Environmental and Social Impact Assessment

June 2017

SOL: Tina River Hydropower Project
(Part 2)

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.

Figure 1-1-2 Approximate location of the reservoir (Tina Valley) looking upstream

Source: BRLi, 2013

1. Figure 1-3 Approximate location of the dam (Tina Valley) looking upstream

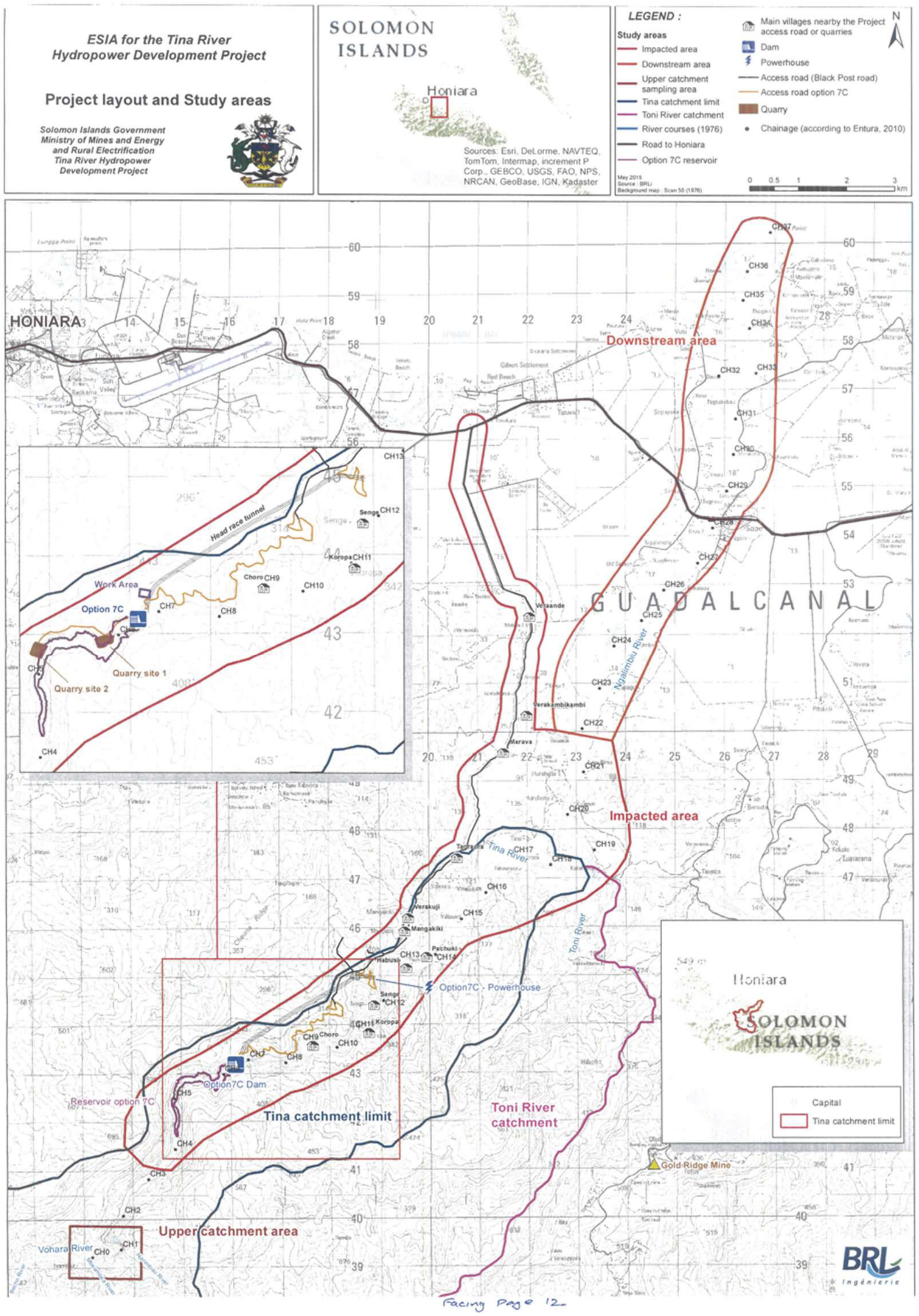
Source: BRLi, 2013

2. Figure 1-4 Approximate location of the left bank powerhouse looking downstream

Source: BRLi, 2013

The following map Figure 1-5: Map of scheme elements and study locations shows the location of the dam, powerhouse and access road within the Central Guadalcanal region. It also indicates the extent of the Tina catchment, the extent of the project affected area, the downstream area and the location of ESIA study sites both within and outside the affected area.

3. Figure 1-5: Map of scheme elements and study locations



1.2 PROJECT PROPONENT

The proponent responsible for developing the Project, is the Government of Solomon Islands, represented by the Ministry of Mines, Energy and Rural Electrification, which has established a TRHDP Project Office (PO) in Honiara, Solomon Islands.

The following contact information applies to the Project:

Entity Responsible for Project Development :	TRHDP Project Office
Address :	Suite 304, Hyundai Mall Mendana Avenue Honiara, Solomon Islands
Principal Contacts for the ESIA :	Mr. Mark France, Project Manager Mark.france@tina-hydro.com Fred Conning, Deputy Project Manager Fred.conning@tina-hydro.com
Project Website :	www.tina-hydro.com

1.3 PARTIES RESPONSIBLE FOR PREPARING THE ESIA

A number of consultants have been involved in preparing the ESIA as follows.

1.3.1 Initial ESIA Preparation

Initial ESIA studies were undertaken, and initial ESIA documents prepared, by BRLi, an engineering company based out of Nimes, France. BRLi was assisted locally by Solomon Environment Services (SES). The initial ESIA report and supporting annexes were submitted in November 2013. The following consultants were responsible for preparing the initial ESIA:

Gilles Pahin ¯ Team leader;

Gerard Fitzgerald ¯ Sociologist;

Lawrence Foanaota ¯ Anthropologist;

Lo¾c Tr¶baol ¯ Aquatic ecology and hydrobiology specialist;

Edgar Pollard ¯ Local fauna specialist;

Robson S. Hevalao ¯ Local aquatic ecologist;

Myknee Sirikolo ¯ Local botanist; and

Eric Deneut - Assistant team leader and biologist.

1.3.2 Supplementary Specialty Studies

Based on reviews conducted by environmental and social safeguard policy specialists from the World Bank, and by the environmental and social experts on the TRHDP Panel of Experts, a number of areas were identified that required additional specialist input. The following is a list of the specialist consultants and the studies for which they were responsible:

- Ian Jowett ¯ Supplementary fish and aquatic habitat assessment study for determining minimum environmental flow requirements.
- Gerard Fitzgerald ¯ inputs into TRHDPˇs Land Acquisition and Livelihood Restoration Plan for determining compensation and restoration actions related to the land acquired for the project and livelihood assets impacted by this acquisition.

Both the fish and aquatic habitat studies and the Land Acquisition and Livelihood Restoration Plan have been completed.

1.3.3 ESIA Quality Review And Final Edit

The initial ESIA prepared by BLRi was amended to reflect the comments received from various reviewers, include the supplementary information developed by the subject specialists, and to ensure that the ESIA conformed to World Bank Operational Directives, and World Bank Performance Standards.

The current document reflects the compilation of this additional information, along with a quality review and final edit. This activity was performed by:

- TRHDP, Project Office, MMERE
- R. Scott Hanna, Senior ESIA Specialist, Roberschan Environmental.

1.4 PURPOSE OF THE PROJECT

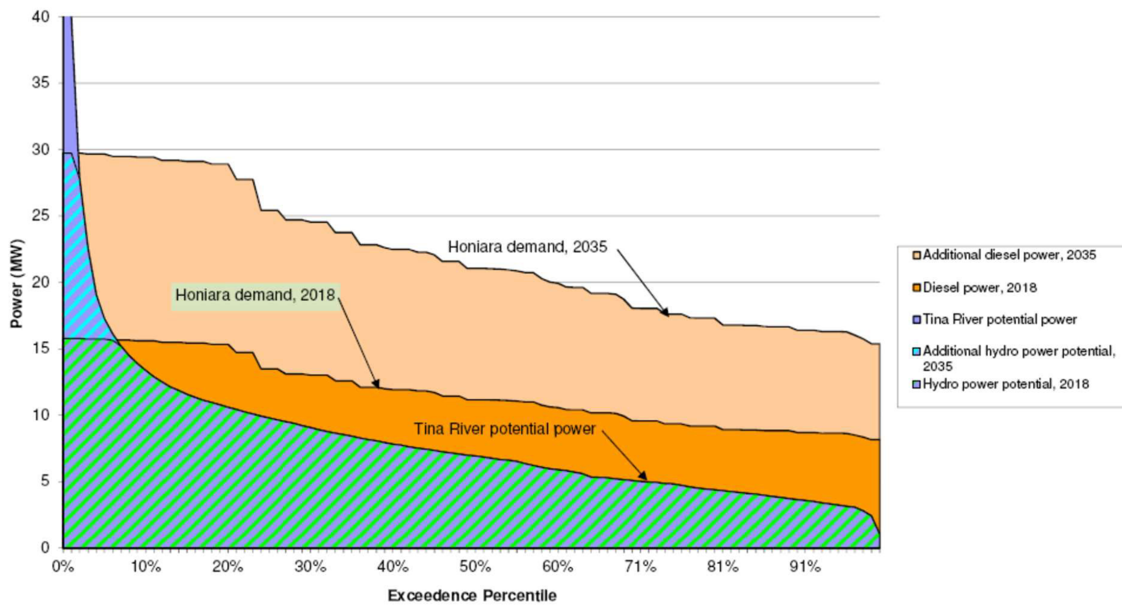
Currently, the Lungga diesel power plant is the main provider of electricity in Guadalcanal. The capital city and key population centre, Honiara, suffers from power shortages, especially during peak demand periods. With increasing population growth and industrialization, Solomon Islands will require an increased supply of reliable power. TRHDP aims to reduce the peak demand requirement from the current diesel system and reduce the need for a backup diesel generating plant. Together, this will defer the need for further investment in Diesel power generation for more than a decade.

The price of electricity in Guadalcanal is amongst the highest in the Pacific region, and is directly the result of having to rely on the importation of costly diesel fuel to generate electricity. Guadalcanal has abundant hydropower potential that could help the country reduce its dependency on oil, reduce uncertainties inherent with world oil markets, and reduce the cost of electricity production.

Electricity generated from diesel leads to environmental impacts such as: greenhouse gas emissions, air pollution and a risk of oil spills during extraction and sea transport to Honiara. Hydropower, as the preferred alternative, has the advantage of allowing Solomon Islands to rely on its own renewable resource to generate electricity rather than importing non-renewable carbon-based resources to generate electricity.

Figures 1-6 and 1-7 show the power demands of Honiara and the power potential of the TRHDP during dry and wet seasons. These two figures illustrate that in both dry and wet seasons, TRHDP will make a significant contribution to power supply in Honiara. Wet year inflows will see the station able to operate at full capacity for most of the time ¯ with unused water being spilled around 40% of the time. In the driest three years on record (i.e. an event with about 10% probability) the station will only rarely be able to utilise all three 5 MW machines.

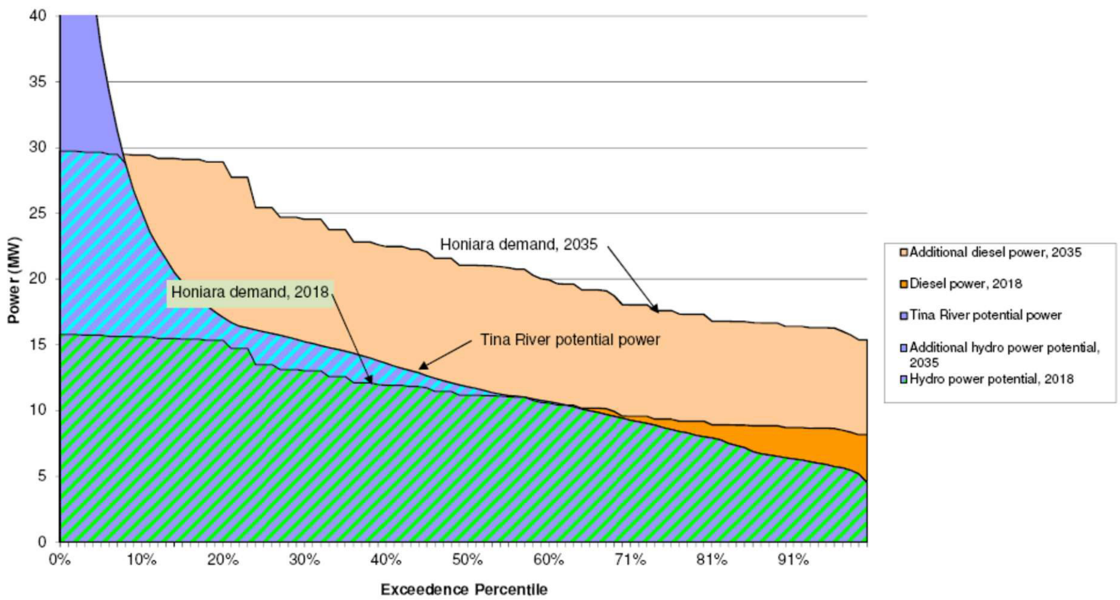
4. Figure 1-6 Power demand and TRHDP power potential during dry seasons



Source: Entura, 2014

In those dry years it is expected that the hydro power station will be used to reduce the need for diesel capacity in the high demand times of the week ¯ between 8 a.m. and 6 p.m. If diesel produced a steady 8MW for the whole of this period of the day, the hydro could produce all of demand which exceeded that base load, in any circumstances modelled. The hydro could also meet all demand above a 6 MW baseload, for all but 4 weeks in the driest year.

5. Figure 1-7 Power demand and potential power from TRHDP during wet seasons



Source: Entura, 2014

In 2014, the unit cost of diesel energy production in Guadalcanal coming from the Lungga power plant was US$ 330/MWh. The unit cost of diesel energy production is expected to rise to US$380 to US$ 422/MWh within 20 years. The unit cost of hydro from the TRHDP is estimated to be US$ 185/MWh and could decrease to US$ 165/MWh, which is significantly lower than the unit cost of diesel. As the diesel price increases in future years, the differential will also increase significantly.

1.5 OBJECTIVES OF THE ESIA STUDY

The objectives of the ESIA are to:

- Comply with Solomon Islands legal requirements for the formulation of an Environment Impact Statement under the Environment Act 1998 since the TRHDP is a prescribed development under schedule 2 (section 16)
- Comply with World Bank/IFC requirements and Performance Standards, including IFC PS 1: Assessment and Management of Environmental and Social Risks and Impacts
- Determine the full range of environmental and broad social impacts of the project within the existing environmental, socio-economic and cultural context of the project area to:
- inform the detailed design and implementation stages regarding how to avoid or manage the assessed impacts; and
- achieve development consent through the timely approval of the outcome of the ESIA.
- Provide an analysis of the project area communities and an assessment of the full range of social impacts and benefits of the project within the project area, with particular focus on social impacts associated with IFC PS 7: Indigenous Peoples.
- Assess and discuss impact on natural habitat, gender aspects and cultural heritage as required by the World Bank safeguard policies and IFC Performance Standards.

Analysis of the impacts of Solomon Islands Government˜s land acquisition on the owners and users of the project land, and compliance with WB OP 4.12 (involuntary resettlement), are addressed separately in the Land Acquisition and Livelihood Restoration Plan.

1.6 ESIA STUDY METHODOLOGY

Preparation of the ESIA has involved several stages, including:

- Identifying the impacted area and study area.
- Identifying and reporting on baseline environmental and social conditions.
- Analysing impacts, and identifying measures to avoid or mitigate impacts, including the use of Mitigation Workshops.
- Reporting on impacts and mitigation.

1.6.1 Area of Influence and Study Area

1.6.1.1 Area of Influence

The Project˜s Area of Influence (AOI) is defined as the geographical area affected by the Project˜s construction and operation activities. This area excludes the wider area which may be affected by cumulative impacts. The AOI includes the Direct Impact Area, Upstream Area, Downstream Area and Infrastructure Area.

- Direct Impact Area (DIA): The DIA is the direct physical footprint of the project being the land on which all project related infrastructure will be located and all construction will be undertaken. The DIA consists of:
  - Core Area ¯ 397 Ha site acquired by SIG in 2014 encompassing all land required for the construction and operation of the dam, reservoir, powerstation, and the portion of the access road from Mangakiki Village to the powerhouse and dam site (also known as Road Lot 2). The Tina Core Land Company (TCLC) will own the Core Area, including the access road. The company is a joint venture between customary landowners and SIG. The map in Figure 1-8 shows the location of the Core Area in red.

    NB: The Core Area acquisition in 2014 also included the customary land component of the Infrastructure Corridor, however this area of land acquired for the road and transmission line is defined as part of the Infrastructure Corridor for the purposes of assessing impacts in this ESIA.
  - Infrastructure Corridor ¯ Encompassing a 50 metre corridor from Mangakiki Village to the Black Post Turnoff to accommodate the access road and dual 66kV transmission lines, and the transmission line route from Black Post Road to the existing Lunnga Power Station.
- Upstream Area: The Upstream Area is the portion of the Tina River Catchment located upstream of the dam and reservoir. Impacts considered in this area include impacts on migratory fish and other aquatic species and impacts of potential reduced access to the hunting and fishing grounds of local communities.

- Downstream Area : The Downstream Area is the area downstream of the dam to tide-water, (i.e., dam to the confluence with the Toni River, where the Tina and Toni Rivers then become the Ngalimbiu River, and beyond to where the river enters Iron Bottom Sound). The downstream area may be affected by changes in the Tina River flow pattern and water quality. Over the long term, erosion and deposition of materials on the riverbanks may modify the way the river is used for such purposes as household water supply, and exploitation of gravel deposits.

- Infrastructure Area : Infrastructure Area is the geographical area within which people and communities are likely to be affected by the Infrastructure Corridor (modifications to, and use of, the access roads and transmission line corridor). It extends beyond the DIA to include villages or communites that may be impacted by noise, dust, traffic or electricity safety concerns.

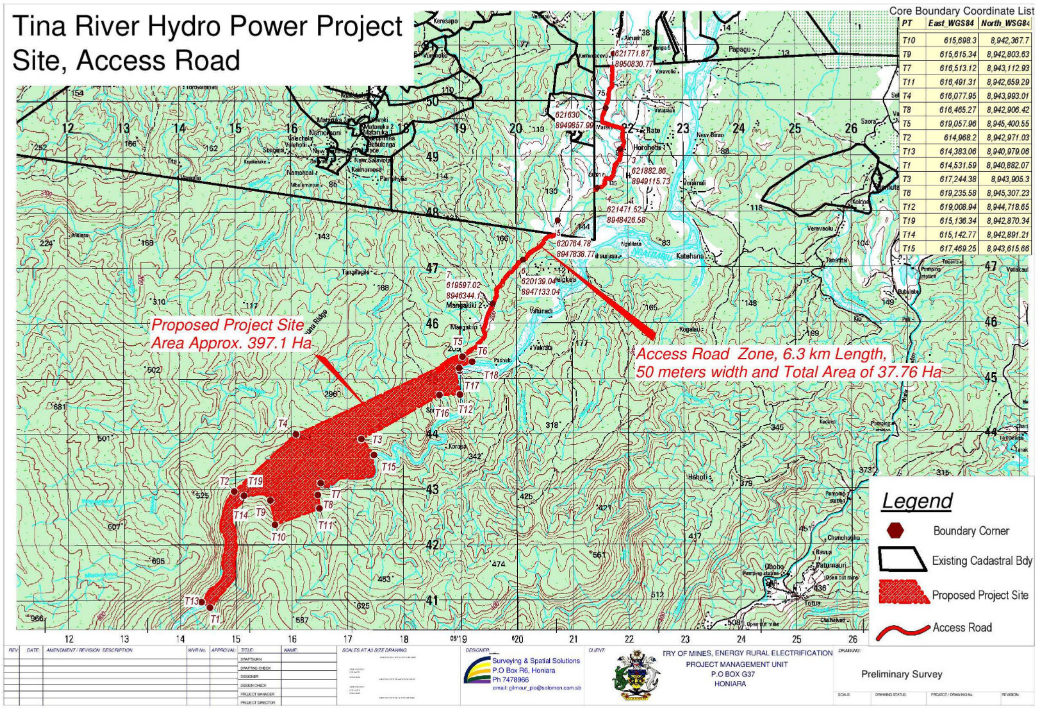
1.6.1.2 Study Area

The study area was selected on the basis of being either part of the Project's Area of Influence or indicative of the wider environmental setting. The study area extends beyond the Project's Area of Influence and is defined as the area in which all potential positive and negative, direct and indirect impacts, including cumulative impacts, may accrue as a result of the project. This includes the entire Tina River and Toni River catchments. It also includes communities that will not be directly affected by the TRHDP, including Behaha and Malango communities, both of which have land interests in the Core Area but are not affected by physical siting of project infrastructure.

For discussion purposes, the Study Area has been broken down into various subunits as follows. The approximate boundary of the Study Area and the subunits described below are shown in the map in Figure 1-5:

- Area of Influence - defined above.
- Toni River Catchment Area - this area covers the entire Toni River catchment from headwaters to confluence with the Tina River, covering approximately 45km^2. It was studied as part of the cumulative impact assessment, since the Toni River meets the Tina River to form the Ngalimbiu River. Development of mining activities may occur in the Toni River catchment area, since part of the catchment is included in the Gold Ridge Special Prospecting License (SPL 194).
- Terrestrial Upper Catchment – The area of terrestrial habitat in the Tina River Catchment above the dam and reservoir.
- Wider Impact Area (WIA) – The term used in the Social Impact Assessment (see Section 8.1.2.5) to describe the people and communities in Malango who have ownership rights to land and resources in the Core Area, but who do not reside within the Area of Influence.

Figure 1-8 Core Area and portion of road infrastructure corridor



Source: TRHDP PO, 2014

1.6.2 Identification of Baseline Conditions

The first stage of the ESIA process involved collecting and assembling information on baseline conditions from the study area, and preparing a report that described the current state of the environmental and social components. The baseline included a description of the physical environment, aquatic ecosystem (e.g., fish and aquatic habitat), terrestrial ecosystem (e.g., fauna and flora), and the social environment (e.g., socio-community and socio-cultural aspects and villagers˘sources of livelihood). The information was gathered from both extensive on site surveys and review of secondary sources.

The objectives of collecting and assembling baseline information include:

- identifying baseline human and natural environment conditions and the sensitive areas to inform stakeholders and project affected communities;
- Establish the pre- project environmental conditions of the project area so that it can be compared to post project conditions.
- enabling TRHDP to understand the area of influence and its sensitive sites and how these may be affected by project components;
- informing stakeholders and Project affected communities about the ESIA process;
- preparing for the Mitigation Workshops; and
- assessing current policies as a measure of compliance with National, Provincial and IFC/World Bank policies.

- ¿ Baseline environmental and socio-economic / socio-community information, including information on sensitive areas, was documented in a baseline report.

1.6.2.1 Literature Review

In preparing the ESIA information was obtained from a number of secondary data sources through a literature review process. The following types of data sources were accessed:

- ¿ TRHDP Pre-feasibilty and Feasibility study reports;
- ¿ Other TRHDP project documents and TRHDP website;
- ¿ Solomon Island Government publications, including data obtained from various ministries;
- ¿ Publications of various South Pacific organisations;
- ¿ Scientific journal publications;
- ¿ ESIA documents published for other projects in the Solomon Islands;
- ¿ World Bank and IFC publications;
- ¿ Maps and satellite imagery (e.g., Google);
- ¿ Local newspaper articles;
- ¿ Information available from various websites (e.g., annual reports for mining companies).

1.6.2.2 Field Studies and Surveys

Secondary data obtained from the literature review was updated and supplemented by primary data collected through field studies and surveys. These included:

Environmental

- ¿ Field visits and sampling took place from 05 to 17 August 2013.

Social

- ¿ Field surveys were carried out from 29 August to 25 September 2013.

Combined Environmental and Social

- é Mitigation workshops - seven workshops with local stakeholders during February 2014 (see Section 1.6.3.1)

1.6.3 Identification of Impacts and Mitigation Measures

The baseline report was reviewed by the Panel of Experts that provided comments that were addressed by carrying out additional analysis during the impact identification stage, and subsequent to this, when the initial ESIA was reviewed.

The following sections summarise the steps followed to identify potential impacts and select mitigation measures:

1.6.3.1 Impact Assessment Methodology

The following steps were used to identify and analyse environmental and social impacts that could potentially accrue as a result of project actions or activities associated with project design and construction, operations and maintenance, and decommissioning and restoration:

- ¿ Define Areas of influence (AOIs) ¯ identify the area within which a project action or activity could potentially affect a given environmental or social resource or attribute. AOIs differ between attributes.
- ¿ Identify Impact Sources - identify the project actions or activities (impact sources) likely to affect environmental or social attributes within the AOIs. An impact identification matrix was used for this purpose.
- ¿ Assess Impacts ¯ assess each impact according to a set of impact criteria, including: duration (temporary vs permanent); reversibility (reversible vs irreversible); extent (site specific vs local vs regional); magnitude or intensity (minor, moderate, major), and probability of occurrence (low, moderate, high).
- ¿ Assess Impact Significance - assess significance of each identified impact. Impacts can be both positive and negative. Negative or adverse impacts are rated using the criteria of duration, extent, magnitude/intensity (major, moderate or minor); and probability of occurrence.
- ¿ Application of identified mitigation measures ¯ identify measures to avoid or reduce negative or adverse impacts.
- ¿ Identify Residual Impacts identify residual effects of the impact after mitigation (significant or not significant).

An impact identification and mitigation matrix was produced. This was used to lead discussions in a series of mitigation workshops. The matrix identified the main impacts and mitigation measures of the TRHDP. The matrix was simplified and used during mitigation workshops to engage local populations and stakeholders, and stimulate discussions.

Seven mitigation workshops were carried out between from 04 to 08 February 2014. The objectives of these workshops included:

- ¿ Presenting potential impacts of the Project;
- ¿ Discussing possible mitigation and compensation measures with stakeholders and Project Affected People; and
- ¿ Obtain input regarding grievances and answer questions.

Table 1-1 identifies mitigation workshop dates, venues, participant groups and number of participants. Additional details on the workshops are provided in Annex 13 of the Annex Report (list of participants) and Annex 12 (minutes of the meetings and lists of grievances and questions).

Table 1-1-1 Mitigation workshops

Date	Venue	Target communities or stakeholders	Number of participants
04 Feb 2014	Heritage park	Ministries and Task force	30 persons
05 Feb 2014	Heritage park	NGOs	14 persons
05 Feb 2014	Tina Village	Communities affected by dam operation	114 persons (including people from surrounding communities such as Antioch and Marava)
06 Feb 2014	Ado	Landowners who have customary rights in the impacted area but that are physically outside of it	60 persons
06 Feb 2014	Mataruka	Landowners who have customary rights in the impacted area but that are physically outside of it	120 persons

Date	Venue	Target communities or stakeholders	Number of participants
08 Feb 2014	GPPOL community building	Downstream affected communities	74 persons
08 Feb 2014	Rate school	Communities affected by dam operation and construction activities	30 persons

1.6.3.2 Environmental Impact Analysis

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

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

Impacts accruing as a result of the following were also assessed:

Changes of flow downstream of the dam

1.6.3.3 Social Impact Analysis

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

- ¿ Health, safety and well-being
- ¿ Women and vulnerable groups
- ¿ Social relations
- ¿ Social organisation
- ¿ Local customs and way of life
- ¿ Employment
- ¿ Education and skills
- ¿ Ecotourism
- ¿ Livelihood strategies
- ¿ River and water resource use
- ¿ Local financial capital and economic development, royalties, resource rents

Impacts accruing as a result of the following were also assessed:

- é Project construction workforce
- é Uninvited visitors, job-seekers and settlers

1.6.4 Impact and Mitigation Reporting

The final step in preparing the initial ESIA involved analyzing and describing impacts and issues raised by communities, and proposing measures to avoid, mitigate and compensate for adverse impacts. Impacts are changes that will accrue to both environmental and social attributes as a result of a project's actions or activities. In addition, environmental and social management and monitoring are proposed for construction and operations phases of the Project. The ESIA, as required by the World Bank and IFC, also analyses cumulative impacts (see Chapter 10).

1.6.5 Supplementary Studies and Finalising ESIA

In response to comments received from the World Bank's environmental and social safeguard policy specialists, and from the TRHDP Panel of Experts, two additional technical studies have been undertaken to address outstanding issues and questions. Key pieces of information from the supplementary studies have been incorporated into this ESIA document, and the studies have been appended as annexes. The impact analysis has also been amended based on new relevant information obtained from the supplementary reports, and mitigation measures adjusted appropriately.

The supplementary reports undertaken since the initial draft ESIA was completed for review, and which have now been incorporated into this current document, include:

1. 'Report on Engineering Geological Assessment for Proposed 7C Dam Site', prepared by by GeoRisk Solution (2014). This study highlights the need for further investigations to answer questions regarding uncertainty associated with geological conditions. The following recommendations for further work were identified by Entura (2014):
   - Storage area: the presence of Karstic limestone in the future storage area needs further study to ensure water tightness and dissolution rate following impoundment of the reservoir. Karstic limestone represents a potential leakage pathway. Additional risks to the reservoir are posed by landslides.
   - Dam site 7C: additional mapping and drillholes are required to characterize the ground conditions upstream and downstream of the dam.
   - Quarry sites: additional mapping and drilling is recommended to better define the suitability of the identified quarry sites. No information is provided for quarry site access roads.
   - Headrace tunnel: a drilling program is required to characterize the rock mass conditions in the tunnel alignment.
   - Powerstation: slope stability and foundation conditions are a concern and field mapping in the vicinity of the proposed powerhouse is required.
   - Access road alignment will require field mapping.
2. 'Tina River Hydropower Development – assessment of effects on aquatic ecology and possible mitigation measures', prepared by Ian Jowett of Jowett Consulting Limited (March 2016). This study assesses the effects on the aquatic environment of the proposed project, including:
   - potential effects of environmental flow and fish passage requirements;
   - assessment of minimum environmental flow requirements;
   - hydro peaking;
   - morphological changes resulting from reduced sediment load; and
   - possible mitigation measures.

1.7 STAKEHOLDER ENGAGEMENT AND ESIA DISCLOSURE

The TRHDP PO has been engaged in communication with local communities since 2011 and is involved in an on-going process of community outreach activities, including:

- Development of a stakeholder engagement plan,
- Informative meetings prior to project experts visiting the site (e.g., prior to drilling activities, ESIA surveys, etc.),
- Establishment of Community Liaison Assistant (CLAs) and capacity building to help the PO communicate and identify grievances from the community, as part of the Stakeholder Engagement Plan,
- Community awareness meetings, which inform people about mitigation and entitlements provided by the project (in line with World Bank and ADB policies on resettlement and indigenous peoples),
- Meeting with landowners, community leaders, women, youth, elders, etc.,
- Mitigation workshops.

Since 2011, the TRHDP PO has organized more than 250 outreach activities with communities, summarised in Annex 14.

Key ESIA findings were shared with communities at 15 mitigation workshops over 4 weeks across Ghaobata, Malango and Bahomea, attended by 512 participants, 45% of whom were women. The minutes of these meetings are provided in Annex 12.

In response to the outcomes of the workshops and stakeholder feedback, the ESIA was further revised and disclosed in 2016. Appendix N provides a table of community feedback received during the 2014 ESIA consultations and how that feedback has been incorporated into the revisions of the ESIA and project design.

Following disclosure of the revised ESIA in 2016, TRHDP PO conducted additional ESIA consultations with target communities and key stakeholders in October/November 2016. Table 1-2 identifies consultation workshop dates, venues, and participant groups and Table 1-3 provides a summary of the community feedback and its incorporation in ESIA revision.

Table 1-2 – Stakeholder Consultations for Revised ESIA

Date	Venue	Target communities or stakeholders
20 October 2016	Hyundai Mall, Honiara	Ministry of Environment and NGOs
31 October 2016	Rate Village, Bahomea	Downstream and infrastructure corridor affected communities affected by dam operation and construction activities
1 November 2016	GPPOL community building, Ghaobata	Lower Downstream affected communities

Table 1-3 - Resolution of Community Concerns - ESIA Consultations Oct 2016

Community	Consultation Feedback	Project Outcome
Ngalimbiu Communities	Concerns of reduction in gravel available for commercial extraction	Gravel monitoring by a river geomorphologist provided in the ESMP in section 13.2.2. Drill holes demonstrate areas of deep gravel depth, suggesting sufficient gravel for a significant number of years.
	Dam safety concerns for downstream villages. Dam will :answer to nature˘s call˘	Dam design complies with dam safety panel requirements. Dam safety panel visited communities in 2012. ESMP section 13.2.2 requires a village level consultation program on modern day dam engineering, construction and operation complemented by community briefings from the World Bank˘s dam safety panel.
	Concern that environment and safety measures discussed will not be implemented or overseen.	Environment and safety measures to be incorporated into all project agreements. New contractual arrangements section 13.7.3 added to ESMP. Project Finance to include funding for TRHDP-PO and MMERE to provide oversight of SPC and HEC E&S implementation.
Bahomea and Infrastructure Corridor Communities	Concerns of dam safety and question regarding possibility of relocation	Dam design complies with dam safety panel requirements. Dam safety advisory panel (DSAP) visited communities in 2012. ESMP section 13.2.2 requires a village level consultation program on modern day dam engineering, construction and operation complemented by community briefings from the World Bank˘s dam safety panel. Relocation not advised by DSAP. WB safeguards do not support unnecessary relocation.
	Could the dam be used to provide a water supply for communities and Honiara	Not a component of the current hydropower project.
	Village water supplies to be built before construction starts	Section 13.2.2.6 revised to clarify that all downstream communities whose use is affected by the Project will receive alternative water supplies before construction commences.
	Employment to prioritise host communities. Concerns of influx of people and workers from other islands.	Project related employment to prioritise host communities, ESMP section 13.2.2.2. Requirement incorporated into Implementation Agreement between SIG and SPC.

Community	Consultation Feedback	Project Outcome
	Will downstream fish migration be impacted by the dam once upstream migration measures are implemented	Downstream fish migration predicted to follow freshes and small floods and make use of spillway.
	Electrification for villages	Electrification for priority infrastructure a component of the JSDF Community Benefit Share Pilot, at section 13.5.1.1.
	Important that dust reduction and malaria prevention plans are properly implemented	Air Quality Management and Dust Control Plan and Community Health and Disease Vector Management Plan to be provided by the Developer. Further information on these plans, and details of timeframes and approvals inserted in section 13.4.
	Will there be improvements to education and clinics? Education is priority.	Funding for education and clinics are expected to be key priorities for the Community Benefit Share Fund. Fund priorities to be determined with reference to community consultations as part of fund design and ongoing operations. Discussion of the Benefit Share Fund updated in section 13.5.1.

The TRHDP PO continues to conduct ongoing consutlations with communities. In addition, the Ministry of Environment, Climate Change, Disaster Management and Meteorology will undertake further stakeholder consultations in 2017 in accordance with timeframes under the Environment Act.

1.8 STRUCTURE OF THE ESIA REPORT

Following the Executive Summary, the ESIA report is divided into the following parts and sections. Additional supporting information is provided in Appendices at the back of this ESIA document, as well as Annexes contained within a separate stand-alone Annex Report.

Part A – Introduction, Project Selection, Rationale and Regulatory Framework

Section 1: Introduction - This chapter provides a general background to the Tina River Hydropower Development Project (TRHDP or the 'Project'), its project proponent and purpose. This chapter also briefly describes the objectives and methodology of the ESIA study.

Section 2: Project Description - This chapter describes in detail the project context, access, components, actions and activities of the Project, and its associated project support facilities. It also broadly describes the activities in the project area, the project requirements and the expected implementation schedule.

Section 3: Institutional and Legal Framework - This chapter summarizes the applicable legislative and regulatory context in the Solomon Islands, and notes the World Bank Group˘s and IFC˘s requirements including the World Bank˘s Environmental and Social Safeguards Policies and IFC Performance Standards.

Section 4: Analysis of Alternatives - This section describes the analysis of project alternatives, the reasoning for selecting the preferred option (Option 7c) over other location options on the Tina River, over the `No Project_ option, and over other power generation alternatives in the Solomon Islands.

Part B ¯ Baseline Conditions

Section 5: Physical Environmental Baseline - This section describes existing baseline conditions for the physical environment within the project area of influence.

Section 6: Biological Environmental Baseline ¯ Terrestrial - This section describes existing baseline conditions for the terrestrial biological environment (flora and fauna) within the project area of influence.

Section 7: Biological Environmental Baseline ¯ Aquatic - This section describes existing baseline conditions for the aquatic biological environment (flora and fauna) within the project area of influence.

Section 8: Socio-economic / Socio-community Baseline - This section describes existing baseline conditions for the social environment within the project area of influence.

Part C ¯ Impact Assessment and Mitigation

Section 9: Assessment of Impacts on the Physical Environment - This section describes potential environmental impacts that are anticipated to accrue as a result of construction and operation of the TRHDP. It identifies and discusses impacts to the physical environment, and briefly outlines the measures proposed to avoid, minimize, and mitigate potential impacts, following good international industry practice (GIIP) for the hydropower sector.

Section 10: Assessment of Impacts on the Terrestrial Biological Environment - This section describes potential environmental impacts that are anticipated to accrue as a result of construction and operation of the TRHDP. It identifies and discusses impacts to the terrestrial biological environment, and briefly outlines the measures proposed to avoid, minimize, and mitigate potential impacts, following GIIP for the hydropower sector.

Section 11: Assessment of Impacts on the Aquatic Biological Environment - This section describes potential environmental impacts that are anticipated to accrue as a result of construction and operation of the TRHDP. It identifies and discusses impacts to the aquatic biological environment, and briefly outlines the measures proposed to avoid, minimize, and mitigate potential impacts, following GIIP for the hydropower sector.

Section 12: Assessment of Socio-economic / Socio-community Impacts - This section describes the potential social impacts of the TRHDP, and the social impact assessment SIA methodology and constraints of the Social Impact Assessment (SIA). It highlights the communities˘ perceptions regarding potential adverse social impacts (e.g., impacts on health, safety and well-being), and potential benefits (e.g., electrification, employment, education and skills, ecotourism). This section also briefly outlines the measures proposed to avoid, minimize, and mitigate potential impacts, following GIIP for the hydropower sector.

Part D ˉ Environmental and Social Management

Section 13: Environmental and Socio-economic / Socio-community Management Plan Framework ˉ This section provides the framework for an environmental and social management and monitoring plan framework in accordance with World Bank Operational Policy 4.01 ˉ Annex C. It identifies mitigation measures, monitoring requirements, an implementation schedule and budget, and project context. Detailed commitments and responsibilities are included in a separate stand-alone environmental and social management plan (ESMP).

Part E ˉ Cumulative Impacts Assessment, Natural Hazards and Dam Safety

Section 14: Cumulative Impacts Assessment - As required by the World Bank and IFC, analysis of cumulative impacts is required. Therefore, this section follows the six steps suggested by the IFC for identifying valued environmental and social components (VECs), identifying past, present or reasonably foreseeable projects or activities that in combination with TRHDP could result in cumulative impacts, and recommending measures for addressing these impacts. The TRHDP is assessed for cumulative impacts with mining, oil palm, timber harvesting, and gravel extraction activities. A second phase of cumulative assessment culminating in a Cumulative Impacts Management Strategy will be carried out during project implementation.

Section 15: Effects of the Environment on the Project ˉ This section examines potential natural hazards that alone or in concert could affect components of the project, particularly dam safety.

Part F ˉ Conclusions and References

Section 16: Conclusions ˉ This section summarises the environmental and social impacts that will potentially remain after mitigation measures have been applied (i.e., residual impacts) and identifies whether these residual impacts are significant, or not. An overall conclusion is made regarding the Project.

Section 17: References ˉ This section identifies the secondary data sources used in compiling the ESIA document.

2. PROJECT DESCRIPTION

This chapter describes in detail the project context, access, components, actions and activities of the Project, and its associated project support facilities. It also broadly describes the activities in the project area, the project requirements and the expected implementation schedule.

The Project description is based on Option 7C as defined in the Feasibility Study, dated March 2014.

2.1 PROJECT CONTEXT

2.1.1 Background to Site Selection

The Tina River Hydropower Development Project (TRHDP) is expected to be the first major hydroelectric project in the Solomon Islands. Tina River is located 30 km South East of Honiara at the upstream end of the Ngalimbui River Basin in Malango Ward 20, Central Guadalcanal District. The Tina River catchment and proposed transmission line route are in the Malango Ward within Central Guadalcanal District. During the project feasibility phase, Entura (2010-2014) studied several sites for locating a hydropower facility along the Tina River. The siting options studied by specific study phase included:

- Phase 1 of the Feasibility Study considered a series of 6 options (option 1 to 6) located along the stretch of the Tina River from its confluence with the Mbeambea River (upstream catchment) to its confluence with the Toni River (Entura, 2010).
- Phase 2 studied Option 6. It reached the conclusion that the Option was too technically risky to proceed further. At the time the ESIA work was set to commence, Option 6e was determined to be the best option (Entura, 2012). A further five options (6 b-f) were identified for possible detailed evaluation.
- Phase 3 involved a re-evaluation of Option 6e against a new option, Option 7c. Option 7c emerged from the Phase 3 studies as the preferred option (Entura, 2014).

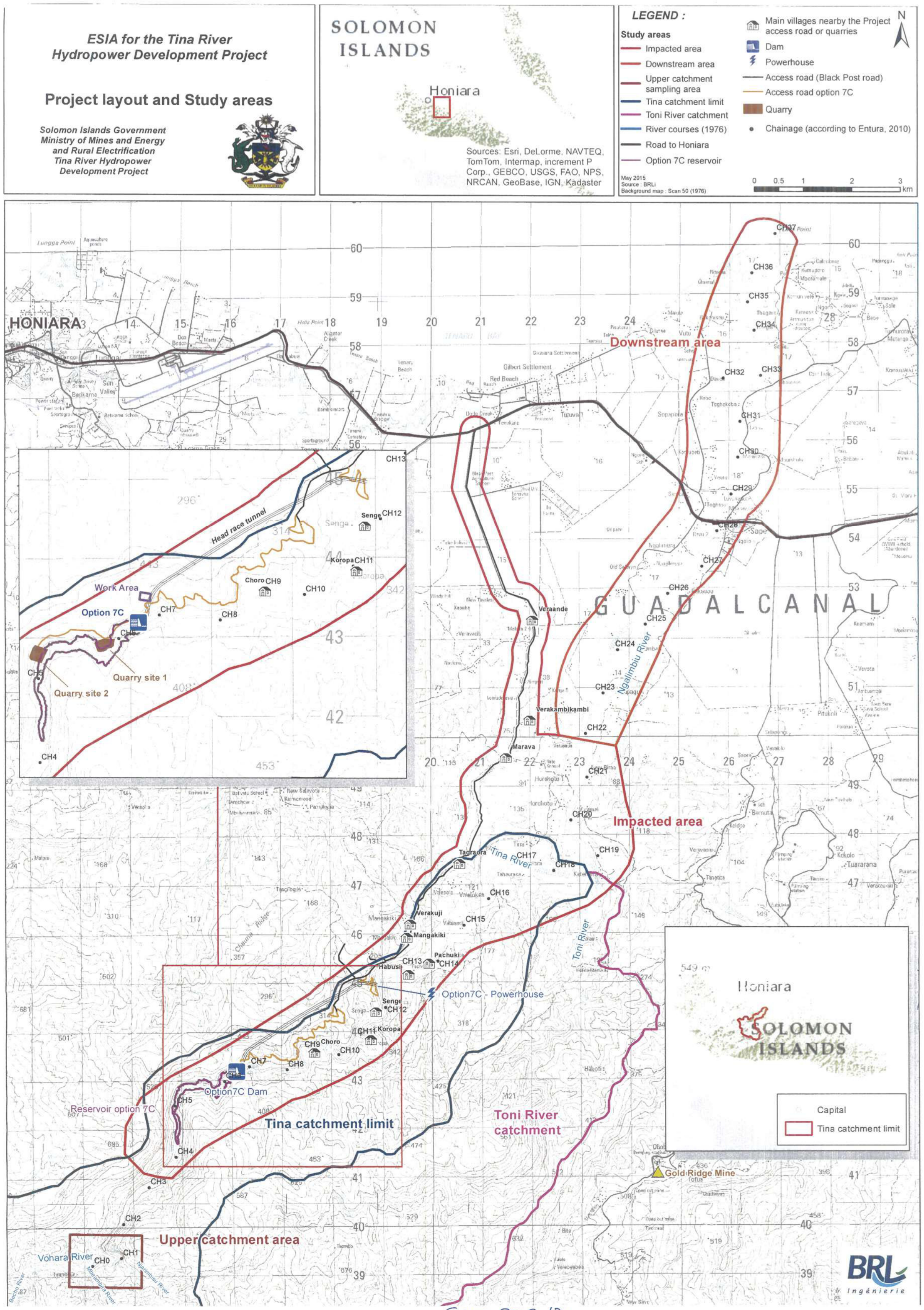
2.1.2 General Area Description

The Tina River is derived from the joining of three rivers: the Mbeambea, the Voraha and the Njarimbisu rivers. The Tina River catchment area is roughly 150km^2. The Tina River joins the Toni River, a much smaller river with a catchment of about 45km^2, to form the Ngalimbiu River, which flows through a coastal plain before discharging into Iron Bottom Sound on Guadalcanal's North coast. This coastal plain is more highly developed than the upstream areas of the catchment, and has more settlements and agriculture activity. At its headwaters, Tina River flows through a very narrow, steeply sided and incised, limestone gorge. In its mid reaches, the slopes gradually become less steep and are dotted with a few human settlements and gardens. A map of the project area is included as Figure 2-1.

The Project area landscape is comprised of volcanic mountains, dissected river ridges in the South and central areas, and low terraces and fertile flood plains toward the North coast. The flora and fauna in Guadalcanal is both rich in diversity and endemism. The project site is dominated by tropical moist forests, and is associated with a majority of low altitude forests, grasslands and mix of habitats. The Tina River upper catchment area is comprised of undisturbed montane forests and aquatic ecosystems.

The majority of the actual inhabitants of the project area are descendants from former settlements located at the base of Mount Popomanaseu, the highest mountain in the Solomon Islands. These inhabitants migrated closer to the North coast plain and Honiara. Most villages are located on the left bank of the Tina River. An unsealed road (Black Post Road) links these settlements with the sealed road to Honiara.

Figure 2-1 Map of project area



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2.2 THE RETAINED OPTION – SITE 7C

2.2.1 Project Description

The project comprises a 53 m high dam located at an elevation of approximately 123 masl, and roughly 30 river km from the sea, a 3.3 km tunnel to a powerhouse and tailrace at elevation 73 masl. The reservoir formed by the dam will extend upstream approximately 2.6 km and will have a surface area of about 0.28 km^2 at an elevation of 175 masl. The operating range of the reservoir formed by the dam will be 5 m but the reservoir will normally be held about 3 m below the full reservoir level to increase utilisation by storing water during floods and freshes and reducing the number of spill events.

Initially, the powerhouse will have 3 turbine/generator units, each with a capacity of 5MW, allowing a maximum discharge of about 18 m^3/s, and a minimum discharge of about 2.4 m^3/s.

An environmental flow will be maintained between the dam and powerhouse tailrace. The river distance between the dam and tailrace is 5.4 km.

Table 2-1 shows the Project main components

Table 2-1 Main Project characteristics (Option 7c) as described in the feasibility study

Project Component or Feature	Parameters
Dam	
Type of dam	Roller Compacted Concrete (RCC)
River Chainage	CH 7km
Height	Crest height 53m ; abutment height 64m
Base length at river	35m
Base length at crest	200m
Material needed for dam and the two cofferdams	Cement: 5.6 thousand m^3 Fly ash: 9.2 thousand m^3 Aggregate: 160 thousand m^3 Water: 30 thousand m^3 Retarding admix: 0.2-0.4 thousand litres
River level at dam	122masl
Minimum operating level (MOL)	170masl
Normal operating level	172masl
Full supply level (FSL)	175masl
Maximum flood level (MFL)	186.5masl
Spillway	
Release of floods	Up to the 1:10,000 year flood level (3,290m^3/s)

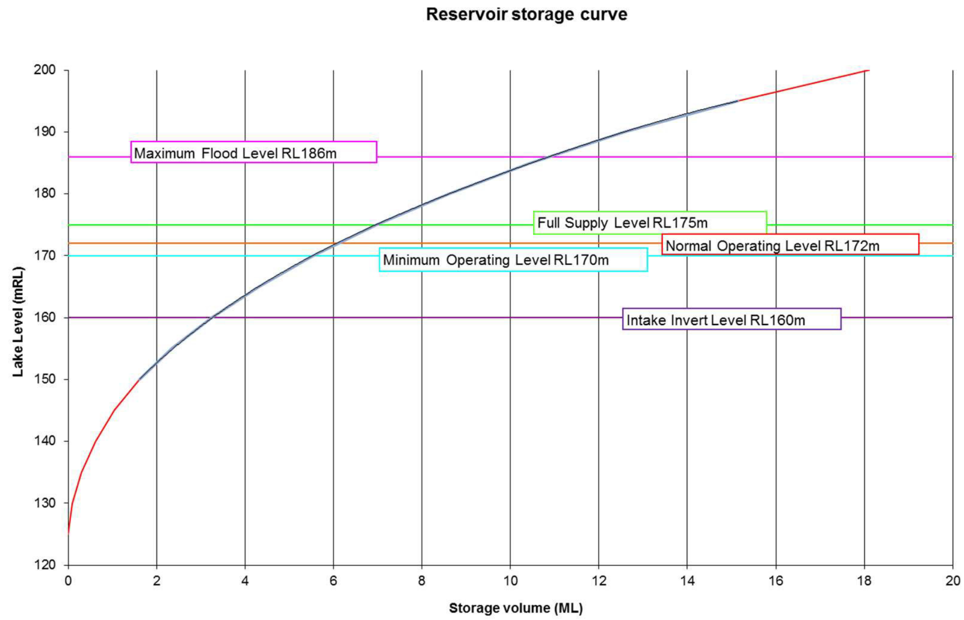
Project Component or Feature	Parameters
	The spillway will release flood water via the by-passed river, on average, 20% of the time (when the inflow is higher than 18m³/s)
Width	45m
Height (FSL)	175masl
Reservoir	
River Chainage	CH 7km – CH 4.5km
Number of days for filling	Between 5 and 9 days plus extra time if minimum environmental flow is implemented during reservoir impoundment.
Volume at FSL	7Mm³
Volume at MOL	7.8M³ +/-
Surface at FSL	30.52ha +/-
Length	2.5km
Power water intake	
Location	162.5masl
Size	3m diameter
Scour outlet	
Location	155masl
Head race tunnel	
Internal diameter	3.3m, suitable for flow rates up to 24m³/s
Flow rate	18m³/s
Length	3.3km
Powerhouse	
River Chainage	CH 12.7km
Average net head of powerstation	97m
Turbine floor	72masl
Turbines	3 x Francis of 5MW
Operating capacity	15 MW, at 18m³/s
Energy production, taking into account a 1m³/s Environmental flow	78.35 GWh per annum
Environmental Flow Outlet Port	
Riparian outlet for the environmental flow	162.5masl
Environmental flow	1m³/s

Project Component or Feature	Parameters
Road	
Permanent existing Black Post road unsealed	13.3km
Permanent access road to powerhouse sealed	1.45km
Permanent access road to dam sealed	4.7km
Temporary access road to intake portal unsealed	0.25km
Permanent road to dam base and mini-hydro sealed	0.66 km
Road to quarries	to be determined as part of detailed design
Transmission line	
Length	23km
Type	33kV double circuit
Project Cost	
Full scheme (initial 3 turbines) + Additional turbine (4th turbine) + extension of the powerhouse	US$133.3 Million + US$ 3.4 Millions
Unit cost for the Project	US$165 -185/MWh
Diesel energy unit cost (Lungga powerstation)	US$330 - 400/MWh
River hydrology	
Mean flow at dam	$11.5m^3/s$
Tina catchment area	$150km^2$
Catchment area above the dam	$125km^2$

Chainage is based on distance in kilometres from the confluence of the Tina River and the Mbeambea River, which is (CH 0km). The dam is localized at CH 7km.

The graph in Figure 2-2 illustrates the reservoir storage curve.

Figure 2-2 Reservoir storage curve



Source: Entura, 2014

2.2.2 Site 7c Scheme Construction Activities

According to Entura (2014), the following activities will be included as temporary work:

- Construction of temporary and permanent access roads
- Temporary site office
- Two cofferdams
- Clearing for tunnel portals, pipeline, power house site
- Stripping the main dam foundation
- Clearing vegetation from the reservoir area
- Temporary concrete batch plant
- Temporary pug mill
- Temporary explosive magazine
- Temporary rock crushing mill

The dam construction activities will take place within the Core Area (see Figure 2-1).

2.3 PROJECT COMPONENTS

2.3.1 Dam

2.3.1.1 Choice of Dam

The dam will be a Roller Compacted Concrete (RCC) dam, located in the narrow gorge of the river. The spillway will release flood flows up to the 1:10,000 year flood level (3,290m^3/s). The spillway will release floodwater in by the by-passed river on average 8% of the time (when the flow is higher than 18 m^3/s)

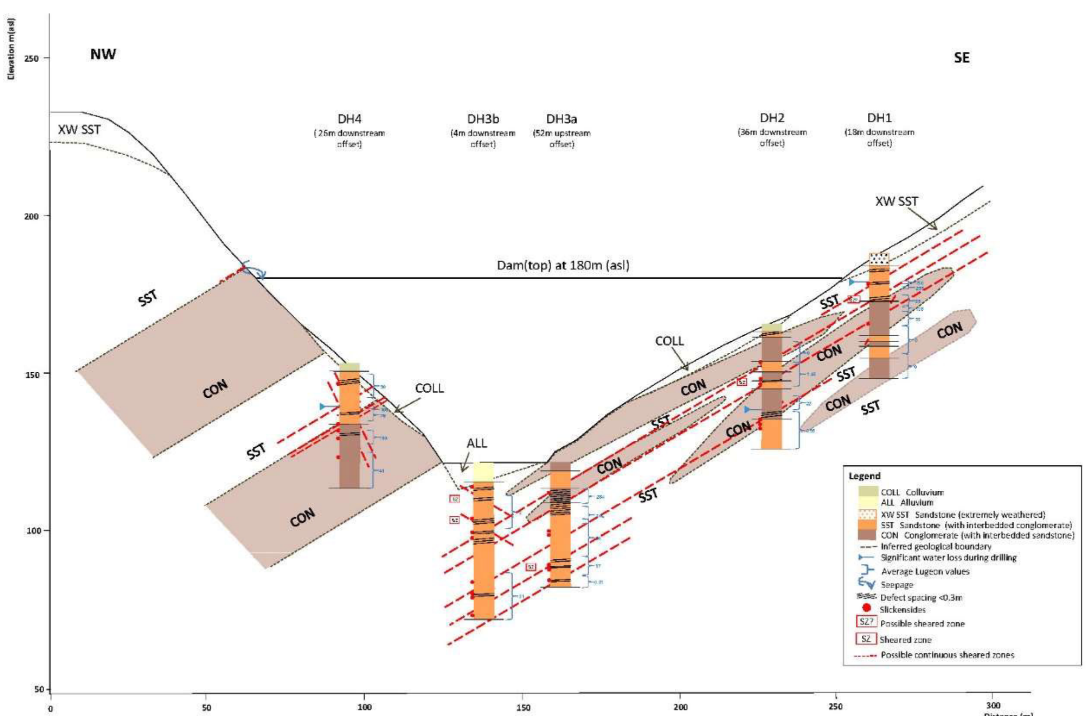
According to Entura (2014), a RCC dam was selected over an embankment dam for the following reasons:

- RCC dams can tolerate over-topping during construction whereas clay core embankment dam will not tolerate over-topping. This is a major element, since flash floods can occur in the Tina River. An embankment dam would need large diameter concrete lined diversion tunnels with high cofferdams to ensure river diversion during flood events. RCC dams require smaller conduit and cofferdam.
- RCC dams can be built with an integral spillway over the dam wall, whereas an embankment dam must have a separate spillway.

An embankment dam would require significant quantities of clay core material, gravel and rock fill. A source of clay was not identified during Entura's field investigations (Entura, 2014).

Dam height was optimized to maximize energy production. Entura (2014) selected the optimum full supply level to be at RL175. In addition, height is limited to RL175 for stability and water tightness reasons, as above this level there is a risk of leakage through Karst features. The height of the dam spillway crest will be 53 m above the riverbed level (RL 122) with abutments which extend on each side to 64metres to provide dam stability. The dam at Site 7c will have a narrow base (35 m) and steep abutments, resulting in minimum concrete volume for a RCC dam. At crest level the dam will be 200 m wide. A roadway will be located at RL 186.5m. Figure 2-3 illustrates the geology of the dam site.

Figure 2-3 Geology at dam site



Source: GeoRisk Solutions (2014)

2.3.1.2 Construction

The dam will be constructed as a roller compacted concrete (RCC) structure, and require approximately 200,000m^3 of roller compacted concrete. The RCC dam, and its two cofferdams, will require an estimated volume of 160,000m^3 of aggregate. The construction of the dam and cofferdams will require the following material:

- Cement: 5.6 thousand m^3. Cement will be imported from outside the country, due to limited capacity to supply it locally.
- Fly ash (pozzolan): 9.2 thousand m^3. This material is required to extend the cement paste, and will be imported from outside the country.
- Aggregate: 160 thousand m^3. Aggregate will be sourced locally from quarries and from the river beds as mentioned below.
- Water: 30 thousand m^3. Water will most likely be pumped from the Tina River, from a location adjacent to the dam site and RCC batch plant, immediately upstream of the cofferdam.
- Retarding admix: 0.2-0.4 thousand litres. Retarding mix will be sourced from outside the country.

According to Entura (2014), available materials that are close to the dam site at Site 7c include: volcanics, river alluvium, sandstone, conglomerate, calcarenite and limestone. Entura assessed the suitability of these locally available materials as RCC aggregates and concluded that river alluvium and limestone are suitable and calcarenite, sandstone and conglomerate may be suitable but would need additional testing. Finally, volcanic material sources are too distant from the dam site and their exploitation would be costly. Additionally, Entura (2014) identified various criteria to be considered when choosing a quarry site: slope stability, isolation from regular flooding accessibility and location. Ideally, quarry sites will be submerged during reservoir impoundment.

Two locations have been identified as potential material sources:

- Quarry 1: Calcarenite - an estimated 2.5 thousand m^3 of material is available. The quarry is located at CH 6.2km to 6.5km.
- Quarry 2: Limestone - an estimated of 1.35 thousand m^3 of material is available. Access is more difficult than Quarry 1. This quarry is located at CH 5.4km to 5.5km.

Screening operations for aggregates will occur near the river. At the time the initial ESIA was prepared, the location of stockpiles had not yet been determined. Material from the head race tunnel excavation will be integrated into the crushing operation. One feed mixing plant (pugmill) and concrete batching plants will be required to blend the material and produce the concrete. They will be located in the core construction area.

The RCC will be placed in 300mm layers. It is planned to place two layers a day over a period of about 5 months in the 2nd dry season. Both faces will be grout enriched. Concrete may be delivered to the site using a conveyor as shown in Figure 2-4. Dam construction will start once the cofferdams and diversion conduit and access road are serviceable. Additional concrete work, in the 3rd dry season, will take place for a period of 3 to 4 months.

Construction will start with excavation of the abutments. Abutment stripping will commence at the beginning of the 2nd dry season, when excavation for the foundations of the dam will be carried out in the riverbed. Hydraulic excavators, rear dump haul trucks, air track drills and rock breakers will be used for dam site excavation.

Figure 2-4 Typical RCC dam construction with concrete conveyor

Source: Entura, 2014

Plan, profile and cross section views of the dam, showing its various components, are provided in Figures 2-5, 2-6 and 2-7.

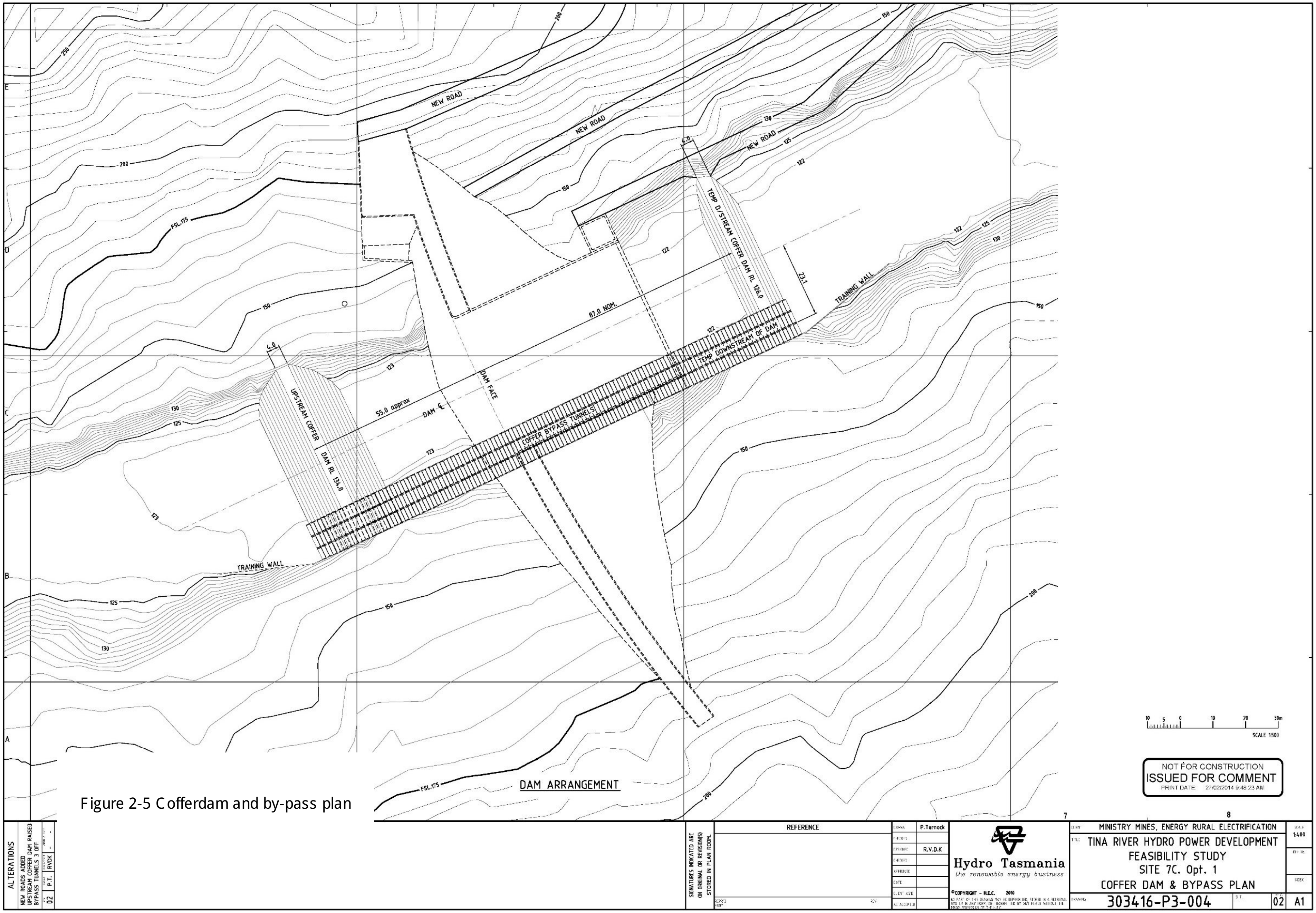


Figure 2-5 Cofferdam and by-pass plan

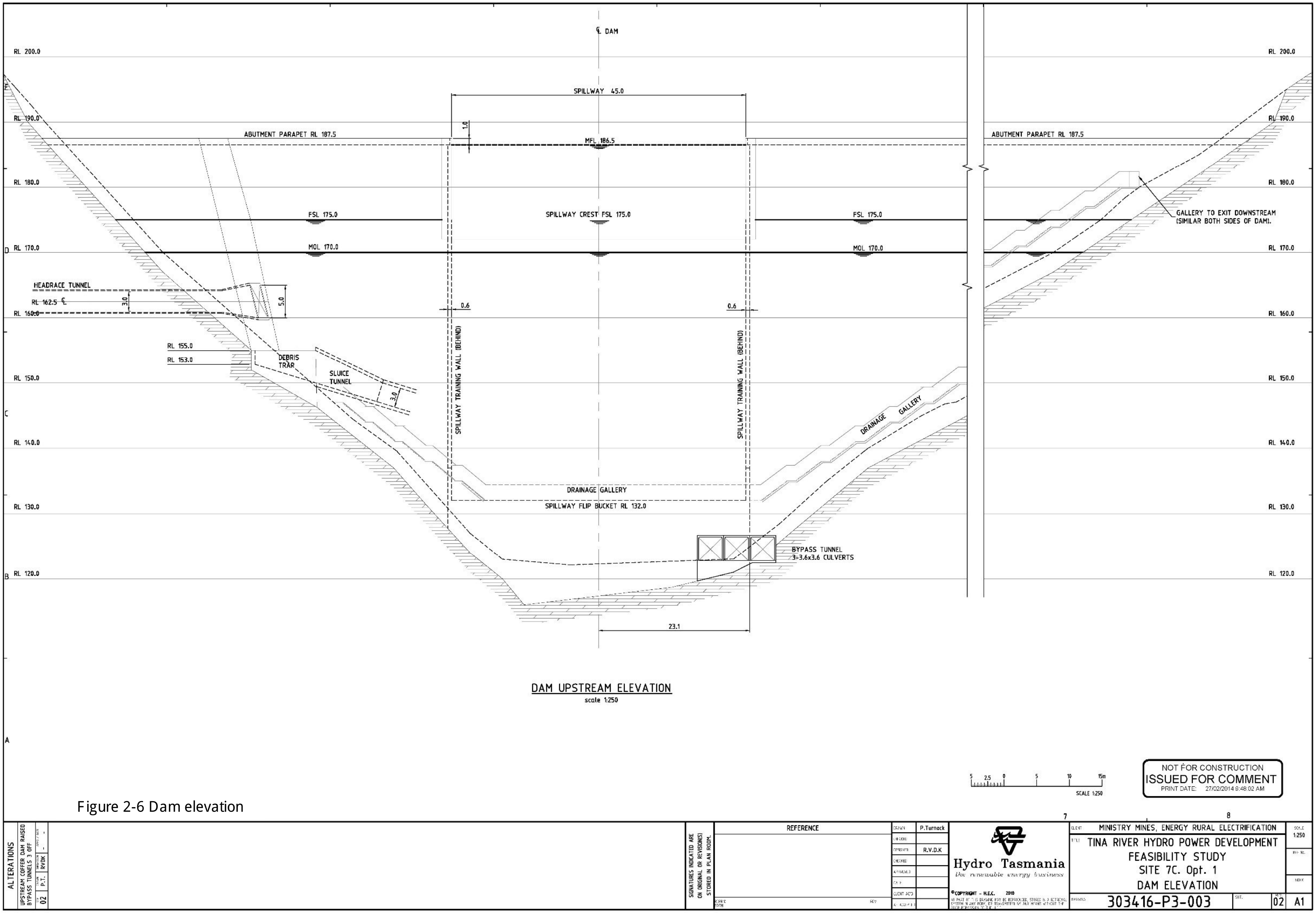


Figure 2-6 Dam elevation