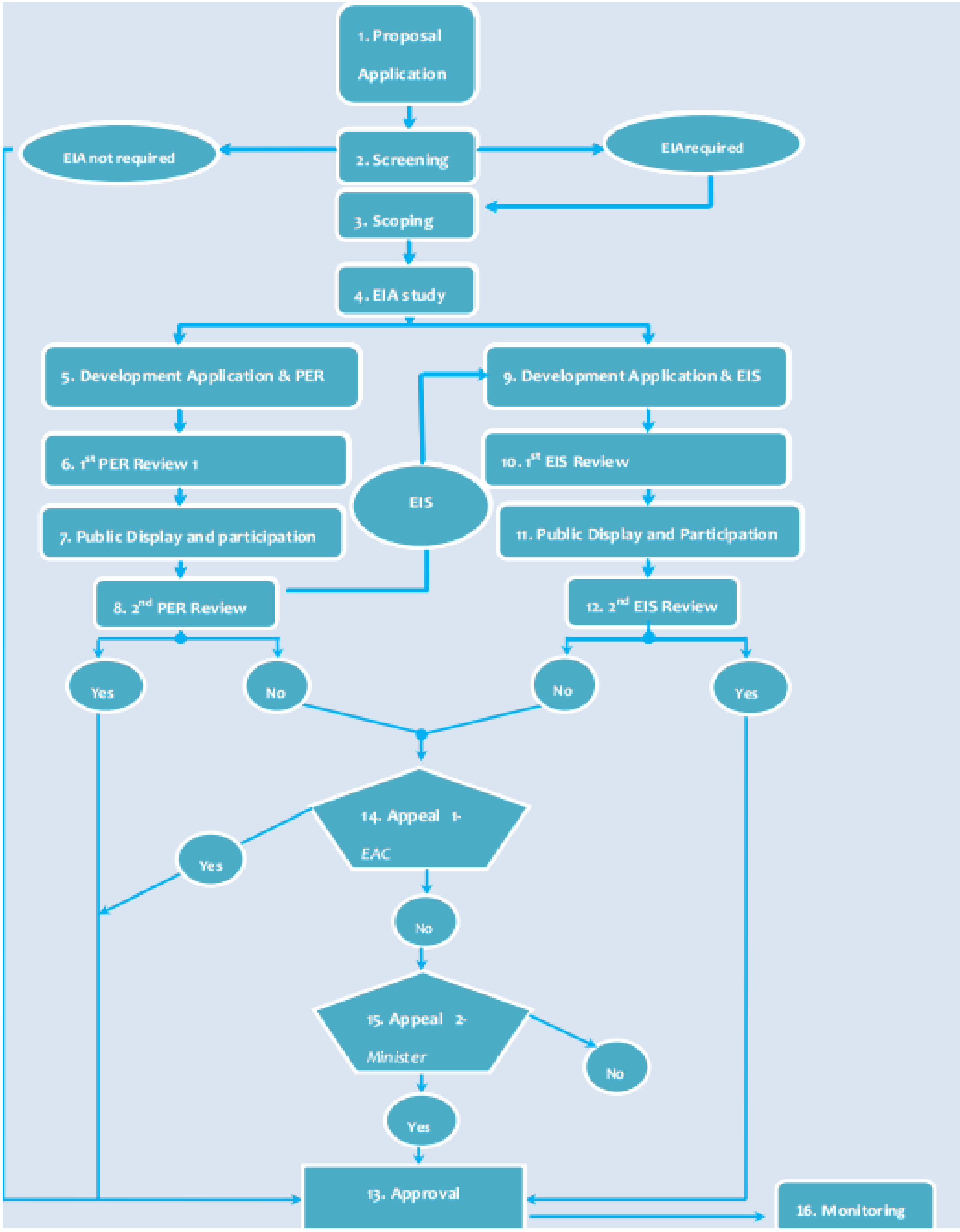


Figure 10: Procedural steps of an EIA[1]

[1] MECM,2015, EIA Guideline

3.2 Acts, Regulations and Ordinances

3.2.1. Environment Act 1998

The Environment Act covers all the environmental issues in Solomon Islands and makes provisions for conservation and protection of the environment and establishes the ECD whose function is to administer the environment legislation. The Act provides for an integrated system of development control, EIA and pollution control. The Environment Act has considerable power by virtue of article 4 (1) which states that in the event of conflict between the Act and other Acts, the provisions of the Environment Act shall prevail[2].

As required under Part III of the Act, all developers must make an application for development consent together with the relevant EIA report and any other relevant information as may be required by the Director of ECD. The Director with responsible staff and government agency then reviews the application with the relevant EIA report and make decision whether to grant or not to grant development consent. The developer shall not commence operation or continue to carry out any prescribe development unless it has complied with relevant provisions of the Act, been issued a 'development consent', or the Director exempted the development from relevant approval requirements.

3.2.2. Environment Regulation 2008

The Environment Regulations 2008 covers detailed requirements for EIA. All prescribed developments require a simple assessment through "screening" or "scoping" process, to see what form of assessment is required. Most development projects require a Public Environment report (PER), while many major projects will also need a second stage of appraisal which include technical, economic, environmental and social investigations presented in an EIA or EIS report. Forms 1 and 3 are relevant forms in second schedule of the environment regulation that provides guidelines to assist in preparation and drafting of the EIS/PER.

[2] *Solomon Islands Environment Act 1998.*

3.2.3. Land and Titles Act 1996

The Land and Titles Act is the major legislation that deals with land tenure in the Solomon Islands. Three main categories of land are recognized under the Act and that include:

(1) Customary Land;
(2) Fixed Term Leases;
(3) Perpetual Estates

The Lands and Titles Act has a system of registration of different types of leases which allows individuals and groups to acquire titles to land and own land but one must develop the land that has been acquired or registered or else loose the title to the land. In terms of mining, the land will be leased to the mining company by landowners for several years for mining operation. In the case of SIRC, the proposed land where mining will take place is a registered land, a perpetual estate by the landowning group who will lease their land to SIRC for some years in order for the company to mine the mineral of interest in the land.

3.2.3. Mines and Minerals Act (Amendment) Act 2008

Provide management for mining and mineral prospecting by regulating controls in all mining and prospecting associated activities including alluvial mining. Part II of the Act regulates the mandate of the Minister to designate any area as a reserved area and prohibit the carrying out of reconnaissance, prospecting or mining thereon[3]. The same section also stipulates reconnaissance, prospecting and mining are prohibited on any village, place of burial, tambu or other site of traditional significance, inhabited house or building, any cultivated land or land rendered fit for planting and habitually used for the planting of crops, any land designated as town land, under the Lands and Titles Act, any state forest or controlled forest within the meaning of the Forest Resources and Timber Utilization Act unless some kind of arrangement authorized by the Minister in consultation with landowners and commissioner of forestry are established.

Some areas in the country have controlled forest but they are being imperfectly located and mapped, example Tubi forest in Isabel. Although not Gazette, Tubi species is unique to

[3] *Mines and Minerals Act (amendment) 2008*.

eastern parts of Isabel and Choiseul Islands. Non-Governmental Organization (NGO) s and government agencies are putting together efforts to conserve the species.

SIRC will need to inform the Director of Mines and Minerals in writing, the scope of development and if there are diversion to water ways. The Director shall issue a permit for development seeing that it does not impede local communities and losses to land.

Section 65 outlines the format of the Building Materials Permit (BMP) application that will be made to the Director of Mines with a prescribed fee that is usually paid at the Inland Revenue Division (IRD) and a receipt attached to the application. Section 66 outlines the forms and content of the BMP application, and Sections 67 and 68 have provisions regarding the rights and obligations of the BMP holder respectively. While Section 69 provides for exemptions for the national government or provincial government to mine building materials on any land that is owned by a government department or a provincial government.

3.2.4. Environmental Health Act [Cap 99]

The Environmental Health Act (Public Health Act), enacted on 1st August 1980, provides for the management and control of community health in Solomon Islands. Mainly administered by the Minister, the provisions also identify Enforcement Authorities for purposes of preventing the occurrence or for checking the spread of any noticeable diseases, provision and protection of water supplies and management of drainage and sanitation practices.

The Public Health Act serves as the Health Impact Assessment reference in identifying the necessary practicable measures for preventing all conditions liable to injurious or dangerous to health arising from the erection, or occupation of the mining project. The Act will be utilized to ensure any diseases that may arise in the future due to the mining operation on Isabel by SIRC will be curbed so that no emergency situation will be reached.

3.2.5. Safety at Work Act 1982

The Safety at Work Act 1982 regulates health and safety at work. The Act protects the health, safety and welfare of workers.

- Part II: Article 4 states that it is the duty of every employer to ensure the health and safety at work of his employees.
- Article 6: states that it is the duty of the employer to provide a safe workplace for persons other than his employees.

- Articles 7 and 8: requires manufacturers, suppliers of tools and equipment and suppliers of chemicals and other hazardous substances to ensure that these are safe and without health risks.
- Article 12: states that any employer who operates unsafe machinery or substances and is injured will be responsible for the damages.
- Part III: Article 15 requires the employer to protect people from dust, fumes, etc. Article 16 provides for limits of exposure to dust and fumes.
- Articles 17, 18, 19 and 20 require employers to comply with the operating requirements for: (i) pressure and vacuum systems; (ii) machinery; (iii) dangerous machinery; and (iv) electrical installations.
- Articles 21 and 22 require workplaces to have fire protection and to take precautions against explosions[4].

Importantly this Act is the basis for which the company is required to prepare the site specific Health and Safety Plan which will be implemented by the company for the safety of its employees and will be monitored by relevant authorities.

3.2.6 Protected Areas Act 2010

The Protected Area Act 2010 was developed with the objective of establishing protected areas to conserve biological diversity. In order for an area to become a protected area (PA), a community or organization will prepare an application to the Director of Environment for their site to be declared as a protected area. The application will need to include a PA management plan and scientific studies to show that the area is of significance to biological diversity and to the community in terms of natural resources. The application will also include an estimated budget for the PA and evidence of agreement by all customary landowners, map showing the boundary and size of the site. The director upon receiving the application will review the application and make recommendation to the Minister if the application have merits and should be declared a PA. The basic requirements for considerations by the minister include;

- (a)the conservation objectives of the protected area are identified and are in accordance with sound conservation practices;

[4] *Solomon Islands Safety at Work Act 1982.*

- (b) the boundaries of the area are accurately identified, or otherwise demarcated and surveyed; (c) the consent and approval are obtained from persons having rights or interests in the area;
- (d) an appropriate conservation, protection or management plan is developed for the area to ensure that the conservation objectives of the protected area will be achieved[5].

Meanwhile, there are no protected areas declared under the Act within the Tenement.

3.2.7. Wildlife Protection and Management Act 2010

The Wildlife Protection and Management Act 2010 provides for the conservation, management and protection of wild flora and fauna in the country. It regulates the export and import of wildlife ensuring compliance to obligations set under the Convention on International Trade in Endangered Species (CITES). The Solomon Islands is a refuge for many species of wildlife (that includes rare and endemic). Therefore it needs to protect and manage these endangered and unique species effectively. The act prohibits the poaching of wild fauna and flora as well as harvesting of protected species. With this, SIRC shall ensure its workers are frequently informed not to undertake poaching of flora and/or fauna. This shall be prohibited under the company's policy as well.

3.2.8. Rivers and Waters Act 1996

The Rivers and Waters Act was enacted to administer and control developments that would impact on a river, however the Act only applies to rivers that have been designated under the Act. The River waters Act which was firstly enacted on 30th December 1964 and recently revised in 1996 is an important Act that is aimed at regulating the proper use, protection and management of waterways. It was made clear in the Act that it is an offence to create a ditch, drain, channel, pipe or any other means whatsoever diverts any water from rivers, felling of trees so that it falls into a river or river bed is also an offence, damages or interferences with the banks of any river is also an offence. Unless carefully following legal procedures, doing this activities are not acceptable. With this, it is important that prescribed developments must be cautious with respect to watercourse ways as far as this Act is concerned.

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[5] *Solomon Islands Protected Areas Act 2010.*

3.2.9 Waters Resource Bill

The Bill has been prepared to go through parliament and if approved and passed by parliament and gazetted, it will supersede the Rivers Waters Act 1996. The purpose of the proposed Bill is to:

- Provide for the integrated water resource management of Solomon Islands;
- To promote the most efficient, fair and beneficial use of natural water;
- To ensure the natural water resources are available for the sustainable use for the benefit of all present and future Solomon Islanders;
- To provide for the protection of natural watercourses and water catchments; and
- To provide for the control of activities occurring over or beside waterways or watercourses[6].

A Water Resources Advisory Board is required under the River and Waters Act, whose function is to advise the Minister on matters pertaining to the Act and consult with the Director of Water Resources on technical matters. The Director with his/her staff shall administer, manage and implement the Act accordingly so as to achieve the above goals.

The Bill covers all water bodies, rivers, streams whether in a registered or non-registered, public or private or customary land in the Solomon Islands. The Ministry has the authority to control the use and development of all water catchments and riverbanks. Logging, mining, sands and gravel extraction in water catchments, riverbanks and river beds may be restricted by the responsible Minister according to the requirements of the catchment management and conservation. Section 21 of the River and Waters Act provides for the Ministry to recommend to the Board to declare a water body such as a catchment, groundwater or flood control zone as a Water Control Area. If approved by the Minister and gazetted, mining, and sand and gravel extraction will be prohibited. This also includes any contraction, altering, removing or in any way impede or be likely to impede flow or movement of surface water. This is very important as it may have direct impact to mining in the future if the current activities are not managed sustainably.

[6] *Solomon Islands Water Resource Bill*

The Bill clearly states that a development must not obstruct, divert or dam the river, if so it must make application to the Minister who upon receiving the request will assess and if agrees will issue a license accordingly.

3.2.10. Custom Recognition Act 2000

The Custom Recognition Act 2000 provides recognition to the existence of any customary law and the nature of such customary law in relation to a matter, and its application in or relevance to any particular circumstances, shall be ascertained as though they were matters of fact[7]. However, the existence shall be provided in proof as required under section 5 of the act.

3.2.11. Shipping Act 1998

The Shipping Act 1998 was purposed for protecting (ensuring safety and health) the shipping industry. The Act gives effect to the International Maritime Organization (IMO) to manage risk, dangers and cleanliness in the marine environment.[8] Part IV mentions the responsibility to respect the safety of all equipment, off and on load the vessel including human beings which applies to safe disposal of wastes (pollutants) to the ocean causing dangers/hazardous to the marine environment and habitat. It is possible that larger vessels coming in to the country to load bulk bauxite soils can cause pollution. Therefore the Act is important to ensure safety in loading of nickel ore.

3.2.12. Shipping (Marine Pollution) Regulation 2011

The shipping regulation was amended into the Shipping Act, which has special emphasis on pollution of the marine environment.[9] The regulation has provisions for and links Solomon Islands to rectifying the IMO. It catered for safety and security of shipping and prevention of marine pollution by ships and MARPHOL.[10] Under this Regulation, no pollution and or harmful substances are to be discharged from vessels, platform or land into the Solomon Islands waters or from a Solomon Islands vessel into any waters. If a person contravene with the

[7] *Solomon Islands Customs Recognition Act 2000*
[8] *Solomon Islands Shipping Act 1998*
[9] *Solomon Islands Shipping (Marine Pollution) Regulation 2011*
[10] ibid.

provisions and standards, the person is liable/guilty to pay fine or serve imprisonment.[11] The enforcement also includes meeting the immediate cost of restoration, rehabilitation and cleaning up within a set timeframe.

The regulation prohibits the discharge of ballast water that contains non-indigenous aquatic organisms (invasive organisms) or microorganism (pathogens) in the Solomon Islands waters. If any harmful and/or hazardous substance discharged to the marine environment in Solomon Islands waters is found to be a health risk, the person in command of the vessel must report to the Principle Surveyor (an officer appointed under the Act). This is also applicable to MPAs or Local Marine Management Area (taboo areas) declared under the Protected Acts 2010. The Director of Marine and the Permanent Secretary responsible for Disaster Management had to be informed of any discharge.

3.2.13. Ports Act 1990

Section VI of the Act makes provision for discharge of waste, etc. into and other pollution of the port.[12] It states that no person shall cause, suffer or permit any refuse, gas, petroleum oil, bilge water, ballast water or other offensive substance whatsoever its nature to be discharged, pumped or cast into or onto any waters or land within the limits of a port without the prior written permission of the SI Ports Authority. This is only relevant for vessels coming to port at the Point Cruz wharf and the Noro Township Port and may not be necessarily relevant to this proposed mining.

3.2.14. Agricultural Quarantine Order 1985

The Order of 1985 provides for preventing the introduction of disease into Solomon Islands through the importation or landing of animals, plants and other things, and preventing the introduction of pests and undesirable plants; for requiring vessels and aircrafts to give notice of their arrival in Solomon Islands; and for connected purposes[13]. This Act grants regulation-making powers to the Minister in respect of the introduction or importation of plants and animals and substances or other material that may be the carrier of plant or animal pests and diseases. The Act further provides for the appointment of inspectors and defines their powers

[11] ibid.
[12] *Solomon Islands Ports Act 1990*
[13] *Solomon Island Agriculture Quarantine Act 1982*

and prescribed list offences. An Order of the Minister may prohibit or regulate the importation or landing of: (a) animals and animal products; (b) plants; (c) earth; and (d) other things by, or by means of, which it appears to the Minister that any disease or pest might be introduced[14]. The First Schedule sets out the matters which may be dealt with by Order made under this Act. This is important for this proposed development as most of the larger vessels will be coming from overseas especially Asia and that Quarantine will be paramount to ensure no diseases are brought in by those vessels.

3.2.15. Forestry and Timber Utilization Act 1979

The timber rights agreement under this act is a legally binding contract made under the Form 4 and has clear conditions attached to it. These conditions include pollution prevention measure, all oil, fuel, chemicals and other pollutants shall be stored at a safe distance (buffered zone away from any river or water course in secure conditions with safeguards against accidental contamination of water).[15] It clearly stated that no refuse, sewage, rubbish, oil, fuel or other pollutants may be discharged into any river, pond, and stream or water source by the Company or any of its employees or sub-contractors. This Act is specifically for logging development whereby loggable trees will be exploited for economic purposes. The processes stipulated in the Act may be required to be followed by the Company if and whenever, economical trees cleared from the tenement need to be exported overseas. There are economical trees in the tenement and before the actual mining, some of these economical trees will be exploited and there may be a need for these trees be sold overseas. Should the need arise, specific processes according to the Forestry and Timber Utilization Act will be adhered to.

3.2.16. Provincial Government Act 1997

The Provincial legislative authority derives from a combination of this Act and the accompanying devolution orders.[16] The Devolution Orders enable each province to make legislative power over a range of matters of direct relevance to natural resource management and environment. Power for making ordinances over wildlife and marine resources is also

[14]ibid

[15] *Solomon Islands Forestry and Timber Utilization Act 1979*

[16]*Solomon Islands Provincial Government Act 1997.*

devolved under the Provincial Government Act 1997. Provincial legislative authority derives from a combination of the Provincial Government Act 1997 (PGA) and the accompanying devolution orders (PGAs33).[17]

The Provincial Government Act 1997 Schedule 3 provides a list of activities for which the provinces have responsibility and have the power to pass ordinances;

- Trade and Industry - Local licensing of professions, trades and businesses, local marketing;
- Cultural and Environment Matters - Protection of wild creatures, coastal and lagoon shipping;
- Agriculture and Fishing - Protection, improvement and maintenance of fresh-water and reef fisheries;
- Land and Land Use - Codification and amendment of existing customary law about land. Registration of customary rights in respect of land including customary fishing rights;
- Local Matters - Waste disposal;
- Rivers and Water - Control and use of river waters, pollution of water;
- Corporate or Statutory Bodies - Establishment of corporate or statutory bodies for provincial services including economic activity.

3.2.11. Provincial Ordinance

The provincial government is being given power under the Provincial Government Act to pass by-laws that are important to protect and perhaps improve the wellbeing of people. With that, the Isabel Provincial Government was known to have gazette the Conservation Area Ordinance which provide guidance towards conservation of certain areas including the Arnavon Islands and other conservation or protected areas on the Island.

[17] *Jan McDonald, 'Marine Resources Management and Conservation in Solomon Islands: Roles, Responsibilities and Opportunities' (Griffith University 2006)*

3.2.12. Unexploded Ordinance (UXO)

Technically WWII ordnance found in the Pacific Islands can be defined as either unexploded (UXO) or abandoned (AXO). Unexploded ordnance is defined as explosive ordnance that has been primed, fused, armed or otherwise prepared for use in armed conflict but has failed to explode. Abandoned explosive ordnance is defined as explosive ordnance unused during an armed conflict and subsequently abandoned or left behind. UXO and AXO are defined collectively as Explosive Remnants of War (ERW)[18.]

Solomon Islands was the scene of bitter fighting during World War II. While this was over 60 years ago, unexploded (UXO) may still be found around our islands including Isabel Island. Should UXO be discovered, the contractor is to immediately cordon off the area, arrange the evacuation of nearby residences and inform the police of the find. Currently all UXO finds are reported to the police who arrange the pickup, transport, storage and ultimate disposal of the finds. It is possible that during the mine construction and operation phase of the mine UXOs could be found. In such case, a chance find procedure for handling the UXOs during the mine construction and operation phase. This will be the responsibility of the mining company. Ultimately, there is a need the whole tenement is cleared of UXOs before the actual mining begins.

3.2.13 Emergency powers (covid-19) (no.2) regulations 2020

The COVID 19 regulation gives power to the Prime Ministry under the Emergency Powers Act to declare emergency zones within the country. This is in responds to contact and spread of the COVID 19 disease. SIRC employees will include workers from oversea. It is therefore important, SIRC adhered to the regulation and COVID 19 guidelines implemented by relevant government agencies.

3.2.14 Public Health Emergency Bill

The government has established a legislative committee to oversee development of public health emergency bill. It is a Bill intended to protect our country and people in times of a public

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[18]Francis S, L and Alama L, 2011. *World War II Unexploded Ordnance,* Retrieved at URL on 29th of October 2013 at URL: http://www.forumsec.org/resources/uploads/attachments/documents/UXO%20final.pdf.

health emergency. The piece of legislation only kicks in when there is a declared public health emergency. As such, there is no need for a state of public emergency to be declared in the event of a public health emergency. Stakeholders include the Ministry of Health and Medical Services, Ministry of Police and National Security, Ministry of Education and Human Resources Development, Ministry of Fisheries among other government Ministries and National Disaster Management Office[19].

3.3 Solomon Islands National Policies

3.3.1. National Development Strategy (NDS)

The National Development Strategy is a policy document that strategizes ways in order to achieve the development aspirations of the country. Using the 17 Sustainable Development Goals (SDGs), "Transforming our World: the 2030 Agenda for Sustainable Development" as a reference, the NDS highlight five important long-term development goals. Mining for instance aligns with objective one of the NDS "Sustained and inclusive economic growth". Proposed mining will contribute significant revenues directly to the SIG. It is anticipated that a proportion of taxes and royalty benefits will be used for local social infrastructure and social development such as education, healthcare and among others long term community projects in southern part of Isabel Province. Not only that, more local people in the area and elsewhere in the country will be employed during the construction phase and operation phase of the mine.

3.3.2. Climate Change Policy

The Solomon Islands Government through the MECDM launched the Climate Change Policy, highlighting steps the SIG would take in aiding the country and its people to exist and adapt to present imminent climate change and its impact. The Policy aims to integrate climate considerations within the framework of national policies, and guiding the government and its partners to ensure the people, natural environment and economy of the country are resilient and able to adapt to the predicted impacts of climate change. To enable the local community become climate change resilient, the company will be embarking on replanting economical

[19] https://solomons.gov.sb/public-health-emergency-bill-consultation-in-full-swing/

trees on mined over areas so that carbon sinks are replenished despite the original vegetation may be changed.

3.3.3. National Environment Management Strategy

The primary document for environment policy in the country is the 1993 National Environment Management Strategy (NEMS), although outdated; it is an import document at the present time in the absence of an environment policy. It ensures, that the physical and social environment are protected and sustainable development is achieved.

3.3.4. National Waste Management and Pollution Control Strategy

The formulation of the National Waste Management and Pollution Control Strategy (NWMPCS) 2016-2024 is part of the ongoing efforts in the country to address the issue of waste and pollution as the country enters a period of rapid social and economic change. The objectives are:

1. The development of our natural resources does not compromise the wellbeing of natural environment, ecosystems and wellbeing.
2. Ensure that existing legislations, strategies and guidelines on waste management and pollution control are effectively implemented and enforced.
3. Support, Encourage 4Rs and where relevant regulate waste minimization for solid wastes noting that organic waste form a large component of wastes produced in the country.
4. Develop institutional capacity and train waste and pollution experts for the country.
5. The government through MECDM, provincial government and Ministry of Infrastructure Development (MID) ensure that all provincial centres have in place proper landfills or waste disposal sites and a functioning waste collection system.
6. All Solomon Islanders are aware of the issue of waste and pollution and are taking appropriate actions address it.
7. Waste management and pollution control activities are undertaken based on accurate data and research, update information, new innovation and technology
8. Encourage public-private partnership and investment in waste management and pollution control.
9. There is in place a long financial mechanism in place at the national level to manage waste and address pollution issues.
10. International guests and tourist are able enjoy and enjoy the natural beauty and aesthetic value of the country.

11. Waste management and pollution control is fully addressed in responding to climate change and natural disasters.

One of the highlights of the strategy is the management of e wastes such as solar batteries. It is important all waste collection and disposal associated with the mining development are in line with the strategy. As part of its commitment to reducing waste, the company will prepare a Waste Management Plan that will be implemented during the mining operation on Isabel Island.

3.3.5. National Minerals Policy 2017

The National Minerals Policy envisions that “The mineral resources of Solomon Islands will be developed for the benefit of all the people of our country in a way that causes minimal environmental impact and respects the different cultures, interests, and relationships that make up this diverse community, both now and for future generations.

The way mining industry is governed is limited to a few and is exclusive rather than open and inclusive. Decision-making is concentrated in the hands of a few. The Policy identifies that a more inclusive of the different parties impacted by mining is necessary for both social cohesion and investor confidence. While some mining companies include communities and other local actors in decision making, this tends to be on an ad hoc basis. Provincial Governments have typically been excluded from sector decision making and information sharing. Bringing Provincial Governments into the fold is critical not only for investor confidence but also for identifying culturally appropriate ways of responding to issues and managing grievances arising from mining activities. Sharing responsibility for the sector is not, however, enough. Capacity at all levels needs developing. The Government envisages this policy as being the starting point for a significant capacity support programme, encompassing not just the National Government but all stakeholders affected by mining activities.

3.3.6 National Implementation Plan for the Stockholm Convention on Organic Pollutants.

The Stockholm Convention on Organic Pollutants is an international treaty signed by one hundred fifty countries to eliminate the use of persistent organic pollutants and toxic chemicals that have impacts on human health. NIP is a fulfilment of SIG commitment to the treaty and comprise of actions the country can implement to eradicate the use of POPs and toxic chemicals. Majority of these POPs and chemicals are imported from oversees. These chemicals are fairly important to all sectors of development including mining in our case. The SIRC waste management manual for this mining will ensure such chemicals or POPs are strictly forbidden from being used in the operations or if they are required or part of any materials used for the mining will be disposed according to this NIP.

3.4 International Environmental and Social Treaties

Solomon Islands is a party to some of the international treaties and conventions. See table below:

Table 8: Multilateral agreements

Multi-lateral Agreements that the Solomon Islands is a party to Convention or Treaty	Status	**Purpose/Aim**	**Agency Responsible**
Regional MEAs			
i. Pollution Protocol for Dumping	Ratified 10/9/98	Prevention of pollution of the South Pacific region by dumping	Marine Div/ECD
ii. Pollution Protocol for Emergencies	Ratified 10/9/98	Cooperation in combating pollution emergencies in the South Pacific region.	Marine Div/ECD Project: National Pollution Prevention Plan
iii. Natural Resources & Environment of South Pacific Region (SPREP Convention)	Ratified 10/9/98	Protection of natural resources and environment of the South Pacific Region in terms of management and development of the marine and coastal environment in the South Pacific Region.	ECD
iv. Waigani Convention on Hazardous & Radioactive Wastes 1995	Ratified 7/10/1998	Bans the importation of hazardous and radioactive wastes into Forum Island countries and to control the trans-boundary movement and management of hazardous wastes within the South Pacific region.	ECD
Chemicals, Wastes and Pollution			
i. Liability for Oil Pollution Damage	Ratified	Strict liability of ship owner for pollution damage to a coastal state within a certain amount.	Marine Div
ii. Marine Pollution Convention (London)	Ratified	Prevention of marine pollution by dumping of	ECD/Foreign Affairs

		wastes and other matter.	
iii. Desertification (UNCCD)	Acceded 16/4/1999	Agreement to combat desertification and mitigate the effects of drought in countries experiencing drought or desertification.	Agriculture Div/ECD Project: National Action Plan on Land Degradation and Drought; National Capacity Self-Assessment (NCSA)
iv. POPs Convention (Stockholm)	Acceded 28.7/2004	Protection of human health and environment from persistent organic pollutants.	ECD/Environmental Health Div. Project: National Implementation Plan
Biodiversity			
i. CITES	Instrument of ratification being prepared	Regulations and restriction of trade in wild animals and plants through a certification system of imports and exports.	ECD
ii. World Heritage Convention	Acceded 10/6/1992	Protection of sites of Outstanding Universal Values. Solomon Islands currently has East Rennell Island as a World Heritage site.	Museum/ECD
iii. Convention on Biological Diversity (UNCBD)	Ratified 3/10/1995	Conserve biological diversity through the sustainable use of its components and the fair and equitable sharing of the benefits arising out of utilizing genetic resources.	ECD Project: NCSA; National Biodiversity Strategy and Action Plan; International Waters Program; 3rd National Report
iv. Cartegena Protocol	Acceded	Protection of human health and the	ECD

4. ANALYSIS of ALTERNATIVES

4.1 Background

This section looks at undertaking the various alternatives of the mining. There are four basic options: (1) Alternative mining technology and design (2) Alternative Locations (3) Alternative infrastructure (4) leave the mining as it is now without undertaking mining. If the mining were to continue, it would be necessary to take technical, environmental and social aspects of the mining into consideration and ensure that these concerns are adequately considered in the decision making. It is therefore important to consider all practicable options and ensure that the best available option(s) is/are chosen. The following section details the development options.

4.2 Alternative mining technology and design

The mining methodology for extraction of the ore is an open cut strip mining. This method normally used when the minerals are found over a large area and relatively close to the surface. Since, the Saprolitic layer where nickel can be found 10-12m below the ground surface, vertical extraction would require an open cut strip mining as the feasible option. This means the extraction will commence at the top rather than at the base. Every location of pockets will have an extraction design and risk assessment to ensure environmental and social impacts are minimized. The company will design and furnish all materials and equipment to be fully compatible with the open cut strip mining taking it consideration the environmental and space conditions of the site.

The mining here at Takata will not involve processing of the ores since the economic viability for establishing such plant is uneconomical at this stage. All ores will be transported offshore for processing. Offshore processing reduces further impacts to the environment.

4.3 Alternative locations

The Takata area had been explored and such investigations over the years indicates that majority of the ores are located on the ridges and hills. As a result there are no option for alternative locations but to mine potential sites identified to have ore deposits. These are often called ore pockets. Open cut strip mining requires removal and stockpile of top soils and the limolitic layer. These will cause migration of sediments to rivers and coastal environments causing turbidity. Stockpile of secondary materials including top soil will be near the pit with proper diversion drainages and sediment ponds. Approximately sixty eight sediment ponds were proposed for the tenement area. However, this will be reviewed from time to time during the operation to see if there are needs for additional sediment ponds.

4.4 Alternative infrastructure

4.4.1 Road networks

The company will build and upgrade existing roads to access deposits and site relevant to the mining operations. The survey recorded a few road networks that can be upgraded to minimum road standards to facilitate movements during mining. All roads networks will be constructed within the tenement area on the approval of the landowners. Minimum road cross section requirements are 8m carriage way, 1m shoulder and 1m drainages on both sides. A total of 10m road corridor. These parameters will be applied to relevant sections only and when necessary.

4.4.2 Port Area

The current facility is shallow and restrict movements due to offshore reefs. The port area would only allow landing craft with minimum load capacity. All ores will be loaded into a landing craft which will then be trans-loaded to larger vessels. Decking of ships at the current facility is restricted and not allowed. This is so to avoid any unforeseen events related to wreckage and damage to corals. Loading will be carefully assessed and monitored to avoid any risk of accidents for example spillage of ores on the coastline. Refer to Annex 14.5. Port Study Plan.

4.5 The No Mining Option

The “No Mining Option” implies not proceeding with the mining rather choosing to leave the tenement area as it is at the current state, which is certainly provided no alternative for the mining. Hence, no impacts on the social environment what so ever. This eliminates all benefits from the mining to the SIG, province and landowners. It is equally important to consider the positive benefits of the mining and collective efforts to avoid the potential negative environmental and social effects.

5. PHYSICAL ENVIRONMENT BASELINE

5.1 Introduction

This section discusses the environment baseline of the proposed Takata Tenement Area. The baseline information are based on literature review and on site field work in June 2019. The objectives of the environmental baseline were to assess the present state of the environmental conditions in the tenement area, and to provide a basis for evaluating environmental impacts and issues related to mining construction, operations, decommissioning and rehabilitation. The Takata and Kolosori tenements were extensively examine and assessed by INCO. Prospecting Company, Solex, Tsumitomo Metal Mining and Axiom Mining Ltd. in the past. The Axiom Mining Ltd. and Tsumitomo Metal Mining EIS reports were cited and relevant information were used in this EIS report for comparison.

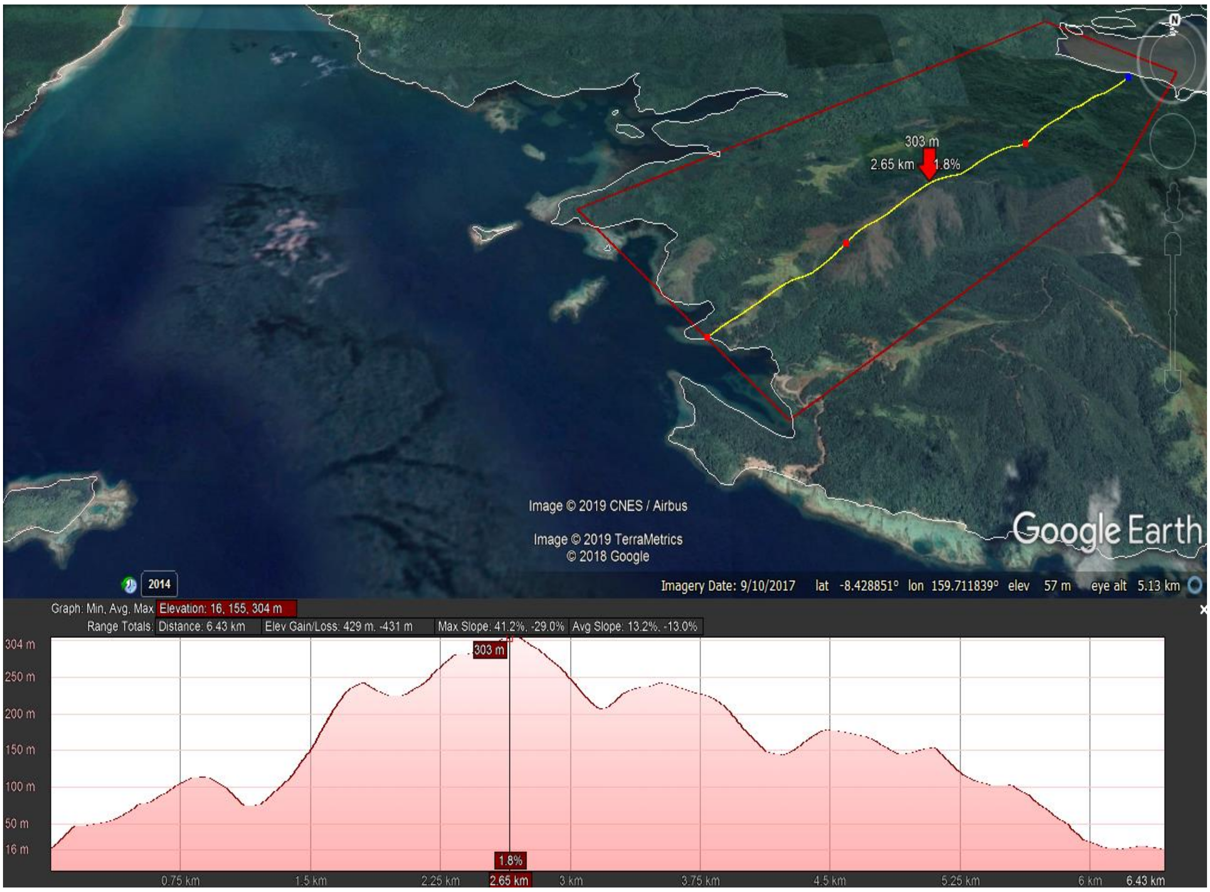
5.2 Topography and Geomorphology

The Isabel Island has been divided into ten physiographic regions, namely; San Jorges-Sakile area, Mbughotu peninsula, Jajao-Hograno footh ills, East-central Mountains and ridges, Maringe-Gao hills and ridges, Ghadanga foothills, Rakata ridges and hills, west central ridges and plateau, Allardyce ridges and foothills and Western Islands. These regions resemble different landform namely; High long ridges, uneven ridges, ridges and hill areas, rounded hills and ridges, low and long ridges, low and short ridges, long radial ridges, karst, plataeux and cuestas, terraces, fluvial plains, swamps and littoral landforms. The coastal region and shorelines are covered with long narrow beaches protected by shallow coral reefs. Mt Sasari is situated in the physiographic region of Maringe-Gao hills and ridges and is the highest mountain on the main island rising up to 1,120 m above sea-level.

The proposed mining tenement area partially cuts through two physiographic regions, the San Jorge Saikile and Mbughotu regions. The Mbughotu peninsula facing east is mostly underlain by pyroclastic rocks and lavas of basaltic composition forming sharp topped hills and ridges. Lenticular masses of ultramafic rock are intruded into the basement rock forming isolated patches in the centre, east of the region and several islands in Huali Bay (Hansel and Wall, 1974). The highest peak in this area is Mt Tirimola jutting towards Tatamba area. The region contains no large rivers but there are few alluvial valleys. Mangroves swamps fringe the larger bays like Huali bay while freshwater swamps occur near Kamaosi and lower Kolongongo’e River.

The San Jorge –Saikile region comprise the San Jorge Island and mainland area directly east of the San Jorge. This region consists of distinctive low, rounded hills, radial ridges of low amplitude, terraces and swamps (Hansel and Wall, 1974). The region is entirely influenced by the presence of ultramafic rocks and derived sediments. The Ortega Channel comprise of extensive swamps and mangrove habitats. There are virtually no beach development on the coastline although onshore reef development occurs along the Takata coastline. The Piregha, Hugevi and Beahutu streams are fairly short rivers and follow angular courses in the hills and parallel course across swamps.

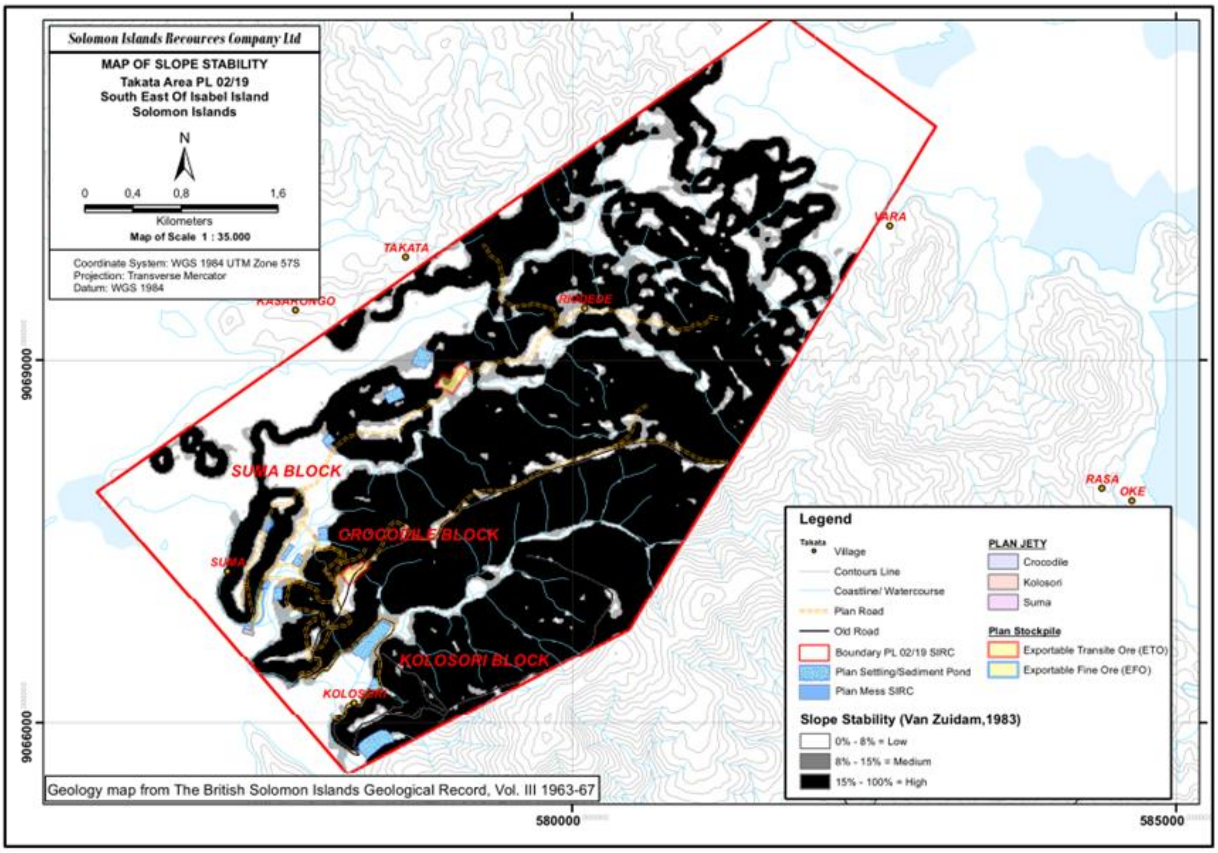
Figure 11: Suma to Huali Bay elevations



5.2.1 Slopes and Slope Stability

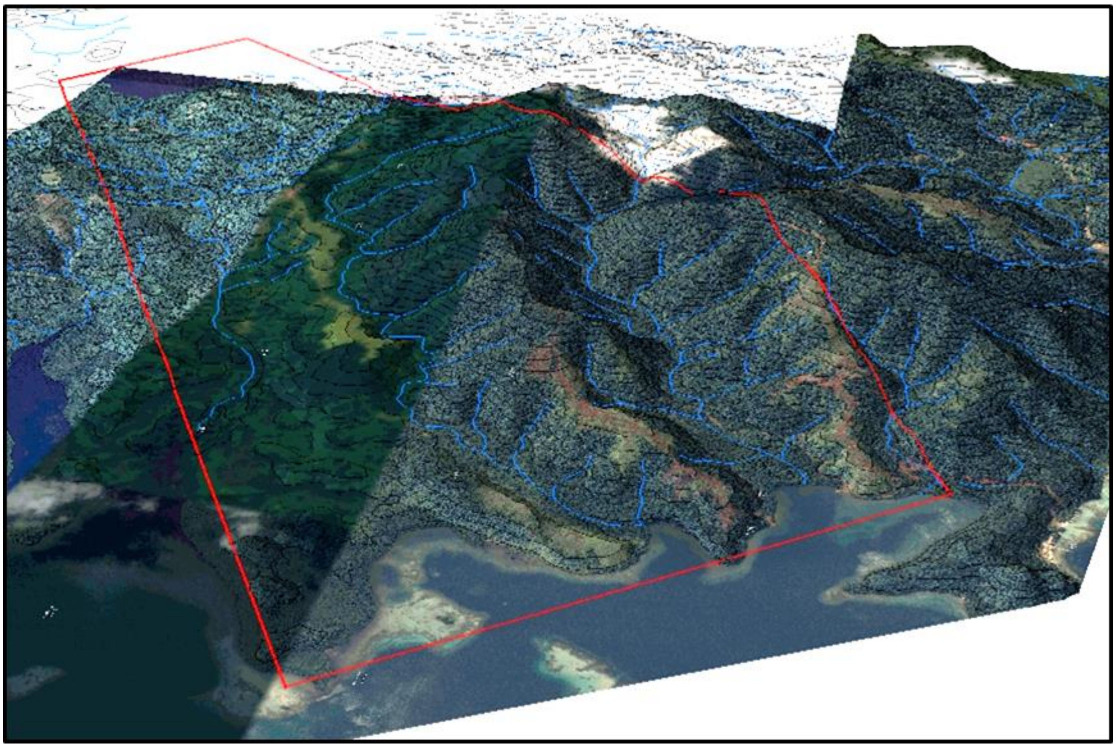
Topographically, the Takata tenement area can be divided into two parts, in the northern part of the tenement area is a plain with an average height ranging from 0 - 300 ft above sea level, while in the south it is in the form of hills with altitudes ranging from 600 - 1200 ft, these hills extend along the relative direction of WSW-ENE, with an average % slope above 15%.

Figure 12: Map of Slope Stability



Based on direct observations at work sites and the results of spatial data processing using the ArcGIS application, a general picture was obtained that the slope levels can be grouped into three parts, namely areas with a slope of 0% -8% have a low risk level, areas with slope of 8% - 15% have medium risk levels and areas with slopes > 15% fall into the high risk category (figure 12 and figure 13).

Figure 13: Topographic 3D modelling of Takata tenement



The landscape in the Takata area is dominated by denudational hill morphology, slopes ranging from 15> 55%, height differences (local reliefs) between 50-500m, with the appearance of valleys, slopes and river flow patterns that appear clear, the level of weathering is quite high, Common erosion is in the form of splash erosion in open areas without vegetation cover.

Figure 14: Tenement Area photo, divided into 3 blocks: Suma block, Crocodile block and Kolosori block, relative direction of shooting W-E

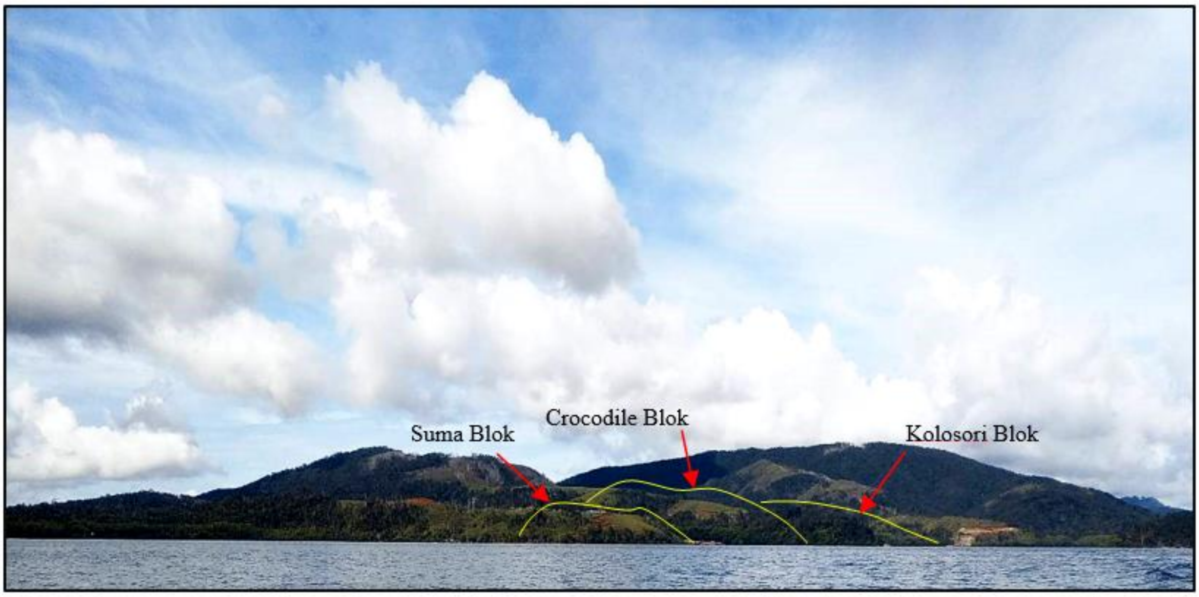


Figure 15: Photo of denundational hills

The lithology that arranges the Takata Area based on regional geological maps can be divided into three rock units namely metabasic units, Sigana Volcanics and Ysabel Ultrabasic.

The Metabasic Unit includes schistose amphibolite, resulting from the metamorphism of dioritic intrusion, where gabbros are usually metamorphosed and amphibolytic: diorites can be sub granitoid and show other plutonic features. The complex is given a Mesozoic age while in the Santa Isabel column, this rock unit is found in small numbers and is found in the western part of the tenement area,

The Sigana volcano cannot be configured in the basement complex and is displayed on the map as a premiocene basaltic volcanic. Several andesitic and pyroclastic andesitic lavas are present, but most of these units consist of olivine-free basalt and basaltic lava pillows. They have a minimum thickness of 2,000 feet but it is likely that the maximum number greatly exceeds this. They are certainly pre-Miocene sediments, their field relationship with lower Miocene sediments shows at Oligocene age. This rock unit can be found in the northern part of the tenement area.

5.3 Geology and Soils

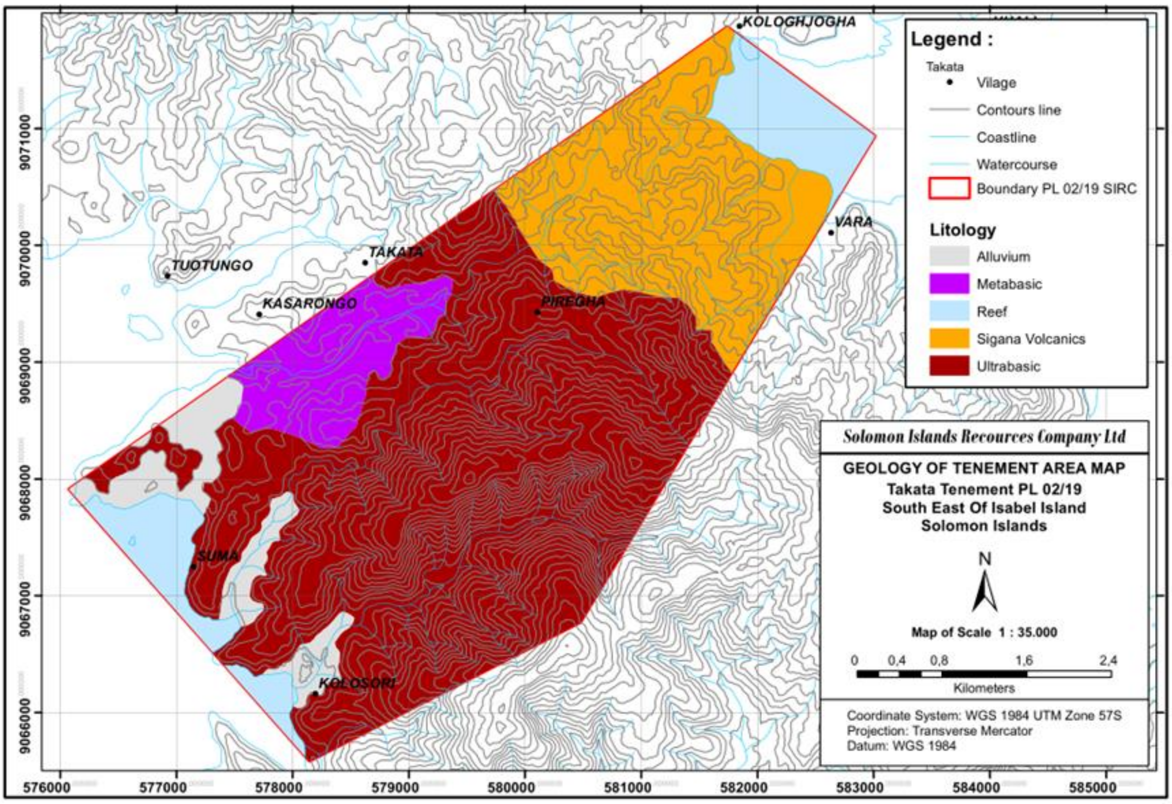
5.3.1 Geology

The central backbone of Santa Isabel comprises of faulted basement basalts largely laid down beneath the sea. Partly laying them in the west and flanking them in the west and east are marine and terrigenous sediments which have been folded parallel to the main axis. These sediments form low hills, cuestas, plateau, ridges and karst scenery, in contrast to long, high and narrow ridges over basalts found in the centre of the island.

The tenement area comprise of uneven ridges associated with outcrops of basement rocks and with younger basaltic extrusive in some areas are blocks of ridges with irregular profiles and random pattern. The rocks are mostly basaltic but may include andesite, gabbross and diorites. In places where these rocks are metaphosed from pyroclastics, lava instrusions to schistose amphibolites. The rounded hills in the tenement are clearly distinctive due to the vegetation type associated with it. The rocks are serpentised harzburgites in the form of intrusive bosses or lenses associated with Korighole-Kaipito trust line and there are smaller areas of metamorphosed andesite lavas.

Harzburgite are late cretaceous ultramafics overlain by massive to pillow Ontong Java Plateau basalts and its plutonic equivalent, gabbro. These are ultramafic rocks and consist of elongate pods of serpentinized harzburgite and dunite, cut by pyroxenite veins. The basal and harzburgite are obvious at some location including at the stockpile area where a 5m cut and fill was conducted and along coastline.

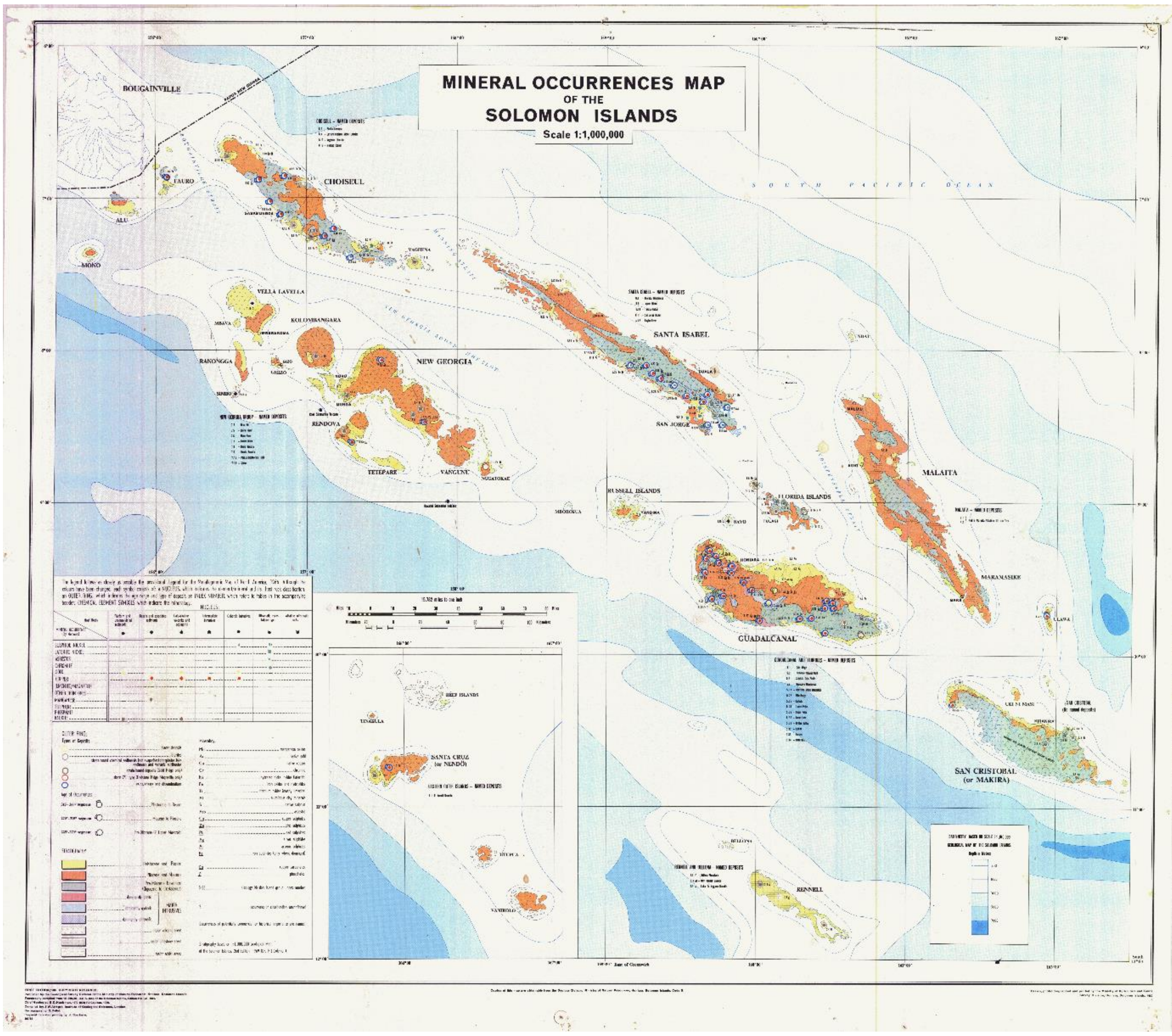
Figure 16: Geology map of the Tenement Area



Ultrabasic Isabel is found in most of the tenement areas or around 70% of the rock composition in the SIRC work site. The most common rock types are harzburgite serpentine, and peridotite.

The mineral of interest, nickel, occurred in the tenement as hydrated nickel oxides (lateritic) within major ultramafic intrusive (Alpine-type) in the area. The age of major laterite deposits or occurrence in the tenement is Pleistocene to recent.

Figure 17: Mineral Occurrence Map of Solomon Islands



5.3.2 Soil

According to Hansel and Wall, the soil in the area are unsuitable for agriculture purpose because it contain high levels of heavy metal, notably chromium, nickel and to the extent accumulation of magnesium to levels of 18% in derived alluvial soil. These added to deficiency in soil nutrients, strongly weather and leached profile. The ALS test results below confirm the findings. The result also indicated high concentration of aluminum and iron which is typical of ultramafic soils. Table 9 below showed recent ALS test of five soil samples from the tenement.

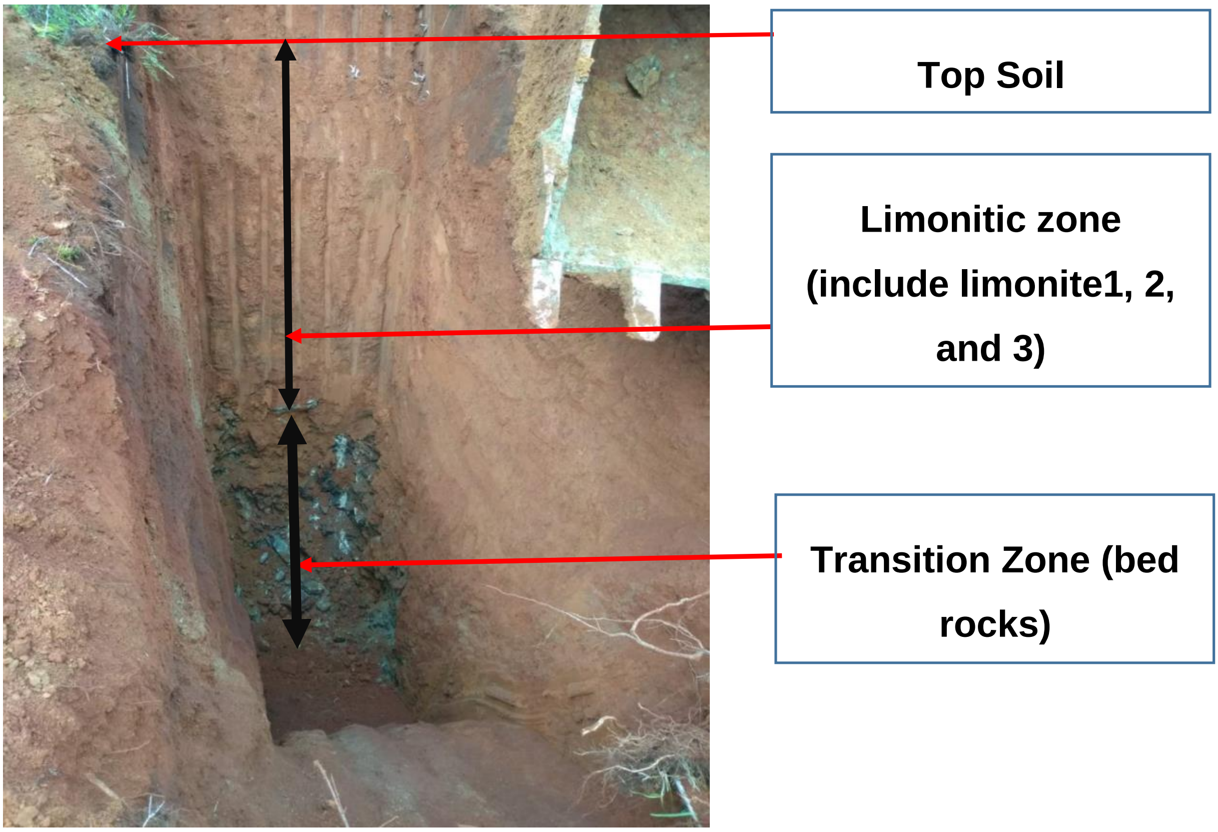
Table 9: ALS Test Result for five location within the tenement, 2020.

Project name/number:	Suma Project		Sample Date:		16/02/2020	17/02/2020	18/02/2020	19/02/2020	20/02/2020
			Client sample ID (1st):		SS-01	SS-02	SS-03	SS-04	SS-05
Analyte grouping/Analyte	**CAS Number**	**Unit**	**Limit of reporting**						
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content		%	1.0		**18.9**	**24.8**	**37.0**	**35.2**	**24.6**
EG005(ED093)T: Total Metals by ICP-AES									
Aluminium	7429-90-5	mg/kg	50		**420**	**820**	**2480**	**2550**	**260**
Arsenic	7440-38-2	mg/kg	5		<5	<5	**21**	**19**	<5
Cadmium	7440-43-9	mg/kg	1		<1	<1	<1	<1	<1
Chromium	7440-47-3	mg/kg	2		**4**	**48**	**69**	**114**	**3**
Copper	7440-50-8	mg/kg	5		<5	<5	**6**	**9**	<5
Iron	7439-89-6	mg/kg	50		**980**	**2330**	**20800**	**24200**	**480**
Lead	7439-92-1	mg/kg	5		<5	<5	<5	<5	<5
Nickel	7440-02-0	mg/kg	2		**5**	**62**	**454**	**472**	**3**
Selenium	7782-49-2	mg/kg	5		<5	<5	<5	<5	<5
Zinc	7440-66-6	mg/kg	5		<5	<5	**8**	**14**	<5

EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	mg/kg	0.1		<0.1	<0.1	<0.1	<0.1	<0.1

ALS result, 2020

Figure 18: Soil Profile



The topsoil is underlain by the Limonitic zone that can extend to a depth of 8-10metres. Saprolitic zone which extends 10-12m is the layer of interest to nickel miners. The profile is different for all locations and depends on the geological formation.

5.4 Climate and Meteorology

5.4.1 Introduction

Average annual rainfall ranges from 3,500 mm in low areas, to more than 6,000 mm on the mountain peaks, with most areas receiving around 4,000 mm. Isabel has not been severely affected by natural disasters in the last 30 years. The island fairly lies on a cyclonic region and is a seismically active area, placing it at risk to natural disasters such as earthquakes and cyclones.

5.4.2 Cyclones

There are 11 cyclones occurred within 200km from the tenement area in the last 60 years. However, no deaths were encountered. Cyclone Ida in 1972 was the most severe cyclone causing an estimated loss of $70 million dollars in export income from logging.

Figure 19: Cyclone Routes within 200km from the mining tenement

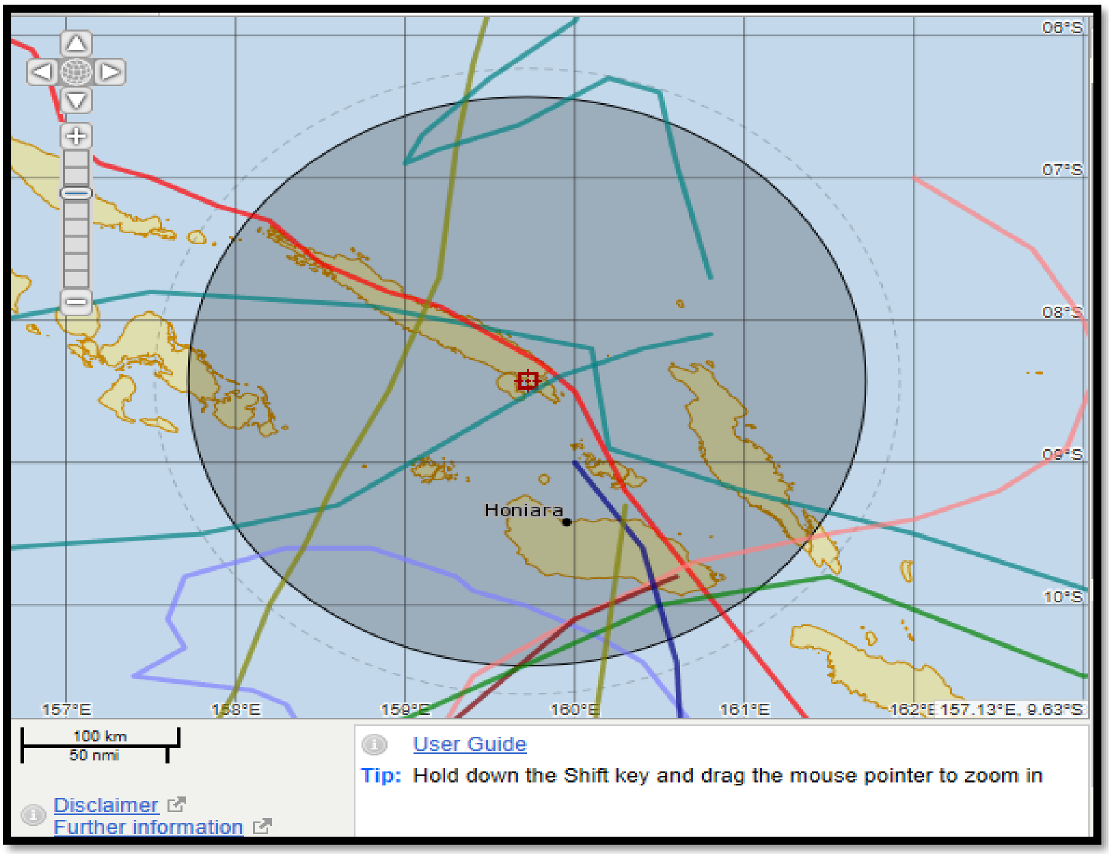


Table 10: Cyclone and Seasons within 200km from the mining tenement area

Season	Number of Cyclones	Names of Cyclones
1969/1970	1	ISA
1971/1972	2	CARLOTTA and IDA
1972/1973	1	MADGE
1981/1982	1	BERNIE
1985/1986	1	NAMU
1990/1991	1	JOY
1993/1994	1	REWA
1996/1997	1	CYRIL

2014/2015	1	RAQUEL
2017/2018	1	LINDA

5.4.3 Humidity and temperature

According to Tsumitomo's weather station in the Lelegia area (IWS01) over 4 years 2008-2012, the minimum temperatures range from 20.39^{0}C to 23.35^{0}C while maximum temperatures ranged from 31.53^{0}C to 35.83^{0}C. The monthly average temperatures range from 25.51^{0}C to 26.92^{0}C. The weather station recorded that humidity data in IWS01 exhibit uniform trend throughout the year except from fluctuations in the minimum temperature.

Table 11: Relative Humidity, Tsumitomo EIS

Month	Relative Humidity (%)														
	2008			2009			2010			2011			2012		
	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
January	ND	ND	ND	52.64	83.87	95.50	55.21	85.97	95.60	52.36	81.51	95.80	51.83	82.68	94.90
February	ND	ND	ND	52.67	84.54	95.60	40.88	83.21	94.70	47.80	83.59	95.60	MD	MD	MD
March	MD	MD	MD	59.90	84.61	94.90	50.14	84.42	95.30	53.05	82.49	95.50	ND	ND	ND
April	52.30	86.13	96.80	47.85	82.06	95.60	55.24	84.04	95.50	39.52	82.45	95.00	ND	ND	ND
May	53.03	83.57	96.70	53.32	84.31	95.40	54.22	84.19	94.90	55.59	83.80	95.60	ND	ND	ND
June	49.46	84.23	96.30	63.98	84.95	95.20	60.42	84.51	94.70	45.44	83.99	95.80	ND	ND	ND
July	51.77	84.72	95.90	59.33	85.92	95.40	60.79	85.02	95.30	56.13	84.11	95.70	ND	ND	ND
August	52.86	83.24	96.00	59.73	85.03	95.40	50.07	85.34	95.60	52.96	85.04	96.00	ND	ND	ND
September	54.05	85.46	96.00	54.73	86.14	95.50	58.41	85.31	95.90	51.93	81.73	95.20	ND	ND	ND
October	54.10	83.34	95.40	50.27	85.48	95.90	53.27	83.53	95.00	53.19	83.34	95.10	ND	ND	ND
November	41.51	80.22	95.20	49.97	83.39	95.00	52.04	83.14	95.20	55.37	82.32	95.60	ND	ND	ND
December	57.23	83.04	95.30	47.24	81.80	94.60	54.39	83.11	95.70	50.64	82.79	95.10	ND	ND	ND

The data in the table below were retrieved from the SIRC weather station at Suma camp, Isabel province. SIRC weather station recorded a high MAX in relative humidity compared to the Tsumitomo weather station. Temperatures are relatively stable.

Table 12: Relative Humidity and Temperature recorded by SIRC weather station from April to June 2020.

Months 2020	**Temperature**			**Relative Humidity**		
	MIN	**AVER**	**MAX**	**MIN**	**AVER**	**MAX**
April	0	24.16147	31.44	0	83.55729	99.51
May	0	26.42694	33.24	0	82.47849	99.51
June	23.05	27.0095	34.25	60.75	91.27702	100

5.4.4 Rainfall

Monthly rainfall data for Buala station directly north of the tenement area, receives more rainfall between February and December. The data recorded at ISW01 indicates there are similar trend in rainfall patterns for Isabel.

Figure 20: Monthly Average Rainfall

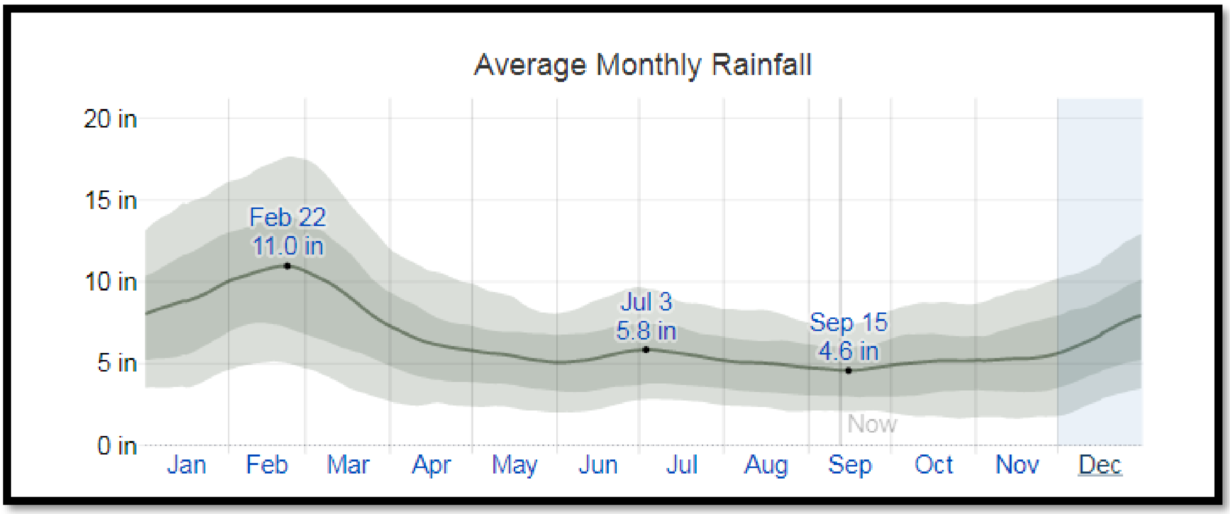


Table 13: Monthly Rainfall, Tsumitomo EIS

Month	2008	2009	2010	2011	2012
January	ND	315.0	643.5	247.0	291.5
February	ND	391.5	305.5	268.0	MD
March	MD	228.0	512.0	193.5	ND
April	217.5	161.5	205.0	189.5	ND
May	270.5	320.0	187.5	137.0	ND
June	222.5	166.0	106.0	254.0	ND
July	259.5	462.5	322.0	273.5	ND
August	284.0	287.0	309.5	295.5	ND
September	345.5	520.5	317.0	208.5	ND
October	295.0	279.0	205.5	399.0	ND
November	138.5	120.5	203.5	171.0	ND
December	243.0	160.5	339.0	271.0	ND

Note: ND - no data; MD – with missing data
Source: IWS01 weather station data

The rainfall data from the SIRC weather station were extremely higher in April and May 2020. This has occurred due low pressure system in the country during this months.

Table 14: Rainfal data, SIRC weather station, 2020

	Rainfall (mm)			
Months 2020	**MIN**	**AVER**	**MAX**	**TOT**
April	0	5.225568	99	1886.43
May	0	7.395296	81.29	2751.05
June	0	2.618282	81.29	685.99

5.4.5 Climate Variations

Like other Pacific nations, the Solomon Islands are exposed to climate variation. The National Adaptation Program of Action (NAPA), 2008 shows that surface air temperatures for Auki (1962-2007) and Henderson Field (1975-2006) have increased by about 1^0C during these periods. Accordingly, adopting the Intergovernmental Panel on Climate Change (IPCC) global assessment, the following changes are expected:

- Global temperatures may rise between 1.1^0C and 6.4^0C during the 21st century with the best estimate for temperatures to rise by between 1.8^0C and 4^0C;
- Sea levels will rise by 18 cm to 59 cm by 2100 mostly from thermal expansion of the oceans;
- There is a greater than 66% confidence level that there will be more frequent warm spells, heat waves and heavy rainfall; and
- There is a greater than 66% confidence level that there will be an increase in droughts, tropical cyclones, extreme high tides and storm surges[20].

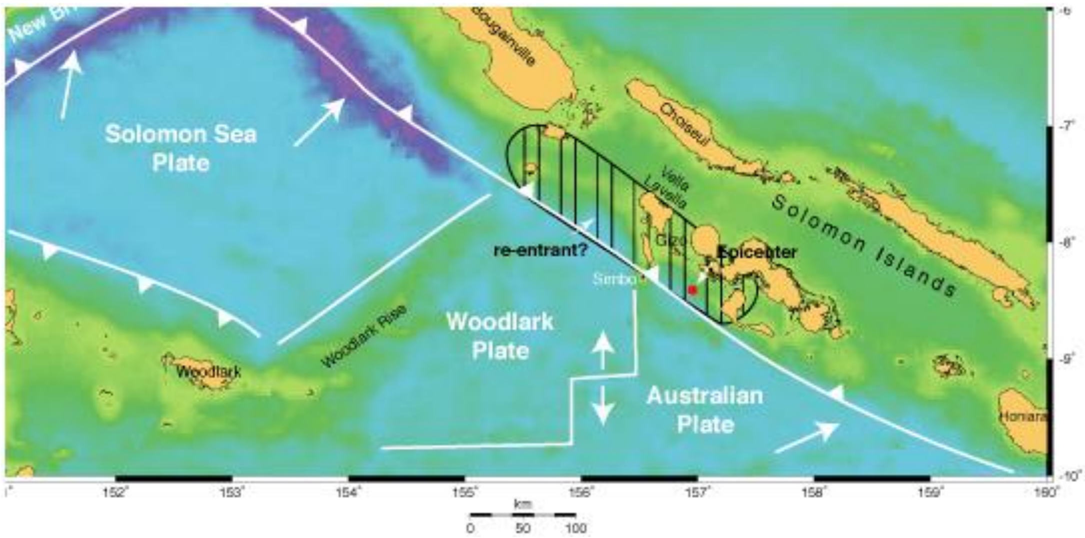
[20] National Action Plan on Adaptation, 2008.

5.5 Geo-hazards

5.5.1 Seismicity

Solomon Islands lies at the boundary of three major plates which form part of the Solomon islands Subduction Zone, the Pacific, Australian and Woodlark plates. In this area the pacific plate is the upper or overriding plate with the others sub-ducting under it. The volcanoes in the Solomon Islands are associated with the Solomon Sea Plate as it is sub-ducted beneath the Pacific Plate. A short spreading center at the southeast margin of the Solomon Sea Plate influences volcanism at Kavachi (Western Province submarine volcano). The uplift of the plates along with intermittent volcanic and seismic activity has contributed to the island masses which now form the Solomon Islands (MID, 2008). The islands are, geologically speaking relatively young, and the larger islands are almost entirely volcanic in origin and consist of basalt surrounded by uplifted coral terraces. See figure below.

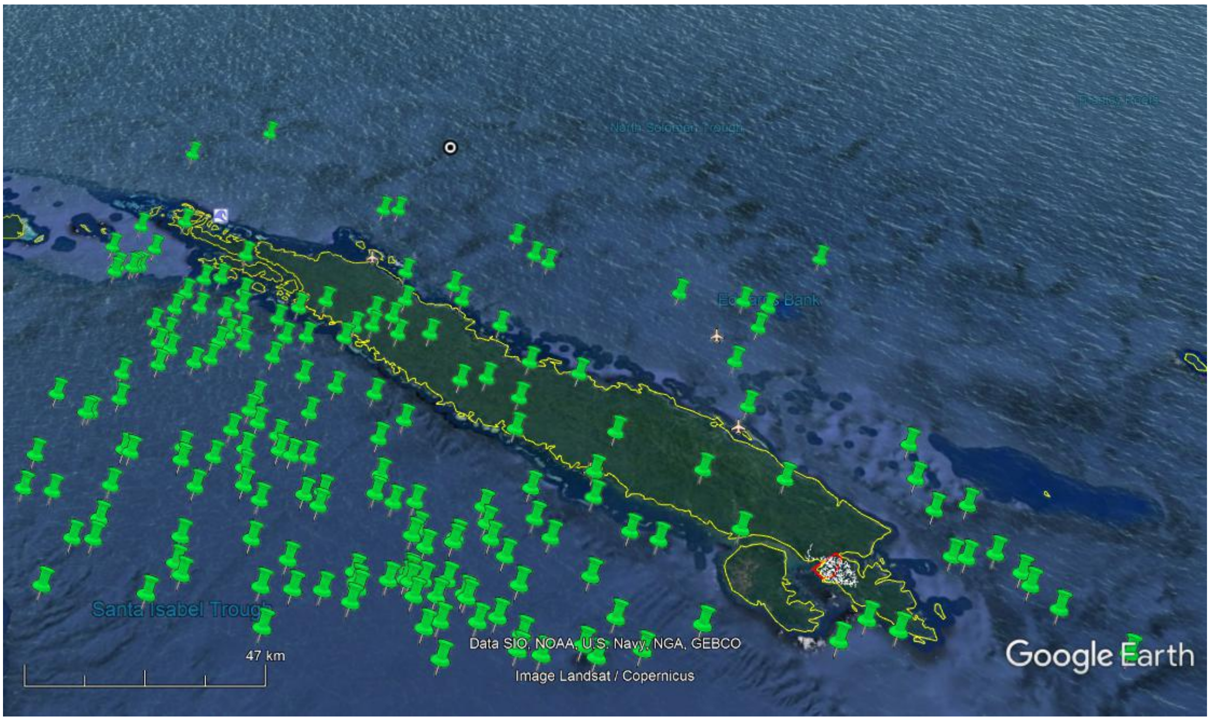
Figure 21: Geotec Activities



*Source:*http://walrus.wr.usgs.gov/tsunami/solomon07/tectonic_big.html

Figure below indicates seismic activities occurring in Isabel Islands and areas within 100km from the island over the last 29 years. These seismic activities may not generate geological hazards to the island, but the fact that Solomon Islands are located in the geological ring of fire, seismic hazards cannot be overstated.

Figure 22: Seismic Activities in Isabel, MMERE



5.5.2 Tsunamis

In 2007, a magnitude of 8.0 earth quake strike near Gizo, resulted in a tsunami. The tsunami killed 52 people and displaces over five thousands of people in Western and Choiseul Provinces. Another Tsunami occurred in 2010 following a 7.1 magnitude originating approximately 200km from the Isabel Island. The highest occurrence in this area is 6.4, at a depth of 29 km, of the Coast of Isabel Island.

5.6 Sediment Transport

It is highly likely, that sediment flow from the tenement area including stockpile areas, campsite areas and excavation areas will have significant impacts on the marine and aquatic environment. Thus, the bays and mangroves are an important sink for runoffs and sediments. According to Axiom Mining Ltd.'s sediment modelling indicates turbidity are more obvious in bays and swamp environments from limited current movements and wave action. Overtime the bays and coastline have been impacted to certain extend by surface runoffs from land use activities including farming practices, logging and demand for space due to population increase. This is evident at Piregha River and Huali Bay where silt deposition covers a larger area at the river mouths.

5.7 Air Quality

The quality of air within the tenement area is typical of a rural setting in the Solomon Island. Air quality is generally excellent in the tenement area and there are no air quality non-attainment areas in the vicinity. Construction and operation activities can be sources of dust pollution during wind events in the general region.

There would be short-term dust impacts during excavation work although this would be limited to fugitive dust emissions and emissions from machinery and vehicles used and dust control would be followed during construction. There would be no negative long-term adverse impacts on air quality due to operation of the mine.

Table below shows P2.5 and P10 readings from the proposed mine camp site every two hours for three months in 2020. The results indicate the air quality in the area is pristine except for a day in June where both P2.5 and P10 levels were extremely high and over the WHO guideline. The noise and temperature were also higher on that same day. Therefore it could have been caused by heavy vehicles emitting smoke and generating dust. The guideline stipulates that PM2.5 must not exceed 0 μg/m³ annual mean, or 25 μg/m³ 24-hour mean; and that PM10 not exceed 20 μg/m³ annual mean, or 50 μg/m³ 24-hour mean[21].

Table 15: PM2.5 and PM10 readings, SIRC weather station.

Months 2020	**PM2.5**			**PM10**		
	MIN	**AVER**	**MAX**	**MIN**	**AVER**	**MAX**
April	0	1.77	10	0	1.94	11
May	0	1.05	8	0	1.14	10
June	0	14.10	728	0	14.27	728

[21] https://en.wikipedia.org/wiki/Air_quality_guideline

5.8 Water Quality

5.8.1 Introduction

The water sampling/analysis approach were adopted from the Australian Laboratory Services, National Public Health and SPS Analytical Lab methods of sampling and analysis. In this assessment, surface water quality assessment include the test and analysis of Total Coli and E.Coli, In-situ test and test for nutrients. The objective of the surface water quality assessment is to understand the chemical properties of the three main rivers Piregha, Hugevi and Beahutu located within the Takata Tenement.

Water quality is a significant environmental determinant of health. It is a measurement of water quality relatively to requirements of biotic species or human use, and often done in reference to a set of standards against contaminants and pollutants compliance levels. It includes the chemical, physical, biological, and radiological characteristics of water. Water quality standards for surface water vary significantly due to different environmental conditions, ecosystem and intended human uses. In the absence of national water quality standard, World Health Organizations (WHO) standards were used as a basis for comparison. The parameters are defined below.

5.8.1.1 Literature Review

Escherichia Coli (E.Coli)

Bacteriological quality standards are set to prevent diseases and infections for human use such as swimming and bathing. A key indicator of bacteriological quality of water is detecting traces of Escherichia Coli (E.Coli) levels. *E. Coli* is the dominant bacterial organism in human faeces but is also found in faeces of birds and mammals (Steblin, 2007). E.Coli is usually used as an indicator organism for pathogens. Total coliforms are also indicator of pathogens, but total coliforms can also be derived from sources other than sewage. These pathogens can cause acute and also chronic health effects. The greatest microbial risks are associated with ingestion of water that is contaminated with human and animal (including bird) faeces. According to the World Health Organization (WHO) Guidelines for Drinking-Water Quality (4rd Edition), the acceptable E.coli levels in drinking water is 0 MPN/100 ml and 200 MPN/100ml for water used for recreational purposes.

Heavy Metals

Heavy Metals are intrinsic, natural constituents of our environment. They are generally present in small amounts in the natural aquatic environment. Apart from the natural sources, several metals originate from anthropogenic sources and also contribute to the metal concentrations in the environment due to increased industrialized activities in recent times. Arsenic and Chromium are examples of natural occurring metal constituents found in surface water. The WHO guidelines states the recommended limits for Arsenic and Chromium to be 0.01mg/l and 0.05mg/l. Synthetic pollutants such as Cadmium, Lead and Mercury have the proposed limit of 0.003mg/l, 0.01mg/l and 0.006mg/l respectively. Cadmium compounds are widely used in battery, steel industry and plastics, and released to the environment in wastewater. Guideline value for Copper is 2mg/l, and 0.07mg/l for Nickel. Levels of Zinc in surface water and ground water do not exceed 0.01 and 0.05mg/l respectively (WHO, 2011a). Heavy Metals are considered a health hazard due to their non-bio-degradable nature, accumulative properties and long biological half-lives. It is difficult to remove them completely from the environment once they enter it (WHO, 2000). Long-term exposure to heavy metals can have carcinogenic acute and chronic health effects. Weathering of sedimentary deposits and ultramafic deposits are probable sources of natural occurring metals such as Iron, Copper, Arsenic and Chromium.

Cat-ions

Presence of Cat-ions in water results in a phenomenon known as “Water Hardness”, which is a measure of the capacity of water to react with soap. It often produces a noticeable deposit of precipitate in containers. Hard water requires considerable amount of soap to produce lather. It is caused by variety of dissolved polyvalent metallic ions, predominantly calcium and magnesium cat-ions, other Cat-ions include aluminium, barium, iron, manganese, strontium and zinc also contribute to water hardness. Water hardness is commonly expressed as milligrams of calcium carbonate equivalent per litre. Water containing calcium carbonate concentrations below 60mg/l is considered as soft water, 60-120mg/l, moderately hard, 120-180mg/l, hard, and more than 180 mg/l, very hard(WHO, 2011b). The primary sources of Calcium and Magnesium along Rivers would be from sedimentary rock such as ultramafic soils, limestone, seepage and runoff from soils.

Potassium-based (mixture of potassium and sodium) water softeners are commonly used to remove minerals such as calcium and magnesium ions from hard water, replacing them with potassium and sodium ions. Potassium is an essential element in humans and occurs broadly in the environment, including all natural waters. It is present in all animal and plant tissues. Potassium and Sodium may cause some health effects in susceptible individuals but their intake from drinking water is well below harmful levels. Sodium is commonly leached from the terrestrial environment to groundwater and surface water (WHO, 2011a).

Anions (Chlorine, Sulphate and Alkalinity)

Chlorine is produced as disinfectants and bleach for both domestic and industrial purposes, and widely used to disinfect drinking-water to control bacteria levels. It reacts with water to form hypochlorous acid and hypochlorite. The WHO guideline value for Chlorine in water is 5mg/l. Sulphate is discharged into water from industrial wastes and through atmospheric deposition. Highest levels of sulphate usually occur in ground water and from natural sources. Ingestion of drinking-water containing high levels of sulphate might result in gastrointestinal effects (WHO, 2011a).

Alkalinity of natural waters is determined by the geological composition of the soil and bedrock it passes through. Carbonate, bicarbonate and hydroxide compounds are main sources of natural alkalinity. Alkalinity of water is important for aquatic life as it protects and provides buffers against rapid pH changes. High alkalinity levels in surface waters will buffer acid wastes and prevent pH changes that are harmful to aquatic life.

Nitrogen, Nitrate and Nitrite as N

Nitrate (NO3-) is found naturally in the environment and is an important plant nutrient. Nitrite (NO2-) is usually present in reducing environment as a result of microbial reduction of nitrate. Nitrate reaches surface water and ground water as an end product of agricultural activity (including use of fertilizer and manures), waste water disposal and from oxidation of nitrogenous waste products such as human wastes . The recommended guideline value for Nitrate is 50mg/l (11mg/l as nitrate-nitrogen) as an ion to protect against methaemoglobinaemia in bottle-fed infants. The guideline value for Nitrite is 3mg/l as ion and 0.9mg/l as nitrite-nitrogen (WHO, 2011a). Nitrate concentrations in surface water can change rapidly due to surface runoff of fertilizer, uptake by phytoplankton and de-nitrification by bacteria. Nitrate and Nitrite levels would be low in less impacted areas (Upstream Rivers) where there is less microbial reduction activity. In densely populated area such as downstream of Rivers, there would be elevated levels of Nitrate and Nitrite as a result of waste water disposal and seepages from septic tanks from the urban areas.

Total Phosphorus

Total Phosphorus is an essential nutrient for all living organisms. It plays a significant role in biological metabolism compared to other macronutrients. Phosphorus is the least abundant and the common nutrient that limits biological productivity. Water bodies containing low Phosphorus concentrations typically support relatively diverse and abundant aquatic life that are self-sustaining and support various water uses. Elevated Phosphorus concentrations can adversely affect aquatic ecosystems.

Phosphorus occurs in three forms in aquatic system: inorganic phosphorus, particulate organic phosphorus, and dissolved (soluble) organic phosphorus. In uncontaminated water, phosphorus occurs as organic phosphates, cellular constituents of organism and dead particulate matter. Total phosphorus concentrations ranges between 0.01mg/l and 0.05mg/l in non-polluted water (WHO, 2011a). Increase algal productivity (algal bloom), accelerated plant growth and low dissolved oxygen from the decomposition of additional vegetation are adverse effects of high concentrations of total phosphorus in rivers or lakes. Surface water rich in organic matter or bogs tend to exhibit high total phosphorus concentrations. In Lake or areas of low turbulence in rivers, sediments tend to contain much higher concentrations of total phosphorus. (Canadian Water Quality Guidelines, 2004).

Tsumitomo's water quality assessments

Tsumitomo's water quality assessments were conducted over two to four years at the adjacent tenements and its data are vital as no other water quality assessment were conducted to that magnitude. On comparison, there is evidence of similarity in the results. In-situ parameters are varied in some locations but are quite similar in the context of fine weather. T.Coli and E.Coli Tsumito results at sampling sites exposed to runoffs have high concentration of the T.Coli and E.Coli. Chromium, aluminum, iron and copper occurrence are obvious in high concentrations.

5.8.2 Methods of Test and analysis

Australia Laboratory Services (ALS) holds corporate NATA accreditation; therefore all tests in this study are covered by NATA. Sampling bottles were ordered based on the analysis and results as specified in the TOR. The samples collected were sent back to ALS Australia for testing.

Table 16 ALS Method of analysis (water)

Water Samples Parameter	ALS Method/ Package Code	Technique/ Method Reference	Limit of Reporting (mg/L)	No.

			(or as indicated)	
Major Cations (Ca, Mg, Na, K)	NT-1	APHA 3120	1	15
Major Anions Suite: (Cl, SO4, Alkalinity)	NT-2	APHA 4500 SO4, APHA 4500-Cl- -B, APHA 2320 B	1	15
8 Metals (As, Cd, Cr, Cu, Ni, Pb, Zn)	W-2T	USEPA 6020, ICP/MS	Cd - 0.0001 Zn – 0.005 Others - 0.001	15
Hg		CV/FIMS/ICP/MS	0.0001	
Nitrogen, Nitrate + Nitrite as N (NOx)	EK059	APHA VCl3 reduction 4500 NO3- + NO2-B	0.01	5
Phosphorus Reactive as P	EK071	APHA 4500 P – F	0.01	15
Nitrogen, Nitrate + Nitrite as N (NOx)	EK059-SW	APHA VCl3 reduction 4500 NO3- + NO2-B	0.02	10

Source: ALS Brisbane

Table 17: ALS Method of Analysis (Soil)

Soil Samples Parameter	**ALS Method/ Package Code**	**Technique/ Method Reference**	**Limit of Reporting (mg/kg)** (or as indicated)	**No.**
Moisture	EA055	In-house	1%	-
Mercury - Total Low level	EG035T-LL	APHA 3112 Hg-B CV/FIMS	0.01	4
8 Metals (Including Digestion) (As, Cd, Cr, Cu, Ni, Pb, Zn)	S-2	USEPA 200.2 (mod) / ICP/AES	1-5	4
Hg		USEPA 200.2 (mod)/CV/FIMS	0.1	

Source: ALS Brisbane

Table 18: SPE Analytical Method of analysis (surface water)

Parameter	**Method**
Sulphate (SO4)	Using Hach Reagent & Method 8051 (US EPA Compliant) And UV Spectrophometry (Hach DR3900, with RFID technology)
Potassium (K+)	Using Hach Reagent & Method 8049 (US EPA Compliant) And UV Spectrophometry (Hach DR3900, with RFID technology)
Total Reactive Phosphorus (PO4)	Using Hach Reagent & Method 8030 (US EPA Compliant) And UV Spectrophometry (Hach DR3900, with RFID technology)

Nitrogen (N)	Using Hach Reagent & Method 8171 (US EPA Compliant) And UV Spectrophotometry (Hach DR3900, with RFID technology)
Total Suspended Solids (TSS)	Using US EPA Gravimetric / Filtration Method
T.Coli and E.Coli	Colilert-18:IDXX

5.8.3 Description of Sampling Sites

Figure 23: Sampling Sites

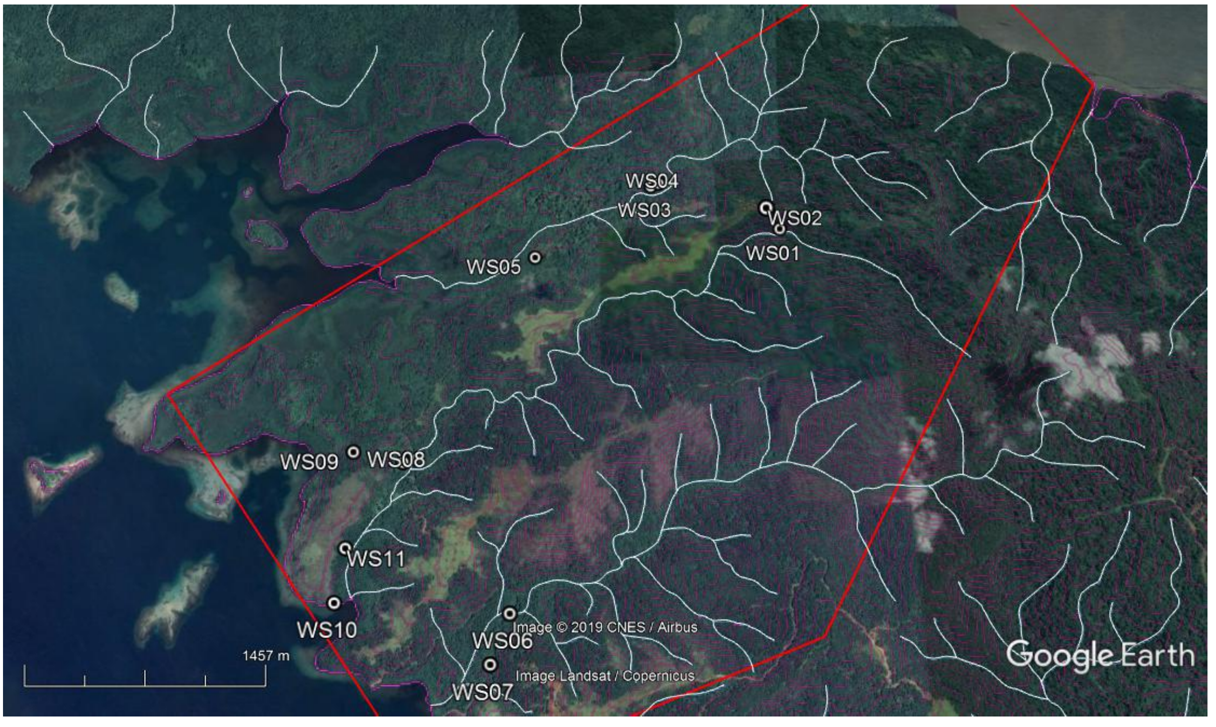


Table 19: Description of Sampling Sites

Sampling Sites	Description	Coordinates	
		x-Axis	Y-Axis

WS01-Beahutu upstream	Intact vegetation in the surrounding. Gentle slops on the embankment. Not much sunlight penetration.	-8.41962	159.72919
WS02-Riudede Tap Water	Water sourced from Beahutu tributary. Water used for drinking and other domestic uses including washing etc.	-8.41831	159.72841
WS03-Piregha upstream (Downstream wet crossing)	Wet crossing recently constructed at the site. Little disturbance on the embankments causes turbidity.	-8.41627	159.72130
WS04-Piregha upstream (upstream wet crossing)	Upstream of the wet crossing, very little disturbance. Susceptible to runoffs from the Riudede settlement.	-8.41609	159.72180
WS05-Piregha Stream Downstream near coastline	Location intact with mangrove strands. Susceptive to salt water instructions.	-8.42110	159.71405
WS06-Hugevi upstream	Minimum sunlight penetration. Approximately 700 from coastline. Susceptible to runoffs from current road works.	-8.44248	159.71310
WS07-Hugevi downstream	Expose to sunlight. Locals used the stream for washing and other domestic use. 500m from coastline.	-8.44518	159.71211

WS08-Hugevi tributary.	Underground water used for drinking and cooking. Close to Kolosori port.	-8.43398	159.70663
WS09-Camp water	Campsite water used for drinking and cooking.	-8.43342	159.70375
WS10-Sediment settling pond	Sediment settling pond adjacent to the existing wharf. Located on the coastline purposely to capture runoffs from the main road towards campsite and vehicle parking space.	-8.441896°	159.703233°
WS11-Sediment Settling Pond	Sediment settling pond-Stockpile area. Purposely built to capture runoffs from stockpile area.	-8.438903°	159.703653°

5.8.4 In-situ Parameters

DS, Temperature, Conductivity, Turbidity are generally higher in the lower catchments than the upper catchments. The results are linked to the concentration of minerals, salts, metals, cat ions or anions occurring in the river naturally or from antropogenic activities. Site WS10, TDS concentration are higher than the Standard WHO (500mg/L) including high conductivity and salinity from being part of the ocean. This is the sump west of the wharf area.

The growth of algae in the rivers is an indication of high nutient supply from earth movements (siltation) from sources including the settlements, logging actitivities and farming practices. Green algae is important because it absorbs metals reducing toxicity levels as well as produce oxygen that is essential for aquatic organism, however excesive amount is unacceptable. Algal growths are common downstream rivers where river velocity is reduced or where water has been stagnant.

Evidence of living organism including fish and eels in the upper catchments is an indication of high DO levels to support life. Temperatures rises steadily at sampling sites downstream while their DOs drop successively. This may be linked to shade cover in the upper stream than on the lower stream from exposure to sunlight associated with removal of vegetation on the bank of the rivers.

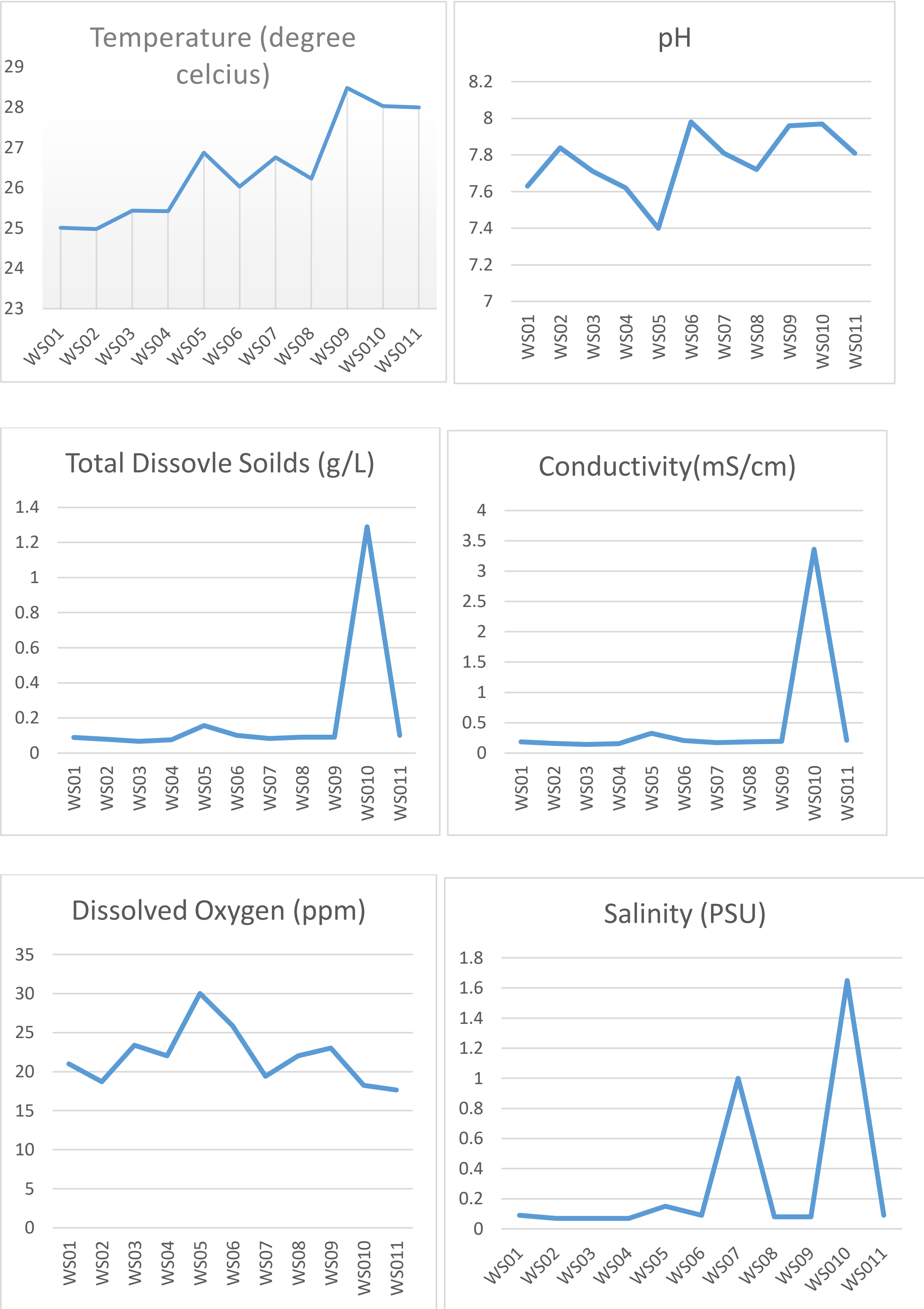
The pHs are generally basic and varies depending on the geological condition and runoffs. Apparently sediment containing carbonates drained into water ways as a result of erosion to ultramafic and limestone soils on the terraces. Occurrence of ultramafic and limetone is believed to play a major role in acidity of the Rivers. Rise in pH in the river system from possible contaminants were neutralised by cabonate containing sediments stored in the river beds.

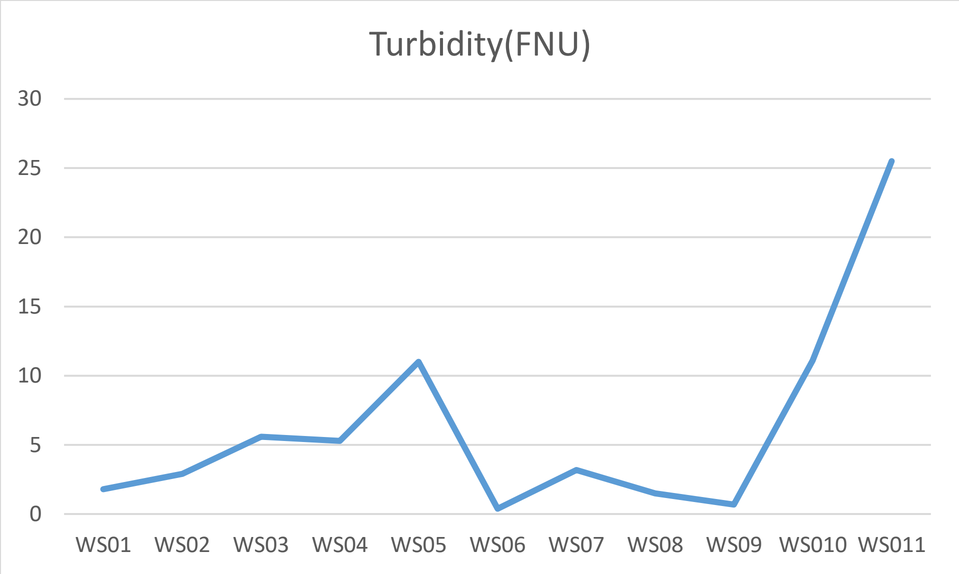
Table 20: In-situ parameters

Date	SW ID	Temperature(	pH	Oxygen Reduction Potential(OR Pmv) Mgltv	Dissolved Oxygen(ppm)	Conductivity Ty(mS/cm)	Turbidity (FNU)	Total Dissolve Solid (gpl)	Salinity (PSU)	Geographical coordinates of the SW sampling sites (Projection: Longitude/Latitude WGS 84	
										x-Axis	Y-Axis
11/08/19	WS01	25.01	7.63	141.6	21.01	0.183	1.8	0.089	0.09	-8.41962	159.72919
	WS02	24.98	7.84	143.1	18.7	0.158	2.9	0.079	0.07	-8.41831	159.72841
	WS03	25.43	7.71	157.2	23.40	0.142	5.6	0.067	5.1	-8.41627	159.72130
	WS04	25.42	7.62	162.1	22.03	0.155	5.3	0.075	0.07	-8.41609	159.72180

	WS05	26.87	7.40	93.1	30.03	0.324	11.0	0.156	0.15	-8.42110	159.71405
	WS06	26.03	7.98	129.0	25.86	0.206	0.4	0.101	0.09	-8.44248	159.71310
	WS07	26.76	7.81	158.4	19.40	0.172	3.2	0.083	2.9	-8.44518	159.71211
	WS08	26.23	7.72	151.4	22.03	0.184	1.5	0.090	0.08	-8.43398	159.70663
	WS09	28.48	7.96	122.8	23.03	0.192	0.7	0.090	0.08	-8.43342	159.70375
	WS010	28.03	7.97	126.9	18.24	3.362	11.1	1.289	1.65	-8.441896°	159.703233
	WS011	28.0	7.81	136.2	17.64	0.209	25.5	0.101	0.09	-8.438903°	159.703653°

Figure 24: Analysis of in-situ parameters





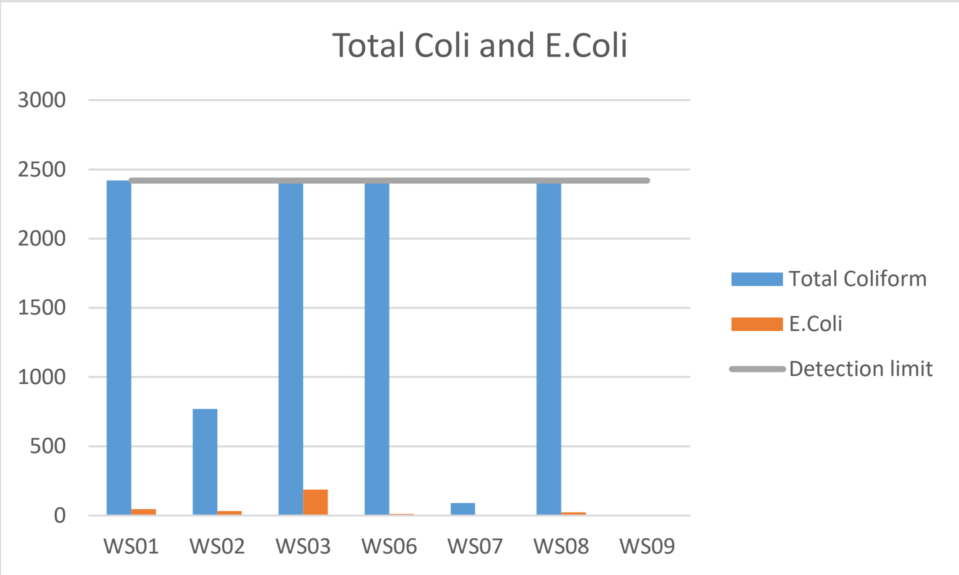
Conductivity, Salinity and Total Dissolved Solids (TDS) are related. Salinity and TDS tend to increase exponentially from upper catchment site WS01 to coastline and downstream of all rivers. The similar trend is also evident on Conductivity with site WS10 having the highest recorded value of 3.362 ms/cm and WS03 with the lowest value, 0.142ms/cm. The high conductivity values detected were due to high concentrations of inorganic salt ions present in the brackish water at the River mouths, coastline and sediment sttling ponds.

5.8.5 Faecal Coliform Bacteria Levels

Table 21: Total Coli and E.Coli Lab Results

Date	**SW ID**	Total Coliform	E.Coli
11/8/2019	WS01	>2420	47
	WS02	770	33
	WS03	>2420	186
	WS06	>2420	11
	WS07	91	<1
	WS08	>2420	23
	WS09	3	<1

Figure 25: Graph of Total Coli and E.Coli



Graphical representation of Escherichia coli (E.Coli) and Total Coliforms levels for the seven (7) sampling sites are presented in figure 25. The campsite water (WS09) and Kolosori stream drinking water contained low levels of E.coli level (<1MPN/100ml), unlike the other five sites that have far exceeded the WHO water quality guideline of zero (0) MPN/100ml for E.Coli levels in water. The major reason is the exposure to runoff from settlements in the area. Human settlements patterns and lack of sanitation facilities are the main sources of fecal coliforms in the rivers. Natural occurrence of fecal colifroms from wildlife faeces could be considered as the prime sources of high fecal coliforms on WS01 in the upper catchment of Beahutu River where there is no human settlements and less human activities on the river.

The results were over the WHO limits for drinking water indicating faceal contaminations in the river system. It is possible that harmful germs like viruses, bacteria, and parasites might also be found in the water. These microbes typically do not make people sick; but high concentration in the long term exposure could result in sickness or diseases. Escherichia coli (E. coli) bacteria normally live in the intestines of healthy people and animals. Most species of E. coli are harmless or cause relatively brief diarrhea and gastro illness.

5.8.6Turbidity

Turbidity are the two most visible indicator of water quality. High Turbidity and TSS levels in the Rivers were caused mostly by suspended particles from soil erosion, runoff from human settlements and developments along the river, and stirred bottom sediments resulting from human use of the water in the lower catchments.

5.8.7 Water Chemistry

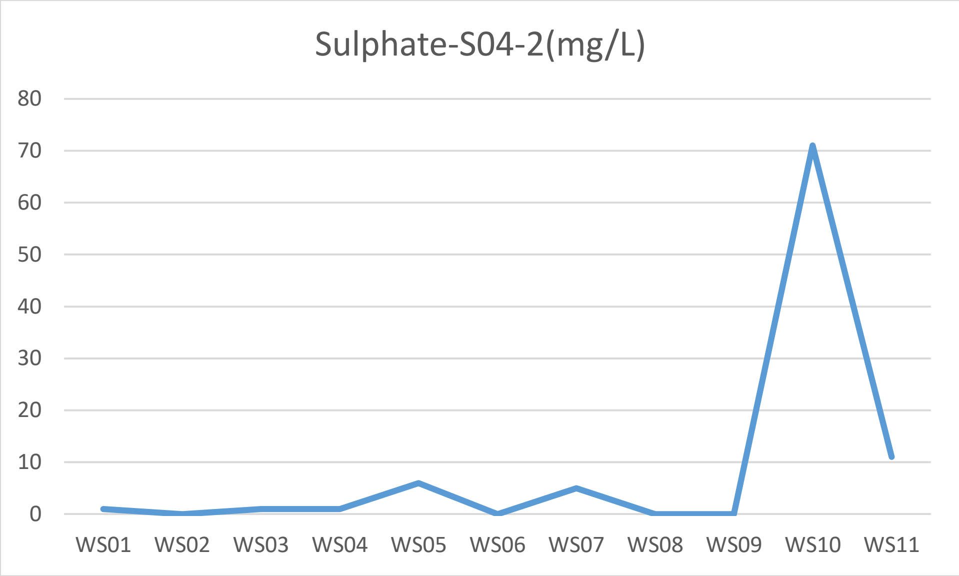
Table 22: Water Chemistry, SPS Analytical Laboratory

Sample ID	Nirate-N-(mg/L)	Nitrate-N03-(mg/L)	Phosphate-P-(mg/L)	Phosphate-PO4-(mg/L)	Potassium-K-(mg/L)	Sulphate-S04-2(mg/L)	TSS (mg/L)
WS01	0.2	0.89	0.12	0.37	2.2	1	10
WS02	0.22	0.97	0.08	0.24	2.5	0	20
WS03	0.34	1.51	0.11	0.34	1	1	10
WS04	0.3	1.33	0.12	0.37	0.6	1	10
WS05	0.36	1.59	0.13	0.4	1.2	6	30
WS06	0.21	0.93	0.04	0.12	0.8	0	20
WS07	0.2	0.89	0.07	0.21	2	5	20
WS08	0.39	1.73	0.01	0.03	0.3	0	10
WS09	0.25	1.11	0.03	0.09	0.6	0	10
WS10	0.31	1.37	0.06	0.18	7	71	30
WS11	0.4	1.77	0.12	0.37	0	11	20

5.8.7.1 Sulphate (SO_4)

Sulfate at sites WS05, WS10 and SW11 were associated with salt water environment and generally higher compared to other sampling sites, however still below the WHO standard 500mg/L. Sulfate varies over the three rivers and were believed to have oxidised from suphides metals. The geological condition associated with sedimentary layers and ultramafic soil in the upper gorge containing iron could be resposible for this chemical property.

Table 23: Sulphates

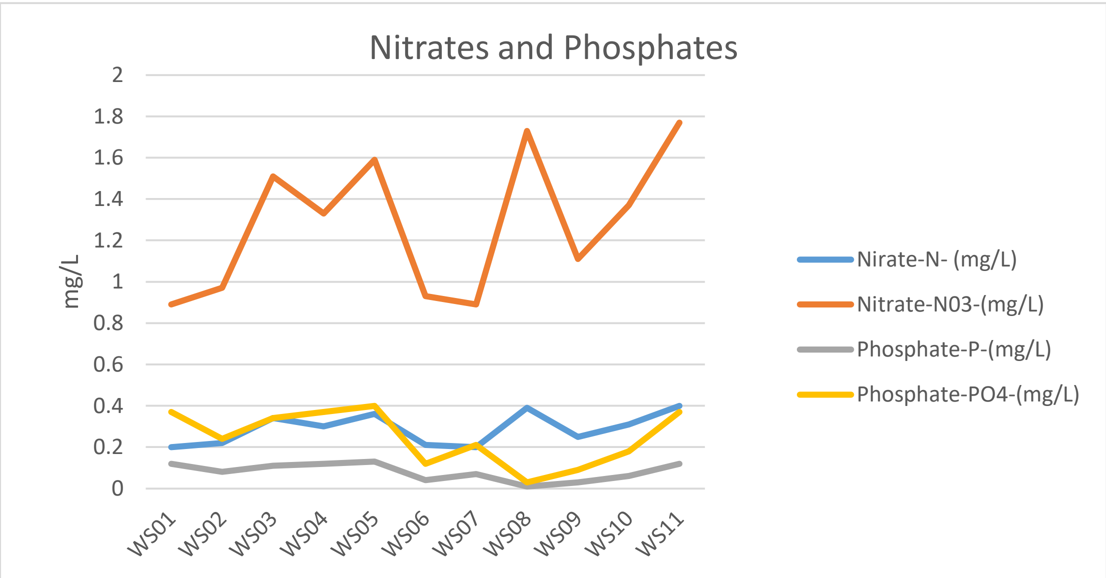


5.8.7.2 Nitrates and Phosphates

WS11 and WS05 have high levels of Phosphates and Nitrates. The potential source of P and N are from runoffs associated with fertilized farms, septic failures and soils/rocks. It is unlikely for aqautic animals to survive in this environment from limited DO to support life. The other sites have P but in small concentration.

Nitrate is remarkably consistent all through out and increased significantly at WS08 and WS 11. Again this can be attributed to high supply of nutrients as a result of human activities.

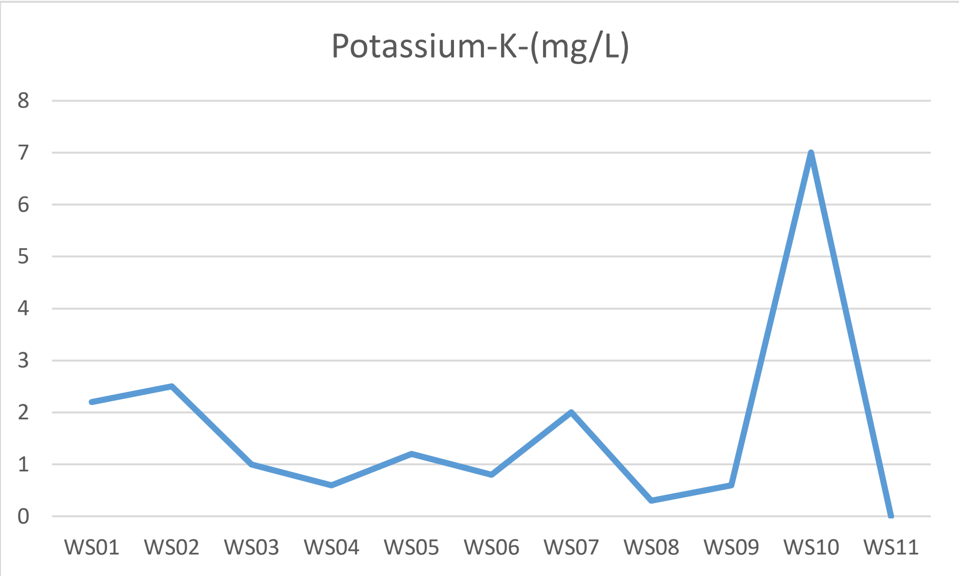
Table 24: Nitrates and Phosphates



5.8.7.3 Potassium

The major cat ions Calcium, Magnesium , Potasium and Sodium are responsible for water hardness and softness. Teoritocally, the concentration of Mg, Ca, K and Na or water softness are expected approaching the ocean. For this EIS assessment, the K was tested for all eleven sites. Salt water environment have played a critical role in chemistry of the K concentration resulted in high concetrations at the sediment setling ponds.

Figure 26: Potassium



5.8.8 Heavy Metals

5.8.8.1 Surface waters

Asenic, Cadmium, Copper, Lead, Selenium, Zinc and Mercury concentrations are below detection limits. Cromium and nickel were detected at all sites. Aluminium is detected at SW01, WS05, SW06, SW07, SW10, SW11, SW12, SW13 and SW14 but were all below risk levels when compared to the WHO drinking water standards. Iron detected at SW01, SW05, SW10, SW11, SW12, SW13 and SW14. Occurance of Nickel and Cromium are obvious at all sampling locations, could have been naturaly from mineralization in the area.

Table 25: Surface water test result, 2020

Matrix:	**WATER**		**Sample Type:**	**REG**	**REG**	**REG**	**REG**	**REG**	**REG**	**REG**	**REG**	**REG**	**REG**	**REG**	**REG**	**REG**	**REG**
Workgroup:	EB2005576		**ALS Sample Number:**	EB2005576001	EB2005576002	EB2005576003	EB2005576004	EB2005576005	EB2005576006	EB2005576007	EB2005576008	EB2005576009	EB2005576010	EB2005576011	EB2005576012	EB2005576013	EB2005576014
Project name/number:	Suma Project		**Sample Date:**	16/02/2020	16/02/2020	16/02/2020	16/02/2020	16/02/2020	16/02/2020	16/02/2020	16/02/2020	16/02/2020	16/02/2020	16/02/2020	16/02/2020	16/02/2020	16/02/2020
			Client sample ID (1st):	WS01	WS02	WS03	WS04	WS05	WS06	WS07	WS08	WS09	WS10	WS11	WS12	WS13	WS14
Analyte grouping/Analyte	**CAS Number**	**Unit**	**Limit of reporting**														
EG020T: Total Metals by ICP-MS																	
Aluminium	7429-90-5	mg/L	0.01	**0.06**	<0.01	<0.01	<0.01	**0.25**	**0.03**	**0.03**	<0.01	<0.01	**0.10**	**0.08**	**0.27**	**0.02**	**0.04**
Arsenic	7440-38-2	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.001	<0.001

Cadmium	7440-43-9	mg/L	0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0005	<0.0001	<0.0001
Chromium	7440-47-3	mg/L	0.001		**0.005**	**0.008**	**0.005**	**0.006**	**0.004**	**0.006**	**0.006**	**0.007**	**0.004**	**0.019**	**0.031**	**0.008**	**0.007**	**0.005**
Copper	7440-50-8	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.050**	<0.005	<0.001	<0.001
Lead	7439-92-1	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.001	<0.001
Nickel	7440-02-0	mg/L	0.001		**0.006**	**0.020**	**0.012**	**0.019**	**0.008**	**0.008**	**0.009**	**0.017**	**0.006**	**0.021**	**0.024**	**0.016**	**0.025**	**0.010**
Selenium	7782-49-2	mg/L	0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01
Zinc	7440-66-6	mg/L	0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.026	<0.005	<0.005
Iron	7439-89-6	mg/L	0.05		**0.10**	<0.05	<0.05	<0.05	**0.49**	<0.05	<0.05	<0.05	<0.05	**0.42**	**0.53**	**1.07**	**0.06**	**0.08**

EG035T: Total Recoverable Mercury by FIMS																		
Mercury	7439-97-6	mg/L	0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

5.8.8.2 Ground Water

Four boreholes were tested for heavy metal. Again Alluminium, Cromium, Nickel and Iron were detected at all sites. The occurance of these heavy metals indicates the ultramafic condition the tenement.

Table 26: Ground water ALS Test result, 2020.

Matrix:	**WATER**		**Sample Type:**	**REG**	**REG**	**REG**	**REG**
Workgroup:	EB2005580		**ALS Sample Number:**	EB2005580001	EB2005580002	EB2005580003	EB2005580004
Project name/number:	Suma Project		**Sample Date:**	16/02/2020	16/02/2020	16/02/2020	16/02/2020
			Client sample ID (1st):	BH01	BH02	BH03	BH04
Analyte grouping/Analyte	**CAS Number**	**Unit**	**Limit of reporting**				
EG020T: Total Metals by ICP-MS							
Aluminium	7429-90-5	mg/L	0.01	**0.34**	**0.01**	**0.01**	**0.02**
Arsenic	7440-38-2	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	mg/L	0.001	**0.019**	**0.006**	**0.002**	**0.025**
Copper	7440-50-8	mg/L	0.001	**0.002**	<0.001	<0.001	<0.001
Lead	7439-92-1	mg/L	0.001	<0.001	**0.003**	**0.006**	**0.010**
Nickel	7440-02-0	mg/L	0.001	**0.072**	**0.001**	**0.022**	**0.028**
Selenium	7782-49-2	mg/L	0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	mg/L	0.005	<0.005	<0.005	**0.007**	<0.005
Iron	7439-89-6	mg/L	0.05	**2.01**	<0.05	**0.18**	**0.10**
EG035T: Total Recoverable Mercury by FIMS							

Mercury	7439-97-6	mg/L	0.0001		<0.0001	<0.0001	<0.0001	<0.0001

5.8.9 Oil and Grease

Oil and grease from five sampling sites near and along the coastline were below detection limits. See results table below.

Table 27: Oil and grease results, ALS, 2020.

Date	16/02/2020	16/02/2020	16/02/2020	16/02/2020	16/02/2020
Site	OG-01	OG-02	OG-03	OG-04	OG-05
mg/L	<5	<5	<5	<5	<5

5.8.10 Limitations

Obtaining realistic results that are more site specific requires testing over a certain period of time, minimum of one (1) year and at different weather or climate conditions. In addition to that, it is important to identify at least twenty (20) to thirty (30) sampling sites that spreads evenly over the entire tenement. At this stage, fourteen sites were covered in this assessment and additional sites likely to be considered relevant would have to be included at the mining stage.

5.8.11 Conclusion

The water quality assessments provide understanding of how diverse the water environment and its link to land use patterns. In the absence of national water quality standards, the WHO standards are used as a basis for comparison. The water quality results confirmed changes in water chemistry approaching the ocean and at location exposed to runoffs. The causes are both natural and anthropogenic.

5.9 Ambient Noise Levels

5.9.1 Ambient Noise – Baseline

There are no noise standards in Solomon Islands, and as any noise generated by the subproject will be temporary (i.e. during construction) and intermittent, preparing a baseline of ambient noise levels for subsequent monitoring is not considered warranted.

Construction, operation, decommissioning noise are generally intermittent, attenuates quickly with distance, and depends on the type of operation, location and function of equipment. During operation of the mine, there will be a temporary impact due to the noise from operating equipment, especially when operations activities are carried out close to residents. WB standard noise levels can be used as a guide[22].

Table 28: WB Noise guide

Table 1.7.1- Noise Level Guidelines[54]		
Receptor	One Hour L_{Aeq} (dBA)	
	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational[55]	55	45
Industrial; commercial	70	70

The result below comprised the minimum, average and maximum noise levels recorded from the SIRC weather station at Suma camp, Isabel Province over three months. This weather station automatically records every two hours of data between 1 pm and 11pm. Noise levels from the raw data indicates majority of the noise are below the WB standards, however, there were occasions during daytime hours when noise were above the residential and industrial standards. The excess noise levels were due to heavy machineries working on road and stockpile areas.

Table 29: Noise Levels, Suma camp, 2020

Months 2020	Noise		
	MIN	**AVER**	**MAX**
April	44.9	46.13	70.8

[22] https://www.ifc.org/wps/wcm/connect/4a4db1c5-ee97-43ba-99dd-8b120b22ea32/1-7%2BNoise.pdf?MOD=AJPERES&CVID=ls4XYBw

May	45	46.04	58.5
June	44.9	47.69	71.3

5.9.2 Noise Emissions – Construction and Operation

The most sensitive receptors are mainly residential buildings in Riudede village and the terrestrial ecosystem. It is the responsibility of the mining company to arrange meetings between the affected community on feasible work schedules (hours of equipment operation etc.). Ideally, noise should not exceed 45 dBA measured at the outside of any residence.

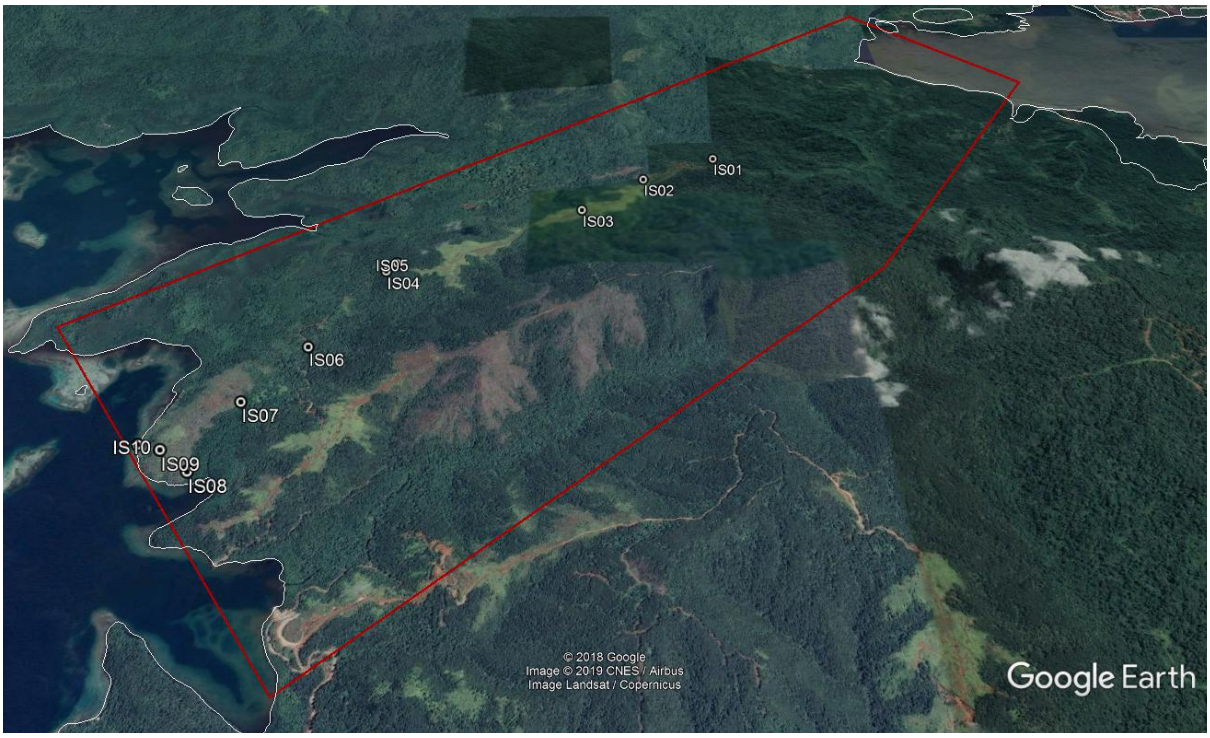
6. TERRESTRIAL ECOLOGY

6.1 Assessment objectives

The main aim of this Assessment is to deliver;

- A description of existing ecological values of the terrestrial environment within the tenement;
- An assessment of potential impacts of the project to the ecological values that exist within the tenement area; and
- A description of the mitigation measures that would be taken in order to mitigate the potential impacts of the project to the ecological values.

Figure 27: Transect Points



6.2 Assessment methodology

The tenement area is situated between the former SMM tenements D and E, with similar physical and biological characteristics. Flora and fauna in the area especially for the two former SMM tenements have been widely studied. With no exception, flora and fauna occurrences for the SIRC tenements would be very similar to that of those two former SMM Ltd tenements. For purpose of this study, two site visits were undertaken to the site. A first site visit was conducted from 3rd to 7th August whereby the assessment only focused on consulting people within and outside the tenement area to obtain their local knowledge in regards to the existing ecological values of the terrestrial environment. The second site visit was undertaken from 9th to 12th of August 2019, with two days (10th and 11th of August 2019) of survey of terrestrial flora and fauna in the project area.

The Terrestrial ecology survey was done through three stages. Firstly, a desktop study and literature search was undertaken including a review of reports from the Ministry of Forest and the ECD. Search and review was also done for other published sources for threatened species known, or considered likely to occur within the locality of the subject site as well as other non-published sources. Importantly, this also includes a review of SMM Limited's EIS for tenements D and E in the same locality which is very relevant to this study as well as a review of Axiom's EIS on the nearby adjacent Island of San-Jorge, which is also relevant to this study. Secondly, interview with key informant in local communities within the Tenement area was undertaken to get their knowledge about flora and fauna in the area. Thirdly, direct field survey/observation was undertaken to record the common occurring species in various habitats within the tenement.

For the Flora assessment, the walking transect method (Economos, 2012) is used, whereby a 50 m linear transect is applied in various spots throughout the tenement. Ten random sites within the tenement are selected. All common flora encountered throughout the transects including 10 meters to the left and 10 meters to the right of each transect are recorded and identified to species level. GPS readings are taken for location of each transects.

The Fauna Assessment was done using the Reconnaissance Walk Method following trails or paths along the tenement to observe medium to large animals (mammals) and record and identify the species names of animals that are present in the tenement and marked using a GPS (Amoakoh & Nortey, 2016). Small animals are captured and later released. For avifauna (birds) assessment, observation was utilized along footpaths or walking trails through different (various) parts of the study area with the aim of covering as much of the area as possible. Slow and attentive walking along footpaths/walking trails was done in order to see or hear birds calling. Birds at a distant point were able to be observed using a binoculars. Amphibian & Reptile assessment were done using area constrained search along the same flora transect lines of 50 meter that is repeated randomly along 10 sites within the tenement. Suitable habitats of amphibians and reptiles were sampled. In this case search techniques including visual scanning of the terrain and refuge examination (e.g. lifting rocks and logs, scraping through leaf litter) and listening to mating calls was undertaken. The assessment is undertaken during daytime hours only from 9am-5pm. For Larger Reptiles, they are difficult to detect given the short period of the survey. Therefore, survey was conducted opportunistically with visual observation supplemented with key informant interviews in communities within the tenement and the nearby communities where investigations are being undertaken.

6.3 Limitation of surveys

The major limitation of the survey is mainly due to time constraint – shorter period for the survey. The fact that the survey period is very short, all the surveys/assessments including flora and fauna (avifauna, amphibian, mammals and reptiles) were undertaken at the same time. The 10 transect lines done for flora survey also include amphibian and small reptile surveys. Search and visual scanning of the terrain was undertaken in those 10 sample transects which is a major drawback. While walking from site to site during the survey period for the sample transects, observation was undertaken for large mammals and avifauna. Survey of amphibians during night-time was not undertaken, however, insects and frog callings were heard and recorded for identification purpose. Survey for larger reptiles such as crocodiles were undertaken on a separate time however, no sign of crocodiles or other larger reptiles were observed. Anecdotal evidences and information for presence of larger reptiles and information from key informants are taken note of in regards to presence of larger reptiles in the area.

6.4 Existing Values

Solomon Islands is endowed with a vast diversity of flora and fauna species. The country is among those that have the most diverse species of terrestrial fauna with high incidence of endemism (species found nowhere else in the world). Several studies have been undertaken for flora and fauna in Solomon Islands. This include; Walker (1918), Whitmore (1966; I969a: 1969b), Woltt (1958), Hansell and Wall (1976), Lewis and Cribb (1991), and Henderson and Hancock (1988). Henderson and Hancock (1988) listed 3,210 species of vascular plants that include 1,077 genera and 205 families. They highlighted the components of flora as; dicots 1,941 species; monocots 880 species; gymnosperms 22 species and ferns 367 species (Henderson and Hancock, 1988).

The NBSAP 2016-2020 highlighted that the country is sometimes referred to as a “Centre of Plant Diversity” due to very high occurrences of plant species that stand at a record of 4,500 and out of those 3,200 are known to be native (indigenous) species (NBSAP, 2016-2020). There are five major vegetation type in the country that include: (i) Grassland, (ii) Swamps, (iii) Lowland Rainforest, (iv) Montane Forests and (v) Secondary Vegetation. Some areas in provinces like Isabel (southeastern part of the island including San Jorge and the adjacent mainland Isabel- Jejevo & Takata), Choiseul (Southeastern part of the island) and

Guadalcanal (the Marau area) have a related Nickeliferous laterites geology that influence the vegetation type that is known as Ultrabasic/Ultramafic Forest. This is believed to be related to the possible occurrence of the mineral nickel in those areas.

Moreover, an EIA study that was thoroughly done by SMM Ltd in nearby tenements D and E (former SMM prospecting tenements) has provided interesting findings in the area and contributed further to the knowledge of flora and fauna in Isabel Island and the Solomon Islands as a whole. Both former SMM Ltd.'s tenements have the same geological, physical and biological characteristics as that of the current SIRC's tenement area. Therefore, the findings on flora and fauna surveys by SMM Ltd in their study would also resemble species composition within the Kolosori – Takata tenement. According to EIS report by SMM Ltd, there are 162 morpho-species of vascular plants in the area and a large percentage of vegetation grow on ultrabasic/ultramafic soils which is closely aligned to the geology of the area.

6.5 Flora

There are two major vegetation type observed in the tenement area and this include the Lowland Forest and the Ultramafic Forest. The survey has categorized the sites sampled according to habitat types which include old growths and secondary forest, Fernlands (that includes Fern Shrublands, Fern Woodlands, ridge and ridge slopes and valleys of fern areas), ultramafic forest habitats, combination of lowland hilly and ultramafic habitats, Lowland Riparian Forest, mangroves forest habitat, Coastal Fernland and Shrubland, and coastal rocky habitat. The survey confirmed that Xanthostemon melanoxylon (Ironwood) is the majority species that occur within the tenement which is consistent to the findings of the SMM Ltd EIS. In most sites the understory and ground level species is mostly composed of Dicranopterus linearis. As such it was influenced by the geology of the area (ultrabasic/ultramafic rocks). Hence, limiting the occurrence of other plant species except for an abundance of the ironwood trees. Common species that occurring in the area are recorded and identified. According to the survey, the findings are outlined below.

6.5.1. Transect locations

Site 1: IS01

Start

Location: S08.41788, E159.72926

End

Location: S08.41759, E159.72957

Vegetation type: Lowland forest

Habitat type: Mixture of old growths and secondary forest

Description: The area being surveyed is a disturbed area which is near the Riudede settlement at the interior of the tenement. Few farmed over area, with secondary growth forest but mostly old growths is visible.

Common species that occur in the sampled area

Trees (Species name)	**Understory (Species name)**
Astronidium sp.	*Macaranga spp*
Finschia sp.	*Merremia peltata*
Dysoxylum excelsum	*Hydrastele hombronii*
Calophylum spp	*Calamas hollrungii*
Diospyros insularis (Ebony)	*Calamus stipitatus*
Trema orientalis	

Site 2: IS02

Start

Location: S08.41971, E159.72491

End

Location: S08.42605, E159.72435

Vegetation type: Ultramafic forest

Habitat type: Fernland (in association with Fern Scrubland and Fern Woodlands) situated on ultramafic soils.

Description: This area is visible of a human disturbed area with the fern *Dicranopterus sp*. covering about 90% of foliage cover on most areas on ridge top. Fern shrubland and fern woodland found to occupy the ridge slopes and the lower parts of the hill. Human induced fire is the possible cause of formation of such habitat.

Common species that occur in the sampled area

Trees (Species name)	**Ground layer species (Species name)**
Myrtella baccarri	*Dicranopterus linearis (foliage cover of 90-100%)*
Hydriastele hombronii	*Calamus spp*
Pandanus spiralis	
Xanthostemon melanoxylon (Queen Ebony)	

Site 3: IS03

Start

Location: S08.42255, E159.72159

End

Location: S08.42241, E159.72122

Vegetation type: Ultramafic forest

Habitat type: Fernlands (Fern Scrubland and Fern Woodlands on ridge slopes and valleys) on ultramafic soils

Description: The area has a mixture of Ferns, *Dicranopterus linearis,* Fern Woodlands and the associated tree species on ridge slopes and valleys. There is also sign of disturbance probably of fire in the past. There are thickets of vines of the Calamas type with shrub and herbaceous species.

Common species that occur in the sampled area

Trees (Species name)	**Ground layer/understory (Species name)**
Myrtella baccarri	*Dicranopterus linearis (foliage cover of 55% on ridge slope)*
Hydriastele hombronii	*Melastoma affine*
Pandanus spiralis	*Lycopodium cernum*
Xanthostemon melanoxylon	*Scelria polycarpa*
Gymnostoma papuana	*Danella ensifolia*
Syzigium spp.	*Flagellaria gigantea* (native vine)
Dillenia crenata	*Hydnophytum formicorum* (native vine)
Commersonia bartramia	*Spathoglotis plicata*
Dacridium solomonensis	*Calamas hollrungii*
Heterosphate minor	
Actinorhtyis calapparia	

Site 4: IS04

Start

Location: S08.42784, E159.71043

End

Location: S08.42812, E159.71001

Vegetation type: Lowland/Ultramafic forest

Habitat type: The habitat is a combination of lowland hilly forest and ultramafic forest on ultrabasic/ultramafic soils.

Description: This is where lowland forest meets ultramafic forest. A combination of plants of the lowland vegetation and the common occurring species of the ultramafic forest. Mostly composed of *Xanthostemon melanoxylon* (Queen Ebony/ironwood) and *Gymnostoma papuana* (pine) with forest canopy very intact.

Common species that occur in the sampled area

Trees (Species name)	**Understory (Species name)**
Xanthostemon melanoxylon	*Lycopodium cernum*
Hydriastele hombronii	*Flagellaria indica*
Gymnostoma papuana	*Dicranopterus linearis*
Callophylum obscurum	*Calamus stipitatus*
Callophylum vitiense	*Calamus Hollrungii*
Dacridium solomonensis	Young *Hydriastelle* palms
Diospyros insularis	Young palms (*Actinorhtyis calapparia*)

Pandanus spiralis

Syzygium sp.

Site 5: IS05

Start

Location: S08.42732, E159.71098

End

Location: S08.42704, E159.71049

Vegetation type: Lowland Hilly Forest on Ultramafic Soils

Habitat type: The habitat is lowland hilly forest and ultramafic forest

Description: The site is mainly with the tree species *Xanthostemon melanoxylon* (Queen Ebony/Hardwood) and *Gymnostoma papuana* (pine). The forest canopy is intact and thick humus layer on the ground mainly from leaves and seeds of the bigger and taller trees. The understorey is composed mainly of the young palm *Hydrastelle spp*.

Common species that occur in the sampled area

Trees (Species name)	**Ground layer/understory (Species name)**
Callophylum vitiense	Young *Pandanus spiralis*
Hydriastele hombronii	*Flagellaria gigantea* (native vine)
Xanthostemon melanoxylon	*Lycopodium cernum*
Gymnostoma papuana	*Scelria polycarpa*

Syzigium spp.

Dillenia crenata

Commersonia bartramia

Dicridium solomonensis

Pondocarpus spp.

Site 6: IS06

Start

Location: S08.43344, E159.70715

End

Location: S08.43308, E159.70753

Vegetation type: Lowland Forest

Habitat type: Lowland Riparian Forest

Description: The site is located on a flat landscape along the plains of the Hugevi Stream which later runs through the mangrove ecosystem further downstream. The canopy is still intact, the ground layer is filled with thick leave litter and understory composed mainly of lianas and ferns that occur intermittent, and a sporadic occurrence of young *Pandanus spiralis* and also germinating seedlings of trees that are common at the site. There are also vines of the Calamus type.

Common species that occur in the sampled area

Trees (Species name)	**Ground layer/understory (Species name)**

Callophylum vitiense

Terminalia calamansanai

Vitex coffasus

Gymnostoma papuana

Ficus spp.

Eudia spp.

Syzygium spp.

Heterosphate solomonensis (Palm)

Cannarium spp.

Sago palms, *Metroxylon (Arecaceae)*

Calamus hollrungii

Calamus stipitata

Merremia peltata

Selaginella rechingeri

Diplazium esculentum

Figure 28: Sago Palm, Metroxylon (Arecaceae) found in the lowland riparian forest in Site 6.

Site 7: IS07

Start

Location: S08.43727, E159.70459

End

Location: S08.43751, E159.70421

Vegetation type: Mangrove

Habitat type: Mangrove Forest

Description: The habitat is undisturbed with thickets of mangroves and mangrove associates. It is a big strand of mangrove steadily fed by the Hugevi Stream freshwater that stabilizes salinity for the forest to thrive. The site being surveyed is behind of the mangrove strand where taller mangrove trees are dominant especially behind the *Rhizophora spp* and is dorminated by *Bruguiera gymnorrhiza*. This forest has its canopy intact.

Common species that occur in the sampled area

Trees (Species name)	**Ground layer/understory (Species name)**
Bruguiera gymnorrhiza	*Acanthus ebracteatus*
Sonerratia	*Acrostichum corniculatum*
Rhizophora stylosa	
Rhizophora apiculate	
Barringtonia racemose	
Brugueira hainsii	
Nypa Fruiticans	
Heritiera littoralis	

Site 8: IS08

Start

Location: S08.44155, E159.70312

End

Location: S08.44126, E159.70349

Vegetation type: Mangrove Forest

Habitat type: Mangrove Forest

Description: This is the same mangrove strand as that of site 7. The survey was done in front of the strand near the coastline. The mangrove trees become shorter compared to that of site 7. The dominant species is the Rhizophora.

Common species that occur in the sampled area

Trees (Species name)	**Ground layer/understory (Species name)**
Rhizophora stylosa	*Acanthus ebracteatus*
Rhizophora apiculate	*Acrostichum speciosum*
Nypa Fruiticans	
Heritiera littoralis	

Figure 29: Mangrove forest left undisturbed at near the proposed port site at Suma. Common species are Bruguierra and Rhyzophora.

Site 9: IS09

Start

Location: S08.44036, E159.70154

End

Location: S08.44054, E159.70126

Vegetation type: Lowland Forest

Habitat type: Coastal Fernland and Shrubland

Description: The site is located on a hilly coastal Fernland area and composed mostly of native shrubs and herbaceous plants that occupy the ground layer.

Common species that occur in the sampled area

Shrub species (Species name)	**Ground layer (Species name)**
Melastoma affine	*Dicranopterus linearis*
Myrtella beccarii	*Lycopodium cernum*
	Scleria polycarpa
	Spathoglotis plicata
	Dianella ensifolia
	Cyperaceae (Sedges)

Site 10: IS10

Start

Location: S08.43991, E159.70030

End

Location: S08.43965, E159.70027

Vegetation type: Lowland/coastal forest

Habitat type: The area is coastal and has rocky substrate covered mostly of pandanus and sedges.

Description: The site is located along the coast with rocky substrate with signs of human disturbance.

Common species that occur in the sampled area

Trees & shrubs (Species name)	**Ground layer (Species name)**
Barringtonia asiatica	*Dicranopterus linearis*
Callophyllum inophyllum	*Wollastonia biflora*
Pandanus tectorius	*Alpinia oceanica*
Casuarina equisetfolia	*Ipomoea pes-caprae*
Pandanus compressus	*Scaevola taccada*
Terminalia catappa	*Cyperaceae* (Sedges)
Cocos nucifera	
Hibiscus tiliaceus	

Premna corymbosa

Intsia bijuga

6.5.2. The Lowland Forest

Site 1 and Site 6 have a distinct feature of a Lowland Forest which is very different from the species composition of the Ultrabasic/ultramafic Forest. The commonly occurring species of the lowland forest that does not have ultramafic soils are; *Astronidium sp., Finschia sp., Dysoxylum excelsum, Calophylum spp, Diospyros insularis* (Ebony), *Trema orientalis, Callophylum vitiense, Terminalia calamansanai, Vitex coffasus, Gymnostoma papuana, Ficus spp., Eudia spp., Syzygium spp., Heterosphate solomonensis* (Palm) and Cannarium spp. This forest type does not have the *Xanthostemon melanoxylon* but the *Hydriastele* palm seem to be present.

Figure 30: The lowland riparian understory composed mainly of ferns and Calamus sp.

6.5.3 Ultrabasic/ultramafic Forest

Site 2, Site 3, Site 4 and Site 5 contain the ultrabasic/ultramafic soils as are obviously depicted by the presence of *Xanthostemon melanoxylon* and the palm *Hydriastele hombronii.* Importantly, *Gymnostoma papuana* which usually occurs in lowland forest in the area seem to occur also in most ultrabasic/ultramafic soils that could be an associate of the ironwood tree due to its ability to adapt to such hostile environment. Site 2 in specific is characterized mostly of the fern *Dicranopterus linearis* with 90-100% foliage cover on ultrabasic/ultramafic soil.

Figure 31: View of Fern land (in association with Fern Scrubland and Fern Woodlands) situated on ultramafic soil.

Figure 32: Xanthostemon melanoxylon and Gymnostoma papuana in lowland forest of ultrabasic/ultramafic soil.

6.5.4 Flora Species of Conservation Significance

There are two species identified during the survey in sites 1 and 4 namely; *Diospyros insularis* and *Callophylum obscurum* which are listed in the IUCN Red List of Threatened Species. The SMM Ltd EIS report listed 27 plant species for the entire Solomon Islands that are listed as Threatened species under the IUCN Red List of Threatened Species (Table 30). Some are recorded while others are possible to have occurred on the island of Isabel. Other species including Ironwood *(Intsia bijuga);* Ebony *(Diospyros spp.);* Nali Nuts *(Canarium indicum)* and other edible fruit trees are found in the area and are listed as protected species under Schedule 1 of Forest Resources and Timber Utilization Act. The mangrove forest found in the area is undisturbed and intact and is worthy of protection or customary reserve. Mangroves however are not listed as threatened but it is important that the mangrove forest be reserved as it will help to mitigate sedimentation and siltation run-offs from the mining operation sites. Not only that, the species *Xanthostemon melanoxylon* is an endemic and native tree species of the Solomon Islands that mostly occur in the area that requires some sort of protection. It is important to note that not all forested areas will be cleared by the mining operation. Pockets of soils will be mined, that means strands of forests located on a particular pocket will be cleared prior to excavations.

Table 30: Flora Species of Conservation Significance and their Potential to Occur on Santa Island (Source: SMM Ltd EIS).

Species	Distribution Record	Habitat Preference	Potential to Occur on Santa Isabel Island
Agathis macrophylla (Lindl.) Mast	Occurs in Solomon Islands (Sta. Cruz)	Lowland forest	Unlikely but still possible
Aglaia brasii Merr & Perry	Solomons, Southeast Asia, Northern Australia and the Pacific	Lowland forest	Possible
Aglaia flavida Merr & Perry	Solomons, Southeast Asia, Northern Australia and the Pacific	Lowland forest	Possible
Aglaia parksii A.C. Sm.	Solomons, Southeast Asia, Northern Australia and the Pacific	Lowland forest	Possible
Aglaia parviflora C. DC	Moluccas, New Guinea, Solomon Islands	Lowland forest	Possible
Aglaia rubrivenia Merr & Perry	Endemic to Solomon Islands	Lowland forest	Possible
Aglaia saltatorum A.C. Sm	Solomon Islands (Sta. Cruz)	Lowland forest	Unlikely but still possible
Aglaia samoensis A. Gray	Solomon Islands (Sta. Cruz)	Lowland forest	Unlikely but still possible
Aglaia silvestris (M. Roem.) Merr.	Solomon Islands	Lowland forest	Possible
Archidendron oblongum (Hemsl.) de Wit	Endemic to Solomon Islands	Lowland forest (alluvial valleys)	Possible
Burckella sorei Royen	Bougainville and Guadalcanal	Lowland forest	Unlikely but still possible
Calophyllum confusum P.F. Stevens	Solomon Islands (New Georgia)	Lowland forest	Unlikely but still possible
Calophyllum obscurum Stevens	Solomon Islands (Choiseul, Santa Isabel and Malaita)	Lowland forest (ridges and coral platforms)	Recorded
Cycas bouganivilleana	Solomon Islands, Bougainville, New Britain Islands	Coastal beach forest	Unlikely but still possible
Diospyros insularis Bakh.	Solomon Islands and New Ireland	Lowland forest	Recorded
Gonystylus macrophyllus (Miq.) A Shaw	Solomon islands (Choiseul and New Georgia)	Lowland forest up to 1,500 m asl	Recorded
Intsia bijuga (Colebr.) Kuntze	Madagascar, Indian Ocean Islands, tropical Asia through Malesia to Northern Australia, Melanesia and Micronesia	Inland from coastal forest	Possible
Livistona woodfordii Ridl.	Solomon Islands (Nggela Island)	Lowland and swamp forests	Unlikely but still possible
Mangifera altissima Blanco	Philippines, Sulawesi, Lesser Sunda Isls, Moluccas, New Guinea, Solomon Islands (Guadalcanal)	Lowland forest	Possible
Mastixiodendron stoddardii Merr. & Perry	New Britain and Solomon Islands	Lowland forest	Possible
Myristica globosa Warb.	Solomon Islands	Lowland forest up to 1,200 m asl	Possible
Myristica guadalcanalensis Sinclair	Solomon Islands (Guadalcanal,	Lowland forest	Unlikely but still

Species	Distribution Record	Habitat Preference	Potential to Occur on Santa Isabel Island
	Renell, Malaita)		possible
Myristica petiolata A.C. Sm.	Solomon Islands (Santa Isabel and Big Nggela Island)	Lowland forest	Possible
Myristica xylocarpa W.J. de Wilde	Solomon Islands (Santa Isabel Island, San Cristobal and Guadalcanal)	Lowland forest	Possible
Podocarpus glaucus Foxw.	Data deficient	Data deficient	Data deficient
Pterocarpus indicus Willd.	Myanmar, Thailand, Cambodia, Ryukyus, Philippines, along Bismarck Archipelago, Vanuatu, Solomon Islands, Caroline Islands	Lowland forest	Possible
Terminalia rerei Coode	Solomon Islands (San Cristobal and Guadalcanal)	Lowland forest	Unlikely but still possible

6.6 Fauna

During the survey, only the frog *Buffo marinus*, millipedes and several bird species were sighted and observed due to limitations of time availability for the survey. No large mammals and reptiles were observed. However, Solomon Islands including Isabel Island are known to have a diverse species of fauna, and endemism within islands is remarkable and distinctive.

According to literatures, there are at least 381 terrestrial wildlife species known for the Solomon Islands (Flannery, 1995; Doughty *et al*., 1999; McCoy, 2006; Brown & Richards, 2008; and Menzies, 2006). It has been identified that Isabel Island has 211 vertebrate fauna which composed of 23 amphibians, 38 reptiles, 126 birds and 24 mammals (SMM Ltd EIS, 2012). SMM Ltd has recorded a total of 93 species of wildlife vertebrates within Tenements D and E during its survey undertaken in 2010 and 2011, which represents approximately 24% of all known vertebrate species for the whole of Solomon Islands, and about 44% of known vertebrate species for the entire Isabel Island.

Figure 33: A spiked spider, Gasteracantha sp. in site 1.

6.6.1. Amphibians

Transects in sampled sites are searched for possible presence of amphibians including the visual scanning of the terrain and refuge examination (e.g. lifting rocks and logs, and scraping through leaf litter). However, no amphibians were found. This could be related to the timing of the survey which was done during mid-day and the sites are commonly used by people- several bush tracks used by people of Riudede who often walk to and from the coastal settlement of Suma, hence a high disturbance area.

However, the island of Isabel is known to have 22 of the 23 species of amphibians (mainly frogs) that are found in Solomon Islands. Two new frog species of the genus Platymantis (*P. desticans and P.parilis*) are recorded in Isabel Island by Brown and Richards, 2008. It is important to note that two frog species in the country including; *Palmatorappia solomonis* (Solomon Islands Palm frog) and *Litoria lutea* (Solomon Islands tree frog) are listed as Vulnerable under the IUCN Red List of Threatened Species. The main reasons for this is the fact that their forest habitats are being threatened and declining at an uncontrolled rate and their extent of occurrences is limited.

6.6.2. Mammals

During the survey, none of the large mammals and small mammals are observed due to time constraint, the sites are highly disturbed and the survey was done during day time. Nonetheless, there are 52 mammal species recorded in the Solomon Islands (Flannery, 1995). Those species represent three orders (Diprotondontia with one species, Rodentia with 10 species and Chiroptera with 41 species. The Rodents include six species of giant rat of the genus *Salomys* and *Uromys* as well as three species of the introduced rat (Rattus rattus) and a melomys. The 41 species of Chiroptera include 23 species of fruit bats and 18 species of insectivorous bats.

27 species of mammals are endemic to Solomon Islands and seventeen of the 27 endemic species are threatened species (IUCN, 2011; in SMM Ltd EIS, 2012). It was highlighted in the SMM Ltd EIS that four of the seventeen threatened mammal species occur in Isabel Island. They are; *Solomys sapientis, Pteralopex atrata, Pteralopex flanneryi* and *Pteropus mahaganus*. According to the IUCN, The *Solomys sapientis* (Isabel giant rat) is endangered as result of a sweeping population decline and forest habitat decline. Two species of recorded bats in the area are listed as protected species in the Wildlife Protection and Management Act 1998. They are; *Dobsonia inermis* and *Melonycteris woodwordi*.

6.6.3. Avifauna

The Solomon Islands is known to have high number of bird species but the exact total species for the country is still not known. There are several studies being undertaken in the country that gives varied number of species occurrences. However, according to a recent bird study by the Avibase (2011), there are 289 species recorded, out of which 59 are endemic species and 26 are globally threatened. Seventeen bird species of the Solomon Islands are listed as threatened under the 2011 IUCN Red List of Threatened Species. Three of those threatened species of the Solomon Islands are recorded in Isabel Island. These are *Haliaeetus sanfordi* (Solomon sea-eagle), *Accipiter imitator* (imitator sparrowhawk) and *Nesasio Solomonensis* (fearful owl). Not only are they endemic to Isabel Island alone but the other islands in Solomon Islands as well.

The bird species of Isabel Island are categorized into 40 families (SMM Ltd EIS, 2012). Eight families are represented by 31 species of shore birds. Canopy or above canopy species are represented by seven families with 14 species. The rest are markedly understorey species. There is no doubt the tenement area has high diversity of bird species due to the presence of large tracts of forest and the understorey as well as the canopy are still intact.

During the survey, cockatoo parrots, crested cuckoo dove, *Haliaeetus sanfordi* (Solomon sea-eagle), *A. imitator*, Seagulls and Kingfisher birds were sighted. The *H. sanfordi* is among the seven endemic species to Solomon Islands that are protected under the Wildlife Protection and Management Act 1998 because of their limited distribution and a speedy declining population due to habitat loss.

Figure 34: The Ultramarine Kingfisher, Todirhamphus leucopygeus, in the mangrove forest in Site 8.

6.6.4. Reptiles

There are 75 species of reptiles in Solomon Islands (McCoy, 2006). This number may not well represent the actual reptile diversity in the country, however, just like amphibians, reptiles are not well studied. The fauna survey undertaken by SMM Ltd for its EIS in 2011 has resulted to the discovery of a new reptile species for the Solomon Islands and this was recorded in Isabel Island just nearby to the Kolosori (Takata) Tenement. The new species is the *Cyrtodactylus solomonensis,* which is the Solomon Islands gecko. Thus, the number of known species of reptiles in Solomon Islands now stands at 76 and in the order Crocodylia and Squamata. 78% of reptiles species belong to the four known lizard families (Agamidae, Gekkonidae, Scincidae and Varanidae with 59 species) (SMM Ltd EIS, 2012). According to the report, 37 species of the 76 known reptile species have their distribution restricted to Solomon Islands.

According to available literatures and previous studies, 38 of the 76 known reptile species for Solomon Islands are found in Isabel Island. Study by SMM Ltd has identified and recorded 25 reptile species within tenements D and E in Isabel Island and nine of which are endemics. This findings by SMM Ltd represents 33% of reptile species for the entire Solomon Islands and 66% of known species on Isabel Island. One reptile species found by SMM Ltd during the fauna survey in Isabel Island, *Tribolonotus blanchardi* (Blanchard's helmet skink), is listed as Vulnerable under the IUCN Red List of Threatened Species. Seven reptile species including *Emoia cyanura, Sphenomorphus solomonis, Eugongylus albofasciolatus, Corucia zebrata, Gekko vittatus* and *Candoia bibroni* are listed as protected species under the Wildlife Protection and Management Act 1998. While the survey does not find any smaller and larger reptiles, anecdotal information has it that there are crocodiles present in the area especially in Piregha stream and Hughevi stream.

6.7 Conclusion

The diversity of terrestrial flora and fauna within the tenement as depicted from the survey, signifies the importance of environmental protection in the area. However, should the much needed development be pursued it is important that the development proponent adhere to the comprehensive Environment Management Plan (EMP) prepared for the proposed development so that any potential negative impacts are carefully managed to an acceptable level. The EMP is very important as it has all the mitigation measures specific to terrestrial environment that if carefully adhered to can help to avoid, reduce or offset the potential negative impacts.

7. FRESH WATER ECOLOGY

7.1 Assessment objectives

The objectives of this Assessment are as follows;

- To provide a description of existing ecological values of the freshwater environment within the tenement;
- To provide assessment of potential impacts of the project to the freshwater ecological values that exist within the tenement area; and
- To provide description of the mitigation measures that would be applied so that the potential impacts of the project to the freshwater ecological values are avoided or reduced.

7.2 Methodology

The freshwater ecological survey only involve the survey of macrocrustaceans and fish that are present at each site. Despite of that, review of available literatures was done for macroinvertebrates (particularly the PET taxa) relevant to the tenement area. There are three main streams within the Tenement including Piregha, Beahutu and Hugevi. However, only the Beahutu and Hugevi streams are being surveyed. Two sites were chosen, one site for each stream.

Site 1 is at Beahutu Stream with coordinates: S08.44281, E159.71260 and Site 2 is at Hugevi Stream with coordinates: S08.43420, E159.70654. Appropriate habitat is selected for each site to ensure a good water depth and where human activity is limited. Snorkeling was then used to visually assess the fish species and macrocustacean species present at each site. An underwater camera for species images, a pencil and water proof paper were used to record commonly occurring fish species and macrocrustaceans observed during snorkeling at each site for each stream surveyed. The common fish species and macrocrustaceans observed are then identified to species level. Snorkeling for each site took approximately 30 minutes for each site. The freshwater survey was done on 11th of August 2019.

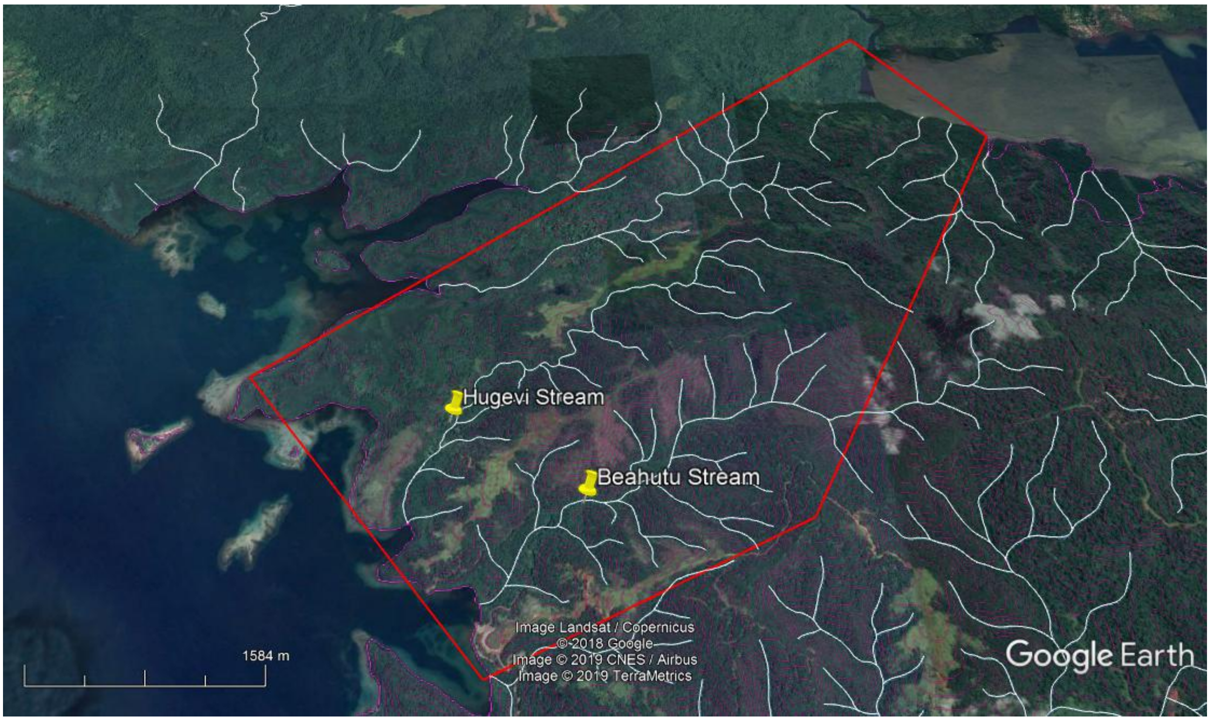


Figure 35: Fresh water survey sites

7.3 Limitation of survey

One major limitation of the survey is related to the very short timing for the assessment and the non-undertaking of benthic macroinvertebrate survey- especially the Plecoptera (stoneflies), Ephemeroptera (mayflies) and Trichoptera (caddisflies). The benthic macroinvertebrate survey is deemed as most significant because these benthic organisms spend most of their lives in water and they often have different tolerance to pollution in varied levels. Therefore, they are reliable and good indicators of biological conditions of waterbodies. However, the survey for these benthic macroinvertebrate was not undertaken and this was seen as a limitation for the freshwater ecology survey. Furthermore, the fact that only one site for each stream surveyed, may not fully represent the health of the streams but a visual assessment of the two streams confirmed that both streams are pristine and the findings for the survey is enough to represent the health of the streams. The freshwater ecology survey is done alongside the terrestrial flora and fauna survey on the last day of the terrestrial survey, therefore, time constrained is a major factor that contribute to the result of the survey.

7.4 Background

7.4.1 Existing values

Freshwater is very important for all living organisms. It plays an important role in ensuring terrestrial and aquatic organisms thrive and helped resolved the social and economic needs of people. It is understood that the current knowledge of freshwaters and their biodiversity in Solomon Islands is still poor.

With no exception the tenement area has freshwater ecosystems that support high diversity of fauna. The sites visited have intact riparian vegetation with limited degree of erosion on banks and channels. There is high environmental values of freshwater ecosystems for the two streams being assessed, with good environmental flow and quality supporting a healthy occurrence of fauna community. Human influences for the two streams assessed is minimal at the current stage. For Site 2 (Hugevi Stream), it is being used as a water source by the Company (SIRC) to provide drinking water to the campsite. A bridge is being created for crossing to access the eastern side of the Tenement. There is free flow of water under the bridge that feeds a large mangrove habitat downstream with location near the proposed port site.

For the two sites, the substrate of stream beds is composed mainly of gravel, pebbles and cobbles and some sand, silt and clay. There are also some leaf litter and debris from fallen tree twigs of the riparian vegetation. It is obvious that the stream bed substrates at the two sites surveyed are vulnerable to change during high flow events i.e., during extreme weather events such as cyclones associated with high precipitations. Macrocrustaceans (freshwater prawns, freshwater shrimp and crabs) and fishes are abundant in those two sites surveyed.

It is important to consider that the survey done by SMM Ltd (2012) for its EIS has identified two freshwater fish species in the area that are listed on the IUCN Red List of Threatened Species. They are; the spotted flagtail (*Kuhlia marginata*) being listed as 'lower risk' and the spotted scat (*Scatophagus argus*) which is listed as 'least concern'. There are no protected areas that include freshwater habitats within the Tenement. According to key informants, those streams are rarely used by people within the tenement to fish for protein food source. This can be proven by an abundance of species in the two sites surveyed.

7.5 Findings

7.5.1 Fish

For the two sites, the most common and abundant fish species is the spotted flagtail (*Kuhlia marginata*) shown in Figure 36. This is mainly due to the ability and biological characteristic of the species which can thrive in any habitat either a gravel/cobble/pebble substrate or a muddy/clay substrate (Boseto, Pikacha & Morrison, 2007). Another common fish species observed in both sites is the *Kuhlia rupestris*. There are presence of fish of the Gobiidae family shown in Figure 38 and Eleotrids shown in Figure 39 which are also relatively common. This is consistent with the findings of SMM Ltd EIS 2012. Not only in Isabel but all other larger islands in Solomon Islands seem to have such high fish diversity occurrences in many of their streams and rivers.

Figure 36: Image of spotted flagtails, Kuhlia marginata, underwater at Site 1, Beahutu stream.

Figure 37: Image of a Jungle Perch, Kuhlia rupestris, underwater at Site 2, Hugevi stream

Figure 38: Image of an eleotrid species, Ophioeleotris hoedti*, underwater at Site 1, Beahutu stream.*

Figure 39: Photo of a gobby species, Sicyopterus micrurus, underwater at Site 2, Beahutu stream.

7.5.2 Macrocrustaceans

The macrocrustaceans found in both streams include prawns, shrimps, and crabs. The prawn species, *Macrobranchium sp* is found in high abundance in both sites that are surveyed. A particular crab species that was found in the area apart from the two surveyed sites is the *Vuruna sp*. it was found with high abundance in nearby mangrove ecosystem downstream of the Hugevi stream.

Presence of macrocustaceans such as prawns and shrimps in both streams depicts a healthy freshwater ecology within the tenement. These crustaceans are important in the freshwater ecosystem food chain and their presence in those streams shows a balance of the ecosystem. These crustaceans are important in maintaining the quality of the inland waterways; they help to breakdown organic matter and provide a food source for other species such as fish, birds and mammals.

Figure 40: Image of a prawn, Macrobranchium sp. underwater at Site 1, Beahutu stream

Figure 41: Image of a shrimp, Caridina sp. caught at Site 1, Beahutu stream.

Figure 42: Image of the crab, Vuruna sp. downstream of Hugevi stream.

7.6 Macroinvertebrates

Macroinvertebrate survey was not undertaken for the two sites. However, a study undertaken by Polhemus *et al* (2008) for aquatic macroinvertebrate in Solomon Islands highlighted the known species richness of common taxa which includes:

- ✓ 93 species of true bugs, with the suborder Heteroptera from 28 genera in 12 families. 56 species are endemic and this represent 60% endemism at the species level.
- ✓ 63 species of dragonflies and damselflies of the order Odonata from 37 genera in 9 families. 4 genera and 28 species are endemic and this represent 44% endemism at the species level.
- ✓ 9 species of whirligig beetles of the order Coleoptera, family Gyrinidae. These are from 2 genera. 8 of those species are endemic which represent 89% endemism at the species level.

- ✓ 10 species of black fly of the order Diptera, family Simuliidae , from 2 genera. 9 of those species are endemic which represent 90% endemism at the species level.

According to Polhemus *et al* (2008); in SMM Ltd EIS (2012), a further 32 new species of macroinvertebrates are found in Solomon Islands with majority are seen to be endemic to a single island. The survey by Polhemus *et al* (2008) finds 31 new species of true bugs of the suborder Heteroptera and one dragonfly of the order Odonata. With that, the island of Isabel actually supports the occurrence of some of those macroinvertebrate taxa that are found nowhere else in other parts of the Solomon Islands.

7.7 Conclusion

Inland waterways at Kolosori (Takata) Tenement are very healthy as they are endowed with a diversity of biological life. As was depicted by an abundance of biological life at the two sample sites, it is important to note that the inland waterways in the area requires some sort of protection. The proposed mining operation in the area will need to apply site specific mitigation measures and techniques to ensure the potential negative impacts on the freshwater ecosystem is avoided or should it happen it must be reduced to acceptable level. The presence of diverse fish species and macrocrustacean species only signifies the intactness of the freshwater ecosystem which is important to maintaining life in the area.

8. MARINE BASELINE

8.1 Introduction

Marine biology is one of the many vital aspects of marine life form. This section of the EIS describes existing marine condition at the proposed tenement area. This include the description of the existing benthic coral cover of the coral reefs within the realms of the tenement area, invertebrate’s biota and its abundancy, the existing reef fish and open ocean fish that are present, and finally describe the hydrodynamic behaviors of the coastal water that surrounds Thousands Ships bay and Huali Bay.

The benthic cover baseline assessment are based on the description of the existing coral reefs and their overall presence within the realms of the tenement area. Types of coral that are present were identified and integrated in this report. Invertebrates found were identified, estimated and presented in this section. Fish survey were done by scaling from their family to species identification if it’s possible. Finally, the hydrodynamic of the coastal waters of Thousands and Huali bay was assessed which include mentioning of the flushing time of both Thousands ships bay and Huali Bay and their spatial and temporal changes.

Understanding the marine ecosystem and its processes is crucial to SIRC port design and mine activities along the coast and foreshore in order to avoid, minimize the impacts associated with the mining on the marine ecosystem.

8.2 Objectives

The main objectives of this assessments are to provide:

- An assessment of the potential adverse impacts of the mining project on the marine habitats and marine flora and fauna in the tenement area; and
- A description of the actions that would be taken to lessen, avoid and reduce the potential impacts of the mining project on the surrounding marine ecosystem.

8.3 Methodology

8.3.1 Benthic Cover

Selected sites were surveyed for benthic cover, fish abundance and invertebrates. Ecological baseline survey was conducted on the reef slope at a depth of 2-4m at a 50m transect.

Photos were taken every 2m along each 50m transects and the coverage of coral and macroalgae were determined using the Coral Point Count (CPC) application as per the methodology by Kohler and Gill (2006). A matrix of 20 randomly distributed points were overlaid on each image and the species or substrate type lying beneath each point. Primary benthic classes used include; live coral, dead coral, bleached coral, macro algae, other organisms, substrate. Each primary category were further classified into one of the thirty (30) benthic classes.

8.3.2 Invertebrates biodiversity and abundance

Invertebrates were surveyed along the 50m transect at every 2m. The targeted invertebrates includes giant clams (Genus: Tridacna and Hippopus); *Trochus niloticus (Trochus)*; pearl oysters (Genus: Pinctada & Pteria); Several species of sea cucumber including Holothuria (lolly fish), *Actinopyga mauritiana* (surf redfish) *Pearsonothuria graffei* (orangefish), *Bohadschia argus* (tigerfish), *Bohadschia marmoratus* (brown sandfish), and Stichopus Chloronotus (greenfish); and crayfish (Genus Panulirus). Indicator species such as the Acanthaster planci (crown of thorns star fish), Tectus pyramis (false trochus) and Charonia Tritonis (Triton Shell) were also recorded.

8.3.3 Fisheries and fish abundance

Fish were surveyed along each transects belt using underwater visual censor (UVC) as described in Albert *et al*. 2013. Each census consists of a diver swimming parallel to the reef slope and recording all fish > 5cm total length (TL) encountered along each transect. Individual fish were identified to Family and species level including population and size. Analysis examine the spatial variation in the composition of fish assemblage and the density of trophic groups (particularly herbivores and piscivores), fish families and individual species. Village interviews were done by showing fish family and species type to local fishermen to confirm their existence and local knowledge.

8.3.4 Hydrodynamic

Hydrodynamic baseline survey was entirely based on site observation and describing the behaviors of waves, swells and characterizing the coastal surroundings within the tenement area. OBM was the mode of transport used in the survey in Huali and Thousands ship bay's. Additional information's were also acquired through interviews with the local fishermen.

The flushing times of the Huali and Thousands ships bays were described based on local understanding and behavior of surface currents movements and observation conducted by the EIS team. In addition to these information's, previous studies by SMM 2012, and Axiom

2018 were used to aid the analysis of the coastal and open waters hydrodynamics within the tenement area.

8.4 Findings

8.4.1 Coral Reef

Most of the corals surveyed within the tenement area during the initial visit comprises mainly the hard corals which is consistence with the coral survey completed by Tsumitomo in 2012. The obvious hard corals found within the tenement area on the southern end at three different sites are branching, massive and sub-massive growth and are from the families:

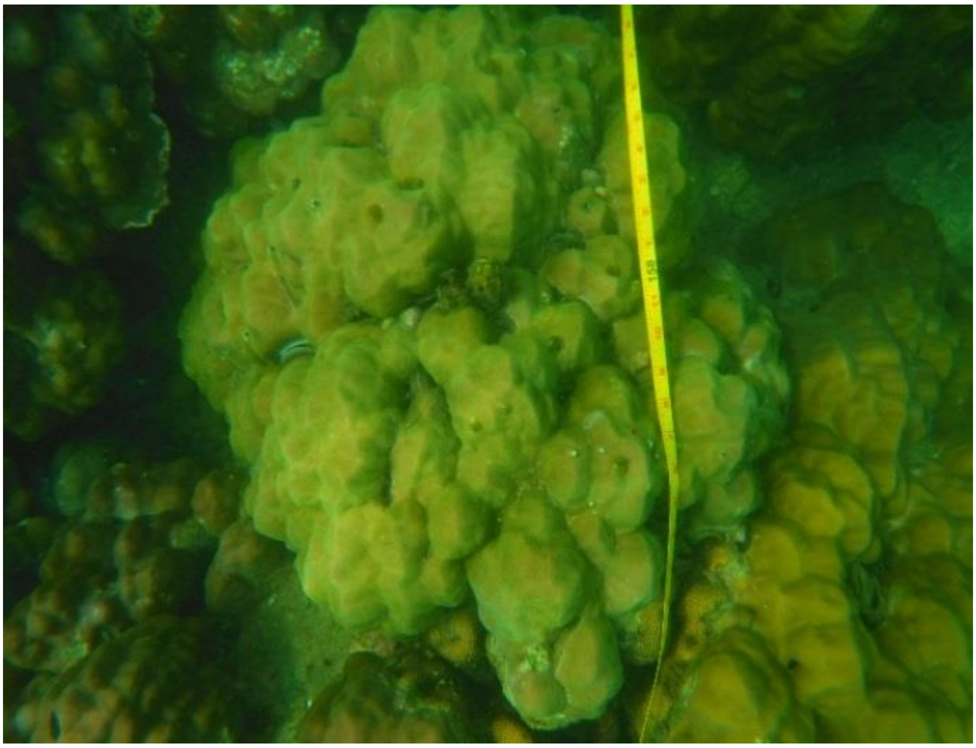
- Acroporidae (Acropora spp.)
- Poritidae (Porites spp.)
- Faviidae (Favia spp.)

Coral families found within three (3) of the sites visited are typical of the coral reef communities in Solomon Islands. Unlike the soft corals, hard corals are common within the reefs of the tenement area.

Figure 43: Typical branching hard coral (Acropora sp.) found on three (3) sites surveyed.

Figure 44: Several of these soft coral (Sinularia sp.) were found on site 1 & 2 of the surveyed tenement reef.

Figure 45: Typical Massive coral at Suma tenement coral reefs



Corals observed at three sites were generally in good health. There are no production of mucus that might indicate corals stress level. A comparison of the status of coral health from

Tsumitomo's EIS to this EIS has been done and the result shows that from then till now, no coral bleaching has occurred within the tenement area.

Coral cover just on the southern end of the tenement area covers about 30% of the coastal regions whilst the northern end covers about 20%.

Apart from the well-known corals, there are commonly known algae species which are also present within the area surveyed and these are:

- Caulerpa racemose
- Chlorodesmis fastigiata
- Dictyota sp.
- Halimeda spp
- Padina gymnospora
- Sargasumm spp, and
- Turbinaria sp.

Most of these macroalgae found within the reefs of the tenement area are typical of coral reef communities of the region.

However, on the northern end of the tenement coastal reef, the common sea urchin species found to be dominating the reefs is ***Diadem sp.*** This sea urchin species feeds on the periphyton (fresh water organism) of the bottom sediments on the coral reefs. Sea urchins are more obvious in areas with ambient concentration of nutrients. The abundant population of ***Diadem sp*** indicates impacted water quality and in this environment enhance eutrophication (McCook 1999: Hill and Wilkinson 2004).

Each of the headlands towards Thousand Ships bay comprises of coral reefs and the bays of each headlands covered mostly by silt from mangroves with less common to no corals found. This is a typical coastal community found in Solomon Islands where there is an existence of coastal mangroves.

Most of the coral reefs surveyed provide the habitat for fish and other marine species. In Huali and Vara bay, the reefs are impacted due to silt deposition associated with limited current movements. This was indicated in the less number of fish found in three locations surveyed in Huali Bay. Locals interviewed, mention that the depletion of fish population at these locations are due to past logging companies.

The high nutrient contents at the surveyed locations indicates high pressure on coastal ecosystem and these has resulted in depletion of fish population. In fact, the healthiness of coral reefs in the Huali and Vara Bay are increasingly declining.

Figure 46: An example of Headland with coral reef surrounding its coastal waters. Suma camp

8.4.2 Invertebrates

Common invertebrates and macroalgae found on the reefs surveyed during the site visit are:

- Giant boring clams (family: Cardiidae)
- Sea urchin (*Diadem sp.)*

Other invertebrates such as Trochus, crayfish, other species of sea cucumber, triton shell and many other marine species important to fisheries in Solomon Islands were not seen during the survey. Huali bay is dominated by ***Diadem spp***. that occupies almost all the reefs found within the bay. Thousands ships bay particularly Suma camp coastal coral reefs and Kolosori coastal reefs have had less of this ***Diadem spp.***

8.4.3 Fish Diversity and Community Composition

The survey indicated that the dominant fish family within the tenement area were: Pomacentridae (common name: damselfish), Labridae (common name: wrasses), Chaetodontidae (common name: butterflyfish) and Scaridae (common name: parrotfish). This finding is consistence with the survey done by Tsumitomo in 2012.

Local fishermen in Huali and Vara Village's mention that other fish families important to fisheries and are edible to human are found in the coastal foreshore. Those fish mentioned are from these families:

- Lutjanidae (Common name: snapper)
- Lethrinidae (Common name: Emperor)
- Chanidae (Common name: Milkfish)
- Belonidae (Common name: needlefish)
- Carangidae (Common name: Trevally/Jacks)
- Sphyraenidae (Common name: Barracuda)
- Scombridae (Common name: Tuna & Mackerel)
- Caesionidae (common name: Fusiliers)
- Serranidae (Common name: Grouper)
- Haemulidae (Common name: sweetlips)
- Holocentridae (Common name: squirrelfish)
- Priacanthidae (Common name: Bigeye)
- Mullidae (Common name: goatfish)
- Blastidae (Common name: triggerfish)
- Carcharhinidae (common name: sharks)

The table below shows fish families, common names and local names.

Table 31: List of fish families found at the site

Scientific name (family)	Common name	Local name (Isabel)
Pomacanthidae	Anemone fish	Sasajafe

Pomacanthidae	Angel fish	Ngorobaba
Toxotidae	Archerfish	Naplesu
Sphyraenidae	Barakuda	Kusa
Lutjanidae	Blue stripped Snapper	
Ostraciidae	Box fish	
Nemipteridae	Bream	
Serranidae	Brown marble Grouper	Dapa, Kabura
Chaetodontidae	Butterfly fish	Sasana'alo
Apogonidae	Cardinal Fish	Fihi
Kyphosidae	Chubs	
Chaetodontidae	Coral fish	
Pomacentridae	Damsel fish	Dova
Muraenidae	Moray Eel fish	
	Emova	Nattati
Lethrinidae	Emperor	Nafaro

Monacanthidae	filefish	Sotu, Vali
Pleuronectidae	Flounder	
Caesionidae	Fusilier	
Mullidae	Goat fish	
Serranidae	grouper	
Terapontidae	grunter	Kakabua
Hemiramphidae	Halfbeak	Ponu
Cirrhitidae	Hawkfish	
Labridae	Humphead wrasses	Mamini
Carangidae	Jacks	
Scombridae	Kingfish	Sojavu
Stomiidae	Large nose boa fish	Poputo
Serranidae	Leopard Coral trout	
Synodontidae	Lizard fish	
Lethrinidae	Long face emperor	Juluala

Mugilidae	Mullet	Graghu
Belonidae	Needle fish	Nabovofu
Labridae	Parrot fish	
Leiognathidae	Pony fish	Groket
Tetraodontidae	Pufferfish	Poput
Siganidae	Rabbit fish	
Pharidae	Razor fish	
Carangidae	Runners	
Carangidae	Scad	Buma
Terapontidae	Silver grunter	Tufru
Lutjanidae	Snapper	Bakusero
Holocentridae	Soldier fish	
Ephippidae	Spade fish	Kubikolo
Holocentridae	Squirrelfish	Suri
Acanthuridae	Surgeon fish	

Haemulidae	Sweet lips	Maradona
Carangidae	Trevally	Kavi
Balistidae	Trigger fish	
Labridae	Tusk fish	
Achanthuridae	Unicorn fish	
Aploactinidae	Velvet fish	Kuokuhe
Nemipteridae	Whiptail	Solu
Labridae	Wrasses	
Mugilidae	Yellowtail mullet	Kabakulu

8.4.4 Brief hydrodynamic descriptions of the two bays

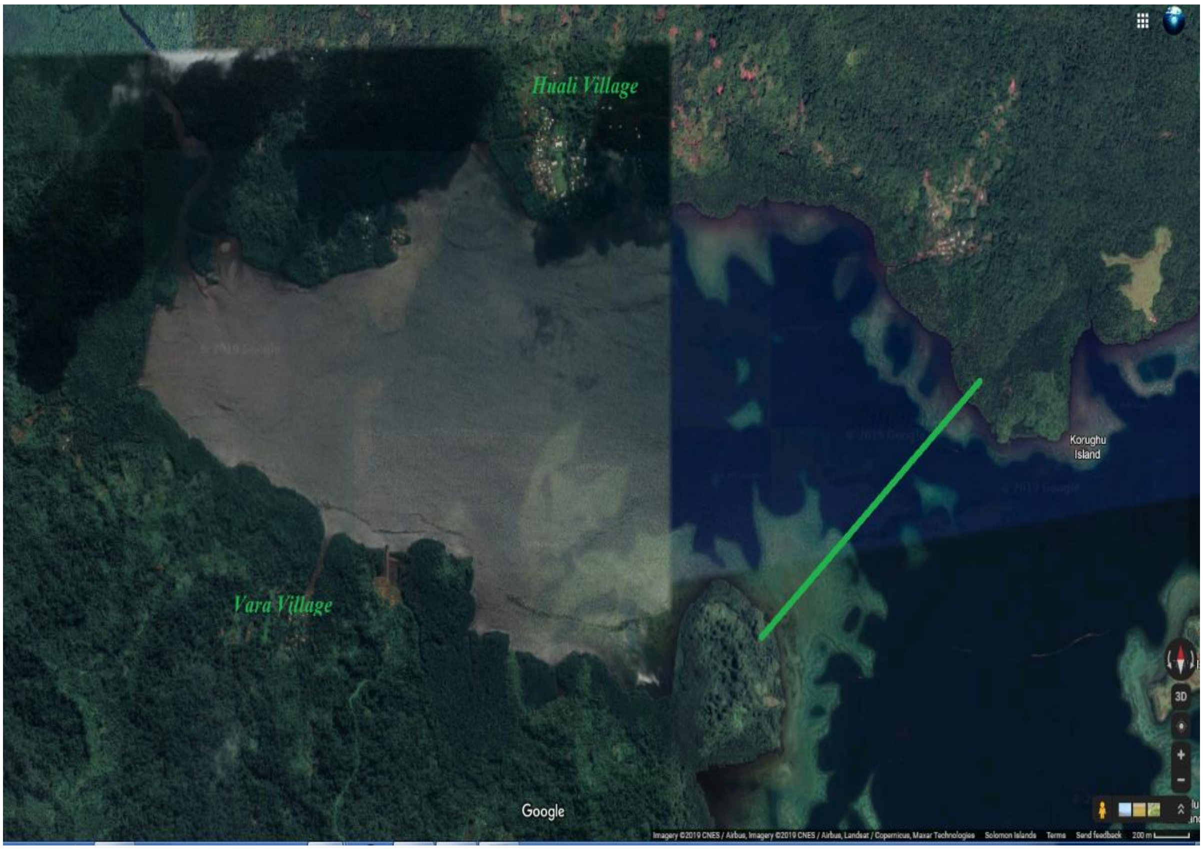
The hydrodynamic of Thousand's Ships bay and Huali Bay behave differently. The differences in their physical hydrodynamic behaviors are due to location, orientation of the bay, coastal structures, depth of each bay, and island barriers that separate these bays. Addition to these factors are the external forces involving variation in the behavior of waters within each bay, easterly trade wind, wind stress, tidal variation and climatology.

8.4.4.1 Huali bay

Huali bay is situated north of the tenement. It is about 2 km wide and about 5 km in length from the tip of the bay to the entrance that lead to the open ocean. It is a single semi-enclosed bay with an opening facing east and connects to the main bay. The bay itself is a relatively quiet environment with no waves higher than 2 m entering the bay. The bay area is flanked with mangroves strands. Surface current is much slower as indicated by its high turbidity. Slow surface current movements resulted in containment of silt, clay, and surface oozes resulted in low clarity of the waters within the bay.

The bay is fed by three main rivers, and these rivers influences the flow of surface current with minimal force. However, the major surface current drivers within the bay is tide. It is the interchangeable flow of tide going in and out of the bay determines the flushing time (length of time water spends in the bay before it is being washed out), discharge within the bay, turbidity rate, shaping of the bathymetry of the bay and the velocity of the incoming and outgoing surface current. There are two main coral reefs about 2 m to 5 m in depth that exist inside the bay, both close to the mouth of Huali Bay. They act as a barrier by splitting surface tidal current coming in and going out of the bay northerly and southerly.

Figure 47: map showing the semi-enclosed Huali bay



8.4.4.2 Huali bay Flashing Time

Huali bay flushing time is controlled primarily by tide. Tidal current behaviors within the bay changes at different times of the day. Having a semi-diurnal tide per day. Huali bay experiences two high tides and two low tides per day (24 hours). Local people revealed, they've found that the murky water within the bay more than three (3) before it becomes clearer. This shows that the flushing time of Huali bay is estimated to be a minimum of 3 days but can take longer up to about a week. The contributing factor to the longer flushing time of the bay is due to only one opening. This one opening creates a to-and-fro movement of tidal current within the bay. During flood tide water flows into the bay and after six hours it goes out with the ebb tide, but this movement transported the volume of water for only a short distance. The continuation of this to-and-fro movement of tidal current into and out of the bay creates a complete flushing time of the bay. This flushing time is determined by the outflowing of the fresh water and the inflowing of the salt water. This completion of the replenishment of the water within the bay is what physical oceanographers referred to as flushing time and is about 3 days to a week for Huali Bay.

8.4.4.3 Thousands Ships Bay

Thousands ships bay is a dual semi-enclosed bay with two openings one which is the smallest opening facing north that connects to Kaevanga while the other larger opening facing south. See figure 48.

Figure 48: Map showing the location of opening of Thousands Ships bay

Thousands Ships bay is more rigorous and high energy bay because of its two openings. Tidal current is the main driver of surface current within the bay. Easterly wind also plays a very important role in contributing to force the surface current to move. Large waves bifurcate through the southern opening and creates large waves and swells that keeps eroding the coastal areas of this region. Towards the northern opening the waves and swells dies but the flowing of current can be felt through to Kaevanga passage. The peak velocity of current during ebb and flood tide is much faster that a person paddling against it can be swept away easily. The higher current velocity is due to the constriction of the Northern Opening. See attached map for description clarity.

8.4.4.4 Thousand ships Bay flushing time

Thousand ships bay flushing time is shorter than Huali bay due to its orientation with regards to the open waters. The survey confirmed that the surface current and shallow underwater current within the bay are moving at a faster velocity than that of Huali bay. The surface current velocity depends entirely on the rising and falling of tides each day (24 hours). Since the variation of tides within the bay are semi-diurnal the rise and falling of tide is twice per day. The range of current velocity of the peak ebb and flood tide will result in 1 to 3 days of flushing time. The waters that comes into the bay through the south opening during ebb tide flows out of the bay through the northern opening. This happens the opposite during flood tide where waters coming through the northern opening goes out through the southern opening. This to-and-fro movement of water within the bay doesn’t allow for the collection of silt, clay and mud and that is good for water clarity, high photosynthetic environment for the health of the reefs. This short flushing time resulted in high mixing of fresh and salt water within the bay and is good for the health of the waters around the area.

8.5 Limitation of Hydrodynamics and Marine Ecological Survey

Acquisition of hydrodynamic data for this EIS are limited due to the following:

- Less sites visited and less data collected for analytic purposes;
- Weather isn’t suitable to do data collection on the designated time of site visits limiting certain data collections such as open ocean salinity and fresh water salinity for proper flushing time calculation;
- Short period of time for site surveying also lessen temporal and special data to be used in describing hydrodynamic behaviors variation over space and time of the surveyed region; and
- More ocean parameter measuring equipment’s needed to do a proper and full ocean surveying of the proposed tenement area.

8.6 Ocean Observational Information

There is some very important oceanic phenomenon that needs to be known and understood as they are playing a very important role in the behavior of our ever-changing ocean. Longshore drift, deposition of sand banks, mud flats accumulation and depletion, Coastal erosion, and other coastal activities are all influenced by these oceanic behaviors. These coastal behaviors including, primary swell heights, primary swell period, significant wave heights, wave mean period, surface wind speed and wind sea heights. These ocean phenomenon behaviors are closely monitored under the Bedan Meteorologi, Klimatologi, dan Geofisika (BMKG) ocean model and Pacific Community (SPC) ocean portal model. Information about these phenomena are captured and recorded from daily to monthly.

8.6.1 Primary Swell height and Swell period

According to National Oceanic and Atmospheric Administration (NOAA) – National Weather Service Environmental Modeling Center (NWSEMC) they define primary swell wave height as "a measure for the wave height for the dominant non-locally generated wave system and are generally referred to as swells". The higher the incoming swells, the greater the rate of coastal erosion along our coastal areas. The incoming swells monitored from BMKG and SPC models for a period of six months from January to June 2020 is provided below.

Figure 49: January 2020 data showing the incoming Primary Swell height with direction that shows higher swells from the North Solomon Islands and a slightly lower level swell from south east of the Solomon Islands

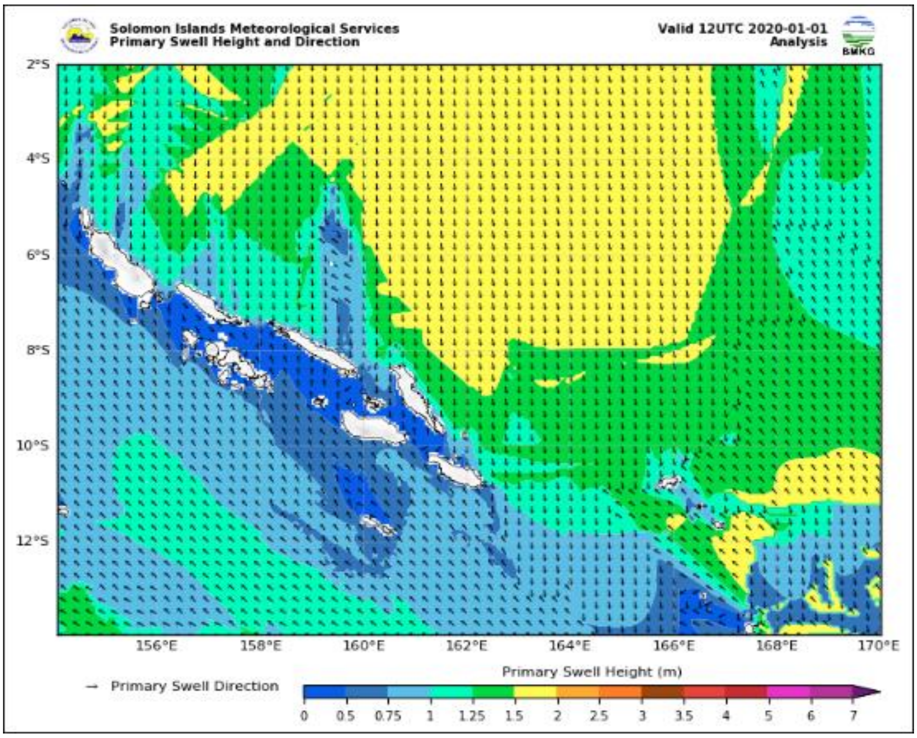


Figure 50: February 2020 data showing a slightly improved swell from the eastern Solomon's however, generally the northern Solomon Islands still experience a much high incoming swell.

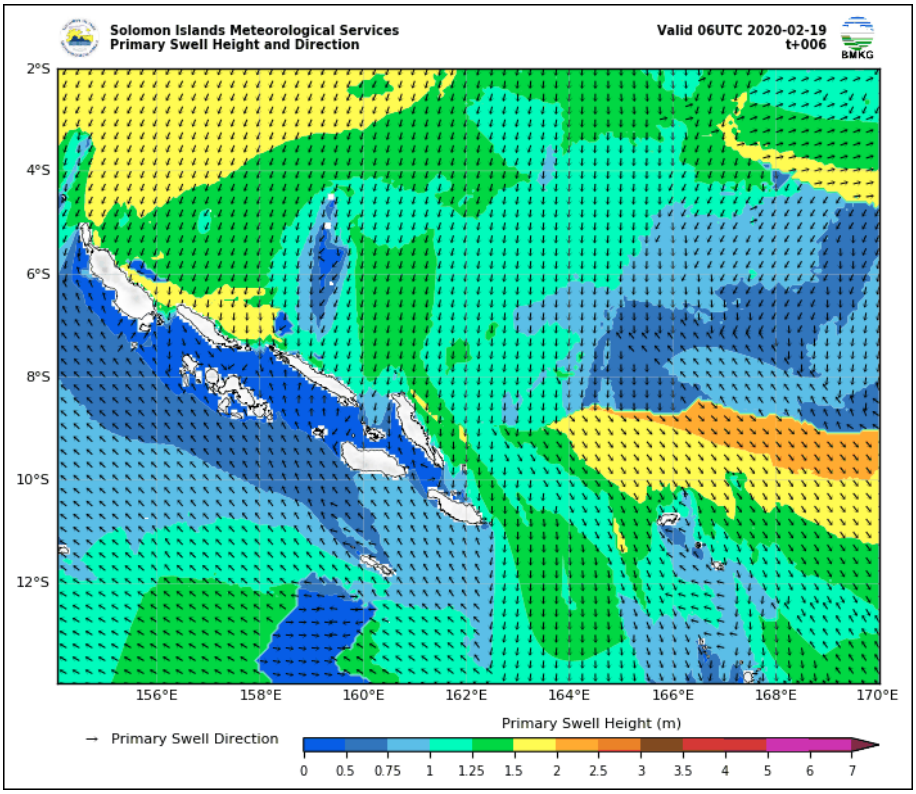


Figure 51: Fast forward to April 2020 the incoming swell from the north Solomon's improved much more, but the swift of swell direction south of the Solomon's is what was detected. As seen on the map, the southern Solomon's experiences higher incoming swells from the south eastern part of the country

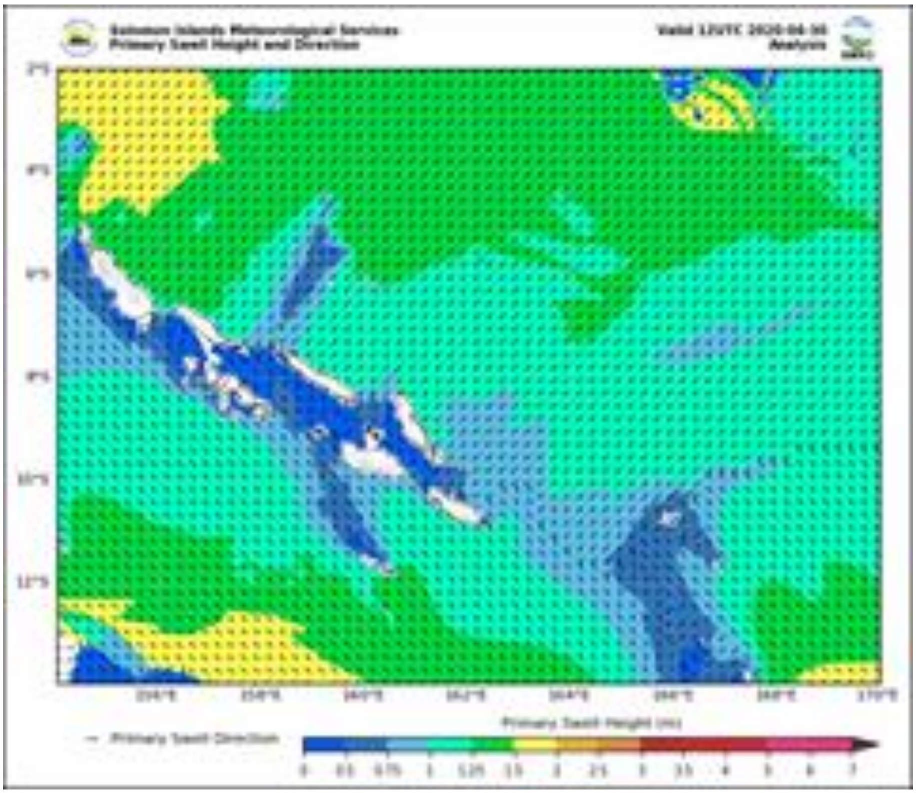


Figure 52: May 2020 is a transitional month of the year and it the swells are also captured on the model. a degree of 0-3 on a Douglas Sea scale saw waves which are much smoother and calmer swells from all direction

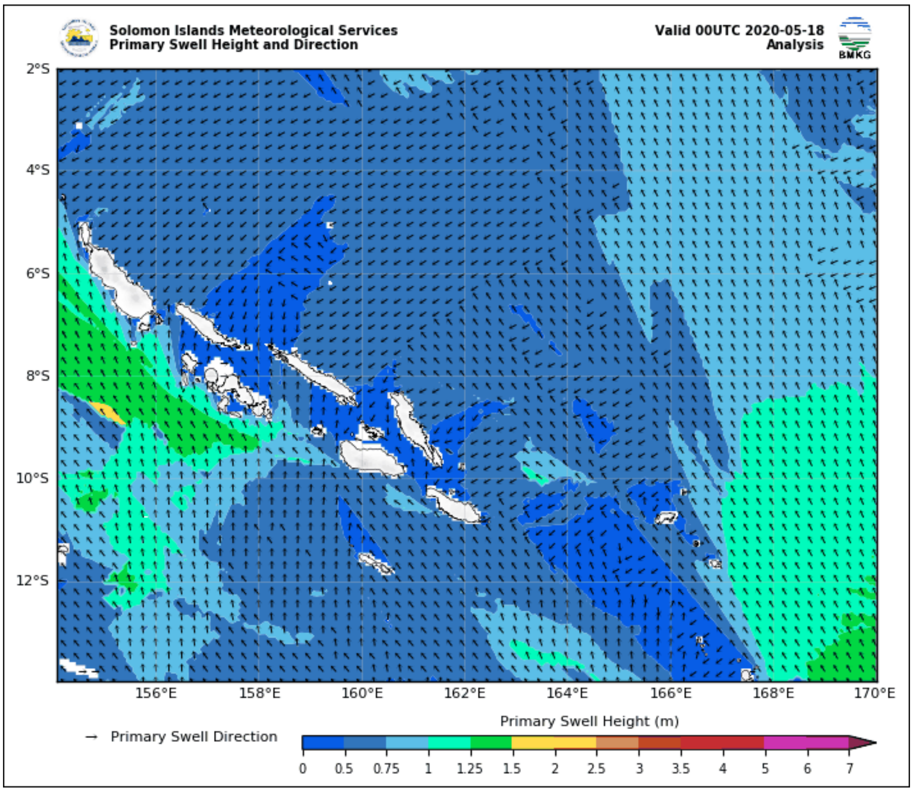
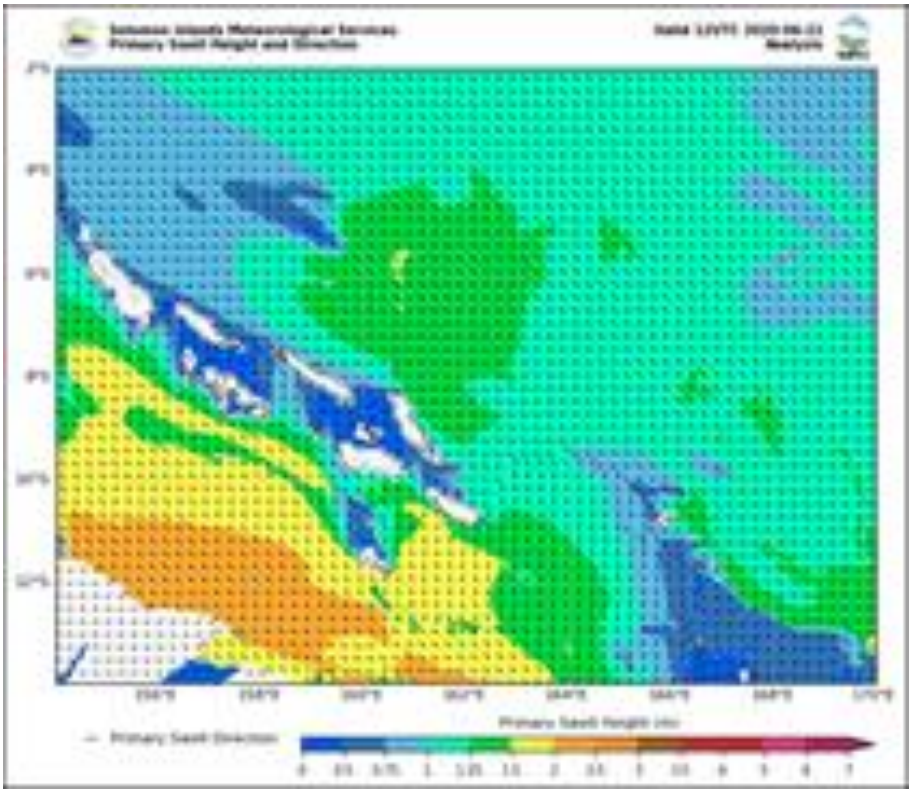


Figure 53: June 2020 has a reversal direction of wind from westerly to easterly and that then has an influence on the direction and magnitude of incoming swells. More swells that are huge and rated as Rough, to very rough hits the southern Solomon Islands.



8.6.2. Direction of swells that enters the Solomon Islands

Swells entering Solomon Islands varies in direction from whence they enter. And that all depends on the climatic season of the region through the year. During the cyclone season and that is from November to April the swells are usually pushed in from the northern part of the Solomon Islands and is due entirely to the Westerly that blows constantly throughout this wet season. The alteration of the direction of incoming swells happens during the dry season from May to October when the easterly takes effect. This then pushes more swells from the southern parts of the country and the southern provinces are mostly victimize by these huge swells.

9. SOCIAL ENVIRONMENT

9.1 Introduction

The Island of Isabel made up one of the nine Provinces in Solomon Islands. Isabel lies west of Malaita, north of Guadalcanal, east of the New Georgia Islands and south of Choiseul. The main island is known as Santa Isabel Island with San Jorge a substantial contiguous island in the south and several smaller islands extending out around Kia in the north.

The highest point is Mt. Kubonitu (Sasari at 1,220 meters) and Isabel is 209 kilometers long (the longest of the geographical Solomon Islands after Bougainville) and thirty-two kilometers across at its widest point. Thousand Ships Bay in the south, between San Jorge (Moumolu Naunitu) and Isabel, is as commodious as its name suggests.

The Island is rich in Nickel laterite Deposits that are very close to the surface. These nickel deposits have an average depth of 7m. Prospecting for nickel in Isabel began on Isabel Island in 1965. Sample nickel mining began there in 1966, by International Nickel Company (Southern Exploration) Ltd. The company applied for a prospecting license over 322 square miles of land on Isabel and San Jorge Islands. In 1967, the company was granted an Interim Permit to Mine at Suma for one year.

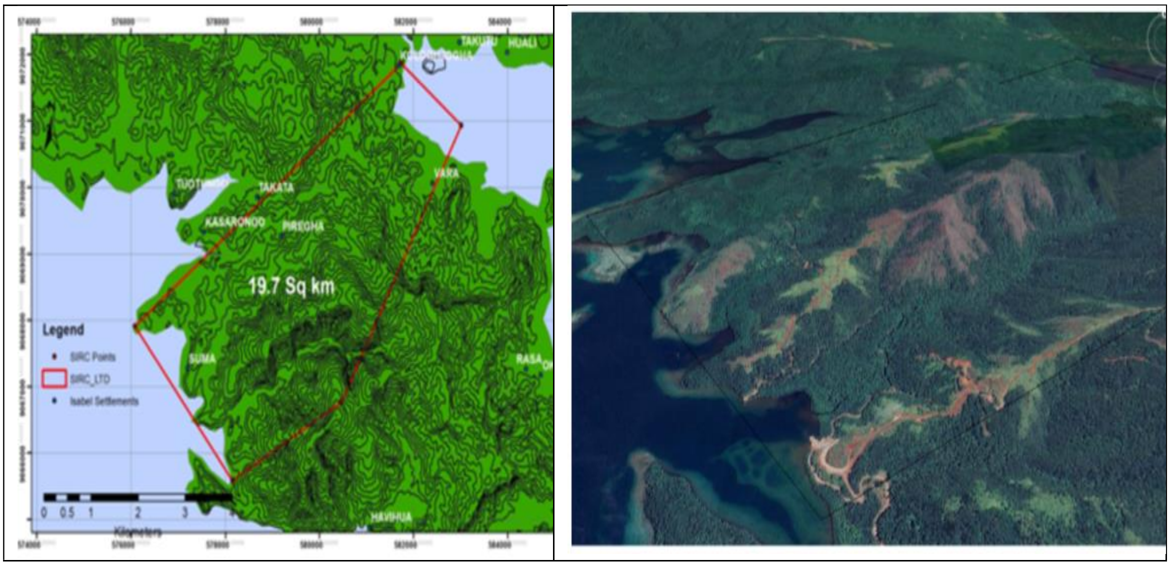
The SIRC proposed to undertake mining of nickel laterite deposits at Takata Tenement (Kolosori area) in the south east of Santa Isabel. The SIRC was granted a prospecting lease (PL02/19) and a three year leasehold over the Kolosori Tenements. The mining lease area covers an area of approximately 19.7 square kilometer in size. The Kolosori landowners subsequently showed their support towards SIRC Ltd to mine the laterite nickel deposit.

This section was prepared in according to Section 17 (1) of the Environmental Act 1998 and Regulations 6 (1) of the 2008 for development Control and section 23 of the Environment Act 1998 and clause 29 of the Environment Regulations' for a development project. The project is also consistent with Activity 2 (NON-METALLIC INDUSTRIES) of Schedule 2 of Environment Act 1998 and Activity (i) (Extractions of minerals and mining) of Schedule 1 of Environment Regulations 2008. This section assesses the potential social impacts of the proposed mining project, evaluating alternatives and designing appropriate mitigation, management and monitoring measures and enhancing positive impacts.

9.2 The Tenement Area

The project's tenement area is located in the south eastern region of Isabel Island. The coordinates are supplied in the table 1.

Figure 54: Location of the proposed mining tenement area



9.3 Objective and Methodology of the Social Impact Assessment

9.3.1 Scope of the Social Impact Assessment

This section was developed as a component of the EIS. Development projects of this magnitude need to capture the social context at the proposed tenement area. And in doing so complies with national legislation and interntational policies on best practices.

It describes the socio-economic environment and identify the anticipated positive and negative impacts (during construction,operational and decommissioning phases) of the proposed nickel mining. It provides the opportunity to refine project design and alternatives in order to avoid or minimize any social impacts.

9.3.2 Baseline Study Area

The main villages identified for the socio-economic baseline study are Leleghia, Suma, Riudede, Vara and Huali. These villages are located within the Japuana and Tatamba Wards. The total number of households is one hundred fourty seven (147), approximately nine hundered sixty five (965) by population. Fourty eight (48) households were randomly selected for the household survey which accounts for 33% of the households. In addition to that, three

(3) villages – Leleghia, Vara and Huali were selected for the Community Consultations and Focus Group Discussions.

Figure 55: Location of the villages under socio-economic baseline study in the tenement area

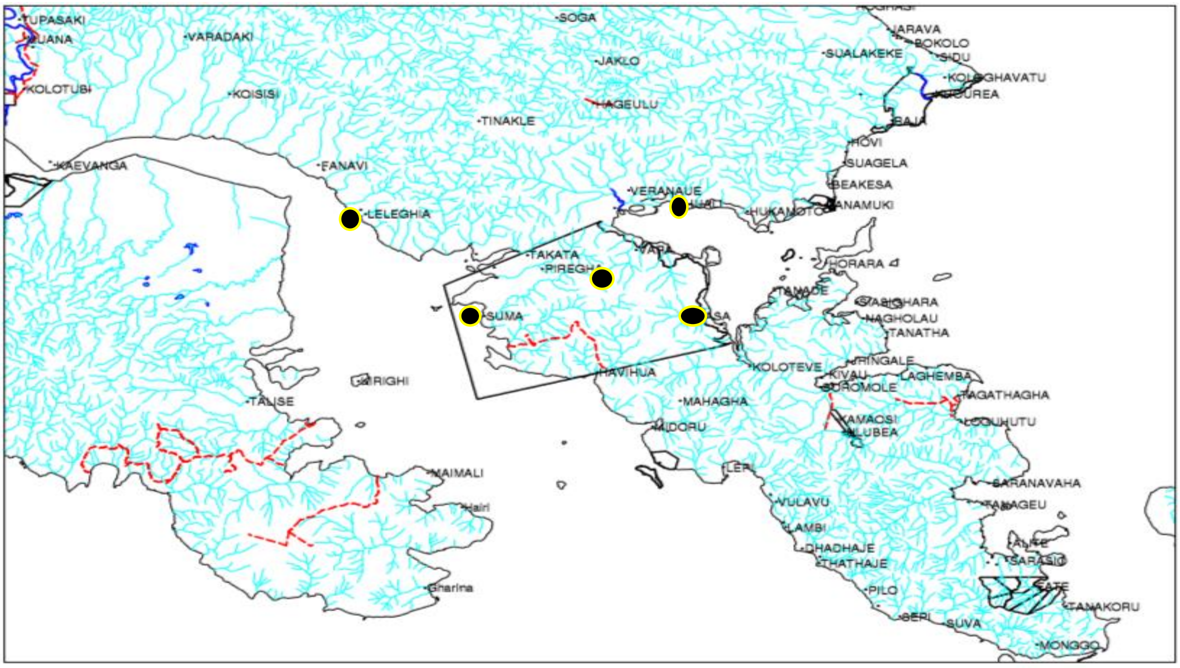


Table 32: Population and the number of households within the Tenement area

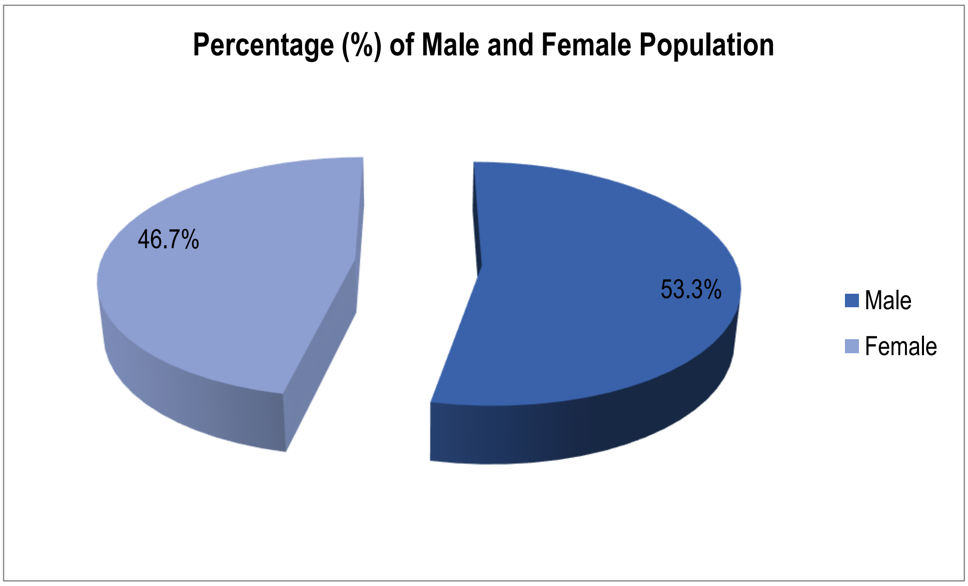
Name of Village	Total No. of Households	No. of Households Surveyed	Population of Villages Surveyed	Community Consultation/ Awareness & FGD	No. of people present during consultations
Leleghia	40	11	178	Lelegha	44
Suma	13	4	30		
Riudede	6	6	25		
Vara	14	5	30	Vara	7
Huali	74	22	230	Huali	80
Total	147	48	493		131

9.4 Baseline Description of the Social and Economic Profile of the Area

9.4.1 Population in the Project Area

The surveyed population is 315, 53.3% male and 46.7% female. This equates to 6.5 person per household. The population in the area therefore is nine hundred sixty five (965).

Figure 56: Percentage of male and female population within the Tenement area



9.4.2 Major Demographic Characteristics of the survey population

9.4.2.1 Age Structure

The table below shows the age catogory of the surveyed population and distribution by gender. The survey revealed the population of young people in the area is higher. The catogory19-64 years age group accounts for 46.3%, 5-18 years age group 30.5%, below 4 years age group 16.5% and above 65 years age group 6.7%. There are less older people in the area. The findings indicate more male than female.

Table 33: Age groups

Age Groups	Total	Percentage
<4yrs old	52	16.5%
5 - 18 yrs old	96	30.5%
19 - 64 yrs old	146	46.3%
> 65 yrs old	21	6.7%

Total	315	

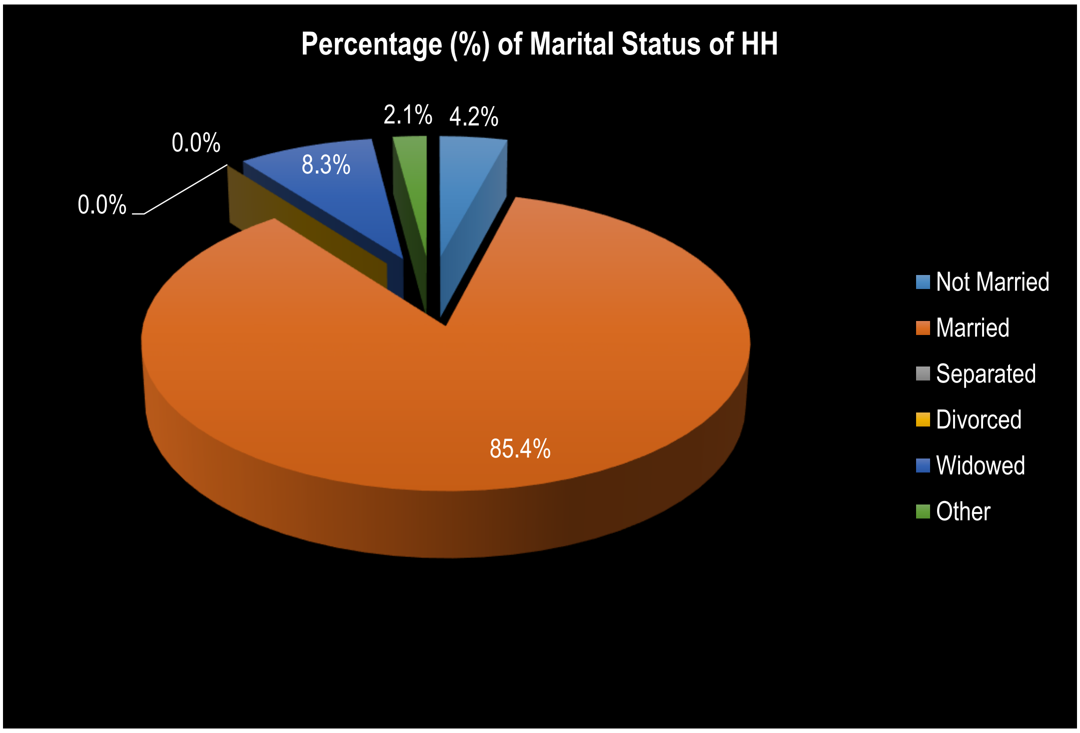
Table 34: Communities' age structure in the Tenement area

Age Groups	Males	Percentage (%)	Females	Percentage (%)
<4yrs old	33	19.6	19	12.9
5 - 18 yrs old	55	32.7	41	27.9
19 - 64 yrs old	71	42.3	75	51.0
> 65 yrs old	9	5.4	12	8.2
Total	168	100	147	100

9.4.2.2 Marital Status of Household Head (HH)

The figure below shows 85.4% of the household heads are married, 8.3% are widowed, 4.2% are not married and 2.1% with unknown marital status.

Figure 57: Percentage (%) of HH Marital Status



9.4.3 Household Characteristics

9.4.3.1 Structure of Family

As shown in the table below, 87.5% of the households are nuclear family and only 12.5% are made up of extended families.

Table 35: Number of households or family structure

Household Characteristic	No. Of Households	Percentage(%)
Nuclear Family	42	87.5
Extended Family	6	12.5
Total	48	100

9.4.3.2 Gender of Household

The survey indicated 77.1% of the household heads are males while only 22.9% are female household heads.

Table 36: Gender of Household Heads in the Tenement area

Gender	No. of HH	Percentage (%)
Male	37	77.1
Female	11	22.9
Total	48	100

9.4.3.3 Household Size

The average household size is 6.5 persons per households. Male members account for 3.4 person per household while female members comprised 3.1 person per household.

Table 37: Average number of people per household in the Tenement area

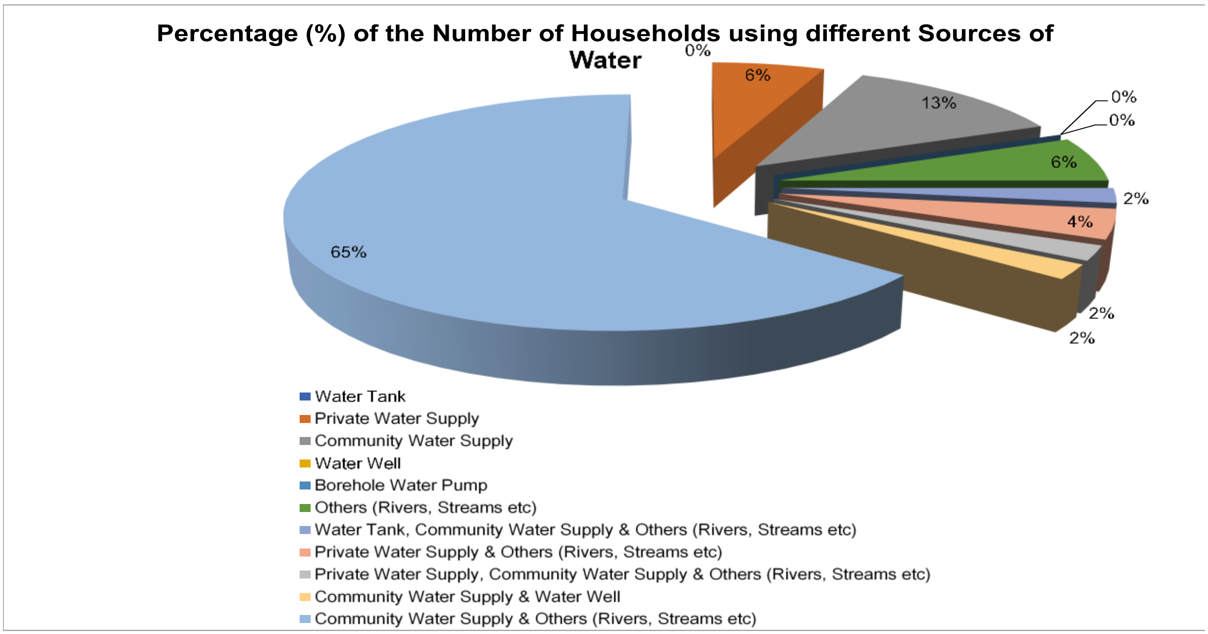
No. of Household	Average Household Size	Average No. of Male/ Household	Average No. of Female/ Household
48	6.5	3.4	3.1

9.4.3.4 Access to Basic Amenities

Community's access to water, sanitation and electricity is an important indicator of country's development and livelihood. According to the 2009 census, 64% of dwellings in Isabel Province were connected to a communal standpipe, another 11% used rivers or streams as their source, and 10% used tanks.

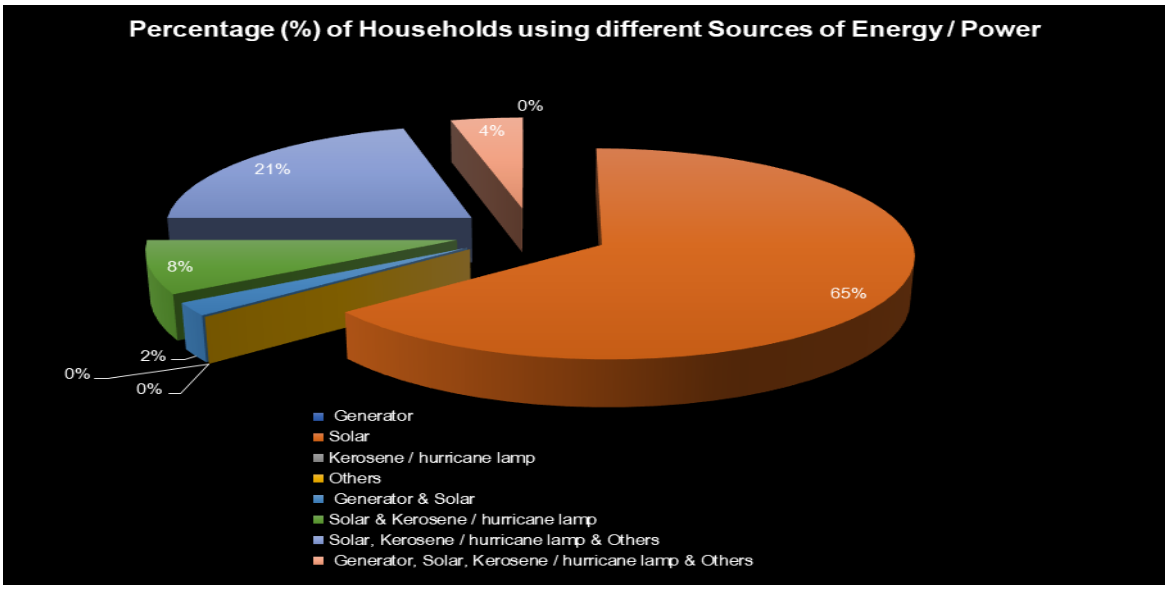
For the study area, majority of the household depend on the both the community water supply as well as nearby streams and rivers for their main water source and this accounts for 65% of the population, 13% rely only on community water supply, 6% private water supply and another 6% from nearby streams and rivers. The remaining percentages are from other sources (refer to pie-chart in Figure 58).

Figure 58: Community Sources of water supply



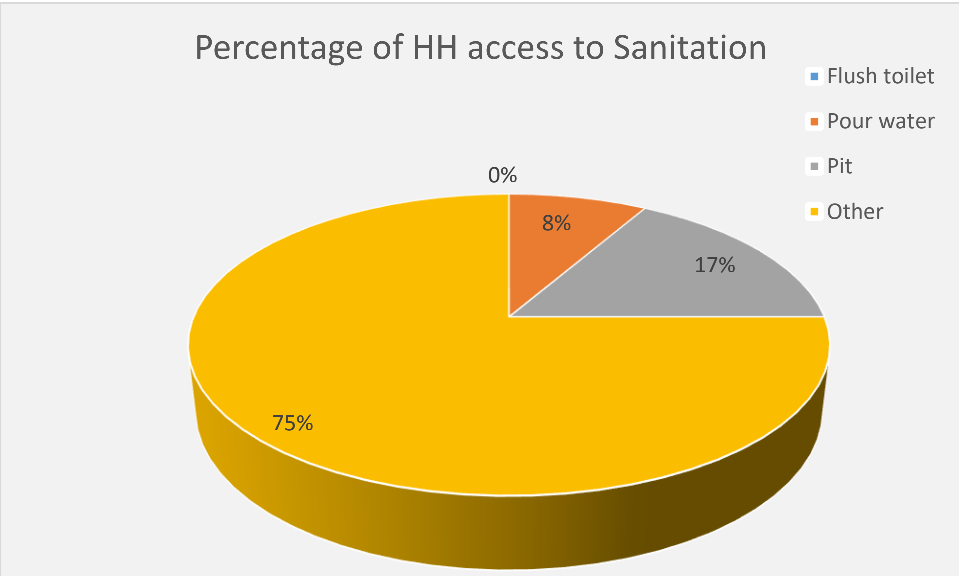
The main source for lighting is solar energy and this accounts for sxity five percent (65%) of the households. The remaining percentages use solar as well as kerosene/hurricane lamps, generator. (Refer to figure 59).

Figure 59: Communities main source of power for lighting



Lack of proper sanitation is a cross cutting issue in rural communities. Seventy five percent (75%) of the household interviewed did not have access to proper sanitation. People use either bush or coast. Seventeen percent (17%) of the surveyed households use pit latrinetoilet, and the 8% use pour water toilet.

Figure 60: Types of Toilet Facility used by households

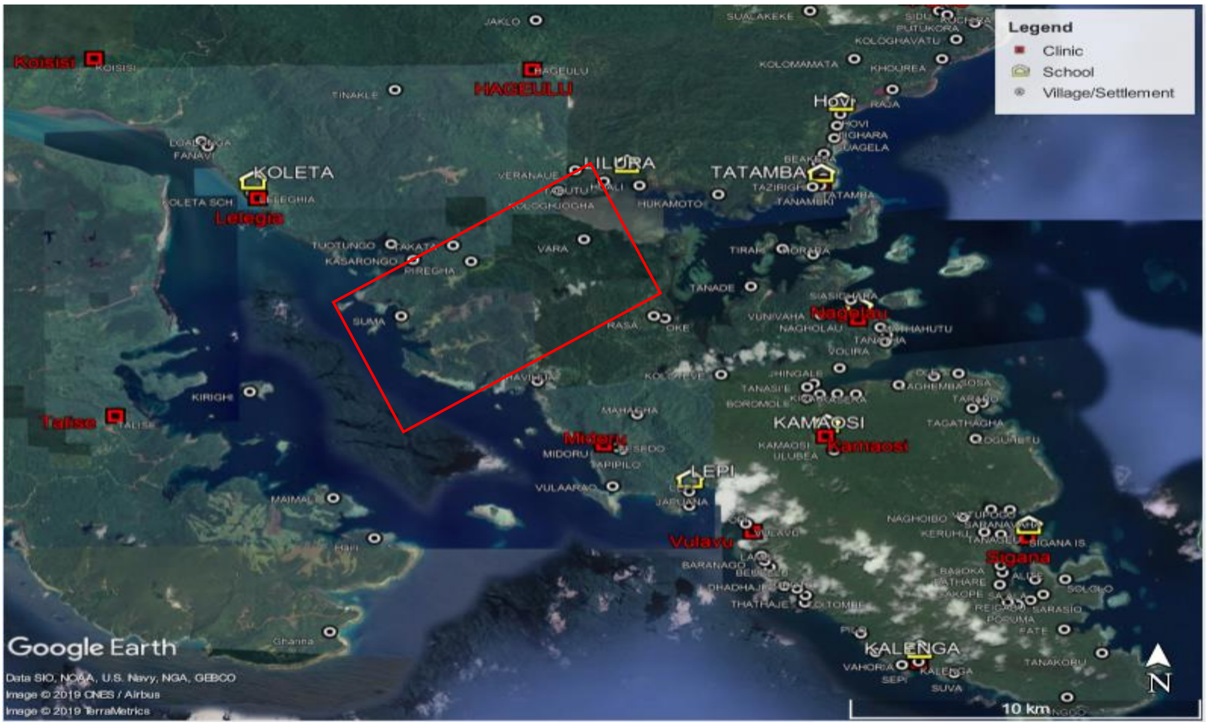


9.5 Access to social services

9.5.1 Health services

Isabel Province is served by 1 Hospitals, 5 Area Health Centres/Clinics, and 18 Aide Posts. The hospital is located in the provicila capital, Buala. There are 2 doctors, 73 nurses, 1 dentist and 35 paramedics (including malaria microscopist, phamarcist and health promotion officers). The closest villages the people can access health services are Lelegia, Midoru and Tatamba.

Figure 61: Map showing clinics accessed by communities within the project area

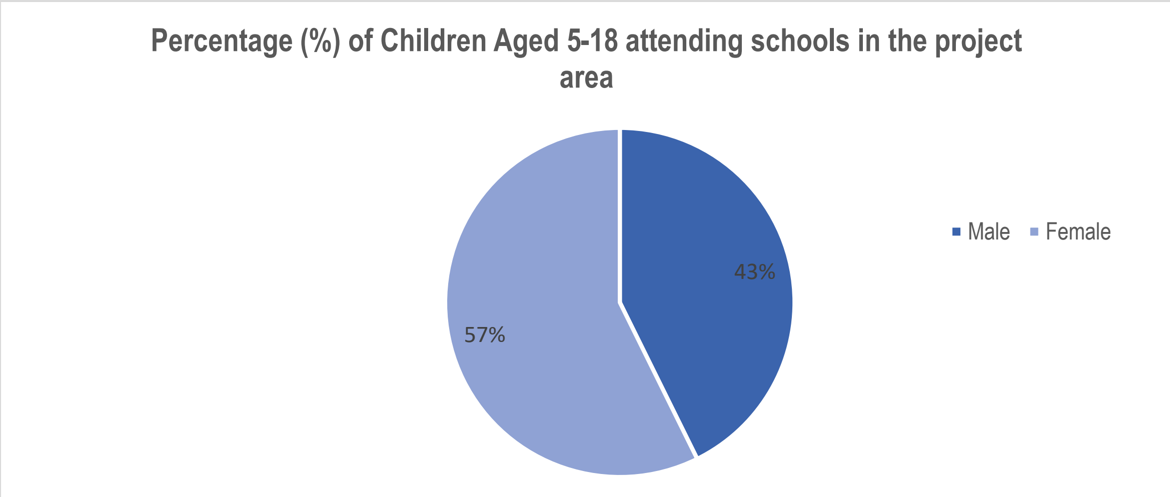


The health centres provide treatment services, immunization, outpatients, family planning and health awareness programmes. The major health problems faced by the people are: respiratory infection, malaria, diarrhea, high blood pressure, pneumonia and various skin diseases. Complicated cases are referred to Buala Hospital or even to Honiara (National Referral Hospital). See figure above for location of clinics communities near and wtihin the tenement area can access health services.

9.5.2 Education

According to the 2009 census survey report, approximately 87 % of the population in Isabel aged 6-15 years were enrolled in schools; of which 86 % are males and 88% are females. School enrolment rates vary significatly by age. From the household survey, 57% of female and 43% of male children are attending school as dipicted in figure 62.

Figure 62: Showing % of Children aged 5-18 years of age enrolled in Schools



Children do have access to the Koleta Primary and Lilura Primary Schools. The closest community high schools are Muana and Sir Duddley Tuti College. The Primary schools are located at walkable distances, however, the community high schools can only be accessed by OBM boats or dugout canoes.

Figure 63: Map showing schools accessed by children in the project area

9.5.3 Communications

In the past it is common that people in the villages either lit fires, blow a conch or beat a drum to signal other communities for relaying of messages in the past. But as time goes on messages are simply passed through the use of radios and now almost all people within the Solomon Islands use mobile phones. The tenement area and adjacent communities have access to 2G telecom services.

9.5.4 Transportation

Majority of the road network in Isabel are located in the provincial Capital Buala. Feeder roads including Buala Garanga, Buala Gozoruru and Buala Tiritona Roads do link the hinterland communities to the main capital. Other roads include the Kaevaga Kolomola and Susubona to Kolaero Training Centre. These roads are isolated and connects communities in land to the coast where the main socio-economic services are located. Other forms of transportation in the province include air and shipping services to the province. The main airport at Suavanao and Fera receives Solomon Airlines weekly flights.

Isabel do have access to shipping services provided by IDC and UTA shipping. In the tenement area and nearby villages, IDC and UTA vessel make weekly schedules to and from Honiara. The main sea ports are Kaevanga and Tatamba. People find it easy to load and unload cargoes at these ports because they are sheltered and have wharves. Ships normally anchored offshore to collect/drop passengers and cargoes in other locations.

The surrounding communities also use OBMs and canoes as transportation mode to visit relatives from the neighboring villages or to travel across to San Jorge. Depending on weather, OBM can be used to travel to Honiara.

9.6 Socio-Economic Analysis

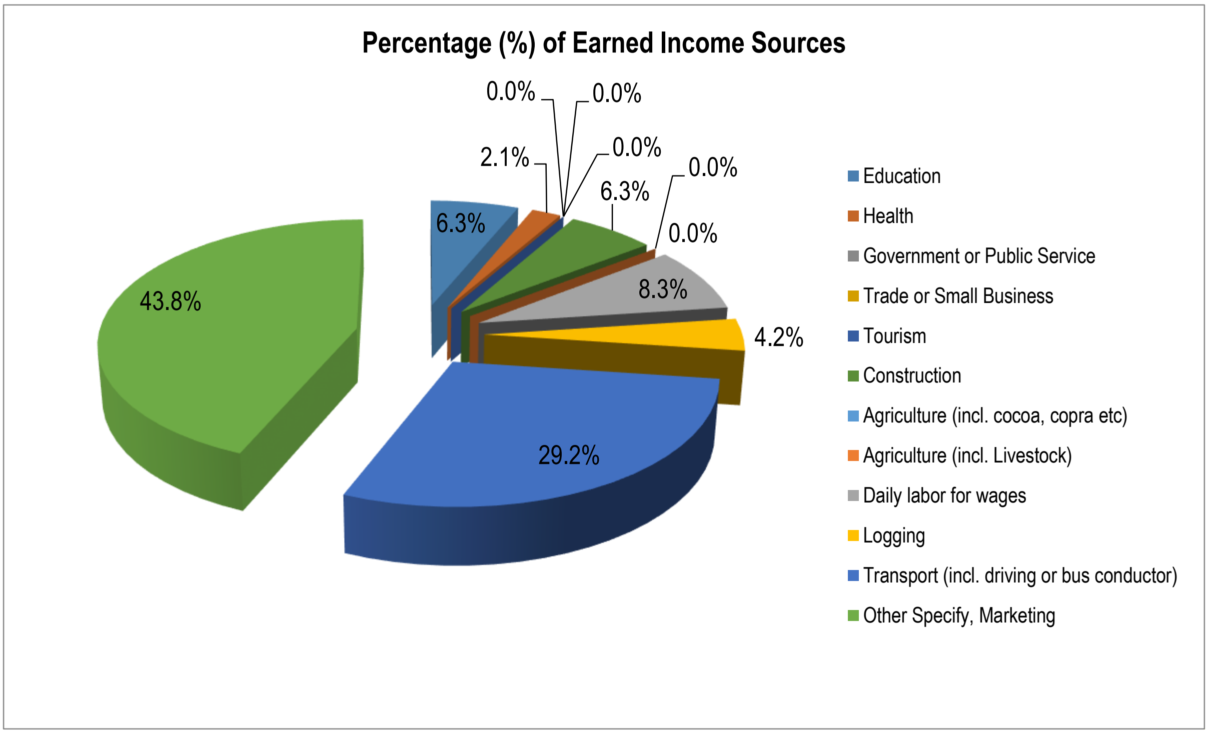
9.6.1 Income Sources

In this report, household income sources are catogorised into earned and unearned income sources. Earned income are money derived from paid work and unearned income from private means other than work. According to the survey, the average total household monthly income from earned income sources particularly from wages and salary is $1,160.42 and from unearned income sources $257.29. The survey indicated that the source of income varied for all households. A household income source can be from both unearned and earned sources.

9.6.2 Sources of Earned Income

The livelihoods of the households and communities in the study area are based on small-scale agricultural production and fishing, with the priority being food production for home consumption. Agriculture is based on shifting horticulture, the staples being root crops, vegetables, fruits, and kava. Most households attempt to produce a surplus for sale. Formal employment mainly health and education sector accounts for 8.4% of the surveyed population. People laboring and on casual basis are not obvious. There are small scale businesses for example canteens, fishing, transportation services and cocoa/coconut production.

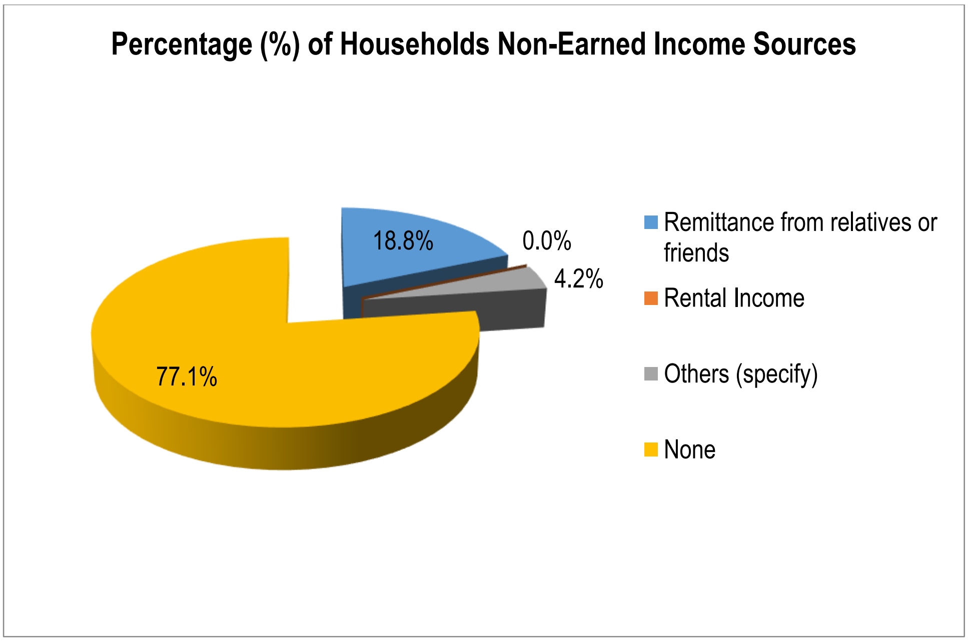
Figure 64: Percentage of households and their earned income sources



9.6.3 Sources of unearned Income

The household survey indicated that 22.9% of the households have unearned income sources. 18.8% of the unearned income sources are by remittances from relatives and friends and 4.1% from constituency assistence.

Figure 65: Percentage (%) of households receiving income from non - earned sources



9.6.4 Economic Development

Economic activity is dominated by copra production, commercial logging, kava production and mineral exploration.

In Maringe District, a locally owned company called Cathliro Commodities Development (CCDL) is producing and exporting cocoa to Malaysia. The company owns 99 hectares of land at Garanga of which 20% is being used for cocoa farming. Apart from its farm, cocoa beans are also bought from other farmers in the country. CCDL in its plan aims to grow more cocoa and also to diversify into other agricultural and horticultural products such as cassava, pigs, poultry, bananas, pineapples and aloe vera.

The North Western part of Isabel has a potential for sustainable tourism industry particularly establishment of the small scale-eco tourism where visitors enhanced the traditional values and the environment and contribute positively to the livelihood of the people. Currently, Papautura Fa'a Island Resort, a small- scale tourism is operating in the area and to that, the Suavanao Airstrip is also operating and accommodates Solomon Airlines weekly flights.

In the southern part of Isabel, in the Gao/Bughotu district, Tatamba is a sub-station, located on a Provincial Government Land. This substation hosts basic services such as health, education, agriculture, fisheries and has served as a major sea port for the people of Gao-Bughotu. In 2016, through the Overseas Fisheries Cooperation Foundation of Japan (OFCF) and Ministry of Fisheries and Resources, the Tatamba Fisheries Centre was assisted with solar powered deep freezers and lightings. A total of 600 litres deep freezers powered by solar power and six solar powered lights were installed.

There is a massive potential for mineral resources especially around the San Jorge area and on the adjacent mainland Isabel. Nickel was discovered in Isabel more than 40 years ago and overseas companies have been eyeing these substantial deposits which are among the largest nickel laterite deposits in the Pacific. In 2011 the Axiom Mining company signed a 50-year deal with landowners for a 45-square kilometre area estimated to contain nickel ore worth almost US$60 billion. However, due to disputes and court cases, the company did not proceed on after its exploration activities. Currently, other mining companies are also proposing to undertake mining exploration on the mainland Isabel, particularly at Kolosori/Takata area.

Tatamba acquired a constituency fishing centre. The Centre was designed to provide shared marketing, cool store and ice making facilities for participating fishermen.

There are cocoa and copra production in the area. The recent decrease in copra prices has affected copra production in the entire area.

There is extensive logging of customary lands adjacent to the tenement area, with the landowners receiving a royalty (or stumpage) after every shipment. Payments from commercial loggers usually go to the customary land trustees and are distributed to the landowners who may invest in improving their housing and transport, and/or use it to pay for school fees or start a small business. In other cases, it is treated as windfall income and spent on consumables and alcohol.

Today, most dressed timber is produced at household level by pooling family labour. The trees are felled and dressed using chain saws or portable mills. Portable (walkabout) mills are often bought by the logging companies and later expenses associated deducted from landowner’s royalty payments. The main markets for dressed timber are locally, Buala and Honiara. The main problem people face in timber production is transportation.

There are few pig and poultry farmers in the study area. The small holder farmers who keep pigs typically have approximately 2-3 pigs, which can sell for SBD$3000-SBD$5000, depending on the size and weight. Most pigs are kept in secure fences away from the village. Imported chicken can be sold for SBD$120. However, the local chickens are cheaper at SBD$50.

9.7 Community and Social Structure

9.7.1 Community and Family Structure

The structures of communities and families in Solomon Islands culture is tied mainly to the different tribal groups found in the islands. Belonging to a kinship group is very important in each rural community and family in and around Solomon Islands.

Isabel Province is one among the few provinces in Solomon Islands that its Chiefly system is still very strong and active and they usually work very closely with the church. This Chieftain system practiced in the study area is active and vocal. They also involve in dispute resolutions and grievances. There is a governing body that consists of Chiefs, Village Elders and Church Representatives that ensures peace and stability in the communities around Isabel.

In rural areas in Isabel including the study area, large villages are often situated on tribal lands. Villages comprise individual families placing their homes next to other relatives. The family usually consist of parents and children living together in a household which is usually about 5-10 people.

In Isabel, men are seen as the head of the household. Men often make critical decisions because they have to negotiate and account for the decisions if need be. Although men take on the critical decisions, women often play a role in these decisions in the background, out of the gaze of others. Women often make decisions pertaining to the household, those that involve women's affairs, and those that involve her own relatives. In this region particularly, men have the rights and responsibilities of decision making on land matters and women are passive observers on land matters.

9.7.2 Land ownership

Land is the only asset held by the majority of people of the Solomon Islands and about eighty seven percent (87%) of land is under customary resource tenure and all natural resources therein belong to customary land owners. Traditional land and resource management is usually community based. Without land, their labour is of little value as there are few opportunities for non-farm work and few have the capital to invest and start businesses. Thus, any actions that alienate, degrade, redistribute, or otherwise impact on land affects livelihoods, identity, and the people’s culture.

In Isabel Province, the land is owned by the tribe and inheritance is passed through the female line (matrilineal). For people to claim ownership of resources within the land; ie, forests, rivers and the land itself, one must undertand, identify and know the main lineages and trace their ancestors to that main lineages and how they move around the island in Isabel. To that, one has to know which tribe he/she comes from..

Customary land tenure has generally proved efficient to maintain access to land for the majority of rural Solomon Islanders. However, customary land tenure systems are under pressure to adapt to irreversible changes: population pressure; increasing demand for land for public purposes; greater social mobility and migration; and new expectations from the cash economy.

For the project site, the land within the project area is registered and owned by three brothers . From consultation with a key informant at Suma, the land (tenement area) is under the administration of the three brothers.

9.7.3 Cultural/Historic Sites

Within the development area, a tabu area is situated at Pireghe. The tabu site is an old grave yard of the early settlers in the area. Also there is a traditional settlement used by early settlers in the area. This was confirmed in the community consultation and also confirmed by key informants interviewed. The grave site is a significant memory to those whom first settled in the area and should not be damaged or destroyed.

Figure 66: Grave site at Pireghe

Traditional Knowledge is significant to the people of Isabel as they are largely attached to it. It is a valuable and sophisticated knowledge system developed over generations and passed on through oral traditions.

People living in the surrounding communities have a vast knowledge of many aspects of their environment and how their livelihood revolve around their surroundings. Community people over the years have learnt how to grow food and preserve and to survive in difficult environments. They know what varieties of crops to plant, when to sow and weed, which plants are poisonous and which plants have medicinal values that can be used for controlling of diseases in plants, livestock and human beings. As they find themselves depended so much on their environment, they know very well how to maintain the environment in harmony.

Communities situated in the highlands have differing gardening methods compared to communities along the coasts and this is determinant by the community's geographical setting and environment. Food has generally been adequate because villages produce most of their own food through farming and fishing. Slash and burn method of gardening is the usual practice in many of the communities in Isabel. Some communities however have had agriculture agencies intervention thus may have adapted to different gardening practices and technical skills for example organic farming/back yard gardening etc. in order to improve soil fertility and opportunities for growing diverse crops and vegetables.

In the traditional slash and burn method for gardening, heavy tasks as cutting down of trees and shrubs for clearance of garden space is done by men. Women and young girls concentrate on the planting of root crops and vegetables and it's continuous maintenance. Historically traditional tools were also used to make gardens as sticks and stones. This has changed overtime however to modern tools for efficiency when making gardens.

Prior to European contact fishing techniques used were very simple and ranged from shell gathering using bare hands to more complex methods. Men are more involved in reef fishing and use a higher number of different traditional fishing methods, while women more often participate in gleaning of other marine resources. Both men and (some) women participate in reef fishing, but women use a more limited number of specific fishing methods, usually from the shore or close to home. Some traditional fishing methods practiced include: poisoning fish when very few fish have been caught using other fishing methods. Two common plant species (B. asiatica and Derris spp.) are used to stagger freshwater and marine fish. Va'e or Kurao is another traditional fishing method specifically used for Turtle hunting in deep waters. Further, Kwarao'o is another fishing method that is done on reefs or shallow waters using vines and leaves of a certain shrub to stupefy fish. The vines are used to encircle the school of fish and the crushed leaves are then thrown into the water to stupefy the fish.

Women and children’s role in fishing is often in gathering and collecting shellfish in reef areas or in mangrove swamps, rivers and estuaries. Shell (Trochus niloticus, Tridacna maxima, Tridacna derasa and Turbo spp) collecting is common during extreme low tides from inshore and offshore reefs and during dry season. Women are also skilled in finding mangrove crab tracks and are more involved in this activity than men, although men sometimes help when required. These harvesting skills are then transferred by older females to younger women.

Tribal Lands in the area are customarily owned except for some areas where it was registered for development. For instance, the land within the project area is registered land. For customary lands, community or tribal men and women use traditional markers for customary land boundaries identification and this include are hills, valleys and streams/waterways and certain trees or plants planted (traditional).

9.7.4 Religion

All the households surveyed are Anglican Church of Melanesia (ACOM) by denomination.

9.8 Conclusion and Recommendation

The estimate population in the study is 965 with the majority aged between 19-64 years. Most of household heads are married and the male gender form more than half of the household heads. 87.5% of the households in the study area are composed of nuclear family while only 12.5% extended family. In average, there are 6.5 persons per household and the male gender accounts for more than half of persons in each household.

People in the study area do have access to basic amenities. They have access to water supply, streams and rivers for water usage. Most communities use solar energy as the main energy source for lighting. Yet others still use the kerosene or hurrican lights. Access to propoer sanitation is a major drawback for communities in the area. 75% of population in the MIA do not have access to sanitation.

With regards to social services, only one major hospital is located in the provincial headquater in Buala. There are several nearby clinics that can be accessed located at Lelegia, Midoru and Tatamba. In terms of education, most children in the area attended schools. The highest number of children who attended schools are aged between 6-15. They attended primary and secondary educations in nearby schools in the area. More female children attended school than male children. There is fair accessibility to communication in the area. Within the MIA access to telecom 2G service is possible. In regards to transportation, there are several roads that connect villages. OBM and dugout canoe can be used to travel from one village to another. Ships also provide an up-to-date shedule to and from Honiara.

Landownership in the area is matrilineal, meaning women has the right to inheritance of the land. However, male have the authority for decision making. The main source of income is through selling of agricultural produces and running of small scale businesses like canteens. There is vast potential of localized economic growth development in the area. Currently, the economic activities are dorminated by copra production, commercial logging, Kava production and mineral exploration. With the proposed mining, it is anticipated that it will bosst economic growth and development. People in the study area will be able to earn income through employment and other spin-offs.

It is recommended that the developer put in place measures that will contribute to community needs, and development plans to support the affected communities in the long term. These measures should support the rural population and vulnerable groups (including poor household, disadvantaged women, persons with special need, and unemployed youth). Similarly, the developer can engage local community people to assist in areas requiring experts to enhance their skills in carrying out certain tasks. This will help generate income for the local households and the community as a whole.

10. CLIMATE CHANGE DISASTER RISK ASSESSMENT

10.1 Introduction

This climate change risk assessment was prepared for purpose of considering the potential climate change impacts that may affect the operation of the mine at Kolosori, located in the south-eastern part of Santa Isabel. The objectives of this report are to:

- Identify and consider the significance of potential climate change risks to the Mine.
- Provide a discussion on the potential implications of these risks to the ongoing operation of the mine.
- Identify any relevant strategies that could be considered to manage any unacceptable risks in future especially in the decommissioning phase and rehabilitation activities.

10.2 Description of the Project Area

SIRC Ltd currently holds a prospecting lease (PL02/19) and a three year leasehold over Kolosori tenement (Takata) in the south-eastern part of Santa Isabel. The company has now proposed to go into mining of the laterite nickel deposit in this particular tenement. The Kolosori landowners have already grant their consent and showed their support towards SIRC Ltd to mine the known laterite nickel deposit in the area.

The tenement area generally cuts from south to north in a SW-NE trending direction. The coastal areas are mainly of littoral landform with mangroves as most vegetation in coastal areas. The inland vegetation in the southern part of the tenement from Suma (campsite) further inland approximately 4 km is mostly occupied by Xanthostemon *melanoxylon* (Queen Ebony/ironwood) and *Gymnostoma papuana* (pine). This is related to the Nickeliferous laterites geology that influence this vegetation type. The northern part from Vara village further up inland approximately a distance of 2.3 km consists of taller trees and old growths which are common in the lowland forest. The proposed mining lease area covers an area of approximately 19.7 square kilometer with a total distance of 6.3 km from Suma (proposed port site) in the southern part, to Huali Bay in the northern part, with an average elevation of 156 m.

10.3 Approach and Limitations

There are no 'state of the art' equipment available to do quantitative study for this assessment. Hence, it is mainly a qualitative study that provides a fair idea of potential climate risks that can affect the proposed mining operation and aid decision making. For this reason site visits are completed on the 3rd – 7th of August 2019 to observe and assess the climate risks that can affect the proposed mining operation.

This assessment has been prepared as part of the general operational management Plan of the Mine. It will be the basis for preparation of the company's Emergency Response Plan. The assessment is based on risks that could affect the future operations of the Mine, over the short to medium term, to 2030.

10.4 Relevant climate considerations and natural hazards

The words hazards and risks are often used interchangeably, however, refer to distinct (though closely related) aspects. The UNISDR (2015) clearly define the two words distinctively. Accordingly, it defined Hazard as: "A potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydro-meteorological and biological) or induced by human processes (environmental degradation and technological hazards)".

The occurrence of a given hazard results in a risk situation when assets, human life, socio-economic or environmental values are potentially exposed. The vulnerability of a given population can also influence the level of risk. In some circumstances, multiple hazards can occur simultaneously or as a chain of events (for example storm surge and flooding from extreme rainfall) and can lead to multi-risk situation; this tends to result in the highest damage but is also harder to identify, analyse and prepare for.

The following sections present information on observed and projected climate variables and natural hazards. The majority of weather observations are drawn from the two Automatic Weather Station (AWS) at the project site. These stations however only provide weather data for 6 months from January to June 2020. Hence, due lack of data meaningful trends cannot be established based on the observed weather data from these two onsite AWS. Because of that, majority of climate projections and analysis has been drawn from the 2013 Pacific-Australia Climate Change Science and Adaptation Planning Program partners.

10.5 Natural Hazards

Natural hazards are inevitable and the impacts associated with hazards can be catastrophic and lead to disasters. White, Kates, & Burton (2001) stated that disasters occur at a very high rate and perhaps faster than the rise of population and wealth. It is believed that disasters have occurred in an unprecedented proportion as a result of exposure and insufficient capacity for communities to reduce or cope with the negative impacts of the hazard events (UNISDR, 2015).

With no exceptions, Pacific Island countries are among the countries of the world that are most vulnerable, due to their very high exposure to frequent and severe natural hazards, and in most cases not having the capacity to manage the resulting risks (World Bank, 2013). According to the World Bank, since 1950 extreme weather events have reportedly affected 9.2 million people, and 10,000 people have reportedly perished from disasters in the Pacific region that are exacerbated by global warming and climate change (World Bank, 2013). Their small size makes the vulnerability of the Pacific Island nations to natural hazards a daily phenomenon, and at the same time poses developmental challenges. In addition, Pelling and Uitto (2001) have highlighted that lack of capacity to mitigate disasters, high population growth and fragile economic and political structure worsen the situation for the island nations.

Solomon Islands is no difference to its other neighbouring Pacific Island countries when it comes to exposure and vulnerability to all forms of natural hazards and the risks that they pose. With the body of knowledge of disaster and climate risks are surfacing in recent decades through experience and research, capacities for managing disaster risks become a goal for all disaster-prone countries. However, according to the Solomon Islands Disaster Management Strategy, the Solomon Islands government has a very low commitment to Disaster Risk Management (DRM). This is obvious in the lack of mainstreaming of Disaster Risk Reduction in national policies, legislations, sector plans and other government budgetary processes. Thus, leads to poor disaster management governance in the country which sees the country highly dependent on aid donors and help from foreign countries for response to and recovery from disaster.

10.6 Observations

10.6.1 Rainfall

Rainfall for the proposed mining tenement is recorded using two Automatic Weather Stations which are located on site. Readings are collected over a period of 5 months from February

2020 to June 2020. The maximum rainfall at the site is 99 mm with several days within a month of no rain. The average monthly rainfall recorded at the site is 4.24 mm. it is important to note that the rainfall record for the proposed mining site is very short, and as such should be read with caution concerning reliability.

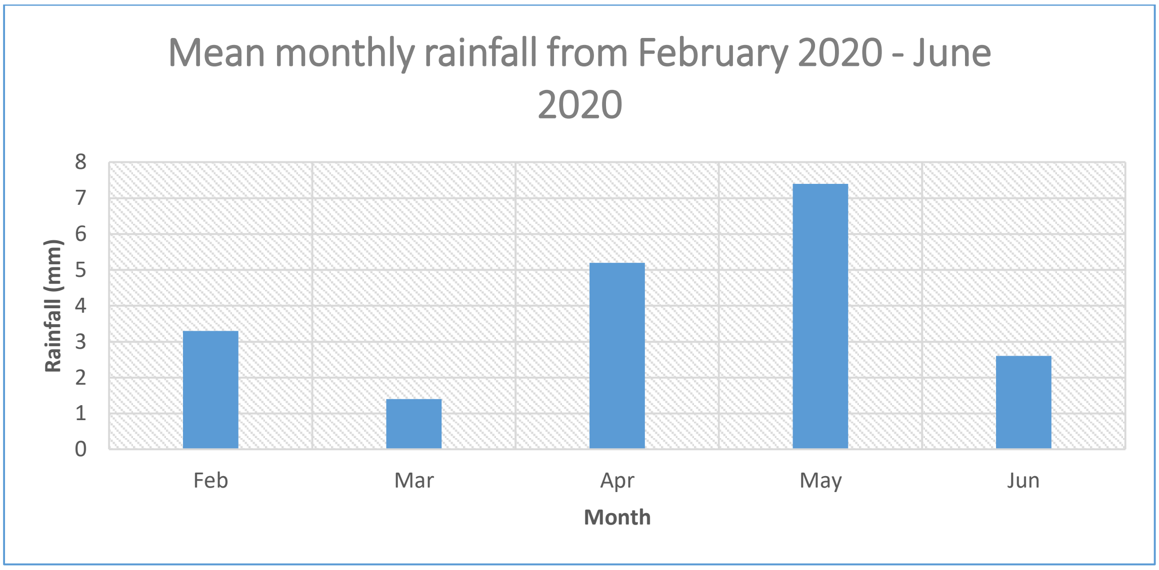


Figure 67: Monthly mean rainfall for the Kolosori tenement as recorded by AWS 1

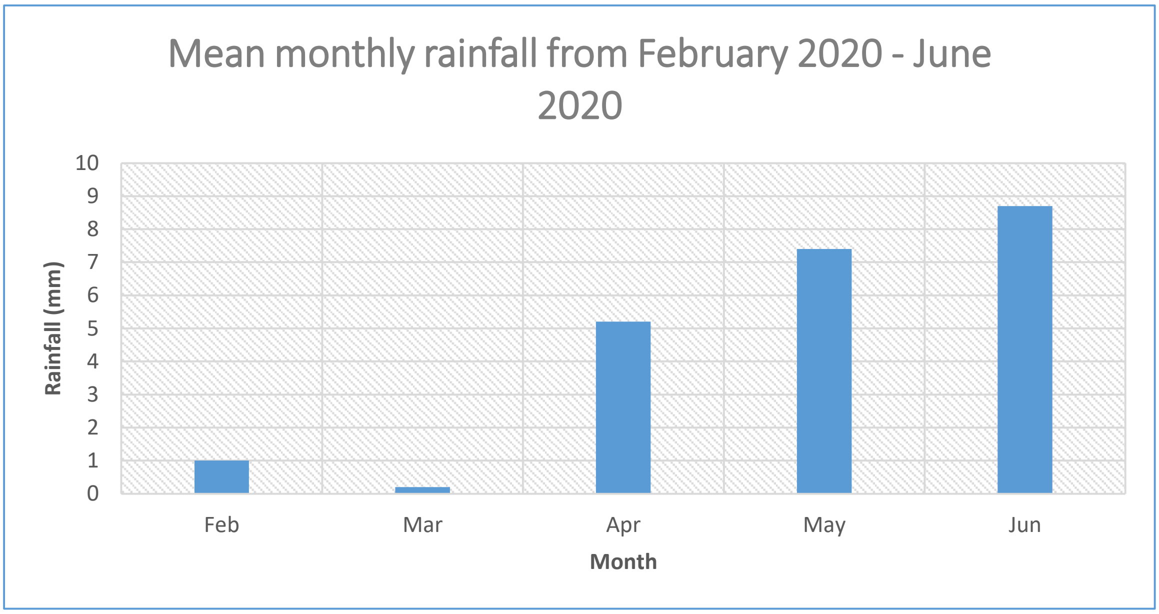


Figure 68: Monthly mean rainfall for the Kolosori tenement as recorded by AWS 2

Generally, rainfall in the Solomon Islands is influenced by movement of the South Pacific Convergence Zone and the Intertropical Convergence Zone. These bands of heavy rainfall are caused by air rising over warm water where winds converge, resulting in thunderstorm activity. The South Pacific Convergence Zone extends across the Pacific Ocean from the Solomon Islands to the Cook Islands (Figure 69). The Intertropical Convergence Zone extends across the Pacific just north of the equator. The West Pacific Monsoon also influences rainfall in the Solomon Islands. The monsoon is driven by large differences in temperature between the land and the ocean, and its arrival usually brings a switch from very dry to very wet conditions.

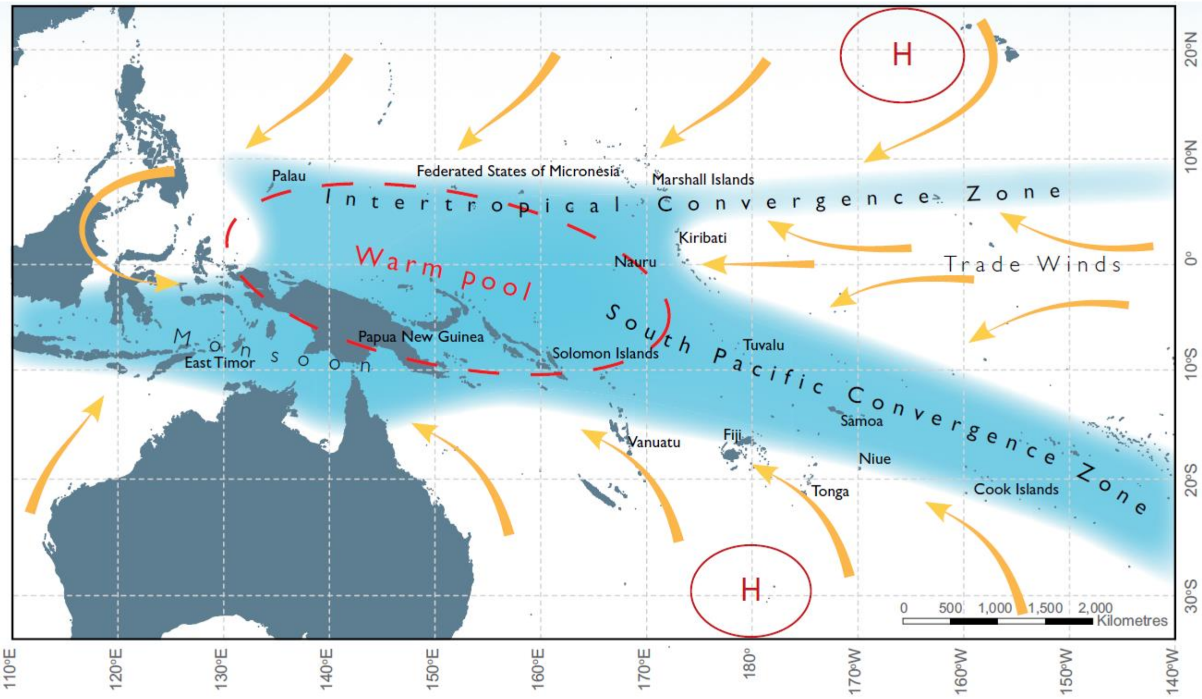


Figure 69: Average positions of the major climate features in November to April. The arrows depict near surface winds, the blue shading denotes the bands of rainfall convergence zones, the dashed oval shows the West Pacific Warm Pool and H represents typical positions of moving high pressure systems (source: PACCSAPP, 2015).

10.6.2 Sea Level

Since 1993, satellite altimeters measured the sea-level rise near Solomon Islands to be mostly over 8 mm per year (BOM and CSIRO, 2011). Sea level near the Solomon Islands has risen and will continue to rise throughout this century (PACCSAP, 2015).

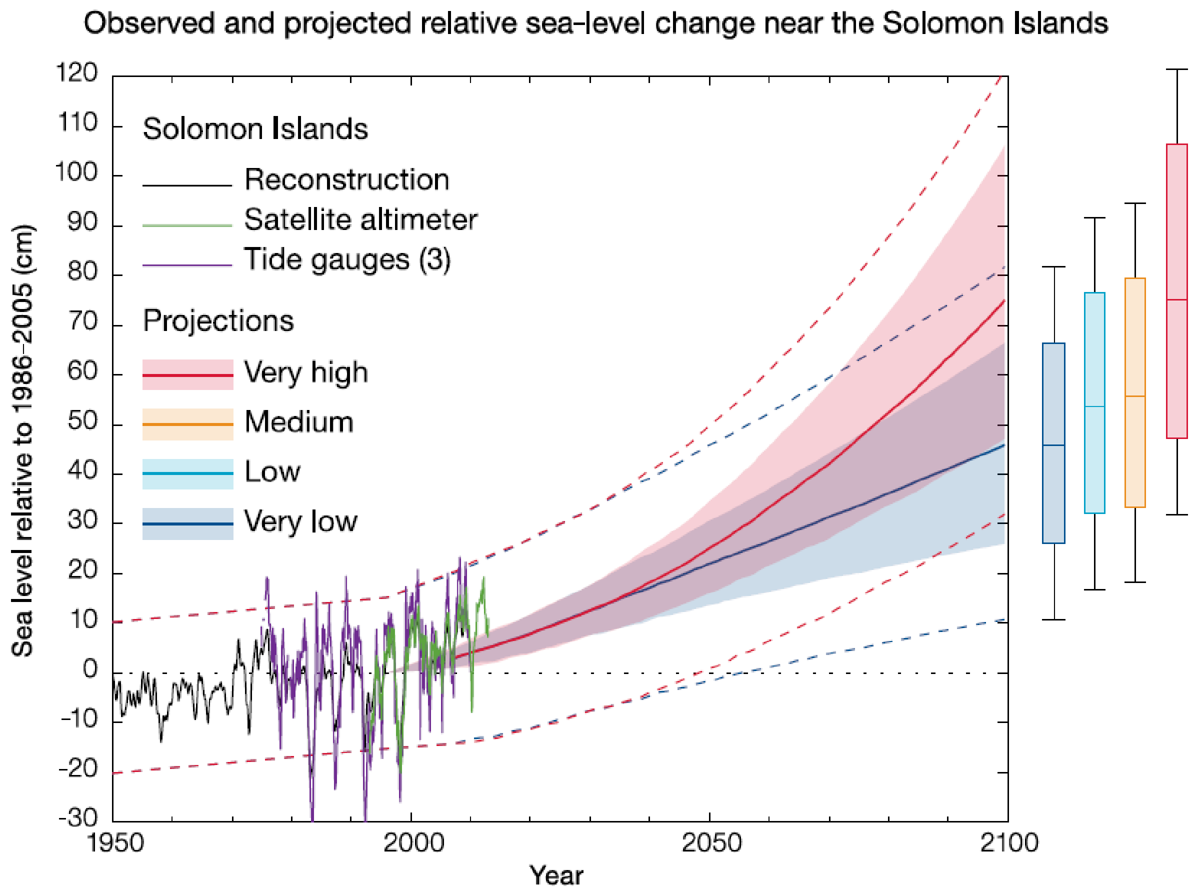


Figure 70: Tide-gauge records of relative sea level (since 1974) are indicated in purple, and the satellite record (since 1993) in green. The reconstructed sea level data at the Solomon Islands (since 1950) is shown in black. Multi-model mean projections from 1995–2100 are given for the very high (red solid line) and very low emissions scenarios (blue solid line), with the 5–95% uncertainty range shown by the red and blue shaded regions. The ranges of projections for the four emissions scenarios by 2100 are also shown by the bars on the right. The dashed lines are an estimate of year-to-year variability in sea level (5–95% uncertainty range about the projections) and indicate that individual monthly averages of sea level can be above or below longer-term averages (source: PACCSAP, 2015).

10.6.3Temperature

Based on readings recorded by the two Automatic Weather Stations on site, the average temperature for the Kolosori tenement is 26.3°C with a maximum temperature of 33.3°C and minimum temperature of 23.8°C.

Feb	Mar	Apr	May	Jun	Average
34.25 mm	33.29 mm	31.24 mm	33.24 mm	34.25 mm	33.33 mm

Table 38: Maximum temperature of Kolosori tenement recorded by the two AWS

Based on observations from Kolosori the temperature seem uniform. Again the record period of temperature on site is very short, it is important to read with caution concerning reliability.

10.6.4 Tropical Cyclones

Tropical cyclones typically occurs in Solomon Islands between November and April. In the period from 1969 to 2010, 16 tropical cyclones passed within 400 km of Isabel Island (BOM and CSIRO, 2011). Historical tropical cyclone tracks to have passed in the vicinity of Isabel Island are shown in Figure 71. Over the period of records, the number of events in any given year as varied from none to three, with a long term average of four cyclones per decade (see Figure 72). Tropical cyclones were most frequent in El Nino years, and least frequent during La Nina years.

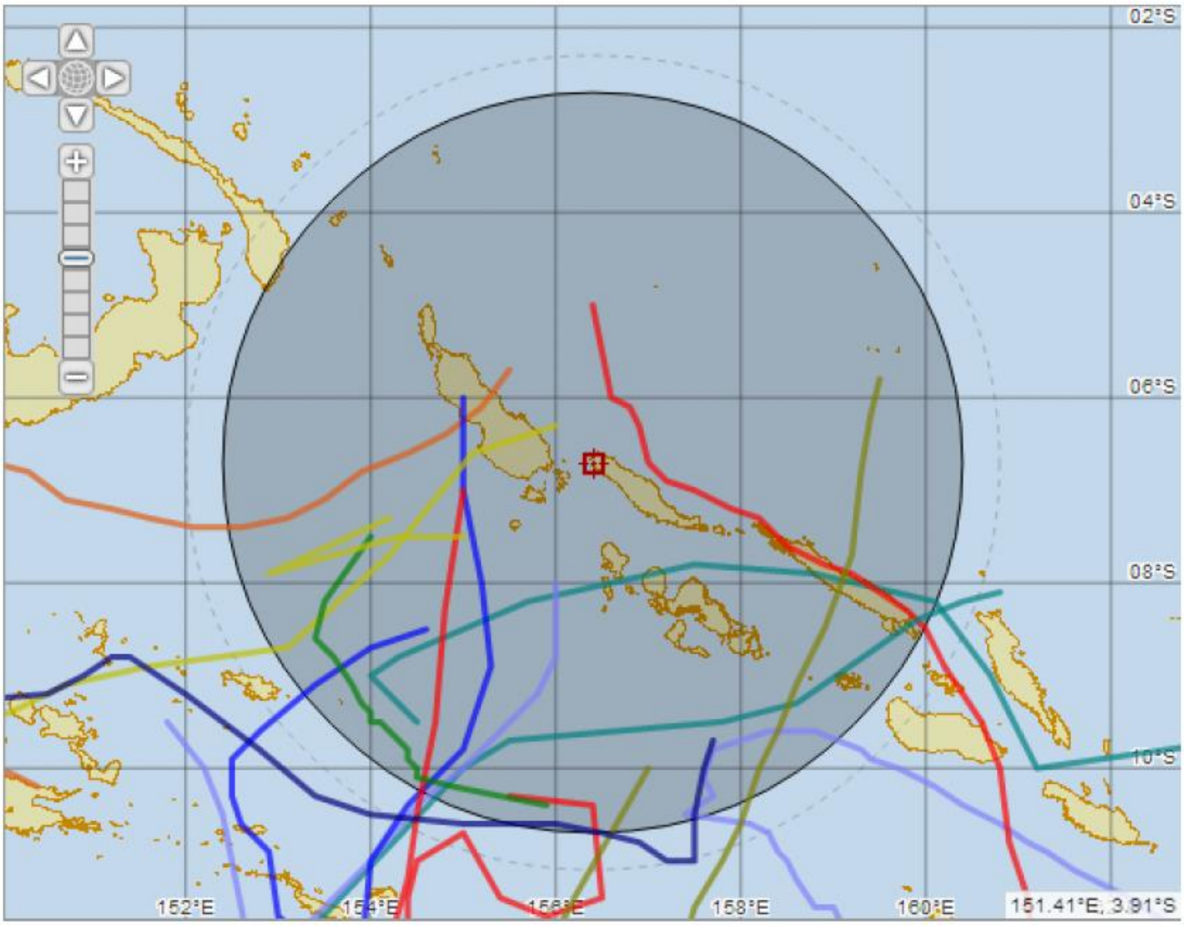


Figure 71: Historical tropical cyclone tracks within 400km of Isabel recorded from 1969/70 - 2010/11 (BOM, 2013)

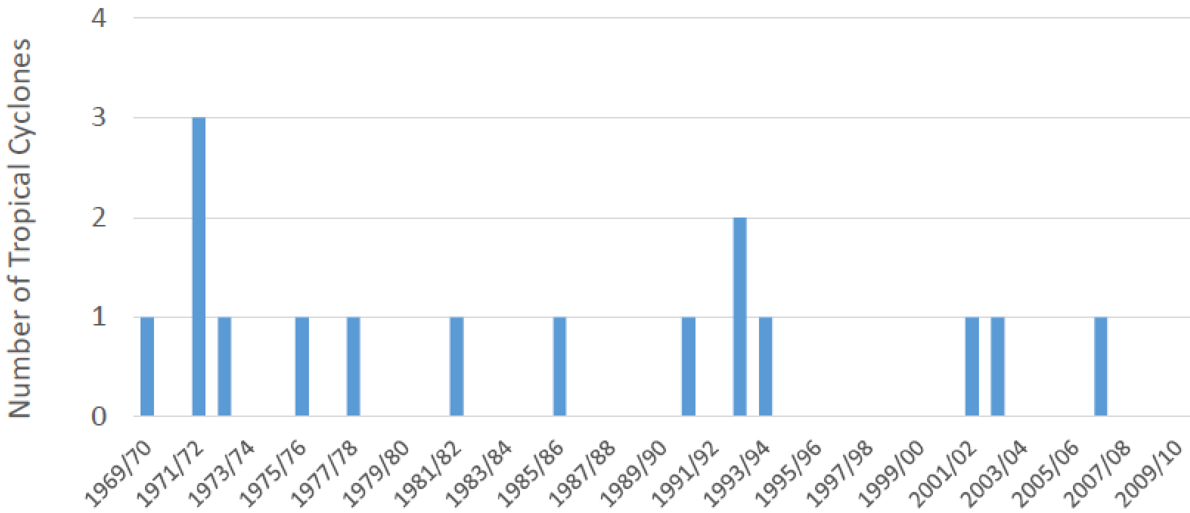


Figure 72: Number of tropical cyclones passing within 400 km of Isabel (BOM, 2013)

10.6.5 Significant wave height

Information on wave dynamics in the vicinity of Kolosori tenement was obtained from the Climate and Oceans Support Program in the Pacific (COSPPac) Oceans Portal. The wave information is derived from the WAVEWATCH III wind-wave model. The Centre for Australian Weather and Climate Research ran the model over the period 1979 – 2009. For this investigation the magnitude of significant waves is of relevance. Significant wave height is the average height (peak to trough) of the upper one third of all waves. Data for the month of January, June and December over the period 1979 – 2009 were used (Figure 73, 74 & 75). The study area which is the Ortega passage is where the company's sea port – Suma port will be located. In this area, the mean significant wave height is averaged at 0.9 m, with a maximum recorded wave height of 3.5 m. It was reported that December to March wave heights and period are projected to decrease (PACCSAP, 2015).

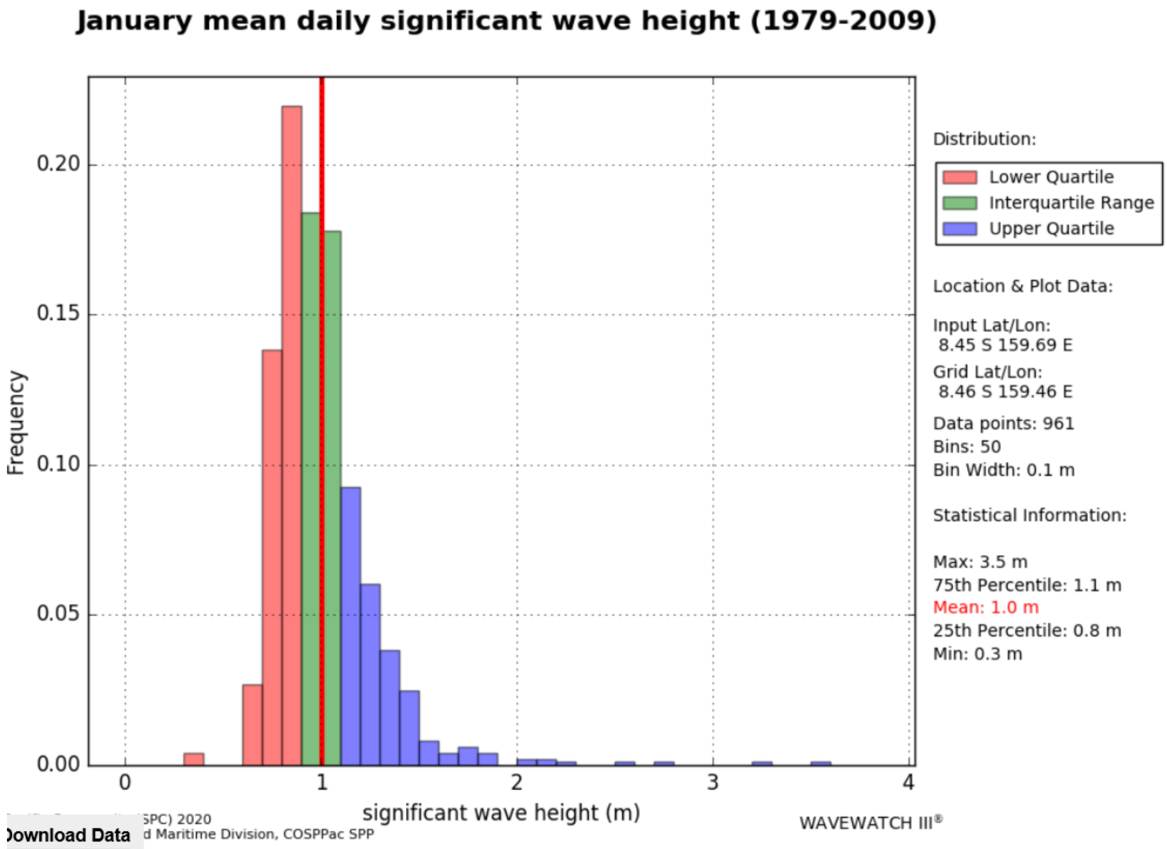


Figure 73: Significant wave height for Ortega channel, Isabel, January 1979-2009

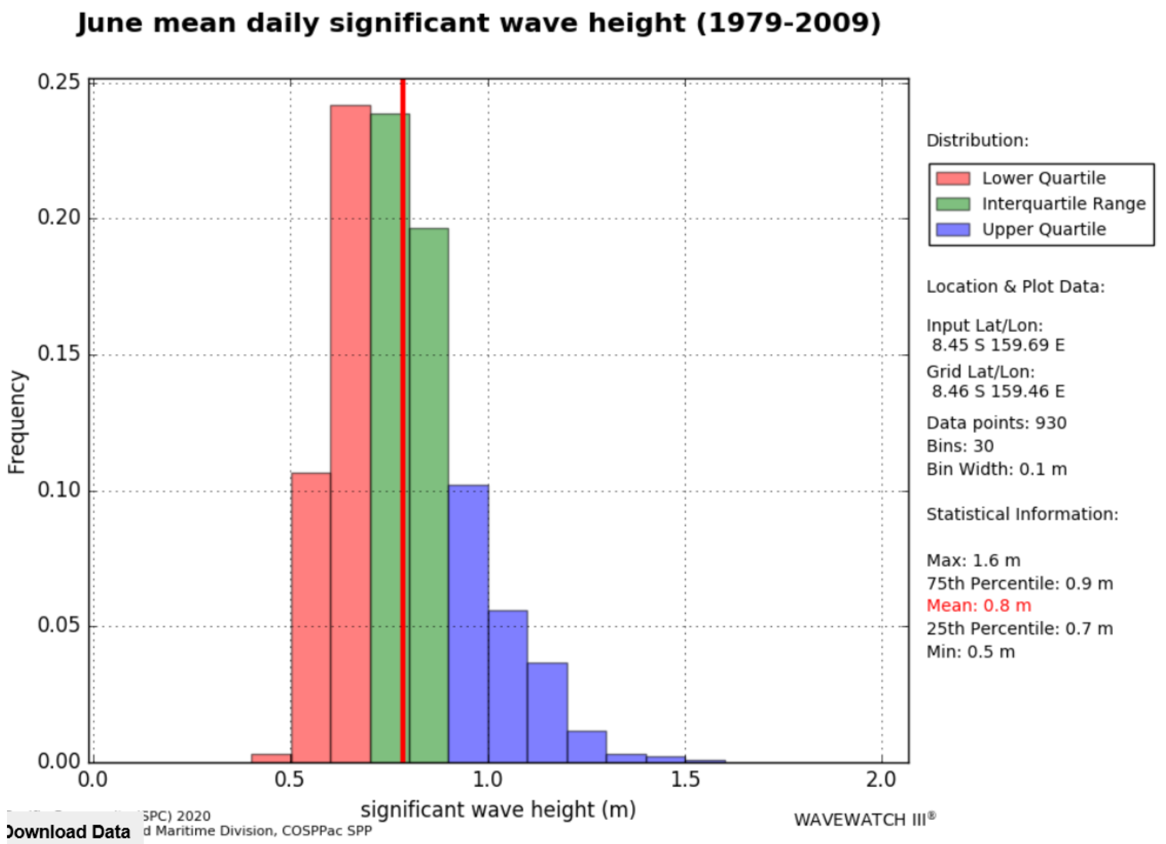


Figure 74: Significant wave height for Ortega channel, Isabel, January 1979-2009

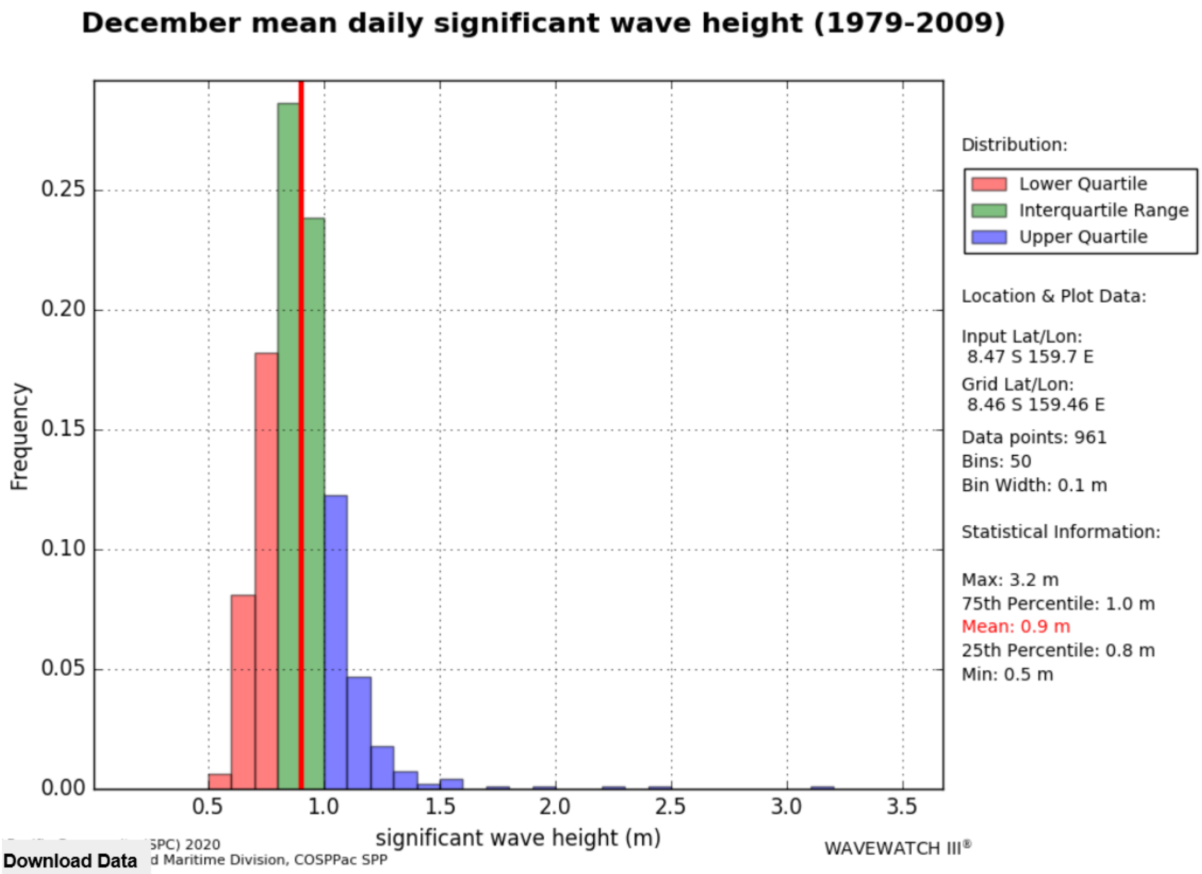


Figure 75: Significant wave height for Ortega channel, Isabel, December 1979-2009

Further, storm tide is another observed weather condition that refers to coastal water levels resulting from the combined effects of astronomical tide and meteorological water level forcing. The meteorological component of the storm tide is the “storm surge” which collectively describes the variation in coastal water levels in response to atmospheric pressure fluctuations and wind setup.

Storm surge occurs only during severe weather events and results in a temporary raising of sea level caused by a combination of low atmospheric pressure and onshore wind. Reliable indications of storm surge are not available for the project area. However, it is known that shelf conditions favoring high storm surges (wide gently sloping continental shelves) tend to attenuate the influence of waves, whereas the shelf conditions that attenuate storm surge (steep shelf margins) allow a larger contribution of waves (Walsh *et al*, 2012). Anecdotally, the bathymetry of this location would not facilitate large storm surge events.

10.6.6 Ocean acidification

Human activities have released Carbon dioxide into the atmosphere and when this gas reacts with sea water it produces carbonic acid. The resulting increase in acidity (lower pH values) reduces the availability of minerals such as aragonite that corals rely on to survive. Over the course of the observational record, aragonite levels have reduced to levels below what is considered optimal for coral growth and the development of healthy reef ecosystems (BOM and CSIRO, 2011). A reduction in the health of reef ecosystems could have implications for coastal erosion on account of a reduction in the ability of reefs to mitigate wave impacts, especially when combined with observed rises in sea level. It is generally, understood that ocean acidification has been increasing in the Solomon Islands' waters. It will continue to increase and threaten coral reef ecosystems.

10.7 Climate Projections

10.7.1 Rainfall pattern

Average annual and season rainfall is projected to increase over the course of the 21st century. However, there is some uncertainty in the rainfall projections and not all models show consistent results. Wet and dry years will still occur in response to natural variability. Drought frequency is expected to decrease slightly by the end of the century.

The 2011 BOM and CSIRO report indicated that annual rainfall projections will increase by 2% (+/- 6%) 1 by 2030, and 9% (+/- 12%) by 2090 under a high emissions scenario. Values for the wet season are also projected to increase by 2% (+/- 7%) for 2030 and 9% (+/- 11%) by 2090 under a high emissions (worst case) scenario. Similar increases are also projected for dry season rainfall. There is moderate confidence around these values.

Most models have projected that the current 1-in-20-year extreme rainfall event will occur, on average, three to four times per 20-year period by 2055 and five times per 20-year period by 2090. This 1 in 20 year event is going to increase in incidence to on average 1 in every 4 years by 2090.

Studies have shown that even in areas where mean precipitation is not changing, heavy precipitation events are becoming more common (Groisman, Knight *et al*. 2005; Alexander, Zhang *et al*. 2006; Trenberth, Jones *et al*. 2007). It was noted that much of the increase in extreme rainfall is likely to occur at much finer sub-daily timescales.

10.7.2 Sea level

Sea level is expected to continue to rise in the Solomon Islands (Table 39). By 2030, under a very high emissions scenario, this rise in sea level is projected to be in the range of 8–18 cm. The sea-level rise combined with natural year-to-year changes will increase the impact of storm surges and coastal flooding. Scientists have warned that larger rises that currently predicted could be possible as there is still much to learn, specifically how large ice sheets like that of Antarctica and Greenland contribute to sea level rise.

	2030 (cm)	2050 (cm)	2070 (cm)	2090 (cm)
Very low emissions scenario	8–18	14–31	19–45	24–60
Low emissions scenario	7–17	14–31	21–48	29–67
Medium emissions scenario	7–17	14–30	21–47	30–69
Very high emissions scenario	8–18	16–35	28–58	40–89

Table 39: Projection of sea level for Solomon Islands. Values represent 90% of the range of the model results and relative to the period 1986-2005 (source: PACCSAPP, 2015).

10.7.3 Ocean acidification

Projections have shown that ocean acidification will continue to increase throughout the 21st century, this is due to increase emission level carbon dioxide in the atmosphere. By about 2045 levels of aragonite are projected to be such that conditions for coral growth would be marginal. The increase acidification is likely to impact on the health of reef ecosystems and it is likely to be compounded by other stressors including coral bleaching, storm damage and fishing pressure (PACCSAP, 2015).

10.7.4 Temperature

Projections for all emissions scenarios indicate that the annual average air temperature and sea-surface temperature will increase in the future in the Solomon Islands (Table 40). By 2030, under a very high emissions scenario, this increase in temperature is projected to be in the range of 0.5–1.0°C. Later in the century the range of the projected temperature increase under the different scenarios broadens.

	2030 (°C)	2050 (°C)	2070 (°C)	2090 (°C)
Very low emissions scenario	0.4–0.9	0.6–1.2	0.4–1.2	0.4–1.2
Low emissions scenario	0.4–1.0	0.7–1.4	0.9–1.8	1.0–2.1
Medium emissions scenario	0.5–0.9	0.7–1.4	1.0–2.0	1.3–2.6
Very high emissions scenario	0.5–1.0	1.0–1.9	1.5–3.0	2.0–4.0

Table 40: Projected changes in the annual average surface air temperature for the Solomon Islands. Values represent 90% of the range of the models and are relative to the period 1986–2005 (Source: PACCSAPP, 2015).

10.7.5 Tropical Cyclones

Extreme events such as tropical cyclones are rare. There is limited data available to make assessments regarding changes in their frequency or intensity. It is also difficult to establish any long-term trends or changes as the extreme events are rarer to happen. However, the 2011 assessment by BOM and CSIRO indicated with moderate confidence that tropical cyclone numbers are projected to decline in the south-west Pacific Ocean basin during the 21st century. Globally, the number tropical cyclones is likely to be decreased (PACCSAPP, 2015). The report also indicated that in the Solomon Islands' region, projections tend to show a decrease in the frequency of tropical cyclones by the late 21st century but their intensity is projected to increase.

10.8 Summary

From the information presented in the previous sections, a summary of main climate variables considered from the observational record, and projected for the future is presented in Table 41 below.

		Historic trend	Projected (2030)	Projected (2090)
Total annual rainfall		Variable (no statistical trend)	↗ +2% (+/- 6%)	↗ +9% (+/- 12%)
Extreme rainfall (daily)		Variable (no statistical trend)	↗ (+15 mm for 1:20 year event)	↗ (+30 mm for 1:20 year event)
Sea level rise		↗ (about 0.8 cm/year)	↗ (up to 15 cm)	↗ (up to 60 cm)
Temperature		↗ (max temperatures up 0.31° C/ten years)	↗ +0.7° C (+/- 0.3° C)	↗ +2.7° C (+/- 0.6° C)
Tropical cyclones		On average, 4 cyclones Each decade within 400 km of Kolosori.	↘ (number of cyclones) ↗ (cyclone intensity	↘ (number of cyclones) ↗ (cyclone intensity)
Wave patterns		Historically, mean significant wave heights for the study area are 0.9 m, with a maximum recorded wave height of 3.5 m. There are No future projections of wave heights.		
Ocean acidity (Aragonite Saturation)		↗ (currently about 3.9)	↗ (about 3.5)	↗ (between 3.2 and 2.8)

Table 41: Summary of observed and projected climate variables. Aragonite saturation levels above 4 are considered optimal for coral growth and health reef ecosystems, between 3.5 and 4 adequate, and between 3 and 3.5 marginal. Coral reef ecosystems were not found at aragonite saturation levels below 3 (Guinotte et al, 2003, in CSIRO and BOM, 2011).

10.9 Sensitivity screening

In climate change context, risk sources are the potential impacts resulting from direct changes in the climate and natural hazards patterns (mean and extreme). These changes can be both direct and indirect. Examples of direct changes include more frequent floods or more intense cyclones. While indirect changes may be attributed to changes in the biophysical or socio-economic systems such as environmental degradation leading to increased consequences of natural hazards (e.g. degradation in mangroves and coral reefs leading to more damaging storm surge). Before completing this risk assessment for the proposed mining project, relevant climate variables and climate driven natural hazards (risk sources) that could impact the project had been identified.

10.9.1 Methodology and results

An initial screening exercise was completed, to investigate the potential sensitivities of the project to climate related hazards. This process looked at the different physical components of the project, and the importance they play in the mining operation process. In this way distinct project elements are established. For the project the following elements are relevant:

- Port site – This include the wharf/ramp area and other port facility. Loading of soils containing the nickel resource will happen at the port site.
- Roads – This include all mining roads. The mining roads are pertinent as these are crucial to accessing the pit and transportation of the nickel ore from the pits/stockpile areas to the port site where they will be transferred to bigger vessels for export.
- Mining pit sites – This are sites where the actual mining will take place and include stockpiles of the resource.

The results of the risk screening exercise are presented in Table 42, whereby climate driven risk sources are placed in the left hand column, and project elements are located along the top row. Relationships between these two elements were identified, and these relationships form the basis for the risk statements that are considered in the detailed risk assessment. Comprehensive identification is critical, because a risk that is not identified at this stage will not be included in further analysis. Identification should include all risks, whether or not Solomon Islands Resource Mining Company Ltd can exercise any direct control over them.

		Port site	Mining roads	Mining pits (Stockpiles)
Sea	Sea level rise	Strong link	No clear link	No clear link
	Storm surge	Strong link	Uncertain or potential	Uncertain or potential
	Surface temperature	Uncertain or potential	No clear link	No clear link
	Ocean Acidity	Uncertain or potential	No clear link	No clear link
Rainfall	Annual average rainfall	No clear link	No clear link	No clear link
	Extreme rainfall events	Uncertain or potential	Uncertain or potential	Uncertain or potential
	Drought	No clear link	No clear link	No clear link
Temperature	Annual average temperature	No clear link	No clear link	No clear link
	Extreme temperature events	No clear link	Uncertain or potential	No clear link
Atmosphere	CO_2	No clear link	No clear link	No clear link
Wind	Cyclones	Strong link	Strong link	Uncertain or potential

Table 42: Risk screening matric used for the project.

10.9.2 Sensitive Project Elements

An initial screening exercise was carried out and completed at the site. The following project elements may be sensitive to climate impacts and climate change:

1. Port site: Cyclones, extreme rainfall events, sea level rise and storm surge.
2. Mining roads: Cyclones, extreme rainfall events, winds.
3. Mining pits (stockpiles): Cyclones, and extreme rainfall events.

10.10 Risk statements

After the completion of the screening process several risk statements were developed to respond to the identified sensitivities associated with the mining project. These risk statements represent potential scenarios that could impact on key mining project activities, or ultimately the ability of the mining project to remain in effective operation. These risk statements form the basis of the detailed risk assessment for the project.

Increase in the frequency and intensity of extreme rainfall causes erosion in sensitive areas like roads, slopes and mining pit areas, therefore, increase sediments and silts carried in surface runoffs.

1. Continued rise in sea temperatures and increasing ocean acidity reduce the effectiveness of barrier reefs and fringing reefs in reducing the impacts from waves.
2. Storm surges, combined with continued sea level rise can cause temporary inundation of the port facility.
3. Continued sea level rise exacerbates coastal erosion causing narrowing of coastline.

10.11 Risk Assessment

10.11.1 Overview

In its simplest form, probabilistic risk assessment defines risk as the product of the adverse consequences of an event and the probability or likelihood that the event will occur.

Risk = Consequence x Likelihood

For instance, the risk to a port (wharf) due to a tropical cyclone with high storm surges might be calculated on:

- ❖ The value placed on the economic disruption due to stoppage of export, and the cost to repair or replace the wharf structure.

Multiplied by:

- ❖ The likelihood that the cyclonic related storm surges above a certain wharf design level, inflicting damage to the structure and disrupting the mining operations revenue earning from export of the resource.

Hazard, exposure, and vulnerability contribute to ‘consequences.’ Hazard and vulnerability also both contribute to the ‘likelihood’: Hazard to the likelihood of the physical event (e.g., the storm surge impact) and vulnerability to the likelihood of the consequence resulting from the event (e.g., economic disruption generally).

10.11.2 Results

For each risk assessed a level of likelihood and consequence is estimated, and the resultant risk level is established. It is important to note that the risk assessment for the project is based on a business as usual specification, or current situation. The complete risk assessment for the project, including the descriptors for determining the likelihood and consequences of the identified risk statements is presented in Table 43.

The analysis indicated that there are no Extreme or High risks. The breakdown of the risk levels is identified in Table 43.

Calculated Risk Level	Number of Risk
Extreme	0
High	2
Medium	2
Low	2

Table 43: Risk levels identified as a result of the risk assessment

10.11.3 Risk Evaluation

The level of risk and corresponding response are represented below. For this report, the *MID Transport Sector Climate Adaptation Guidance Manual* was used as a basis to deduce the different management actions depending on the level of risk identified.

Table 44: Risk management actions for the proposed project

Level of Risk	Required Response
Low	Low risks should be remained under review but it is expected that existing controls should generally be sufficient and no further action should be required to treat them unless they become more severe. - These risks can be acceptable without treatment.
Medium	Medium risks could be expected to form part of routine operations but they should be assigned to the mining company's management for action, maintained under review and carefully monitored for any immediate action. - These risks are possibly acceptable without treatment.
High	High risks are the most severe that can be accepted as a part of mining operations without mitigation measures. The responsible company's

	environmentalist should carefully monitor this and report to management for action. - These risks are not acceptable without treatment.
Extreme	Extreme risks demand urgent attention and cannot be simply accepted as a part of normal mining operations. - These risks are not acceptable without treatment.

11. ENVIRONMENTAL and SOCIAL MANAGEMENT PLAN

11.1 Impact Identification and Risk Assessment

The potential environment and social impacts for the mining have been identified and their significance assessed. The durations of the impacts are assessed based on the scope of work, the bio-physical and social environment at the tenement area. Mitigation measures are designed to avoid and/or minimize each of the potential environment and social impacts. Impacts may be minor, moderate, major or negligible based on the scale of impact itself and whether it is mitigated or not.

Table 45: Impact Identification and Assessment

Project activities	Potential Impacts	Duration	Mitigation approaches	Mode of impact if not mitigated	Comments
CONSTRUCTION PHASE					
Surveying, demarcation, clearing for mining camp set up, stoke plie areas, workshops and offices.	• Felling of forest and coastal plants causing loss to important plant species and or wild life.	• Medium term.	• Minimize clearance to relevant areas of activities; • Unnecessary clearance avoided; • Acquire land clearing permit from the Ministry of Forestry if necessary; • Build campsites on existing space provided by and in agreement with the local community; • ***(Biodiversity Management Manual applies).***	• Marginal.	• Existing space will be utilized. Local village houses could be rented.
Mobilisation of SIRC company and presence of construction workers	• Poaching of terrestrial and marine fauna, unnecessary felling of trees for cooking.	• Long term.	• SIRC company responsible for information and sanctions regarding harm to wildlife and felling of trees (not requiring to be cleared); • SIRC company to supply sufficient cooking fuel to avoid use of local timber or felling of trees; • ***(Biodiversity Management Manual applies).***	• Significant.	• Mitigation cost to be part of mobilization and mining set up package.
	• Community exposure to campsites Spread of STIs and HIV/AIDS.	• Short to long term.	• Village protocols discussed. Worker awareness as part of mobilization; • Signage and security at camp i.e. prohibition on unauthorised people (esp.	• Marginal.	• Workers will be drawn from the community.

			Children and women) entering camp; • Workers to respect village and landowner boundaries • STIs and HIV/AIDS awareness program for workers and villages; • A communications and complaints plan will be used for liaison and correction among stakeholders; • SIRC company to provide health facilities and First Aid post in camps and provide safety equipment for workers; • ***(Health and Safety Manuals applies).***		• Regular awareness/training HIV and other diseases and sickness.
	• Increase social disruptions	• Short term	• SIRC company to ensure worker's actions are controlled and village rules, code of conduct observed; • Educate workers to respect village protocols; • Such that if the situation is beyond the capacity of the community leaders, police will be informed to investigate problem.	• Minor	
	• Generation of Solid and Sanitary waste impacting coastal and water quality	• Long term	• Collect and dispose of solid waste regularly at designated dump site; • Install waste collection and temporary storage facilities fully label; • Awareness and educated construction workers on waste management system;	• Minor	

			• Establish sanitary latrines for workers; • ***(Waste Management Manual applies)***		
Operation of construction machinery generating emissions	• Emission of exhaust from vehicles and machinery	• Short term	• Maintain construction equipment; • Prohibit use of equipment that causes excessive pollution (e.g. generates smoke); • ***(Traffic Management Manual applies).***	• Minor	• Prestart on construction machines and vehicles.
	• Dust caused by vehicles running at high velocity	• Short term	• Thorough watering to avoid dust.	• Minor	
Operation of construction machinery creating noise	• Noise to communities (Riudede)	• Short term	• Construction machine exhaust systems and noisy equipment will be maintained to minimise noise; • SIRC will develop a schedule of operations with village chiefs to identify days of no work and hours for certain activities; • Limit noisy construction activities to day time hours, i.e. construction activities prohibited between 9pm and 6am; • ***(health and safety manual applies).***	• Marginal	
	• Impacts on construction workers	• Short term	• Workers limit of exposure to noise will be strictly below 70decibels per 8 hour shift; • Provide workers with noise abatement equipment (ear-muffs etc);	• Minor	

			• Complaints will be addressed by SIRC company; • ***(Health and safety manual applies).***		
Stockpile of Construction Materials	• Construction materials washed out into coast or water bodies.	• Short term	• Construction materials will be stockpiled 20m away from coastline or water bodies; • Stockpile areas properly bunded; • Placement of diversion ditches around stockpiles; • ***(Erosion management Manual applies).***	• Marginal	• Existing water source (ground and surface water will be taken into consideration); • Emergency response plan approved by MECDM; • During constructing plumes of disturb water will be pumped into a sediment settling pond; • SIRC company's rehabilitation plan approved by MMERE, MECDM; • Regular coastal, surface and ground water quality monitoring.
	• Dust from exposed stockpiles	• Short term	• Material stockpiles located in sheltered areas and to be covered	• Minor	
Construction of causeway-wharf, cut and fill activities for the road and stockpile areas, quarrying and construction of campsite/offices.	• Changes to coastal processes as a result of wharf construction.	• Short to Long term	• Coastal protection to avoid littoral drift effects; • Avoid tipping soil; • Construction works undertaken with extreme care.	• Marginal	• Coastal water quality monitoring; • Sediments traps to be regularly checked and repaired; • SIRC company's Extraction plan approved by MMERE and MECDM; • Comply with standard extraction specification. •
	• Silt generation	• Short term	• Construction works especially at the coast to be undertaken with extreme care; • Use of silt control devices and sediment traps/fences Construction of sediment settling ponds and bunds. Diverting turbid water to sediment settling ponds;	• Marginal	

			• ***(health and safety manual applies) & (health and safety manual applies)& Surface and ground water manuals***		
	• Accidental release of hydrocarbon from construction machines impacting soil and water and frequent machine exposure to sea or water releases hydrocarbons	• Short term	• Ensure all construction machines are well maintained; • A prestart on construction machine carried out every morning; • Oil/fuel remediation agents, oil pads, oil booms and geo-fabric clothes are ready for usage as ***per emergency response plan;*** • ***(Hazardous material management manual).***	• Marginal	
	• Access and Mobility restricted	• medium	• SIRC company to allow areas within the tenement to be continuously accessed by affected communities and public.	• Minor	

	• Barrow pits exposed water table	• Short to Long term	• Avoid Barrow pits exposing water table • Barrow pit immediately covered when water tables are exposed	• Marginal	
Fuelling construction machines and storage of Hydrocarbons	• Hydrocarbon leakage / spills from construction camps / workshops	• Medium term	• ***Detailed Emergency Response Plan*** (as part of EMP) prepared by SIRC company to cover hazardous materials/oil storage, spills and accidents; • Chemicals will be stored in secure containers 20m away from the coastline; • Chemicals stored in area or compound with concrete floor and weatherproof roof and fire extinguishers; • Spills will be cleaned up as per emergency response plan; • Ensure all construction machines are well maintained; • Accidents reported to police and MMERE and MECDM within 24 hours;	• Minor	• Emergency response plan approved by MECDM, MMERE; • Construction workers to undergo some form safety training.

			• ***(Hazardous material management manual)***		
	• Smoking near storage and workshop areas causing fire.	• Short term	• Prohibit smoking close to fuel storage areas; • Put up signs of no go smoking zones; • Provide extinguishers and train workers on their use; • ***(Health and Safety Manuals applies).***	• Minor	
OPERATION PHASE					
Encroachment into precious ecology	• Workers poach animals • Protected areas affected	• Medium	• SIRC Company responsible for information and sanctions regarding harm to wildlife. • ***(Biodiversity Management Manual)***	• Marginal	• A Rehabilitation Plan is currently being developed by SIRC which will be part of the Environment Management Plan.
	• Runoffs carrying turbid water impacting corals and aquatic organisms	• Medium to long term	• Use of silt control devices and sediment traps/fences including Construction of embankments and replanting to avoid direct runoffs; • ***(Biodiversity Management Manual)&*** (***Erosion management Manual applies) & Surface and ground water manuals.***	• Marginal	
	• Fragmented terrestrial habitat	• Short	• SIRC company responsible for information and sanctions regarding felling of trees (not requiring to be cleared); • Provision for plant collection and plant nursery to be later used in the rehabilitation work; • ***(Biodiversity Management Manual).***	• Marginal	

Encroachment into archaeological and cultural sites	• Damage to archaeological and cultural sites	• Short term	• The mining is not going to impact any cultural or archaeological sites; • Such that during the operation a site is accidently exposed, clearing will be stopped and National Museum officers will be informed to assess site.	• Significant	• GPS position of all archaeological and cultural sites, values, historical backgrounds, ownership will be recorded and included as part of the detailed EMP.
Presence of mining workers	• Public are exposed to sexual exploitation in camps	• Short to Long term	• Village protocols discussed. Worker awareness as part of mobilization; • Signage and security at camp i.e. prohibition on unauthorised people (esp. children) entering camp; • Workers to respect village and landowner boundaries; • STIs and HIV/AIDS awareness program for workers and villages; • A communications and complaints plan will be used for liaison and correction among stakeholders; • SIRC Company to provide health facilities in camps and provide safety equipment for workers.	• Marginal	• The company will carry out awareness/training to workers before the construction and regular throughout the operation.
	• Waste generated at campsites and operational sites causing nuisance and potential contamination to coastal waters and or ground water.	• Medium term	• Septic tanks and garbage receptacles will be set up at construction camp sites which will be regularly cleared by the SIRC company; • SIRC company to prepare waste management manual as part of EMP;	• Minor	• The SIRC company is required to incorporate the ***waste management manual*** as part of their EMP

			• All wastes from work sites and camps to be disposed of in approved landfill / areas; • SIRC company will provide sufficient training in appropriate waste disposal methods; • ***Waste Management Manual (Hazardous material management manual).***		
		• Short term	• No wastes to be dumped in waterways or close to the coast; • SIRC company ensures wastes not discharged to rivers or coastal waters and that all wastes disposed of in proper areas; • Construction camps will have sanitary latrines; • SIRC company to provide adequate and safe drinking water in camp; • SIRC Company will provide sufficient training in appropriate waste disposal methods.	• Marginal	
	• Possibility of conflicts or antagonism between residents and SIRC Company.	• Short term	• Facilitate reconciliation between parties- Chiefs, SIRC Company and ECD to involve in resolving the issue.	• Marginal	• Construction workers to be drawn from the communities • Important to involve community chiefs through all the project phase
Mining, quarrying, stockpile of ore and waste rocks/soils,	• Siltation to water bodies/Stockpile	• Short to long term	• Mining works especially near coast or rivers to be undertaken with extreme care;	• Marginal	• The company will designate sites for monitoring water quality

treatment of ores, transporting and loading ore.	materials washed out to adjacent water bodies.		• Use of silt control devices and sediment traps/fences and sediment settling ponds; • Water quality monitoring undertaken regularly for compliance levels ***(Surface and Ground water operating manuals).***		(control sites and potential impacted areas) • Waste rocks/soils removed and stockpiled for a long period of time is likely to generate acid drainages. Acid drainages resulted from high concentration of heavy metal leached out from waste rock/soil deposits. Simple management approach includes management of waste by –acid-base-acid-base stockpiling arrangement so that it neutralizes water leaching out from the stockpiles.
	• Increase in acid drainage from in appropriate management of waste rock/soil and top soil	• Long term	• Manage waste rock site in such as a way the acidity are kept at reasonably levels; • (***Waste Rock/Soil Management Manual as part of the EMP).***	• Significant	
	• Accidental spills associated with loading of the ores	• Long term	• Workers are trained in SOPs for loading of ores; • Avoid loading during bad weather; • Acquire weather forecast of the site 2 months before loading; • SIRC will develop an emergency response plan to manage any accidents; • SIRC will procure relevant materials to ensure readiness during spills.	• Significant	• Emergency response plan approved by MECDM and MMERE •
Fueling mining machineries and storage of Hydrocarbons	• Hydrocarbon leakage / spills from construction camps / workshops/operational sites	• Medium term	• ***Detailed Emergency Response Plan (as part of EMP***) prepared by SIRC company to cover hazardous materials/oil storage, spills and accidents;	• Minor	• Emergency response plan approved by MECDM and MMERE • Construction workers to undergo some form safety training

			• Chemicals will be stored in secure containers away from the rivers and coastline; • Chemicals stored in area or compound with concrete floor and weatherproof roof and fire extinguishers; • Spills will be cleaned up as per emergency response plan; • Ensure all construction machines are well maintained; • Accidents reported to police and ECD within 24 hours; • ***(Hazardous material management manual).***		
Waste Management Issues	• Waste generated at campsites, offices, and operational site causing nuisance to public and villages.	• Medium term	• Septic tanks and garbage receptacles will be set up at operational camp sites, which will be regularly cleared by the SIRC company; • Construction camps will have sanitary latrines; • SIRC company ensures wastes not discharged to rivers or coastal waters and that all wastes; disposed of in proper areas; • SIRC company to provide adequate and safe drinking water in camp; • SIRC company to prepare waste management plan (as part of EMP); • All wastes from work sites and camps to be disposed of in approved landfill / areas;	• Minor	

			• SIRC company will provide sufficient training in appropriate waste disposal methods; • ***Waste Management Manual.***		
Operation of construction machinery generating emissions	• Emission of exhaust from vehicles and machinery	• Short term	• Maintain construction equipment; • Prohibit use of equipment that causes excessive pollution (e.g. generates smoke); • ***Air quality management manual.***	• Minor	• Prestart on construction machines and vehicles
	• Dust caused by vehicles running at high velocity	• Short term	• Thorough watering to avoid dust.	• Minor	
Operation of machinery creating noise	• Noise to communities and schools	• Short term	• Construction machine exhaust systems and noisy equipment will be maintained to minimise noise; • SIRC company will develop a schedule of operations with village chiefs and Engineer to identify days of no work and hours for certain activities; • Limit noisy construction activities to day time hours, i.e. construction activities prohibited between 9pm and 6am.	• Minor	
	• Impacts on construction workers	• Short term	• Workers limit of exposure to noise will be strictly below 70 decibels per 8 hour shift; • Provide workers with noise abatement equipment (ear-muffs etc.); • Complaints will be addressed by SIRC Company.	• Minor	

DECOMMISSIONING IMPACTS					
Waste	• Decommissioning will result in numerous waste and recycled materials including stockpile materials, oil and fuel, batteries, steel, to name a few	• Short to long term	• At the mine closure, campsites and associated facilities can be dismantled using minimal impact approach and recycled or disposed of safely. SIRC will ensure waste due to the mine closure does not eventuate into negative impacts. Relevant authorities including ECD and MD will inspect tenement area at the mine closure to ensure no impacts remain or generated due to decommissioning	• Significant	No waste remain at the site.
Storage	• The scope of the current mine is to extract and export the ore. So there is no need for storage unless it requires the company do so.	• Long term	• All wastes whether is it is solid, liquid or gas stored at any location in the tenement will be removed by SIRC in the first instance during operation. The SIRC Company will make arrangement for recycling with oversea companies together with ECD once it is necessary. The storage site will have concreate platform, weather proof roofs and secure. The company is liable for any storage onsite including any impacts that may arise due to the storage.	• Significant	SIRC will ensure no storage of wastes.
Access and mobility	• Disruption to access	• Short term	• The company will agree work schedule with the community before decommissioning activities commences.	• Minor	Community tracks will not be impacted.

Decommissioning causing exposure of soil surfaces	• Siltation/sedimentation	• Long term	• All ore pockets and sites exposed will be rehabilitated with local indigenous and economical trees.	• Marginal	All sites exposed after decommission will be rehabilitated with local and economical species

11.2 Potential Impacts and Mitigation

11.2.1 Construction Impacts

11.2.1.1 Impact on Flora and Fauna

There will be marginal damage to vegetation from construction of campsites, stockpile areas, accommodation, offices, workshops, wharf, road and other essential infrastructures. Majority of the area is pristine and fragmented to certain extent. Existing space or areas of least concern habitats will be cleared for construction of campsites and other amenities. The road corridor whenever possible constructed on the existing alignment with minor widening on the sides. The design of hauling routes will ensure minimal damage to primary vegetation. As part of the Environmental Management Plan, the company will to develop a **Biodiversity Management Manual** which will cover management of endemic species and other factors likely to cause harm to the flora and fauna in the area. In terms of impacts on fauna, there is potential for construction workers to poach edible animals and birds of the locality in spite of prohibitions and poaching being regulated by Wild Birds Protection Act and Wildlife Management and Protection Act. The SIRC Company will be responsible for providing adequate information to workers regarding the protection of fauna and imposing sanctions on workers trapping, killing or wounding birds or other wildlife.

11.2.1.2 Impacts on Air Quality

The construction works will have a minor impact on local air quality through emission of exhaust from construction machineries, as well as through dust generation from vehicles transporting materials and from exposed stock-piles. The company is required to develop an **Air Quality Management Manual** which covers best practice at worksites including provision for public and workers safety. There are number of good engineering practices that can be employed to ensure that any air quality impacts generated during construction are mitigated. These include:

- Construction equipment being maintained to a good standard. The equipment will be checked at regularly to ensure they are maintained in working order and the checks will be recorded by the company as part of environmental monitoring;
- Prohibition of the use of equipment and machinery that causes excessive pollution(i.e. visible smoke) at the project sites;
- Provide workers with protective safety equipment including masks;

- Ensuring that all vehicles transporting potentially dust-producing material are not overloaded, are provided with adequate tail-boards and side-boards, and are adequately covered with a tarpaulin (covering the entire load and secured at the sides and tail of the vehicle) during transportation;
- Material stockpiles being located in sheltered areas and be covered with tarpaulins or other such suitable covering to prevent material becoming airborne; and
- Periodic qualitative air quality monitoring (by observation rather than testing).

10.2.1.3 Impacts on Water Quality

Water quality can be affected during construction activities when soils, wastewater, oils and lubricants, sewage and other materials are allowed to move into the environment. Construction activities that may exacerbate the movement of these materials into the fresh or marine water environments will be addressed as per the mitigation developed in this EIS and other EMP. Initial baseline water quality showed that fresh water environment are affected to certain extent. Water quality monitoring sites have been identified and will continue to be monitored during operations to ensure water bodies likely to be affected by the mining including coastal waters and ground water are managed at acceptable standards. As part of the EMP, the company is responsible for developing a **Surface and Ground Water Quality Management Manual**. This will include water quality samplings using bottles and field site analysis using field instruments. Mitigation measures include:

- Sediment controls such as silt fences or other sediment reducing devices (rock dams, silt ponds or silt barriers), to prevent both siltation and silt migration during works being undertaken in the near stream when necessary;
- Minimizing interference with natural water flow in rivers, water courses or streams within or adjacent to worksites;
- Solid wastes, debris, spent oil or fuel from construction machinery or plant, construction material, or waste vegetation removed from worksites will not be dumped in streams or near streams;
- Hydro-carbons, fuel, and other chemicals as required for the works, will be stored in secure containers or tanks located away from the surface waters, or streams. Any spills will be contained and immediately cleaned up as per the requirements of the emergency response plan prepared by the; and
- All water, waste-water and other liquids used or generated by project works and activities will be collected and disposed of in an approved manner and in an approved location. Such disposal will not be permitted to cause either pollution or nuisance.

11.2.1.4 Impacts on Soils and Erosion

During construction, excavated areas will need to be reviewed for potential soil erosion damage and protection provided as necessary to avoid the movement of eroded soil from the site into watercourses or coastline and onto adjoining areas including the worksite. Arrange to limit the area that is being excavated and use soil conservation technology such as silt fences to reduce and control erosion from these areas. At the completion of work, all disturbed areas will be stabilized by re-vegetation techniques. Existing patterns of erosion, soil characteristics and topographic conditions will be accounted for in the mining concept plan. Certain types of earth works, e.g. extensive, cut and fill, trenching and back filling can result in sedimentation. The company will develop an **Erosion and Sediment Control Management Manual** which will cover the management of erosion and sedimentation resulting from mining and ancillary activities at the tenement areas. The Manual applies to erosion and sedimentation issues over the life of the mine, including the construction, operational and rehabilitation phases.

The potential impacts on soil, or from erosion, during construction are from (i) turbidity impact on the adjacent streams and creeks; (ii) soil erosion and loss of protective vegetation in areas of slopes; and (iii) soil contamination from fuel, chemicals and/or construction material spillage. Material stockpiles will be susceptible to erosion, creating sediment laden run-off, particularly during rains and re-suspension of dust during the dry season. Stockpiles will not be permitted on the nearby water bodies. There will be loss of soil of productive when it crosses any lands currently being used for gardens or plantations. Potential soil impacts and erosion will be mitigated by:

- In the event that the company causes damage to agricultural land, productive land or gardens, the company is solely responsible for repairing the damage and/ or paying compensation;
- The side slopes will be protected and designs used that protect soils in order to reduce erosion; and
- Random and uncontrolled tipping of spoil, or any material, will not be permitted.

11.2.1.5 Impacts on Noise Levels

There are no noise standards in Solomon Islands, and as any noise generated by the mining will be intermittent and attenuates with distance, preparing a baseline of ambient noise levels for subsequent monitoring is not considered warranted.

Construction noise is generally intermittent, attenuates quickly with distance, and depends on the type of operation, location and function of equipment. During construction, there will be a temporary adverse impact due to the noise of the construction equipment, especially heavy machinery when construction activities are carried out close villages.

The most sensitive receptors include the Riudede villages. The company will agree work schedule with the communities. Ideally, noise should not exceed 70 dBA measured at the outside of any residence. Measures to be included in the mining to mitigate the effects of noise include:

- Requirements in the EMP that all vehicle exhaust systems and noise generating equipment be maintained in good working order and that regular equipment maintenance will be undertaken;
- Prohibition of any construction activities between 9pm and 6am in, or close to, residential sites;
- The company will prepare a schedule of operations that will be approved by affected stakeholders. The schedule will establish the days, including identifying days on which there should be no work, and hours of work for each construction activity and identify the types of equipment to be used;
- Workers will be provided with noise abatement equipment as may be required; and
- Any complaints regarding noise will be dealt with by the SIRC Company in the first instance through the redress grievances mechanism.

11.2.1.6 Impacts on Access

The mining will cause temporary negative impacts, including inconvenience, minor disruptions to traffic using the road and on local access during the construction period. Mitigation of impacts on access will include:

- Care must be taken during the construction period to ensure disruptions to access and traffic are minimized;
- Signs and other appropriate safety features will be used to indicate construction works are being undertaken; and
- The company will ensure access roads/hauling routes to private owned land are not disturbed.

11.2.1.7 Impacts on Health and Safety

The mining's construction phase can cause a range of health and safety impacts. The main impacts on health and safety are associated with (i) risk of accidents at work sites, and (ii) traffic safety issues and (iii) chemical spills. The risk of spread of communicable disease is considered to be negligible. The company will need to develop a Health and Safety Manual to cover public and workers safety including job safety analysis of various activities undertaken by mining workers from office to the field sites.

Observing general health and safety requirements, including provision of safety and PPE for workers, will reduce the risk of accidents at the work sites. Air pollution and noise, which also have a health and safety aspect, have already been discussed.

The SIRC Company will need to observe general health and safety requirements and, as a minimum, will be compliant with the Labour Act of 1978 and the Safety at Work Act of 1996.

Mitigation measures for reducing and avoiding impacts on health and safety include:

- **Company** to provide workers health and safety induction, and on the specific hazards of their work;
- Provide workers with personal protection equipment, such as safety boots, safety glasses, reflector vests, helmets, gloves, and protective clothing and ensure workers adhere to OH&S policy at all times;
- Garbage receptacles will be setup at project sites, which will be regularly cleared. The garbage will be dumped only at approved site; and
- Provision of adequate protection to the general public in the vicinity of the work site, including advance notice of commencement of works, installing safety barriers if required and signage or marking of the work areas.

11.2.1.8 Fire

Smoking near fuel storage areas causing fire and loss to construction resources are expected to be minor. Mitigations measures include:

- Prohibit smoking close to fuel storage areas;
- Put up signs of no go smoking zones; and
- Provide extinguishers and fire hydrants including training workers on their use.

11.2.1.9 Accidental discovery of archaeological and cultural resources

Any site clearance, digging and excavation activities undertaken during construction can un-earth archaeological sites or resources. In the event this occurs, work shall cease immediately and the authorities (National Museum Tambu Register, Ministry of Culture and MECDM) shall be informed.

- Activities shall not re-commence until the authorities have signed-off that the site/resources have been dealt with appropriately and that work may continue. The company shall be responsible for complying with the requirements of authorities, and the company shall monitor the same.

11.2.1.10 Emergency Response Plan

The Company will be responsible for preparation of an emergency response plan which will cover containment of hazardous materials, oil spills, and work-site accidents. The plan will detail the process for handling, and subsequently reporting, emergencies, and specify the organizational structure (including responsibilities of nominated personnel).

11.2.1.11 Community concerns

Community concerns regarding the project will be dealt with through the redress grievances mechanism in chapter six. Impact on adjacent communities will be from the noise of equipment. Other risks including spread of diseases between the construction team and the residential population is deemed minor or negligible. The SIRC Company will need to provide first aid kits, safety equipment for workers and provision for taking victim to hospital. The Company will be responsible for providing adequate knowledge to construction workers in relation to safety issues. The Company will conduct an STI and HIV/AIDS awareness program for the construction force and villagers. Alcohol consumption and inappropriate behavior by the workers or public will be monitored and dealt with by company and police to certain extent.

Mitigation measures include:

- SIRC company to ensure worker's actions are controlled and code of conduct observed;
- Awareness to SIRC company s on HIV/AIDS remediation protocols; and
- Educate workers to respect village laws and customs.

11.2.2 Operation Impacts

11.2.2.1 Encroachment into precious ecology

There will be encroachment into precious ecology from mining of the nickel due to clearing for potential ore sites, removal of top soil and stockpile of ore in sensitive habitats. These encroachment areas/zones will need to be rehabilitated with indigenous or economical plant species to bring them to their original condition before the mining. As part of the mining requirements, the company will develop a mining rehabilitation plan which will be part of the company's detailed EMP and **Biodiversity Management Manual**. The Biodiversity Management Manual covers the need to recover both the flora and the fauna in the area, establishment of nursery, recovery of top soil and natural revegetation.

11.2.2.1 Fuel Delivery and Storage

There are marginal impacts involving delivery and storage of fuel. Negligence of Standard Operating Procedures (SOP) can result in a disaster. Where fuel is being transferred from a vehicle/ship, the tank truck/ship must be certified to standard and ensure that all truck/ships used to transport fuel tanks meet international requirements. There will be signs, indicating that the ignition must be turned off and smoking is not permitted while the ship/vehicle is being refueled and will be visible to the operator. Travelling along road will be not more than 60km/hr to avoid accidents. Maintain at least one 20-B:C portable fire extinguisher with the tank vehicle. Refueling equipment from a tank vehicle is permitted if the following conditions are met:

- the fuelling is conducted outdoors on commercial or industrial establishments;
- the fuelling is conducted using approved hose-reel and automatic closing nozzles; and
- appropriate training and equipment are supplied to deal with any incidental spillage.

All storage tanks for combustible and flammable liquids will be built 20m from water bodies, bunded and maintained regularly. There should be thorough inspection from the management for possible leakages and faults. Whenever a problem occurs, a spill response kit capable of containing and absorbing fuel spills will be made available and maintained. Ensure that spills are recovered and that contaminated soil is removed or treated. Post spill response procedures and maintain an emergency response manual within the fuel facility.

11.2.2.2 Management of waste (solid and liquid waste)

The operation of the mining can cause minor impacts from accumulation of solid wastes such as drums, cables, timber, metal off cuts and kitchen waste given. One of the most important requirements for effective waste management is to sort or segregate material at the respective work areas, and then transport it to the designated site for disposal.

During overhaul and maintenance of operational machines large quantities of oil are discharged and pumped into drums. Sometimes these were not managed properly resulted in seepage into nearby environment. During heavy rainfall, the oil storage sites may be flooded and spill into storm water drainages. To mitigate this risk, SIRC Company will construct bunds and oil separators whenever necessary. Long term measures proposed includes a common outlet for all drainages coming out from the workshops.

All sewage generated at the campsites/offices shall be directed through the sewage system: the offices, workshop and related facilities have piped sewerage connections to a specified septic tank. Sludge shall be stored in holding tanks. The holding tanks will be periodically pumped out and the sludge buried at a suitable location which minimizes the risk of any leaching to watercourses or groundwater.

Activities likely to cause spillage of hydrocarbons either into land or water shall be undertaken so far as possible in bunded areas. In particular, vehicle wash downs, maintenance and refueling, except in emergencies, should take place in workshops and other hardstand areas with appropriate drainage systems, including capacity to intercept spilt hydrocarbons or oily water; Earth-bunded locations within the mining area where spilt hydrocarbons or oily water can be contained within the bund.

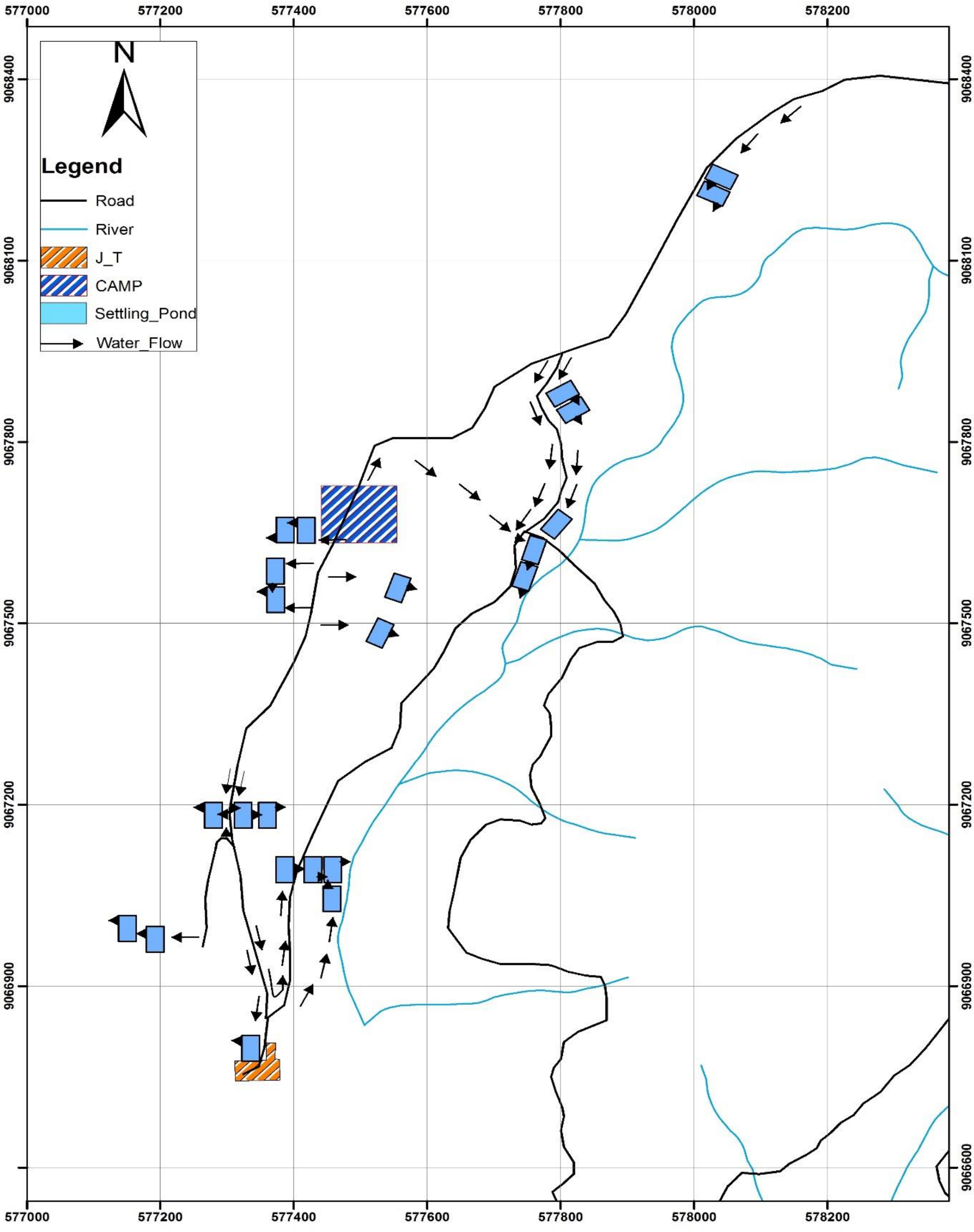
11.2.2.3 Impacts on Air Quality

The operation of the mining machineries will have a minor and temporary impact on local air quality. Engineering practices that can be employed to ensure that any air quality impacts generated during operation are mitigated include:

- Equipment will be checked at regular intervals to ensure they are maintained in working order and the checks will be recorded by the SIRC company as part of environmental monitoring; and
- Periodic qualitative air quality monitoring (by observation rather than testing).

11.2.2.4 Impacts on Water Quality

Figure 76: Sediment Settling Ponds Plan



The figure above indicates the initial sediment ponds proposed. But there are likely to be over sixty eight sediments ponds. Refer to Annex 14.6 for the sediment pond design.

Water quality can be affected during operation activities when soils, wastewater, oils and lubricants, sewage and other materials are allowed to move into the environment. Operation activities that may exacerbate the movement of these materials into the fresh or marine water environments will be investigated and reviewed regularly. See figure 66 above outlining the plan to manage siltation from disturbed areas. Mitigation will include the following:

- Sediment controls such as silt fences or other sediment reducing devices (rock dams or silt barriers), to prevent both siltation and silt migration during works being undertaken in the near stream when necessary;
- Minimizing interference with natural water flow in rivers, water courses or streams within or adjacent to worksites;
- Solid wastes, debris, spent oil or fuel from construction machinery or plant, construction material, or waste vegetation removed from worksites will not be dumped in streams or near streams;
- Hydro-carbons, fuel, and other chemicals as required for the works, will be stored in secure containers or tanks located away from the coast, surface waters, or streams. Any spills will be contained and immediately cleaned up as per the requirements of the emergency response plan prepared by the SIRC company ; and
- All water, waste-water and other liquids used or generated by project works and activities will be collected and disposed of in an approved manner and in an approved location. Such disposal will not be permitted to cause either pollution or nuisance.

11.2.2.5 Noise

The noise will come mainly from the mine machineries. The most sensitive receptor is the Riudede Village. The company will discuss works schedules with the Riudede community. Ideally, noise should not exceed 70 dBA measured at the outside of any residence. Measures to be included in the project to mitigate the effects of noise include:

- Requirements in the EMP and contract documents that all vehicle exhaust systems and noise generating equipment be maintained in good working order and that regular equipment maintenance will be undertaken;
- Prohibition of any construction activities between 9pm and 6am in, or close to, residential sites;
- The company will prepare a schedule of operations that will be approved by affected stakeholders. The schedule will establish the days, including identifying days on which

there should be no work, and hours of work for each construction activity and identify the types of equipment to be used;

- Workers will be provided with noise abatement equipment as may be required; and
- Any complaints regarding noise will be dealt with by the SIRC Company in the first instance through the redress grievances mechanism.

11.2.2.6 Health and Safety

The SIRC Company will need to observe general health and safety requirements and, as a minimum, will be compliant with the Labour Act of 1978 and the Safety at Work Act of 1996. Mining requires a high standard of health and safety procedures due to the exposure of workers to high risk working environment. These include, operation of machineries, loading of vessels, handling of chemicals to certain extend and exposure to emission form machineries overtime.

Observing general health and safety requirements, including provision of safety and protective gear and equipment to workers, will reduce the risk of accidents at the work sites. Measures include ongoing training of workers and reviewing Standard Operating Procedures to suit condition at the Mine Site. Mitigation measures include:

- Provide construction workers training in health and safety issues, and on the specific hazards of their work; and
- Provide workers with personal protection equipment, such as safety boots, safety glasses, reflector vests, helmets, gloves, and protective clothing.

11.2.2.7 Emergency Response Plan

SIRC will be responsible for preparation of an emergency response plan which will cover containment of hazardous materials, ore spills, oil fuel spills, and work-site accidents. The plan will detail the process for handling, and subsequently reporting, emergencies, and specify the organizational structure (including responsibilities of nominated personnel).

11.2.2.8 Ship loading and unloading management

An assessment of trans-loading and loading sites identified the offshore Suma, in Ortega Bay to be feasible. The anchorage site was discussed with the Solomon Islands Maritime Safety Agency (SIMSA). The risks associated with loading are so high that careful attention and management be given priority. Experience from other areas in the Solomon revealed that lack of risk management has resulted in major oil/fuel/ore spills. SIRC interest is to avoid such incidents at all cost. Mitigations will include:

- Ensuring loading does not exceed minimum loading capacity at the wharf;
- Load manager ensuring ores does not spill on coastline;
- Loading will be conducted in dry season;
- Ensuring there is forecast of fine weather 2 months before loading;
- Avoid loading in rainy and bad weather conditions;
- Report incidents to the relevant authority if such events occurs;
- The company will develop an emergency response plan ensuring accidents involving spillage of ores, chemicals and oils are mitigated.

11.2.3 Social Impacts and Mitigation

11.2.3.1 Impacts on future Land use

Currently the tenement areas are used for gardening and subsitence activities but as such in the future will be restricted when the mining commence operations. In addition to that, the land may not be siutable for cultivation compared to before the minining.

11.2.3.2 Impacts on Assets and Income

The survey found that all respondents expect substantial increase in their household incomes from access to employment, availablity of services and oppotunity to maket root crops and vegetables. In addition to that, landowners will benefit from royalty payments as per the surface access agreements.. The mining is expected to improve standard of living and alleviate unemployment and poverty.

11.2.3.3 Influx of workers

The development will attract people from various backgrounds from different provinces in the country and people from other countries that will be recruited to undertake skilled and unskilled jobs. This will result in increase of the localized population and pressure on the natural environment. Those recruited from outside of the mining tenement area will be accommodated at the mining campsite. Such camps create social changes by introducing new people to the area which can bring both positive and negative impacts. Contruction workers not sourced locally may contribute to creating numerous social problems especially for surrounding communities situated within close proximity to the tenement area, particularly potential conflict between outside workers and local communities enhanced by a feeling of competition for scarce resources (much needed employment opportunities). Also, influx of workers from outside could aggravate existing social problems such as alcohol, drug abuse, prostitution, trafficking and extra marital affairs. An influx of people with disposable income might lead to an increase in prostitution, trafficking, extra marital affairs, which can lead to spread of sexually transmitted disease (STDs/HIV-AIDS) and unwanted pregnancies.

The company will prioritise recuitement of all citizens for both skilled and unskilled work. Disagreement might arise when there are influx of workers from outside the tenement.

The developer should ensure and be responsible for to take appropriate measures to ensure that workers comply with local norms and culture. In that regard, the developer should orient workers regarding local norms, values and cultural issues. Also enforce penalties for incompliances by workers.

11.2.3.4 Relocation of Households

Riudede settlement is located within the tenement area and on potential ore site. The settlement has six households and a church with a population of about 25 people. Relocation is uncertain at this stage but a ressettlement plan is expected to be rolled out once it is confirmed. Relocation will include finding a suitable site convenient for the affected households and rebuilding houses at their replacement value.

11.2.3.5 Social Conflicts/Disputes

The nature of the disccusions and consultations with the communities indicated that there are persistent land tenure issues over the tenement area. Social disruption are expected prior to and during the mining between land owning families or between workers and community people. In addition to that, the treatment of workers on site by the company can also lead to disputes. The compnay will provide shelter and will ensure equal wage payments to all workers.

11.2.3.6 Impacts on Community Health

Grievances regarding the mining will be dealt with through the redress grievances mechanism described in chapter 10. Impact on nearby community will be from the noise and vibration which are considered to be very minimal. Other risks including spread of diseases (HIV/AIDs, COVID 19, Hepatitis, Gonorrhoea, Syphilis etc) and malaria between the construction team and the residential population are deemed minor or negligible. The contractor will need to provide first aid kits, safety equipment for workers and provision for taking the victim to hospital. The contractor will be responsible for providing adequate knowledge to construction workers and public in relation to safety issues. Alcohol consumption and inappropriate behavior by the workers or public will be dealt with by the company including the police if it's beyond the control of the company's management. Any issue related to the mining will be addressed through the GRM process. Mitigation measures include:

- Contractor to ensure worker's actions are controlled and code of conduct observed;
- Contactor to discipline workers who do not respect the code of conduct;
- Adhere to relevant SIG regulations including the COVID 19 regulation; and
- Educate workers to respect public properties and other important services.

The developer will maintain proper hygiene and cleanliness in the camp and the surroundings. There should be appropriate awareness program conducted both among the construction workers and among local people regarding COVID 19, STD, HIV and AIDS. Recruitment process should ensure workers having a clean medical record and are properly orientated. Included that, contraceptives are provided on site camps that can be easily accessed by both workers and local community people.

11.2.3.7 Increase in Traffic and Impact on Access

The road networks including hauling routes intersects bush tracks and roads. The mining activities will cause temporary impacts, including minor disruptions to people and traffic using local access especially during hauling of ores. Mitigation of impacts on access will include:

- Advance notice to public and especially to affected road users on disruption to access due to the construction will be put up at designated sites (e.g. Community halls, shops and canteens).
- Care must be taken during the construction and operation period to ensure disruptions to access and traffic are minimized;
- Signage and other appropriate safety features will be used to indicate construction works are being undertaken; and
- Contractor will ensure access roads to private owned land are not disturbed.

11.2.3.8 Community and Cultural Impacts

Since there will be recruitment of workers, both skilled and unskilled workers from villages surrounding the tenement area and other communities including other provinces in the country and expatriates. It is expected that people from outside may not be familiar with the local culture and community norms or even identify sensitive areas of cultural or traditional significance. Such may result in impacts on the cultural beliefs or norms of the local communities.

11.2.4 Rehabilitation Plan

A mine rehabilitation plan is in progress which will detail methods of rehabilitation and responsibilities. Mine rehabilitation normally involves the (1) development of designs for appropriate landforms for the mine site, (2) creation of landforms (landscaping) that will behave and evolve in a predictable manner, and (3) establishment of appropriate sustainable ecosystems on these landforms. A rehabilitation study of the adjacent tenement by Tsumitomo indicates natural revegetation and the use of local species proven as viable methods. SIRC will develop its mine rehabilitation plan as part the detail EMP at the mining stage. SIRC rehabilitation strategy will include:

- Top Soil Management (recovery and reapplication);
- Establishing a natural vegetation community (natural revegetation and Enrichments plantings);
- Agro-forestry systems;
- Establishment of a nursery; and
- Conserve patches of forests.

SIRC had constructed a nursery house and commence the nursery of local plant seedlings. The seedlings are mainly tubi and pine species. It is an evidence of commitment to rehabilitate affected areas, however will need the rehabilitation plan to manage this operation.

Figure 77: Plant Nursery, Suma camp, Isabel.

11.3 Decommissioning Impacts

11.3.1 Waste Impacts

Decommissioning or closure of the mining has always been a challenge for many companies Worldwide because of the waste associated. Decommissioning will result in numerous waste and recycled materials including stockpile materials, oil and fuel, batteries, steel, to name a few. At the mine closure, campsites and associated facilities can be dismantled using minimal impact approach and recycled or disposed of safely. SIRC will ensure waste due to the mine closure does not eventuate into negative impacts. Relevant authorities including ECD and MD will inspect tenement area at the mine closure to ensure no impacts remain or generated due to decommissioning. Decommissioning will require a separate EIS.

11.3.2 Storage sites

The scope of the current mine is to extract and export the ore. So there is no need for storage unless it requires the company do so. All wastes whether is it is solid, liquid or gas stored at any location in the tenement will be removed by SIRC in the first instance during operation. The SIRC Company will make arrangement for recycling with oversea companies together with ECD when the need arises. The storage site will have concreate platform, weather proof roofs and secure. The company is liable for any storage onsite including any impacts that may arise due to the storage.

11.3.3 Access and Mobility

During decommissioning, access and mobility at the tenement area will be impacted, however minor. The company will agree work schedule with the community before decommissioning activities commences.

11.3.4 Infrastructures

All infrastructures including wharf, road and houses to certain extend will eventually be handed over to the SIG and landowners.

11.3.5 Rehabilitation

All ore pockets and sites exposed will be rehabilitated with local and economical tree species.

11.4 Cumulative impacts

This part of Isabel has experienced the environment and social impacts of logging and prospecting. Some are currently in operation to this present time. Five kilometers west in the Takata bay is a logging company. Three companies were granted prospecting license for the current tenement in the past years. These operations including subsistence activities and establishing new settlements have caused degradation to the environment and furthermore social disruptions due to grievances between families and tribes. The company will ensure its mining activities does not eventuate into negative impacts that will enhance existing environment and social issues at the MIA.

Activities that contributes to cumulative impacts includes:

- Logging;
- Prospecting activities;
- Subsistence farming activities;
- New settlements.

11.4.1 Methodology for Cumulative Impacts

The methodology used for assessing the cumulative impacts are based on IFC Good Practice Handbook Cumulative Impact Assessment and Management: Guidance for the Private

Sector in Emerging Markets. A rapid assessment was conducted based on the guideline and processes listed below:

- Selection of special boundaries: Establish the geographic scope of the potential cumulative impacts or the mining area of influence. These include the rivers, settlements, location of subsistence activities including adjacent developments such as logging, log port and prospecting activities.
- Selection of valued environmental components (VEC): Based on the EIS, select the VECs and evaluate the cumulative impacts. These includes vegetation, water quality, flora and fauna, and economic activity.
- Assess cumulative impacts: Assess the magnitude of the cumulative impacts of selected VEC.
- Assess significant of cumulative impacts: The significance of cumulative impacts was qualitatively assessed in five categories: null, positive (+), highly positive (++), negative (-), and highly negative (- -).
- Develop management measures: Develop specific management actions to minimize the cumulative impacts.

11.4.2 Assessment findings

11.4.2.1 Vegetation removal

The vegetation in the MIA can be regarded as fragmented due to settlement patterns, prospecting, logging and subsistence activities, though several locations especially in the valleys remain intact. The mining operation will involve excavation works and digging which means vegetation will be cleared.

VEC	Criteria Rating	Criteria rating rational
Vegetation	Impact Balance: Significance.	Vegetation will be cleared during operations. Management measures will be in place to minimize any impacts.
	Spatial Boundary: Project area	Impact is expected to occur soil pockets, roads, stockpile areas, camp and port.

	Magnitude: Moderate	Not all vegetation will be removed. Unnecessary removal of vegetation will be avoided.
	Significance: Negative and significant.	Habitats will be degraded.

11.4.2.2 Water and Sediment Quality

As noted in the chapter six, water and sediment test results indicated water and sediment qualities are impacted to certain extend by both natural and anthropogenic activities. The anthropogenic sources are mainly from subsistence activities and settlement patterns, siltation due to logging and prospecting. Nutrients and elements associated with these activities have leached into the soil profile subsequently affecting ground water quality.

VEC	Criteria Rating	Criteria rating rational
Water and Sediment Qualities	Impact Balance: Negative	Water quality is likely to be affected when management measures are not implemented.
	Spatial Boundary: Project area	Impact is expected to occur on surrounding waters bodies, the rivers, coastline and ground water.
	Magnitude: Major	Based on experience to date, water and sediment qualities are expected to degrade.
	Significance: Negative.	Cumulative impacts are expected from the development. Expected to be

		significant when management measures are not implemented.

11.4.2. 3 Flora and fauna

The marine, fresh water and terrestrial surveys showed the diversity of the environment in the project site is lower compared to other sites. A decade ago prior to all the developments, the marine and terrestrial habitats would have had a diverse environment with unique and endemic species.

VEC	Criteria Rating	Criteria rating rational
Flora and fauna	Impact Balance: Significance	As noted above, degradation in water and sediment qualities will also affect species population and distribution. Pouching of animals' increases due to influx of people and population as a result of the development.
	Spatial Boundary: Project area	Impact is expected to occur throughout the project area.
	Magnitude: Moderate	The developer's concept design indicated areas for park, nature reserves and buffer areas.
	Significance: Negative.	The marine environment is the first impression every would know the environment is healthy.

11.4.2.4 Economic Activity

The proposed development will contribute significant revenues directly to the SIG over the life of the development. It is anticipated that a proportion of tax benefits will be used for local social infrastructure and social development such as education, healthcare and among others long term community projects. Not only that, more local people in the area and elsewhere in the country will be employed during the mining operation.

VEC	Criteria Rating	Criteria rating rational
Economic	Impact Balance: Significance	Economic activity expected to improve.
	Spatial Boundary: Project area	Impact is expected to occur throughout the project area.
	Magnitude: High	The development will improve primarily at the project site but will be experienced throughout the country.
	Significance: Positive.	Improvements to economic activity are expected to be positive and significant (+).

Table 46: Cumulative Impacts

Mining	**Logging**	**Prospecting**	**Subsistence farming**	**New settlements**	**Mitigation measures**
Vegetation clearing	Logging requires larger space and vegetated areas to be cleared.	Survey and prospecting activities requires vegetation clearance.	Subsistence farming activities/shifting cultivation led to clearance of grasslands and riverine vegetation.	In recent years, people migration to inland areas has resulted in felling of trees and vegetation to build homes and settlements.	Rehabilitate mined sites with local species.

Water and soil quality impacts	Siltation/sedimentation from soil exposure caused degradation to water and soil qualities.	Siltation/sedimentation from soil exposure caused degradation to water and soil qualities.	Siltation/sedimentation from soil exposure caused degradation to water and soil qualities.	Siltation/sedimentation from soil exposure caused degradation to water and soil qualities.	Use of engineering practices that minimizes silt e.g. sediment settling ponds and sediment traps.
Disturbance to flora and fauna	Vegetation clearance causing degradation to precious habitats.	Vegetation clearance causing degradation to precious habitats.	Vegetation clearance causing degradation to precious habitats.	Vegetation clearance causing degradation to precious habitats.	The project will minimize any impacts that are likely to affect flora and fauna in the area.

Employment	Creation of unskilled and skilled employment.	Creation of unskilled and skilled employment.	Self-employment.	Majority of the homes are semi-permanent. These buildings have had to acquire minimum labor.	Unskilled and skill work may be sourced from the nearby communities.

Accessibility.	Network of roads constructed.	Network of roads constructed.	Increase subsistence activities demands more access.	Increase settlements demands road access.	Existing roads will be upgraded to minimum road standards. But in the event that access will be affected, relevant landowners will be informed including public notices and road signage.

11.5 Environmental Management, Mitigation Monitoring Matrix

Table 47: Environmental Management and Monitoring Matrix

	Impact Management				Impact Monitoring		
Project activities	**Potential Impacts**	**Mitigation approaches**	**Responsibility**	**Mitigation cost**	**Parameter to monitor**	**Means of verification and frequency**	**Responsibility**
CONSTRUCTION PHASE							
Surveying, demarcation, clearing for mining camp set up, stoke plie areas, workshops and offices.	• Felling of forest and coastal plants causing loss to important plant species and or wild life.	• Minimize clearance to relevant areas of activities; • Unnecessary clearance avoided; • Acquire land clearing permit from the Ministry of Forestry if necessary; • Build campsites on existing space provided by and in agreement with the local community; • ***(Biodiversity Management Manual applies).***	• SIRC	• Part of mining cost	Area of vegetation; area of felled trees/vegetation removal	• During survey and activities - visual inspection before, during and after	• SIRC
Mobilisation of SIRC company and presence of	• Poaching of terrestrial and marine fauna, unnecessary	• SIRC company responsible for information and sanctions regarding harm to wildlife	SIRC and ECD	Part of construction cost	Check for poaching and unnecessary vegetation clearance; Progress of re-vegetation of work areas;	Spot inspections; monthly - visual inspection of camp and work sites;	SIRC

construction workers	felling of trees for cooking.	and felling of trees (not requiring to be cleared) • SIRC company to supply sufficient cooking fuel to avoid use of local timber or felling of trees • ***(Biodiversity Management Manual applies)***			Adequate fuel supplies in camp; Training of workers in information	Re-vegetation activities as per EMP; Consultations with villagers and workers	
	• Community exposure to campsites Spread of STIs and HIV/AIDS	• Village protocols discussed. Worker awareness as part of mobilization; • Signage and security at camp i.e. prohibition on unauthorised people (esp. Children and women) entering camp; • Workers to respect village and landowner boundaries • STIs and HIV/AIDS awareness program for workers and villages; • A communications and complaints plan will be used for liaison and correction among stakeholders; • SIRC company to provide health facilities and First Aid post in camps and provide safety equipment for workers; • ***(Health and Safety Manuals applies).***	SIRC and ECD, MHMS	Part of Construction cost	STI/HIV/AIDS prevalence Increased awareness about transmission and prevention	Prior to construction - check SIRC company records, consultation with employees, discussions with NGO	SIRC and ECD, MHMS

	• Increase social disruptions	• SIRC company to ensure worker's actions are controlled and village rules, code of conduct observed; • Educate workers to respect village protocols; • Such that if the situation is beyond the capacity of the community leaders, police will be informed to investigate problem.	SIRC and ECD, RSIPF	Part of construction cost	Complaints of incidents between workers and villagers; No. of children & WOMEN entering camp; Number and effectiveness of signs	During activities - checking records for complaints, consultation with workers about protocols; Issues raised with CLO or ESO	SIRC and ECD, RSIPF
	• Generation of Solid and Sanitary waste impacting coastal and water quality	• Collect and dispose of solid waste regularly at designated dump site; • Install waste collection and temporary storage facilities fully label; • Awareness and educated construction workers on waste management system; • Establish sanitary latrines for workers; • ***(Waste Management Manual applies)***	SIRC and ECD	Part of Construction cost	Waste management - visual inspection that solid waste is disposed of as per EMP; Provision of sanitary facilities; No direct discharges to local streams or rivers; Regularity of waste removal	Monthly, as required and spot checks - visual inspection; Review of waste management manual	SIRC
Operation of construction machinery generating emissions	• Emission of exhaust from vehicles and machinery	• Maintain construction equipment; • Prohibit use of equipment that causes excessive pollution (e.g. generates smoke); • ***(Traffic Management Manual applies).***	• SIRC	• Inc. in construction cost	• Air quality, emissions,	• Weekly or after complaint - periodic visual inspection; • Any particulate matter and smoke	• SIRC

	• Dust caused by vehicles running at high velocity	• Thorough watering to avoid dust.	• SIRC	• Inc. in construction cost	• dust, particulate matter; • Use of tarpaulins and loading of vehicles; • Stockpiles.	• Weekly or after complaint - periodic visual inspection	• SIRC
Operation of construction machinery creating noise	• Noise to communities (Riudede)	• Construction machine exhaust systems and noisy equipment will be maintained to minimise noise; • SIRC will develop a schedule of operations with village chiefs to identify days of no work and hours for certain activities; • Limit noisy construction activities to day time hours, i.e. construction activities prohibited between 9pm and 6am; • ***(Health and safety manual applies).***	• SIRC	• Inc. in construction cost	• Adherence to agreed schedule; • Complaints (no. logged with resolution).	• Weekly or after complaint - review schedule • Consultation (ensure schedule being adhered to)	• SIRC • ECD
	• Impacts on construction workers	• Workers limit of exposure to noise will be strictly below 70decibels per 8 hour shift; • Provide workers with noise abatement equipment (ear-muffs etc); • Complaints will be addressed by SIRC company; • Workers strictly abide the relevant SIG regulations e.g. COVID regulations.	• SIRC	• Inc. in construction cost	• Workers safety equipment.	• Weekly • Workers are provided with safety equipment	• SIRC • ECD

		• ***(Health and safety manual applies).***					
Stockpile of Construction Materials or Soil	• Construction materials washed out into coast or water bodies.	• Construction materials will be stockpiled 20m away from coastline or water bodies; • Stockpile areas properly bunded; • Placement of diversion ditches around stockpiles; • ***(Erosion management Manual applies).***	• SIRC	• Inc. in construct ion cost	• No stockpiling close to water bodies.	• Weekly-Visual Inspection	• SIRC • ECD
	• Dust from exposed stockpiles	• Material stockpiles located in sheltered areas and to be covered	• SIRC	• Inc. in constructi on cost	• dust, particulate matter; • Stockpile covered.	• Weekly or after complaint - periodic visual inspection	• SIRC
Construction of causeway-wharf, cut and fill activities for the road and stockpile areas, quarrying and construction of campsite/offices.	• Changes to coastal processes as a result of wharf construction.	• Coastal protection to avoid littoral drift effects; • Avoid tipping soil; • Construction works undertaken with extreme care.	• SIRC	• Inc. in constructi on cost	• Erosion	• Weekly	• SIRC
	• Silt generation	• Construction works especially at the coast or rivers to be undertaken with extreme care; • Use of silt control devices and sediment traps/fences Construction of sediment settling ponds and bunds. Diverting turbid water to sediment settling ponds; • ***(health and safety manual applies) &***	• SIRC	• Include in construct ion cost	• Reduced soil erosion and sedimentation • Vegetation clearance minimized • No dump sites near waterways	• Weekly - visual inspection •	• SIRC and ECD

		(health and safety manual applies)& Surface and ground water manuals					
	• Accidental release of hydrocarbon from construction machines impacting soil and water and frequent machine exposure to sea or water releases hydrocarbons	• Ensure all construction machines are well maintained; • A prestart on construction machine carried out every morning; • Oil/fuel remediation agents, oil pads, oil booms and geo-fabric clothes are ready for usage as ***per emergency response plan;*** • ***(Hazardous material management manual).***	• SIRC	• Include in construction cost	• Construction machineries maintain in good working order • Spot check for visible oil • Water quality	• Weekly - visual inspection	• SIRC and ECD
	• Direct discharge to adjacent creeks or streams	• Development footprint will be provided with effective drainage systems which will avoid direct discharge to creeks or streams	• SIRC	• Include in construction cost	• No direct discharge to water bodies	• Weekly - visual •	• SIRC and ECD
	• Access and Mobility restricted	• SIRC Company to allow areas within the tenement to be continuously accessed by affected communities and public.	• SIRC •	• Include in construction cost	• Maintenance of access; • Signage; • Road free of materials and debris; • Haulage routes rehabilitated	• During activities - Visual inspection; • Consultations; • Review of traffic management plan	• SIRC and ECD

	• Barrow pits exposed water table	• Avoid Barrow pits exposing water table • Barrow pit immediately covered when water tables are exposed	• SIRC	• Inc in cont cost	Barrow pits	• Weekly	• SIRC
Fuelling construction machines and storage of Hydrocarbons	• Hydrocarbon leakage / spills from construction camps / workshops	• ***Detailed Emergency Response Plan*** (as part of EMP) prepared by SIRC company to cover hazardous materials/oil storage, spills and accidents; • Chemicals will be stored in secure containers 20m away from the coastline; • Chemicals stored in area or compound with concrete floor and weatherproof roof and fire extinguishers; • Spills will be cleaned up as per emergency response plan;	• SIRC	• Include in construct ion cost	• Ensure storage sites are using existing concrete base;	• Weekly inspection	• SIRC and ECD

		• Ensure all construction machines are well maintained; • Accidents reported to police and MMERE and MECDM within 24 hours; • ***(Hazardous material management manual)***					
	• Smoking near storage and workshop areas causing fire.	• Prohibit smoking close to fuel storage areas; • Put up signs of no go smoking zones; • Provide extinguishers and train workers on their use; • ***(Health and Safety Manuals applies).***	• SIRC	• Include in construct ion cost	• Signs and fire extinguishes	• Code of conduct and housekeeping rules being adhered to. • Verify records of accidents	• SIRC and ECD
OPERATION PHASE							
Encroachment into precious ecology	• Workers poach animals • Protected areas affected	• SIRC Company responsible for information and sanctions regarding harm to wildlife. • ***(Biodiversity Management Manual)***	• SIRC and ECD	• Part of operatio nal cost	• Check for unnecessary vegetation clearance; • Progress of re-vegetation of work areas; • Adequate fuel supplies in camp; • Training of workers in information	• Monthly	• SIRC and ECD
	• Runoffs carrying turbid water impacting corals and aquatic organisms	• Use of silt control devices and sediment traps/fences including Construction of embankments and replanting to avoid direct runoffs;	• SIRC and ECD	• Part of operatio nal cost	• Water quality along coast and water bodies; • Suspended solids from road or areas of erosion, if identified	• Monthly or after complaint - periodic visual inspection	• SIRC and ECD

		• ***(Biodiversity Management Manual)&*** (***Erosion management Manual applies) & Surface and ground water manuals.***			• Visual inspection- signs of stress to corals • • Water quality samplings and testing including field parameters		
	• Impact on terrestrial habitats	• SIRC company responsible for information and sanctions regarding felling of trees (not requiring to be cleared); • Provision for plant collection and plant nursery to be later used in the rehabilitation work; • ***(Biodiversity Management Manual).***	SIRC and ECD	• Part of operatio nal cost	• Check for unnecessary vegetation clearance; • Progress of re-vegetation of work areas; • Adequate fuel supplies in camp; • Training of workers in information	• Monthly	• SIRC and ECD
Encroachment into archaeological and cultural sites	• Damage to archaeological and cultural sites	• The mining is not going to impact any cultural or archaeological sites; • Such that during the operation a site is accidently exposed, clearing will be stopped and National Museum officers will be informed to assess site.	SIRC and ECD	Part of operational cost	Check for Complaints	Monthly	SIRC and ECD

Presence of mining workers	• Public are exposed to sexual exploitation in camps	• Village protocols discussed. Worker awareness as part of mobilization; • Signage and security at camp i.e. prohibition on unauthorised people (esp. children) entering camp; • Workers to respect village and landowner boundaries; • STIs and HIV/AIDS awareness program for workers and villages; • A communications and complaints plan will be used for liaison and correction among stakeholders; • SIRC Company to provide health facilities in camps and provide safety equipment for workers.	SIRC and ECD	Part of operational cost	STI/HIV/AIDS prevalence Increased awareness about transmission and prevention	Prior to construction - check SIRC company records, consultation with employees, discussions with NGO	SIRC and ECD
	• Waste generated at campsites and operational sites causing nuisance and potential contamination to coastal waters and or ground water.	• Septic tanks and garbage receptacles will be set up at construction camp sites which will be regularly cleared by the SIRC company; • SIRC company to prepare waste management manual as part of EMP; • All wastes from work sites and camps to be	SIRC and ECD	• Part of operational cost	Waste management - visual inspection that solid waste is disposed of as per EMP; Provision of sanitary facilities; No direct discharges to local streams or rivers; Regularity of waste removal	Monthly, as required and spot checks - visual inspection; Review of waste management plan	SIRC and ECD

		disposed of in approved landfill / areas; • SIRC company will provide sufficient training in appropriate waste disposal methods; • ***Waste Management Manual (Hazardous material management manual).***					
		• No wastes to be dumped in waterways or close to the coast; • SIRC company ensures wastes not discharged to rivers or coastal waters and that all wastes disposed of in proper areas; • Construction camps will have sanitary latrines; • SIRC company to provide adequate and safe drinking water in camp; • SIRC Company will provide sufficient training in appropriate waste disposal methods.	•	•	•	•	•
	• Possibility of conflicts or antagonism between residents and SIRC Company.	• Facilitate reconciliation between parties- Chiefs, SIRC Company and ECD to involve in resolving the issue.	• SIRC and ECD	• Operatio nal cost	• Construction workers to be drawn from the communities • Important to involve community chiefs through all the project phase	• Monthly and when conflict arises	• SIRC and ECD

Mining, quarrying, stockpile of ore and waste rocks/soils, , transporting and loading ore.	• Siltation to water bodies/Stockpile materials washed out to adjacent water bodies.	• Mining works especially near coast or rivers to be undertaken with extreme care; • Use of silt control devices and sediment traps/fences and sediment settling ponds; • Water quality monitoring undertaken regularly for compliance levels ***(Surface and Ground water operating manuals).***	• SIRC and ECD	• Part of operational cost	Water quality in streams, rivers and coast; Suspended solids from road or areas of erosion, if identified • Visual inspection-effectiveness of drainage system	Monthly or after complaint - periodic visual inspection	SIRC and ECD
	• Increase in acid drainage from in appropriate management of waste rock/soil and top soil	• Manage waste rock site in such as a way the acidity are kept at reasonably levels; • (***Waste Rock/Soil Management Manual as part of the EMP).***	• SIRC and ECD	• Part of operational cost	Water quality in streams, rivers and coast; Suspended solids from road or areas of erosion, if identified • Visual inspection-effectiveness of drainage system	Monthly or after complaint - periodic visual inspection	SIRC and ECD
	• Accidental spills associated with loading of the ores	• Workers are trained in SOPs for loading of ores; • Avoid loading during bad weather; • Acquire weather forecast of the site 2 months before loading; • SIRC will develop an emergency response plan to manage any accidents; • SIRC will procure relevant materials to ensure readiness during spills.	• SIRC	• Part of operational cost	• Workers are trained in loading SOPs and emergency procedures	• Daily inspection	• SIRC

Fueling mining machineries and storage of Hydrocarbons	• Hydrocarbon leakage / spills from construction camps / workshops/operational sites	• ***Detailed Emergency Response Plan (as part of EMP***) prepared by SIRC company to cover hazardous materials/oil storage, spills and accidents; • Chemicals will be stored in secure containers away from the rivers and coastline; • Chemicals stored in area or compound with concrete floor and weatherproof roof and fire extinguishers; • Spills will be cleaned up as per emergency response plan; • Ensure all construction machines are well maintained; • Accidents reported to police and ECD within 24 hours; • ***(Hazardous material management manual).***	SIRC and ECD	Part of operational cost	EMP and emergency response plan; Ensure storage sites are using existing concrete base; Spills cleaned and area rehabilitated	Monthly or after event or as required - review and approval of emergency response plan; Visual Inspection of storage facilities;	SIRC and ECD
Waste Management	• Waste generated at campsites, offices, and operational site causing nuisance to public and villages.	• Septic tanks and garbage receptacles will be set up at operational camp sites, which will be regularly cleared by the SIRC company; • Construction camps will have sanitary latrines;	SIRC and ECD	Part of Construction cost •	Waste management - visual inspection that solid waste is disposed of as per EMP; Provision of sanitary facilities; No direct discharges to local streams or rivers; Regularity of waste removal	Monthly, as required and spot checks - visual inspection; Review of waste management plan	SIRC and ECD

		• SIRC company ensures wastes not discharged to rivers or coastal waters and that all wastes; disposed of in proper areas • SIRC company to provide adequate and safe drinking water in camp; • SIRC company to prepare waste management plan (as part of EMP); • All wastes from work sites and camps to be disposed of in approved landfill / areas; • SIRC company will provide sufficient training in appropriate waste disposal methods; • ***Waste Management Manual.***					
Operation of construction machinery generating emissions	• Emission of exhaust from vehicles and machinery	• Maintain construction equipment; • Prohibit use of equipment that causes excessive pollution (e.g. generates smoke); • ***Air quality management manual.***	SIRC and ECD	Part of operational cost	Air quality, emissions,	Monthly or after complaint - periodic visual inspection; Any particulate matter and smoke managed as per EMP	SIRC and ECD
	• Dust caused by vehicles running at high velocity	• Thorough watering to avoid dust.	SIRC and ECD	Part of operational cost	Air quality, dust, particulate matter; Use of tarpaulins and loading of vehicles; Stockpiles	Monthly or after complaint - periodic visual inspection; Any particulate matter and smoke managed as per EMP	SIRC and ECD

Operation of machinery creating noise	• Noise to communities	• Construction machine exhaust systems and noisy equipment will be maintained to minimise noise; • SIRC company will develop a schedule of operations with village chiefs and Engineer to identify days of no work and hours for certain activities; • Limit noisy construction activities to day time hours, i.e. construction activities prohibited between 9pm and 6am.	SIRC and ECD	Part of operational cost	Adherence to agreed schedule; Complaints (no. logged with resolution); Workers safety equipment	Monthly or after complaint - review schedule Consultation (ensure schedule being adhered to)	SIRC and ECD
	• Impacts on construction workers	• Workers limit of exposure to noise will be strictly below 70 decibels per 8 hour shift; • Provide workers with noise abatement equipment (ear-muffs etc.); • Complaints will be addressed by SIRC Company.	SIRC and ECD	Operational cost	Visual inspection – construction workers worn safety abatement equipment (ear-muffs etc Consultation with workers if safety standards have been provided	Monthly or after complaint - review schedule Consultation (ensure schedule being adhered to)	SIRC and ECD
DECOMMISSIONING IMPACTS							

Waste	• Decommissioning will result in numerous waste and recycled materials including stockpile materials, oil and fuel, batteries, steel, to name a few	• At the mine closure, campsites and associated facilities can be dismantled using minimal impact approach and recycled or disposed of safely. SIRC will ensure waste due to the mine closure does not eventuate into negative impacts. Relevant authorities including ECD and MD will inspect tenement area at the mine closure to ensure no impacts remain or generated due to decommissioning	• SIRC,	• Decommissioning cost	• No waste remain at the site	Decommission stage	SIRC and MECDM, MMERE
Storage	• The scope of the current mine is to extract and export the ore. So there is no need for storage unless it requires the company do so.	• All wastes whether is it is solid, liquid or gas stored at any location in the tenement will be removed by SIRC in the first instance during operation. The SIRC Company will make arrangement for recycling with oversea companies together with ECD once it is necessary. The storage site will have concreate platform, weather proof roofs and secure. The company is liable for any storage onsite including any impacts that may arise due to the storage.	• SIRC,	• Decommissioning cost	• No waste remain at the site	Decommission stage	SIRC and MECDM, MMERE

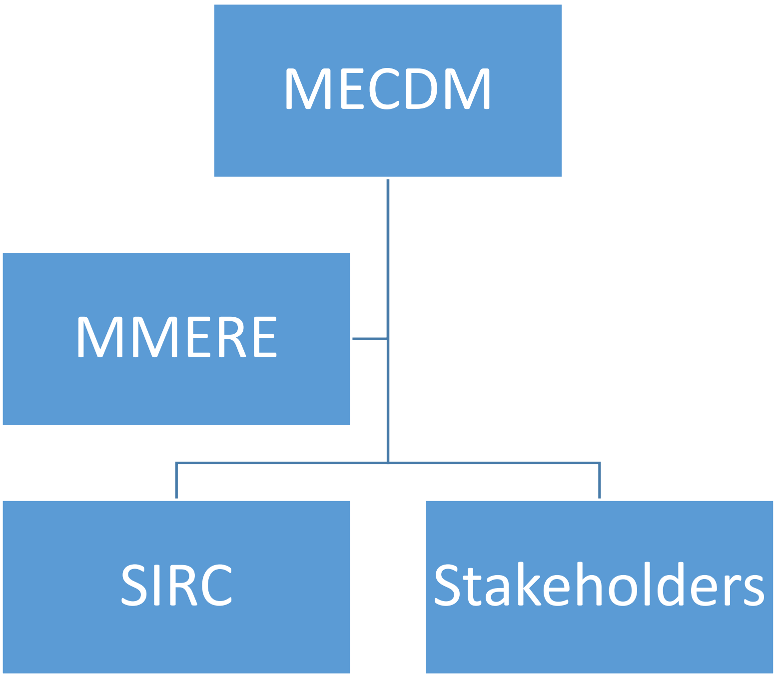
Access and Mobility	• Disruption due access	• The company will agree work schedule with the community before decommissioning activities commences.	• SIRC,	• Decommissioning cost	• No waste remain at the site	Decommission stage	SIRC and MECDM, MMERE
Decommissioning causing exposure of soil surfaces	• Erosion due to exposure of soil	• All ore pockets and sites exposed will be rehabilitated with local indigenous and economical trees. •	• SIRC,	• Decommissioning cost	• No waste remain at the site	Decommission stage	SIRC and MECDM, MMERE

11.6 Institutional Arrangement

This section identifies mitigation and management measures to avoid, reduce, mitigate or compensate for adverse environmental impacts that have already been identified in the previous sections. The EMP is a management tool and the issues are accordingly addressed with regard to the sequence of operations. A summary of the EMP is in Table 47.

The overall organizational structure for environmental management for the project is shown in Figure 78 below.

Figure 78: Organizational Structure for Environmental Management



11.6.1 SIRC Company

The overall management of all monitoring tasks comes under the SIRC Company. This covers all aspects of the required activities including coordination with other agencies that have national responsibilities over some of the tasks. The company is responsible for general mining operations and with day-to-day project management activities, as well as monitoring. As required, SIRC Company will be responsible for compliance monitoring during construction and operation of the mining. The ECD will also be responsible for verifying the monitoring undertaken by the SIRC Company through audits and spot-checks. The outcomes of the monitoring will be included in the overall monthly progress reports to be submitted by SIRC Company to ECD and MD.

The SIRC Company will be responsible for updating the EMP at construction stage and during implementation, whenever additional engineering information is available. SIRC Company will also develop an Emergency Response Plan including other important manuals as part of their updated EMP. SIRC will recruit two environmental safety officer (ESO), one safety officer and two community relation officers whose responsibilities will include:

- Coordinating with ECD for updating the EMP;
- Develop SIRC Environment Management Manuals (Refer to EMP);
- Participating in monitoring with ECD to ensure that environmental management activities are reported as required;
- Provide HIV/AIDS/COVID 19 awareness to surrounding communities and workers;
- Facilitating consultation with the affected stakeholders and ensuring smooth implementation of the project;
- Keep thorough records of grievances and how they were resolved;
- Develop budgets to allow implementation of the EMP and Manuals.

11.6.2 Environment & Conservation Division (ECD)

As the national agency responsible for environment and conservation, the ECD will need to be involved in the various aspects of the environmental management activities. Under the requirements of the Environment Act 1998, the ECD will need to review the EIS and monitor the progress of implementation activities if consent is given. The ECD has been fully informed of the status of the project and also awaits the submission of the EIS.

The ECD will need to be consulted during the construction and operational phase of the mining to ensure that all monitoring requirements are adhered to. The ECD will be tasked also to assist in auditing the implementation and compliance to the EMP.

11.6.3 Ministry of Mines, Energy and Rural Electrification

The Mines Division (MD) is responsible for issuing Prospecting or Mining license through the mines and minerals board which meet once a months. **SIRC Company** will submit mining application as a condition to the Mines and Minerals Act of 2008 regarding mining and sourcing materials. The board will grant the ML after all the conditions in the Act are fully satisfied and that the company had submitted relevant documents that substantiate the condition and need for mining. Following the issuance of license, MD from time to time will monitor the progress of the mining and will ensure the company complies with national and international laws and standard practices.

11.6.4 Ministry of Commerce, Industry, Labor and Immigration

SIRC acquired business license to operate in the Solomon Islands from the MCILI in 2017. Work permits for internationals are also processed by the Ministry. Mining workers both local and international are covered under the Labour Act and Safety at Work Act of the Solomon Islands. These two important acts under MCILI governs the management labour and to the extent provision for safety of all workers.

10.6.5 Ministry of Finance

The MoF will ensure SIRC does pay relevant tax and fees to the SIG including PAYE, vehicle fees, export and import duties. The MoF, central bank and MD will ensure the process and transaction are carefully checked and monitored.

11.6.6 Isabel Provincial

The Isabel provincial administration is responsible for issuing provincial business license to companies. SIRC has acquired the provincial license at the PL stage, however a new application will be required for mining operations. The provincial administration's roles include monitoring and ensuring SIRC comply with the provincial ordinances.

11.6.7 Communities

The impact of the mining will affect landowners and nearby communities. Landowners and nearby communities will need to be consulted and involved in the environmental social management activities for the mining. Village leaders and organizations will assist in arranging meetings with, facilitating consultation with, and providing information about, affected communities and environmental social impacts. An account of the process will be an integral part of the internal monitoring report prepared by SIRC.

The company will need to establish a community relations department whose roles will include liaison between the ECD, MMEMRE, MLHS, Isabel provincial administration and the communities to ensure compliance and transparency.

11.7 Grievances Redress Mechanism

During the course of the project, it is possible that people may have concerns with the project's environmental performance including the implementation of the EMP. Issues may occur during construction and again during operation. Any concerns will need to be addressed quickly and transparently, and without retribution to the affected person (AP)[23].

The following process is to be used and commences with an attempt to sort out the problem directly at project level. If this cannot be resolved, then the grievance will be addressed by being referred to the Environment and Conservation Division (ECD) within the Ministry of Environment Conservation and Meteorology (MECDM).

11.7.1 During construction

Most complaints arising during construction are expected to be complaints concerning dust, health &safety implications, siltation and noise that should be able to be resolved quite easily. All complaints arriving at the Site Office are to be entered in a Register that is kept at the site by: date, name, contact address and reason for the complaint. A duplicate copy of the entry is given to the AP for their record at the time of registering the complaint. The Register will show who has been directed to deal with the complaint and the date when this was made together with the date when the AP was informed of the decision and how the decision was conveyed to the AP. The Register is then signed off by the person who is responsible for the decision and dated. The Register is to be kept at the front desk of the **SIRC Company Public relation's office** and is a public document. The duplicate copy given to the AP will also show the procedure that will be followed in assessing the complaint, together with a statement affirming the rights of the AP to make a complaint. For anybody making a complaint, no costs will be charged to the AP.

Affected People are in the first place to discuss their complaint directly with the company's ESO. For straightforward complaints, the ESO can make an on-the-spot determination to resolve the issue.

[23] *Affected Person (AP) refers to anyone affected by the development, can be an organization or government agency.*

For more complicated complaints, the ESO will forward the complaint to the **SIRC Company** Management. The **SIRC Company** Management has a maximum of five days to resolve the complaint and convey a decision to the AP. The AP may if so desired, discuss the complaint directly with the **SIRC Company** Management. If the complaint of the AP is dismissed, the AP will be informed of their rights in taking it to the next step. A copy of the decision is to be sent to the ECD.

Should the AP not be satisfied, the AP may take the complaint to the Permanent Secretary (PS) in the MECDM and MMERE to review the complain. The PS will have 30 days to make a determination.

11.7.2 During Operation

During operation, the same conditions apply; i.e., there are no fees attached to the AP for making a complaint, the complainant is free to make the complaint which will be treated in a transparent manner.

11.8 Consultation and Disclosure

The EIS documenting the mitigation measures and consultation process will be submitted to MECDM and will be available for public review. Further consultation and disclosure will be carried out prior to and during the construction and operation through:

- The preparation and dissemination of a brochure in English and Pidgin (and other languages as required), explaining the mining, works required and anticipated timing of the works;
- **SIRC Company** will be responsible for managing the grievance redress program during the construction, operation and decommissioning; and
- Information regarding the approved mining and the proposed environmental social management measures will be posted at suitable locations at the tenement area or.

The **SIRC Company** Report will be available to the public from **SIRC Company and ECD** upon request.

11.9 Environment Monitoring and Reporting

Monitoring is a component of impact assessment purposely to combat uncertainties pertaining to unanticipated impacts, to ensure mitigation measures are working and to reassure public on the progress of the development. Progressive monitoring must accompany various stages of the project activities (construction and operational phase). The Environmental monitoring plan is based on the potential impacts, significance of the impacts and mitigation approaches identified during the screening. It comprises of parameters to be monitored, frequencies and responsible authorities as per impact. **SIRC Company** will require preparing a detail environment monitoring plan based on chapter five. ECD is responsible for monitoring compliance, review **SIRC Company** monthly monitoring report and suggest ways to improve or strengthen mitigation approaches.

The ECD are required to:

- Co-ordinate compliance monitoring programs; and
- Review **SIRC Company** monthly monitoring report and suggest ways to strengthen mitigation approaches.

Table 48: Responsibilities for Environmental Management & Monitoring

Project Stage	Responsible Organization	Responsibilities
Feasibility studies and appointment	**SIRC Company**	Prepare EIS including overall EMP (Table 47) Concept mine plans
Feasibility studies and project review and approval	ECD and **SIRC Company**	Review and approval of EIS including overall EMP (Table 47) Review all feasibility study documentation, prepare Board presentation and submit to Steering Committee (as required) Provide inputs to monitoring requirements
Detailed Design	**SIRC Company**	Prepare detailed design and specification Submit design to ECD MME for approval Update EMP based on specifics of detailed design Submit EMP to ECD for review and approval Preparation of Environment Management Manuals.
Construction and Operation	**SIRC Company**	Implementation of EMP Supervise implementation of EMP Audit construction phase through environmental inspections and review monitoring data Submission of monthly reports Provision of awareness/training to workers
	MECDM and MMERE	Ensure compliance with Government requirements Review complicated issues arising from the project

11.10 Training

SIRC will carry out environment, health and safety training for all workers before construction commences. The trainings will prepare workers to manage and protect the environment at all cost including safety of public and the construction and operation team.

11.10.1 Environmental and Safety Induction Training

Mandatory all workers attend the Environmental Safety Induction Training. The training covers legislation and regulations, policy, organization structure, duties and responsibilities, mitigation measures, targets in the EIS and housekeeping rules/guidelines. The major topics will include: air pollution control; waste management; vegetation clearance controls, health and safety, handling of hazardous substances, emergency preparedness; and, first aid training.

11.10.2 Environmental and Safety toolbox Talk

In addition to that, all workers will attend the weekly environmental and safety tool box talk. The purpose of the talk is to rectify lesson learnt and re-emphasizing the importance of environment and safety procedures. The Environment Safety Officer will update all workers when a Standard Operating Procedures (SOP) is being developed or reviewed.

11.10.3 Refresher training

There are provision for refresher training on specific topics. These can be done annually depending on the nature of the work and approval from the SIRC management.

11.11 Environment Management Manuals

SIRC will commence developing the manuals listed below as part of the company's detail Environment Management Plan. These manuals will be site specific based on detail engineering designs and scope work. ECD and SIRC will ensure, these manuals are thoroughly reviewed from time to time to ensure they are effective. The list of manuals are as follows:

1. Biodiversity Management Manual.
2. Health and Safety Manual.
3. Waste Management Manual.
4. Traffic Management Manual.
5. Erosion Management Manual
6. Surface and ground water quality Manual.
7. Emergency Response Plan/Manual.
8. Hazardous material Management Manual.
9. Waste Management Manual.
10. Waste Rock/Soil Management Manual.
11. Air quality Management Manual.

12. PUBLIC CONSULTATION AND PARTICIPATION

11.1 Community Consultations

Community consultation and awareness program were conducted in three villages; Lelegia (29th July), Vara (30th July) and Huali (31st July). The attendance list of those that participated in the community consultations are included in the consultation report in appendix 14.3.

Community Chiefs, Church Leaders, women and youth representatives, and general community members living within/neighboring to the three villages attended the consultation. The aim of the community consultation and awareness is to provide project-specific information, identify community issues and concerns as well as information on the potential social, economic and environmental impacts, relating to the mining project. The main issues raised during the consultations are listed below:

- Mining and its effect are not new to people living within the tenement area or the surrounding villages. Communities feel there is a need for coordination among landowning groups. This is important to avoid disputes and social disruptions.
- The SIG need to support land owners understand the mining process and how to safeguard their land and people.
- Provision for job in the surrounding villages should be encouraged and prioritized by the company. The company should provide equal employment opportunities for all and not for landowners' relatives only.
- Communities and landowners strongly highlighted the need to comply with national legislation and community code of conducts.
- It is important the SIG accounts for all minerals extracted from the tenement.
- Rehabilitation of disturbed sites should be given high priority during the operation and at the decommissioning stage of the mine.
- Concern over lack of monitoring and enforcement by relevant authorities has resulted in degradation to water ways and coastal ecosystem in some past developments. Respect for all tambu site is important. In this tenement a tambu site is located at Pireghe that was an old settlement. The mining operations must avoid disturbance to these tambu sites.

The public consultation meeting were well attended by the ordinary people in the communities and landowners. They appreciated the consultation and awareness program and requested the company to continue to show transparency in its operation. Information provided and the issues raised are crucial to the design and implementation of the mining.

11.2 Consultation with Government Agencies

Consultations were carried out to get views, issues and concerns raised by stakeholders. The major stakeholders include the MECDM, MMERE and the Isabel Provincial Government. The outcomes of that process have been integrated into the EIS.

Table 49: Consultation with government agencies

Government Agencies	Names	Comments/Remarks
ECD	Director Joe Horokou	Mining is a prescribed development and requires an EIS. Mining in the Solomon Islands are faced with issues related to lack of compliance to the Environment Management Plan. Lesson learnt following spill in Rennel requires mining companies to play proactive roles in managing mining activities and its impact on the environment.
Isabel Provincial Government	Provincial executives (Premier and executives)	SIRC is required to submit application for business license to the Isabel Province. The province will ensure the company is complied with relevant conditions including provincial ordinances.
MEMRE	Director of Mines	Provide management for mining and mineral prospecting by regulating controls in all mining and prospecting associated activities including alluvial mining. All mining application requires an EIS and development consent.

13. CONCLUSION

SIRC is pursuing a mine proposal after findings of the Takata nickel deposits were considered to be viable. This has increased investment confidence among SIRC shareholders to submit mining application for the tenement. The proposed mining lease area covers an area of approximately 19.7 square kilometer in size currently held under a Prospecting License (PL 02/19).

The proposed mining project will contribute significant revenues directly to the SIG, and provide benefits to local communities through employment, social services, infrastructures and royalties.

The SIG and its legislation allows exploitation of minerals while taking appropriate considerations to the effects on the environment, the human and social welfare of people living on the area. The mines and minerals act is the legislation that governs the way mining operates whilst the environmental act and regulations governs issues that may arise from the environmental social impacts. The MMERE is the agency responsible for the mines and minerals act and MECDM the environment act. Under the Environment Act, mining is a prescribed development, therefore requires an EIS.

This EIS report was developed according to the Solomon Islands Environmental Impact Assessment Guideline. The objective of the study is to establish the baseline information, identifying the potential environmental and social impacts of the mining, and formulate an Environmental Management Plan to minimize and avoid impacts during construction, operation and decommissioning of the mine.

Establishment/operation of campsites, offices, workshops, stockpile, excavations, transportation, loading and unloading of materials have had the potential to cause environmental and social impacts including but not limited to the following:

- Forest clearing with direct effect on flora and fauna.
- Infrastructure constructions causing siltation to river system and coastal areas;
- Handling of diesel and oil spill causing spills to the marine environment and aquatic environments;
- Alterations to landforms from construction earth works with excavations;
- Transportation of heavy machineries infested with invasive species such as African snails and black ship rata- *Rattus rattus*;
- Fragmentation of terrestrial forests leads loss to species diversity;

- Noise pollution from heavy machineries will drive the avifauna away;
- Exhaust from machineries and vehicles pollutes the air;
- Disturbs coral reefs;
- Ballast water from ships a threat to the natural environment.

However, the following mitigations have been proposed to address the likely impacts. They are;

- Close restriction of forest clearance during construction and operations;
- Use of control devises to minimize silt and sedimentation to marine and terrestrial environments.
- A mine rehabilitation plan enabling revegetation of disturbed sites;
- Defining cut and fill profiles in terms of geological conditions to reduce risk of instability;
- SIRC will develop plans including Health and safety, waste management plan, traffic plans, biodiversity manual, erosion and sediment control, emergency response plans as part of the EMP.

The study indicates that there are significant environmental social impacts and the ESMP has described mitigation measures ensuring that all impacts can be mitigated to environmentally friendly levels. No significant flora or fauna will be affected nor will any conservation, cultural or heritage sites will be affected at this stage.

Further management of environmental and social issues requires SIRC to develop Environment Management Manuals and Standard Operating Procedures. This will be site specific as this EIS is a general assumptions of the risks.

There are limitation as discussed in the main report which will require further studies to certain extent. However, this is a decision of the ECD to make and advice SIRC if further study are required. This EIS report will be submitted to ECD for review and approval.

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15. APPENDIX

14.1 Water quality results

Analytical SIBN 734/2013

Solls, Plants and Environmental Analytical and Scientific Supplies Services

Location: Best Buys Building, Ranadi Industrial Estate, Honiara; Postal address: P.O Box R40, Honiara, Solomon Islands, Tel: +677 38585; mobile ph: +677 7487599; email: spc.analytical@gmail.com

WATER QUALITY ANALYSES OF WATER SUPPLY, DOWNSTREAM & WATER SOURCES

Client:
C/o Winston Lapo
SIRL
Honiara

Job No:	*01_19*
No of Samples:	*11*
Date Samples Received:	*14/08/2019*
Date of Issue:	*19/08/2019*

No.	Sample ID	Nitrate (N)	Nitrate (NO_3)	Phosphate (P)	Phosphate (PO_4)	Potassium (K)	Sulphate (SO_4^{2-})	TSS
		mg/L	mg/L	mg/L	mg/L	mg/L	Mg/L	mg/L
1	WS 01	0.20	0.89	0.12	0.37	2.2	1.0	10
2	WS 02	0.22	0.97	0.08	0.24	2.5	0.0	20
3	WS 03	0.34	1.51	0.11	0.34	1.0	1.0	10
4	WS 04	0.30	1.33	0.12	0.37	0.6	1.0	10
5	WS 05	0.36	1.59	0.13	0.40	1.2	6.0	30
6	WS 06	0.21	0.93	0.04	0.12	0.8	0.0	20
7	WS 07	0.20	0.89	0.07	0.21	2.0	5.0	20
8	WS 08	0.39	1.73	0.01	0.03	0.3	0.0	10
9	WS 09	0.25	1.11	0.03	0.09	0.6	0.0	10
10	WS 10	0.31	1.37	0.06	0.18	7.0	71	30
11	WS 11	0.40	1.77	0.12	0.37	0.5	11	20

Analysed by: Annie Apusae (Lab Technologist, SPE)

Authorised & Approved By: Dr Shane Tutua Signature

National Public Health Laboratory (NPHL)
P.O. Box 349, Honiara, Solomon Islands.
Telephone: (+677) 38871

Test Report No. MTR 87/19 Date of Issue: 14/08/2019 Page **1** of **1**

MICROBIOLOGY TEST REPORT

Customer: SIRC – Winston Lapo
Address: SIRC

Sample Type: Raw water

Date/time received: 13/08/2019, 1:00 pm

Sample No.	Date/time collected	Sample description	Analysis	Result	Units	Method
19-750	11/8/19	W/S 01	Total coliforms	>2420	MPN/100 mL	Colilert-18: APHA (online) 9223 B
			E. coli	**47**	MPN/100 mL	
19-751	11/8/19	W/S 02	Total coliforms	770	MPN/100 mL	Colilert-18: APHA (online) 9223 B
			E. coli	**33**	MPN/100 mL	
19-752	11/8/19	W/S 03 - Pireghu	Total coliforms	>2420	MPN/100 mL	Colilert-18: APHA (online) 9223 B
			E. coli	**186**	MPN/100 mL	
19-753	11/8/19	W/S 06 - Beahutu	Total coliforms	>2420	MPN/100 mL	Colilert-18: APHA (online) 9223 B
			E. coli	**11**	MPN/100 mL	
19-754	11/8/19	W/S 07 - Kolosori	Total coliforms	91	MPN/100 mL	Colilert-18: APHA (online) 9223 B
			E. coli	<1	MPN/100 mL	
19-755	11/8/19	W/S 08 - Hugevi	Total coliforms	>2420	MPN/100 mL	Colilert-18: APHA (online) 9223 B
			E. coli	**23**	MPN/100 mL	
19-756	11/8/19	W/S 09 – Camp water	Total coliforms	3	MPN/100 mL	Colilert-18: APHA (online) 9223 B
			E. coli	<1	MPN/100 mL	

Results apply to samples as received

P/A = Presence/Absence in 100 mL water
MPN/100 mL = Most Probable Number per 100 mL of water
CFU/mL = colony forming units per mL of water
< = less than, > = greater than

WHO guidelines (2011) for drinking water: Water intended for public consumption must not contain any *E. coli* in a 100 mL sample.

Signature:
Authorised by: Kim Irofufuli
Section Head, Microbiology

Signature:
Released by: Dickson Manong
Director

14.2 Seismic Data

Ministry of Mines, Energy and Rural Electrification
P O Box G37
Honiara
Solomon Islands
Tel: (+677) 21522, 21523 Fax (+677) 25811

SEISMOLOGY SECTION EARTHQUAKE DATA FOR ISABEL PROVINCE FROM 1900 - JULY 2019.

Date	Time	latitude	longitude	Depth	Mag	Epicentre
28/07/2019	08:59:51.305Z	-8.4236	159.9636	35	5	51km SE of Buala, Solomon
10/07/2019	14:00:58.191Z	-8.5692	158.9696	118.37	4.3	57km S of Dadali, Solomon
27/05/2019	09:25:19.033Z	-8.174	158.6247	102	5.5	47km WSW of Dadali, Solomon
21/05/2019	18:49:55.236Z	-8.3088	160.0199	59.57	4.7	50km ESE of Buala, Solomon
30/04/2019	16:47:20.914Z	-7.6357	158.1149	10	4.3	111km WNW of Dadali,
11/03/2019	09:45:04.358Z	-8.2471	159.9288	56.91	4.5	38km ESE of Buala, Solomon
18/02/2019	13:25:05.910Z	-8.4925	158.7704	134.93	4.2	56km SSW of Dadali, Solomon
06/02/2019	16:58:43.390Z	-8.0654	158.1969	91.43	4.6	92km W of Dadali, Solomon
01/02/2019	21:36:34.630Z	-8.1016	158.5642	10	4.4	51km W of Dadali, Solomon
23/07/2018	09:38:43.860Z	-8.4662	159.2719	77.69	4.2	50km SW of Buala, Solomon
19/07/2018	20:27:55.780Z	-7.8543	158.8298	44.32	4.7	31km NW of Dadali, Solomon
05/06/2018	17:38:45.830Z	-8.3317	158.2999	38.64	4.4	86km WSW of Dadali, Solomon
27/04/2018	17:31:22.240Z	-8.5489	159.1017	127.36	4.3	55km S of Dadali, Solomon
04/03/2018	15:57:57.540Z	-8.1684	158.5515	78.38	4.2	54km WSW of Dadali, Solomon
26/02/2018	20:51:26.640Z	-8.4324	158.4782	10	4.4	74km SW of Dadali, Solomon
02/02/2018	21:16:06.760Z	-8.2757	158.7325	98.86	5	41km SW of Dadali, Solomon
18/01/2018	07:35:54.630Z	-8.454	158.926	104.65	4.4	46km SSW of Dadali, Solomon
31/10/2017	13:42:25.010Z	-8.2696	159.1507	153.85	4.4	27km SSE of Dadali, Solomon
31/10/2017	12:31:05.020Z	-8.2299	159.4983	158.8	4.1	13km SW of Buala, Solomon
11/10/2017	20:53:52.630Z	-8.4577	160.0885	59.93	4.9	64km ESE of Buala, Solomon
22/09/2017	23:25:47.420Z	-7.7533	159.6233	37.28	4.9	43km N of Buala, Solomon
02/09/2017	18:11:51.850Z	-7.1754	158.8818	10	4.1	98km N of Dadali, Solomon
22/07/2017	18:30:22.380Z	-8.5019	159.0366	116.62	4.2	49km S of Dadali, Solomon
12/05/2017	05:39:00.060Z	-7.8361	159.6495	50.33	5.1	34km N of Buala, Solomon
07/05/2017	10:31:24.950Z	-	159.9318	53.98	4.4	37km E of Buala, Solomon
22/01/2017	13:25:00.000Z	-7.558	158.19	50.42	4.5	107km WNW of Dadali,
14/12/2016	02:23:41.300Z	-	158.5574	48.67	4.3	54km WNW of Dadali, Solomon
13/12/2016	22:10:45.880Z	-	158.546	46.91	4.7	53km W of Dadali, Solomon
11/11/2016	18:14:57.710Z	-	159.2769	107.55	4.3	37km SE of Dadali, Solomon
05/11/2016	20:47:50.820Z	-	159.951	58.01	4.6	44km ESE of Buala, Solomon
06/05/2016	13:24:45.020Z	-7.668	158.3404	65.36	4.1	87km WNW of Dadali, Solomon
05/05/2016	09:05:34.330Z	-	158.4228	40.74	5	84km NW of Dadali, Solomon
12/04/2016	19:45:22.880Z	-	160.0484	9.82	4.4	58km ESE of Buala, Solomon
15/02/2016	21:25:59.570Z	-	159.278	53.16	4.7	33km SE of Dadali, Solomon
02/02/2016	19:32:26.380Z	-	158.4719	85.28	4.2	66km WSW of Dadali, Solomon

26/01/2016	07:48:51.300Z	-	159.0782	79.83	4	37km S of Dadali, Solomon
17/12/2015	03:13:24.670Z	-	158.713	40.08	4.3	35km W of Dadali, Solomon
18/11/2015	03:06:08.640Z	-	158.9241	32.05	4.6	48km SSW of Dadali, Solomon
30/07/2015	22:48:22.080Z	-	159.8214	6.16	4.2	64km NNE of Buala, Solomon
27/07/2015	16:59:43.230Z	-	158.8008	66.54	4.5	25km W of Dadali, Solomon
05/06/2015	00:31:58.690Z	-	158.9849	138.97	4.5	50km S of Dadali, Solomon
24/05/2015	09:25:10.560Z	-7.803	158.5454	109.47	4.1	60km WNW of Dadali, Solomon
07/01/2015	08:27:26.290Z	-	159.0016	103.29	4.7	46km S of Dadali, Solomon
16/12/2014	12:49:14.880Z	-	158.2489	78.03	4.2	86km W of Dadali, Solomon
22/08/2014	15:23:27.400Z	-	158.1218	10	4.1	103km WSW of Dadali, Solomon
09/08/2014	04:04:48.090Z	-8.427	159.9907	61.64	5	53km SE of Buala, Solomon
22/07/2014	09:45:17.310Z	-	158.7748	35	4.4	74km NNW of Dadali, Solomon
30/06/2014	16:24:13.310Z	-	159.0579	98.13	4.3	29km S of Dadali, Solomon
01/06/2014	03:40:03.240Z	-	158.5598	106.23	4.2	55km WSW of Dadali, Solomon
03/05/2014	14:06:12.640Z	-8.583	159.1477	10	4.2	60km SSE of Dadali, Solomon
11/12/2013	01:25:11.350Z	-	158.6966	108.28	4.1	45km SW of Dadali, Solomon
10/12/2013	08:14:03.290Z	-	158.6094	126.74	4.4	53km WSW of Dadali, Solomon
09/12/2013	09:19:44.090Z	-	158.2397	64.73	4.1	109km NW of Dadali, Solomon
26/11/2013	19:22:38.730Z	-	158.3015	58.53	4.7	83km WNW of Dadali, Solomon
12/11/2013	13:46:11.550Z	-	158.2985	125.77	4.4	84km WSW of Dadali, Solomon
03/08/2013	01:24:01.850Z	-	158.1869	96.14	4.2	93km W of Dadali, Solomon
20/01/2013	17:11:36.830Z	-7.474	158.132	35	4.2	Solomon Islands
26/11/2012	05:16:34.790Z	-8.49	158.836	135.7	4.1	Solomon Islands
21/11/2012	12:40:08.390	-8.622	159.185	1	4.	Solomon Islands
04/10/2012	03:44:57.190	-8.382	158.613	149.8	4.	Solomon Islands
20/08/2012	09:49:27.950	-8.381	159.009	74.4	4.	Solomon Islands
04/09/2011	01:26:59.920	-8.166	158.299	90.8	4.	Solomon Islands
21/06/2011	09:58:57.970	-8.554	159.779	67.9	4.	Solomon Islands
04/02/2011	19:22:48.160	-8.341	159.161	99.1	4.	Solomon Islands
06/12/2010	14:25:49.750	-8.596	159.721	96.5	4.	Solomon Islands
14/07/2010	04:55:23.550	-7.829	158.768	3	4.	Solomon Islands
10/07/2010	12:54:19.920	-7.863	158.709	47.2	5.	Solomon Islands
03/01/2010	00:27:59.690	-8.557	158.997	132.3	4.	Solomon Islands
03/08/2009	01:31:01.370	-8.613	159.142	83.7	5.	Solomon Islands
24/05/2009	15:48:21.750	-8.477	158.831	105	5.	Solomon Islands
14/03/2009	07:25:13.840	-8.122	159.111	3	4.	Solomon Islands
10/02/2009	19:40:48.710	-8.077	158.669	79.7	4.	Solomon Islands
25/09/2008	17:46:57.620	-8.042	159.115	50.1	4.	Solomon Islands
04/06/2008	06:53:34.320	-7.772	159.679	58.3	4.	Solomon Islands
28/03/2008	06:54:14.450	-8.37	159.348	68.1	4.	Solomon Islands
17/02/2008	05:31:31.430	-8.258	158.57	88.1	4.	Solomon Islands
14/02/2008	09:18:08.200	-8.363	158.933	65.1	4.	Solomon Islands
10/02/2008	17:14:38.880	-8.163	158.421	3	4.	Solomon Islands
19/01/2008	03:39:18.800	-7.802	158.81	81.6	3.	Solomon Islands
14/12/2007	17:53:36.820	-7.96	158.232	3	4	Solomon Islands
26/10/2007	10:58:20.520	-7.834	158.472	3	4	Solomon Islands

01/10/2007	16:39:45.010	-7.622	158.153	1	4.	Solomon Islands
10/08/2007	01:39:20.140	-8.458	158.496	166.6	3.	Solomon Islands
31/07/2007	05:29:18.820	-8.403	158.953	91.7	4.	Solomon Islands
11/06/2007	02:20:17.530	-8.564	159.477	83.9	3.	Solomon Islands
02/04/2007	16:13:17.060	-7.653	158.822	1	4.	Solomon Islands
17/02/2007	03:52:32.330	-7.747	158.647	44.8	4.	Solomon Islands
01/10/2006	14:08:16.090	-8.365	159.564	47.4	3.	Solomon Islands
30/07/2006	14:55:33.820	-8.375	158.261	147.8	4.	Solomon Islands
27/07/2006	04:56:08.910	-8.46	158.928	99.5	3.	Solomon Islands
11/12/2005	21:49:05.440	-7.748	158.966	5	4.	Solomon Islands
08/12/2005	10:33:09.860	-8.484	160.098	42.9	4.	Solomon Islands
28/11/2005	06:58:05.940Z	-	158.491	92.8	4.9	Solomon Islands
10/10/2005	19:41:24.930Z	-	158.306	35	4	Solomon Islands
01/10/2005	11:25:14.520Z	-	158.512	153.8	4.2	Solomon Islands
21/08/2005	17:44:38.720Z	-	158.73	133.8	4	Solomon Islands
07/08/2005	19:28:32.160Z	-	159.403	59.3	3.9	Solomon Islands
14/07/2005	15:50:10.390Z	-	158.377	35	4.5	Solomon Islands
14/07/2005	08:01:05.680Z	-	158.419	105.1	4	Solomon Islands
22/01/2005	20:30:17.350Z	-	159.475	29	6.4	Solomon Islands
10/11/2004	02:53:57.170Z	-	159.08	10	4.1	Solomon Islands
07/11/2004	03:23:22.560Z	-	158.833	10	4.5	Solomon Islands
22/10/2004	16:34:45.810Z	-	158.653	150	4.1	Solomon Islands
02/08/2004	22:59:36.100Z	-	159.588	21.4	4.9	Solomon Islands
18/07/2004	03:21:10.620Z	-	158.903	43.5	4.6	Solomon Islands
22/04/2004	18:26:49.010Z	-	158.766	55	4.2	Solomon Islands
03/02/2004	02:18:27.880Z	-	159.366	108	4.6	Solomon Islands
03/06/2003	17:23:00.460Z	-	159.194	103.3	4.5	Solomon Islands
25/01/2003	05:45:41.400Z	-	158.878	500	4.5	Solomon Islands
26/08/2002	11:49:54.030Z	-	159.006	200	4.3	Solomon Islands
24/03/2002	02:16:41.710Z	-	158.874	33	4.1	Solomon Islands
11/03/2002	12:13:43.210Z	-	158.441	250	3.7	Solomon Islands
18/01/2002	23:51:18.110Z	-	160.241	52.9	4.2	Solomon Islands
13/01/2002	13:59:26.470Z	-	158.237	137.1	4.4	Solomon Islands
15/11/2001	07:35:33.720Z	-	158.186	33	3.8	Solomon Islands
14/11/2001	21:12:04.410Z	-	158.636	33	4.6	Solomon Islands
13/05/2001	02:40:31.210Z	-	158.843	100	4	Solomon Islands
06/05/2001	20:35:31.490Z	-	158.613	96.8	5.1	Solomon Islands
29/03/2001	03:10:48.850Z	-	158.673	33	3.6	Solomon Islands
05/03/2001	01:45:14.770Z	-	160.139	33	4.5	Solomon Islands
27/12/2000	06:20:25.700Z	-	158.827	33	4.3	Solomon Islands
20/10/2000	21:14:49.420Z	-	158.574	50.6	5.3	Solomon Islands
02/04/2000	15:40:33.940Z	-	158.288	33	4.1	Solomon Islands
28/10/1999	06:16:32.710Z	-	159.067	58.4	4	Solomon Islands
08/06/1999	03:45:41.040Z	-	158.652	100.4	4.6	Solomon Islands
11/02/1999	23:30:05.230Z	-	158.839	33	4.6	Solomon Islands
27/11/1998	11:48:06.690Z	-8.49	158.714	131.2	3.7	Solomon Islands

25/11/1998	18:05:25.700Z	-	158.622	47.9	6.2	Solomon Islands
10/10/1998	12:53:06.680Z	-	158.32	78.4	4.1	Solomon Islands
04/10/1998	14:32:31.390Z	-	158.827	135.6	4.2	Solomon Islands
15/07/1998	14:16:00.570Z	-	158.117	42.3	4.3	Solomon Islands
06/06/1998	10:02:15.460Z	-	158.171	33	4.3	Solomon Islands
11/05/1998	09:31:21.850Z	-	158.117	33	3.1	Solomon Islands
09/05/1998	16:35:07.160Z	-	158.587	33	4.2	Solomon Islands
02/03/1998	00:28:02.080Z	-	158.309	33	4.2	Solomon Islands
01/03/1998	12:55:12.550Z	-	158.083	33	4.7	Solomon Islands
01/03/1998	06:15:51.490Z	-7.62	158.16	33	5.5	Solomon Islands
28/02/1998	22:15:12.050Z	-	158.44	44.7	5.6	Solomon Islands
12/02/1998	21:28:06.790Z	-	158.688	33	4.3	Solomon Islands
04/02/1998	19:14:53.130Z	-	158.426	87.4	3.8	Solomon Islands
04/02/1998	02:58:54.930Z	-	158.385	75.5	4.8	Solomon Islands
24/12/1997	02:05:30.250Z	-	158.727	50.3	4.3	Solomon Islands
12/09/1997	02:48:32.380Z	-	159.284	148.1	4.4	Solomon Islands
30/07/1997	08:03:51.160Z	-	158.473	150	4	Solomon Islands
14/04/1997	02:35:10.140Z	-	158.943	108.7	5	Solomon Islands
08/04/1997	09:36:35.650Z	-	158.315	105	4.6	Solomon Islands
27/02/1997	11:37:53.880Z	-	158.984	33	4.1	Solomon Islands
08/02/1997	01:55:55.760Z	-	158.957	101.3	5.7	Solomon Islands
11/01/1997	18:45:28.280Z	-	159.128	100	3.8	Solomon Islands
20/04/1996	13:16:59.500Z	-	158.921	33	3.7	Solomon Islands
09/04/1996	03:24:54.800Z	-	159.108	89.8	4.1	Solomon Islands
26/02/1996	06:42:50.220Z	-	158.737	33	4.3	Solomon Islands
17/02/1996	05:36:51.530Z	-8.51	159.042	33	3.4	Solomon Islands
24/01/1996	13:56:50.050Z	-	158.106	33	4.4	Solomon Islands
11/01/1996	03:51:34.400Z	-	158.693	93.1	5.9	Solomon Islands
05/10/1995	00:05:34.800Z	-	158.446	33	4.7	Solomon Islands
12/08/1995	08:24:06.750Z	-	159.066	173	4.3	Solomon Islands
25/06/1995	15:46:32.590Z	-	158.184	102.7	3.9	Solomon Islands
25/04/1995	11:56:32.320Z	-	158.539	86.1	4.3	Solomon Islands
23/01/1995	12:08:38.720Z	-	159.259	144.8	4.6	Solomon Islands
13/01/1995	11:48:57.190Z	-	158.425	66.5	4.6	Solomon Islands
05/12/1994	16:20:09.360Z	-	159.833	49.2	5.5	Solomon Islands
22/11/1994	19:08:12.650Z	-	158.296	33	5.4	Solomon Islands
10/11/1994	10:48:23.590Z	-	158.354	33.1	5.3	Solomon Islands
04/08/1994	18:36:20.490Z	-	158.38	34.2	5	Solomon Islands
30/07/1994	01:07:48.300Z	-7.88	158.483	33	4.7	Solomon Islands
25/07/1994	15:46:45.860Z	-	158.452	29.4	5.4	Solomon Islands
22/07/1994	16:57:48.420Z	-	158.417	19.2	6	Solomon Islands
05/05/1994	14:25:41.970Z	-	159.322	33	4	Solomon Islands
30/12/1992	06:25:26.670Z	-	159.041	50.1	5.6	Solomon Islands
21/08/1992	17:35:25.960Z	-	158.303	33	4.6	Solomon Islands
17/07/1992	16:28:14.810Z	-	159.605	33	4.8	Solomon Islands
17/05/1992	15:46:49.040Z	-	159.133	50.7	5	Solomon Islands
11/05/1992	20:57:48.220Z	-	158.924	117.6	4.8	Solomon Islands

29/10/1991	18:18:45.700Z	-7.7	158.941	33	4.7	Solomon Islands
29/10/1991	02:32:58.110Z	-	159.243	33	4.6	Solomon Islands
02/09/1991	03:48:44.850Z	-	159.005	130.2	4.9	Solomon Islands
23/06/1991	05:03:15.430Z	-	159.06	60.9	5.3	Solomon Islands
07/04/1991	20:18:10.010Z	-	159.319	78.4	4.7	Solomon Islands
20/03/1991	01:15:46.340Z	-	158.26	33	4.6	Solomon Islands
06/11/1990	17:27:54.710Z	-	159.163	39.2	5.2	Solomon Islands
11/09/1990	22:37:19.540Z	-	158.932	162.5	4.9	Solomon Islands
22/03/1990	02:11:50.680Z	-	158.891	116.2	5.6	Solomon Islands
17/03/1990	16:53:37.560Z	-	159.663	33	4.1	Solomon Islands
03/03/1990	02:25:39.010Z	-	159.138	105.9	5	Solomon Islands
23/02/1990	21:29:06.190Z	-	158.824	121.6	4.9	Solomon Islands

14.3 Consultation Report

SIRC

COMMUNITY CONSULTATION AND AWARENESS REPORT

(28th July to 4th August 2019)

Contents

1.0 Introduction

This document provides an overview of the community consultation activities (including Focus Group Discussion) and socio-economic survey conducted from 28th July to 4th of August 2019.

Community Consultation and awareness were conducted for communities within the tenement area and the catchment areas. The main objective of the consultation activity are to:

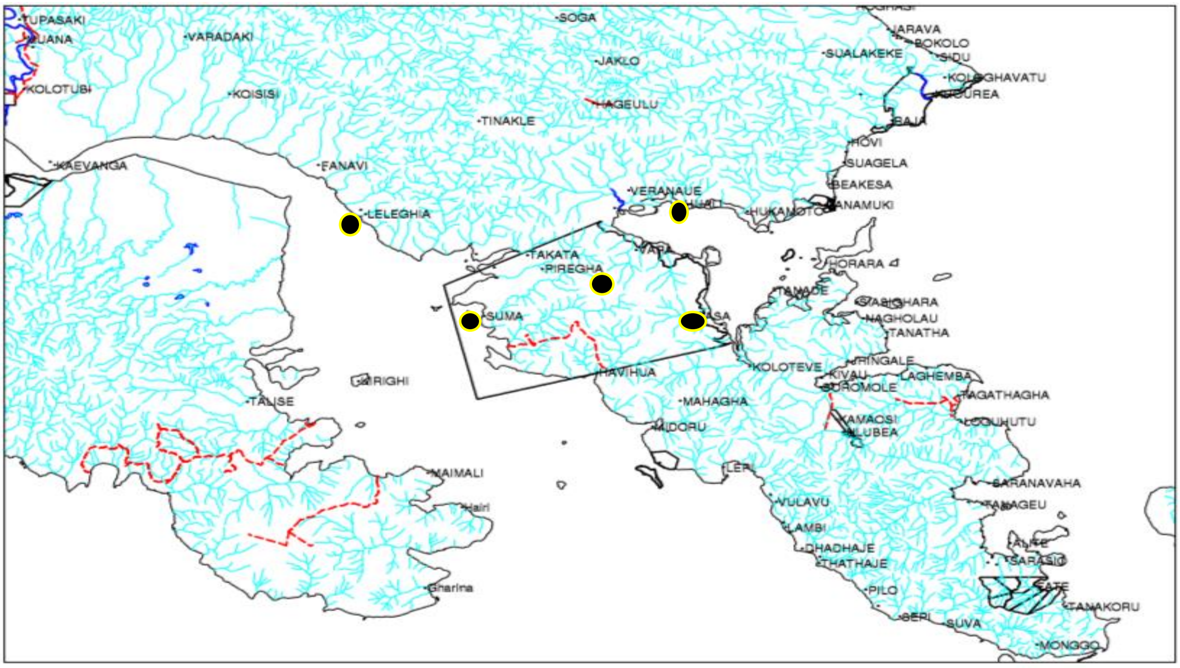
- Provide communities with information about the proposed mining development;
- Explain the expected environment and socio-economic impacts as a result of the mining development; and
- To listen to community concerns, issues and feedbacks.

The purpose of the survey is to understand the socio-economic conditions and economic profile of the communities likely to be impacted by the proposed mining.

2.0 Consultation area

The study area falls within the Gao/Bughotu and Tatamba Ward in the Isabel Province. The main villages identified for consultations were Lelegia, Vara and Huali and villages selected for socio-economic survey were Lelegia, Suma, Rudede, Vara and Huali.

Figure 1: Location of the villages under socio-economic baseline study/Community Consultation in the project area



3.0 Methodology

The methods used by the EIS Team to collect information about the community profiles are:

i. Community Consultation and Awareness

Community Consultations were conducted at 3 Villages – Leleghia, Vara and Huali. Nearby communities were also invited to attend the consultation and awareness. A written notification was sent to all communities prior to the consultations.

Table 50: Villages consulted

Community Consultation/ Awareness	**No. of people present during consultations**
Leleghia	44
Vara	7
Huali	80

	131

ii. Household Surveys

Socio-economic data were collected using a Household Survey Questionnaire. The enumerators were provided training on the contents of the survey instrument and the procedure on how the interviews should be conducted prior to the field site visit. Survey focused on Household Data, Utilities and services available in the communities, Residency and Land Ownership, Income and Expenditure, livelihood (land use, economy, mobility etc) and view on the proposed development.

The five villages comprise a total of 147 households. The total household number was determined after a mapping exercise with the community elders. A total of 48 households were randomly selected for household survey representing 33% of households in the area.

Table 51: Surveyed villages

Name of Village	**Total No. of Households**	**No. of Households Surveyed**	**Population of Villages Surveyed**
Lelegha	40	11	178
Suma	13	4	30
Rudede	6	6	25
Vara	14	5	30
Huali	74	22	230
Total	**147**	**48**	**493**

To ensure uniformity in getting field data, attention was given to check accuracy of data collected. Following the survey exercise, the data was then analyzed and amalgamated into the EIS. Identification of potential mitigation measures were also part of the analysis process.

iii. Focus Group Discussion

During the household survey, in-depth semi-structured interviews were also undertaken with chiefs, elders, women and youth present during the community consultation and awareness. Focus Group discussion were undertaken in order to get a broader view of the communities and their livelihood, observations and perception on the mining development.

4.0 Results of Public Consultation/Focus Group Discussion

Community Consultation and awareness Program were conducted at Leleghia (29th July), Vara (30th July) and Huali (31st July). See attendance list in Appendix 3.

Community chiefs, church leaders, women and youth representatives, and general community members living within/neighbouring to the three villages attended the consultations. The objectives of the community consultation and awareness are to provide project-specific information, identify community issues and concerns as well as information on the potential social, economic and environmental impacts, relating to the mining project. The main issues raised during the consultation are listed below:

- Mining and its effect are not new to people living within the tenement area or the surrounding villages. Communities feel there is a need for coordination among landowning groups. This is important because it can avoid disputes and social disruptions.
- The SIG need to support land owners understand the mining process and how to safeguard their land and people.
- Provision for job in the surrounding villages should be encouraged and prioritised by the company and landowners. The company should provide employment not only for landowners' relatives but for everyone in the community.
- It is important the SIG accounts for all minerals extracted from the tenement.
- Rehabilitation of disturbed sites should be given high priority during the operation and at the decommissioning stage of the mine.
- Concern over lack of monitoring and enforcement by relevant authorities that has resulted in degradation to water ways and coastal ecosystem.

- Respect for all tambu site is important. In this tenement a tambu site is located at Pireghe that was an old settlement. The mining operations must avoid disturbance to these tambu sites.

Information gathered from the Focus Group Discussion include:

- Land is inherited from their forefathers and land ownership is passed through the female line;
- Leaders (Chiefs/Community Leaders) in the villages are proactive in decision making and help resolve disputes;
- The tenement area communities and people use the Maringhe Dialect.
- The main denomination is Anglican Church of Melanesia;
- Tribal Lands in the area are customarily owned while others are registered;
- Traditional land boundaries are identified by hills, valleys and streams/waterways and certain trees or plants;
- All people have primary right to their customary land. Those that do not have primary rights always seek permissions from the landowning groups to use land;
- Land disputes are common in the area and over the past 5 years most disputes are related to land trespass, land ownership and land boundaries. In many occasions' disputes were solved through Chiefs Hearing while others go through Court;
- Traditional rights over coastal waters (reef edge, traditional fishing grounds) exist in the area;
- Threats affecting food gardens include low soil fertility, logging, pests/diseases;
- Main uses of rivers in the villages are bathing, washing, drinking, swimming and food sources;
- Main source of drinking water is from the rivers while others use rain water tanks.
- Within the Mining area, there is an old settlement located at Pireghe;
- The communities have access to schools, clinics, roads connecting to villages and telecommunications (Telekom);
- Communities main source of electricity/lightening is solar;
- Main sources of income in the community are from the sale of root crops and vegetable;
- Main mode of transportation to and from Honiara is via shipping services. In the villages, people use OBM and canoes;

- People have observed changes to weather patterns in their respective villages. They have observed the following:
  - Rainfall is becoming regular with a high intensity
  - Temperature is becoming very hot during day time;
  - Increase frequency of extreme weather events
  - Weather (sunshine, rain) is just unpredictable
  - Abnormal weather patterns
- Some adaptive measures by the communities in response to impacts of climate change is:
  - Moving to higher grounds
  - During strong winds and cyclonic season, they stay indoor
  - Plant crops that can adapt to the weather conditions.
- Community people receive warnings of floods/Tropical cyclones and tsunami through SIBC and Phone calls from relatives/family members.
- Concerns Raised with regard to the proposed development include:
  - Mining will have impact to land and fishing grounds which will directly and indirectly affects livelihood.
  - .
  - Mining companies must abide by the laws and regulations of Solomon Islands and provide equal employment opportunities for the local people. As seen from other companies, majority of mining workers are from overseas (Asians) and only few from the villages surrounding the mining areas.

5.0 Conclusion

The public consultation meeting were well attended by the communities and landowners whom have also appreciated the consultation and awareness program the EIS team conducted. Information provided and the issues raised from past experiences with previous companies (mining/logging) operating in the same area are crucial to the design and implementation of the mining. Communities and landowners strongly highlighted the need to comply with national legislation and community code of conducts.

Annex

Appendix 1 – Focus Group Questionnaire

Focus Group Discussion

	Community Background
1.1	Name of Village?
	Name of Ward?
	Estimated Village Population:
	Number of Household:
1.2	Describe the brief history of the people (how people came to settle in the village?
1.3	How does the traditional leader (village chief/headman) chosen?
1.4	Are village leaders influential in decision making? Yes/No
1.5	Do they help resolve disputes? Yes/No
1.6	Do you think village leaders can help resolve dispute, if land related issues arises during the mining operation
1.7	What dialect is spoken in this area?
Q2	**RELIGIOUS LIFE**
2.1	What main denomination exist in the village?
2.2	Do you think that church leaders assist solving issues arise in the communities ? Yes/No
Q3	**Land, Land Ownership, Use of Land and water resources**
3.1	What type of Land ownership exists in the community?

	Customary?	Y/N	Registered?	Y/N			
3.2	What traditional markers are used for customary land boundaries identification? (Streams/Ridges)?						
3.3	How is land inherited in ? Briefly describe.						
3.3	Do all the people in the village have primary right to the customary Land? Y/N						
3.4	If No, then what rules are in place to decide on who should use the customary land/sea or settle on the land?						
3.5	Are there disputes related to land in the past 5 years? Yes/NO						
3.6	What was the cause of the land dispute?						
3.7	Where the disputes resolved? Yes/No						
3.8	How can land disputes be addressed in the village?						
3.9	Is there any traditional right over coastal waters (reef edge, traditional fishing areas?						
3.1	What are the main use of Land in the village?						
	Gardening		Farming/Agriculture		Logging		Mining

3.2	What are the main crops/plantation							
	Main Crops							
	Main Cash Crops							
	Plantations							
3.3	What are some threats you see affecting your food gardens?							
	low soil fertility	invasive species		Logging	pests/disease			no land available for gardening
3.4.	What are the main use of Rivers in the village?							
	Bathing		washing		drinking		swimming	food source
3.5	Where do local communities source drinking water from?							
3.6	Does the community involve in fishing activites?							
3.7	Are there any culturally significance area/tambu sites in the vicinity of the mining area? Yes/No							
3.8	Describe site and identify location (ie, will the project impact on such area?)							
Q4	**Access to Social Services & Facilities**							
4.1	Do the communities have access to schools? Yes/No							
	Closest Primary:				Closest Community High School:			
	Distance				Distance			
	Travelling Time				Travelling Time			
4.2	Do communities have access to health and medical services?Yes/No							

	Closest Health/Medical Services?			Distance:	
	Travelling Time				
4.3	What communication coverage are available in the village [1] telecom [2] Bmobile [3] VHF radio				
4.4	What is your main source of electricity / lighting? [1] Solar [2] generator {3} kerosene lamp				
4.5	Are there network of roads connecting to villages? Yes/No				
4.6	Access to Market?		Market days?		
Q5	**Sources of Income**				
5.1	What are the major sources of income in the community?				
5.2	What are the minor sources of income in the community?				
Q6	**Transport and Travel**				
6.1	What is the main mode o f transport to travel to Honiara/Buala?				
	Honiara			Buala	
6.2	How many ships come per week to the community?				
6.2	What is the main mode of transport to travel to other villages?				
Q7	**Natural Hazards and Disaster Risks**				
7.1	Do you notice or observe any changes in the weather pattern in your village? If 'yes, what changes were observed?				
7.2	What is your observation of the following climatic variables in your village?				
	Rainfall	Temperature	Sunshine	Humidity	Wind

	Rate them in terms of their frequency of occurrence and intensity						
	Climatic variable	Rainfall	Tempt.	Wind	Sunshine	Humidity	
	Frequency						Rare / Often /Regular
	Intensity						Low/ Medium/ High
7.3	Identify from the list the main climate change threats you have experienced in your village?						
	Climate Threats	Coping and adaptive measures you use or apply when you are impacted by these impacts?					
	Strong Winds						
	Flooding						
	Extreme drought						
	Storm surges						
	Sea level Rise						
7.3	How do people in the community receive warnings of floods, Tropical cyclones and Tsunami?						
Q8	**Community Perception on Mining Development**						
8.1	Do you have any concerns regarding the Nickle Mining operating here?						
8.2	What do you think are the potential benefits of the Nickle Mining for the people or country's economy?						

8.3	Do you support the Mining Activity occuring in the tenement area?
	Even if it will impact your land, forest, rivers or the marine environment?
	END OF CONSULTATION

Appendix 2- Household Survey Form

SIRC

HOUSEHOLD SURVEY FORM

Name of Enumerator:		**Date:**	
Province:		**Ward:**	
Name of Village:		***Constituency:***	

Confidentiality: The information obtained from this household survey will be used only for the purpose of the Baseline Socio - Economic Conditions of Households within the catchment area of the Mining Tenement Area for SIRC. The Data will not be used to disclose an individual's identity in any way but will be published to represent the population in the area.

1 - Household Data

1.1. Is the 'respondent' the Household Head? *Yes [1] or No [2]*

1.2. If *'No'* , who is the Household Head?

[1] Husband; [2] Father; [3] Mother; [4] Brother; [5] Sister; [6] Grand Father; [7] Grand Mother

1.2.1. What is the Gender of the Household Head? *Male [1] or Female [2]*

1.3. What is the Marital Status of the Household Head?

[1] Not Married; [2] Married; [3] Separated; [4] Divorced; [5] Widowed; [6] Other

1.4. What is the age of the Household Head?

1.5. Does the Household Head regularly work for wages or salary? *Yes [1] or No [2]*

1.6. **If answer to Question 1.5.** is *'Yes',* what sector does the HH works in?

[1] Education; [2] Health Services; [3] Government or Public Service (All Ministries); [4] Trade or Small Business; [5] Tourism; [6] Construction; [7] Agriculture (Inc. Copra, Cocoa etc.); [8] Logging; [9] Daily Labor; [10] Transport (Incl. Driving or Bus Conductor); [11] Other (Specify)

1.7. Including any dependent family members currently living away from home, how many people are in your household?

1.7.1. How many males and females?	*1.6.1.1.*	*# of Males:*
	1.6.1.2.	*# of Females:*

1.8. How many household members are in the following age groups?

Years		*# of Males*		# of Females
<4 years old	*M.1.8.1.*		*F.1.8.1.*	
5 - 18 yrs old	*M1.8.2.*		*F1.8.2.*	
19 - 64 yrs old	*M1.8.3.*		*F1.8.3.*	
>65 yrs old	*M.1.8.4*		*F.1.8.4.*	

1.9. Are any persons in the family considered disabled? *Yes [1] or No [2]*

1.9.1. If 'Yes' please indicate gender, number and age:	*M/F*	#:	*Age:*

1.10. Does more than one family make up your household? *Yes [1] or No [2]*

1.10.1. If *'Yes'* , how many families? (married and living in one house with parents)

1.11. How many household members between the ages 5 to 18 years old regularly attend school?

1.11.1. How many males and females?	*1.11.1.1*	*# of Males:*
	1.11.1.2.	*# of Females:*

1.12. Where is the nearest school located?

2 - House Construction Materials

2.1. Which type of house do you have? *[1] Permanent; [2] Semi - permanent; [3] Traditional/Thatch*

2.2. What types of construction materials do you use? *[1] Earth; [2] Leaf; [3] Corrugated Iron Sheet;*
[4] Rough Sawn Timber; [5] Solid / Milled Timber; [6] Brick / Concrete; [7] Other

2.2.1.	*Floor*	
2.2.2.	*Walls*	
2.2.3.	*Roof*	

3 - Utilities & Services

3.1. What is the main source of water supply for your household? *Yes [1] or No [2]*

	Water Source	***Yes [1] or No [2]***
3.1.1.	Water Tank	
3.1.2.	Private Water Supply	
3.1.3.	Community Water Supply	
3.1.4.	Water Well	
3.1.5.	Bore Hole Water pump	
3.1.6.	Others (Rivers & Streams etc.)	

3.2. Does your household have access to the National Electricity Grid? *Yes[1] or No[2]*

3.2.1. If 'No', what is the source of energy used by your household? *Yes[1] or No[2]*

	Source of Energy	***Yes[1] or No[2]***
3.2.1.1.	Generator	
3.2.1.2.	Solar	
3.2.1.3	Kerosene Lamp / Hurricane Lamp	
3.2.1.4.	Others	

3.3. Do you have proper toilets? *Yes[1] or No[2]*

3.3.1. What types? *[1] Flush Toilet; [2] Pour Water; [3] Pit; [4] Bush; [5] River; [6] Other*

4 - Residency and Land Ownership

4.1. Do you own a land? *Yes[1] or No[2]*

4.2. What is the owneship status of the land?

[1] Registered; [2] Traditional / Customary; [3] Owned with other people

4.3. How long have you been leaving in the area?

[1] Less than 5 Years; [2] 10- 50 Years; [3] More than 100 Years

5 - Income and Expenditure

5.1. Apart from the Household Head, does anyone in your household work for regular cash income? *Yes[1] or No [2]*

5.1.1. How many males and females?

5.1.1.1.	*# of Males:*	
5.1.1.2.	*# of Females:*	

5.2. If 'Yes', what sector do /does they / he/ she work/s in? *[1] Education; [2] Health; [3] Government or Public Service;*

[4] Trade of Small Business; [5] Tourism; [6] Construction; [7] Agriculture (Incl. Cocoa, Copra, etc); [8] Agriculture (Inc. Livestock); [9] Daily Labour for Wages; [10] Logging; [11] Transport (Incl. Driving or Bus Conductor); [12] Other (Specify):……...

5.3. What is the estimated total monthly salary or wage of the entire household in SBD$?

(That is all males and females)

5.5. What is the total non - wage / labor income per mont of your household?

Type of Non - Labor Income	***Total Income/Month***
Remittance from Relatives/ Friends	
Rental Income	
Other (Specify)………………………………	

5.6. What are the main sources of income to your household and about how much do you earn in a week?

Income Source	***Amount / Week (SBD$)***

5.7. Does your household produce any of the following listed below for sale at the market? *Yes[1] or No[2]*

Produce	***Yes [1] or No [2]***
Vegetables (Cabbage, Tomato, Pepper, etc.)	
Root Crops (Kumara, Pana, Cassava, etc.)	
Fruits (Melon, Mango, Pawpaw, etc)	
Cocoa	
Copra	
Other Crops	
Livestock (Pigs, Cow)	
Poultry	
Timber / Wood forest products	
Non - Timber forest Products (Sago palm leaf, Honey, etc.)	

5.8. If *'Yes'*, please provide an estimate of your monthly income from the specified products in 5.7 above.

Produce	***Estimate/ Month (SBD$)***
Vegetables (Cabbage, Tomato, Pepper, etc.)	
Root Crops (Kumara, Pana, Cassava, etc.)	
Fruits (Melon, Mango, Pawpaw, etc)	
Cocoa	
Copra	
Other Crops	
Livestock (Pigs, Cow)	
Poultry	
Timber / Wood forest products	
Non - Timber forest Products (Sago palm leaf, Honey, etc.)	

5.9. Did you see any changes in your household income over last 5 years? (Yes or No)

5.10. What causes the change?

5.11. Do you have a village market? *Yes [1] or No [2]*

5.11.1. If *'Yes'*, what is the name of the market?

5.11.2. If *'No'*, which local market do you access?

5.11.3. How far is the local market from your village?

5.12. How do you transport your produce to the market? *Yes[1] or No [2]*

Mode of Transport	***Yes[1] or No[2]***
Walk	
Road Transport	
Sea Transport	

5.13. How frequently does your household sell produces at the market? *Yes[1] or No[2]*

Frequency	***Yes[1] or No[2]***
Once a Week	
Twice a Week	
More than Twice a Week	
Fortnightly	

Once a Month		
At least 3 times a Month		

5.14. On average how much does your household spend in a week on transportation?

	Total Weekly (SBD$)
Fuel for Boat & Vehicle	
Truck Fares	
Boat Fares	

6 - Transport & Travel

6.1. What is the mode of transport, time taken and how much do you or the members of your household pay to get to the following services? ***(Modes: [1] Private Car / Ute; [2] Public Bus; [3] Truck; [4] Taxi; [5] Bicycle; [6] Walk; [7] Other)***

Social Services	**Mode of Transport**	**Time Taken (minutes)**	**Fares (SBD$)**
Primary School			
Secondary School			
Health Centre			
Hospital			
Local Market			
Central Market			
Nearest Shop			
Nearest Town			

6.2. How many people in your household make regular trips? How many males and how many females? What is the purpose of travelling? (Purpose of travelling ([1] Work/ Employment; [2] Education; [3] Health Care; [4] Buying / Selling goods; [5] Others)

Frequency	***No. of people travelling***		***Purpose of travelling***	
	# of Males	***# of Females***	***# of Males***	***# of Females***
Daily				
Twice a Week				
Five days a Week				
Weekly				
Fortnightly				
Monthly				
Every 2 Months				

7: Perception/Observation

What is your view or concern with regard to the mining development occuring in your land?

Thank you

Appendix-3 Attendance List

Attendance List

Name of Village le Leghin

Venue of Meeting Rest house

Date 27/07/2019

Name	Position	Contact /Phone
HUDSON AUTHEGNA	fisherman	7219518
Rubenson Roradi	Farmer	
BACIL Manelegua	Farmer	
Jemy Michael	fisherman	
DAVID [illegible]	fisherman	
MIKE NASORO	Fisherman	
Robert Aloue	farmer	
Francis Solomon	farmer	
Nelson B. Kalu	Minister	7618810
Thomas Maeke	fisherman	7874294
chief. Melchior Vakin	Koxoloi [illegible]	
STEPHEN Vaguon	fisherman	
Chris Braun	Chief (3)	—
Joses Vouli		
Jordan Kolha.		
ELIZABETH CARE	farmer	
BOKOLI CALEB		—
GLORIA Pohuni		—
Sisterwood	Farmer	—
Jessy Gasedia		—
Mary Ann		—
Margsie	Doctor	
William	lawyer	
JASPER	Fisherman	
DAVID	Four man	
John Pijulu	farmer	
Wenson maclaw	Duckman	
Denis Hathe	crewman	
JEVORY HOKE	"	
NARKIY SENI	Youth	
Simon Thegna	"	
Damaris	[illegible]	

Clariser Hua	scout	
Nelly Kaio	scout	
Allen Riumana	Self Employed	7752567
Tony Lino	member	7270936
Josés Valia	Elder	
Shyman Thoma	Elder	7135500
Thomas Marie	Chief	7874394
Jerry Micheal		7108928
Jessica	House wife	
Casper Kandze	chief	77560014
Noelyn Kdeai	house wife	
Charice Ramumana	father	7751010

7

Attendance List

Name of Village VARA
Venue of Meeting VARA
Date 30/07/2019

Name	Position	Contact /Phone
Aristaha	Mother	7898940
Lesly	Brother	7951037
Tommy	Father	7122083
HUGO RALOSO		
HUGO ILERALA		
SILAGAVA		
DANISAN AVIMANA [chief]		

Attendance List

Name of Village: Hunli

Venue of Meeting: Market House (Hunli)

Date: 21/07/2019

Name	Position	Contact /Phone
Cecelia		
Neoyn Mau		
Jenny Loata		
Gwenyth Ostel		
Rovlyn Edith		
Jimarina Ellis		
Pepetua Tusi		
Lynia Dcosta		
Cathy Atkin		
Kevlyn Dicoan		
Catrine Jao		
Nancy Rore		
Janet Willy		
Vegilinda R.		
Charles pana		
Danstan Ari		
Menson. Jone		
Freemana		
Lonsdale		
Mosafau		
Lilly Tadavale		
Fricsil		
Ethel Kofu		
Freda Gaston		
Nose-Catherine		
M. Kudau		
Melody. Grofu		
Nesilyn Arimana		
Daina Sari		
Wendy. Charlie		
Nogu. Mildred		
Derick. Au		

Appendix 4: Photos of Community Consultation: Leleghia, Vara and Huali

14.4 Preliminary risk assessment form

	Details	
Name of assessor	Steve Sae	
Date of assessment	6th August 2019	
Site Address	Kolosori tenement	
Development Proposed	Mining	
Historical findings	**Rainfall**- not much rainfall on the months of June to October **Temperature** – Temperature is around 27°C normally. On extreme weather events, it can sometimes go lower. **Sea level** – Sea level has been affecting the area as can be noted from eroded coastal areas. Anecdotally this is one major issue around Kolosori. **Tropical cyclones** – Tropical cyclones happen rarely. During its occurrence, strong winds and associated high intensity rainfall are remarkable. Storm surge impact is minor as the area is sheltered in the thousands ships bay and located along the Ortega channel, barred from impacts of storm surges by the San Jorge Islands. **Wave height** – Is not an issue for this mining area as it is protected from impacts of waves with its location within the Thousand Ships bay and the Ortega channel and protected by barriers from the San Jorge islands. **Ocean acidification** – All the interviewees do not aware about this issue, could be partly due to lack of knowledge about it. However, from observations, some fringing reefs are seen to be affected.	
	Name of interviewee	Detail

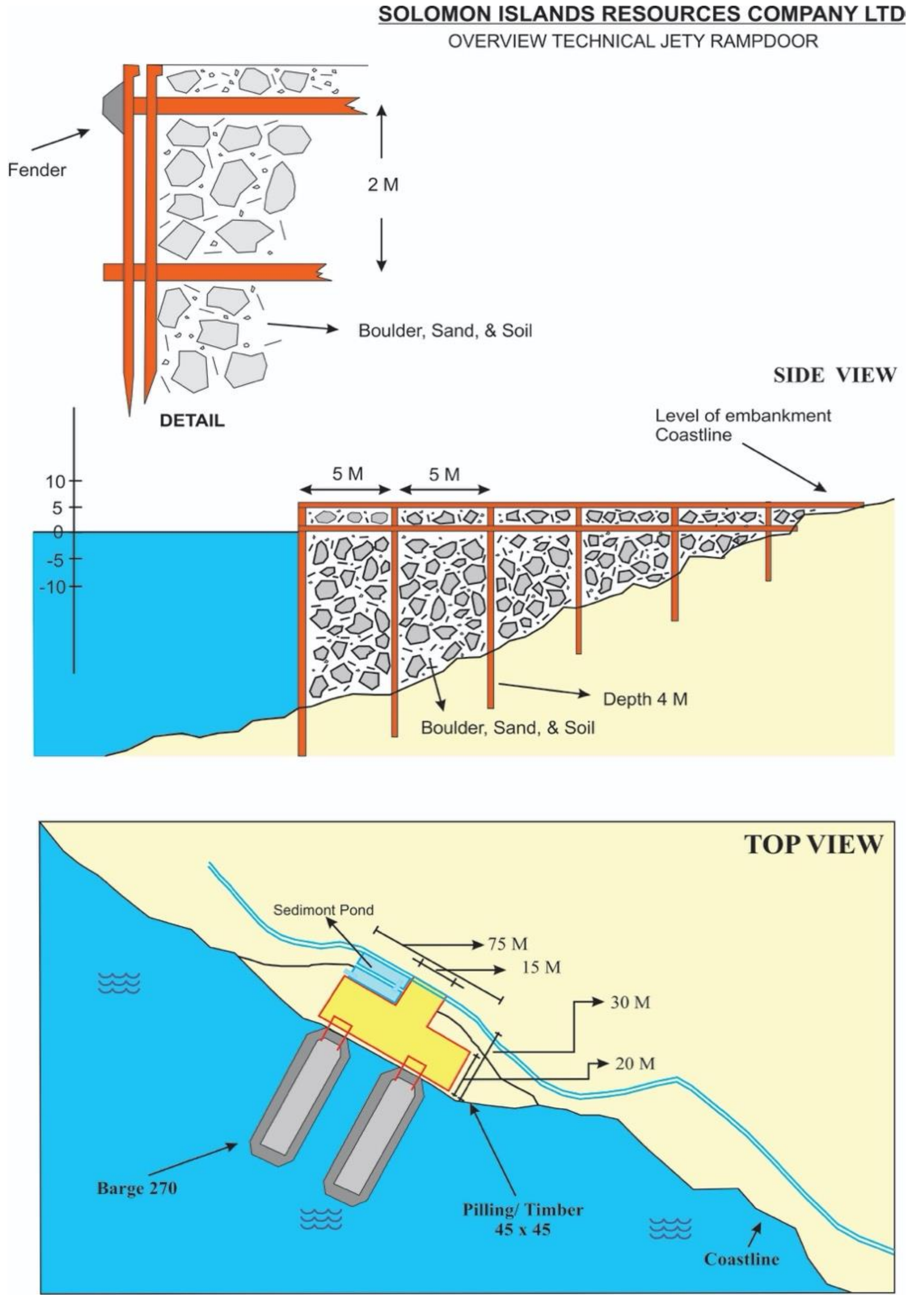
<table>
<tr><td>Findings from interviews</td><td>Ben. Luther
Dicosta. J
Jimson. K</td><td colspan="2">Huali village
Vara village
Suma (Riudede) village</td></tr>
<tr><td rowspan="2">Threat potential/Probability</td><td colspan="2">Probability and risk of climate change variables</td><td>Rating</td></tr>
<tr><td colspan="2">Rainfall
Sea level
Temperature
Tropical cyclone
Significant wave heights
Ocean acidification</td><td>Rating 1 LOW
Rating 2
Rating 3
Rating 4
Rating 5 MODERATE
Rating 6
Rating 7
Rating 8
Rating 9 - 10 HIGH</td></tr>
<tr><td>Recommendation</td><td colspan="3">- The port site need to be backfilled and raised 1 m high from normal height with reference to sea level.
- Roads need to be gravelled and compacted to withstand erosion/surface runoff which can wash out soils and loose gravels along mining roads which can pose risk of accidents.
- Mining pits and associated stockpiles need to be carefully protected from surface runoffs. Heavy rainfalls or in extreme weather events surface runoffs can be enhanced and erosion become significant. Hence, proper sediment ponds on contour style be created to trap sediments and silts. Also, sediment traps and silt fence need to be installed along slopes so that sediments and silts are trapped and prevent them from travelling further to waterways.</td></tr>
<tr><td>Other Notes</td><td colspan="3">- All in all it is obvious that, rainfall, extreme weather events and sea level rise can have some impacts to certain extent but they can be seen as low to moderate. Therefore, climate change impacts are not a very serious concern but must be treated with caution and the company must use the climate change risk assessment report as a basis of preparing its Emergency Response Plan.</td></tr>
</table>

14.5 Port Study Plan

The port facility is essential for docking of barges to collect the ore and transporting it to ocean going vessels (OGV).

The port designed for Barge Ramp door to use a 270 ft (82.2 m) x 72 ft (x 21.9m) x 18 ft (5.4m), capacity is （5,500- 6,000 tons） DWT X 2 sets, requires a land area of 80 meters x 50 meters. This port caters to hold two barges at one time,

A loading rate of at least 5,000 tons per day per barge, target to exports two times within one month, every time is 50,000 tons. This loading Target to be served by this port, even suffering from a sufficiently dense delivery frequency.



Overview Technical Construction Port/Jetty Rampdoor

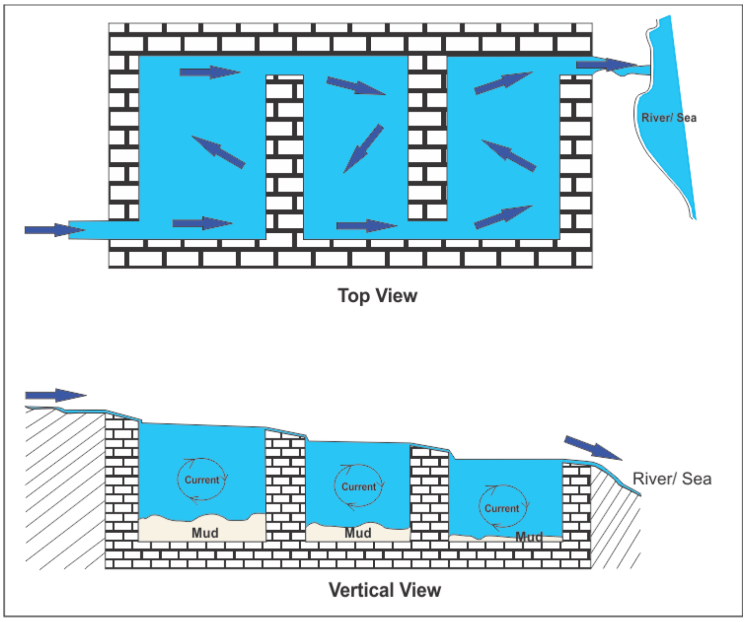
14.6 Sediment Pond Control

Due to the topography, high rainfall and soil conditions, there will be a high sediment load in the runoff water generated from the Project sites during construction and operations. The soil material is lateritic with the red colored surficial limonite classified as a clayey silt. Due to the fine nature of the soil particles, it is challenging for this material to settle out in ponds very quickly.

The sediment control philosophy is to remove the sediment from the surface water management system as close as possible to the source and not rely on large downstream 'last line of defense' sediment dams although these may be required in some instances.

Sediment control should focus on preventing erosion 'at source' with the use of erosion control matting, tackifiers and hydro mulching/revegetation amongst many of the available techniques. It should be supported with sediment control devices (such as decanters, rock filter check dams, etc.) installed in conjunction with the regular drainage infrastructure to limit the requirement for large sediment ponds. Where required, sediment control ponds will be constructed to treat large disturbed areas such as platforms, where the smaller sediment control devices will have a lesser effect. The primary function of the sediment control basin is to provide detention of runoff water to allow settlement of suspended solids (sediment).

The size of the sediment pond will be based on the volume required to hold the water in accordance with the above design criteria and provide 'dead' storage for accumulated sediment equivalent to 30% of the design volume. Next at the edge/ boundary of mining activities, make a check dam to trap all the water runoff from the front mining and the stockpile ETO into the sediment pond and give time for the deposition process. Water coming out of the sediment pond expected not to contain mud or have very small amount of suspended sediments anymore so that it can be disposed to river waters without damaging the quality of existing river or stream water. The size of the channel and check dam will be adjusted to the water runoff debit.



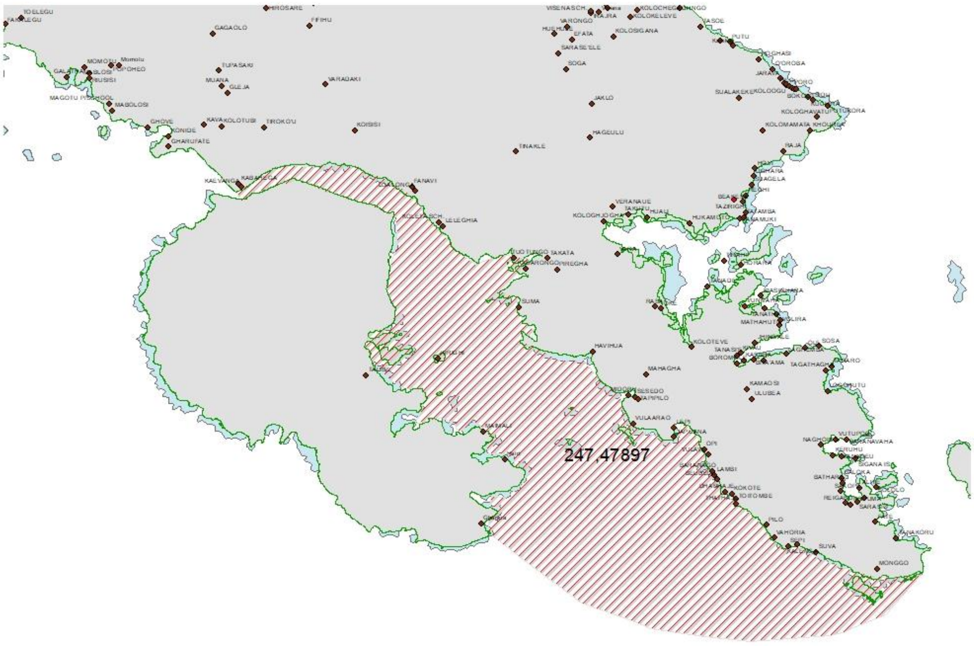
Sketch of Sediment Pond

14.7 Study Plan of the Anchorage

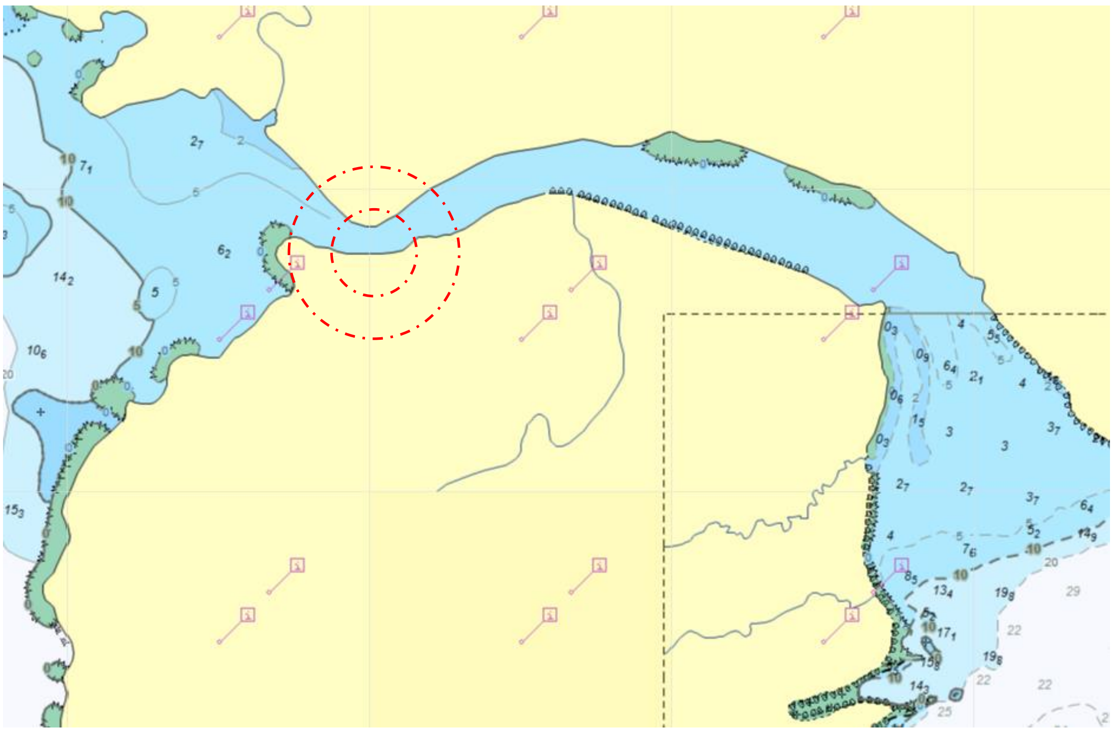
1 Position

A good choice of anchorage for Bulk Carrier and Barge Work at sea is based on the premise that there is a wide sheltered sea area. Thousand Ships Bay is one such good bay, which is shaped like a capital A. The water area is about 247 km², and each has an entrance in the northwest and southeast, the north-west entrance is narrow (Min. Narrowest: 306 M, Max Depth: 6 M) but is accessible by small merchant vessels such as landing craft, while the south-east entrance is open like a trumpet shape and the waterway is wide enough for large vessels such as Bulk Carrier to pass. To the west of Thousand ships bay, San Jorge Island blocks the westerly winds and swells from the Solomon Islands Sea, while to the East, the southern tip of the main island of Isabel blocks the monsoon winds and swells from the Pacific. The Bay (Thousand Ships Bay) is usually calm, and very suitable for large ships loading cargo by Ship-To-Ship.

Study area in rectangular red Dots of the Position of Anchorage



. *Thousand Ships Bay Marked with Pink Lines*



The North-West Entrance Is Narrow at The Point Marked with Double Red Dotted Circles

At present, several large Bulk Carriers are using the bay as anchorages loading logs as cargo on to the ship for several nearby logging/timber companies. With the above information of the bulk carriers using the bay an archorage for loading round logs, this also indirectly proves the feasibility of choosing here as the loading anchorage.

2 Regional Natural Conditions

Typhoon

Detailed in Section 5.4.2 of the EIS report, the area experienced 11 major typhoons in 60 years.

Tsunamis

See Chapter 5.5.2 of the EIS report. In 2007, a magnitude of 8.0 earthquake strike near Gizo, resulted in a tsunami. The tsunami killed 52 people and displaces over five thousand people in Western and Choiseul Provinces. Another Tsunami occurred in 2010 following a 7.1 magnitude earth quake originating approximately 200km from the Isabel Island. The highest occurrence in this area is 6.4 magnitudes, at a depth of 29 km, of the Coast of Isabel Island.

Monsoons

From May to October, easterly winds dominate the region, while westerly winds dominate during the typhoon season from November to April.

Tides

Since the variation of tides within the bay are semi-diurnal, the rise and falling of tide are twice per day.

The waters that come into the bay through the south opening during ebb tide flows out of the bay through the northern opening. This happens the opposite during flood tide where waters coming through the northern opening goes out through the southern opening.

Swells

Ocean Observational Information

- From November to April, swells usually come from the north of the Solomon Islands.
- Swells usually come from the south between May and October.

Visibility

Thousand Ship Bay year-round visibility is good, the average line of sight is 3n mile, belongs to high visibility, low-risk areas.

Submarine Geology

Due to the action of wind, wave and current, the anchored ship will move and may collide and run aground. Therefore, the geological requirements of the seabed anchorage are soft and hard moderate; in this seabed geological situation, the anchor can not only grasp the seabed, fixed position but also deep enough to fix.

After field investigation and study, the seabed of Suma anchorage is mostly mud, sand and clay, which is an ideal mixed bottom for anchoring.

3 Anchorage Design

The definition of Anchorage is in the harbor or bay, is a fixed area used exclusively for berthing, frontier quarantine, the transit of goods, replenishment and discharging and loading cargo.

Firstly, the whole resources around the anchorage must be evaluated scientifically and reasonably. Then, according to the code and the actual situation, the anchorage point or anchor position circle of the ship should be planned out in the waters around the anchorage, and marked on the chart, ensuring the safety of ships at anchor.

3.1 Design Ideas

- The anchor point should not be too far from Suma and Kolosori wharfs, the normal distance should be kept between 1 ~ 2 nautical miles (1.852km or 3.704km respectively), and it is the key to ensure safety to shorten the sailing time of barges from the wharf to large vessels (Bulk Carriers) as possible.
- The depth of the anchorage should be kept between 18 and 60 meters.
- Energy away from rocks and obstacles, water buildings and marine environmental protection zones and other dangerous and sensitive areas. The connection between the Anchorage and the danger zone shall be as far away from the current and wind direction as possible. The relative distance from dangerous waters shall be determined based on the time and drift speed used by the ship's emergency vehicle. The Shipping Industry and Marine Spatial Planning a Professional Approach, recommendation: The safe distance between an anchored vessel and a nearby building or hazardous area should be The distance required for The crew to activate The main engine of The vessel and brake it after discovering that

The vessel is anchored, the safe distance is 1.15 km (0.65 n Mile). In rough seas, the safe distance is 3.15 km (1.7 miles).

- Anchorage is 1.2 km or more from the Light signal on the Crocodile Hill Reef.
- Between the Anchorage and the channel, there is at least 2 ~ 3 times the captain's, which is convenient for passing ships.
- The anchor point should be kept a safe distance from the surrounding timber vessels. The minimum safe distance between the circular anchorages of large ships is recommended in the CHIRP Rules (Marine Advisory D. Anchoring and Anchor Equipment [R] . LONDON: CHIRP. 2017,) to be 3 chains (nautical unit of measurement, 1 chain = 1/10n mile), about 556 meters.

3.2 Calculation of Safe Anchorage Distance

Based on the actual situation of the Suma shipment, there is usually only one large ship loading nickel cargo at the Anchorage. Still, this section calculates the safe distance between them in case two large ships are at anchor. This research adopts the conservative calculation method of turning radius, and each anchor position occupies a circle, its radius is,

$R = L + 3H + 90$ Wind Force ≤ 7

$R = L + 4H + 145$, wind force > 7

L is the ship length(m)

H is the water depth of Anchorage(m)

R=190+3x30+90 =370 m @ Wind Force ≤ 7

R=190+4x30+145 =455 m @ Wind Force > 7

3.3 Allowable Error Analysis

Due to its own maneuverability and the master's level, the ship cannot anchor at the specified latitude and longitude. The data of allowable error needs to be given.

According to the empirical formula, the maximum allowable error is 80(L-2R)

L is the ship length (m)

R is the Anchor Ring Radius (m)

Allowable Error Analysis

Radius of Gyration （R ）	Radius of Gyration of Adjacent vessel（m）	Anchorage Spacing (L)	Allowable Error (m)
238	-	556	80
265	-	648	118
280	-	648	88
335	280	648	126
383	335	741	115

4 Ship Particular

Since trade contracts generally stipulate a volume of 50,000 tons ± 10% , and the type of vessel used is mostly Handy size Bulk Carrier, the main dimensions of anchor vessels are usually as follows:

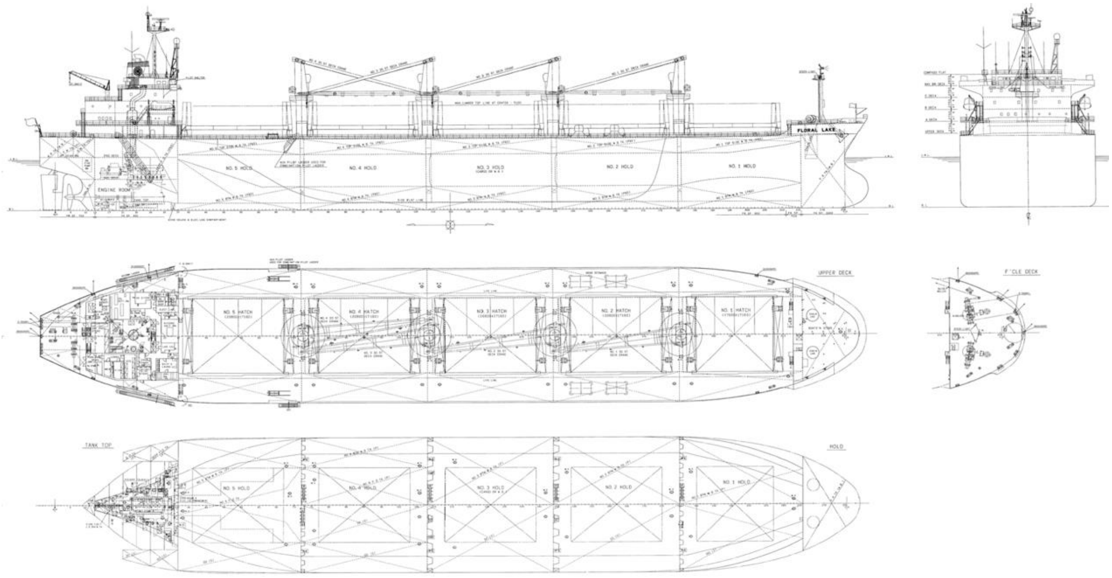
Ship Particular

Length:	190 m	Width:	32 m	Depth:	18 m
Draft:	11.5 m	Capacity:	55,000 Ton	M/E:	9480 Kw

Statistical Table of Water Depth Of Anchorage Required For Various Ship Types

Ship Type (10k ton)	Load Draught （m）	Anchorage Depth（m）
DWT≤1	4~8.5	4.8~10.2
1＜DWT≤5	8.5~12.7	10.2~15.2

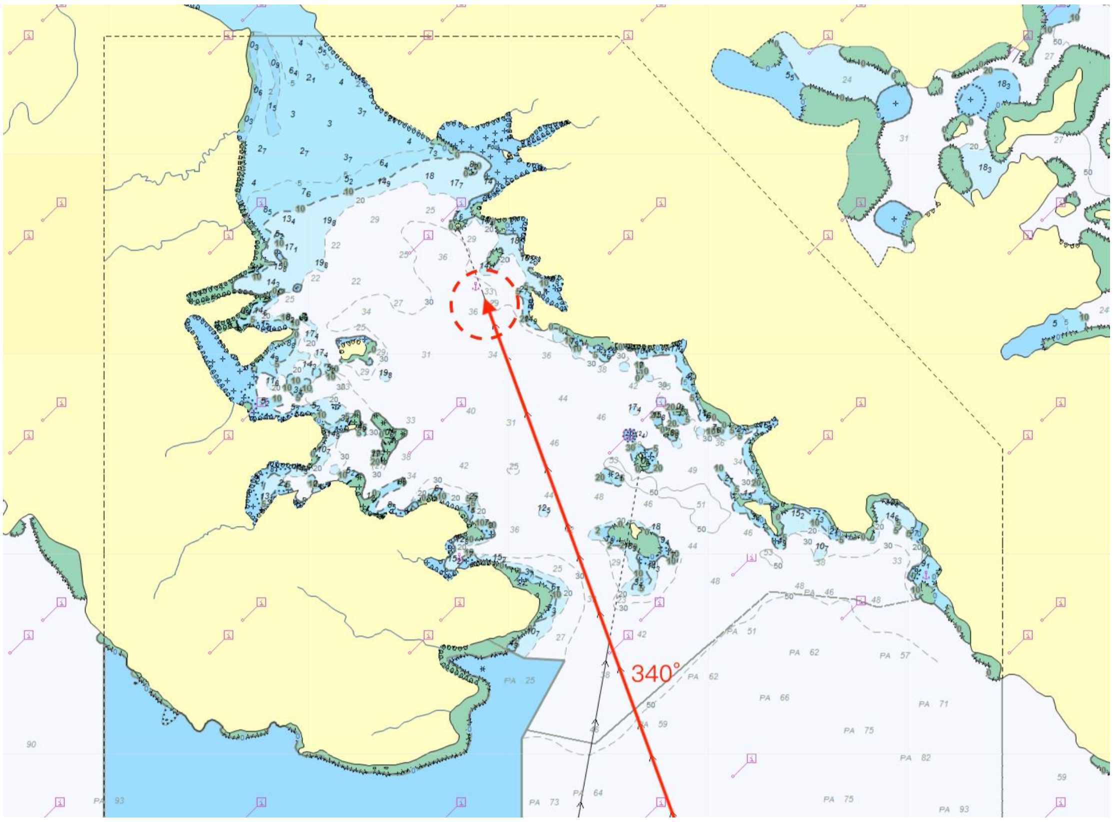
5≤DWT≤10	12.7~15.2	15.2~18.2



Ship General Arrangement

5 Route Guide

Cargo ship was going into the bay from South entrance, Course heading 340 °, following the 30-50 M Isoline, and moving slowly into the bay.

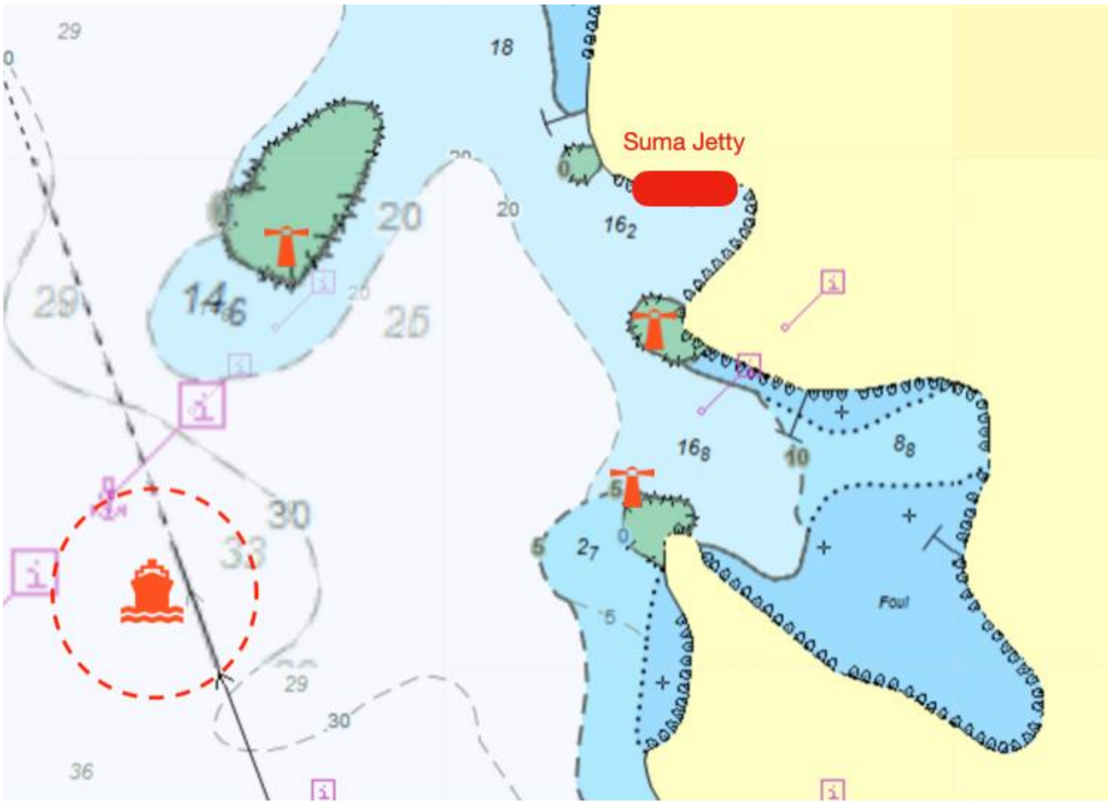


Route Guide from The Southeastern Entrance to The Anchorage Point (Red Dotted Circle)

The first time a large ship enters or leaves the bay, it will be guided by a pilot boat sent by SIRCL.

The Sea Chart Number is **SLB304** published by **ADMIRALTY CHART PAPER SERVICE.**

Position of 3 light signals indicating hazardous area for night operation.



Position of 3 Light Signals

6 Management Plan

The Safety Management Measures for the Suma Anchorage are as follows to prevent ships from Anchor moving and collision, resulting in irreversible marine accidents and the safety of human life:

6.1 Publicity

- After obtaining the approval of the Maritime Safety Administration, it must be released to the public as soon as possible.
- Identify and specify the name of the Anchorage as Suma Anchorage to avoid confusion with other anchorages in the area.

6.2 Water Area Control

- The manager of the Suma camp is the main person in charge of this task and is responsible for the unified command and dispatch of large vessels, barges and tugs.

- A Marine radio station will be set up in the command center to monitor the movements of ships on VHF13 and VHF16 channels. Ships operating in the command area will be dispatched on a dedicated channel.
- Tugboat and barges engaged in loading operations should inform the command center before15 minutes when berth jetty and the ship, the name of the vessel, the quantity of cargo, the time when the barge starts, and ends should be reported through VHF.

6.3 Safety Management

- During the operation of large vessels, fishing operations and anchoring are strictly prohibited.
- Ask passing vessels to keep a safe distance.
- To keep track of the weather and to immediately inform the vessels in operation to prepare ahead of time.
- All vessels shall comply with the legal provisions and provisions relating to the prevention of pollution from ships at sea. In the event of a pollution incident, immediate and vigorous measures should be taken to prevent the expansion of pollution or other adverse consequences.

6.4 Skills Training

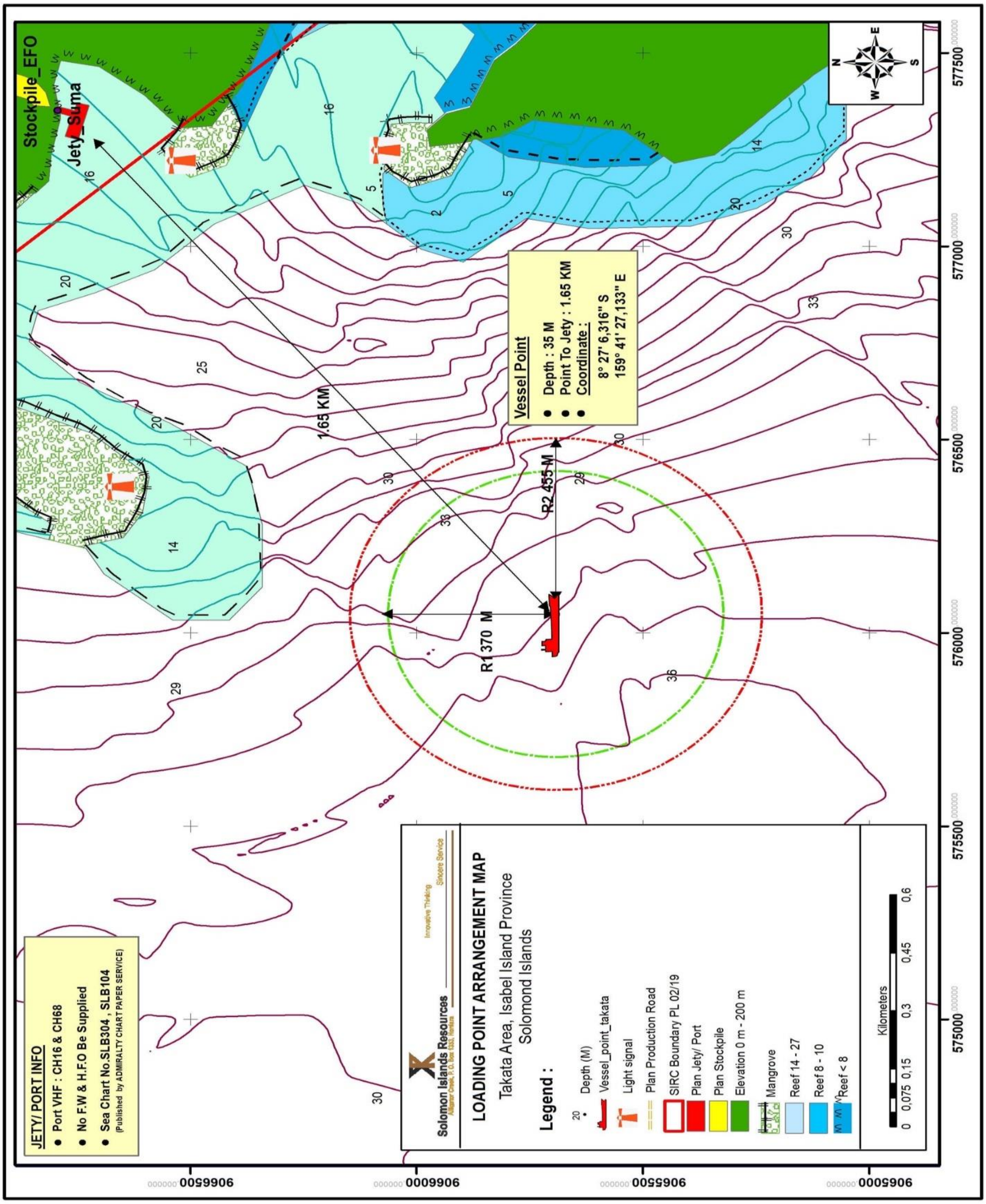
Pay attention to strengthen the command center on-duty personnel and tugboat cadres crew training, familiar with the operation process, close cooperation, alarm bell ringing, remain vigilant.

7 Conclusion

To sum up, following the International Industry Authority data and regulatory requirements, combined with the actual situation on-site, the final selection of a safe anchorage, and marked on the drawing, as follows:

- That the anchorage point is located at
  - 08°27’6,316″ S
  - 159°41’ 27,133″ E
- Point of Anchorage depth is 35m (marked with a red anchor) in figure below
- Distance of Point of Vessel (OGV) anchorage to Jetty is 1.65km
- Marine radio frequency (VHF) of use allocated are CH16 and CH68
- That the name of the anchorage is called Suma Anchorage

- That all the Standard Operation Procedures outlined in sections 2, 3, 4, 5 and 6, above shall be adhered to.



Map of Suma Anchorage Point (In Green Anchor) Located West of Kolosori Jetty or Southwest Of Suma Jetty