# Environmental and Social Impact Assessment

June 2017

# SOL: Tina River Hydropower Project (Part 7)

Prepared by the Government of Solomon Islands for the Asian Development Bank.

**CURRENCY EQUIVALENTS**
(as of 9 June 2017)

| | | |
|---|---|---|
| Currency unit | – | Solomon Islands dollar (SBD) |
| SBD1.00 | = | $0.1276 |
| $1.00 | = | SBD7.8308 |

**NOTE**

(i) In this report, "$" refers to US dollars.

Mangakiki, on the ridge above Senge, is likely to require land containing trees and plants that are used by local households, and will possibly subsume parts of the main bush track to Senge (see Figure 12-8). Satellite imagery from August 2013 suggests that the road may affect land previously cleared for food gardens. The earthmoving required to construct the road, which traverses the ridge and slopes above Senge, could potentially damage resources belonging to the village if not carefully managed.

Section 12.4.2 ¯ Land Ownership, noted that all of the customary land taken for the project was previously owned by local indigenous people and is valued by them. The LALRP sets out the process and measures for identifying and compensating for land value and loss of resources (plants/hunting etc.). However, it is not expected that the loss of the land required for the project will have significant adverse impacts on local livelihoods.

The LALRP assesses and addresses the livelihood impacts of the land acquisitions and covers the impacts of acquiring title to the Core Land.

The TRHDP PO has proposed that the land in the designated Core Area become legally owned/leased and registered to a Tina Core Land Company ¯ a 50:50 joint venture between the traditional land owners and the SIG. This company would then lease the various sites to the developer and would then determine future rights of access and uses of the Core Area, including the storage reservoir.[78]

#### 12.5.7.4.3 Water Use

### Water Quantity

Notwithstanding that there will be reduced flows in the Tina River between the proposed damsite and the powerhouse, the TRHDP PO reports that there will be sufficient permanent flow to meet the consumption needs of villagers from Choro, Koropa, and Senge, once the project is operational. As noted, at minimum flow there will not be sufficient water or current in this section of the river to float rafted timber downstream to haul out sites at Habusi, Antioch, and Tina Village. The powerhouse tailrace structures and outflow may also present a physical barrier to timber rafting and a safety hazard. Reduced river flow for most of the time will make the riparian areas between Senge and the dam site more accessible to landowners, and possibly encourage an expansion of livelihoods activities in that area.

The reduced nighttime flows downstream of the powerhouse will likely to be noticeable during periods of natural low flow in the Tina/Ngalimbiu River catchment. There are implications for communities living adjacent to the river downstream of the powerhouse in terms of timing and safety of river-based activities such as bathing, washing and recreation. A staged release of flows through the power station in the mornings is proposed to minimize safety risks.

### Water Quality

The construction, upgrading, and use of the road, during the project construction period, may disturb and damage existing water resources used by villages adjacent to the road (e.g., Marava, Vera˘ande, Verakabikabi, Valesala/Antioch, Verakuji, and Mangakiki) (see Figure 12-7). In addition, the construction of the new section of road at Rate may also damage the catchment area for the Verakabikabi water supply, and minimally, will pollute the water (see Annex 17 in the Annex Report). Water quality could also be reduced due to fuel spills, sewage disposal, and chemical leaching and spills at the dam and powerhouse construction

[78] See Project Office press release, ¯Tina River Core Land Owners Give Consent_ dated 17 July, 2014)

sites, or the incorrect management of concrete waste water or sediment run-off from cleared areas.

Almost all of the communities in the Tina/Ngalimbiu catchment rely on the Tina/Ngalimbiu River for their domestic water supplies. Consequently, the potential loss of access to clean and potable water due to river pollution and sedimentation during the construction of the dam, is a major health concern for all the riverside communities of the Downstream Area, especially for women. While villages along the Tina Road get their water from other sources, they are still concerned that construction activities, such as road building, will disturb and contaminate these sources of water. Water pollution problems often occur after heavy rains, due to land disturbances, such as logging.

In addition to concerns about the water taken from the Ngalimbiu River for domestic purposes, the Ghaobata communities of the lower catchment on the Guadalcanal Plain, are worried about the effect of the dam on the water levels in their wells and boreholes, especially in the dry season. Throughout the project area, members of all riverside communities noted the potential impacts of reduced water quality and availability on bathing, washing of clothes and food, recreation, and fishing. Women expressed particular concern about these matters.

The TRHDP PO has agreed to provide alternative water supplies to local communities. Options include:

- River-based supply with appropriate treatment systems and supply points for each village;
- Rainwater collection and storage tanks and/or regular transportation and distribution of clean water by tanker truck;
- Establishment of alternative supplies from local streams, and
- Borehole / ground water supplies, piped to several villages / hamlets..

Figure 12-7 Locations of the known water supplies adjacent to the Tina Road (blue drops)


Source: base map from Google Earth, 2014

#### 12.5.7.4.4 Hunting and Fishing

As described previously, all of the indigenous communities of Bahomea and some of the adjacent Malango communities occasionally use the rivers, streams and forests of the upper Tina River catchment for hunting, fishing and camping. The household survey found that game animals and fresh river fish are no longer common in local peoples˘diets. Hence, hunting - and to a lesser extent fishing - tend to be seen as a cultural activity involving young people and to provide wild pork for church and community feasts, rather than as an essential part of peoples˘livelihoods. In contrast with some Ghaobata households, fishing is not a source of income for people of Bahomea.

The extent of the loss of fishing, hunting and gathering opportunities will depend on the access arrangements for and future management of the upper catchment.

Some fishing spots could be permanently lost. Conversely, the proposed storage reservoir may provide future aquaculture and fishing opportunities.

Downstream of the dam site, the river will become more turbid due to reservoir clearing, cofferdam installation and removal, and other riverbed disturbances during construction, and will be less suitable for spear fishing using snorkel diving gear. Conversely, the new access road will enable landowners (and potentially outsiders) to access fishing spots upstream of the construction area more easily. The TRHDP PO has suggested that access to upstream areas via the new road, would ultimately be determined by the Core Land Company, subject to the mitigation measures recommended in the ESIA.

Poorer water quality caused by construction could also have a negative impact on the fishery at the mouth of the Ngalimbiu River, although this is considered unlikely. Gravel mining in the lower Ngalimbiu River bed already introduces sediment to the river, yet fishing appears to continue.

During project operation, the main effect on fishing will be the reduced number of rock pools where people spearfish. This will occur in the reach of the Tina River covered by the reservoir, and in the reach that will have reduced flow. In addition, there may also be changes in the fisheries due to the barrier to migration of the dam and powerhouse turbines. The study by Ian Jowett suggests that the reduced flow in the river will be advantageous to certain fish species, detrimental to others, and provide an overall increase in fish densities. Proposed mitigations include using trap and haul methods to move fish over the dam.

Hunting areas will also be lost, although the reservoir may provide better access to areas in the upper Tina River catchment, where hunting effort seems to be concentrated.

Specific hunting-related impacts mentioned by villagers include:

- Displacement of wild pigs, the main game animal, from riparian areas and possibly pushing them downstream and closer to settlements and gardens as occurred with logging. This migration of pigs could be accelerated by the creation of the new road, and;
- Displacement of waterfowl that rely on the river and adjacent streams for their habitat.

Measures to address livelihood impacts of reduced access to hunting and fishing, including providing ongoing access for local communities during the operational period, are set out in the LALRP.

#### 12.5.7.4.5 Food and Materials Gathering

The riparian area (micro-wetlands) between Senge and Choro is reported to be a source of wild fruits, edible ferns, nuts, medicinal plants, plants deemed to have magical properties, and bush materials. These plants will be affected by the reduced river flow, since floods that periodically replenish the riparian areas, will be controlled by the dam. This could have consequences on the livelihoods and wellbeing of the four households in the two villages. It seems, from discussions with local people, that most materials should be available in other locations. The creation of the dam access road will reduce the availability of some materials and plants (e.g., in the road corridor), but will also make it easier to access alternative areas and supplies.

As part of any resettlement planning for the project, SIG has, in close cooperation with the affected landowners, investigated the occurrence of culturally or economically important plants in the core project area, that may be destroyed by the Project and for which compensation would be payable. A process for compensation and retained access for local users of the Core Land Area is set out in the LALRP.

### 12.5.8 Cultural Heritage ¯ Impacts and Mitigation

The local indigenous people of Bahomea and Malango have traditional authority and use rights over the project area, and are concerned about the potential desecration and damage to their cultural sites as a result of the Project.

The most significant cultural impact of the project will be the loss of, and/or damage to, sites of importance to the indigenous people. The potential adverse cultural impacts include:

- the permanent loss of tambu sites, including natural features and objects, rock pools, streams, and former habitation sites within the proposed project area (Core Land); and
- during construction, disturbance to or desecration or destruction of tambu sites, graveyards and other places of social and cultural importance located next to the Black Post-Tina Road, and in the new road corridors.

The construction and operation of the TRHDP could have direct physical effects on several types of culturally sensitive sites. These include places of:

- long term cultural significance such as archaeological sites, historical places and former village sites; and
- religious or spiritual significance and associated with custom stories and ancestors (e.g., tambu sites, graves, custom houses, places of worship, and boundary markers such as special trees, rocks, streams). For example, people from Marava, Vatupaua, Rate CHS, Ngongoti communities noted that several burial places may be affected if the existing Tina-Black Post Road was to be enlarged.

Sacred sites may be owned by, or have particular importance to individual groups or clans, and underpin notions of identity and land ownership. Knowledge of the location and meaning of tambu places can, therefore, be a proof of land ownership. Thus, the information can be highly confidential. Unfortunately, only the very old members of a clan may have such knowledge, and there is `no effective system_ for the management and protection of ancestral and scared sites and objects (Ministry of Culture and Tourism, 2012).

The protection of sites and cultural materials is covered by the `Nasinol Policy Framework blong Kalsa_(The National Cultural Policy Framework, 2012), which sees protection and preservation of Solomon Islands indigenous languages, arts, customs, traditional knowledge, and heritage as crucial for maintaining Solomon Islands peoples ¯dignity and identities, and as

:an essential component of the socioeconomic, political, and spiritual development aspirations of the Solomon Islands_ (SIG, 2012: 3). Policy goals listed in the framework document that are relevant to the TRHDP include:

19.1 The country has a proper and effective system for the management and protection of ancestral and sacred objects and sites;

19.2 The cultural heritage of the country is protected and preserved for the cultural education of today's youth and future generations;

24.1 The country has a national database and effective system for the management and protection of cultural landscapes of archaeological and historical significance;

24.2 Cultural landscapes of archaeological and historical value are integrated into cultural tourism development; and

24.3 Cultural education, historical knowledge and field research are enhanced and facilitated through the availability of well-protected and well-managed sites throughout the country.

Other than proposing a database, the Framework proposed no concrete steps for protecting culturally important sites.

The ESIA is limited as far as baseline studies of cultural heritage in the project area are concerned. Because most of the knowledge is kept confidential, investigators were not able to gain detailed information to locate all sacred or cultural sites for the potentially affected communities and landowners . In some cases, broad descriptions were provided during interviews with senior men. Riparian surveys conducted by Pacific Horizons Consulting Group (PHCG) in 2011 noted and mapped the locations and names of various streams and features between the upper end of the Tina River catchment and Pachuki (see Section 5 ¯Physical Environment Baseline). In addition, the approximate locations of some old villages were recorded. During the ESIA village workshops, the names of originating villages and the sequence of village settlements prior to the current settlement patterns were recorded, though exact locational data was not obtained. Also, the existence of present day graves and other cultural features were noted during the village workshops, though except in the case of Mangakiki and Verakuji villages, their exact locations were not recorded.

It is recommended that, prior to commencing any construction on the access roads or on the hydropower development sites, the SIG or project developers carry out a more detailed cultural heritage and sites monitoring program within the designated Core Area, and in the communities adjacent to any road building or upgrading. This monitoring should be undertaken by a suitably qualified heritage expert, working closely with the landowners, accompanied by an advisor from the National Museum. All sites should be recorded, mapped and photographed. Also, prior to construction, the TRHDP should be required to implement a protocol for managing cultural heritage (see Annex 18 of the Annex Report and the ESMP).

## 12.6 Potential Beneficial Social Impacts

During the mitigation workshops, participants were asked to share their expectations and hopes on the benefits of the Project to them and their communities.

### 12.6.1 Access to Electricity

According to the communities, bringing electricity to villages, churches, and houses is the main benefit of the TRHDP. This is a strong indicator that local people understand the nature of the proposed hydroelectric development and the benefits of having electricity.

Based on the workshop consultations and the householder surveys, electric lighting is the most sought after benefit of the project because it will:

- Enable children and adults to study in the evenings;
- Provide security in the home and around the village, especially for women;
- Increase levels of community interaction, by facilitating evening gatherings and, thus enriching the community life.

Having their own electricity supply will enable households to take advantage of modern electrical appliances and machines, specifically:

- Refrigeration, providing greater food hygiene and security and, therefore, providing financial and health benefits;
- Electric cookers and washing machines, which will reduce the level of manual labour and resources currently required for cooking and washing, and improve the quality of women's lives;
- Home and community entertainment systems, which are seen as providing educational, psychological, and socio-political benefits, and reducing the sense of isolation; and,
- Use of power tools and machinery, especially for carpentry and building, sewing, and craft work, which will enable the establishment of small businesses and workshops, and provide additional income opportunities for both males and females. Power tools will also considerably reduce some of the heavy labour for men in building, improve efficiency and productivity, and improve working conditions.

### 12.6.2 Increase in Employment Opportunities

The principal benefit to human capital from the TRHDP will be additional employment opportunities. Stakeholders believe that the construction of the project will provide opportunities for direct and indirect employment, for both males and females, and for landowners. The TRHDP PO anticipates that the construction of the TRHDP will require up to 175 workers at its peak. The percentage of locals in the workforce is expected to be high, as the developer for TRHDP will not be permitted to employ any semi-skilled or unskilled foreign workers and training is to be provided to improve local residents' opportunities. The actual number of people recruited locally will depend on the skills required and the availability of jobseekers.

The landowners and communities of Bahomea and Malango are expected to be given priority for employment on the Project and to receive training in plant and machinery operation, administration and security work. Some local people will take advantage of providing goods and services to the project such as food preparation, cleaning, and security. On the operations side of the project, young people may see opportunities of developing new careers and providing ongoing services. New opportunities associated with the new reservoir (e.g., tourism and possibly fish farming) are also possible. Finally, these potential business and employment opportunities could improve income diversification and standard of living.

The World Commission on Dams (WCD) notes that the wages paid to construction workers represent the single largest social benefit during the construction phase of a hydropower project. The social benefits have positive consequences on the workers' families and community. Jobs may be created to provide support services to workers and to the Project

(e.g., accommodation, meals, transport and retail). Off-site jobs may also be created in the manufacture, supply of construction materials, and transportation.

Priority is given to employment of people from the project's immediate area of influence. Workers from outside the host community will also be needed, chiefly for technically specialised skills which may not be available locally An influx of job-seekers into rural and isolated areas can have an adverse impact on local communities and the environment; to preclude this induced effect the developer will provide for accommodations for all non-local workers in Honiara.

Some local residents may be trained to fill operational positions. There may be a small number of other paid jobs (e.g., site security) for local people during the operations phase of the Project once it has been commissioned. Routine maintenance will be done under an Operations and Maintenance contract with the SPC. The required operational workforce is still under consideration.

### 12.6.3 Livelihoods Strategies

During construction of the Project, people who are working on the TRHDP are likely to spend less time producing food from their gardens. Findings of the community workshops highlighted a variation in nutrition, with an increase in intake of imported carbohydrates. These variations were attributed to an increased reliance on cash from paid employment, timber sales, rents and royalties from Gold Ridge mining and from natural forest logging.

Finally, in the longer term, the TRHDP is likely to have a positive benefit in local people's livelihoods. Improvements to the road infrastructure could make life easier, and provide better access to Honiara's markets. The much-desired electrification of local villages could bring diversification in household livelihoods, with the opportunity for home-based manufacturing and artisan activities. This would reduce household income vulnerability. Provision of other benefits, such as reliable water supplies within the villages, would reduce the domestic workload on women and girls, and free them up for other income-generating work.

### 12.6.4 Improved Education and Skills

If suitable training and learning arrangements are put in place, the Project offers an opportunity for developing new skills for the indigenous people through pre-employment job training through institutions, and on the job training[79].

The local landowners anticipate that the SIG will provide education and training sponsorships and scholarships as part of a benefits program. The opportunities for education and training will become clearer once project planners have identified the workforce requirements, and employment policies have been developed.

It is recommended that the TRHDP PO survey local villagers to identify people interested in working on the project construction, and that the survey include a preliminary skills and experience audit. On the basis of the survey and the workforce requirements, the contractors,

[79] Don Bosco Technical Institute and the Solomon Islands Association of Rural Vocational Training Centres offer village-based and residential training in relevant areas (See http://www.siartc.org.sb/publications.html)

working with SIG and local training providers, should facilitate community participation in the project, by providing:

- Project work-readiness courses to job seekers/aspirants in the project area, including resume preparation, work safety and health, and money management, and;
- Training, where possible, in specific skills (e.g., driving, plant operation, trades assistants, etc).

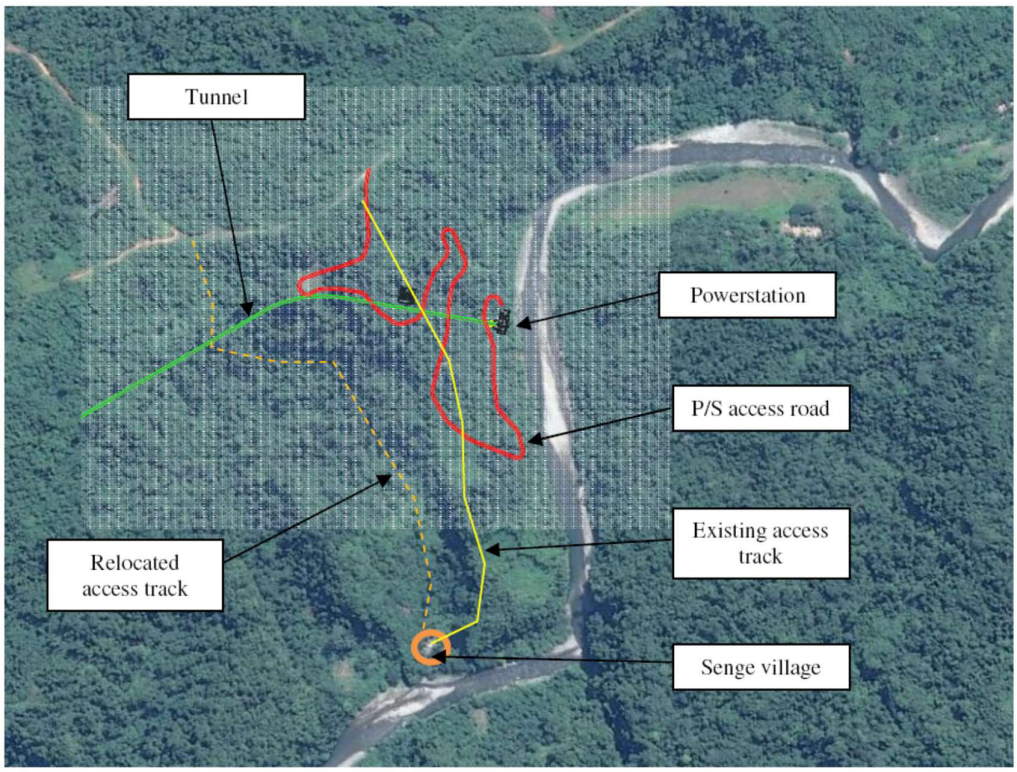
As part of a promised benefits sharing program the SIG has begun implementing a much needed and well-received $2 million upgrade to schools in the Bahomea area. The project could also support transportation to the schools.

### 12.6.5 Ecotourism Opportunities

One on hand, tourism could be enhanced as a result of improved roads and access to the upper catchment. However, the reduced flow in the by-passed section of the Tina River could reduce the site's attractiveness for eco-tourists.

The access track to Senge Village (see Figure 12-8), which used to run a small-scale ecotourism operation[80] (receiving over twenty international visitors in 2013), will be disrupted by the access road to the powerhouse. Sadly the manager of the Senge operation passed away and the homestay is no longer running.

Figure 12-8 Relocation of the footpath to Sengue




[80] See http:// www.sengevillage.com.

Various tourism development opportunities may be available for tribes/clans that are owners of the core land as well as neighbouring lands. These tourism opportunities are associated with the creation of the hydro reservoir and the possible future creation of a forest reserve in the upper Tina River catchment. Tourism could become a source of employment and revenue for these people. Over the long term, such development could be linked to a potential development of a trans-Guadalcanal trail, linking the North coast with the central mountains and the Weather Coast.

## 12.6.6 No Population Displacement or Resettlement

One of the main concerns of local people regarding the TRHDP is the change in the size and composition of the population in the project area. People fear that they will be swamped by squatters, and by workers from other islands. There are two ways in which hydroelectric developments typically affect the size, character, and distribution of the population by:

- Displacing existing residents from particular locations; and
- Introducing a construction and/or operations workforce which becomes temporarily or permanently resident in the host area.

The potential for such effects is discussed below.

#### 12.6.6.1.1 Damsite and Reservoir

No houses or community facilities are located within the Core Area or the land required for the Infrastructure Corridor. For example, the village of Choro, is the closest settlement to the dam site, but is located 2.3km downstream outside the project Core Area, and has two elderly part-time residents. Senge Village is located 4.8km downstream from the dam site and has 3 households and approximately 16 residents. Although the construction of the powerhouse access road may cause disruption to people from Senge Village, no households will need to be relocated to make way for construction of the dam, quarries, or storage reservoir.

#### 12.6.6.1.2 Powerhouse Site and Access Road

The proposed powerhouse will be located 5.7km downstream of the dam. Habusi settlement, which is located on the right bank of the river, is approximately 0.5km downstream of the proposed powerhouse site. Pachuki lies on the left bank 1km downstream of the powerhouse. Neither Habusi or Pachuki will require temporary or permanent relocation due to the construction of the powerhouse and tailrace.

Upgrading and realignment of the main access road to the project area (Black Post Road) will not require the resiting of any individual houses. Houses located very close to the road reserve could experience temporary disruption (vibration, noise, dust, physical danger) during the construction period.

In summary, the construction and operation of the preferred alternative (Option 7C) will not require any current villages to be relocated or residents to be displaced from their homes. Physical resettlement is, therefore, not required.

## 12.6.7 Improved Roads and Accessibility

The Black Post Road provides access to several communities located around the Tina village but not to settlements adjacent to the Ngalimbiu/Tina River. Settlements between the Tina village and Senge village can only be accessed on foot by bush tracks or along the river bed.

The upgrading of the existing Black Post-Tina-Mangakiki Road are seen by local people as a considerable benefit to the community. The improvement of the road will allow:

- Better and more reliable transportation services throughout the area;
- Reduce the maintenance costs for those who already have vehicles; and
- Improve access to health and other public services, facilities, markets, events, and employment opportunities both within and outside of the immediate district. Women see considerable benefits in being able to better access health services for themselves and for their children.

In the longer term, and providing the roads are maintained, the people of Bahomea will benefit from having a much higher quality and safer road than at present, which will enable the provision of better public transportation services to and from Honiara. Better quality roads will also mean shorter travel times and higher service reliability, especially during wet weather. Accessibility should, therefore, improve for all local rural communities, with flow-on effects to people's welfare and development.

### 12.6.8 Local Financial Capital and Economic Development

Local communities have considerable expectations that the TRHDP will be accompanied by a SIG funded benefits program, which aims to improve local services and facilities, such as schools, health centres, roads, water and electricity supplies. New schoolrooms and road improvements have already been provided by the SIG, which has fostered a degree of confidence in the ability of the Project to deliver benefits to local communities.

Based on previous and ongoing experience of developments in the Central-north Guadalcanal area, people in the wider project area believe that the TRHDP may be a good (and perhaps easy) source of income. Local people expect this to come from access fees, meeting fees, compensation (for the purchase of land and loss of livelihood assets) and community or individual payments for agreeing to the project. Some also expect to receive cash rather than traditional :compensation' payments for damages to their land and resources. According to the local communities, such payments are seen to potentially improve their standard of living and status.

The TRHDP has already contributed - and will continue to contribute - to the amount of financial capital available to the communities of the project area. This contribution has come from:

- Payments to land owners for access fees, and for provision of services during planning and feasibility studies, and;
- Payments for the acquisition of the rights to use the Core Area.

Unfortunately, it is often reported in Solomon Islands that the distribution of royalties or other project payments is not done properly. Solomon Islands newspapers regularly feature articles about intra and intertribal conflicts and legal battles over land ownership, resource sales, and royalty entitlements. Research shows that only a fraction of the cash from logging royalties goes to the actual owners of the forest resources[81]. As a case in point, only a small amount of the SB$2.7 million paid by the SIG to the 27 tribes/clans of the Landowners Council to

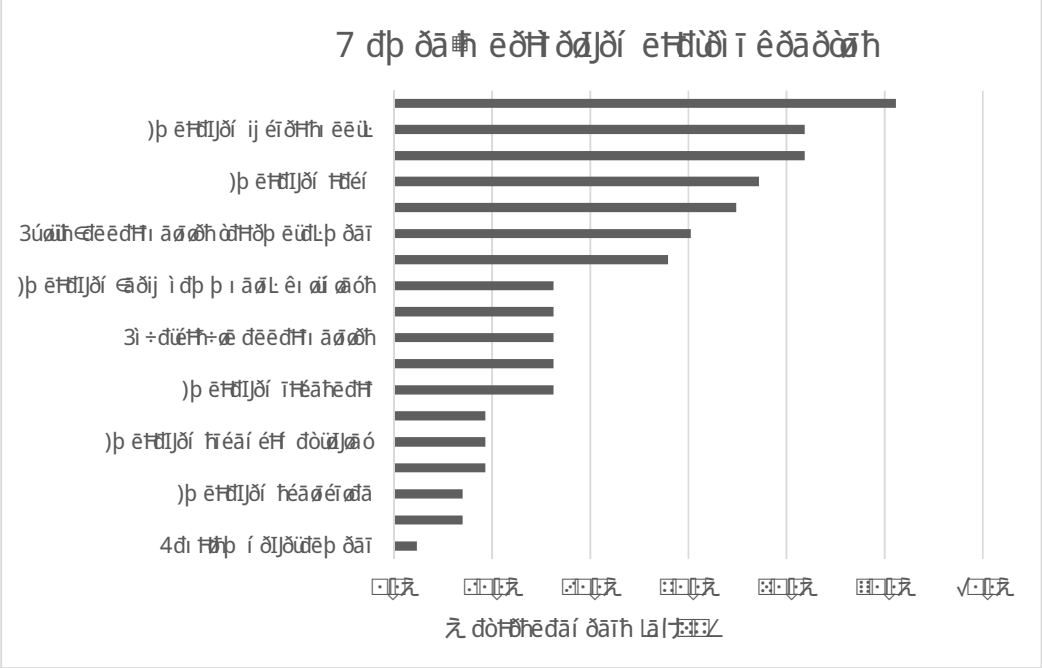
[81] ◦ situation

obtain access to the project area for geotechnical and other studies appears to have found its way to individual households. The PO has terminated working with the Landowners Council and has addressed potential distribution problems. This is addressed through the arrangements in which compensation and acquisition payments have been and are being distributed directly to individual tribal members, set aside for investment, or paid transparently towards cultural expenses as set out in the LALRP.

### **12.6.9** Potential Project Benefits for Women

According to women's perception on the benefits of the TRHDP, the main benefits are: electric lighting; improved water supply; electric supply; improved roads; community facilities (e.g., clinic); and skills and opportunities for employment (see Figure 12-9). Other potential benefits of the Project are reflected in the survey results.

Figure 12-9 Women's perception on the benefits of the TRHDP



# 13. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

## 13.1 INTRODUCTION

This section sets out TRHDP's Environmental and Social Management Plans. It is, among other things, the basis for the construction (CESMP) and operations (OESMP) ESMPs that will be prepared by the Project Company. Information is provided on environmental and social mitigation measures, monitoring programs, capacity development and training, implementation schedule and budget, and project integration. Information is provided on environmental and social mitigation measures, monitoring programs, capacity development and training, implementation schedule, an indicative budget, and project integration.

The developer is to prepare a CESMP and an OESMP as stand-alone documents, regarding this ESMP as setting out the minimum requirements. The developer is also to prepare a number of management sub-plans in accordance with section 13.4. The detailed management plans will identify specific measures for environmental protection and for mitigation of social impacts in line with this ESMP and the applicable policies of the World Bank and ADB, and will provide specific actions to be taken during construction and operation, including roles and responsibilities, and timeframes.

In addition to World Bank assessment and approval, the developer's CESMP will be reviewed and assessed as a component of the developer's Environmental Impact Statement under the Environment Act and the OESMP will be prepared and submitted to the Ministry of Environment, Climate Change and Disaster Management prior to commissioning.

Overall responsibility for environmental and social management of the Hydropower Project will rest with the Special Purpose Company managed by K-Water (SPC), which will, in turn, contract the construction day-to-day environmental and social management to the EPC contractor (HEC).

Solomon Power will have primary responsibility for the implementation of measures applicable to the construction and operation of the transmission lines. The Ministry of Mines, Energy and Rural Electrification will be the key actor for measures applicable to the access road upgrade from the Black Post turnoff to Mengakiki (Lot 1), and will delegate the day to day management to the road construction contractor.

SIG (through the TRHDP-PO), and WB, will undertake monitoring and oversight of environmental and social management, and project finance is allocated to supporting SIG in this role.

## 13.2 MITIGATION MEASURES

Mitigation measures are identified as those aimed at protecting the natural (physical and biological environment) and those that are focused on protecting the social (socio-economic / socio-community) environment, during construction, operation and post-operation phases, and ultimately, project decommissioning.

## 13.2.1 Measures to Protect the Natural Environment

This section presents good international industry practice (GIIP) for activities such as forest clearing, vegetation control, earthworks, and access road construction, that may adversely affect terrestrial and aquatic ecosystems.

In addition to the specific measures outlined in this section, it is recommended that the following information sources be consulted:

- Best Management Practices presented in the document `Low-Volume Roads Engineering Best Management Practices Field Guide, USAID (2013); and
- Roads in Rainforest: Best Practice Guidelines for Planning, Design and Management. Guidelines prepared for the Queensland Department of Transport and Main Roads and the Australian Government's Marine and Tropical Sciences Research Facility (2010).

### 13.2.1.1 Reservoir Preparation, Filling and Operation

Reservoir vegetation clearing will reduce the emission of GHG from the reservoir. The level of reduction is, however, impossible to predict since GHG are also produced from organic matter trapped in river bed load material and sediment. Clearing will also reduce the amount of biochemical oxygen demand resulting from decaying plant material that can impair reservoir water quality.

| Impacts Addressed: |
|---|
| <u>Reservoir Preparation:</u><br>Impacts of GHG Emissions on physical environment (see section 9.2.3.5)<br>Impacts of increased suspended solids and siltation on aquatic life (see section 11.4.3.1)<br>Impacts of River Pollution on aquatic life (see section 11.4.3.2)<br>Disturbance to aquatic habitats and aquatic life (see section 11.4.3.3)<br>Impacts of temporary diminished water quality and quantity on aquatic environment (see section 11.4.3.5)<br>Temporary de-watering impacts on aquatic environment (see section 11.4.3.6)<br>Reservoir Water Quality (see section 11.4.4.8)<br><br><u>Reservoir Impoundment:</u><br>Impacts on Surface Hydrology (see section 9)<br>Impacts on aquatic life of reduced flow (see section 11)<br><br>Impacts on water users (see section 12) |
| Measures: |
| <u>Reservoir Preparation:</u> |

Prior to reservoir impoundment, trees with a diameter larger than 10cm will be cleared from within the reservoir area up to an elevation of 186.5masl, which corresponds to Maximum Flood Level (11.5m above FSL 175masl). Loose rocks and rubble along the steep faces of the river gorge will be removed where possible.

Reservoir vegetation clearing will be conducted during the latter phase of the construction program, as the dam and powerhouse are nearing completion, just before reservoir inundation is set to commence. The timing is critical so as not to enable vegetation to regrow or become re-established before water is impounded. Depending on the schedule for reservoir filling, vegetation clearing may proceed in distinct phases, with the lowest elevation areas of the future reservoir inundation zone being cleared first, followed by the higher elevation inundation zone.

Ideally, all plants and topsoil should be stripped off of the future reservoir to limit organic matter decomposition in the lower layer of the reservoir creating anaerobic conditions.

Due to the steep topography, vegetation is to be manually removed by workers hired from local communities, and that the relatively thin layer of organic topsoil be left in place. Sawn timber could be transported either by access road or by river as it is currently done from Choro and Koropa.

Vegetation clearance will be carried out during the dry season where possible.

Use of Glyphosate or any herbicide to kill trees is strictly forbidden during all vegetation clearing activities including vegetation control under the transmission line.

Reservoir clearing will not involve grubbing (removal of stumps) and soil stripping, since only manual work will be feasible.

Reservoir to be demarcated with spray paint to avoid encroaching on additional natural habitat

Reservoir Impoundment:

é Maintain an environmental flow of 1m$^3$/s during reservoir impoundment at all times.

| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
|---|---|---|
| Developer<br><br>Local Community (for reservoir clearing) | TRHDP PO | PPA |

### 13.2.1.2 Hydro Facility Operation

| Impacts Addressed: |
|---|

| |
|---|
| Reduced Flow Between Dam and Powerhouse:<br>Physical impact of reduced flow between the dam and power station during normal operations on surface hydrology (see section 9)<br>Indirect impacts on fauna species (see section 10.6.1.2.1)<br>Impacts of changes of flow downstream of dam on aquatic life (see section 11.4.4.4)<br>On-going disturbance to downstream aquatic habitats (see section 11.4.4.10)<br>Impacts on water users (see section 12)<br>Reduced Overnight Flow:<br>Impacts of reduced river flows downstream of dam site during overnight reservoir refill on surface hydrology (see section 9)<br>Impacts on aquatic life of reduced flow (see section 11)<br>Impacts on water users (see section 12)<br>Reduced Sediment Transport:<br>Impact of physical reduction of sediment transport (see section 9)<br>Impact of reduced sediment transport on aquatic life (see section 11)<br>Impact of reduced sediment transport on gravel extraction activities (see section 12)<br>Impacts of reservoir sedimentation on aquatic environment (see section 11.4.4.2) |
| Measures: |
| Reduced Flow Between Dam and Powerhouse:<br>Maintain a minimum environmental flow of 1m$^3$/s at all times in the bypassed section of river between the dam and power station<br>Reduced Overnight Flow:<br>Recommended to maintain a minimum flow of 3.4 m$^3$/s flow below the power station during over night reservoir refill. One option for achieving this is to maintain the 1m3/s environmental flow and continue to run 2.4m3/s through the power generators.<br>Reduced Sediment Transport:<br>Flushing to be undertaken periodically. An outlet of 3x3m is proposed near the power intake at 160masl. Once sediments reach this level, the outlet will be used either for local flushing or for lowering the reservoir to permit dredging/excavating of accumulated sediments.<br>Storage operation to be designed to enable occasional dewatering for the purposes of excavating or dredging accumulated bed load sediments. The design study should consider access to the reservoir to excavate the accumulated bed load. |

| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
|---|---|---|
| Developer | TRHDP PO | PPA |

### 13.2.1.3 Barrier to Fish Passage, and Fish Entrainment

| Impacts Addressed: |
|---|
| Barrier to Fish Passage:<br><br>Barrier to passage of migratory fish species (see section 11.4.4.3)<br><br>Fish Entrainment:<br><br>Barrier to passage of migratory fish species (see section 11.4.4.3)<br><br>On-going disturbance to downstream aquatic habitats (see section 11.4.4.10) |
| Measures: |
| Barrier to Fish Passage:<br><br>Implement a trap and haul system in accordance with Appendix G of the ESIA<br><br>Fish Entrainment:<br><br>Proposed to increase the normal operating level to near full supply level, during the first month of the wet season, to facilitate the downstream movement of adult eels over the spillway during floods. The loss of generation resulting from increasing spill would be partially offset by the increased generation from the extra head on the turbines.<br><br>Proposed to install 15-25 mm screens in front of the intake structure to prevent the ingress of large eels. |

| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
|---|---|---|
| Developer | TRHDP PO | PPA |

### 13.2.1.4 Access Road Location, Design, Construction and Operation

| Impacts Addressed: |
| --- |
| Location and Design:<br>Slope stability and geological impacts (see section 9)<br>Erosion (see section 9)<br>Human encroachment to upper Tina (see section 12)<br>Installation of Drainage Works and Stream Crossings:<br>Construction and operation impacts on fauna (see section 10.5.2.1)<br>Impacts of hydrological changes on flora (section 10.5.1.2.1)<br>Impacts of increased suspended solids and siltation on aquatic life (see section 11.4.3.1)<br>Impacts of River Pollution on aquatic life (see section 11.4.3.2)<br>Impacts of diminished water quality and quantity on aquatic environment (see section 11.4.3.5)<br>Disturbance to aquatic habitats and aquatic life (see section 11.4.3.3)<br>Environmentally and Culturally Sensitive Areas:<br>Impact of deforestation on environmentally and culturally sensitive areas (see section 9)<br>Road Access Restrictions:<br>Operational impacts on flora (see section 10.6.1.2.1) |
| Measures: |
| Location and Design:<br>Retain structures, such as gabion walls and remove of upslope colluvium to minimize the risk of landslides occurring during both access road construction and operation.<br>Upgrading of Black Post Road to be carried out in close consultation with the relevant villages, including with respect to village water supply locations.<br>Access roads to quarries to be unsealed to allow vegetation to regrow after use and to avoid encouraging human settlement in upper Tina areas.<br>Temporary roads to be permanently closed at Project completion. This requires removal of all stream crossings, breaking of road surface (scarification) to allow vegetation to regrow and installing earth mound at road entrance. Important cut areas to be refilled with excess soil. |

Road shall have surface drainage and subsurface drainage. Proper compaction of the subgrade and pavement will improve subsurface drainage. If necessary, under-drains to be installed.

Sufficient cross drains will be installed to avoid erosion. Drains will not be hydraulically connected to streams. Instead, they will exit via ditches into stable, vegetated areas or discharge into settling ponds.

The period of time between forest clearing and sealing of the road will be minimised to avoid erosion of exposed soil. Sediment control structures (e.g., silt fences, settling ponds, blind ditches, French drains, etc.) will be installed as earthworks progress along the access road. Along earthworks and work areas where disturbed soil may remain exposed during construction, ditches will installed to receive stormwater, and to drain exposed soils. These ditches will drain to vegetated areas or, in the case of spoils disposal sites or soil stockpile areas, to settling ponds. Settling ponds will be built to allow for percolation and dimensioned to receive stormwater inflows during heavy rainfall events, and to allow sediment to settle out of suspension. Wherever small channels of stormwater are identified during construction, they will be temporarily diverted away from areas to be cleared of vegetation. However, this does not apply to permanent streams whose channels will not be diverted. After initial clearing, culverts will be installed within small channels.

Ditches along the access road will never directly drain water to water bodies or wetlands. Surface drainage will be directed to silt fences, vegetated areas or erosion control mats.

Keep haul roads off sloping terrain wherever practical.

Depositing soil outside the limits of access road earthworks prohibited within 100m of nearby streams.

Design the slope of a cut to minimise the angle of incline.

<u>Installation of Drainage Works and Stream Crossings:</u>

A watercourse crossing management plan will be produced by the construction contractor prior to construction

Surface watercourses in vicinity of access road shall be geo-referenced and physically delineated during the rainy season, to ensure that crossings are properly sized taking into account high flows.

All identified tributary streams in the vicinity of construction activities to be protected by fences.

Sites for crossings shall be identified prior to forest clearing to ensure that they are excluded from alignment clearing since clearing at stream crossings will be undertaken within a narrower corridor. Deeply anchored silt fences will be positioned to avoid sediment from entering streams during earthworks.

Where a road will cross a stream the road crossings shall be constructed perpendicular to the stream to reduce the area of disturbance

Culverts shall be equipped with head walls to ensure long-term stabilization of the crossing and their outlet shall be protected with riprap to avoid erosion. Culverts will be open bottomed, and not alter stream bottom elevations.

Culverts and stream crossings will be constructed with the use of an excavator, instead of a bulldozer, to avoid excessive soil disturbance and to avoid sediment laden soils from entering into the watercourse.

Fauna friendly underpasses/culverts shall be constructed under access road at stream crossings. Culverts shall be large enough to provide dry passage for terrestrial animals (i.e., reptiles and small mammals). In addition, it is recommended that wildlife passage culverts be installed in such a manner as to allow wet passage for amphibians and fish, and dry passage for amphibian, reptiles, and small mammals (see Figure 13-3.

The dry passage will provide suitable cover such as rock piles, logs, and brush. For example, ledges will be large enough to allow Cuscus to cross (with a width of 1m).

Size and type of stream crossing will be designed to avoid affecting the flow (i.e., the crossing will be large enough to pass design flood flows), to allow debris to pass and to miminize environmental impacts. In addition, due to the nature of the environment, metal trash-rack should be installed just upstream from stream crossings to prevent debris from blocking culverts.

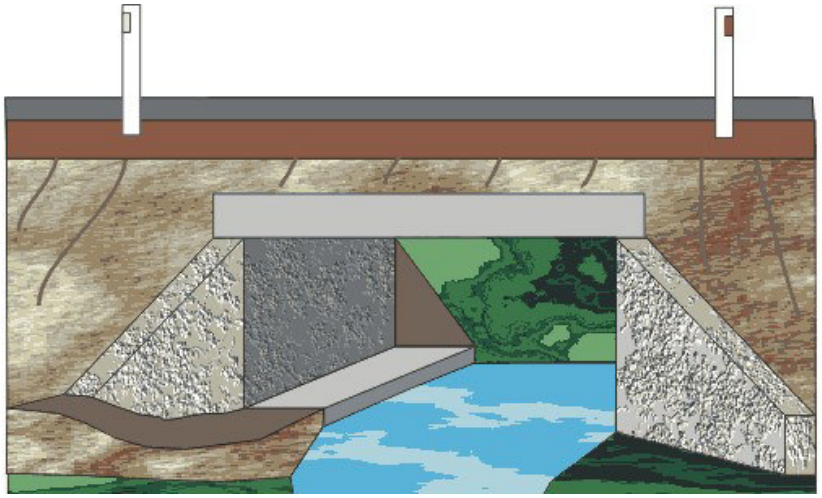


Figure 13-1 Culvert with dry passage for reptiles

Source: Vinci autoroute, 2014

Environmentally and Culturally Sensitive Areas:

Once the final access road alignment has been determined, and all areas that require forest clearing have been identified, a botanist will walk the full length of the road (starting from Mangakiki) and other areas where construction will take place to geo-reference and fence environmentally and culturally sensitive areas such as:

- Wetlands;
- Streams;
- Rare, endangered plants and culturally or economically important plants colonies; and
- Large trees that need to be kept to maintain canopy closure to decrease the amount of edge-effected forest.

Fencing will be done using orange plastic construction fencing material supported on wooden or steel pickets.

Once fenced, each environmentally or culturally sensitive area will be mapped. The map of these protected sensitive areas will then be presented to a committee comprised of the resident engineer for the dam construction, construction contractors and forest clearing subcontractors, and the independent environmental expert. This committee will discuss potential solutions for protecting each sensitive area identified, including:

- Wetlands located in the right-of-way ¯ if road alignment bi-sects a wetland then culverts shall be installed. If the work areas are located in a wetland, they shall be relocated nearby.
- Streams located in the right-of-way ¯ sites where the road will cross streams will be fenced to denote the site of the crossings, the areas outside of which would be `no go_ zones. Work should not occur within the wetted perimeter of any streams. Stream crossings requiring bridging should be clear-spanned.
- Rare or endangered plants in the right-of-way ¯ in case of encounter avoidance measures will be discussed to adapt road alignment or to relocate work area. If measures to avoid endangered plants are not possible, then transplanting plant colonies should be

considered an option. Plants would be relocated as far as possible away from the area of disturbance under the supervision of a botanist.

Large canopy trees - large trees that provide canopy cover will be protected from unnecessary clearing, wherever possible. Fencing will be placed around these trees.

Road Access and Land Occupation Restrictions:

Extension of Black Post Road from Mangakiki to dam site to remain a private access road that will be gated. Access will be restricted by the Project Company and the TCLC to local population and hydropower facility operator. Commercial logging trucks will be prohibited.

The TCLC and Developer will not permit anyone to live or construct housing within the land leased for the project, except where strictly necessary for project activities, including housing fort rangers or security staff.

These measures will be developed and implemented with the assistance of the TCLC, and set out in the Biodiversity Managemept Plan and Construction ESMP. The plans will include enforcement measures to prevent the use of the land for a workers camp. The BMP will also address restrictions on the use of the private project road through the Core Area by people seeking to build new settlements beyond the Core Area.

| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
|---|---|---|
| Ministry of Mines, Energy and Rural Electrification (MMERE)<br><br>Road Design Contractor<br><br>Road Construction Contractor<br><br>Developer with respect to maintenance of the access road:<br>- from Mengakiki to dam site for BOOT period<br>- from Black Post turnoff to Mengakiki until commissioning<br><br>Ministry of Infrastructure Development (MID) with respect to maintenance of access road from Black Post turnoff to Mengakiki following commissioning<br><br>Tina Core Land Company (for controlling access to Core Lands) | TRHDP PO | Incorporated into Road Design Contract<br><br>To be incorporated into road construction contact between MMERE and road construction contractor<br><br>PPA (with respect to road closure) |

### 13.2.1.5 Vegetation and Forest Clearance

| Impacts Addressed: |
| --- |
| Extent of Clearing:<br>Physical impact of soil compaction and erosion (see section 9)<br>Impact of sediment run-off on aquatic life (see section 11)<br>Clearing and Grubbing:<br>Impacts of vegetation burning on regional and local air quality (see section 9)<br>Physical impact of soil compaction and erosion (see section 9)<br>Loss of or disturbance to terrestrial natural habitat (see section 10)<br>Impacts of increased suspended solids and siltation on aquatic life (see section 11.4.3.1)<br>Impacts of River Pollution on aquatic life (see section 11.4.3.2)<br>Disturbance to aquatic habitats and aquatic life (see section 11.4.3.3)<br>Impacts of diminished water quality and quantity on aquatic environment (see section 11.4.3.5)<br>Construction impacts on grassland dependent birds (see section 10.5.2.1)<br>Construction impacts on river dependent birds (see section 10.5.2.1) |
| Measures: |
| Extent of Clearing:<br>Coordinate work schedules so no delays in construction activities resulting in disturbed land remaining unstabilised.<br>Program construction activities so that the area of exposed soil is minimised during times of the year when the potential for erosion is high, for example during rainy season when intense rainstorms are common.<br>During any pause in construction, stabilise site and install and maintain erosion controls so that they remain effective during pause. This is particularly important if project stops during the wetter months.<br>Clearing and Grubbing: |

Forest and vegetation clearing activities shall be strictly limited to the minimum footprint required. Work areas to retain riparian forests where possible. Contractors may be tempted to fell trees of commercial value that will remain close to clear-cut areas. However, this activity is prohibited, even if requested by landowners. An independent environmental expert will monitor clearing activities to ensure compliance with this measure. The developer's Biodiversity Action Plan will provide for an offset to achieve no net loss of biodiversity as a result of conversion of natural habitat. It will include protection of remaining natural habitat in the Core Area and rehabilitation of modified habitat at least equal in area to the amount of natural habitat that is cleared.

Where vegetation clearance subcontracted to logging company, work shall be subject to strictest contractual measures to ensure compliance with environmental plans and shall be monitored by the independent environmental expert.

Cleared vegetation shall not be stored or dumped into streams.

Use of Glyphosate or other herbicides to kill trees or other vegetation will be strictly prohibited during all vegetation clearing activities, including vegetation control under the transmission line.

Vegetation control shall be carried out during the dry season to limit erosion and sediment-laden runoff from disturbed ground.

Existing vegetation or revegetating and mulching disturbed areas to be done as soon as possible.

Wherever possible, clearing areas of highly erodible soils and steep slopes which are prone to water and wind erosion to be avoided.

Work areas to be clearly delineated near riparian habitats prior to commencement of work.

Revegetate and mulch progressively as each section of work as completed. The interval between clearing and revegetation should be kept to an absolute minimum.

Wetlands in the transmission line right-of-way not to be drained, unless they represent a threat to stability of the access road, and will be protected from machinery.

Use of machinery to control vegetation to be limited to stable areas.

Close to streams, machinery will not be used to clear vegetation to minimise disturbance to stream banks;

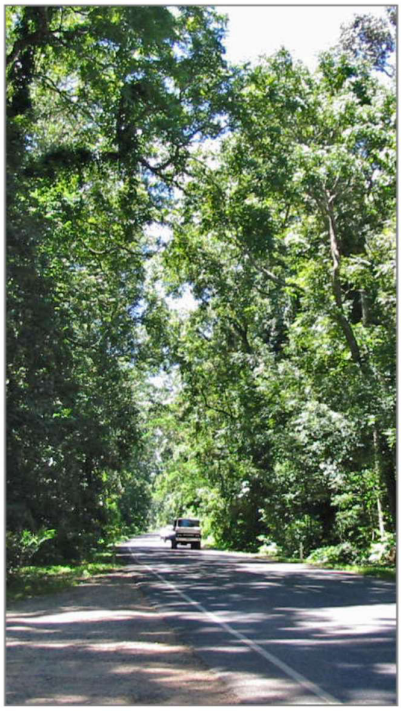
Workers in charge of vegetation control will be trained on health and safety issues and will wear suitable personal protective equipment, when removing or cutting vegetation, especially when felling trees.

For safety reasons, local communities will be notified prior to vegetation control activities in the vicinity of residential areas.

Non-merchantable vegetation shall be shredded rather than burned and shredded materials used to produce mulch to assist with erosion control.

Wherever possible, the canopy shall be `sealed_ by minimizing large tree clearing to maintain canopy connectivity and reduce the edge effect. Along the road alignments, a botanist will identify large canopy trees that will be retained to maintain canopy closure (see Figure 13-2). However, for the transmission line, electrical grid protection prevails over this measure.

Figure 13-2 Monitoring canopy closure to mitigate edge effect



Source: Goosem et al., 2010

Transmission Line - After the initial vegetation clearance, Solomon Power or its contractors will carry out vegetation control to cut back vegetation that could potentially grow to a height that would interfere with the electrical conductors of the transmission line. Training shall be conducted to ensure workers identify and leave low-level native vegetation to prevent spread of invasive weeds.

| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
|---|---|---|
| Developer (including botanist for demarcating environmentally and culturally sensitive areas)<br><br>Solomon Power | TRHDP PO | PPA |

### 13.2.1.6 Drilling and Blasting

| Impacts Addressed: | | |
|---|---|---|
| Construction impacts on physical environment of noise and vibration (see section 9)<br>Construction impacts on fauna (see section 10.5.2.2.2) | | |
| Measures: | | |
| The Project Company will prepare a Drill and Blast Management Plan that includes specific drill and blast methods to reduce noise and vibration. Hydraulic rock drill equipment will be used instead of pneumatic equipment because it produces less noise. Moreover, blasting and drilling equipment will be equipped with silenced masts, which can reduce noise levels by up to 10dBA. Blasting charges will be covered with blasting mats and screens to reduce generation of noise, fly rock and dust. | | |
| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
| Developer | TRHDP PO | PPA |

### 13.2.1.7 Accidental Release of Sewage and Other Wastewater

| Impacts Addressed: | | |
|---|---|---|
| Impacts of Point Source Pollution on Flora (section 10.5.1.2.1)<br>Impacts of River Pollution on aquatic life (see section 11.4.3.2)<br>Disturbance to aquatic habitats and aquatic life (see section 11.4.3.3)<br>Impacts of diminished water quality and quantity on aquatic environment (see section 11.4.3.5) | | |
| Measures: | | |
| The presence of on-site toilet facilities for workers mandatory.<br>All sanitary wastewater will be regularly transported outside of the study area for treatment. | | |
| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
| Developer | TRHDP PO | PPA |

### 13.2.1.8 Hazardous Materials, Explosives and Concrete Works Handling

| Impacts Addressed: |
| --- |
| Impacts of Point Source Pollution on Flora (section 10.5.1.2.1)<br>Impacts of increased suspended solids and siltation on aquatic life (see section 11.4.3.1)<br>Impacts of River Pollution on aquatic life (see section 11.4.3.2)<br>Disturbance to aquatic habitats and aquatic life (see section 11.4.3.3)<br>Impacts of diminished water quality and quantity on aquatic environment (see section 11.4.3.5) |
| Measures: |
| A hydrocarbon (fuel, oil, lubricant) management plan will be prepared and implemented by the construction contractor(s) prior to commencement of construction.<br>Facilities for storing hazardous materials, including fuel, lubricating oil, concrete curing agents, form releasing agents, sealants, and other hazardous products, will be approved by the resident engineer.<br>The resident engineer will also approve a separate secure `bunkered_ facility for storing explosives.<br>Secondary containment will be required for all hydrocarbon products (fuel, oil, lubricants) used on the Project. Hydrocarbons will be stored on flat ground at least 100 meters from any water body or wetland.<br>Any hydrocarbon storage tanks or oil/fuel drums will be free of rust and cracks. Bund walls shall be provided and maintained around hydrocarbon storage areas within the Site. These bund walls will be of a sufficient height to contain a volume equal to one and one half (1.5) times the entire contents of its fuel storage facilities.<br>Fuel dispensing areas and machinery maintenance areas will be built with concrete hard standing surface, which will drain to oil separators. The oil will be pumped by a tanker and sent to Honiara for treatment.<br>Wash water from concrete works not to be directly or indirectly released in waterbodies or wetlands. Must be reused, stored and treated on site or collected and transported by road tankers for treatment in Honiara. A designated impermeable containment area must be used for concrete activities. To treat concrete washout onsite, a combination of settling ponds can be useful:<br>é Coagulants or flocculants will need to be added before discharging the water into the first or primary pond. This will help to reduce the size of ponds. Water must flow over small weirs from one basin to the next until the quality is good enough to be reused as plant water (closed loop system). The first pond will require periodic cleaning. The hardened concrete that is removed can be crushed and sent to a landfill in Honiara or reused on site as non-structural aggregate for road ballasting or surfacing works yards. The capacity of each pond must be greater than a full day supply of wash water and will take into account that the area often receives considerable rain. Due to the sensitive nature of the area, wash water will never be released in the Tina River.<br>é Each settling pond could allow for seepage and evaporation. For seepage, the water table needs to be low enough so that the water can be filtered without escaping. Settling ponds will need to be well sealed to limit any risks of infiltration of groundwater. |

| |
|---|
| é Water levels of settling ponds will be inspected daily. Before intense rain, the water levels will be lowered. Suitable cover will be installed to cover the pond in the event of intense rain (e.g., folding tarps). Tarps will cover the pond at night to keep birds and bats from drinking unsafe water. When excess water becomes a disposal issue, its pH will be adjusted with automatic pH neutralizer using $C0_2$ gas (the use of acids for that purpose is prescribed) prior to a potential discharge off-site in Honiara. |

| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
|---|---|---|
| Developer | TRHDP PO | PPA |

### 13.2.1.9 Excavation and Movement of Soils

| Impacts Addressed: |
|---|
| <u>Soil Stripping and Stockpiling:</u><br><br>Construction impacts of soil management on flora (section 10.5.1.2.1)<br><br>Impacts of increased suspended solids and siltation on aquatic life (see section 11.4.3.1)<br><br>Impacts of River Pollution on aquatic life (see section 11.4.3.2)<br><br>Impacts of diminished water quality and quantity on aquatic environment (see section 11.4.3.5)<br><br>Disturbance to aquatic habitats and aquatic life (see section 11.4.3.3)<br><br><u>Accidental Colonisation by Invasive Species:</u><br><br>Impacts of Colonisation by Invasive Species on Flora Species (see Section 10.5.1.2.1)<br><br>Impacts of invasive species on Fauna Species (see Section 10.5.2.2.2) |
| Measures: |
| <u>Soil Stripping and Stockpiling:</u><br><br>Salvaging topsoils with high organic content, and mineral soils (i.e., subsoil not capable of supporting plant growth) - prior to commencing construction of the access road, the contractor will be required to do soil coring to assess the depth of organic soil in the right-of-way in cleared forested areas, from Mangakiki to the dam and quarry sites. This will determine the depth of soil stripping that is required. Collection of soil cores, and the management of soil stripping, will be done under the supervision of a soil expert. The aim is to conserve the topsoil for future use in rehabilitation of disturbed areas and to reuse subsoil for road embankments.<br><br>Usually, machinery will be used to strip topsoil layers to a depth of 1m. |

Storage of topsoil ¯ topsoils having a high organic matter content, that have good potential for plant regrowth, will be stored within a soil stockpile area. Topsoil storage will be done away from all water bodies on a flat terrain, and close to work areas. Stockpiles will be either compacted and covered with geo-fabric tarps to avoid unwanted prolific plant or seeded with indigenous herbaceous plant species to maintain the organic content of piles. If the supply of native plants to vegetate piles is limited then stockpiles will be covered. In both cases, stockpiles slopes will not exceed a horizontal to vertical ratio of 5H:1V, and will be surrounded by sediment control structures, such as deeply anchored sediment fences, ditches, or berms around the stockpiles.

In addition, stockpiles and all disturbed areas, including those adjacent to road alignments, will be drained to enable sediment control structures, such as settling ponds, to prevent sediment laden runoff flowing into water bodies. Stockpiles of topsoil will be maintained at a pH of greater than pH5.5.

Monitoring of stockpiles will be done throughout the construction phase. Exact location being determined by the construction contractor, a botanist, and the independent consultant.

Recommended that spoils be stored in the remnant forest habitat to minimize forest clearing

In addition to soil spoils, non-organic (mineral subsoil spoils) and rock will also need to be removed and disposed, or reused, as follows:

- Subsoil spoils - Soil spoils produced by cuts to be reused for fill embankments and unsuitable soil spoils to be transported outside the Project area to a designated disposal site.
- Rock spoils - Spoils not utilised in construction to be disposed of in quarries.

Accidental Colonisation by Invasive Species:

Machinery to be checked by designated staff before equipment can enter project area. Wheels, tracks, buckets and other parts of machinery must be clean of mud and soil materials. Washing station will be installed just outside the project area at Veroande (see Section 6.4.2.1 ¯ Invasive and Feral Species). Drainage water from washing stations to be diverted away from water bodies.

Importation of soil from outside work areas will be prohibited.

Soil deposited in the construction area will never be permanent in order to avoid colonization by invasive species. Soil stockpiles will be covered with geofabric tarps or revegetated with native plants. Soil Management Plan will be prepared by developer to assess the amount of spoils from road cuts, the need for road embankment and future use of excess soil; and to locate stockpiles.

Topsoil will be left on site and will be reused as much as possible.

Chemical and biological control of invasive plant species is not recommended as the extent of the impacts will be limited spatially.

Local population will be sensitized regarding the threat posed by Water Hyacinth and the consequences should it find its way into the area.

Terrestrial habitat fragmentation:

To mitigate indirect impacts of the terrestrial habitat fragmentation and the edge effect, the following actions will be implemented:

| | | |
|---|---|---|
| é Construction activities will be favoured in already affected areas (such as along the existing access road) and in disturbed and remnant forests rather than undisturbed primary forests.<br>é Where possible, impact-causing activities will be spatially concentrated to limit any encroachments. | | |
| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
| Developer<br><br>(Soil Expert)<br><br>Overseen by Environmental Monitoring Consultant | TRHDP PO | PPA |

### 13.2.1.10 Activities Causing Disturbance to Wildlife

| Impacts Addressed: |
|---|
| Workers Affects on Fauna:<br><br>Construction and operational impacts on fauna (see section 10.5.2.1)<br><br>Lighting Disturbance:<br><br>Construction impacts on fauna (see section 10.5.2.2.2)<br><br>Transmission Line Operation:<br><br>Operational impacts on bats, birds and marsupials (section 10.6.2.1)<br><br>Harvesting by Workers:<br><br>Impacts of over fishing (see section 11.4.3.4)<br><br>Operational impacts on fauna (see section 10.5.2.2.2) |
| Measures: |
| Workers Affects on Fauna:<br><br>Workers prohibited from harming wildlife.<br><br>Workers to receive wildlife awareness training informing them of the requirement to request the project's environmental specialist capture and remove animals that are either in danger or are dangerous to construction workers. Workers will be restricted to work areas and shall not enter adjacent natural habitat except where required for Project purposes. |

Workers to discard all rubbish and food waste in designated areas.

Lighting Distrurbance:

The number of artificial lights during construction period shall be kept to a minimum, while still maintaining a safe working environment.

Light intensity will also be limited, where possible, and the lights will be oriented toward the ground to avoid disorienting bats in flight.

Regular use of artificial lights during operational period shall be avoided.

Transmission Line Operation:

Metal shields to be installed on wooden power poles in forested areas to prevent Cuscus from climbing poles and becoming electrocuted.

Harvesting by Workers:

Workers will be prohibited from fishing in the Tina River, noting that this restriction will not prevent local villagers who also work on the Project from continuing their existing subsistence fishing activities outside of work hours.

Project's food services / caterers will be prohibited from purchasing fish from local villagers.

Vehicle speed limits will be controlled along the access roads, to ensure that drivers are able to prevent running over wildlife that may be lying on, or crossing, the access road.

| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
|---|---|---|
| Developer<br><br>Solomon Power (for transmission line) | TRHDP PO | PPA |

### 13.2.2 Measures to Protect the Social Environment

This section consolidates the recommendations made throughout the ESIA on the avoidance, mitigation, and management of the adverse social impacts of the TRHDP. The recommendations draw upon:

- Consultations and findings of local people, communities and stakeholders on the potential social impacts of the project during the ESIA fieldwork, community and stakeholder mitigation workshops;
- Review of related projects and studies; and
- Comments of peer reviewers, World Bank experts, and members of the TRHDP team.

The objectives are to:

- Specify the strategies to mitigate the adverse social impacts identified in the ESIA, and to maximise the benefits, as required under the World Bank Operational Policy 4.10 regarding indigenous peoples;

- é Establish the responsibilities for managing the social impacts during the construction and operation phases of the TRHDP, including implementation of specific impact mitigation and avoidance measures;
- é Outline a strategy to ensure ongoing community and stakeholder communications, consultation and involvement in project decision-making, including the management of impacts and benefits. Arrangements for including women in decision-making should be explicit;
- é Specify issues regarding loss of livelihoods resources and vulnerable people to be addressed in a Resettlement Action Plan or Livelihood Restoration Plan, as required under the World Bank's operational policies;
- é Present a plan for ongoing social impacts monitoring and reporting; and
- é Present benefits intended for females, children, and vulnerable communities.

#### 13.2.2.1 Siting of Workers Camps

| Impacts Addressed: | | |
|---|---|---|
| Local Customs and Way of Life (see section 12.5.6)<br><br>Health Safety and Wellbeing During Construction (see section 12.5.3) | | |
| Measures: | | |
| To avoid unwanted long-term residence of outsiders in the Tina River communities, the construction contractors are required to provide residential accommodation for incoming construction staff and workers outside of the Tina Valley, preferably in Honiara.<br><br>No workers camps or similar facilities shall be permitted in the project area. The Developer shall explore accommodation options on the east side of Honiara (eg. Panatina) and at Lungga and Henderson, for the workers who live outside of Malango and Bahomea. | | |
| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
| Developer | TRHDP PO | PPA |

#### 13.2.2.2 Employment and Recruitment Practices

| Impacts Addressed: |
|---|
| Uninvited Job Seekers (see section 12.5.5.3)<br><br>Increase in Employment Opportunities (see section 12.6.2) |
| Measures: |

The construction contractor shall implement a recruitment policy prioritizing work-seekers from Bahomea and Malango. If additional recruitment is necessary, job applications shall be open to residents of the nearby areas and Honiara. This measure will be a condition of the Implementation Agreement between SIG and the contractor.

The construction contractor shall include a quota for women and be able to identify explicit strategies to ensure that women are recruited to work on the TRHDP.

It is recommended that the TRHDP PO conduct a survey of local villagers to identify those interested in working on the project construction. The survey should aim to identify preliminary skills and experience.

Based on the survey, the Project Office, together with local training providers, shall provide training to youth and other job seekers in the project area, on subjects such as safety and health, money management, driving, plant operation, trades, and other relevant subjects. Funding for this training is proposed to be provided through a JSDF grant.

Facilities created for the construction of the Project (e.g., storehouses and offices) shall be made available, if requested, for any future use by the community. This use will be facilitated through the Tina Core Land Company and it is proposed that this measure form part of the lease between TCLC and the Developer.

| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
|---|---|---|
| Developer<br><br>TCLC (Facilities Retention)<br><br>TRHDP PO (pre-employment training)<br><br>Training Provider Contractor (pre-employment training) | TRHDP PO | PPA (recruitment policy and quota)<br><br>Pre-employment training (JSDF Community Benefit Share Fund Grant) |

#### 13.2.2.3 Worker Behaviour, and Activities that could Affect Worker Health and Wellbeing

| Impacts Addressed: |
|---|
| Local Customs and Way of Life (see section 12.5.6.1)<br><br>Moro Movement (see section 12.5.6.2)<br><br>Health Safety and Wellbeing (see section 12.5.3) |

| Measures: |
|---|
| The Developer is required to implement the workers˘ code of conduct (see Annex 18 of the Annex Report) covering, for example, working hours and conditions, safety, driving, socially and culturally appropriate behaviour, alcohol and drug use, prohibition on hunting and fishing, driving and use of vehicles, conflict and violence, gender based harassment and cultural heritage protocols. The code of conduct should also set a dress code for women workers who interact with local communities.<br><br>The Developer shall conduct Code of Conduct pre-commencement training with workers.<br><br>The construction contractor will provide tailored workplace health and safety training for construction workers before the start of the project.<br><br>A full-time first aid / nursing post will be established on site and arrangements will be made for medical assistance and evacuation facilities. These matters will be covered in the construction contractor˘s Health and Safety Plan as part of their overall CEMP. |

| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
|---|---|---|
| Developer | TRHDP PO | PPA |

#### 13.2.2.4 Activities that could Affect Villagers˘ Safety, Wellbeing, and Amenities

| Impacts Addressed: |
|---|
| Health Safety and Wellbeing ¯ Construction (see section 12.5.3.1)<br><br>Health Safety and Wellbeing - Operation (see section 12.5.3.2) |
| **Measures:** |
| Road safety concerns related to traffic on Black Post Road will be addressed by:<br><br>¨ Installing roadside fencing and speed controls near residential areas;<br><br>¨ Creating separate footpaths and safe crossing points and bus stop bays; and<br><br>¨ Using best practices for transportation of dangerous goods.<br><br>The construction contractor will develop a protocol for managing contractor-related road accidents and injuries (including compensation and restitution arrangements). The protocol will also address accidents involving power transmission lines. This plan be included in the construction contractor˘s health and safety management plan. |

To avoid traffic-related noise and dust, access roads will be sealed in areas adjacent to villages, community facilities, and food gardens.

Educational programs will be organised by the TRHDP PO to reduce the level of fear expressed by communities regarding potential risks of dam failures and catastrophes. Moreover, to reduce any potential opposition to the development of the Project, the TRHDP PO will design and run a village level educational program to present information, at an overview level, on modern-day dam engineering, construction and operation. The program will pay special attention to reaching women and young people. Community briefings from the World Bank's Dam Safety Panel could complement this program.

As the time for villages to be electrified gets close, Solomon Power shall carry out educational programs in communities and schools to familiarize residents on electricity and its safe use in homes and communities, including safe behaviour around transmission lines and other power infrastructure components.

Specific measures will be implemented to avoid any social threats or mis-conduct.

A strict drug and alcohol prohibition for all workers will be implemented by the construction contractor to minimise any threats of antisocial behaviour. The ban also aims to reduce risks of road accidents on the Tina Road and on the project site.

Awareness will be conducted on STDs including HIV/AIDS to prevent and mitigate the impacts of social behaviors which will encourage sexual behaviours. Outside parties will be engaged to carry out this awareness program.

Condoms will made freely available at the first aid/nursing post to be established on site.

| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
|---|---|---|
| Developer<br><br>Road Design and Construction Contractors<br><br>Solomon Power<br><br>TRHDP PO | TRHDP PO | PPA<br><br>Road Design and Construction Contracts |

### 13.2.2.5 Activities that could Affect Vulnerable Groups and Minorities

| Impacts Addressed: |
|---|
| Minority and Vulnerable Groups (see section 12.5.4.3) |
| Measures: |

Social Impacts Monitoring Plan shall include monitoring of impacts of the project's construction and operation phases on squatters and settlers. The Stakeholder Engagement Plan shall assist communities in having their issues dealt with as the project progresses. This should include a grievance / complaints mechanism, and nominated community representatives for CLAs.

These plans shall include measures directed towards isolated communities, such as Senghe, Choro and Koropa, as these are particularly vulnerable due to changes of flow in the by-passed section of Tina River and due to their remote location.

| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
|---|---|---|
| Developer | TRHDP PO | PPA |

### 13.2.2.6 Activities that could Affect Water Supplies

| Impacts Addressed: |
|---|
| Water Quality and Quantity (12.5.7.4.3)<br><br>For the three-year period of project construction, the water of the Tina/Ngalimbiu River may become, without treatment, unusable for some human domestic purposes. This is likely to continue for several years after the construction has ended. Many of the downstream riverside villages, which represent more than 2,000 people, will be affected. Many villages rely on the river as their main water source, while a number of villages further downstream on the Ngalimbiu have access to water supplies.<br><br>Uncertainty exists in the community about the long-term effects of the dam and reservoir on water quality. |
| Measures: |
| Downstream Alternative Water Supplies<br><br>In consultation with local communities, the Developer is to undertake a detailed survey and mapping of community drinking and washing river use downstream of the dam site. The downstream area will include communities using the Tina River as well as the Ngalimbiu. The survey is also to identify communities with existing alternative water supplies. These measures will form part of the Developer's Water Supply Feasibility Study.<br><br>The Study is to include modelling of predicted impacts on water quality and assess whether these impacts will affect community river use. |

Access to alternative water supplies shall be provided for all river dependent communities whose use of the river is anticipated to be affected. Appropriate water supply solutions will be site specific. Alternatives may include:

- é River-based supply with appropriate treatment systems and supply points for each village;
- é Rainwater collection and storage tanks;
- é Establishment of alternative supplies from local streams, and;
- é Borehole / ground water supplies, piped to several villages / hamlets.

Transportation and distribution of clean water could also be done by tanker truck on a regular basis. The water will be stored in tanks at the village level. Regardless of the method, it shall not create an additional workload for women. For example, the villages of Valesala and Antioch could obtain water from the Kolohio stream. Therefore, the design of replacement or alternative water supplies should explicitly include the views of women and teenage girls, and consider the impacts to them.

Alternative water supplies shall be provided to affected communities prior to construction work on the dam, powerstation, river quarries or reservoir. During the impact mitigation workshops, community leaders specifically requested the provision of alternative reliable clean water supplies to affected communities.

A list of affected communities along the Tina River and a map showing their locations is provided below. Communities reliant on the Ngalimbiu River shall be mapped as part of the Water Supply Feasibility Study:

Table 13-1 Table of Water Supply Affected Communities on the Tina River

| Communities & affiliation that rely on Tina River for their domestic use and/or as a drinking water supply | Villages/ hamlets | 2013 households (approx.) | 2013 population (approx.) |
|---|---|---|---|
| Senge community | Senge | 3 | 16 |
| | Choro | 1 | 4 |
| | Koropa | 3 | 19 |
| Pachuki community | Pachuki | 14 | 65 |
| | Habusi | 6 | 33 |
| Namopila comm. | Namopila | 5 | 27 |
| | Komureo | 6 | 28 |
| | Vatunadi | 1 | 5 |
| | Valekocha | 5 | 26 |
| Antioch community | Antioch | 23 | 110 |
| | Valesala | 20 | 105 |
| | Kolanji | 2 | 10 |
| | Komeo | 0 | 0 |
| Tina community | Tina | 23 | 104 |
| | Valebarik | 6 | 22 |
| | Valebebe | 22 | 104 |
| | Tahurasa | 5 | 15 |

| Communities & affiliation that rely on Tina River for their domestic use and/or as a drinking water supply | Villages/ hamlets | 2013 households (approx.) | 2013 population (approx.) |
|---|---|---|---|
| | Valemaota | 4 | 12 |
| Vuramali comm. | Vuramali | 18 | 70 |
| | Haimane | 26 | 111 |
| | Horohotu 2 | 17 | 84 |
| | Vuvamali | 16 | 77 |
| Horohutu comm. | Horohotu 1 | 12 | 60 |
| Verakuji community | Verakuji | 11 | 56 |
| | Managikiki | 21 | 111 |
| Marava community | Marava | 28 | 168 |
| | Ngongoti | 1 | 20 |
| | Vatupaua | 5 | 50 |
| | Rate school | ? | ? |
| Vera'ande community | Vera'ande | 6 | 30 |
| | Verakweli | 6 | 24 |
| | New Mahata | 2 | 15 |
| Verakabikabi comm. | Verakabikabi | 44 | 219 |
| **Total** | | **362** | **1800** |

Figure 13-3 Map of Tina River dependent affected communities


Water quality monitoring

Management of water quality will need to be investigated, monitored, and managed as part of the overall environmental management of the TRHDP over the long term.

The construction contractor shall commence monitoring water borne diseases in the Tina/Ngalimbiu River catchment just prior to commencement of construction. This should continue as part of the ongoing environmental management and monitoring throughout construction and the initial years of reservoir operation.

During the period of construction and initial years of reservoir operation, when water quality may be impaired, all affected villages will be made aware that water in the Tina River may not be drinkable, and that the use of traditional small `sand point_ holes in river gravel will not be sufficient to treat water.

Survey of water supplies near road works

In consultation with local communities, all present and alternative village water supply resources in the vicinity of the access road works will need to be identified, surveyed, mapped, and engineer-assessed, prior to construction work on the access road.

| | | |
|---|---|---|
| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
| Developer | TRHDP PO | PPA |

### 13.2.2.7 Activities that could Affect Ecotourism Opportunities

| Impacts Addressed: | | |
|---|---|---|
| Ecotourism Opportunities (see Section 12.10.5) | | |
| Measures: | | |
| Senghe village foot track will be disrupted by heavy traffic on the access road to the powerhouse. It is important to relocate the access track prior to the construction of the access road, so that visitors are not affected by traffic. | | |
| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
| Developer | TRHDP PO | PPA |

### 13.2.2.8 Damage to, or Loss of, Core Area Resources

| Impacts Addressed: |
|---|
| Natural Capital (see section 12.5.7.4) |
| Measures: |
| Use-rights for the storage reservoir and its margins, dam and powerhouse access roads, and other land acquired for the project Core Area shall be defined by the proposed TCLC as the entity responsible for managing the use of the core area resources.<br><br>The Land Acquisition and Livelihood Restoration Plan shall discuss local householders˘use of the land and resources on sites required for the Project, and quantify impacts as a basis for compensation. The LALRP provides an entitlements matrix where local households lose access to livelihoods resource areas because of the project.<br><br>Where construction activities damage or destroy resources outside of the acquired Direct Impact Area, compensation for these resources should be payable using transparent formulae. |

| | | |
|---|---|---|
| Where feasible, the TRHDP PO should contract out the reservoir vegetation clearing work to local community members. | | |
| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
| Developer | TRHDP PO | PPA |

### 13.2.2.9 Activities that could Affect Cultural heritage

| Impacts Addressed: |
|---|
| Cultural Heritage (see section 12.5.8) |
| Measures: |
| As part of the Construction ESMP (CESMP), the Developer shall put in place a protocol for managing cultural heritage. This should include arrangements for relocation and for compensation.<br><br>This Cultural Heritage Protocol is presented in Annex 18.<br><br>Prior to any construction commencing, the Developer, with the assistance of the Project Office, shall carry out a `tambu site compensation follow-up_ to identify areas that will require compensation in the designated Core Area and in the communities adjacent to any road building or upgrading and construction. A suitably qualified cultural heritage expert, working closely with knowledgeable elders and the National Museum, should undertake this task. All sites that will be destroyed and compensated will be recorded and photographed for monitoring purposes, but the details and records of the sites shall only be disclosed to affected communities and the construction contractor and the SIG for confidentiality purposes to ensure that the construction contractor does not destroy any sacred (tambu) before compensation for losses are granted to communities.<br><br>Prior to construction, the Developer, in conjunction with culturally knowledgeable locals and a botanist, shall survey the project and road construction sites to identify culturally important medicinal and magical plants that may need to be protected or relocated.<br><br>Fear that the customs and lifestyle of the Gaena ălu followers will be disrespected will be averted by not having a workers camp located within the Tina/Ngalimbiu area, and by the contractor establishing and enforcing a strict code of conduct for its workers with respect to contact with local villagers. |

| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
|---|---|---|
| Developer | TRHDP PO | PPA |

| | | |
|---|---|---|
| | | Tambu Site Disturbance Compensation - Component of allocated SIG budget for land compensation |

### 13.2.2.10 Decisions Made on the Project

| Impacts Addressed: | | |
|---|---|---|
| Social Impacts (see section 12) | | |
| Measures: | | |
| The Developer will continue consulting directly with the project-affected communities throughout the life of the Project using culturally appropriate, inclusive and proven methods and arrangements. District-level consultations could be done through a representative of the Community Liaison Committee or any similar forum.<br><br>The Developer will address any issues raised by communities and should report any corrective measures to the communities and to the SIG. | | |
| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
| Developer | TRHDP PO | PPA |

### 13.2.2.11 Dam Failure and Emergency Flow Releases

| Impacts Addressed: |
|---|
| Fear of dam failure (see section 12) |
| Measures: |
| The Design study shall prepare a disaster/extreme event model showing the submersion wave in case of dam break, covering the management or responses to situations of extreme floods and cyclones in the catchment, emergency water releases, and dam beaching or overtopping. Such plan shall be part of the design report and then integrated in the Emergency Preparedness Plan.<br><br>Through training and sensitization carried out by the Developer, powerhouse start-up and shut-down procedures must be clearly understood by local communities to avoid any accident with sudden release of water at power station outlet (peak hour releases). |

| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
|---|---|---|
| Developer | TRHDP PO | PPA |

### 13.2.2.12 Daytime Peaking Flow Releases

| Impacts Addressed: |
|---|
| Operational Impacts (12.5.3.2) |
| **Measures:** |
| The detailed design study shall include a disaster / extreme event model showing the inundation zone that would result in the event of a dam break, and cover emergency management or responses to situations of extreme floods and cyclones that may affect the catchment, emergency water releases, and dam beaching or overtopping.<br><br>This plan shall be part of the design report.<br><br>The Developer shall install an early warning system when floods will flow over the spillway along the by passed section of the River. This shall be incorporated into an Emergency Preparedness Plan which shall include:<br><br>¿ The need to train local communities on actions to follow in the event of floods,<br><br>¿ How to recognise and respond to the powerhouse flow release / flood warning system. |

| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
|---|---|---|
| Developer | TRHDP PO | PPA |

### 13.2.2.13 Changes Associated with Diminished River Flows

| Impacts Addressed: |
|---|

Sediment Recruitment:

Extraction of Aggregates from the River (section 12.5.7.3)

There is potential for reduced or altered stream flow in the Ngalimbiu River on gravel deposition and the sustainability of gravel extraction. However this effect will only be noticeable over the long term.

Timber Transport and Recovery:

Small scale timber harvesting (section 12.5.7.2)

Measures:

Sediment Recruitment:

Monitoring of gravel transport shall be undertaken by a river geomorphologist. This may include:

- Identifying key river points
- Taking annual transect measurements, including gravel depth
- Taking additional transect measurements after 1 in 10 year flood events.

Further mitigation measures to be considered where measured changes in gravel distribution affect livelihoods of downstream communities.

This measure is in addition to other mitigation measures in this ESMP in relation to sluicing of sediments.

Timber Transport and Recovery:

An alternative to timber rafting as a mean to transport sawn timber down the Tina River will be proposed by the TRHDP PO, so timber millers can continue to transport and recover their timber around the dam and the bypassed section of Tina River. Arrangements for the transport of timber extracted by local landowners from their lands above the proposed dam site will need to be put in place prior to dam construction and operation. One option to do this is through the creation of a truck pickup point beside the river and future reservoir, connected to the dam access road.

| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
|---|---|---|
| Developer | TRHDP PO | PPA |

### 13.2.2.14 Activities that could affect fishing effort

| Impacts Addressed: |
|---|
| Livelihood Impacts (Chapter 12) |
| **Measures:** |
| Fish monitoring is to be undertaken in accordance with a fish monitoring plan to be prepared by the Developer in accordance with section 13.3.3.3. |

Monitoring will include fish quantity and species diversity in the Tina River and Ngalimbiu River including the estuary, and in the Toni River as a control site. Monitoring is to include both comprehensive baselines studies and ongoing monitoring throughout the operational period.

Where monitoring identifies statistically relevant reductions in fish quantities or species during operations, adaptive management procedures for fish migration are to be implemented.

Where construction impacts on water quality have a statistically relevant affect on fish species used as a source of food or income for downstream communities, compensation measures will be implemented for impacted communities. If this measure is triggered, the Developer shall undertake a study of the impacts on fishing efforts, and the compensation payable. A compensation management plan is then to be prepared and approved by SIG.

| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
|---|---|---|
| Developer | TRHDP PO | PPA |

#### 13.2.2.15 Activities that could Strain Relations with Project-Affected Communities

| Impacts Addressed: |
|---|
| Community Liaison, and Capacity Buiding:<br><br>Social Impacts (numerous, see section12) |
| Measures: |

Community Liaison:

This measure is intended to ensure communication between affected communities and the Developer/TRHDP Project Office

Community liaison committees (CLC) shall be established for the construction and the operations phases, supported by a small group to oversee monitoring and mitigation measures and provide input to reporting on conditions in the project-affected communities.

This monitoring shall include the state of relationships between the different clans as well as the distribution of water to affected communities. Each Community liaison committee will include the existing Community Liaison Assistant (CLA) as well as women and youth. The former role of the CLA will be formalized by the CLC so that grievances are documented in reports and in the Stakeholder Engagement Plan.

Each committee shall have a secretary that will be in charge of producing regular reports on community grievances and monitoring of impacts. These reports will aim at communicating with the Developer, the SIG and TRHDP as well as the independent Consultant specialized in environmental and social management.

Capacity Building:

Capacity building is required to CLAs as discussed separately in this ESMP.

The Developer with assistance of TRHDP PO shall provide capacity development, training and administrative support to the Community Liaison Assistants and Community Liaison Committees.

TRHDP PO's ongoing training with landowning tribes in money management and administrative procedures shall continue throughout the pre-construction and construction stages of the Project. This work includes facilitation of financial benefit sharing among all tribal members.

TRHDP PO to facilitate management training for TCLC board members where required.

The Benefit Sharing Program facilitated by TRHDP PO shall focus on delivering pre-employment training to members of the Bahomea and Malango areas.

To minimise any social disruptions arising from increased amounts of cash in the community, the Developer/TRHDP PO provide budgeting and money management training as part of the induction and training of locally recruited workers.

| Implementation Actor: | Oversight Actor: | Costing/Funding Source: |
|---|---|---|
| Developer<br><br>TRHDP PO<br><br>Community Liaison Committees | TRHDP PO | PPA<br><br>Pre-employment training through JSDF Grant. |

## 13.3 MONITORING ACTIVITIES

### 13.3.1 Measures for Ensuring Environmental and Social Monitoring Implementation

Measures will be put in place to ensure that environmental and social mitigation and monitoring is implemented and communicated with stakeholders. Mitigation measures will be monitored by an environmental and social safeguards management specialist engaged by the SPC (SPC ESS Specialist), and audited by an environmental and social safeguards specialist engaged by the Project Office (PO ESS Specialist).

- Both specialists shall have extensive experience in issues and impacts related to the Project such as aquatic ecology, water quality, etc.
- The SPC ESS Specialist will ensure that all general mitigation measures are implemented especially those that apply to the construction contractor and health and safety.
- The following reports/plans shall be prepared by the Developer (with the assistance of the SPC ESS Specialist). Allreports will be submitted to the PO for review with support of PO ESS Specialist:
  - Recruitment policy(ies) of the Developer
  - Health and safety plan of the construction contractor as well as data on accident and injuries. Minutes of meeting of various trainings to workers
  - Construction and operation management plans
  - Reports from the Community Liaison Committees
  - Minutes of meetings on the educational programme about modern day dam engineering and other sensitization trainings
  - Reports of STD awareness training
  - Report on protection of sensitive habitats prior to construction
  - Data on water quality, bed load and sediment model, environmental flows in the by-passed section and flows through the powerstation
  - Reports on aquaculture results and fishery monitoring
  - Report of the soil expert regarding topsoil stripping and stockpiling.
- The PO ESS Specialist will:
  - assess compliance of SPC with ESMP and management plans throughout the lifespan of the Project;
  - report to the PO and support the PO and MECDM in ensuring SPC compliance; and
  - build MECDM capacity to monitor compliance during operations.
- It is required that the PO ESS Specialist be present 3 times a year to audit measure implementation as well as consult with other actors of the ESMP. During each mission, the specialist will produce a report to the attention of the Developer and its subcontractors to inform them of non-compliances. The PO ESS Specialist will work with the SPC ESS Specialist to ensure that corrective measures are implemented. The role of PO ESS Specialist is expected to be undertaken by an independent NGO or firm.
- It is expected that the SPC ESS Specialist will be a full time role during the period of construction.
- The tasks of the Developer ESS Specialist and the PO ESS Specialist are to be described in detail in sub plans.

In addition to these monitoring and auditing roles, it is anticipated that the EPC contractor will appoint a safeguards specliast as part of the their key personnel to oversee the implementation of construction mitigation measures.

### 13.3.2 Plans to be prepared by Developer

Environmental monitoring will be undertaken in accordance with the ESMP and supporting Environmental and Social Action Plans (ESAPs), the LALRP, and good international industry practice for preparing and implementing management plans.

The Developer will develop monitoring plans for each key issue including:

- Construction Works Monitoring Plan
- Air Quality and Noise Monitoring Plan
- Social Impacts Monitoring Plan
- Sediment Transport Monitoring Plan
- Water Quality Monitoring Plan
- Aquatic Life Monitoring Plan
- Flora and Fauna Monitoring Plan

The flora and fauna plan will include monitoring of invasive plant and animal species, e.g., Water Hyacinth to assess its presence in the reservoir and to ensure quick response in case it becomes established. This monitoring will be done twice each year and will include surveys of the entire reservoir. In the event that Water Hyacinth does become established in the reservoir, immediate removal of the plant and its roots will be carried out to limit the ability for it to propagate further.

Each monitoring plan will identify the parameter being monitored, how it will be monitored, how frequently and who will be responsible for monitoring.

Monitoring plans for suspended sediments monitoring and water quality are set out below.

### 13.3.3 Monitoring Plan Frameworks

#### 13.3.3.1 Suspended Sediments Monitoring

Water quality during construction is a central issue for local communities (see social impact) and communication with stakeholders regarding water quality is important. A typical indicator of water quality is TSS, as this parameter is the main element that will change during construction. This section presents how TSS should be monitored.

The Tina/Ngalimbiu River exhibits natural peaks in TSS during heavy rains/fast flood events, with direct impacts on water uses by riparian communities (subsistence fishing by sight, clothes washing, water consumption).

During the planned 3-year construction period, the river is assumed to be exposed to accentuated peaks of TSS, due to sediment-laden run-off from cleared areas and works within the river bed. This extra-load of TSS might represent a significant inconvenience for riparian populations.

It is recommended that TRHDP collect regular TSS data on the natural suspended sediment load and to monitor TSS during construction,

Besides being a good indicator of water quality, monitoring TSS at a location immediately upstream of the damsite and reservoir, it will be useful as a means of estimating the rate of siltation of the reservoir. Monitoring TSS downstream of the damsite will provide reliable data about TSS peaks, information that may prove useful if disputes arise with communities over what are natural versus project caused increases in turbidity..

This type of monitoring was undertaken in Tahiti, where construction of new dam and emptying/mucking out operations of existing reservoirs was a source of conflict with downstream populations.

Notwithstanding that TRHDP may undertake regular monitoring of TSS, this should not be used as an excuse to abandon or relax measures to control the release of sediment laden runoff from disturbed areas or worksites

The objective of monitoring TSS is to determine the load of suspended solids in the Tina/Ngalimbiu River over a long period, through regular monitoring of TSS during peak river flows prior to, and during, construction.

Monitoring should begin one month before construction work begins and continue until the work is completed.

The following protocols should be implemented:

- Water samples / measurements should be made at four stations: (i) upstream of the reservoir; (ii) immediately downstream of the toe of the dam; (iii) at Horohutu or Valekotcha, approximately 10km downstream of the dam; and (iv) at Ngalimbiu bridge, approximately 20km downstream of the dam.
- The samples / measurements should be done at least once a week on a fixed day. Additional sampling should be conducted during floods.
- TSS will be analyzed at SIWA laboratory. Turbidity will be measured using a turbidity probe. For each sampling event, a blank sample will be taken to assess the laboratory accuracy.

The results will be treated as follows:

- Correlation between TSS and turbidity.
- Correlation between suspended solids and flow measured at the gauging station.
- Comparison of peaks of suspended solids during construction work with those observed in natural conditions.
- Commented results will be made available to stakeholders (e.g., on the project website) or by mean of regular environmental reports.

Since the Tina River has natural peaks of TSS during flash floods, trigger values should not be used to describe thresholds where specific measures need to be implemented. Rather, a comparison should be made between pre-construction and construction conditions, as an important indicator of the efficiency of sediment control structures, such as silt fences and settling ponds. The efficiency of sediment trapping structures will be monitored throughout construction, to ensure that peaks in TSS do not originate from sediment erosion associated with work being conducted on land.

Monitoring should begin at least one month prior to commencing construction and continue at least two months after reservoir inundation and commencement of dam operation.

Several stakeholders should be involved in putting into practice the monitoring program:

- Local environmental specialist under the direct responsibility of TRHPD - or construction contractor (sampling / measurements)
- SIWA Water quality laboratory (analysis).

#### 13.3.3.2 Water Quality Monitoring

In addition to applying GIIP, construction environmental management and water quality monitoring will be necessary.

Throughout the 3-year construction period and initial reservoir impoundment a constant concern of TRHPD will be: (i) to ensure implementation of the environmental and social management plan (ESMP), and the associated health, safety and environment (HSE) policies, and environmental management system (EMS), standards and national regulations; and (ii) to follow-up on environmental impacts and to adapt mitigation measures or implement new ones as necessary.

The construction environmental supervision and monitoring activities will be undertaken by an independent environmental monitor.

During construction of the dam, when the risk of water quality alteration is highest, a program of water quality monitoring will be undertaken to assess key parameters.

Water quality monitoring during construction and impoundment will include communication of results to stakeholders in an appropriate form. Besides monitoring of TSS (see Section 13.4.1.1 - Suspended Sediment Monitoring), daily water quality monitoring of the Tina/Ngalimbiu River will be undertaken for key parameters shown in Table 13-1.

During operation, monitoring will be undertaken at the environmental flow outlet of the dam, in the by-passed river reach (i.e., upstream of the powerhouse), and downstream of the powerhouse, for the key pollution indices shown in Table 13-1. Monitoring will be conducted weekly for the first 2 to 3 months following commissioning, then quarterly for the first year, followed by annually when annual testing is conducted of the project electro-mechanical systems. Trigger values (threshold values for health and biodiversity protection) will include:

- ANZECC Water Quality Guidelines for tropical Australia, for upland or lowland rivers for parameters that can affect aquatic life; and
- Australian Drinking Water Guidelines (ADWG), or World Health Organization (WHO) guidelines for potable water, for parameters that can affect domestic use.

Table 13-2 Key water quality parameters

| Construction phase water quality parameters | Operation phase water quality parameters | Reference | Trigger values (or range of acceptable values) |
|---|---|---|---|
| Temperature | Temperature | - | - |

| | | | |
|---|---|---|---|
| pH | pH | ADWG | 6.5-8.5 |
| | | ANZECC | 6.4-7.9 |
| Conductivity | Conductivity | ANZECC | 20-250 uS/cm |
| Dissolved oxygen | Dissolved oxygen | ANZECC | > 6 ppm |
| Oil and grease | Oil and grease | | Any detection is a sign of spills |
| Nutrients $NH_4$-N | Nutrients $NH_4$-N | ANZECC | [illegible] |
| Nutrients $N0_3$-N | Nutrients $N0_3$-N | WHO | [illegible] |
| Nutrient Ptot | Nutrient Ptot | ANZECC | [illegible] |
| Fecal contamination : Ecoli | | WHO | 0 MPN |
| Fecal contamination : total coliforms | | WHO | [illegible] |

Environmental management and monitoring of the construction works and operation of facilities will facilitate minimal environmental impacts and risks, under a continuous supervision.

Some pollution of the river is anticipated if GIIP are not followed during construction. If monitoring determines that trigger values have been reached, the root cause will be determined (e.g., release of sewage, concrete leachate, fuel / oil, spoils, or other contaminants), and procedures will be refined to prevent future occurrences.

Water quality results will be disclosed to local villagers. The construction contractor will implement an alarm system in case of oil/concrete/dangerous substance spill. This includes alerting local villages along the Tina River., An emergency warning system will be used in the event of a dangerous spill to alert downstream communities in the event of a spill of a hazardous material into the river (e.g., fuel / oil, concrete leachate, or other hazardous substance), without first waiting for laboratory results to confirm the risk posed by the spill.

During construction, regular environmental monitoring and supervision of impacts and activities, with regular assessment reports will be undertaken on a daily basis. Monitoring of nutrient parameters will be carried out on a monthly basis. Regular (weekly) monitoring will be carried out for the first 2 to 3 months after the project has been commissioned and is operational. Quarterly monitoring will be undertaken for the first year of operation and then reduce to annual monitoring to coincide with annual inspections of the dam and powerhouse systems.

Several stakeholders will be involved in the monitoring program as follows:

- Water quality laboratory (water quality analysis reports);
- TRHDP and / or construction contractor environmental management and monitoring staff (self monitoring and auditing); and
- Local environmental authorities (compliance auditing).

Aside from very limited sand and gravel extraction for personal or village use in communities upstream of the Tina and Toni rivers, there is little anthropogenic disturbance (e.g., no gold placer mining, no major sources of TSS, no agriculture activities, or other enterprises) that could presently affect the rivers. Therefore, heavy metals such as mercury, arsenic, cadmium that are associated with industrial mineral processing, or agricultural pesticides, are unlikely to be a pre-project water quality issue. However, it is probable that the downstream reach of the Ngalimbiu River experiences fertilizer and pesticide pollution introduced from waters that drain adjacent oil palm plantations. Therefore, it is strongly recommended to conduct a single sampling of water, sediment and fish flesh to test for these pollutants in the river system prior to construction of TRHDP. National laboratories do not have the capacity to analyse such sources of pollution. Samples could be sent to Brisbane, Australia.

The following potential contaminants will not be generated by the Project. However to ensure proper cover in the event of complaints from downstream communities, these parameters should be analyzed as par of a single monitoring event prior to construction:

- Pesticides such as Glyphosate CT, Basta, 2-4-D Amine, Ally (Metsulfuron Methyl), Kamba 500 Selective herbicide (present as the dimethlyamine salt). Gramoxone Tropical (Paraquat) in the Ngalimbiu River system. These sources of pollution are suspected from oil palm plantations.
- Metals such as Cyanide, Nickel, Aluminium, Copper, Arsenic, Cadmium, Lead, Cobalt, Mercury, Silver, Copper, Lead and Zinc in water and sediment. These are the common sources of pollution from the mining industry.
- Bioaccumulated metals in fish flesh related to mining activities for the following metals: Silver, Arsenic, Cadmium, Cobalt, Copper, Mercury, Lead and Zinc.

The sample site for pesticides should be located downstream in the Ngalimibiu River reach, and the sample site for metals should be located on the Tina River. If any of the metal parameters exceed detection levels on the Tina River, additional samples will be collected and analysed. Pesticides are expected to be found in Ngalimbiu River samples. In addition to these measures, wastewater from the cement plant will not be directed to any water body. Rather, it will be collected and treated.

#### 13.3.3.3 Fish, Algae and Macro-invertebrate Monitoring

The Tina River is a relatively pristine, low nutrient watercourse originating from bedrock-controlled substrate in the undisturbed montane forests found on the higher elevation slopes of Guadalcanal. Lower trophic level aquatic organisms, such as algae and macro-invertebrate species support many of the fish species found within the Tina River. Species assemblages and populations can be used as an index of aquatic ecological health.

This fish monitoring plan is to frequently monitor the physical changes of the Tina River during and after the construction of the hydro electrical system. This is to conduct a long term water shed health monitoring in the Tina River reaches and its tributaries over time.

Field studies conducted in support of the ESIA involved only limited sampling of aquatic macro-invertebrates, primarily aquatic dependent insect species, mostly in their emergent adult forms. In the interest of monitoring potential impacts of TRHDP construction and operation on the health of the aquatic habitat, TRHDP will implement a program of algae and macro-invertebrate monitoring. Baseline algae and macro-invertebrate data collection will be undertaken pre-construction during a typical low flow period, when it is safe to enter the river to collect samples. Periodic algae and macro-invertebrate sampling will be subsequently carried out to measure potential changes to these lower trophic levels that may result from construction and operation

of the Project. At least one station will be located upstream of the reservoir, to be used to determine whether the project is having any impact on the aquatic ecosystem there.

The monitoring plan shall:

1. Review and understand the terrain, river and hydrology of Tina River through the series of respective studies especially the hydrology, fish and fisheries and water quality. gather information from relevant stakeholders and plan for specific indicators for aquatic health. In this area, the expert will do and formulate baseline data of the area and the gaps that may be considered during monitoring.
2. Identify sampling locations. It is proposed to have at least eight consistent sample stations in the Tina, Toni and Ngalimbiu areas. This should include 2 sample stations on the Toni River, 4 sample stations on the Tina River and 2 sample stations on the Ngalimbiu river, including one station in the river mouth to monitor the commercial fishing area. Sample stations are to be homogenous to allow consistent monitoring over time. Sample stations should be reference by either human features (e.g. roads, barriers) or any natural attributes due to changes of stream physical changes. Baseline data should be collected for each sampling station.
3. Identify parameters to be tested and observed
4. Formulate schedules of tests/sampling dates
5. Data collection tools
    - ¿ Field data sheets
    - ¿ Hand-held GPS
    - ¿ Waders
    - ¿ Digital camera
6. Reporting framework and policy in the case of emergency declarations

Stakeholders are to be involved in the process with proper awareness of the results analysed during the monitoring.

## 13.4 MANAGEMENT PLANS

### 13.4.1 Management Plans to be prepared by Developer

In preparing the CESMP and OESMP, the constructor/operator shall developer and include a number of detailed management plans. The timeframe for these and the framework for review and approval is set out in Table 13-3. As a guide to preparation of CESMP an outline of environmental specifications for construction is provided at Appendix O. Management Plans required shall include the following Dam Safety Plans in accordance with World Bank OP 4.37:

¿ Construction and Quality Assurance Plan

¿ Operation and Maintenance Plan

¿ Instrumentation Plan

¿ Emergency Preparedness Plan

All plans relating to dam safety and response to operations related emergency events will be prepared by the SPC and reviewed by the TRHDP š Dam Safety Panel.

The Draft Construction and Quality Assurance Plan, and Draft Operations and Maintenance Plan will be submitted for review and approval prior to Bank Appraisal.

An Instrumentation and Emergency Response Plan will be developed by the SPCduring the project design phase, and will be submitted for review and approval prior to project commissioning.

In addition to the dam safety plans, the constructer/operator shall also prepare the detailed management plans listed below to reflect and elaborate on the mitigation measures set out in this ESMP. Brief descriptions are provided for items whose titles are not self-explanatory, and some of the plans are discussed in more detail in subsequent sub-sections of this report as noted in the list.

Plans Required for Construction Only

¿ Water Course Crossing Management Plan

¿ Unexploded Ordinance (UXO) Management Plan (see section 13.4.2);

¿ Spoil and topsoil management plan

¿ Forest clearance plan. In addition to procedures for clearing and for use or disposal of cleared vegetation, the practices will describe the mandatory pre-clearing field survey by a qualified botanist of proposed road alignments and other areas to be cleared. The botanist will identify and demarcate plants that should not be disturbed or that should be transplanted. The botanist will recommend changes in alignment as necessary.

¿ Drainage, Erosion and Sediment Control Plan

¿ Reservoir Preparation Plan. Plan will describe the types of vegetation to be cleared, the extent of removal to be achieved, methods of clearing, methods and arrangements for use or disposal of cleared biomass, arrangements for plan implementation including opportunities for local community members and small businesses to benefit from contracts and timber.

¿ Drill and Blast Management Plan. In addition to addressing technical and worker and community safety issues, the plan will include measures prepared in conjunction with the Noise and Vibration Management Plan to minimize adverse impacts on local fauna. Plan preparation will include modelling of noise levels at various distances from blasting locations and a review of literature to identify noise levels likely to disturb wildlife.

¿ Air Quality Management and Dust Control Plan

¿ Noise and Vibration Management Plan. See comments on Drill and Blast Management Plan above

¿ Influx Management Plan. The plan will provide measures to manage social and environmental impacts that may arise from the influx of `outsider_ workers at the construction site and also at locations where the workforce will be housed near Honiara. It will also consider impacts of the influx of any job-seekers, entrepreneurs seeking business opportunities, and undesirable opportunists such as prostitutes and drug dealers, into Malango and Bahomea.

¿ Workers Code of Conduct. This will be a free-standing document for distribution to and training of workers but will also be an element of the Influx Management Plan and the Community Engagement Plan.

¿ Spill Prevention and Emergency Response Plan

¿ Traffic Management Plan

¿ Post-construction Rehabilitation and Revegetation Plan (see section 13.4.2.7.1)

¿ Quarry Management Plan

Plans Required for Construction and Operations

Biodiversity Management Plan. (See Appendix P and section 13.4.2.5

Health and Safety Plan

¿ Cultural Heritage Management Plan (see Annex 18 and section 13.4.2.3);

¿ Community Health and Disease Vector Management Plan. This plan will address control of disease vectors that could be exacerbated by the project and could affect local communities, with particular attention to malaria, as well as prevention of transmission of HIV/AIDS, STDs, and other communicable diseases from the workforce to communities;

¿ Stormwater Management Plan;

¿ Point Source Pollution Management Plan. Includes water from concrete work.

¿ Stakeholder Engagement and Communications Plan

¿ Security Management Plan

¿ Grievance Redress Mechanism (see section 13.4.2.1)

¿ Waste Management Plan

¿ Hazardous Materials Management Plan. Includes arrangements for storage and handling of fuels and other hydrocarbons.

Plans Required for Operations Only

¿ Reservoir Operation and Management Plan. This plan will cover the environmental aspects of reservoir management, including options to establish a reservoir fishery (natural development versus stocking), to prevent arrival of invasive species, and to monitor fishery status. It will also address water quality; it will be linked to the Reservoir Preparation Plan and will provide predictions of water quality in the reservoir, identify potential impacts on water quality in the river downstream, describe real-time monitoring techniques to detect deterioration in quality that could result in adverse downstream impacts, and propose remedial actions.

Plans Required for Dam and Power Station Closure

¿ Project Decommissioning Plan (see section 13.4.2.7.2)

¿ Retrenchment Plan

In addition to the management plans, the developer shall also develop the series of monitoring plans as set out in section 13.3.

Table 13-3 – Management Plan Timeframes and Approvals

| No. | Name | Completion Date | Prepared by | Implemented by | Review/Approval by | Applicable Policy/PS |
|---|---|---|---|---|---|---|
| Dam Safety Plans | | | | | | |
| DS-1 | Construction and Quality Assurance Plan | By appraisal (as TOR of Owner's Engineer) | SPC (Sponsors) | SPC and Owner's Engineer | DSAP/MMERE/WB | PS4 (OP4.37) |
| DS-2 | Instrumentation Plan | Before tendering EPC (as part of PPA MFS and EPC contract) | SPC (Sponsors) | EPCC | SPC/DSAP/MMERE/ WB | PS4 (OP4.37) |
| DS-3 | Operation and Maintenance Plan | Draft by appraisal; final 6 months before reservoir filling | SPC | SPC and O&M Contractor | SPC/DSAP/MMERE/ WB | PS4 (OP4.37) |
| DS-4 | Emergency Preparedness Plan | Framework by appraisal; plan 1 year before reservoir filling | SPC | SPC throughout PPA; O&M Contractor during operation | SPC/DSAP/MMERE/ MECDM/WB | PS4 (OP4.37) |
| Preparation Phase Plans | | | | | | |
| P-1 | Construction ESMP (CESMP) | Before contractor mobilization | EPCC | EPCC | SPC/MMERE/MECDM /WB | PS1 |
| P-2 | Biodiversity Management Plan | Before contractor mobilization | EPCC | EPCC, SPC and O&M Contractor | SPC/MMERE/MECDM /WB | PS6.OP4.04 |
| P-3 | Stakeholder Engagement and Communications Plan | Before contractor mobilization | SPC | SPC | MMERE/WB | PS1.PS4 |

| No. | Name | Completion Date | Prepared by | Implemented by | Review/Approval by | Applicable Policy/PS |
|---|---|---|---|---|---|---|
| P-4 | Influx Management Plan | Before contractor mobilization | EPCC | EPCC | SPC/MMERE/WB | PS2.PS4 |
| P-5 | Grievance Redress Mechanism | Before contractor mobilization | EPCC and SPC | EPCC and SPC | SPC/MMERE/WB | PS1,PS2,PS4 |
| P-6 | Security Management Plan | Before contractor mobilization | EPCC and SPC | EPCC and SPC | SPC/MMERE/WB | PS4 |
| P-7 | Health and Safety Plan | Before contractor mobilization | EPCC | EPCC | SPC/MMERE/WB | PS2<br>EHS Guidelines |
| P-8 | Workers Code of Conduct | Before contractor mobilization | EPCC | EPCC | SPC/DMMERE/WB | PS2.PS4 |
| P-9 | Community Health and Disease Vector Management Plan | Before contractor mobilization | EPCC | EPCC and SPC | SPC/MMERE/WB | PS4 |
| P-10 | Traffic Management Plan | Before contractor mobilization | EPCC | EPCC | SPC/MMERE | PS1, PS4 |
| P-11 | Waste Management Plan | Before contractor mobilization | EPCC | EPCC | SPC/MMERE/WB | PS3<br>EHS Guidelines |
| P-12 | Hazardous Materials Management Plan | Before contractor mobilization | EPCC | EPCC | SPC/MMERE/WB | PS3<br>EHS Guidelines |
| P-13 | Spill Prevention and Emergency Response Plan | Before contractor mobilization | EPCC | EPCC | SPC/MMERE | PS1,PS3 |
| P-14 | Accidents and Malfunctions Plan | Before contractor mobilization | SPC and EPCC | EPCC | SPC/MMERE | PS1,PS2,PS4 |
| P-15 | Air Quality Management and Dust Control Plan | Before contractor mobilization | EPCC | EPCC | SPC/MMERE | PS1,PS4 |

| No. | Name | Completion Date | Prepared by | Implemented by | Review/Approval by | Applicable Policy/PS |
|---|---|---|---|---|---|---|
| P-16 | Point Source Pollution Management Plan | Before contractor mobilization | EPCC | EPCC | SPC/MMERE | PS3 |
| Construction Phase Plans | | | | | | |
| C-1 | Cultural Heritage Management Plan | Before land clearing | EPCC | EPCC | SPC/MMERE/WB | PS8 |
| C-2 | UXO Management Plan | Before land clearing | EPCC | EPCC | SPC/MMERE | PS1,PS2 |
| C-3 | Forest Clearance Plan | Before land clearing | EPCC | EPCC | SPC/MMERE/MECDM /WB | PS6,OP4.04, OP4.36 |
| C-4 | Watercourse Crossing Management Plan | Before land clearing | EPCC | EPCC | SPC/MMERE | PS1 |
| C-5 | Spoil and Topsoil Management Plan | Before land clearing | EPCC | EPCC | SPC/MMERE | PS1 |
| C-6 | Drainage, Erosion and Sediment Control Plan | Before land clearing | EPCC | EPCC | SPC/MMERE | PS1 |
| C-7 | Post-construction Rehabilitation and Revegetation Plan | Before land clearing | EPCC | EPCC | SPC/MMERE/MECDM | PS1,PS6 |
| C-8 | Water Supply Replacement Plan | Before construction start | EPCC | EPCC | SPC/MMERE | PS4 |
| C-9 | Drill and Blast Management Plan | Before construction start | EPCC | EPCC | SPC/MMERE/MECDM /WB | PS2,PS4 EHS Guidelines |
| C-10 | Stormwater Management Plan | Before construction start | EPCC | EPCC | SPC/MMERE | PS1 |
| C-11 | Quarry Management Plan | Before construction start | EPCC | EPCC | SPC/MMERE/MECDM | PS1,PS2,PS4 EHS Guidelines |
| C-12 | Reservoir Preparation Plan | Before biomass removal | EPCC | EPCC | SPC/MMERE/MECDM /WB | PS1,PS6 |

| No. | Name | Completion Date | Prepared by | Implemented by | Review/Approval by | Applicable Policy/PS |
|---|---|---|---|---|---|---|
| C-13 | Noise and Vibration Management Plan | Before construction start | EPCC | EPCC | SPC/MMERE/MECDM/WB | |
| C-14 | Cumulative Impact Management Strategy | Within one year of mobilization | SIG | various public and private entities | MMERE/WB | PS1 |
| Operations Phase Plans | | | | | | |
| O-1 | Operations ESMP (OESMP) | 3 months before reservoir filling | O&M Contractor | O&M Contractor | MMERE/MECDM/WB | PS1 |
| O-2 | Reservoir Operation & Management Plan | 3 months before reservoir filling | O&M Contractor | O&M Contractor | MMERE/MECDM/WB | PS1,PS6 |
| Decommissioning Phase Plans | | | | | | |
| D-1 | Decommissioning Plan | 1 year before station closure | SPC (SIG, if it continues to operate after PPA period) | SPC | MMERE | PS1,PS2,PS3, PS4,PS6 |
| D-2 | Retrenchment Plan | 1 year before station closure | SPC (SIG, if it continues to operate after PPA period) | SPC | MMERE | PS2 |
| Transmission Line Plans | | | | | | |
| T-1 | ESIA/ESMP | Before start of construction | SIEA | SIEA | MMERE/MECDM/WB | OP4.01,4.04, 4.10,4.11,4.36 EHS Guidelines |
| T-2 | LALRP | Before right of way clearance | SIEA | SIEA | MMERE/WB | OP4.10, 4.12 |
| Monitoring Plans | | | | | | |

| No. | Name | Completion Date | Prepared by | Implemented by | Review/Approval by | Applicable Policy/PS |
|---|---|---|---|---|---|---|
| M-1 | Suspended Sediment Monitoring Plan | Before land clearing | EPCC | EPCC and SPC | SPC/MMERE/MECDM/WB | PS1,PS |
| M-2 | Water Quality Monitoring Plan | Before land clearing | EPCC | EPCC and SPC | SPC/MMERE/MECDM/WB | PS1 |
| M-3 | Algae, Macro-Invertebrate and Fish Monitoring Plan | Before land clearing | EPCC | EPCC and SPC | SPC/MMERE/MECDM/WB | PS6 |
| M-4 | Social Impacts Monitoring Plan | Before contractor mobilisation | TRHDP-PO | TRHDP-PO | MMERE/MECDM/WB | PS1,PS7 |
| M-5 | Flora and Fauna Monitoring Plan | Before land clearing | SPC and EPCC | SPC and EPCC | MMERE/MECDM/WB | PS1,PS6 |
| M-6 | Construction Works Monitoring Plan | Before land clearing | EPCC | EPCC | SPC/MMERE/MECDM/WB | PS1 |
| M-7 | Air Quality and Noise Monitoring Plan | Before land clearing | EPCC | EPCC | SPC/MMERE/MECDM/WB | PS1,PS3 |

SPC shall report on the implementation of the above plans, and the results of studies executed as part of the plans, to the PO, WB and MECDM.

## 13.4.2 Management Plan Frameworks

### 13.4.2.1 Grievance Mechanism

This ESMP shall utilise the following process as the mechanism for addressing grievances between the different project stakeholders. The Grievance Mechanism (GRM) is designed to facilitate feedback from any project participant or stakeholder regarding project operations, management, use of resources and impacts of activities, intentionally or otherwise, and resolution of the same by the developer. Grievances related to land acquisition will be dealt with separately under the GRM proposed in the LALRP.

Grievance mechanism allows the developer to interact with communities living along the Tina/Naglimbiu Catchment. The document will be reviewed as project development stages progress.

The SPC will advertise and inform communities including isolated communities of the grievance mechanism and also ensure that communities are well aware of its structure. In the event that the communities of the Tina/Ngalimbiu Catchment feel that environmental and social complaints have not been adhered to or followed, those stakeholders have the right to raise their concerns and to seek satisfactory acknowledgement and resolution of their grievances. This right is essential to ensure transparency and accountability. Communities will be informed of the Project GRM through community meetings, project documentation and through the local media.

#### 13.4.2.1.1 Grievance Mechanism Structure

Community liaison committees (CLC) will be established for the construction and operation phases of the project supported by a team from the TRHDP PO to oversee the monitoring and implementation of the mitigation measures. The Monitoring team will also provide report on any impacts that may be happening in the project affected communities.

The CLCs will be the focal points for information dissemination to the project affected communities.

#### 13.4.2.1.2 Documenting Grievances with Communities

The CLC would be responsible for recording the grievance or complaint through regular meetings with members of each community. Raised concerned will be written down in a report and presented to the TRHDP PO and the Developer. The CLC will consult with the developer on all complaints received to respond to any systematic issues or problems.

#### 13.4.2.1.3 Responding to Grievances

Responses to grievances will be the responsibility of the Developer. If, due to its nature, the grievance requires immediate attention, the developer should commit to address raised issues in an acceptable time frame. The developer shall keep minutes of meetings and other form of records regarding the way they have addressed the issues.

Where grievances cannot be resolved at this level, the aggrieved party or person will have recourse to a review and a decision made by the TRHDP-PO where a grievance relates to a construction impact and to MECDM where a grievance relates to an operational impact.

If the Grievance Committee cannot resolve the issue, or at any other time, an aggrieved person may have recourse to the Solomon Islands Courts.

#### 13.4.2.2 UXO Management

Regarding UXO management there is a chance that UXO, which is a historic remnant of WWII, may be found within the project area. A UXO Management Plan shall be included as part of the stand-alone ESMP for the Project, the aim of which is to reduce the risk of interaction between workers/communities and UXO, and identify the procedures to follow in the event of a chance find.

Once the project layout has been finalised, and prior to commencement of construction, the Royal Solomon Islands Police Force Explosives Ordnance Unit (RSIPD EOU) will be engaged to review the project layout, including access roads, temporary and permanent construction sites, and areas where project-related infrastructure is to be provided to communities. The RSIPD EOU will, if necessary, carry out a site survey and, if UXO is encountered, clear the UXO, following best practices for protecting workers and the surrounding communities.

#### 13.4.2.3 Physical Cultural Resources Management Plan

This ESIA discusses the initial findings of the physical cultural resources assessment, and identifies resources that may be adversely affected by the project, including Tambu Sites. The TRHDP is committed to protecting physical and cultural resources within the project-affected area and will carry out additional, more detailed assessment of physical cultural resources as the Project develops.

A Physical Cultural Resources Management Plan will be prepared for the TRHDP. The objective of the plan is to prevent any inadvertent loss of physical and cultural resources during project construction and operation.

The Plan will describe sites that were identified in the ESIA that will require preservation, or excavation and relocation, and the steps to be taken, timing, and responsibility for carrying out these measures. These activities will be undertaken in conjunction with authorities of the Ministry of Culture, and the National Museum. Additional physical and cultural resources (chance finds) may be encountered during construction. The BOOT Contractor will develop Chance Find Procedures that identify what measures will be taken to protect these cultural resources. The Plan will also address measures to monitor any physical cultural sites that may be affected by on-going operation of the TRHDP.

The Physical Cultural Resources Plan will be in place two months prior to the commencement of construction works involving clearing and grubbing, or other land disturbing activities. This includes access roads, and main project site(s).

The BOOT Contractor will be responsible for the preparation and implementation of the Plan, which will be reviewed by the TRHDP PO and the Ministry of Culture, and the National Museum. The Plan will identify measures to be followed for both the construction and operation phases of the Project.

#### 13.4.2.3.1 Cultural Sites Chance Find Procedure

For unknown Tambu sites, the following procedure specify how the construction contractor will act if a site is discovered. This process shall be subject to consultation with the five identified landowning tribes,

- ¿ first work will stop,
- ¿ the relevant previous customary land owning tribe (pre SIG land acquisition) to be identified,
- ¿ a scientific examination and/or cultural rituals performed and compensation agreement shall take place (in case of destruction),
- ¿ additional actions shall be carried out to protect the rest of the site if the tambu is to be preserved (fencing the site).

#### 13.4.2.3.2 Cultural Heritage Sites Plan

The following is provided by way of guidance in the preparation of a physical cultural resoures plan by the future TRHDP developer and contractor/s.

i. First, talk with the members of the Landowners Core Group (LCG ¯ the representatives of the landowners of the `core_ project area) concerning the need to identify someone among them who has the knowledge of any tambu site(s) and their location(s) in the Project Impacted area(s).

ii. An expert with experience in recording the information associated with the tambu sites should be deployed from within or outside of the LCG to assist the knowledgeable person(s) they have identified and selected.

iii. Such knowledgeable and experience persons must be approved by the representatives from the LCG prior to involving them in this task.

iv. After the known tambu sites within the Project Impacted areas have been identified and the data collected and recorded, it must be stated clearly whether they will be completely or partly destroyed or only disturbed during the construction work on the Project.

v. It is of paramount importance that any tambu sites that are certain to be completely or partly destroyed should be prioritized for documentation while those that may be only disturbed could be clearly marked by using red and white painted posts erected around them to show that they are tambu sites and to be avoided. Where cultural sensitivities exist to the publicizing of a tambu site, alternate ways of bringing the site to the attention of workers will be adopted.

vi. Any tambu sites located within the construction areas that the LCG really feels should not be destroyed should be demarcated with fence, and worked around where possible. This will help avoid any disagreements or demands for huge compensation payments which might delay the construction programme.

vii. Any decisions or agreements to move, relocate, or destroy any sacred objects from tambu sites must come either from the LCG or the heritage protection expert. This should be done before the construction work on the Project starts.

viii. For unknown tambu sites, it is important that, prior to construction, a clear understanding and written agreements (in the form of an accidental discovery protocol)

between the LCG and the contractor should be made. This should specify how a contractor will act if a site is discovered , e.g., work will stop, the nominated LCG representative contacted (if not already on site supervising the work), the site owner identified, a scientific examination and/or cultural rituals performed, and any additional actions carried out to protect the rest of the site if required.

ix. The current compensation rates for disturbance or damage to tambu sites depend on the scale of destruction, and the distances between the sites and where the construction work is being carried out.

x. Table 13-3 provides some examples as a guide highlighting the different rates being paid by either loggers, miners or any development projects for the destruction of tambu sites:

Table 13-4 Costs associated with compensation for Tambu site destruction

| Destruction or Disturbance of Tambu Sites | Compensation rates (Solomon Dollars) |
|---|---|
| Major Scale | $50,000 |
| Minor Scale | $20,000 |
| Disturbances:<br>50 meters from Sites<br>100 meters from Sites | <br>$10,000<br>$15,000 |
| Graves in Cemetery (per grave) | $10,000 |

Note that disturbances are caused when trees fall into nearby tambu sites, and machines or employees pass through these sites during construction work even though they might not cause any physical damage to them.

#### 13.4.2.4 Workers Code of Conduct

The project developer and construction contractors will be expected, in advance of any construction work commencing on the project, to prepare and promulgate a code of conduct for its workers (and related visitors), including locals, other Solomon Islanders, and immigrants/expats. Induction training should include a cultural induction, delivered with the help of local knowledgeable elders.

The project developer and construction contractors will be expected, in advance of any construction work commencing on the project, to promulgate this code of conduct for its workers (and related visitors), including locals, other Solomon Islanders, and immigrants/expats. Induction training shall include a cultural induction, delivered with the help of local knowledgeable elders.

The following is the code of conduct :

é Prior to entering a village or hamlet for the first time, the Chief, a leader from a church, or the head of a family (usually the father) shall be met for the construction contractor to show his respect.

- All workers must always consult the Chiefs, and community leaders (such as a church pastor or an elder) about any issues that may not be clear in the local culture.
- If no male members of the community are present, the outsider/visitor must not enter and talk to women, especially young girls and married women. This will help avoid any unnecessary arguments arising between a man and his wife or parents with their daughters.
- When talking or shaking hands with someone (whether a man or woman) do not look straight at them in the eyes or press their hands strongly because to some it is disrespectful, shameful or could mean something different, especially to a woman.
- Custom requires that visitors who enter a village are suitably attired. In particular, all genders should wear clothes that cover thighs. Do not criticize someone openly but always call the person aside and talk to him or her separately to avoid any ill feelings. Such incidents may even escalate to a stage where other relatives may become involved.
- Saturdays and Sundays are days when some people in the communities go to Church and so there will be no work. Death and funerals are also times when work and other activities stop in the community. Always seek advice and clearance from the Chiefs or community leaders in such cases whether work should continue on or temporarily stop.
- No alcohol or any form of drugs shall be consumed in the communities by any project employees. The contractor/developer should have and enforce an alcohol and drug-free policy (in the work place, while driving vehicles, or use of the access roads). The company policy should develop a position on the use of betel nut in the workplace.
- All employees should respect the local custom or culture of the people. For example one must always ask before taking any produce growing in the area, such as bananas, kumara, cassava/root crops, nuts, fruits from trees, and coconuts etc. There is always someone in the community who owns them. Picking something without asking first is regarded as disrespect for the owner, or stealing, and may require payment of compensation to the owner.
- Workers and visitors should not make any disrespectful gestures or use any swearing words to anyone either in the community, or along the access road, especially to women or co-workers in the company workforce. These may lead to demand for compensation fees from communities.
- No unlicensed person shall drive work vehicles. Drivers shall be tested prior to starting work on the project, and have a valid license.
- Construction Company vehicles or trucks shall not be permitted to pick up anyone who is not an employee of the Project, except in case of an emergency.
- Heavy machinery shall only be operated by those who have the license and proven skills to use those types of machines. This shall be embedded in the recruitment and other policies of the contractor/s. This will help avoid health and safety problems and the unnecessary destruction of property, resources, and tambu sites.
- Workers and visitors shall drive slowly when passing villages that are very close to the access roadside or a pedestrian walking along the side of the road.
- Drivers and passengers shall watch out for domesticated animals or people crossing the access road.
- Take Prior Consultation, Careful Listening, and Paying Respect (PC-CL-PR) seriously because they are the key to avoiding conflict. Incidents can easily escalate into company-community conflicts.

### 13.4.2.5 Biodiversity Management Plan

Because of its particular importance, the terms of reference for the BMP are included with the ESIA as Appendix P. The BMP will include measures to achieve no net loss of biodiversity as a result of natural habitat conversion, degradation, or fragmentation in the area of influence, including protected set-asides, restoration of areas temporarily disturbed, and offsets in the form of rehabilitation of modified habitat. It will also contain wildlife management measures to protect fauna that may pass through or reside in the project footprint, including prohibition of hunting and on-call experts to assist in relocations. The requirements for minimum flows that have been established in the ESIA and the provisions in the design to move migrating fish past the dam are also measures that contribute to no net loss of biodiversity in the aquatic ecosystem. The BMP will also include detailed management provisions to mitigate the impacts of invasive species, incorporating as a minimum standard this ESMP˘s measures, including machinery washing stations.

Impacts the project may cause, if any, on the river upstream of the reservoir are difficult to predict, and the BMP will therefore link to the monitoring plans so that benthic organisms, fish fauna, and water quality are monitored upstream of the reservoir. Findings of adverse impacts will lead to adaptive management measures. The BMP will also include measurs to restrict public vehicular access, including commercial logging access, south of the end of the existing road close to Mengakiki.

### 13.4.2.6 Quarry Management Plan

The developer shall prepare a Quarry Management Plan incorporating the following measures as appropriate. Some measures, including rehabiltiation, will not be required for quarry sites located within the reservoir area.

- ¿ Water quality monitoring to be undertaken, including baseline moniitoring before works commence. Water quality monitoring will be incorporated into the water quality monitoring plan and sediment transport monitoring plan;

- ¿ Fish and invertebrate monitoring to be undertaken, including baseline monitoring. This monitoring will be incorporated into the Aquatic Life Monitoring Plan;

- ¿ Maintain natural continuity of sediment transport through the river system by implementation of good international industry practice for river mining;

- ¿ Minimise impacts on riverbank and channel by maintaining a buffer zone either side of river banks to maintain their integrity. Channel not to be undermined by extracting from or below banks. Protect vulnerable banks and remedy erosion where apparent;

- ¿ Ensure trucks and industrial machinery are in proper working condition to minimse avoidable exhaust fumes

- ¿ Fuels, lubricants, coolants, waste oil and chemicals must be stored in an approved manner such as in drums or surface tanks with impervious bunds to contain spillage and located away from operating areas, natural or engineered drainage pathways, waterways and areas prone to flooding ;

- ¿ Minimise total disturbed area at any one time to reduce erosion potential and transfer of suspended solids to adjacent surface waters ; and

- ¿ Minimise areas exposed to vegetation removal (if any), and rehabilitate each disturbed area immediately after use.

- ¿ Detail measures to construct and rehabilitate quarry access roads, incorporating access road measures set out in 13.2.1.4.

- ¿ Where additional aggregate is purchased from a licenced gravel supplier, the supplier shall show:

    - ⊡ Compliance with approval requirements under the Environment Act;

    - ⊡ Compliance with applicable licensing requirements under the Mines and Minerals Act ;

The SPC and EPC Contractor will be responsible for ensuring that third party suppliers comply with the Quarry Management Plan.

### 13.4.2.7 Post-construction and Decommissioning Activities

There will be two stages of rehabilitation, 1) upon the completion of the construction phase; and 2) upon the decommissioning of the hydropower facility.

#### 13.4.2.7.1 Post-construction Rehabilitation

Toward the end of the construction phase, the developer will amend its Post-Construction Rehabilitation Plan. Amendments will detail how the construction contractor intends to carry out the following:

- é Remove hazardous materials, hazardous materials storage facilities, and concrete production works;
- é Remove other structures that are not required for operation, and which the TCLC does not wish retained on the site (e.g., work areas, work sheds and storage buildings) and which may become safety hazards;
- é Test for soil and groundwater contamination at key sites, including fuel and lubricant storage facilities, machine shops and other locations where hazardous materials were stored and/or used;
- é Remediation measures that may be required following testing, including removal of contaminated soil and spreading of clean topsoil, and treating contaminated groundwater; and
- é Rehabilitate work areas by spreading clean topsoil over former temporary work sites and access roads. As previously noted, based on observations of disturbed sites within the project area, it appears that vegetation regeneration is vigorous in areas where topsoil has been retained. Weeds will likely invade some sites as long if natural regrowth of trees is delayed. According to preliminary assessment, rehabilitation will be necessary in the following areas:
    - ¿ Work areas, covering approximately 1.18ha;

- ¿ Construction areas at the entrance to the headrace tunnel covering roughly 2ha; and
- ¿ Temporary quarry access roads (approximately 1.5km long and 15m wide), covering roughly 2.25ha. The project intends to have most of the quarry sites to be within the reservoir and will be inundated by the reservoir

If one meter of topsoil is spread over these areas, the total amount of topsoil necessary for rehabilitation will be about 54,300$m^3$. The total amount of topsoil to be stockpiled is estimated to be about 327,900 $m^3$. Therefore, there will be an excess of soil to deal with. It is recommended that the site of the soil stockpiles be re-contoured using the excess soil and allowed to naturally re-vegetate.

On areas to be rehabilitated, soil should be spread no closer than 100m from any water body and be uniformly distributed to a thickness of 1m, and compacted. Sites where soil has recently been spread will be surrounded by deeply-anchored silt fences. Soils will not be spread during the rainy season., Silt fences will be removed after one year by a local contractor that has been contracted by the TRHDP PO.

Site restoration using native plant species will be undertaken in affected areas. Native vegetation species are expected to become quickly established if planted in good quality soils.

Since the two rock quarries are expected to be inundated by the reservoir they will not have to undergo rehabilitation. However, if other quarry sites are used that are outside of the reservoir area, a re-vegetation plan will be required as part of the Quarry Management Plan.

Temporary access roads, including those to the quarries, will be permanently decommissioned once construction of the Project has been completed, to avoid unnecessary human encroachment into the upstream Tina River catchment area. Road decommissioning will involve removing all stream crossings, breaking up the road surface (scarification), spreading topsoil to allow vegetation to regrow, and installing an earth mound at road entrance to prevent vehicle access. Significant cut areas along the road will be refilled with soil.

#### 13.4.2.7.2 Project Decommissioning

Although it is expected that the TRHDP will operate for many decades, there may come a time when the facility is no longer required. In the run-up to that time, a dam closure plan will be prepared by the operator and submitted to the Ministry of Environment (MECDMM) for approval. A new ESIA will be prepared at that time by the operator. Information that will be required in a decommissioning plan includes:

é Detailed engineering design dealing with:

- ¿ Relocation and/or stabilization of nearby structures prior to decommissioning (e.g., access roads, bridges, etc.);
- ¿ Site access requirements (e.g., access roads), temporary easements, construction staging and lay down areas;
- ¿ Method for dewatering the reservoir and restoring flows to the by-passed section o the river;
- ¿ Method for demolishing the dam and removal of concrete and metal debris;
- ¿ Material testing for safe disposal and identification of locations for off-site disposal; and
- ¿ River channel improvement works, including natural channel design (bio-engineering techniques), especially within the former reservoir reach.

é Regulatory permits, including a new ESIA which will focus on the following:

¿ Environmental impact assessment:

- Fish surveys in the reservoir;
- Invasive plant species survey in the reservoir;
- Identification of impacts from the sudden release of fish and plant species adapted to lentic environment downstream into the river;
- Water quality monitoring, including stages of stratification in the reservoir and downstream impacts of releasing sudden deoxygenated water.
- Bathymetry mapping to assist in determining thickness of accumulated sediments in the reservoir;
- Characterization of accumulated sediments both above and below the dam (granulometry, volume, presence of pollutants);
- Estimation of the duration of natural flushing to achieve a sediment distribution pattern similar to pre-dam conditions.; and
- Assessment of impacts on the Tina River's geomorphology; and
- Mitigation measures for demolition methods based on staged release of sediments; and
- Assessment of impacts on the mouth of the river.

¿ Socio economic impact assessment:

- Consultation with riparian communities ;
- Description of users and uses of the modified Tina River environment (i.e., reservoir, and 5.7km by-passed section of river below the dam);
- Economic impacts of sudden changes in the dam area and economic impacts of sediment releases on downstream communities;
- Description of settlements on the right bank of the Tina River that had become dependent on the by-passed river reach for easy crossing to the left bank; and

¿ Fate of the Core Area post-project monitoring:

- o Water quality monitoring;
- o Long-term monitoring of sediment distribution patterns and river geomorphology; and
- o Long-term monitoring of socio economic modifications.

## 13.5 PROTECTION OF THE TINA RIVER UPPER CATCHMENT

The protection of the upper Tina River catchment has the potential to create one of the largest terrestrial protected areas in Solomon Islands, providing conservation support to a key portion of the cloud forests of Guadalcanal identified as habitat Key Biodiversity Area by the IUCN and Bird Life International. Protection could bring potential benefits to the ecosystem, the landowners and the wider community.

As customary land owned by a number of indigenous tribes, the protection of the catchment depends upon the leadership and support of the indigenous landowners. Appendix K provides an outline of (a) the legal process for according protected status to customary land ¯ a process that is landowner driven; (b) actions that have already been taken by the Project to promote the protection of the area, including the support of the University of South Pacific's :Islands in the Sky˘biodiversity expedition; and (c) a framework of the stages needed to promote and facilitate protection.

As a component of project financing SIG will fund an NGO within a year of receipt of funds to consult with landowners and communities and to conduct studies towards the creation and management of a protected area. Also as a component of the first stage of establishing a protected area, SIG will work with the Developer to monitor and report on changes in forest cover using satellite imagery, and to monitor trends in logging truck traffic into and out of the catchment through existing logging roads.

The Biodiversity Management Plan will also incorporate measures for the Project Company and Tina Core Land Company (TCLC) to restrict vehicular access to the catchment through the Project˜s access road.

## 13.6 COMMUNITY BENEFIT SHARE

TRHDO PO is preparing a benefits sharing package for the host communities of Malango and Bahomea.

The Community Benefit Share is proposed as two components, a construction period pilot scheme and an ongoing sustainable

### 13.6.1 Construction period Community Benefit Share Pilot

To prepare the community for the benefit share arrangement, the TRHDP and the World Bank propose to pilot a project with financing from the Japanese Social Development Fund (JSDF). MMERE through the TRHDP PO, is in the process of applying for US$ 2.8 million (approximately SB$22.6 million) to `establish the institutional arrangements and capacity for affected communities to effectively manage benefit sharing revenues from the Tina River Hydropower Development Project and improve their basic services and economic opportunities _.

The fund is proposed to provide pre-operation community infrastructures such as water supply and electricity access, as well as training for jobs during construction. The JSDF is intended to provide community benefits from the project before the power scheme becomes operational.

This pilot stage will design and establish the detailed operational arrangements and build capacity for the ongoing community benefit share fund (post operation). It will also facilitate the following three sub-projects:

- ¿ Electricity distribution to identified communities in the Bahomea and Malango Area;
- ¿ Provision of pre-employment training to members of the Bahomea and Malango Area; and
- ¿ Water supplies for identified communities.

### 13.6.2 Operational Period Community Benefit Share Fund

The structure of the ongoing benefit sharing package is not yet finalised. This will be completed as part of the overall financial structure of the Project in 2017. The flow of finances from the benefit sharing scheme will be associated with the flow of funds under the Power Purchase Agreement, but the precise methodology has yet to be agreed. The magnitude of funds will be calibrated so as to enable investments in community development that will result in significant impacts.

The internal management of the benefit sharing fund, and its formal objective, will be designed in partnership with the community under the Community Benefit Share Pilot project. The fund is intended to focus on community benefits and services and is not intended to incorporate cash payments. Early consultations suggest that some key objectives of the fund may include:

- ¿ Permanent provision of reliable clean water supplies;
- ¿ Provision of sanitation and drainage facilities with improved water supplies;
- ¿ Provision of better quality, more accessible education for the young people of this community;
- ¿ Implementation of in-village and residential training for local youth in technical skills;
- ¿ Improvement of access to health services, especially for women and children;
- ¿ Skills based training for women and utilisation of women`s centres; and
- ¿ Development of ecotourism opportunities in the Central Guadalcanal area, involving people of Malango ward.

## 13.7 LAND ACQUISITION AND LIVELIHOOD RESTORATION PLAN (LALRP)

### 13.7.1 Rationale for Preparing a LALRP

The land required for the TRHPD was identified at the end of the feasibility Study. It was an objective of Solomon Islands Government (SIG) to ensure that only the minimum amount of land reasonably necessary to enable the project to proceed would be acquired from the indigenous owners. It was also an objective of the SIG that there be `No Loss_. That is, that none of the indigenous peoples affected by the Project would be worse off as a result of its construction and operation.

World Bank Environmental and Social Safeguard Policies require that where a project undertaken by a Client of the Bank involves World Bank funding, the Operating Procedures (OP) must be followed. In the case of the acquisition of the project land, OP 4.10 (Involuntary Resettlement) and OP4.12 (Indigenous Peoples) were identified as relevant Safeguards against which the Project needed to comply.

A usual consequence of these two safeguards would be the preparation of Resettlement Action Plan and an Indigenous Peoples Plan. For the TRHDP, it became clear after Option 7C was ultimately identified as the preferred option, that the project area was sufficiently far upstream and sufficiently small that no residential buildings or households would need to be relocated. Therefore, to provide clarity to all stakeholders, the nomenclature was changed to Land Acquisition and Livelihoods Restoration Plan to reflect that land was being acquired, and that the consequent impacts on livelihoods and livelihood assets were assessed and mitigated in accordance with the Safeguards.

As currently proposed, the transmission line component of the project will be constructed along the road corridor acquired for the project area to a point where it travels West to the Lunnga Power Station. The transmission line will be constructed using IDA funding, by Solomon Power, a commercial enterprise owned by the SIG. Therefore, its impacts will be addressed under the World Bank Performance Standards in accordance with OP4.03 (Performance Standards for Private Sector Activities). The route of the line to Lunnga has not yet been finalised by Solomon Power. The LALRP provides a framework for a separate ESIA to be prepared by Solomon Power and TRHDO PO.

The related Indigenous Peoples Plan is incorporated into this ESIA and the associated ESMP and LALRP.

## 13.7.2 Summary of the LALRP

### 13.7.2.1 Land Acquisition

The LALRP identifies the actions that will be taken to avoid, minimise, mitigate, and otherwise manage the adverse livelihoods impacts of the land acquisition and restrictions on land use arising from the Project, by achieving an equitable and socially and economically sustainable situation for the people and whose land has been acquired. This includes ensuring those affected by the hydro development are engaged in its planning, and have opportunities to participate in devising and implementing livelihoods mitigations and enhancements where offered.

The construction and operation of Tina Hydro Option 7C requires the acquisition of 428 ha of land - referred to as the `Core Land_. The Core Land is described in the acquisition :Process Agreement˘ with the customary landowners as the area required `to provide all things necessary for the construction and operation of the scheme, including a concrete dam, reservoir, 3.5 km water tunnel, power station, access road, surge shaft, substationŭ transmission lines, telemetry, and helicopter landing pads_. It will also contain temporary sites and structures required for construction, such as quarries, materials borrow pits, a concrete batching plant, set down and storage areas, office and workshop buildings, generator sheds and so on.

The Core Land is in the customary ownership of five local tribal groupings or lineages, as determined by the Commissioner of Lands.

In 2011, to facilitate site investigations and other fieldwork for the Tina Hydro Project, the SIG entered into a land access agreement with the 27 land owning tribes of the Ngalimbiu-Tina River area. In the agreement, the customary landowners guaranteed to provide physical access to their lands for 18 months to enable investigative drilling, environmental and social impact

studies to be carried out. In return the SIG gave each tribe a `goodwill payment_ SB$100,000, i.e., a total of $2.7 million, paid into a `special account held on behalf of the landowners, and under control of the [then] Landowner Council`.

In February 2013, following a programme of community consultations involving more than 500 members of the affected communities, the landowners agreed to extend the access agreement for a further 18 months to enable finalisation of the technical studies.

While the process used was a :compulsory˘ process under the Land Titles Act, the acquisition of the Core Land was contingent on first obtaining the consent of all identified landowning tribes. This consent was obtained through the negotiation of a written :process agreement˘. The land acquisition process is consistent with the requirements of the World Bank˘s OP 4.12 and 4.10, and the IFC˘s PS5 and PS7 where there must be free prior and informed consent by the landowners and communities. Community support for the overall project was evident in the community SIA workshops held in 2013 and 2014.

Through the Process Agreement the Core Land Tribes consented to the compulsory acquisition of the land by the SIG under the LTA, and unimpeded access to the Core Land for the constructor, and developer / operator. In exchange, the SIG agreed to: a 50% ownership in the acquired land after the acquisition through the creation of the Tina Core Land Company (TCLC); assistance to the Core Land and Reservoir Land tribes for each to establish a corporation to receive and invest or distribute the royalty payments, dividends from the TCLC, and the compulsory acquisition compensation; a revenue share (royalty) of 1.5% of the price paid by SIEA to the developer each year; a consent fee for each tribe and signatory; financial, management and investment training for tribal members; a guaranteed minimum payment per hectare for the acquired land; and other benefits.

The LALRP sets out a series of measures undertaken by the TRHDO PO to ensure an equal sharing of benefits to tribal members and to support opportunities for the tribes to invest in businesses.

The land required for the project infrastructure corridor (for the road and power transmission lines) included customary land compulsorily acquired for the infrastructure corridor, plus an additional four parcels of registered land at the northern end of the corridor. One parcel is owned by the Commissioner of Lands, for which acquisition is not required. Consultation with the interest holders on the remaining registered land required for the infrastructure corridor has occurred on multiple occasions over the last 2 years, and negotiations for its purchase are continuing.

#### 13.7.2.2 Livelihoods Restoration Plan

Livelihood restoration is not required under Solomon Islands law but is required by the World Bank. The aim is to ensure that the livelihoods of people affected by the land acquisition for the TRHDP are maintained at the same level, and preferably, improved ¯ both in terms of sustainability and standard.

The consideration of livelihoods restoration measures and entitlements has been guided by the findings of the social studies and consultations carried out as part of the project planning, along with the documented socio-economic and cultural circumstances of those likely to be affected by the project land acquisition.

The LALRP proposes a range of mechanisms and actions to protect and maintain the livelihoods of those potentially affected by the acquisition of the land for the Tina Hydro project. ☎he entitlements provided for are intended to protect, restore, and where possible improve the livelihoods of all persons and households affected by the acquisition of land for the construction and operation of the project. ☎he main agent for the implementation of the livelihoods restoration plan will be the TRHDP PO. It is proposed that it establish sufficient in-house capacity to undertake the day-to-day implementation of the LRP early in the project design phase.

Other participants in the plan include the BOOT Contractor, various government departments including the Ministry of Agriculture and Livestock, the Ministry of Forests (and/or forestry consultants) and an independent external specialist.

While not strictly part of the livelihoods restoration programme, people belonging to tribes that are part of the Bahomea or Malango Houses of Chiefs will be included in benefit share arrangement made possible by the Tina Hydro project, even if their land or assets are not being acquired for the project. ☎

The details of the proposed community benefit share are still being developed by the Project Office in consultation with the beneficiaries communities. It is anticipated that the design of the benefits programme and its implementation will involve a high level of community involvement and that the various benefits programme activities will result in livelihoods improvements and increased wellbeing for local people.

The IFC and World Bank require that the SIG as the client `establish procedures to monitor and evaluate the implementation of a Livelihood Restoration Plan and take corrective action as necessary_. The extent of monitoring activities should be `commensurate with the project's risks and impacts_.

The principal purpose of any monitoring will therefore be to assess whether the livelihoods of those affected by the acquisition of the land for the project have been sustained or improved. Internal monitoring will be undertaken by the TRHDP PO to confirm the delivery of the livelihoods restoration entitlements to the affected persons, and their outcomes. External monitoring and evaluation will be carried out by an independent consultant to: assess the overall performance of the LRP and its goal of sustaining the livelihoods of affected persons; verify that the particular livelihoods restoration activities have been undertaken, and the compensation funds appropriately delivered; review the community engagement and awareness activities of the TRHDP PO; review the overall performance of the grievance resolution mechanisms; and assess the adequacy of measures put in place to protect vulnerable groups and households. ☎

A grievance mechanism is provided. Grievances relating to land acquisition, livelihoods restoration, compensation and related matters will be separated from grievances relating to the impacts of the project on local communities that arise from the construction and operation of the hydro power facility.

## 13.8 INSTITUTIONAL RESPONSIBILTIES FOR ESMP IMPLEMENTATION

A full description of Government, NGOs and Stakeholders, and their roles with respect to this ESIA, is set out in Section 3.1 ¯ Institutional Framework. This section describes the roles and responsibilities of key actors with respect to the implementation and oversight of the ESMP.

### 13.8.1 Construction and Operation Contractor (Developer)

#### 13.8.1.1 Role

The Developer plays the key role in the implementation of the mitigation and monitoring measures relating to the construction and operation of the Project. The `Developer_ encompasses both the Special Purpose Company (SPC) (proposed to be jointly ownedby Korea Water Resources Corporation and the Investment Corporation Solomon Islands, a SIG state owned enterprise), and its Engineering, Procurement and Construction (EPC) contractor, proposed as Hyundai Engineering Company.

The Developer is not responsible for mitigation measures relating to the construction of the Access Road or Transmission Lines which are intended to lie with the road design/construction contractors and Solomon Power respectively. However, the Developer is responsible for operational measures relating to the use of the Access Road and for the maintenance of the road from Mengakiki to the dam site (during the BOOT period) and from the Black Post turnoff to Mengakiki (until commissioning).

The ESMP will form an annexure to the Power Purchase Agreement (PPA) between Solomon Power and the SPC and is also proposed to form part of the Implementation Agreement between SIG and the SPC. Compliance with the ESMP will become a contractual obligation and Solomon Power and SIG will hold contractual rights to enforce these requirements.

The Developer will assign specific responsibilities to key personnel in the stand alone Construction Environmental and Social Management Plan and Operation Environmental and Social Management Plan and accompanying action plans.

In terms of organization, the SPC will assign an experienced, senior environment, social, health and safety manager. A lesson learned from the Star Hydropower Project supported by IFC in Pakistan is that early, continuous, and authoritative presence of this manager is essential for satisfactory performance of the company, its contractors, and its consultants. The manager is anticipated to supervise a team of local staff in a unit which will hold responsibility for Environmental/Social Impact Mitigation, Health/Safety Management, Stakeholder Engagement/Government Agency Liaison, and Monitoring/Data Management/ Reporting.

It is likely that the EPC contract between the SPC and HEC will allocate responsibility for the preparation of the CESMP and the construction management plans to the HEC. The HEC is expected to engage environment and social specialists to lead and oversee the implementation of the ESMP construction measures. It is possible that some of the EMU functions during construction will be contracted to the Owner's Engineer. The SPC will retain the responsibility for environmental, social, health and safety compliance with ESMPs, the project's Environmental and Social Action Plan (ESAP), the Performance Standards, and applicable SIG regulations. The SPC will ensure that the HEC, and Owner's Engineer where appropriate, are contractually obligated to provide the necessary number of qualified personnel and will monitor to ensure they perform according to the contract.

The SPC and its contractors will ensure that all staff, as appropriate with their job profile, understand the environmental and social policies, procedures and mitigations. Contractors will be required to provide sufficient resources to manage the E&S aspects of their work. They will be required and responsible for the training and awareness of their staff on the project environmental and social setting, potential environmental and social impacts of their work activities, management and mitigation measures, and the existence of, and importance of complying with, the TRHDP CESMP and OESMP, including relevant interfacing with contractor's management systems.

The Developer's final stand alone ESMPs are intended to form part of the conditions of the Development Consent issued by the Ministry of Environment, Climate Change, Disaster Management and Meteorology (MECDMM) under the Solomon Islands' Environment Act. The SPC will apply for and hold the Development Consent and will be responsible for compliance under the Act.

#### 13.8.1.2 Capacity

It is anticipated that the Developer shall engage personnel with the relevant skills and experience to implement the mitigation and monitoring measures of this ESMP. As such, no capacity building is considered to be required.

### 13.8.2 TRHDP PO

#### 13.8.2.1 Role

The Project Office will have a key oversight role for ESMP compliance during the construction period. The Project Office will appoint an Environmental and Social Safeguards Expert to facilitate this role.

As part of this role the Project Office shall:

- Review and approve the final ESIA and stand alone ESMPs prior to submission by the Developer to MECDMM for development consent approval (under the Environment Act);
- Review and approve Developer's management action plans in accordance with section Error! Reference source not found.;
- Undertake audits in accordance with the schedule set out in 13.9.1; and

- ¿ Facilitate expert training for PO staff and MECDMM staff on monitoring skills specific to the Project and specified safeguards.

These Project Office roles will be incorporated in the Implementation Agreement between SIG and the Developer.

#### 13.8.2.2 Capacity

The Project Office and its local contractors have capacity to oversee some mitigation measures, with particular strengths in social monitoring and water quality monitoring, but will require further support and training in others areas. World Bank and DFAT propose significant funding to the Project Office to be used for training Project Office staff and responsible agencies, including MECDMM, to conduct environment and social audit and oversight roles.

### 13.8.3 Environment and Conservation Division of MECDMM

#### 13.8.3.1 Role

The Environment and Conservation Division (ECD) will play an important role under the Environment Act in evaluating and issuing the development consent for the Project and in monitoring the environmental impacts of the Project.

ECD will be responsible for reviewing and assessing the developer's final environmental impact statement and stand-alone CESMP and OESMP under the Environment Act. In undertaking this review the Director of the Environment and Conservation Division will confirm that the documents meet the requirements of the Act and Regulations. The Director will run a public consultation process and ultimately determine whether or not to issue a development consent and with what conditions.

ECD staff will have ultimate responsibility for ensuring that the Developer complies with the Development Consent and its conditions, breaches of which constitute an offence under the Act.

#### 13.8.3.2 Capacity

The increasing number of large scale developments in the country has put pressure on the division, which has limited capacity in terms of staff and technical ability to assess and monitor environmental and social impacts.

ECD has developed some recent experience addressing the social and environmental issues facing the neighbouring Gold Ridge Mine, however, it has had little involvement in ongoing management of other major projects and no experience with a large hydro dam.

ECD would benefit from technical inputs and analysis of water quality and other parameters by third parties. For this reason, the Project Office will engage an environmental and social safeguards specialist and other personnel as relevant to provide assistance and training to the ECD in undertaking its approval, statutory monitoring and compliance roles.

### 13.8.4 Solomon Power

#### 13.8.4.1 Role

Solomon Power (the trading name of Solomon Islands Electricity Authority) will have the central responsibility for all mitigation measures relating to the construction and operation of the transmission line corridor from the Solomon Power owned Lunnga power station to the Project's power station.

In addition to this role, Solomon Power shall oversee the developer's ESMP compliance during the operational stage of the Project. Solomon Power will work closely with MECDMM in undertaking this role.

#### 13.8.4.2 Capacity

The organisation is currently going through an institutional reform with support from the World Bank to increase its revenue collection capacity and improve its services. If capacity shortcomings are identified before the operational stage commences, the World Bank shall arrange monitoring and compliance training for Solomon Power.

### 13.8.5 Road Design and Road Construction Contractors

#### 13.8.5.1 Role

The Access Road upgrade and construction from the Black Post turn off to the dam site shall be designed and constructed by contractors engaged by the Ministry of Mines, Energy and Rural Electrification.

As a component of the road design contract, the road design consultants shall prepare a stand-alone environmental impact assessment report for review and approval by MECDMM under the Environment Act. This EIA shall incorporate the conditions of this ESMP document.

The road design contractors shall incorporate access road design measures, including culverts and drainage measures, into the final road design.

The road construction contractor has not yet been engaged. Contractual arrangements will require the contractor to comply with the measures set out in this ESMP and the detailed stand-alone access road EIA to be completed as a component of the road design contract.

#### 13.8.5.2 Capacity

Contractors selected through international tender are anticipated to have sufficient skills and experience to implement the mitigation measures.

### 13.8.6 Ministry of Infrastructure Development

#### 13.8.6.1 Role

The Ministry of Infrastructure Development (MID) plays a role in maintaining the access road from the Black Post turnoff to Mengakiki once the Project is commissioned.

#### 13.8.6.2 Capacity

Current indications are that the capacity of the MID is sufficient to respond to the post construction maintenance requirements with the support of the TRHDP PO and donor agencies.

## 13.9 IMPLEMENTATION SCHEDULE AND BUDGET

### 13.9.1 Schedule

The schedule for implementing the ESMP is presented in Table 13-4.

Table 13-5 Proposed schedule for implementing environmental and social management program

| Phase | Activity | Constructor/operator (Manage and Monitor) | TRHDP PO (Auditor) |
|---|---|---|---|
| Detailed design | Prepare detailed construction ESMP;<br><br>Provide environmental inputs to design | 3 Months from execution of the PPA<br><br>Monthly review meetings during design process until developer submits detailed design | Review and sign-off `No Objection_<br><br>`No Objection_- PO to ensure that environmental inputs are captured in developer's final design |
| Construction | Implement Construction ESMP; | 3 months prior to commencement of construction through completion of construction | Schedule of reporting and monitoring to be included in final CESMP forming conditions of the Development Consent under the Environment Act.<br><br>PO to oversee developer's monitoring programme and arrange regular audits ¯ quarterly in first year and then |

| | | | |
|---|---|---|---|
| | | | at least semi-annually until commissioning |
| Project commissioning | Prepare draft Operations ESMP | Prepare 6 months prior to commissioning | PO to review and provide No Objection. The OESMP and schedule of monitoring, reporting and audit will be an annex to O&M Contract.<br><br>Director of Environment and Conservation Division of MECDM to review and approve OESMP |
| | Implement Operations ESMP for commissioning | Weekly Monitoring of environmental and social compliance during commissioning period. | Weekly Monitoring during Commissioning and PO and developer agree on the Schedule of Monitoring and audit which will be fed into the operations ESMP, annexed to O&M contract |
| | Finalise operations ESMP | Finalise 3 months prior to commencement of operation with information gathered during commissioning | Review and sign-off `No Objection_ |
| Operation and maintenance | Implement operations ESMP | Monitoring will be carried out on a quarterly basis on the first year and decisions on how often this is required (e.g. semi annually or annually) can be confirmed in this first year | Initially, audits of environmental and social performance will occur on a quarterly basis.<br><br>PO and Developer in consultation with Ministry of Environment will agree a frequency of subsequent monitoring based on their experience of the first year. |

### 13.9.2 Budget

KW-HEC, has been granted an exclusive development right to prepare the project within a period ending on June 30, 2017, by when the PPA should be signed. HEC will be primarily responsible for the EPC development; K-Water will be responsible for the Operation and Maintenance contract during the BOOT period. The BOOT concession period is expected to be for a period of 30 years from commissioning, approximately 34 years from mobilisation. Unless otherwise stated, costs of ESMP implementation are incorporated into the EPC contract for the construction period and through the ongoing budgets for the SPC for the life of the PPA. Compliance monitoring by PO and MECDM during construction will be a component of the project financing managed by SIG. Compliance monitoring during operations will be continued by the relevant ministries, in particular MECDM.

### 13.9.3 Contractual Arrangements

The environment and social safeguard measures will be accommodated and enforced through contractual and approval arrangements between institutional actors. Table 13-6 sets out the key project agreements and actors. Figures Figure 13-5Figure 13-4 demonstrate these arrangements for the hydropower, transmission line and access road project components respectively.

Table 13-6 ¯ Contractual Arrangements

| Agreement/Approval | Safeguard Responsibility | Safeguard Oversight |
|---|---|---|
| Implementation Agreement (IA) | SPC | SIG |
| Power Purchase Agreement (PPA) | SPC | Solomon Power |
| Engineering Procurement Construction Contract (EPC Contract) | HEC | SPC |
| Financial Agreements | SIG (Ministry of Finance) | Financiers |
| Project Agreements | SPC | Financiers |
| Development Consent | SPC | MECDM |
| Subsidiary Finance Agreement | Solomon Power | SIG |
| Project Agreement (Transmisison Line) | Solomon Power | Financiers |
| Works Contract | Road Contractor | MMERE |

Figure 13-4 ¯ Hydropower Project Contractual Arrangements

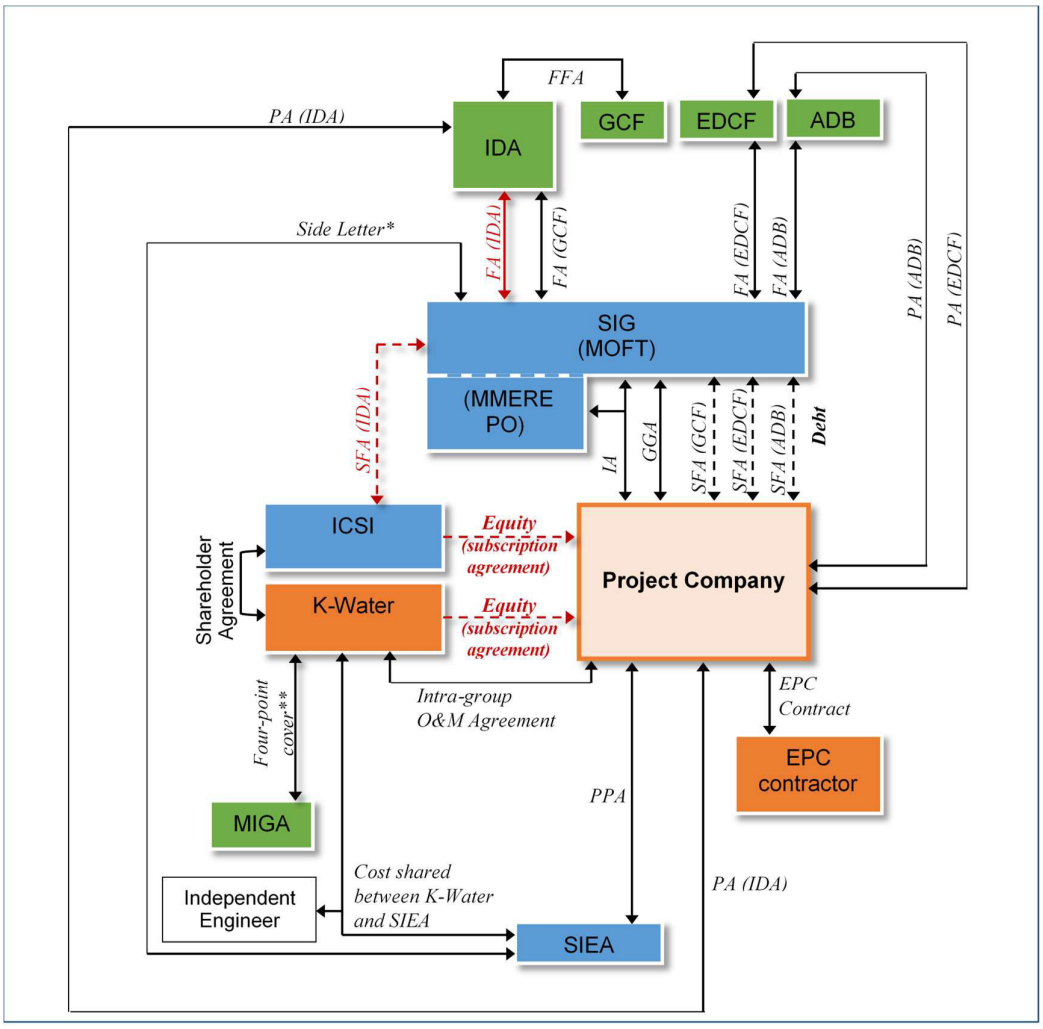
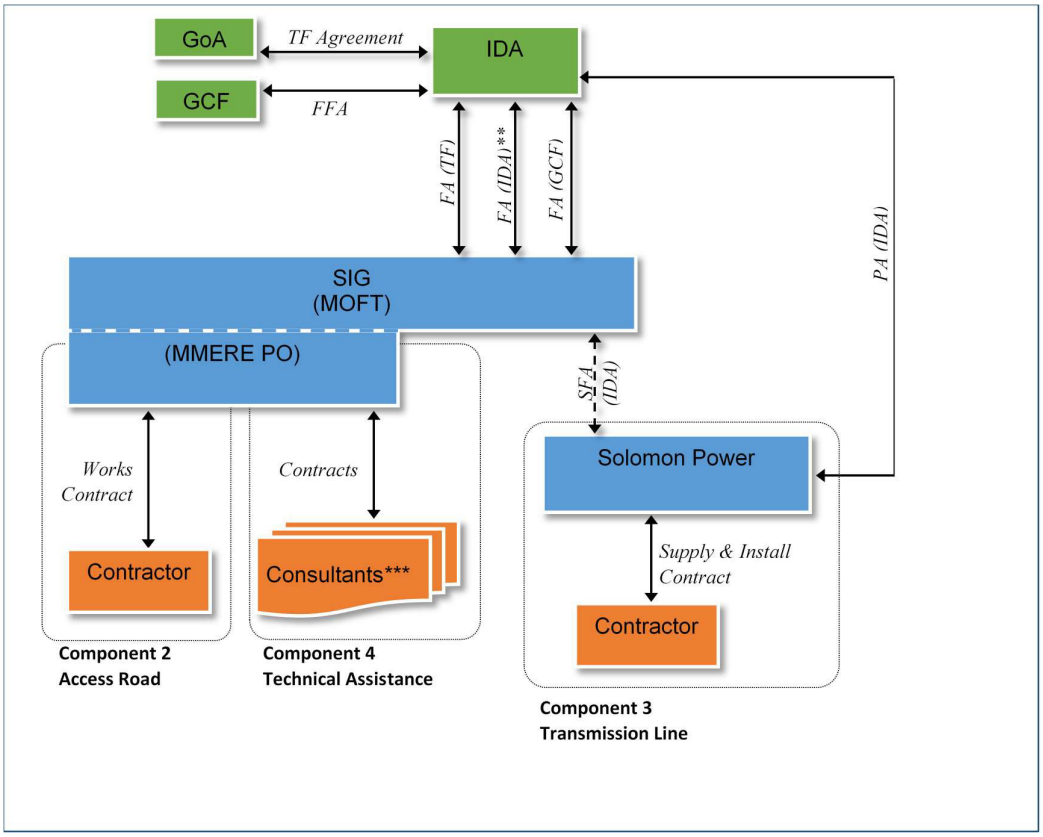



Figure 13-5 ¯ Transmission Line and Access Road Contractual Arrangements




### 13.9.4 Integration of ESMP in Project Management

As the TRHDP will be designed, constructed and operated under a build-own-operate-transfer project delivery model, the construction contractor and the operator will be one and the same (i.e., constructor/operator). The constructor/operator will be responsible for establishing an environmental management office that employs environmental and social specialists to provide their input during detailed design, construction and operation of the TRHDP. The constructor/operator's environmental and social management team will be required to function autonomously, from the constructor/operator, to ensure the contractor complies with GIIP, and they will be given `stop work_ authority to halt specific project-related actions or activities that are deemed by the monitors to be immediately threatening valued environmental or social components.

During construction and operation, the TRHDP PO will engage an environmental and social expert to audit the performance of the constructor/operator's environmental management, monitoring and actions.

A Dam Safety Advisory Panel (DSAP) has been engaged to ensure that the design for the dam complies to international accepted dam safety standards. The PPA will also ensure that the project complies with the applicable environmental, social and labour Legal Requirements. Some of these requirements include WB performance standards, the World Bank Group / IFC Environmental, Health and Safety Guidelines.

Figure 13-1 illustrates the reporting structure for developing and implementing the main Environmental Management System and Environmental Management Plan components into the TRHDP.

Table 13-5 provides a summary matrix of the Environmental and Social Management Plan, including project activities / actions, effects, mitigation measures implementation and monitoring and reporting roles and responsibilities, project phase timing and budget.

Figure 13-6 EMS and ESMP reporting structure

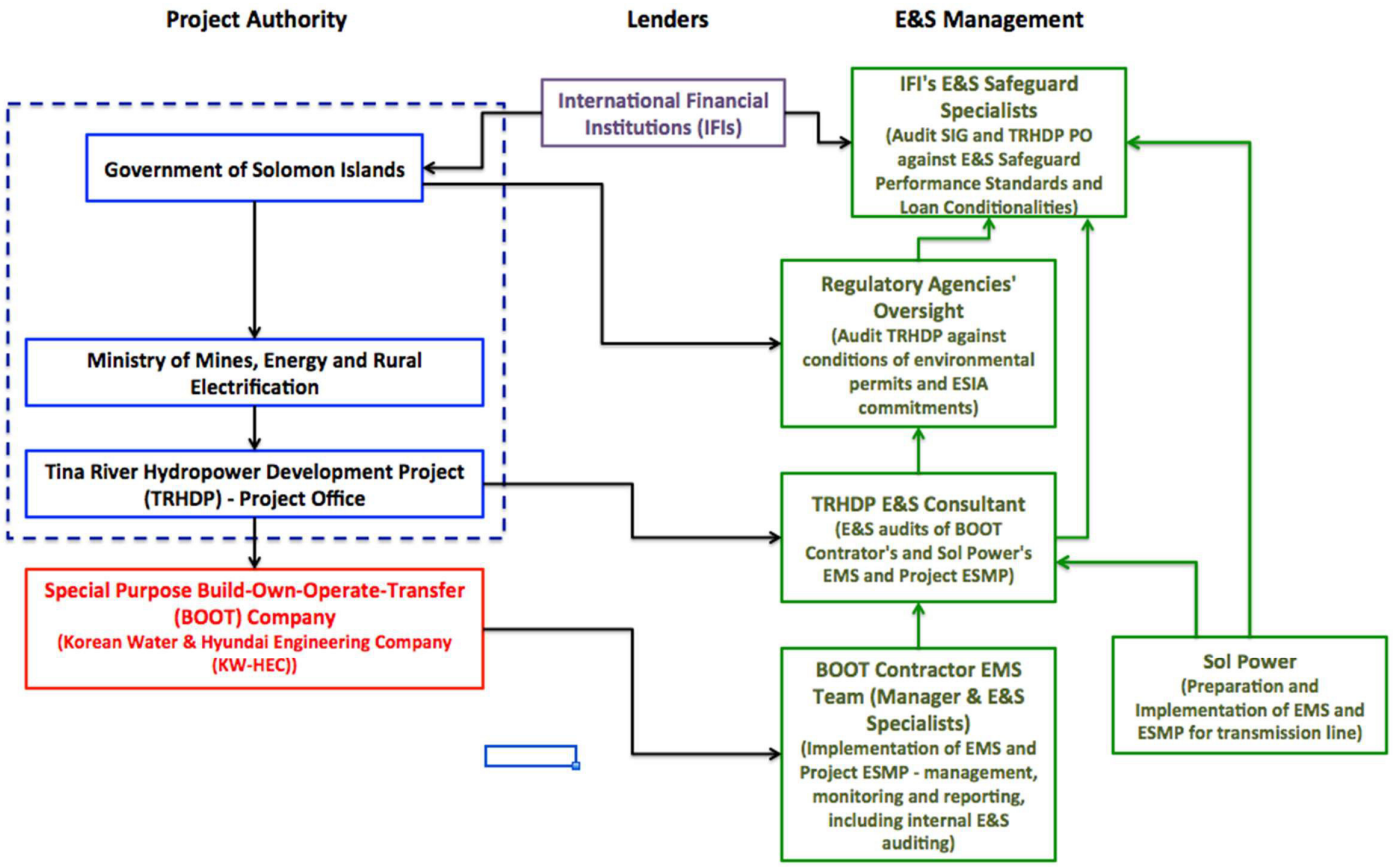


Table 13-7 Summary ESMP matrix

| # | Project Activity / Action and Its Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility / Timing | Monitoring & Reporting Activity | Responsibility / Timing | |
| Measures to Protect the Natural Environment During, or as a Result of: | | | | | | |
| 1 | Reservoir Preparation, Filling, and Operation | | | | | |
| | GHG emissions; suspended solids on aquatic life; river pollution on aquatic life; temporary diminished water quality; reservoir water quality | ¿ Prepare Reservoir Preparation Plan<br>¿ Clear trees >10cm dbh and strip loose soil and rocks from reservoir area during dry season prior to inundation;<br>¿ Use of herbicides will not be permitted<br>¿ (see also Vegetation Management Plan)<br>¿ (see also Sediment and Erosion Management Plan) | ¿ BOOT Contractor to prepare plan / pre-construction;<br>¿ BOOT Contractor to implement with support from local Community labourers in last dry season of construction phase; and operation phase | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report on pre-construction completion of plans, and construction phase implementation | ¿ Included in BOOT Contractor¨s USD2.0M ESMP budget |
| | Surface hydrology; reduced flows on aquatic life; water users | ¿ Maintain minimum E-flow of 1.0$m^3$/s in bypassed section of river at all times | ¿ BOOT Contractor / late construction phase; and operations phase | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report / operations phase | |

| # | Project Activity / Action and Its Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility / Timing | Monitoring & Reporting Activity | Responsibility / Timing | |
| Measures to Protect the Natural Environment During, or as a Result of: | | | | | | |
| | Reduced overnight flows on surface hydrology, aquatic life, and water users | ¿ Maintain minimum of 3.4m$^3$/s flow downstream of powerhouse | ¿ BOOT Contractor / operations phase | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report / late construction phase; and operations phase | |
| | Reduced sediment transport, with changes to aquatic life; reduced gravel extraction; reservoir sedimentation | ¿ Periodic flushing of sediments from reservoir, or drawing down of reservoir to excavate/dredge sediments | ¿ BOOT Contractor / operations phase | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>BOOT Contractor E&S Subconsultant to monitor and report in construction phase implementation | |
| 2 | Hydro Facility Operation | | | | | |
| | Reduced flows between dam and power station; indirect impacts on fauna; direct impacts on aquatic fauna; water users | ¿ Prepare Environmental Flows Management Plan<br>¿ Maintain minimum E-flow of 1.0 m$^3$/s in bypassed section of river | ¿ BOOT Contractor to prepare plan / pre-construction<br>¿ BOOT Contractor to implement in operation phase | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report on pre-construction completion of plans, and construction phase | ¿ Included in BOOT Contractor's USD2.0M ESMP budget |

| # | Project Activity / Action and Its Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility / Timing | Monitoring & Reporting Activity | Responsibility / Timing | |
| Measures to Protect the Natural Environment During, or as a Result of: | | | | | | |
| | | | | | implementation | |
| 3 | Barrier to Fish Passage and Fish Entrainment | | | | | |
| | Dam as barrier to upstream fish migration | ¿ Prepare Fish Passage Plan<br>¿ Implement trap and haul fish passage system | ¿ BOOT Contractor to prepare plan / pre-construction<br>¿ BOOT Contractor to implement onwards from commissioning stage of late construction phase | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report on pre-construction completion of plans, and construction phase implementation | ¿ Included in BOOT Contractor's USD2.0M ESMP budget |
| | Dam as barrier to downstream fish migration; entrainment of fish into power intakes | ¿ Spill water over spillway early wet season; install fish exclusion screens | ¿ BOOT Contractor / operations phase | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report / operations phase | |

| # | Project Activity / Action and Its Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility / Timing | Monitoring & Reporting Activity | Responsibility / Timing | |
| Measures to Protect the Natural Environment During, or as a Result of: | | | | | | |
| 4 | Access Road Location, Design, Construction and Operation | | | | | |
| | Slope stability; erosion; human encroachment into upper watershed | ¿ Locate roads away from sloping terrain where possible;<br>¿ Engineer for road stability and drainage;<br>¿ Roads to quarries to remain unsealed to facilitate decommissioning;<br>¿ No spoils within 100m of watercourses<br>¿ Restrict vehicular use of the access road to project staff. Commercial logging vehicles prohibited. | ¿ Ministry of Mines, Energy and Rural Electrification;<br>¿ BOOT design and construction contractors / design phase and construction phase | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report / design phase and construction phase | ¿ Included in BOOT Contractor's USD2.0M ESMP budget |
| | 5.1.1.1.2 Installation of drainage and stream crossing works - operation effects on fauna; hydrological changes on flora; soil erosion; suspended solids and siltation on aquatic life; river pollution on aquatic life; diminished water quality on aquatic environment; disturbance to aquatic habitats and aquatic life | ¿ Prepare Watercourse Crossing Management Plan<br>¿ Geo-reference watercourses in vicinity of access road for proper sizing of crossing;<br>¿ Protect tributary streams with fencing;<br>¿ Exclude proposed stream crossings initial forest clearing as they will be selectively cleared;<br>¿ Construct road crossing perpendicular to stream;<br>¿ Culverts to be equipped with headwalls to ensure bank stability; | ¿ BOOT Contractor to prepare plan / pre-construction<br>¿ BOOT Contractor to implement / construction phase | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor; BOOT Contractor E&S Subconsultant to monitor and report on pre-construction completion of plans, and construction phase implementation | |

| # | Project Activity / Action and Its Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility / Timing | Monitoring & Reporting Activity | Responsibility / Timing | |
| Measures to Protect the Natural Environment During, or as a Result of: | | | | | | |
| | | ¿ Fauna friendly underpasses to be installed in culverts;<br>¿ Construct crossings using excavators, not bulldozers to minimise excessive soil disturbance;<br>¿ Size culverts to facilitate dry passage of terrestrial animals, and wet passage for amphibians and fish, including provision of suitable cover;<br>¿ Size crossings to pass design flood flows;<br>¿ Install upstream trash racks;<br>¿ (see also Drainage Management Plan)<br>¿ (see also Erosion and Sediment Control Plan) | | | | |
| | Vegetation clearance on environmentally and culturally sensitive areas | ¿ Prepare Vegetation Management Plan<br>¿ Botanist to walk access road / TLine alignments to geo-reference, and fence environmentally and culturally sensitive areas using orange plastic fencing, and map for presentation to clearing committee of resident engineer, BOOT sub-contractors and independent environmental expert | ¿ BOOT Contractor to prepare plan / pre-construction<br>¿ BOOT Contractor to implement / construction phase | ¿ Monitor and report on implementation of mitigation measures | | |

| # | Project Activity / Action and Its Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility / Timing | Monitoring & Reporting Activity | Responsibility / Timing | |
| Measures to Protect the Natural Environment During, or as a Result of: | | | | | | |
| | | ¿ (see also Physical Cultural Heritage Management Plan) | | | | |
| | Road Access Restrictions - Operations effects on flora | ¿ Black post road to remain private access between Mangakiki to dam site;<br>¿ Access restricted to local populations. Vehicular access restricted to TRHDP operator;<br>¿ No occupation of Core Area lands except for necessary Project housing (eg.security staff or on call engineers);<br>¿ No workers camp on Core Area lands; BMP to be developed, implemented and enforced to restrict access through Core Area to prevent establishment of new settlements in areas beyond | ¿ TCLC to assist BOOT Contractor in preparing settlement policy within the Biodiversity Management Plan | ¿ Monitor and report on implementation of mitigation measures / operation phase | ¿ TRHDP PO to Audit BOOT Contractor; BOOT Contractor E&S Subconsultant to monitor and report / operation phase | |
| 5 | Vegetation and Forest Clearance | | | | | |
| | Soil compaction and erosion; suspended solids and water pollution on aquatic life; | ¿ Prepare Erosion and Sediment Control Plan<br>¿ Minimise spatial and temporal extent that soils are exposed to water erosion;<br>¿ Stabilise sites and install / maintain erosion controls in wet season | ¿ BOOT Contractor to prepare plan / pre-construction<br>¿ BOOT Contractor to implement construction phase | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report on pre-construction completion of plans, and construction phase implementation | ¿ Included in BOOT Contractor¨s USD2.0M ESMP budget |

| # | Project Activity / Action and Its Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility / Timing | Monitoring & Reporting Activity | Responsibility / Timing | |
| Measures to Protect the Natural Environment During, or as a Result of: | | | | | | |
| | Burning on air quality; disturbance to aquatic habitats and biota; grassland dependent birds; river dependent birds; loss of terrestrial natural habitat and associated biodiversity | ¿ Prepare Vegetation Management Plan<br>¿ Minimise clearing footprint;<br>¿ Strict contract language to be applied to BOOT logging contractor;<br>¿ Clearing to be monitored by independent expert;<br>¿ Incorporate in the Biodiversity Action Plan an offset for conversion of natural forest habitat in the Core Area<br>¿ No storing / dumping cleared vegetation into streams;<br>¿ No use of herbicides;<br>¿ Vegetation control during dry seasons;<br>¿ Avoid where possible vegetation clearing on erodible / steep slopes;<br>¿ Revegetation / mulch progressively;<br>¿ No draining TLine wetlands unless threatening access roads;<br>¿ Avoid using machinery on stable areas or close to streams;<br>¿ Train workers in EHS;<br>¿ Notify communities to avoid active clearing works;<br>¿ No burning of non-merchantable | ¿ BOOT Contractor to prepare plan with input from Solomon Power (for TLine) / pre-construction<br>¿ BOOT Contractor to implement / construction phase | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report on pre-construction completion of plans, and construction phase implementation, and operation phase implementation for TLine | |

| # | Project Activity / Action and Its Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility / Timing | Monitoring & Reporting Activity | Responsibility / Timing | |
| Measures to Protect the Natural Environment During, or as a Result of: | | | | | | |
| | | vegetation. Vegetation to be shredded.<br>¿ Minimise removal of large canopy trees;<br>¿ TLine vegetation control during operation by trained persons.<br>¿ (see also Sediment and Erosion Management Plan) | | | | |
| 6 | Drilling and Blasting | | | | | |
| | Physical impacts from noise and vibration; disturbance to fauna | ¿ Prepare Drilling and Blasting Plan<br>¿ Select methods to reduce noise and vibration;<br>¿ Hydraulic instead of pneumatic drills; equipment to be equipped with engine exhaust silencers / mufflers;<br>¿ Use blasting mats to reduce noise, fly rock and dust.<br>¿ (See also Wildlife Protection Plan) | ¿ BOOT Blasting contractor to prepare plan / pre-construction<br>¿ BOOT Contractor to implement construction phase | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report on pre-construction completion of plans, and construction phase implementation | ¿ Included in BOOT Contractor˜s USD2.0M ESMP budget |
| 7 | Accidental Release of Sewage and Other Wastewater | | | | | |

| # | Project Activity / Action and Its Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility / Timing | Monitoring & Reporting Activity | Responsibility / Timing | |
| Measures to Protect the Natural Environment During, or as a Result of: | | | | | | |
| | Point source pollution on flora; river pollution on aquatic life; disturbance to aquatic habitat and aquatic life; diminished water quality and quantity | ¿ Prepare Wastewater Management Plan ¯ mandatory installation of toilets for workers; transport wastewater offsite for treatment | ¿ BOOT Contractor to prepare plan / pre-construction<br>¿ BOOT Contractor to implement / construction phase | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor; BOOT Contractor E&S Subconsultant to monitor and report on pre-construction completion of plans, and construction phase implementation | ¿ Included in BOOT Contractor˜s USD2.0M ESMP budget |
| 8 | Hazardous Materials, Explosives and Concrete Works Handling | | | | | |
| | Point source pollution on flora; increased suspended solids and siltation on aquatic life; disturbance to aquatic habitats and aquatic life; diminished water quality and quantity on aquatic environment | ¿ Prepare Hazardous Materials Management Plan (which includes Hydrocarbon [fuel, oil, lubricants] Management Plan ¯ Resident Engineer to approve hazardous materials storage, including explosives storage bunker; secondary containment required for hydrocarbon storage; no hydrocarbons to be stored closer than 100m from any water body or wetland; hydrocarbon storage systems must be sound; fuel dispensing areas to be located on concrete hard stand, with drains to oil/water separators, from which product will be removed and transported by tanker truck to Honiara; | ¿ BOOT contractor(s) / plans prepared pre-construction; BOOT Contractor to implement before construction commences, then throughout construction phase | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor; BOOT Contractor E&S Subconsultant to monitor and report on pre-construction completion of plans, and construction phase implementation | ¿ Included in BOOT Contractor˜s USD2.0M ESMP budget |

| # | Project Activity / Action and Its Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility / Timing | Monitoring & Reporting Activity | Responsibility / Timing | |
| Measures to Protect the Natural Environment During, or as a Result of: | | | | | | |
| | | concrete wash waters must not be released to water bodies or wetlands; concrete washwater control system will be constructed in the form of settling ponds<br>¿ Prepare Emergency Response Plan -<br>¿ (see also Drainage Management Plan)<br>¿ (see also Sediment and Erosion Control Plan)<br>¿ (see also Solid Wastes Management Plan) | | | | |
| 9 | Excavation and Movement of Soils | | | | | |

| # | Project Activity / Action and Its Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility / Timing | Monitoring & Reporting Activity | Responsibility / Timing | |
| Measures to Protect the Natural Environment During, or as a Result of: | | | | | | |
| | Loss of flora; increased suspended sediment and siltation on aquatic life; river pollution on aquatic life; diminished water quality and quantity on aquatic environment; disturbance to aquatic habitats and aquatic life | ¿ Prepare Soils Management Plan ¯<br>¿ Under supervision of soil expert, collect soil cores to determine depth of organic soils and strip organic soils along access roads; stockpile soils for later use for revegetation; store soils in remnant forest habitat to minimise clearing, and locate away from water bodies on flat terrain; compact or cover to prevent re-colonisation; surround stockpiles with sediment control works including settling ponds<br>¿ (see also Sediment and Erosion Control Plan)<br>¿ (see also Biodiversity Management Plan) | ¿ BOOT Contractor to prepare plan / pre-construction<br>¿ BOOT Contractor to implement / construction phase | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor; BOOT Contractor E&S Subconsultant to monitor and report on pre-construction completion of plans, and construction phase implementation | ¿ Included in BOOT Contractor¯s USD2.0M ESMP budget |
| | Accidental colonisation by invasive flora and fauna | ¿ Prepare invasive species measures as a component of the Biodiversity Management Plan<br>¿ Machinery to be washed by designated staff before entering site;<br>¿ Mud and soil to be removed at designated wash station;<br>¿ No importation of soils from outside work areas | ¿ BOOT Contractor to prepare plan / pre-construction<br>¿ BOOT Contractor to implement / construction phase | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor; BOOT Contractor E&S Subconsultant to monitor and report on pre-construction completion of plans, and construction phase implementation | |

| # | Project Activity / Action and Its Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility / Timing | Monitoring & Reporting Activity | Responsibility / Timing | |
| Measures to Protect the Natural Environment During, or as a Result of: | | | | | | |
| | | ¿ Control of waste food to avoid attracting feral animals | | | | |
| 10 | Activities Causing Disturbance to Wildlife | | | | | |
| | Workers effects on fauna | ¿ Prepare Wildlife Protection Plan<br>¿ Workers prohibited from harming wildlife;<br>¿ Workers to receive wildlife awareness training<br>¿ (see also Environmental Awareness Training Plan) | ¿ BOOT Contractor to prepare plan / pre-construction<br>¿ BOOT Contractor to implement / construction and operation phases | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor; BOOT Contractor E&S Subconsultant to monitor and report on pre-construction completion of plans, and construction and operation phase implementation | ¿ Included in BOOT Contractor˜s USD2.0M ESMP budget |

| # | Project Activity / Action and Its Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility / Timing | Monitoring & Reporting Activity | Responsibility / Timing | |
| Measures to Protect the Natural Environment During, or as a Result of: | | | | | | |
| | Lighting disturbance to fauna, especially bats | ¿ Prepare Wildlife Protection Plan<br>¿ Use only enough artificial lighting to maintain safe work conditions;<br>¿ Minimise light intensity and orient to ground, where possible;<br>¿ Avoid use of artificial light during operation | ¿ BOOT Contractor to prepare plan / pre-construction<br>¿ BOOT Contractor to implement / construction and operation phases | ¿ Monitor and report on implementation of mitigation measures | | |
| | Electrocution of Cuscus during T-Line operation | ¿ Install metal shields on wooden poles prior to operation to prevent climbing | ¿ BOOT contractor(s) / construction | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>BOOT Contractor E&S Subconsultant to monitor and report / construction phase | |
| | Harvesting by workers | ¿ Prepare Environmental Awareness Training Plan<br>¿ Prohibit workers from fishing in Tina River;<br>¿ Prohibit food services from | ¿ BOOT Contractor to prepare plan / pre-construction<br>¿ BOOT Contractor to implement / | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report on | |

| # | Project Activity / Action and Its Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility / Timing | Monitoring & Reporting Activity | Responsibility / Timing | |
| Measures to Protect the Natural Environment During, or as a Result of: | | | | | | |
| | | purchasing fish from local villagers;<br>limit vehicle speeds on access roads<br>¿ (see also Wildlife Protection Plan)<br>¿ (see also Traffic Management Plan) | construction and operation phases | | pre-construction completion of plans, and construction and operation phase implementation | |

| # | Project Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility & Timing | Monitoring & Reporting Activity | Responsibility & Timing | |
| Measures to Protect the Social Environment During, or as a Result of: | | | | | | |
| 1 | Siting of Worker Camps | | | | | |
| | Disruption to local customs and way of life; concerns for health, safety and wellbeing of community during construction | ¿ Accommodation for incoming workers and workers from outside Tina area to be located outside project area;<br>¿ No workers camps in project area;<br>¿ Accommodation to be planned well in advance | ¿ BOOT Contractor to establish accommodation / pre-construction | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report on pre-construction completion of worker accommodation | ¿ Included in BOOT Contractor¨s USD2.0M ESMP budget |
| 2 | Employment and Recruitment Practices | | | | | |
| | Uninvited job seekers from outside the region; increased employment for local inhabitants | ¿ Recruitment policy to favour those seeking work from Bahomea, Malango, and landowning clans;<br>¿ Expand recruitment further afield if necessary;<br>¿ Include quota for women;<br>¿ Conduct job-seeker survey of local villages;<br>¿ Provide training to local job-seekers;<br>¿ Future access to post-construction buildings to be provided to community | ¿ BOOT Contractor to implement TRHDP PO¨s recruitment policy / pre-construction, construction and operation phases;<br>¿ TRHDP PO to provide pre-employment training through contracted training provider / pre-construction, | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report on pre-construction completion of worker accommodation | ¿ Included in BOOT Contractor¨s USD2.0M ESMP budget;<br>¿ Funding for training to come from JSDF grant |

| # | Project Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility & Timing | Monitoring & Reporting Activity | Responsibility & Timing | |
| Measures to Protect the Social Environment During, or as a Result of: | | | | | | |
| | | | construction and operation phases;<br>¿ TCLC to manage buildings / post-construction | | | |
| 3 | Worker Behaviour, and Activities that could Affect Worker Health and Wellbeing | | | | | |
| | Affects on local customs and way of life; Moro movement; health, health safety and well being of workers | ¿ Implement the Workers˘ Code of Conduct<br>¿ Conduct Code of Conduct training;<br>¿ Provide tailored workplace health and safety training before workers commence work on the project;<br>¿ Establish a full-time first aide / nursing post on site, and arrange for medical assistance and evacuation facilities<br>¿ (see also Health and Safety Plan) | ¿ BOOT Contractor to implement / prior to worker mobilising to work on project | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report on pre-commencement worker health and safety training | ¿ Included in BOOT Contractor˘s USD2.0M ESMP budget |
| 4 | Activities that could Affect Villagers˘ Safety, Wellbeing, and Amenities | | | | | |
| | Threats to health, safety and wellbeing due to project construction and operation activities | ¿ Address potential road safety concerns;<br>¿ Develop protocol for managing contractor-related road accidents / injuries;<br>¿ Roads to have sealed surfaces through villages to control noise and dust; | ¿ BOOT Contractor, Subcontractors, Solomon Power and TRHDP PO / construction and operation phase | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report / construction and operation phases | ¿ Included in BOOT Contractor˘s USD2.0M ESMP budget<br>¿ Included in TRHDP PO Budget |

| # | Project Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility & Timing | Monitoring & Reporting Activity | Responsibility & Timing | |
| Measures to Protect the Social Environment During, or as a Result of: | | | | | | |
| | | ¿ Provide information sessions to local communities to explain dam safety measures;<br>¿ Educate local communities on the use of electricity before villages electrified;<br>¿ Implement strict measures to avoid worker misconduct toward locals;<br>¿ Zero drug and alcohol tolerance for workers on site;<br>¿ STD awareness training;<br>¿ Free condoms to be available at first aid/nursing post to be established on site<br>¿ (see also Traffic Management Plan)<br>¿ (see also Health and Safety Plan) | | | | |
| 5 | 5.1.1.1.3 Activities that could Affect Vulnerable Groups and Minorities | | | | | |
| | Threats to wellbeing of vulnerable groups and minorities due to construction and operation activities | ¿ Prepare a Social Impacts Monitoring Plan;<br>¿ Monitor impact of squatters and settlers on vulnerable and minority people;<br>¿ Establish grievance mechanism and nominate community representatives;<br>¿ Ensure coverage of isolated communities | ¿ BOOT Contractor to implement / construction and operation phases | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report / construction and operation phases | ¿ Included in BOOT Contractor's USD2.0M ESMP budget |

| # | Project Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility & Timing | Monitoring & Reporting Activity | Responsibility & Timing | |
| Measures to Protect the Social Environment During, or as a Result of: | | | | | | |
| 6 | Activities that could Affect Water Supplies | | | | | |
| | Diminished water quality and quantity due to project construction activities for construction and commissioning period | ¿ Identify, survey, map and engineer assess village water supplies pre-construction;<br>¿ Establish alternate water supplies that are reliable and clean, where required;<br>¿ Conduct water quality monitoring, including for water borne pathogens;<br>¿ Establish village water committee(s);<br>¿ Notify communities of risks of using river and sand-point water sources | ¿ BOOT Contractor to implement / construction and early operation phases | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report / construction and early operation phases | ¿ Included in BOOT Contractor's USD2.0M ESMP budget |
| 7 | Activities that could Affect Ecotourism Opportunities | | | | | |
| | Disruption to Senghe Village foot track due to heavy access road traffic; loss of ecosystem opportunities | ¿ Relocate access track prior to construction;<br>¿ Monitor effects on ecotourism | ¿ BOOT Contractor to relocate foot track / pre-construction | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report on pre-construction completion of foot track relocation, and construction phase ecotourism | ¿ Included in BOOT Contractor's USD2.0M ESMP budget |
| 8 | Damage to, or Loss of, Core Area Resources | | | | | |

| # | Project Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility & Timing | Monitoring & Reporting Activity | Responsibility & Timing | |
| Measures to Protect the Social Environment During, or as a Result of: | | | | | | |
| | Damage to and/or reduced access to natural capital due to construction related site disturbance | ¿ Prepare Land Acquisition and Livelihood Restoration Plan;<br>¿ Define use rights for Core Area lands;<br>¿ Compensate for lost resources or diminished access to resources;<br>¿ Rehabilitate modified habitat of at least 9.5ha in the Core Area and protect remaining natural habitat within the Core Area<br>¿ Contract local community members for reservoir clearing where feasible | ¿ BOOT Contractor to prepare plan / pre-construction<br>¿ BOOT Contractor to implement / construction phase | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report on pre-construction completion of plan, and construction and operation phase implementation | ¿ Included in BOOT Contractor's USD2.0M ESMP budget |
| 9 | Activities that could Affect Cultural Heritage | | | | | |
| | Adverse affects on cultural heritage from site disturbance during construction | ¿ Prepare protocol for managing cultural heritage, including arrangements for relocation and compensation; identify Tambu Site compensation follow-up; survey project and road construction sites to identify medicinal and magical plants for protection or relocation;<br>¿ Workers to reside outside Tina/Ngalimbiu area; enforce strict code of worker conduct | ¿ BOOT Contractor to prepare plan and conduct Tambu Site assessment / pre-construction<br>¿ BOOT Contractor to implement / construction phase | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report on pre-construction completion of plans and Tambu Site assessment, and construction and operation phase implementation | ¿ Included in BOOT Contractor's USD2.0M ESMP budget;<br>¿ Tambu Site Disturbance Compensation (paid out of SIG land compensation budget) |
| 10 | Decisions Made on the Project | | | | | |

| # | Project Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility & Timing | Monitoring & Reporting Activity | Responsibility & Timing | |
| Measures to Protect the Social Environment During, or as a Result of: | | | | | | |
| | Concern that local communities will be left out of project management decisions that may affect them | ¿ Continue to consult with project-affected communities using culturally appropriate, inclusive, proven methods;<br>¿ Address issues raised through grievance mechanism process | ¿ BOOT Contractor to implement / all project phases | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report / all project phases | ¿ Included in BOOT Contractor¨s USD2.0M ESMP budget |
| 11 | Dam Failure and Emergency Flow Releases | | | | | |

| # | Project Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility & Timing | Monitoring & Reporting Activity | Responsibility & Timing | |
| Measures to Protect the Social Environment During, or as a Result of: | | | | | | |
| | Concern of local communities of risks posed by potential dam failure and emergency releases | ¿ Prepare Dam Safety Plan;<br>¿ Prepare Emergency Preparedness Plan;<br>¿ Model extreme events and prepare inundation zone maps;<br>¿ Install early warning system to warn of flood / emergency spillway releases<br>¿ Deliver information sessions to local communities on dam design, operation and maintenance | ¿ BOOT Contractor to implement / commissioning and operation phases | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report / commissioning and operation phases | ¿ Included in BOOT Contractor¨s USD2.0M ESMP budget |
| 12 | Daytime Peaking Flow Releases | | | | | |

| # | Project Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility & Timing | Monitoring & Reporting Activity | Responsibility & Timing | |
| Measures to Protect the Social Environment During, or as a Result of: | | | | | | |
| | Operational flow release effects on community safety under during daylight peaking and non-peaking | ¿ Provide ramping flow releases to enable local inhabitants that may be within the river bet to safely remove themselves as water levels rise during peaking generation;<br>¿ Deliver notification sessions to local communities on expected daily flow releases and water levels are specific locations along the river | ¿ BOOT Contractor to implement / commissioning and operation phases | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report / commissioning and operation phases | ¿ Included in BOOT Contractor˜s USD2.0M ESMP budget |
| 13 | Changes Associated with Diminished River Flows | | | | | |
| | Diminished sediment recruitment from upper watershed; reduced supply of riverbed construction aggregates only noticeable in long term | ¿ River geomorphologist to monitor gravel transport;<br>¿ Develop mitigation measures, including potential sluicing sediments from reservoir, where changes in gravel distribution affecting livelihoods | ¿ BOOT Contractor to implement / operation phase | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report / operation phases | ¿ Included in BOOT Contractor˜s USD2.0M ESMP budget |

| # | Project Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility & Timing | Monitoring & Reporting Activity | Responsibility & Timing | |
| Measures to Protect the Social Environment During, or as a Result of: | | | | | | |
| | Affects on ability of small-scale timer harvesters to mill, transport and recover timber when river flows are curtailed | ¿ Develop alternative method to rafting timber down the river to enable timber to be recovered from upstream of dam, and in dewatered sections of the river | ¿ TRHDP PO to develop alternative / pre-construction phase;<br>¿ BOOT Contractor to facilitate alternative timber transport system / construction and operation phases | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report / construction and operation phases | |
| 14 | Activities that could Strain Relations with Project-affected Communities | | | | | |
| | Potential for relations to be strained between community, BOOT Contractor and TRHDP PO | ¿ Establish community liaison committees (CLCs) for monitoring and mitigation input;<br>¿ Each CLC to include existing Community Liaison Assistant (CLA), as well as women and youth representation;<br>¿ Each CLC to be supported by a secretary and report on community grievances and monitoring of impacts;<br>¿ Provide capacity building through training and administrative support for CLCs, CLAs, and landowner tribes;<br>¿ Deliver pre-employment training to Bahomea and Malango areas; | ¿ BOOT Contractor with support from TRHDP PO to implement CLC and CLA training, including budget / construction and operation phase;<br>¿ TRHDP PO to continue training of landowner tribes in money management and administrative procedures, and facilitate management training of TCLC board | ¿ Monitor and report on implementation of mitigation measures | ¿ TRHDP PO to Audit BOOT Contractor;<br>¿ BOOT Contractor E&S Subconsultant to monitor and report / construction and operation phases | ¿ Included in BOOT Contractor's USD2.0M ESMP budget;<br>¿ Included in TRHDP PO's E&S budget |

| # | Project Effect(s) | Mitigation | | Monitoring & Reporting | | Budget |
|---|---|---|---|---|---|---|
| | | Mitigation Measure(s) | Responsibility & Timing | Monitoring & Reporting Activity | Responsibility & Timing | |
| Measures to Protect the Social Environment During, or as a Result of: | | | | | | |
| | | ¿ Provide budget and money management training to locally recruited workers;<br>¿ (see also Stakeholder Engagement Plan) | members as required;<br>¿ BOOT Contractor with support from TRHDP PO to implement money management training for local workers | | | |

## 13.10 PROCESS FOR PREPARATION OF CESMP AND OESMP

As noted above, this ESMP focuses on design and construction of the Project, and is intended to be a guide for the constructor/operator. The constructor/operator will be required to further refine this ESMP to turn it into its own detailed construction ESMP (or CESMP), which takes into consideration the specific construction timing, location and work methods. The CESMP will be reviewed for adequacy by the TRHDP PO. As required by law, the document will then form part of the constructer's Environment Impact Statement to be reviewed and assessed by the Ministry of Environment, Climate Change, Disaster Management and Meteorology prior to the granting of development consent under the Environment Act.

As project construction nears completion, and before the Project is commissioned, the constructor/operator will be required to prepare a detailed stand-alone operation ESMP (or OESMP). The OESMP will be reviewed for adequacy by the TRHDP PO's environmental and social expert.

The stand-alone CESMP and OESMP shall include the following information:

- Parties responsible for implementing the ESMP and ESAPs and capacity assessment;
- Regulatory agencies;
- Permitting procedures and IFC Performance Standards requirements;
- Mitigation measures;
- Action plans that identify roles and responsibilities, rudimentary levels of effort and schedules, management and monitoring actions as set out in section 13.3; and
- Cost estimates and sources of budget.

All OESMP and CESMP mitigation measures should be designed, discussed and implemented with the participation of the relevant affected persons, regardless of their affiliation. Mitigation targeted at specific groups should be designed in partnership with those groups.

Mitigation programs should be available to all project-affected communities including Bahomea landowner communities, settler communities, Ghaobata communities, and squatters who were already living in the area on the cut-off date of 23 August 2014, which is the date of the publication of the Gazette notice for the taking of the land.

Where possible, works associated with mitigating impacts should employ local people as a priority.

As part of the overall ESMP, community liaison committees should be established during project construction and operation phases of the TRHDP. These committees should be supported by a small group to monitor, and provide input on, the conditions in the project-affected communities.

# 14. CUMULATIVE IMPACT ASSESSMENT

## 14.1 INTRODUCTION

This section provides a cumulative impact assessment (CIA) for the TRHDP.

### 14.1.1 Objective of the CIA

The overall objective of the CIA is to identify environmental and social impacts associated with the TRHDP, that when combined with potential impacts of existing, planned and reasonably foreseeable developments or activities, may generate cumulative impacts that could jeopardise the sustainability of the TRHDP.

### 14.1.2 Scope and Methodology of the CIA

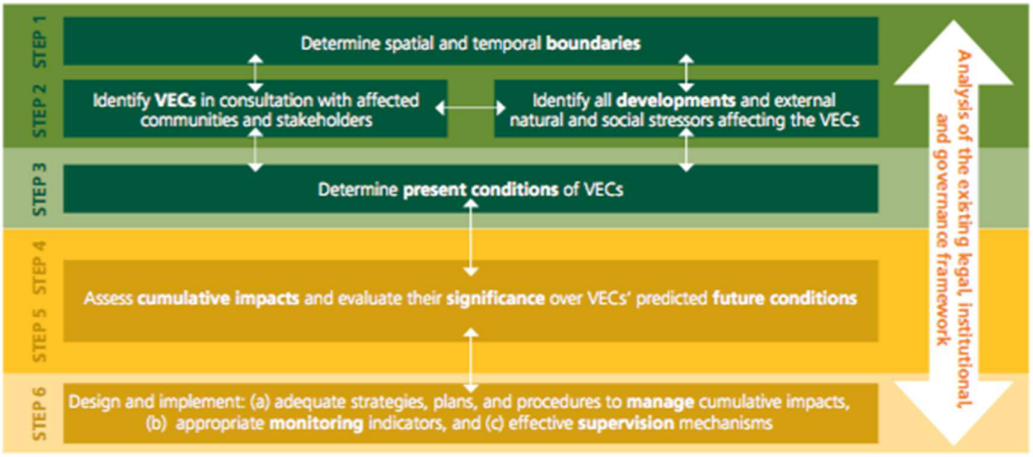
The CIA for the TRHDP examines the cumulative impacts of the Project against past, present and reasonably foreseeable projects and activities within the Tina/Ngalimbiu River catchment.

The approach follows the six steps recommended by the Good Practice Handbook on Cumulative Impact Assessment and Management for the Private Sector in Emerging Markets (IFC, 2013).

The CIA focuses on the environmental and social attributes of the Tina/Ngalimbiu River catchment that are considered to be most important to community and government stakeholders. These attributes are referred to as Valued Environmental and Social Components or VECs.

The six-step process used to undertake the CIA is illustrated in Figure 14-1.

Figure 14-1 Six-step process for conducting a CIA



Source: Good Practice Handbook on Cumulative Impact Assessment and Management for the Private Sector in Emerging Markets (IFC, 2013)

Steps 1 and 2 ¯ CIA Scoping - VECs for the TRHDP, and their respective spatial and temporal boundaries, were identified through consultations with local communities and SIG during the course of preparing the ESIA. Information on other past, present and reasonably foreseeable future developments was obtained through review of existing documents, direct observations in the field, and discussions with various SIG resource agencies.

Step 3 ¯ Present VEC Conditions - Baseline conditions of the VECs were also identified as part of the baseline physical environment, biological environment and socio-economic / socio-community environment studies undertaken for the ESIA.

Steps 4 and 5 ¯ Assess CIA and Evaluate Significance ¯ A VEC centred approach was followed, whereby, direct and indirect impacts to VECs arising from proposed TRHDP-related actions were evaluated against impacts on the same VECs arising from other past, present and reasonably foreseeable future projects and activities.

Step 6 ¯ Prepare Management Framework - Wherever significant cumulative impacts were identified, control measures to mitigate these impacts were recommended. These will be carried over to the ESMP.

# 14.2 ENVIRONMENTAL AND SOCIAL CONTEXT

## 14.2.1 Regional Context

### 14.2.1.1 Introduction

The proposed TRHDP will be located in the Tina/Ngalimbiu River basin on the North side of Guadalcanal Island, Solomon Islands. The Tina River emerges from the higher elevation mountains and flows North to the sea. The total catchment covers an area of 150km$^2$. Elevation of the catchment progressively decreases in a downstream direction toward Tenaru Bay. For the purposes of this assessment, the river was divided into three main reaches: upper, middle and lower. The main features of each of these areas are described in the following sub-sections.

### 14.2.1.2 Upper Tina River Catchment

The upper catchment area is defined as the area upstream of the proposed TRHDP dam. It covers an area of 125km$^2$, and represents 83% of the total Tina/Ngalimbiu catchment area. The Tina River upper catchment is characterized by mountainous terrain, with peaks ranging from 800masl to 2300masl. Approximately 60% of the catchment is higher than 800masl.

The Tina River headwaters (270masl), which are comprised of the junction of two main rivers: Vohara River (1) and Mbeambea River (2) and a minor tributary: Njarimbisu River (3). Becho River (4), a tributary of the Vohara is located further upstream.

At its headwaters, the Tina River flows through a very narrow, steeply sided and incised, limestone gorge. The Tina River upper catchment area is comprised of undisturbed montane forests and aquatic ecosystems. The river itself is characterized by sequences of pools and rapids and sharp meanders. Major boulders, some greater than 3 m diameter, have accumulated along the channel bars. These large boulders indicate that intense floods occasionally occur within this reach.

This reach of the Tina River flows along a north-south orientated thrust fault (GeoRisk Solutions, 2012).

#### 14.2.1.3 Middle Tina River Catchment

For the purposes of this assessment, the middle Tina River is defined as the stretch of river from immediately downstream of the dam to the Tina/Toni river confluence, and includes the 5.7km section of by-passed river. The upper half of this reach is dominated by the steep-sided Tina River gorge. Moving down the river toward the Tina/Toni river confluence, the slopes gradually become less steep and are dotted with a few human settlements and gardens.

#### 14.2.1.4 Lower Tina River/Ngalimbiu River

The Tina River joins the Toni River 17km downstream from the Tina River's headwaters. The Toni River is a much smaller river with a catchment area of roughly 45km$^2$ and flows that are 1/3 that of the Tina River. From the confluence of the Tina/Toni river, the river becomes the Ngalimbiu River, which flows through a coastal plain before discharging into Tenaru Bay in Iron Bottom Sound, on Guadalcanal's North coast.

The Toni River, which flows from a hilly area of elevation 600 masl to 200 masl, meets the Tina River at 40 masl, which marks the beginning of the Ngalimbiu River plain.

The Ngalimbiu River flows across an area characterized by denser human settlement, and other anthropogenic human activities, such as gravel extraction. Drainage from agricultural lands, such as oil palm plantations, enters the river. A small delta has formed at the mouth of the Ngalimbiu River where it enters the Solomon Sea at Lasa Point (close to Tenaru Bay).

### 14.2.2 Environmental Conditions

Historic rainfall records for Tina River do not exist. However, based on modelling it is estimated that annual rainfall at the dam site exceeds 2500mm. The same model predicts in excess of 3500mm of total annual rainfall in the headwater reaches of the Tina River. Average daily temperatures in Guadalcanal range from 22éC to 31éC throughout the year, with a yearly average of 26.6éC in Honiara.

From the flora survey, a total of 159 plant species were identified. Among the species identified, 5 are listed as vulnerable, and 19 are listed as threatened. A total of 66 species of trees, fern trees and palm trees were identified. They are classified in the `tree stratum_. Many species are regrowth and secondary trees species and are, therefore, good indicators of past disturbances, whether from natural events (e.g., cyclones; landslides) or anthropogenic activities (e.g., timber harvest). At least 23 identified tree species are of commercial timber value. A total of 36 shrubs and vines, and a total of 57 herbaceous plants were identified.

The upstream area is dominated by highly valued, undisturbed lowland forests, whereas, the downstream area near Choro, is dominated by disturbed forests. This is mainly the result of anthropogenic activities (e.g., logging, settlements, garden, trails, etc.). However, even though the forests are disturbed, they still show rich plant diversity, which is a factor of rapid vegetation regeneration due to a tropical humid climate and fertile soils.

Wildlife observed within the project included: 9 amphibian species out a total of 13 potential species[82] from 4 families; 5 reptile species out a total of 23 potential species representing 5 families; 41 bird species, representing 28 families, out of a total of 67 potential species previously recorded; and 5 mammals were observed out of a total of 14 potential species from 4 families.

### 14.2.3 Socio-economic / socio-community Conditions

The TRHDP study area consists of over 30 villages and hamlets of mainly indigenous people originating from the central Guadalcanal mountain lands, and several official `settler_ villages made up of people originating from South Guadalcanal/Weather Coast. Settlements range in size from two-house hamlets with one extended family, up to villages with dozens of houses and over a hundred residents.

Most hamlets in the study area are connected together by walking tracks and in some cases by dirt roads, which are prone to becoming impassable during wet weather. In recent years, settlements have been established along the main Bahomea access road and logging track that run up the ridge that marks the left side of the Tina Valley.

At present, the mountainous area of the upper catchment is essentially unpopulated, apart from periodic expeditions by the traditional owners for hunting and camping, and to reconnect with customary :homelands_.

Previous local estimates put the population of the TRHDP area at approximately 2000, with half of these having `direct access_ to the Tina/Ngalimbu River (Entura, 2012:32). The counts made during the ESIA fieldwork put the Bahomea/Tina population at about 1800, divided among approximately 362 households.

The villages of the project area have an average population of approximately 56 people, and an average of 11 households. Settlement sizes vary from 4 persons for Choro (the isolated occupation site in the upper Tina River), to 219 for the settler community of Verakabikabi. Nearly half the surveyed settlements had 5 households or less, and only 11 of the 32 villages had 20 households or more. The largest indigenous villages (with 100 people or more) are Tina, Antioch, Valebebe, Haimane, Mangakiki, and Marava. The average household size in the TRHDP area is 5 persons

[82] The term :potential species˘ is defined as species that were found in the vicinity by previous studies and have a likelihood of being present, even if they were not observed in the course of this study.

The main livelihood activities of communities and households of the project area appear to be daily food security, and protection of the family from risks of climate and loss of resources. With a paucity of financial capital, local people use a range of strategies, including: a mix of traditional garden cultivation and gathering of staple foods for subsistence needs, combined with occasional hunting; cash-earning activities (e.g., cash crops, small-scale timber milling; day labouring; fishing; small home-based businesses; full or part-time employment for government and private sector companies).

## 14.3 SCOPE FOR CIA

This section identifies the VECs, their spatial and temporal boundaries, and the past, present and reasonably foreseeable projects and activities that could contribute to cumulative impacts on VECs.

### 14.3.1 Identification of VECs

As previously noted, VECs were defined for the ESIA baseline and assessment studies based on the following:

- Consultation with project-affected communities;
- Consultation with SIG resource management agencies; and
- Review of existing documents.

The VECs, the rationale for their selection and their spatial and temporal boundaries are presented in Table 14-1.

Table 14-1 VEC selection, rationale and boundaries for CIA

| VECs | Rationale for Selection | Area of Influence Boundaries | |
|---|---|---|---|
| | | Spatial | Temporal |
| Slope Stability, Soil Erosion and Water Quality | Potential impacts from an expanded Gold Ridge Mine, timber harvesting soil damage, GPPOL oil palm plantation chemicals in drainage, gravel extraction turbidity | Tina River/ Ngalimbiu River - from upper catchment to ocean, and Toni River catchment | TRHDP construction operation period |
| Terrestrial and Aquatic Habitat and Biodiversity Loss | Potential impacts from timber harvesting, and gravel extraction | TRHDP Core Area, access road and transmission lines, and upper catchment | TRHDP construction operation period |

| VECs | Rationale for Selection | Area of Influence Boundaries | |
|---|---|---|---|
| | | Spatial | Temporal |
| Employment | Potential conflicts between locals and expatriates for jobs; competition with other key projects | Villages in vicinity of TRHDP Core Area | TRHDP construction period |
| Food Security | Potential resource depletion owing to food supplied to the key projects | THRDP Core Area and surrounding communities that grow and sell food | Primarily TRHDP construction period |
| Challenges to Cultural and Traditional Practices | Potential conflicts arising from presence of workers from outside Core Area | TRHDP Core Area and surrounding communities from which workers may be drawn | Primarily TRHDP construction period |
| Substance Abuse, Domestic Violence and other Increased Crime | Potential conflicts arising due to increased cash economy. | TRHDP Core Area and surrounding communities from which workers may be drawn | Primarily TRHDP construction period |
| Visual Intrusion | Potential reduction in visual amenity due to large man-made structures and intrusive lighting at night | TRHDP damsite and powerhouse, GPPOL and Goldridge facilities | Primarily during operation period |
| Natural Resources Availability | Pressure on natural resources due to increased population | TRHDP Core Area and upstream and downstream catchments | TRHDP construction and operation periods |
| Natural Hazards and Dam Safety | Potential for catastrophic dam failure primarily from natural hazards | TRHDP damsite and upstream catchment | Primarily TRHDP operation period |

### 14.3.2 Projects or Activities Considered for CIA

Only those projects or activities whose impacts on the selected VECs potentially overlap (spatially and temporally) with the impacts of the same VECs for past, present or reasonably foreseen projects or activities, were considered for CIA.

There are four key projects or activities whose impacts could potentially overlap with the impacts generated by the TRHDP to create cumulative impacts. These include:

é Potential expansion of mining on the Gold Ridge tenement;

- GPPOL's Oil Palm production;
- Artisanal and commercial harvesting of timber; and
- Gravel extraction on the Ngalimbiu River.

### 14.3.2.1 Mining Activities

5.1.1.1.4 Past and Present Mining Activities

As stated in the Gold Ridge Mining Agreement, dated 14 September 1995, Gold Ridge's prospecting license (SPL194 – Vanusa Tenement) extends over a rectangular portion of the Bahomea area and covers 130 $km^2$ (see Figure 14-2). The lease overlaps with the middle section of the Toni River watershed, and overlays much of the Tina/Ngalimbiu River watershed near the Tina/Toni river confluence. However, at present, none of the pits, mineral processing or tailings facilities affect the Toni/Ngalimbiu river system.

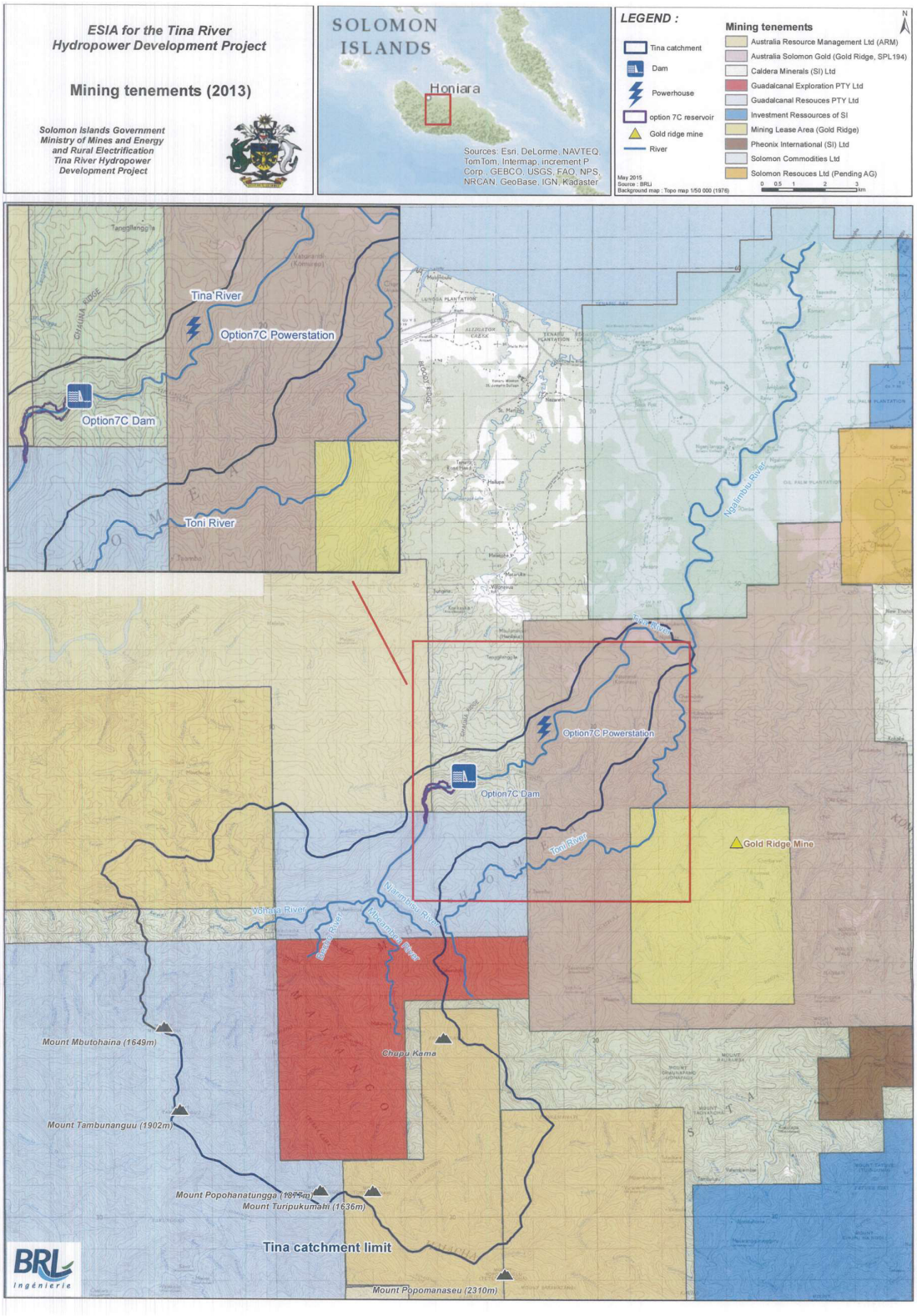
Gold Ridge Mining's facilities, including its Tailings Storage Facility, are presently located on the upper Tinahulu River, which is part of the larger Matepono River catchment. The tailings facility is located approximately 10.5km to the east, and outside of, the Toni River watershed. The tailings dam contains turbid water with high concentrations of cyanide, arsenic, copper, zinc and nickel, particularly in the sediments, which is not supposed to be released into the Tinahulu River. A water quality monitoring program is in place for the Matepono catchment, to confirm whether mine related contamination is occurring, or not. Arsenic, Mercury, Cadmium and other metals were found in sediments of the Chovohoi and Matepono Rivers, many of which exceeded ANZECC guideline values. However, aluminium, copper, arsenic, cadmium, lead, cobalt and mercury levels also exceeded the ANZECC guidelines at some surface water sampling sites that were unaffected by the Project. Some heavy metal concentrations in groundwater samples also exceeded ANZECC guidelines. Highly turbid surface water is also common. Other activities carried out within this river catchment include artisanal placer gold mining, and logging (Golder Associates, 2009).

Fish sampled from the Tinahulu River showed high concentrations of bio-accumulated metals (silver, arsenic, cadmium, cobalt, copper, mercury, lead and zinc), relative to reference samples. It was determined that these high concentrations were attributable to mining activities. Some metal concentrations were potentially detrimental to human and animal health (Golder Associates, 2009).

As part of mine decommissioning, tailings water is to be treated before being released into the river. The substrata of the tailings dam is made of impermeable clay which prevents groundwater pollution. (Ross Mining NL, 1996).

The mine was recently closed and all shares in the holding company sold to a special vehicle corporation established for the purpose, owned primarily by landowners in the Central Guadalcanal area. To reduce the tailings dam level, water from the dam is currently being treated and released in accordance with the terms of the sale.

Figure 14-2 Map of mining tenements (2013) relative to the project area



#### 14.3.2.1.1 Reasonably Foreseeable Mining Activities

Before the closure of the mine, some discussions were underway with landowners regarding possible future extension of mining activities.

A Western extension of the Gold Bridge mine was planned, with new ore pits potentially opening in the upper Toni River watershed. However, with the mine closed and infrastructure and facilities largely destroyed, any mine expansion project is indefinitely on hold unless and until a new investor is found. The current owner of the mine, Goldridge Community Investment Limited, paid a purchase price of $100 and does not have the resources to develop and re-open the mine without investor support. If new mine pits are established, the excavated ore will probably be processed at existing process facilities, once restored, located within the Tinahulu watershed, rather than within the Toni River watershed.

### 14.3.2.2 Oil Palm Plantation Activities

#### 14.3.2.2.1 Past and Present Oil Palm Activities

The existing oil palm industry, operated by GPPOL, is located on the coastal plain in the lower Tina River catchment. The industry is currently affecting the aquatic ecosystem of the Ngalimbiu River through the use of herbicides, such as Glyphosate CT, Basta (Glufosinate), 2-4-D Amine, Ally (Metsulfuron Methyl), Kamba 500 Selective herbicide (dimethlyamine salt), which are manually applied to keep vegetation under control. Use of other herbicides, such as Gramoxone Tropical (Paraquat), has been discontinued (New Britain Palm Oil Limited, 2011).

Water quality in the Ngalimbiu River has also been affected by GPPOL's use of soil nutrients, including nitrogen-based fertilisers, Keiserite (magnesium), Muriate of Potash (potassium) and boron.

According to Sol-Law Lawyers, monthly water quality sampling of discharges from ponds and watercourses that drain the plantations, is done for BOD, pH, TSS, and Oil and Grease. However, the Ngalimbiu River is not being monitored for pesticides or fertilizers. Also, water quality results are not publicly available.

#### 14.3.2.2.2 Reasonably Foreseeable Oil Palm Activities

There is no indication that the existing oil palm industry plans to expand further up the Tina/Ngalimbiu River, beyond the current coastal plain. Given the hilly topography of the upstream area and the issues of land ownership, it is doubtful that expansion would occur in this direction.

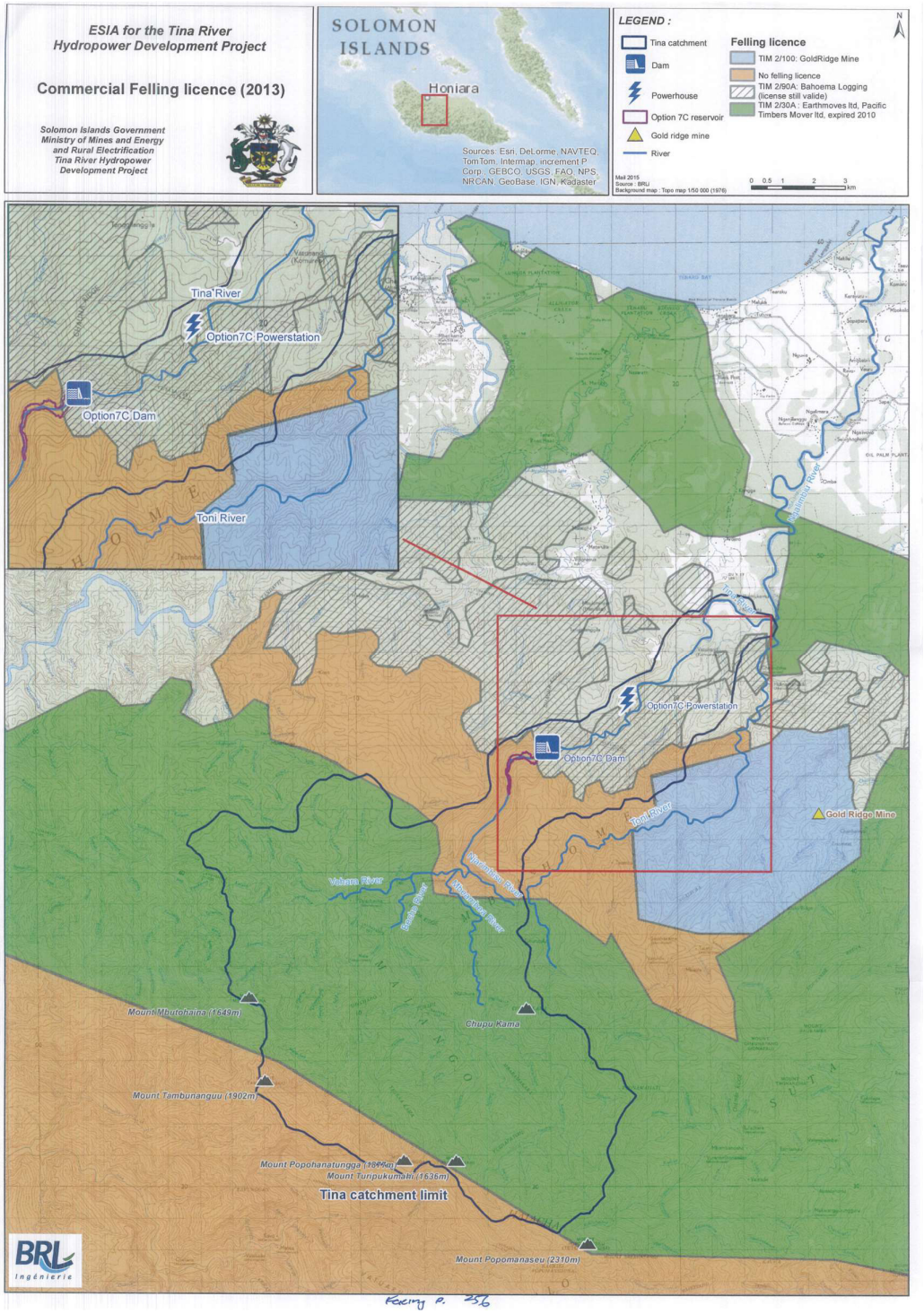
### 14.3.2.3 Timber Harvesting Activities

#### 14.3.2.3.1 Past and Present Timber Harvesting Activities

As mentioned previously, timber in Tina River catchment is either commercially exploited, when a customary landowner sells the timber rights, or is selectively harvested by local communities. Either way, timber harvesting is poorly documented.

No information appears to be available regarding the type or volume of timber harvested, or the royalties being paid by timber companies to customary landowners. A single timber harvesting license (TIM 2/90A), which is held by the Bahomea Logging Company, is the only license in the Tina River catchment (see Figure 14-3). Since logging is a poorly documented activity, the full extent of both social and environmental impacts is difficult to assess.

Figure 14-3 Map of timber harvesting licenses relative to the project area



Based on field observations, impacts from selective logging are currently minimal along the banks of the Tina River catchment. Whereas, many areas along the Ngalimbiu River are prone to landslides, either as a result of naturally unstable slopes, or because of past forest clear-cutting or other human activities. The photographs in Figure 14-4 provide examples of landslide features along the Ngalimbiu River, downstream of the confluence of the Tina/Toni rivers in an area that appears to have been recently clear-cut.

Figure 14-4 Landslides on Ngalimbiu near confluence of Tina and Toni rivers

#### 14.3.2.3.2 Reasonably Foreseeable Timber Harvesting Activities

It is reasonable to predict that communities will continue to practice selective timber harvesting in the Project area, which will be made easier with the new access road. However, it is not possible to predict whether legal or illegal commercial logging will occur, as this is largely dependent on whether customary landowners will (or will not) sell the rights to their timber.

Commercial timber harvesting will not be permitted within the area of land acquired for the TRHDP.

#### 14.3.2.4 Gravel Extraction in the Ngalimbiu River

##### 14.3.2.4.1 Past and Present Gravel Extraction Activities

Current gravel extraction in the Ngalimbiu River removes bed material (primarily sand and gravel) to be used as aggregate material in construction activities.

As it is the case with logging activities, there are no official records regarding the amount of gravel extracted, and whether the rate of extraction is faster than the rate of natural replenishment. The latter may be the case, as the activity currently contributes to erosion of river-banks. In the long term, the industry is probably not sustainable. As an industry, it is not monitored by the SIG, and does not pay royalties to government. Instead, royalties are paid to customary landowners (SOPAC Secretariat, 2006).

##### 14.3.2.4.2 Reasonably Foreseeable Gravel Extraction Activities

Given that the TRHDP will act as a barrier to recruitment of sand and gravel to the downstream Ngalimbiu reach, it is unlikely that new gravel extraction enterprises will develop within the river in future.

#### 14.3.2.5 Other Past, Present or Reasonably Foreseeable Projects

No other projects or activities, past, present or reasonably foreseeable, were identified by local community or SIG stakeholders that would have a spatial or temporal overlap with the TRHDP, such that they would contribute to cumulative impacts.

### 14.3.3 Assessment of Cumulative Impacts

#### 14.3.3.1 Slope Stability, Soil Erosion and Water Quality

The downstream communities are important stakeholders for any development on the Guadalcanal plains. The GPPOL and Gold Ridge experience have shown that not taking downstream communities seriously will result in operations being frequently sabotaged. Gold Ridge, in particular, has had to deal with a disgruntled downstream community that blames many issues relating to the river system and water quality on the mining operations located upstream. The downstream communities are related to those upstream and, generally, when they take matters into their own hands the upstream communities usually do not interfere. Gold Ridge is faced with all the risks of disturbance to their operation. This risk will probably be no different for the TRHDP.

The cumulative impacts are in part based on the fact that the hydropower, oil palm and mining activities all overlap temporally, and have a degree of spatial overlap as well (see Table 13-4). The oil palm industry is located downstream of the TRHDP partly within the Ngalimbiu River catchment, and partly within the Matepono River catchment, while the Gold Ridge mine is located on the Tinahula / Chovohoi River catchment, with both rivers joining into the Matepono River. SPL194 Mining Tenement is located on both the Tina River and Toni River catchments (see Figure X-Y), and the actual Gold Ridge mining lease is located partly on the Toni River, although no activity has taken place in the Toni River catchment.

Water quality for many of the major rivers on Guadalcanal has been a source of concern. The communities along the Matepono River, downstream of the Gold Ridge operation, are in frequent conflict with the company. They claim that the river was contaminated by mining operations, resulting in the loss of livelihoods that are dependent on the river. Changes in water quality during rainy seasons are also blamed on the mining operation. The construction of the hydropower dam for the TRHDP will be a source of concern for downstream communities, due to changes to flow levels and perceived pollution levels.

An important aspect is the pollution from the use of chemicals during the construction phase of the dam, in particular, the use of large quantities of concrete. In terms of pollution, the Gold Ridge tailings dam is a potential threat for downstream communities along the Matepono River. In addition, GPPOL uses herbicides. Table 14-2 summarizes the threat to water quality caused by various projects or activities.

Table 14-2 River reaches potentially affected by cumulative impacts

| Activities | River systems concerned | | | | | |
|---|---|---|---|---|---|---|
| | Tinahulu River (headwater tributary of the Matepono River) | Chovohoi River (headwater tributary of the Matepono River) | Matepono River | Tina River (headwater tributary of the Ngalimbiu River) | Toni River (headwater tributary of the Ngalimbiu River) | Ngalimbiu River |
| Actual Gold Ridge Mining Limited activities | X | X | X | | | |
| Actual mining lease of Gold Ridge Mining Limited | X | X | | | X | X |
| Foreseen activities of Gold Ridge Mining Limited (SPL 194, Vunusa Tenement) | X | X | X | X | X | X |
| Actual Oil Palm activities | | | X | | | X |
| Tina River Hydropower Development Project | | | | X | | X |

There is a present risk of cumulative impacts on water quality and aquatic habitats due to the interaction of the TRDHP and GPPOL projects, and a potential interaction of these two projects with the Gold Ridge project if the Gold Ridge project expands westward into the Tina River catchment, such that there is spatial overlap between all three. The previous Gold Ridge mine activities did not spatially overlap with the TRHDP or GPPOL projects and any expansion of the Gold Ridge mine is now less likely following the closure of the mine. Therefore, at present there are no cumulative impacts foreseen arising from the TRHDP and Gold Ridge's mining activities on water quality; previous mining activities, including drainage from existing tailings outlets, do not connect to the Toni River, i.e., there is no spatial overlap with the TRHDP's area of influence. Therefore, the cumulative impact is presently not significant.

If any Gold Ridge's mining activities expand to involve tailings works, mine access roads, or overburden spoils dumps within the Toni River catchment during the period when the TRHDP is being constructed, cumulative impacts on water quality and suspended sediment loading could occur downstream of the Tina/Toni river confluence. Additional indirect cumulative impacts would then accrue to aquatic habitats, aquatic organisms, and to water uses. However, at present, there is no indication that the mine will actually be reactivated or, if it is, whether mine development would expand into the Toni River drainage. Therefore, the cumulative impact continues to be not significant.

The TRHDP and oil palm industry overlap both spatially and temporally, insofar as potential releases of sediment-laden runoff and contaminants into the Tina and Ngalimbiu rivers during construction of the TRHDP, and herbicide and nutrient containing runoff releases from oil palm plantations into the Ngalimbiu River, coincide. However, until sampling data on contaminant levels in oil palm plantation drainage waters released into the Ngalimbiu River are available, it is difficult to assess the magnitude of cumulative impacts to water quality in the lower Ngalimbiu River. Notwithstanding, it is anticipated that surface water and sediments in the river will contain traces of the chemicals used on the plantations. During TRHDP construction, water will become turbid due to sediment-laden runoff draining the earthworks. This impact will combine with the impacts from oil palm fields, and will be more significant on days with high rainfall, when drainage water from the field will discharge pollutants into the Ngalimbiu River.

Construction and operation of the TRHDP, when combined with logging activities, will generate cumulative impacts. These will be brought about because:

- The presence of a new access road into the forest could make it easier for timber companies to access areas of standing timber than it is with the logging roads that presently exist; and
- Construction of the access road will further degrade the state of disturbed forest in the area, as it will be easier to remove remaining trees.

Selective logging has less impact on topsoil erosion than forest clear-cutting. Regardless of the type of logging activity, the threat to water quality from current logging or past logging activities along Tina River is a reality, particularly at stream and river crossings.

With the creation of the access road, logging activities could intensify if no formal protection of the Tina River catchment is implemented. Increased logging could contribute to erosion or slope failure, and increased suspended sediment loading of the river. If this occurred upstream of the reservoir, it would speed up reservoir sedimentation, and impact aquatic life both in the reservoir and in the river downstream. As documented in the Gold Ridge ESIA, an increase of logging activities occurred as a result of improving road access around Gold Ridge mine.

Gravel extraction is likely to be the most important cause of current turbidity level in the Ngalimbiu River. Therefore, during construction of the TRHDP dam, there will be cumulative impacts on water quality. Operation of the dam will, however, release clear water, thereby eliminating the cumulative impacts.

#### 14.3.3.2 Terrestrial and Aquatic Habitat and Biodiversity Loss

Cumulative impacts of habitat and biodiversity loss will also be significant between the TRHDP (hydropower) and GPPOL (oil palm) projects. However, unless the Gold Ridge (mining) project expands westward into the Toni River catchment area, there is no spatial overlap and, therefore, no cumulative impact with mining. A portion of forest will be removed and a portion of the river system will be impounded to create the reservoir behind the dam. This is in addition to the significant habitat loss that occurred when the GPPOL operation expanded its production to new `out-growers_ who supply oil palm kernels from new satellite plantations, and Gold Ridge prospected onto new sites in central Guadalcanal. This will result in a net loss of habitats and biodiversity.

How the combination of the TRHDP and chemical contaminants discharged from the oil palm plantations into the Ngalimbiu River will affect fish and other aquatic life is difficult to assess, since most studies on herbicide toxicity are carried out using organisms that are not present in Solomon Islands (see Canadian Water Quality Guidelines for the Protection of Aquatic Life, 2012; Dinehart et al., 2008; USDA, Forest Service, 2006; and USDA, Forest Service, 2004).

The presence of the TRHDP dam will act as a barrier to sediment coming from upstream. Without mitigation in the form of periodic replenishment of downstream bed load, there will eventually be a net deficit in recruitment of sand and gravel into the Ngalimbiu River. Such deficit may eventually lead to river-bank erosion and may impact fish communities that rely on gravel for spawning. However, there is sufficient material present as bed-load and on river terraces in the middle and lower reaches of the Tina River to provide for downstream sediment recruitment for many decades to come. Any dewatering and excavation or dredging of accumulated bed load sediments from the reservoir will further ameliorate any cumulative impacts over this time period.

#### 14.3.3.3 Land Acquisition and Tenure

A major cumulative environmental impact will be the land tenure change from customary land tenure to alienated land in the Core Area in addition to the land already alienated to GPPOL for the oil palm plantations, and to Gold Ridge Ltd., for mine development.

The process of land tenure alienation sometimes leads to land disputes, although the process followed for TRHDP has averted any serious disagreements. This situation remains prevalent on Guadalcanal with, for example, recent disputes at Gold Ridge. Many of the landowners of the TRHDP area are also landowners of the Gold Ridge mining sites. The disagreements over land ranges from land boundaries, to royalty payments, access rights, tambu sites and even access to developed lands.

Tensions for land acquisition could flair as families, tribes and villages attempt to reconcile the customary land ownership with the government's requirement for landowners to be legally registered, so that the developer can gain land access rights. In the process of acquiring land, identifying the lawful landowners is usually difficult, sometimes leading to more conflict in the community, and ongoing tensions amongst tribes and families. Some disputes of land boundaries are many years old, and have not been resolved sometimes due to a delay in process.

Disputes over royalty payments for land access, is the most common cause of disagreements. Where no clear guidelines and transparency of process is defined, it amounts to continuous tension and disruption of the development activities. This is the experience of both Gold Ridge and GPPOL.

Reclamation of alienated land is among the most challenging land issues, the background of which was the recent civil-conflict which in part involved a request for alienated land on Guadalcanal to be returned to indigenous landowners. At Gold Ridge, after the civil-conflict, some 400 relocated villagers returned to the mine area. Among them, 100 do not have recognizable claims to the land.

#### 14.3.3.4 Employment

Employment is among the most important benefits that all projects have brought to communities and landowners on the Guadalcanal plains and the broader Solomon Islands. The development of the TRHDP would mean a new employment opportunity for communities in the project area.

Post-conflict Guadalcanal has also been resistant to allowing workers from other provinces to work on development projects within their province. This is a challenge that GPPOL and Gold Ridge have had to address, in particular, when skilled workers were needed.

Employment of non-local workers for jobs that could be done by locals could be a threat to the stability of activities. Gold Ridge's experience with the employment of Fijian security officers exacerbated tensions and resulted in resentment by the communities within the project area. GPPOL, on the other hand recently employed local contractors to provide security for its operation, which resulted in significant improvement of the company's operations.

#### 14.3.3.5 Food Security

The combination of three large-scale developments (hydro, oil palm and mining) could further increase the pressure on food security for many communities around the project site. Many of these communities are already supplying local produce to the GPPOL and Gold Ridge work forces, and TRHDP will be an additional one. The increasing dependence on the cash economy will mean that most farmers could produce more to meet market demands, which could mean more pressure on food security of the communities.

#### 14.3.3.6 Challenges to Cultural and Traditional Practices

The added pressure on traditional norms and cultural practices due to the presence of three large-scale developments will result in potential tensions and conflicts within the project area.

Existing internal issues and tensions between communities, tribes and individuals created by existing activities nearby could spill over to affect TRHDP. Also, issues relating to Gold Ridge or GPPOL could spill over to affect the TRHDP, due to relationships of kinship and land shared among the people and communities.

The pressures on traditional norms and cultures from the influence of `western_ and modern ways, will increase significantly as communities interact with those participating in the development activities. These interactions could be beneficial in terms of cross-cultural interaction but, at other times, will result in strains on project-affected communities. It could be argued that Gold Ridge is gone, and GPPOL is an example of good practice that TRHDP is following, so the cumulative impact if any is likely to be positive.

#### 14.3.3.7 Substance Abuse and Increased Crime

Substance abuse and alcohol related abuse are frequent among men working at both GPPOL and Gold Ridge. This issue was frequently raised during the Project social surveys, as well as during the February 2014 Mitigation Workshops. The main reason is that some men are unused to regularly receiving a cash salary and do not have the necessary experience to manage their money. Consulted communities fear that the TRHDP will be no exception. This is a challenge that the TRHDP will need to take seriously, to develop appropriate prevention measures. Alcohol and drug abuse result in domestic disputes and issues that threaten peace and harmony within the communities. The experience is that many of the disputes are often started with alcohol and drug abuse. The relatively sudden availability of cash can also result in inappropriate and illegal social behaviour, ranging from petty crimes to criminal related activities.

#### 14.3.3.8 Visual Intrusion

The Guadalcanal Plains already have a very distinct visual impact due to the presence of oil palm. The GPPOL plantations and Gold Ridge are highly visible from a distance. The TRHDP access road and the by-passed river reach would create a significant additional visual intrusion to the area, reducing the natural visual amenity of the whole area. The development of the dam and hydropower station will also be distinct features, although they will only be visible to nearby observers, owing to the steep topography. Already at night the GPPOL oil palm and Gold Ridge mine projects emit light that can be seen at a distance, and TRHDP will be an additional light source. To mitigate this impact, it is recommended not to light the dam at night during operation, or to use only low flux lighting if security lighting is required.

#### 14.3.3.9 Natural Resources Availability

The three major projects - TRHDP, Gold Ridge mines and GPPOL oil palm ¯ have allowed, and will continue to allow, local communities to significantly improve their livelihoods. Although social challenges, such as land tenure issues and disruption of traditional ways of life, are still present, these projects contribute to positive changes to local communities. These projects also have a downside, insofar as improved livelihoods contribute to increased population, new human settlements and demand for land. The projects will, therefore, contribute to increased pressure on natural resources such as wildlife, fish, and forest products. Increased population will lead to degraded water quality, primarily as measured by turbidity and coliform. There is also a risk that squatters will arrive on site and initiate land disputes with local villagers. Human settlement expanding into previously forested areas could bring domestic animals that can become feral, and could open the path for invasive species.

#### 14.3.3.10 Natural Hazards and Dam Safety

Community consultations indicated a concern for dam safety, particularly catastrophic dam failure that could send a wave surging down the Tina River valley, destroying homes and taking lives as it inundated villages. The primary activity that would combine with the TRHDP to create a cumulative impact is timber harvesting in the upper catchment area of the Tina River. The concern is related to commercial clear-cutting, as opposed to select harvesting as it is currently carried out. Clear-cutting on steep slopes could expose fragile soils, destabilise slopes, and result in flooding, landslides and debris flows that could endanger the dam and reservoir. If commercial timber harvesting were prohibited in the catchment upstream of the dam, the potential cumulative impact would be mitigated and not significant. Commercial timber felling of sloped land above 400m is currently not permitted under the relevant law (Forest Resources and Timber Utilisation Act). Where this law is enforced it will prevent commercial logging over the vast majority of the upper catchment area.

## 14.4 MEASURES FOR ADDRESSING CUMULATIVE IMPACTS

Many cumulative impacts are related to land tenure issues, water quality issues, loss of biodiversity and economic growth in the area, the latter of which is a positive impact. Most measures presented in this ESIA already address TRHDP's contribution to cumulative impacts. However, this section focuses specifically on additional means of addressing cumulative impacts.

Addressing cumulative impacts requires measures that encompass a larger area of influence than that for the TRHDP on its own, to reflect the spatial overlap of the projects and activities discussed above. Since cumulative impacts are the result of projects or activities that are beyond the jurisdiction of any one project developer or operator, they must by necessity involve the SIG along with the project staff. Three measures are proposed to address cumulative impacts. These include:

1. The Solomon Islands Government (SIG) could create an inter-community environmental and social action committee comprised of representatives of the government, affected communities and local industries.

- ¿ The committee would need to include representatives of all communities in a defined area. It would meet on a regular basis to discuss the activities of the various industries whose impacts on VECs overlap spatially and temporally. Subjects of discussion would include water quality and environmental monitoring results, health and wellbeing of communities, safety issues, and other relevant topics. The committee would base its discussions on Stakeholder Engagement Plans of the various activities in the area.
- ¿ A constraint to the efficiency of such a committee is that the focus of discussions could be drawn into land ownership and royalty payment issues.
- ¿ Another constraint is that each community has its own interests regarding industries. The oil palm industry mainly benefits downstream communities, while TRHDP will likely benefit upstream communities. Discussions may be counter-productive and may be hindered by community rivalry.
- ¿ The committee would, therefore, require a facilitator/mediator to ensure that discussions were focused on the common issues related to managing cumulative impacts and directing individual grievances from communities to specific industries, landowners and the government, to be dealt with outside the committee process.

2. The Solomon Islands Government (SIG) could develop a Local Spatial Development Plan for alienated and customary lands, to ensure good management of the rapid land development in the area:
   - ¿ Many of the lands that will be utilized for both construction and operation of the TRHDP will be alienated from customary ownership. In addition, many lands in the area are still under indigenous ownership. A Local Spatial Development Plan for the project area would guide and manage the growth of peri-urban (i.e., rural-urban transition) areas, and set goals for good governance of land. The plan would aim at defining long-term developments and a vision for the desired spatial form and structure of the area, to ensure that land use demands are well managed both socially and environmentally.
   - ¿ Such a plan would define strategies aimed at safeguarding environmental quality, improving health and education, and peoples˘ livelihoods. For example, it would define biodiversity networks and assess ecosystem values and services.
   - ¿ Such a plan would define area zoning, and restrict some land use in highly valued areas.
   - ¿ Such a plan would spatially coordinate and align public investment, and provide policy guidance for decision-making processes.
   - ¿ A challenge to such a plan would be that there are both alienated lands and customary lands. Currently planning legislation does not extend national jurisdiction to planning controls on customary land. The SIG would, therefore, need to fully involve communities in spatial planning procedures, and be adaptable and flexible. However, given the difficulty in reaching agreement for land development in the area, and given indigenous land tenure conflicts (i.e., Indigenous land identification process is lengthy), and the limited capacity of the SIG, implementing such a plan may not be realistic.
3. All industries in the area would cooperate to implement common actions:
   - ¿ Local industries could create a fund to implement common actions for the benefit of communities, or could join to create a global community communication plan.

- A major constraint to such a measure is that some activities in the area are unorganized and, therefore, have no communication system.. This includes the timber harvesting and gravel extraction industries, neither of which are transparent, have a Stakeholder Engagement Plan, or a formal means of communicating with communities.

In conclusion, many constraints limit the implementation of global actions to mitigate cumulative impacts, particularly the lack of capacity of the SIG, the mixed-land tenure system in the area, and the lack of transparency of some local industries. Since TRHDP will be located in the upstream area of the Tina River system, mitigation measures designed for the Project will also address some of the cumulative impact issues.

## 14.5 LIMITATIONS

The primary limitation in conducting the CIA was the lack of available information on other reasonably foreseeable projects or activities that may have either a spatial or temporal overlap with the TRHDP. A second phase of the CIA is anticipated during project implementation, to focus in greater depth on the most pertinent VECs and explore possible management responses in more detail.

## 14.6 CONCLUSIONS ON CUMULATIVE IMPACTS

A summary of the CIA analysis is presented in Table 14-3.

Table 14-3 CIA summary

<table>
<tr><th>Impacts of TRHDP</th><th>Timber Harvesting</th><th>GPPOL Oil Palm</th><th>Gold Ridge Mine</th><th>Gravel Extraction</th></tr>
<tr><td>Decrease in slope stability, leading to increased soil erosion, and decreased water quality during construction</td><td rowspan="3">Low risk of cumulative impacts as long as no clear cutting are allowed nearby Tina River<br>High risk of cumulative impacts if, in the future, clear cutting is practiced nearby Tina River</td><td></td><td rowspan="3">If new gold mines are exploited in the SPL 194, there is a high risk of cumulative impacts in the Tina/Ngalimbiu River Catchment</td><td rowspan="3">Cumulative impacts along the Ngalimbiu River</td></tr>
<tr><td>Disturbance to aquatic habitats and aquatic life during construction</td><td>Aquatic habitat disturbance from drainage of the palm fields in the Ngalimbiu River Catchment</td></tr>
<tr><td>Disturbance of water uses during construction</td><td></td></tr>
</table>

| Impacts of TRHDP | Timber Harvesting | GPPOL Oil Palm | Gold Ridge Mine | Gravel Extraction |
|---|---|---|---|---|
| Colonization by invasive species | Risk of cumulative impacts if additional logging activities take place in the upstream area thanks to improved access | Oil Palm has opened the way for plant and wildlife invasive species | | |
| Habitat fragmentation | | | | |
| Direct habitat and biodiversity loss | | Oil Palm has transformed some downstream areas in monoculture fields | | |
| Land Related Issues | Land dispute | Land tenure alienation and land dispute | Land tenure alienation and land dispute | Land dispute |
| Employment | Creation of non-qualified employment | Creation of non-qualified and qualified employment | Creation of non-qualified and qualified employment | Creation of non-qualified employment |
| Food security pressure | | Increased pressure on food security | Increased pressure on food security | |
| Challenges to cultural and traditional practices | | Added pressure on traditional norms and cultural practices | Added pressure on traditional norms and cultural practices | |
| Substance abuse and increased criminal activities | Substance abuse and alcohol related abuse among men | Substance abuse and alcohol related abuse among men | Substance abuse and alcohol related abuse among men | |
| Visual intrusion | Degradation of landscape quality | Degradation of landscape quality | Degradation of landscape quality | Degradation of landscape quality |

| Impacts of TRHDP | Timber Harvesting | GPPOL Oil Palm | Gold Ridge Mine | Gravel Extraction |
|---|---|---|---|---|
| Degraded water quality | Suspended solids release due to logging | Herbicides and fertilizers pollution in both water and sediment in Ngalimbiu River | Turbidity, metal and heavy metal pollution in both water and sediment in Matepono River and in the Tina/Ngalimbiu River Catchment if SPL 194 is developed | Major increase of turbidity in the Tina/Ngalimbiu River Catchment |
| Pressures on natural resources availability | Improved livelihoods - leads to increased population and related increased pressures on land and availability of natural resources | Improved livelihoods - leads to increased population and related increased pressures on land and availability of natural resources | Improved livelihoods - leads to increased population and related increased pressures on land and availability of natural resources | |
| Natural hazards and dam safety | Removal of forest upstream of dam, leading to floods, landslides and debris flows that could threaten the dam | | | |

# 15. EFFECTS OF THE ENVIRONMENT ON THE PROJECT

People in most riverside communities, especially women, expressed concern about potential failure of the dam and the devastating consequences that would result from a sudden release of water stored in the reservoir. This concern is related to the effects that cyclones, earthquakes and/or landslides could have on the Project. Some members of the community suggested that to avoid such risks, all riverside villages should be relocated to higher ground. However, the TRHDP PO does not believe that this is a required course of action, given that the project will be designed to withstand the various impacts of the environment on the Project, as discussed below.

## 15.1 IMPACTS OF SEISMIC EVENTS

As noted in Section 5.5.2, the damsite is located in an area of significant seismicity (GeoRisk Solutions, 2012), and large earthquakes are common. Fourteen earthquakes having a magnitude of greater than 7.5 have been recorded in the South Solomon trench since 1900 including a 7.8 magnitude earthquake in December 2016.

A series of reports have been undertaken to assess seismicity risks and incorporate these into design. The Seismology Research Centre undertook a Seismic Hazard Assessment of the Project in December 2014. This assessment included an examination of historical seismological data, and identified peak ground acceleration (PGA) and horizontal and vertical seismic co-efficients.

A severe earthquake can have a direct impact on a dam by causing it to fail. To mitigate this potentially significant environmental affect on the Project, the dam, headrace tunnel, powerhouse and associated power generation equipment will be designed to sustain an Operating Base Earthquake (OBE) (Annual Return Period 1 in 500 years) and to withstand a Maximum Design Earthquake MDE (Annual Return Period 1 in 10,000 years). An MDE means that the dam can suffer significant damage and movements but will not collapse and cause an uncontrolled release of the reservoir water. These design stipulations are incorporated into the earthquake design requirements of the Minimum Functional Specifications, forming an annexure to the PPA between the Developer and Solomon Power.

Table 15-1 – Peak Ground Acceleration and Seismic Co-efficients, Dam Safety Advisory Panel Report, March 2016

| Return Period | PGA (g) | Horizontal Seismic Coefficient (kh) | Vertical Seismic Coefficient (Kv) |
|---|---|---|---|
| 145 (OBE) | 0.179 | 0.12 | 0.08 |
| 475 (DBE) | 0.286 | 0.19 | 0.13 |
| 10,000 (MDE) | 0.678 | 0.45 | 0.30 |

The Developer has compiled a Geotechnical Design Review Report which sets out the geotechnical conditions and design criteria that they intend to use for the Project's outline design. This document, together with the Geotechnical Baseline Report for Construction

(GBR-C), stipulate the design measures proposed to meet the OBE and MDE seismic risk requirements.

The Dam Safety Advisory Panel, engaged in accordance with World Bank OP 4.37, has reviewed the relevant reports, including the Seismic Hazard Assessment, Geotechnical Design Review Report and GBR-C and has prepared recommendations to be incorporated into final design in the Dam Safety Panel Advisory Report, March 2016. The design requirements include:

- foundation excavations for diversion conduit to take place on the left bank where the bedding dip of the sandstone/conglomerate is into the abutment; and
- RCC concrete compressive strength to be not less than 10-15MPa to prevent cracking during an OBE.

The Dam Safety Advisory Panel will continue to review design iterations, and final design, in accordance with the dam safety management plans under WB OP 4.37, discussed further in the Environment and Social Management Plan – Chapter 13.In the event of an earthquake occurring, a post quake assessment would be undertaken of all components of the project to ensure they are structurally and functionally sound. In the unlikelihood that quake damage occurred to the dam, the reservoir would be lowered to ensure no additional strain was placed on the structure and a full assessment would be carried out to identify measures required to remedy any engineering concerns.

A severe earthquake could also adversely affect power generation, by causing switches to be automatically thrown in the switchyard, and transmission line pylons to fall over. Whilst this would be a significant inconvenience to Guadalcanal for the period of time it would take to affect repairs, it would not present a threat to the safety of villagers residing in the downstream communities.

Indirect impacts associated with an earthquake event include triggering landslides or mass wasting. This is discussed in Section 15.2. An earthquake could also cause trees to topple over and block the access road, or knock out the transmission line.

## 15.2 LANDSLIDES AND DEBRIS FLOWS

Landslides and debris flows triggered by earthquakes, floods undermining toe of slopes, wind thrown trees losing root cohesion and exposing soils to water-logging

As noted in Section 5.5.1, a significant number of landslides occur within the Tina River catchment, particularly on the steeper slopes. However, they remain relatively small (100$m^3$ to 200$m^3$), and are primarily associated with rockslides along bedding planes. Other slope failures are located in the upstream end of the proposed reservoir, in Suta Volcanics. Debris flows are also a feature of the upper watershed, and are caused when boulders and logs that are trapped in steep gullies or streams are suddenly mobilised due to a flash flood or small headwall landslide being released in the upper reach of the stream during a major rainfall event.

According to Entura (2014), large landslides can have a detrimental effect on the dam and its reservoir if they occur near the dam, or if the landslide causes wave propagation that could overtop the dam, which is a particular concern for earthfill dams. The TRHDP dam will be an RCC dam with an open spillway. Therefore, the risk of overtopping is not an issue, due to the

solid concrete construction and the open spillway design that would pass a landslide propagated wave, should a landslide of significant mass enter the reservoir.

Likewise, debris flows that enter the Tina River upstream of the dam as a result of cyclone generated rainfall deluge, are unlikely to affect the dam or the downstream powerhouse, providing that the fish screens are in place over the power intake, to prevent entrainment of floating woody debris entering the reservoir from debris flows, into the headrace tunnel, as this material could damage the turbine runner blades.

Notwithstanding the above, Entura (2014) has suggested that design of the dam and construction planning should assess the risk of remobilizing existing landslides during construction work. They note that large-scale landslides are unlikely to directly affect the dam.

## 15.3 Impacts of Severe Weather or Climate Related Events

Depending on how global climate change is manifested in the Solomon Islands, it is possible that one of three effects will be felt: 1) no significant change to the pattern and volume of rainfall within the region (status quo); 2) increasing frequency of severe tropical cyclones and rainfall events; and 3) reduced frequency and magnitude of rainfall patterns that by present standards would be considered `drought_ conditions.

### 15.3.1 Status Quo Weather and Climate Conditions

As noted in Section 5.6, the Tina River is a single channel meandering river. It has a torrential behavior with regular flash floods. High rainfall events generate periodic flash floods, and debris flows. These events are unlikely to have any direct impact on the dam or associated power generation facilities. The open spillway will pass floodwaters, and the fish screens on the power intake will prevent debris from entering the headrace tunnel and turbines.

### 15.3.2 Cyclones, Severe Rainfall Events and Floods

As noted in Section 5.4, the project area is subject to periodic cyclone events. In May 1986, cyclone Namu contributed 1200mm of rainfall over a period of a few days, causing rivers to overflow their banks. Water depth at the project site was said to be 7m. The floods and mudflows precipitated by Cyclone Namu reshaped the course of the Tina River.

The primarly affect of a cyclone on the Project is the extremely high rainfall that would fall within the catchment area, generating flash floods, debris torrents and, potentially, landslide events. The RCC dam will incorporate an open spillway feature which will be capable of passing a 1:10,000 year flood event without any threat to the dam or its facilities. As the spillway does not have gates or stoplogs, floodwaters will pass over the lip of the spillway unimpeded.

Significant flooding would have the potential to cut off immediate access to the dam due to the likelihood that roads would be flooded or washed out. Due to the small size of the reservoir, it would not have any flood attenuation capacity to mitigate floods generated by high rainfall patterns that accompany a cyclone.