Environmental Monitoring Report

Report
August 2016

SOL: Transport Sector Flood Recovery Project / Transport Sector Development Project

Public Environmental Report

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

Environmental Assessment Document

Solomon Islands
Transport Sector Flood Recovery Project
Public Environmental Report

August 2016

Prepared By: SMEC International Pty Ltd in Association with IMC Worldwide Ltd

For: Ministry of Infrastructure Development, Government of the Solomon Islands The Asian Development Bank

Project Name:	Loan No. 3152-SOL and Grant 0403-SOL: Transport Sector Flood Recovery Project and Grant 0243-SOL: Transport Sector Development Project – Design and Supervision Consultant Contract
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PREPARATION, REVIEW AND AUTHORISATION

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FEASIBILITY STUDY REPORT REGISTER

S. No	Abbreviation	Report Title	Author	Submission Date
1	OAR	Option Assessment Report	Bridge/Structural Design Engineer	04-Sep-15
2	HHAR	Hydrologic and Hydraulic Analysis Report	Hydrology & Hydraulics Engineer	04-Sep-15
3	CC&DRM	Climate Change Impact & Disaster Risk Management Report	CCA&DRM Specialist	10-Nov-15
4	EER	Economic Evaluation Report	Transport Economist	04-Sep-15
4.1	EER (REV01)	REV01 Economic Evaluation Report	Transport Economist	06-Nov-15
5	CCR	Community Consultation Report	Social Safeguards Specialist	14-Sep-15
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6	DPA	Development Proposal Application	National Safeguards Specialist	14-Oct-15
6.1	PER	Public Environmental Report	Environmental Safeguards Specialist / National Safeguards Specialist	02-Dec-15
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ABBREVIATIONS AND DEFINITIONS

ADB	Asian Development Bank
AP	Affected Person
CBOs	Community Base Organizations
CDS	Community Development Specialist
CITES	Convention on International Trade in Endangered Species
CLO	Community Liaison Officer
CPIU	Central Project Implementation Unit
DSC	Design and Supervision Consultants
EEZ	Exclusive Economic Zone
EMP	Environmental Management Plan
ECD	Environment and Conservation Department
ESO	Environmental and Safety Officer
GPPOL	Guadalcanal Plains Palm Oil Limited
GPS	Global Positioning System
GRM	Grievances Redress Mechanism
HIV/AIDs	Human Immunodeficiency Virus / Acquired Immunodeficiency Syndrome
HLB	High Level Bridge
IEE	Initial Environmental Examination
LAR	Land Acquisition and Resettlement
LLB	Low Level Bridge
M&E	Monitoring and evaluation
MECDM	Ministry of Environment, Climate Change, Disaster Management and Meteorology
MHMS	Ministry of Health and Medical Services
MID	Ministry of Infrastructure Development
MMERE	Ministry of Mines, Energy and Rural Electrification
MOA	Memorandum of Agreement
MPA	Marine Protected Area
NGO	Non-Government Organisation
RCBC	reinforced concrete box culvert
REA	Rapid Environmental Assessment
RP	Resettlement Plan
SIG	Solomon Islands Government
SIRIP	Solomon Islands Road Improvement Project
SP	Subproject
SPC	South Pacific Commission
SPM	Safeguard Procedures Manual
SPS	Safeguards Policy Statement
TNC	The Nature Conservancy
TSDP	Transport Sector Development Project
TSFRP	Transport Sector Flood Recovery Project
UNDP	United Nations Development Program
WHS	World Heritage Site

1 EXECUTIVE SUMMARY

1. The completion of the North East and North West Guadalcanal Bridges, Causeways and Culverts was prioritized under the Transport Sector Flood Recovery Project (TSFRP). The Project is implemented through the Central Project Implementation Unit (CPIU) under which MID is the executing agency. The construction will include repair and reconstruction of at least 3 High Level Bridges and 5 small stream crossings, 1.6km of bridge approaches, 80 meters of cross culverts, 1km of bridge and approach road protection work and 300m of river training works. This accounts for 5 subproject (SP) sites in North East Guadalcanal and 14 SP sites in North West Guadalcanal. However, only a prioritized list of eight (8) subproject sites was first approved following a list of ten (10) subproject sites to be constructed under the project. Leaving the total number of SPs to eighteen (18).

2. The TSFRP has been subjected to a screening exercise and risk assessment to determine the reporting level required for each SP. Given the total scope of works required for the TSFRP, it is concluded that the level of reporting is a Public Environmental Report (PER), which is equivalent to ADB's Initial Environment Examination (IEE) Report. The PER will be submitted to Environment Conservation Division (ECD) of the Ministry of Environment, Climate Change, Disaster and Meteorology (MECDM) who will approve and issue a Development Consent for the Project to proceed.

3. The PER is based on field studies and secondary information that were available in other reports. The scoping assessment was carried out from May through to September 2015. Detailed Engineering Layout Plans are prepared and provided by the Design and Supervision Consultant (DSC) Engineers.

4. As part of the PER process, public consultations were undertaken to determine community attitudes to the possible development. This has been carried out to ensure that potential or likely adverse environmental impacts were identified and mitigated to acceptable levels. The sub – projects are classified as Category B according to the ADB Safeguards Policy Statement (SPS), and Tier 3 according to the MID Safeguards Procedures Manual (MID SPM).

5. The potential environment and social impacts for completion of the proposed development have been identified and importance assessed. The duration of the impacts is assessed based on the scope of works as well as the physical and biological environment at the SP site. Mitigation measures for each potential physical, environment and social impacts may be negligible, minor, marginal and significant based on the impact itself and if it is not mitigated.

6. The major environmental impacts are predicted to occur during the construction phase from piling, extraction of aggregates and materials, compaction of approaches, filling and back filling, grading clearing and excavation works. The scoping assessments anticipate that deterioration to water quality; sedimentation and siltation; waste disposal problems and potential oil / fuel spillage are expected. The approach to addressing the potential environmental impacts is to mitigate them or avoid the impact altogether. Overall, the earth works does not traverse any sensitive ecosystems, protected areas, archeological or historically significant sites, ecologically sensitive or densely populated areas. There will be no significant impacts on any rare or endangered species that may be present in the area or the island.

7. Possibilities for other likely environmental and socioeconomic impacts including climate change and disaster risks have been identified and their significance discussed in brief. Mitigation measures to avoid and minimize the potential environment and social impacts are also considered. The scale and significance of potential impacts arising from the project is rated from minor to moderate if not mitigated. The project area are highly disturbed natural environments due to village settlements, agricultural activities and activities relating to the communities' livelihoods adjacent to the North East and North West Guadalcanal Roads and projects scope of works. The outcome of the project will be repair, reconstruction and climate and disaster proofing by "building back better" prioritized structures.

8. Land acquisition will only be required for Mberande Bridge SP as there will be realignment, while the entire SPs will be constructed at the existing foot print and areas that were acquired previously and only properties will be removed. Additional consultations had been carried out and are still ongoing with the customary landowners. Inventory of non-land assets at Mberande including the other seven sites had already been done.

9. An Environmental Management Plan (EMP) was developed for the sub-project; this will be detailed by the Contractor. The Contractor will be responsible for updating the EMP during detailed design or at construction stage, whenever further engineering information is available. The DSC through the CPIU will approve the updated EMP before physical earth works. The institutional framework under the EMP section summarizes the overall responsibilities for EMP implementation. In the implementation of environmental management and monitoring tasks specific technical assistance will be provided by environmental specialists that are part of the DSC.

10. The Contractor will be required to prepare a detailed environmental management and monitoring plan based on Section XIV and what is set out in the contract documents. A review committee comprised of MID-CPIU, DSC and MECDM will be responsible for monitoring compliance, review contractor's monthly monitoring reports and suggest ways to improve or strengthen mitigations.

11. A Grievances Redress Mechanism (GRM) was developed for the Project because it is possible that people may have concerns with the project's environmental performance including the implementation of the EMP. Most complaints arising during construction are expected to be minor complaints concerning dust or noise that should be able to be resolved quite easily. During construction, all complaints arriving at the Site Office are to be entered in a Register that is kept at the site by: Date, Complainants Name; Contact Address and Reason for the Complaint. If the AP is dissatisfied with the determination from the PS in the MECDM, the AP may appeal to the National Court. This will be at the AP's cost but if the court shows that the PS, or the CPIU have been negligent in making their determination the AP will be able to seek costs. During the operation of the infrastructure, all complaints will be directed to TSFRP through CPIU.

12. The conclusion is that the Project complies with the Solomon Islands Environment Act 1998 and no further environmental study is required for the North East and North West Guadalcanal SPs under the TSFRP.

13. The recommendations of this PER are:

- That the PER be accepted by MECDM and ADB as the statement of the SPs environmental effects and how they will be mitigated;
- That the Contractor be assisted by DSC to prepare a CEMP based on the generic model included in this PER; and,
- That the SP's impacts and mitigation thereof be monitored as per the enclosed monitoring plan.

PUBLIC ENVIRONMENTAL REPORT – GUADALCANAL MAIN ROAD

Loan/ Grant	Amount	Country	Category
Loan No. 3152 – SOL and Grant 0403 – SOL: TSFRP and Grant 0243 – SOL: TSDP	USD $15.58million	Solomon Islands	B
Infrastructure: Highways and Roads			
Mission Chief: Pivithuru Indrawansa	**Executing Agency:** Ministry of Infrastructure Development	**Prepared by:** Jaysie Boape	

Major Project Components:

This project includes a total of eight (8) subprojects (SPs) scheduled for construction. They include both bridges and culverts replacements on the Guadalcanal Main Road in both eastern and western directions of Honiara, inlcuding rivertraining and embankment protection works for selected sites.

Need for EIA:

- Not needed. No further concern with Environmental Parameters

Comments:

The SPs that are the subject of this PER already exist; either as bridges, causeways or culverts. As part of the feasibility study phase of this Project (the TSFRP), a total of 19 SPs were assessed with eight of these being prioritized for implementation (construction) under the same Project. An additional ten (10) subproject sites was later added to the project for implementation under the same contract.

They do not traverse any primary forests, protected, ecologically sensitive or densely populated areas and will not create any conflicts in resource use or development.

A climate change projection adjusted hydrology and hydraulic flood modelling analysis, as well as consideration of further climate change measures were accounted for in the detailed design of these SPs.

The individual SPs are located on existing roadways and as such have been impacted in the past. All major and minor works will not impact on any rare, endemic or endangered species. There will also be minimal impacts on beaches, coral reefs and sea grass beds.

Community disruption including land, structure and asset (i.e. trees and crops) acquisition and resettlement is minimal. Consultations with Affected Persons (APs) and communities has been comprehensive and is still currently ongoing, with the proposed new Mberande Bridge having the most significant (albeit still minimal) impact.

This Project should have an environmental categorization of Category B, and thus does not require any further investigation or a full EIA.

2 CONTACT DETAILS OF THE PROJECT PROPONENT / APPLICANT

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4 INTRODUCTION

4.1 Project Summary

5 The Solomon Islands Government (SIG) with support from the Asian Development Bank provided funding for the repair and reconstruction of bridges damaged by the April 2014 flash floods, in Guadalcanal Province under the Transport Sector Flood Recovery Project (TSFRP). TSFRP seeks to rehabilitate and reconstruct 19 bridges, causeways and culverts; rehabilitate approach roads; protect bridge approaches and do river training works. This however was reduced to a total of eight prioritized subproject (SP) sites which include four SP sites along the North East Guadalcanal Road and four SP sites along the North West Guadalcanal Road. Following this, a total number of ten (10) subproject sites was later added to the project for construction under the same contract. Hence, the project encompasses eighteen (18) subproject sites.

6 The TSFRP is being implemented by the Solomon Islands Government (the Government) with the assistance of the Asian Development Bank (ADB) through the Ministry of Infrastructure Development (MID) as the Executing Agency. The Central Project Implementation Unit (CPIU) of MID is the Implementing Agency.

7 The project overall day to day management of TSFRP is done through the Central Project Implementation Unit (CPIU) under which MID is the executing agency. The focal point is the Permanent Secretary of MID. A Joint Venture Association of SMEC International Pty Ltd of Australia and IMC Worldwide Ltd of the United Kingdom hereinafter referred to as the Design and Supervision Consultant (DSC) has been engaged to undertake design consultancy to provide a more disaster resilient transport infrastructure by reconstructing priority assets.

8 The TSFRP was the result of the severe flooding experienced in early April 2014 as a result of Tropical Cyclone Ita. Most of the infrastructure including roads, bridges, housing, and sewerage and water supply systems were damaged and destroyed. Excessive outflows and waste buildup caused extensive damage to bridges including piers, abutments and scour protection works. Bridge approaches, causeways and culverts collapsed or were washed away.

9 This disaster caused the Solomon Island's Gross Domestic Product (GDP) to contract by 0.2 % in 2014, with per capita GDP falling by 2.4 %. The hardest impact on GDP came from cessation of gold production at the Gold Ridge Mine. The Government of Solomons Islands (the Government) estimated damage and losses attributable to the flooding at USD 108 Million, or 9 % of GDP (statistics source: ADB).

10 The transport sector was one of the sectors which sustained the highest level of damage. The primary aim of this TSFRP is to restore socioeconomic activities impacted by the disaster to pre flood conditions, and to also provide more disaster resilient road and bridge infrastructure by reconstructing priority assets i.e. "building back better". The TSFRP is expected to be a substantial contributor to the recovery of the Solomon Islands, with growth prospects for 2015 expected to rebound to 3.0 %, and subsequently 3.5 % in 2016 (statistics source: ADB).

11 This TSFRP (the Project) includes repair and / or replacement of bridges, causeways and culverts damaged by the April 2014 floods. Road approach and river embankment protection work is included, as well as river training.

12 The prioritized structures are situated along the North West and North East Guadalcanal Roads. From Chainage 5.0 km to Chainage 49.5 km in the North West, and Chainage 24.0 km to Chainage 43.0 km in the North East including Chainage 31.0 km inland of the main road. The project requires a PER which meets the requirements of the Ministry of Environment, Climate Change, Disaster Management and Meteorology (MECDM) in accordance with the Environment Act 1998 and Environment Regulation 2008. Following approval of the PER, the Director of the Environment and Conservation Department (ECD) within the MECDM will issue a Development Consent.

4.2 Overview

13 Guadalcanal Island is one of the six major islands of the Solomon Islands archipelago. The archipelago is located in the South-West Pacific region more than 1500km North-West of Australia. It stretches in a 1,450 km long chain of islands South-East from Papua New Guinea to Vanuatu in the South between 5° and 13°South latitudes and 1550 and 169oEast longitudes and consists of about 997 islands of which only 147 are inhabited. From the far west to the east the islands are: Choiseul, the Shortland Islands; the New Georgia Islands; Santa Isabel; the Russell Islands; Nggela (the Florida Islands); Malaita; Guadalcanal; Sikaiana; Maramasike; Ulawa; Uki; Makira (San Cristobal); Santa Ana; Rennell and Bellona; the Santa Cruz Islands and three remote, tiny outliers, Tikopia, Anuta, and Fatutaka. The total land area is 28,785 km2 situated within an Exclusive Economic Zone of 1.34 million km2.

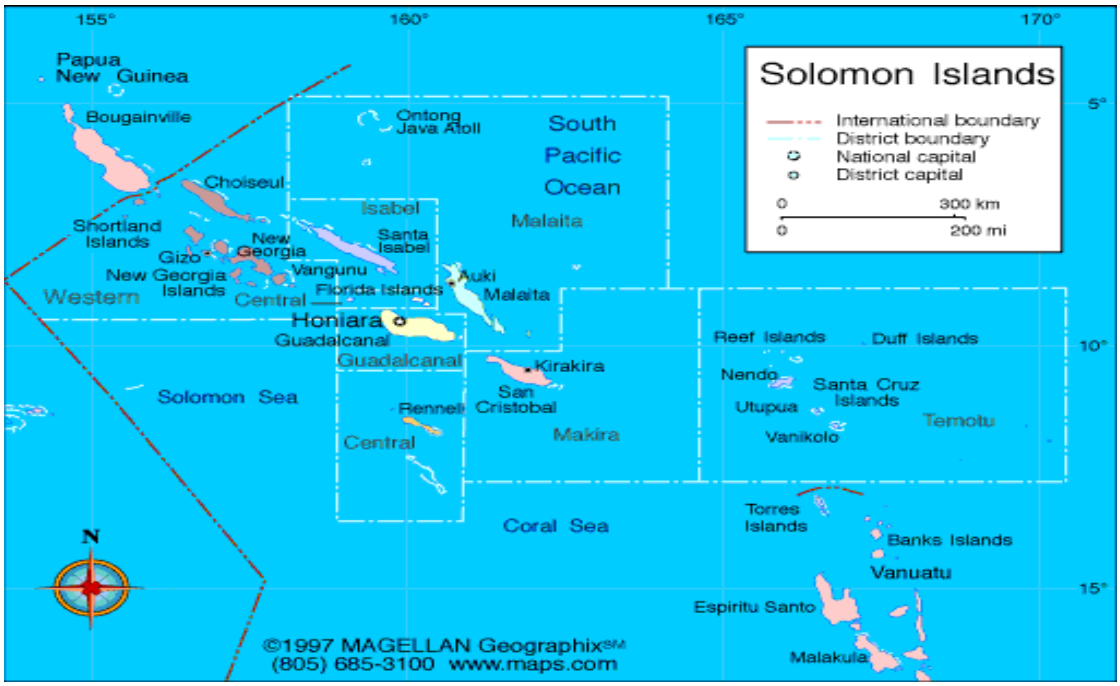


Figure 1. Map of Solomon Islands

14 In assessing reconstruction needs the transport infrastructure of the country consists of roads (with bridges) for land transport, ports, wharves and jetties for marine transport and airports/airstrips for air transport. The existing infrastructure is largely in poor condition as a result of neglected maintenance, insufficient funding, lack of comprehensive planning and poor management capacity. However, the commitment of Solomon Island Government supported by its development partners through ongoing projects and programs is gradually changing the situation.

15 While affordable transport services are essential for economic development, the widely dispersed and relatively small population in the Solomon Islands together with a relatively small transport demand and low economic activity creates a serious challenge in the provision and maintenance of transport services.

16 Any long term development plans in the Solomon Islands must consider the archipelagic nature of the country and how this relates to economic development opportunities. The islands must be interconnected by good transport and communication networks that will open up new economic opportunities, reduce transport and transaction costs, increase access to social services, and foster national cohesion.

17 The project is consistent with the country's National Transport Strategy which recognizes the provision of both land, sea and air transport as critical for increasing connectivity of communities, building local economies and assisting poverty reduction. The project has a strong focus on community empowerment with labor-based approaches in planning, construction and maintenance.

4.3 Objectives and Scope of the PER

18 This PER has been prepared to meet the requirements of the ADB's Environmental Assessment Guidelines for the Transport Sector Flood Recovery project. The main purpose is to assess the potential impacts of the road infrastructure rehabilitation on the adjacent biological, physical and social environment and develop features that take care of environmental impacts.

19 The project will include constructing bridges, culverts, approach roads and river training works and the typical impacts and mitigation measures and monitoring program.

20 The objectives and scope of the PER is to:

- Assess the existing environmental conditions in the vicinity of each SP site area including the identification of environmentally sensitive areas;
- Assess the proposed location, design, construction and operation activities to identify and evaluate their potential impacts, and determine their significance; and
- Propose appropriate mitigation and monitoring measures that can be incorporated into an Environmental Management Plan (EMP) that will avoid or minimize adverse impacts so that residual impacts are reduced to acceptable levels.
- Assess relevant climate change impacts on specific SP sites; and

- Identify adaptation measures to counter or mitigate any potential adverse impacts to the environment and development.
- Design details have been provided by the engineering consultants. Public consultation was undertaken as part of the PER process to determine community attitudes to the possible development.

4.4 Objectives of the Project

21 The main objective of the repair and reconstruction of bridges, causeways and culverts is to improve access by the local community to important socioeconomic services and opportunities. It is consistent with the overall objective of improving the road network as stated in the National Transport Plan.

22 Short term benefits include better accessibility (for both vehicles and pedestrians), reduced road safety hazards and immediate improvement in service delivery. In the longer term, the road will improve access for agricultural activities including plantations, palm oil, mineral ore, garden produces and small subsistence farming. The road will improve employment opportunities in the area and improve rural – based incomes. Also restore connectivity through a more climate and disaster resilient infrastructure.

4.5 PER Methodology

23 To meet the Project feasibility requirements of the SIG and ADB, an assessment was carried out for a total of 19 SPs (bridges, causeways and culverts) in both Northwest Guadalcanal (from Selwyn College to the Tanaghai Arch Culvert) and Northeast Guadalcanal (from Ngalimbiu Bridge to Mberande Bridge, and including Gold Ridge (Tinahulu) Bridge to the south of the northeast Guadalcanal Road. Of these total 19 SPs, eighteen (18) will however be constructed under this the TSFRP.

24 The assessment complies with the requirements for a PER under the Environment Act and IEE under ADB's SPS. The PER assesses the potential negative impacts of improving or constructing the SPs on the biophysical, ecological and social environments. It also suggests measures for addressing any potential impacts that may have been identified.

25 The research work was carried out through the months of May-15 to Sep-15. It involved community consultation, focus group discussions and site investigations guided by Rapid Environmental Assessment (REA) Checklists for Roads and Bridges. It was supervised by the DSC's International Environmental Specialist working alongside the National Safeguards Specialist, and closely with MID as the executing agency and MECDM as the authorized agency overseeing environmental related work in the Solomon Islands.

26 The PER was developed after Community and Focus Group Consultations, baseline review of data (physical, biological and social), relevant information upheaval from the various SIG Ministries, identification of potential impacts based on the design and scope of work to be carried out, development of mitigation measures for potential impacts and for the Environment Management Plan (EMP) which will be detailed by the successful civil works Contractor ahead of commencing construction.

5 SUMMARY DESCRIPTION OF THE PRESCRIBED DEVELOPMENT

5.1 Identification of the Proposed Development

27 In April 2014, Tropical Cyclone Ita caused severe flooding in the Solomon Islands. Most of the infrastructure which consisted of roads, bridges, housing and sewerage and water supply were damaged. Large flows and debris build up caused damages to bridges, culverts and were washed way or collapsed.

28 Heavy scouring has taken place at pile foundations, behind bridge abutments and at road edges or road shoulders. Most of the river training protection works have been severely damaged and there has been complete washout of the approach roads to the damaged structures.

29 The proposed development involves the repair and reconstruction of eighteen (18) transport infrastructure in North East and North West of Guadalcanal. That is four (4) structures in the north east and fourteen (14) in the north west of Guadalcanal. Prioritized sub – projects for both east and west Guadalcanal are as follows; Mberande Bridge, Kovelau Bridge; Mbalasuna Bridge; Ngalimbiu Bridge; Veranaso Causeway; CBSI Culvert; Turtle Beach Culvert and Tanaghai (Kakabona) Arch Culvert. The additional ten (10) SPs are located along the north west Guadalcanal Road this include: Tambea Culvert; Sasa Low Level Bridge; Aruligo Causeway; Tomba Low Level Bridge; Belamatanga Bridge; Belamatanga Culvert1; Belamatanga Culvert 2; Mbonege Bridge; Poha Bridge and Tanavasa Bridge.

30 Scope of works will encompass repair and rehabilitation of bridges, causeways and culverts; rehabilitation of approach roads; protection of bridge approaches and river training works including bank and embankment protection works. The structures comprises of Low Level Bridges, High Level Bridges, Causeways and Culverts. The detailed design and procurement of the repair and rehabilitation works is under the Transport Sector Flood Recovery Project (TSFRP) implemented by the Central Project Implementation Unit (CPIU) under the Ministry of Infrastructure Development (MID).

5.2 Category of the Proposed Development

31 The TSFRP is focused mainly on the repair and rehabilitation of bridge, culverts and causeways including bridge and road approaches to the structures. Proposed works include bank and embankment protection works, river training works, drainage works, improvement of road and bridge approaches including construction of bridges and culverts. These works will likely result in temporary sedimentation with in the water bodies and have minor environmental in the area within the vicinity of the SP sites. Hence, will produce a series of possible adverse but not significant environmental impacts.

32 Most of the subprojects are on an existing road alignment and does not traverse or interfere any primary forests, protected, ecologically sensitive or densely populated area and will not create any conflicts in resource use or development. Except for Mbalasuna and Mberande in which the proposed structures will be constructed on previous alignment and highly disturbed areas respectively. That is at Mbalasuna the area is now overgrown with regrowth and subsistence farming including cocoa plantation. While at Mberande the area proposed is not used for agricultural purposes but is always disturbed by and subjected to heavy flooding.

33 Relocation of three (3) market huts at Tanaghai is likely to occur and removal of non – land assets such as fruit trees and crops at Tanaghai, Selwyn (Veranaso), CBSI, Mbalasuna, Kovelau and Mberande. Removal of the crops and trees including road side vegetation is purposely for rehabilitation of approach roads, work area during construction and realignment of the Mberande and Mbalasuna Bridges. While for the additional ten (10) SPs there will be relocation of one (1) thatched market hut at Tambea and two thatched market huts at Belamatanga Bridge area. With minor removal of some fruit trees and other commercially viable trees at Tambea, Belamatanga Bridge and Culverts areas. In depth information for relocation and land acquisition issues will be documented in a separate report on Land Acquisition and Resettlement Plan Report for the MID and Due Diligence Report.

34 In accordance and compliance with the ADB's SPS the Project is classified and categorized as Category B. Being that possible adverse environmental impacts are site specific, few if any of them are irreversible, and in most cases mitigation measures are readily designed.

5.3 Description of the Location, Nature and Size of the Proposed Development

35 Guadalcanal Province is one of the largest island of the Solomon Islands archipelago it comprises of the main island of Guadalcanal and the Marau group of islands to the east of the main island. The island is 144.84 km long and 40.23 km wide at the center and has a total land area of approximately 5,336 km2. It has coral reefs on the south shores and mountains up to 8,000 feet high in the interior of the island. The North East and North West Guadalcanal Coast is famously known as one of the battle fields of the Second World War (WWII) and there are war relics, monuments, and memorials on the island.

36 The northern coast is the heart of the province, whereas the southern coast, called the "weather coast" because of heavy rainfall, is host to small villages and is less accessible due to poor transport services and lack of major infrastructure.

37 The SP sites are located along Chainage 5.0 km to Chainage 49.5 km west and Chainage 24.0 km to Chainage 43.0 km east of Honiara, the capital city of the Solomon Islands on the island of Guadalcanal, in Guadalcanal Province. The North West Guadalcanal Road extends more than 60 km west up to Lambi and more than 60 km east up to Aola. In the east the SP sites are located within two wards; that is, Ngalimbiu and Mbalasuna Bridges are in the Ghaobata Ward. Kovelau and Mberande Bridges are in the East Tasimboko Ward. The SP sites along the north west Guadalcanal Road also spread over two wards. That is Tandai and Sahalu Wards: Tanaghai Arch Culvert, Tanavasa, Poha, Turtle Beach Culvert, Mbonege Bridge, Belamatanga Bridge and Culverts and Tomba Bridge are situated in the locality of Tandai Ward. While CBSI Culvert, Aruligo Causeway, Sasa Low Level Bridge and Veranaso Causeway are situated in the Sahalu Ward.

38 The roads passes through agricultural farm lands for subsistence and commercial purposes including plantations of cocoa and coconut including palm oil, particularly in the North East Guadalcanal plains which the road traverse. The eight prioritized SP sites as shown in Table 1 will undergo repair and rehabilitation works by building back better, to improve the structures to pre-flood conditions or before the April 2014 floods taking into consideration climate change risks and hazards.

39 The north east and west Guadalcanal Road are in the most part located on flat flood plains with common vegetation being regrowth, coconut and cocoa plantations including palm oil in the east along the road sides. Minor subsistence and commercial farming by families is also common along the road sides. The road surface between the SPs along the north east road is sealed while on the north western road is sealed and unsealed or gravel roads with overall condition ranging from good to poor and requiring improvement.

Table 1. SP Chainage from Honiara and Existing Crossing Types of Prioritized Subproject Sites

SP No. & SP Name	Chainage (Km) – *from Honiara*	Crossing Type		
		Bridge	Culvert	Causeway
West Guadalcanal				
SP01 – Veranaso Bridge	49.5			✓
SP02 – Tambea Culvert	43.3		✓	
SP0 3 – Sasa Low Level Bridge	30.5	✓		
SP04 – Aruligo Causeway	29.5			✓
SP05 – CBSI Culvert	26.0		✓	
SP06 – Tomba Low Level Bridge	21.2	✓		
SP07 – Belamatanga Bridge	16.3	✓		
SP08 – Belamatanga Culvert 1	15.8		✓	
SP09 – Belamatanga Culvert 2	15.9		✓	
SP10 – Mbonege Bridge	13.6	✓		
SP11 – Turtle Beach Culvert	10.0		✓	
SP12 – Poha Bridge	7.9	✓		
SP13 – Tanavasa Bridge	6.5	✓		
SP14 – Tanaghai Culvert	5.0		✓	
East Guadalcanal				
SP20 – Mberande Bridge/Causeway	43.0	✓		✓
SP21 – Kovelau Bridge	39.0	✓		
SP22 – Mbalasuna Bridge	36.0	✓		
SP24 – Ngalimbiu Bridge	24.0	✓		

Source: MID's Infrastructure Damage Assessment Report

5.3.1 SP01 – Selwyn (Veranaso) Causeway

40 Selwyn (Veranaso) Causeway is located approximately 52.6km West of Honiara along the North West Guadalcanal Road on coordinates longitude 159o37'17.60"E and latitude 9o17'21.80"S, in Guadalcanal Province.

Figure 2. SP 01 – Selwyn (Veranaso) Causeway Location Map 1

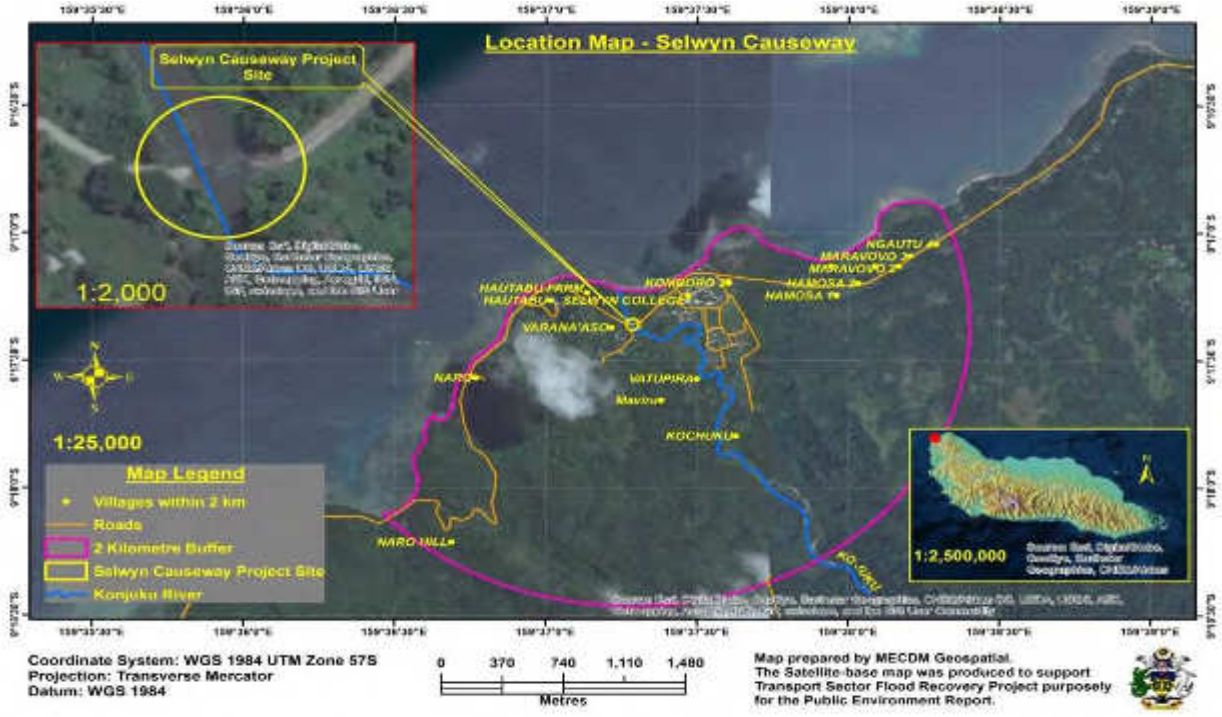


Figure 3. SP01 – Selwyn (Veranaso) Causeway Location Map 2

41 The communities surrounding the Selwyn (Veranaso) Causeway including Selwyn College, Sisters of Melanesia and Konjuku village rely on the river for washing and bathing and recreational activities upstream. Gardens and coconut plantations immediately on the road side are major income sources for the communities. People from the communities depend heavily on the road for transportation of goods and services and socioeconomic development.

42 Within the SP area there are no protected areas, ecologically sensitive areas or areas of cultural significance. However, there is a formerly declared Marine Protected Area about 1Km west of the SP site at Naro, but this will not be affected by the works.

43 The land in which the SP site is located is registered under the Anglican Church of Melanesia (ACOM) but was previously customarily owned. The land is used mainly for food gardens and coconut plantations and hosts a College and two Convents to the west under the ACOM. The College Market is the main location for people living as far as 6Km east and west to sell their produces and it plays a vital role in the exchange of goods and services.

5.3.2 Tambea Culvert

44 Tambea Culvert is located on the northwest Guadalcanal road approximately at Chainage 46.7Km west of Honiara City on co – ordinates, Longitude 159^0 39' 51.913E" and Latitude 9^0 5' 49.247"S, in Guadalcanal Province.

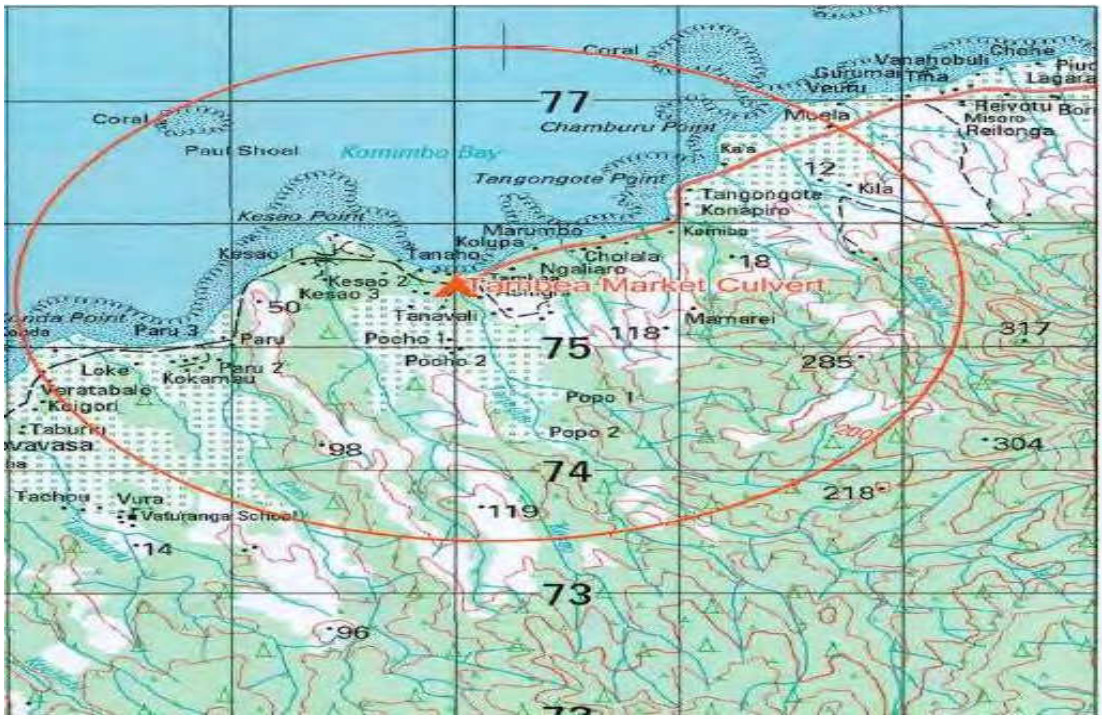


Figure 4. SP02 – Tambea Culvert Location Map

45 Within the premises of the Tambea culvert there is a community thatched market hut next to the culvert, and a family home less than 50m from the culvert. Inland approximately 100m from the culvert with coconut, sago palms and other fruit trees such as cut nut, alite trees and bananas growing in the surrounding area. People residing in the village rely on the market hut to sell their produces to people travelling along the road on a daily basis, and subsistence agriculture for living. The road over the years since rehabilitated has been providing goods and services and contributing to the socioeconomic development of the communities not instantly but continuously.

46 The land in which the culvert is located was registered and owned by Mr. Tommy Chan but was previously customarily owned it was not used for agricultural farming but people rely on the market hut for selling their produces. Hence, plays a major role in the exchange of goods and services. There is no ecologically sensitive area within the site only a culturally significant asset located about 100m at the coast which was already under water due to rising sea level.

5.3.4 Sasa Low Level Bridge

47 The Sasa low level bridge is located at approximately Chainage 30.5Km west of Honiara City along the North East Guadalcanal Road at co – ordinates, Longitude 159^0 45' 23.536" and Latitude 9^0 17' 10.443" in Guadalcanal Province.

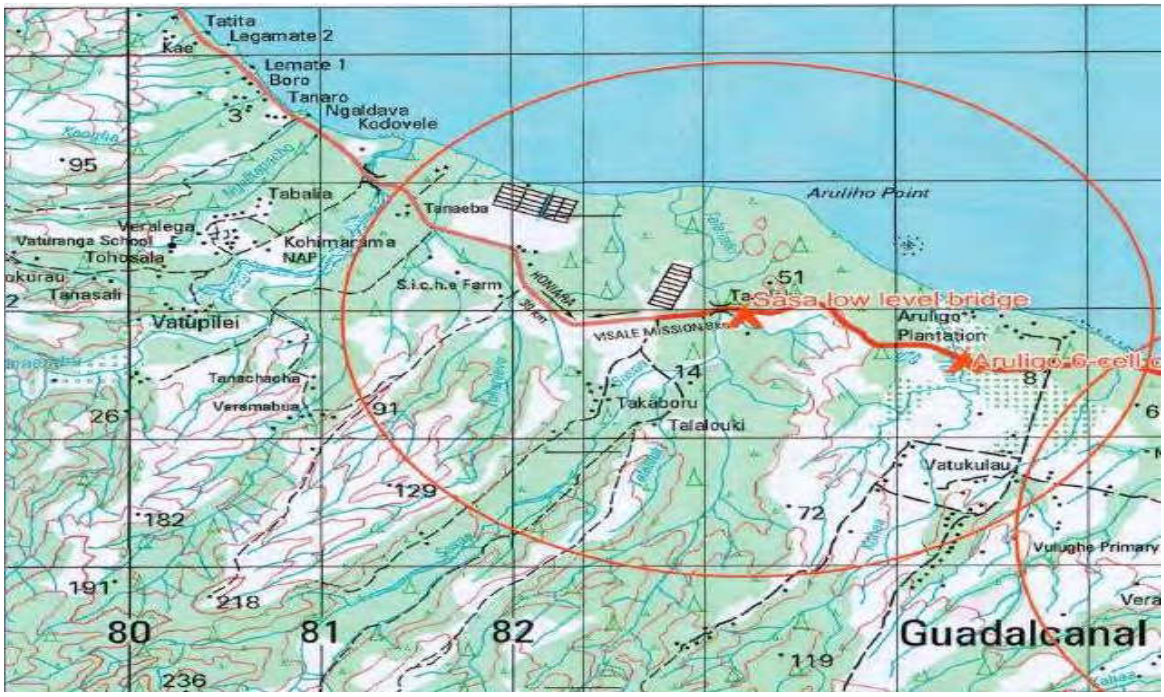


Figure 5. SP03 - Sasa Low Level Bridge Location Map 1

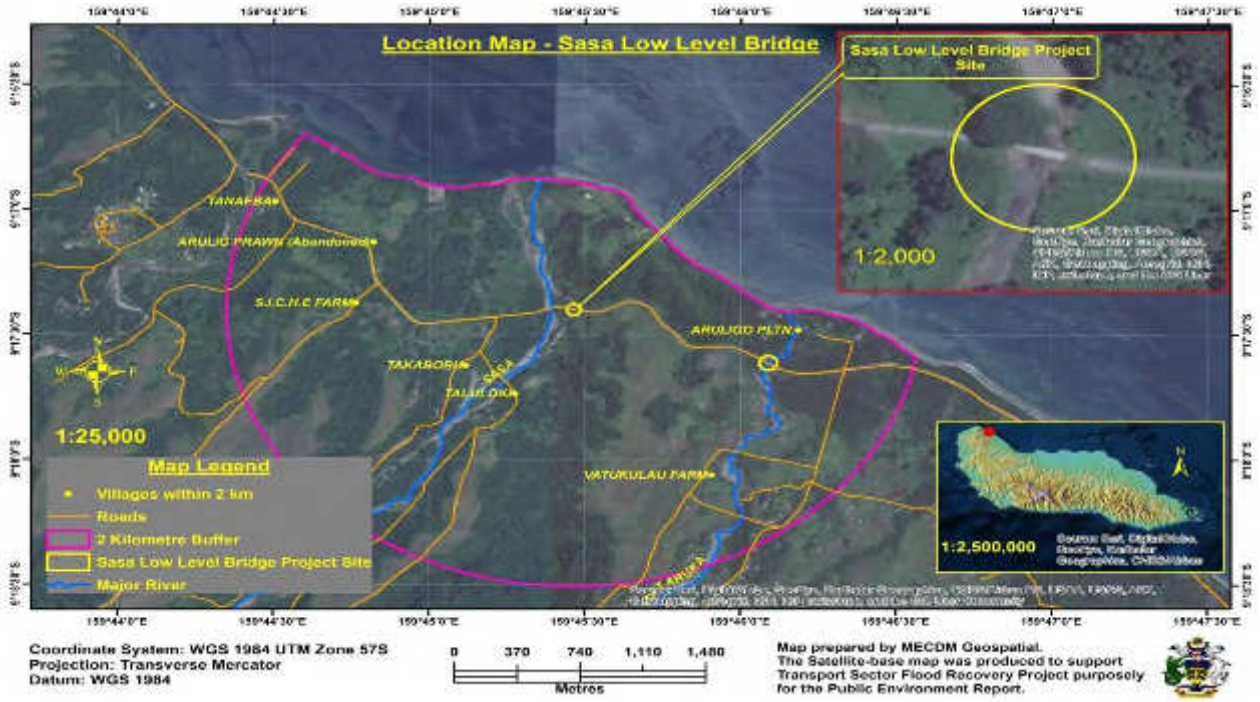


Figure 6. SP03 - Sasa Low Level Bridge Map 2

48 The bridge was constructed over the Sasa River with no valuable fruit trees or communities existing next to the structure. A market area is located about 100m west of the bridge including a High Level Bridge about 50m and is more than 2km away from the coast. People residing in a village 2km inland used the market area to sell their products to the travelling public.

49 The road and bridges provide for socio – economic development and is crucial for the transportation of goods and services to the communities surrounding and further down the bridge. Land in which the structure was constructed was formally owned customarily but is now owned and registered by the Roman Catholic Church.

50 From consultations with the communities there are no ecologically significant or sensitive areas closer to the bridge except a culturally significant area located east and inland of the structure more than 100m away. This will not be disturbed during the works at the subproject site.

5.3.5 Aruligo Causeway

51 Aruligo causeway is located 29.5km west of Honiara City along the North West Guadalcanal road at co – ordinates, Longitude 159^0 46' 5.485" and Latitude 9^0 17' 23.534" in Guadalcanal Province.

Figure 7. SP04 - Aruligo Causeway Location Map 1

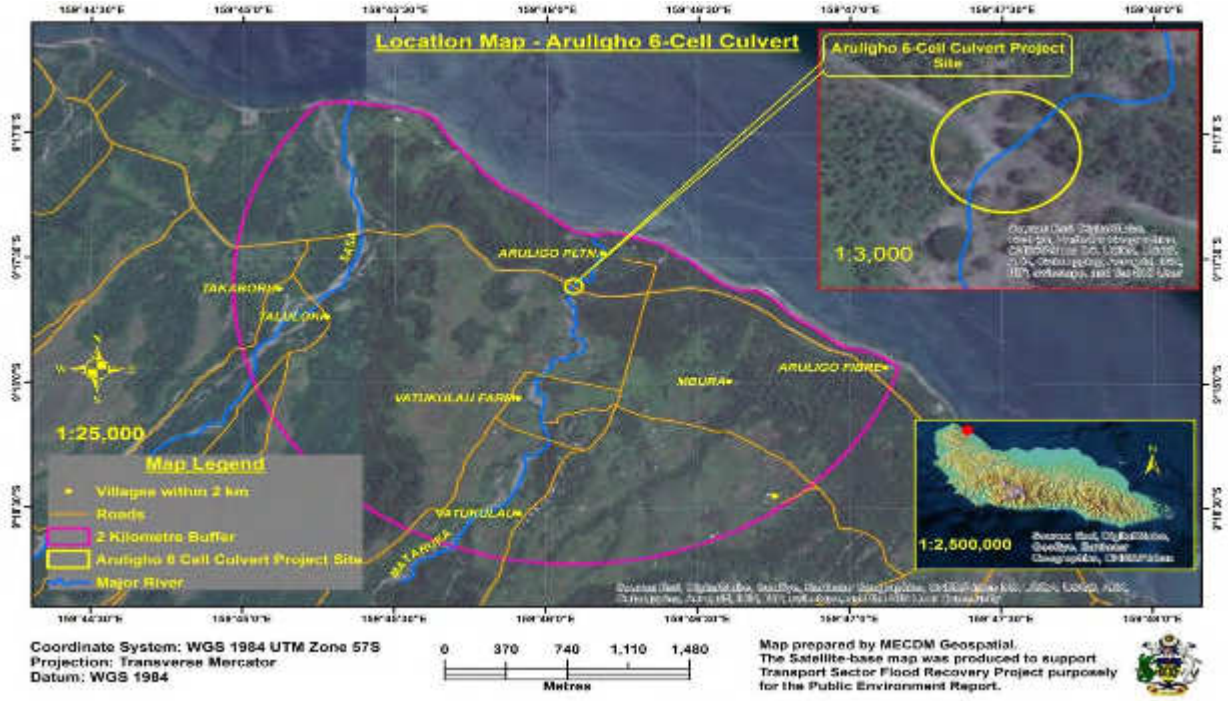


Figure 8. SP04 - Aruligo Causeway Location Map 2

52 The Causeway was constructed under the MID Solomon Islands Road Improvement Project (SIRIP) in 2012, it was formerly a ford. Downstream of the causeway less than 1km to the coast is a School for disabled people owned by the Roman Catholic Church and upstream (inland) are three large villages. There are no gardens within the vicinity of the structure except for coconut plantation which is mostly used by the local residents. People living within the area rely on the structure for transportation of goods and services to and from the Honiara City on a daily basis. Particularly, the school has poultry and piggery farms and that people usually travel down to purchase chicken and eggs including pigs from the school.

53 No ecologically sensitive or significant area including culturally significant or cultural sites is located within the area but there is a swampy area less than 100m west of the structure which usually overflows into the structure during heavy rains. The land has some settlements and villages but was solely owned by the Roman Catholic Church hence residents are former plantation workers including people from the weather coast of Guadalcanal who were resettled by the Government after an earthquake in the late 1970s.

5.3.2 SP05 – CBSI Culvert

54 CBSI Culvert is located approximately 26.4km West of Honiara on the North West Guadalcanal Road on coordinates 159^{0}47'21.15"E longitude and latitude 9^{0}18'19.42"S, in Guadalcanal Province.

Figure 9. SP05 – CBSI Culvert Location Map 1

55 Only the New Tohunaovo village is located in the SP area while other villages are inland. The culvert crosses a swampy stream which is not used by the people in the area. The villagers fetch water for drinking and cooking about 500m from the village. Washing and bathing are also done at the latter location.

56 There are some coconuts owned by the Roman Catholic Church, which the people are also permitted to harvest and sell in the area, as well as some sago palm trees owned by the villagers. The road is seen as very crucial to the economic welfare of the people. To the north of the structure is a recreational area owned by the Central Bank of Solomon Islands. People from the village farm crops and vegetable for subsistence and selling in Honiara.

Figure 10. SP05 – CBSI Culvert Location Map 2

57 There are no protected, ecologically sensitive and culturally significant areas in the locality of the SP site as the road was developed when the Solomon Islands was still under the British Colony.

58 From consultations with the community, the land to the eastern side is owned by the CBSI (north side) and the Roman Catholic Church. The western end is owned by Mr. Raymond Saurongo and Mr. Michael Tovosia. But the whole coconut plantation is owned by the Roman Catholic Church.

5.3.6 Tomba Low Level Bridge

59 Tomba low level bridge is situated on the North West Guadalcanal Road approximately 23.6.km west of Honiara City at co – ordinates, Longitude 159^0 48' 13.911" and Latitude 9^0 19' 7.333" in Guadalcanal Province.

Figure 11. SP06– Tomba Low Level Bridge Location Map 1

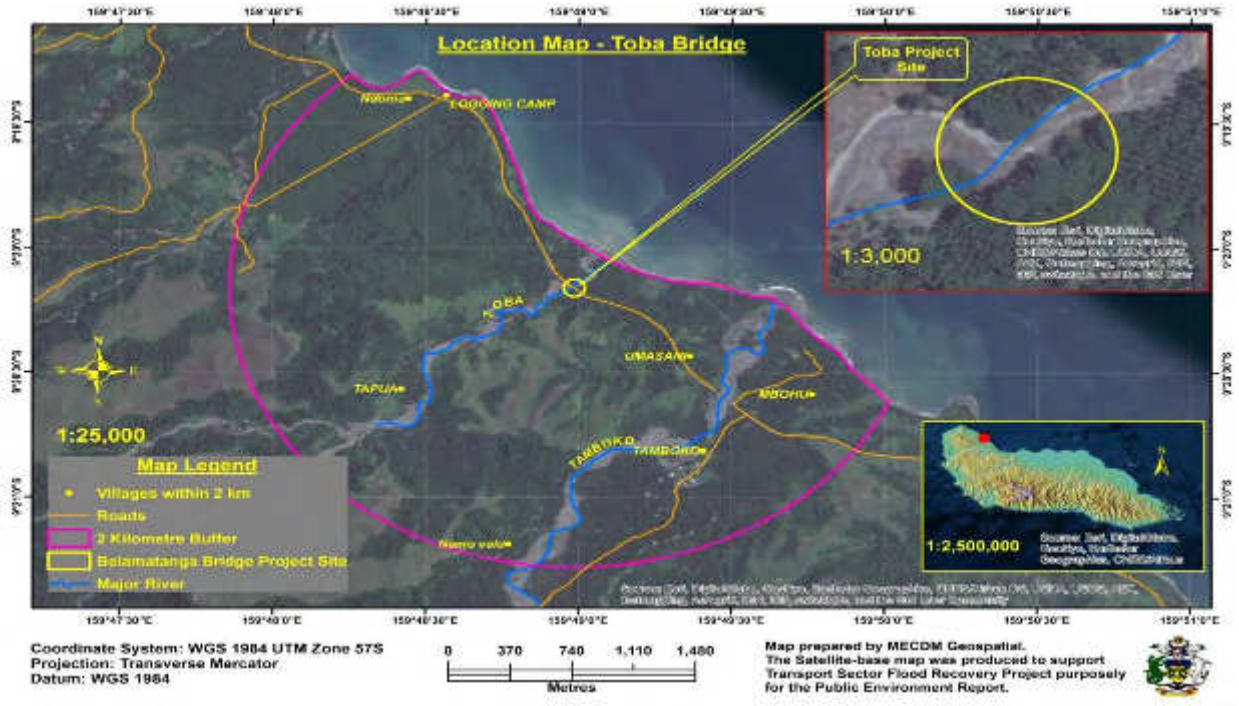


Figure 12. SP06 - Tomba Low Level Bridge Location Map 2

60 Tomba Bridge was a ford and was later upgraded to a bridge under the SIRIP project in 2012. To the east of the structure is a cocoa plantation owned by the Guadalcanal Provincial Government while minor settlements of families exist within a 100m radius of the bridge. This had been developed recently and is slowly increasing in numbers. No gardens for family consumptions are within the premises but can be located more than 100m inland. Upstream (inland) of the river is a recent logging operation with the log pond at the coast less than 1km east of the structure. The stream is literally dry during days of no rain but can be flooded during heavy rains. Goods and services reaching the villages are mainly transported through the road and bridges, and socio – economic well-being of the people rely heavily on the infrastructure.

61 The land in which the structure was constructed is owned by the Guadalcanal Province but was previously owned by the Ghaobata tribe, who currently claimed their ownership of the land. There are no ecologically sensitive or culturally significant areas within the premises of the structure.

5.3.7 Belamatanga Bridge

62 Belamatanga Bridge is located at Chainage 19.9km from Honiara City on co – ordinates, Longitude 1590 49' 28.236" and Longitude 90 20' 23.547" on the northwest Guadalcanal Road in Guadalcanal Province.

63 The area surrounding the Belamatanga Bridge is covered with old coconut plantation which is now only harvested by the people living in the nearest village, Vura, which is located 2km from the bridge. New developments of thatched market huts exist within 100m west of the bridge and one at the eastern end which is usually used also as a bus stop hut. Less than 20m west of the structure are two market huts owned by two families from Vura village. A cocoa plantation exists at the eastern end south of the structure. As reported by one of the tribal chiefs residing in the area the river mouth about 100m downstream hosts crocodiles but community people still tend to use it for washing dirty clothes and dishes particularly at the bridge location. People living in the area claimed that the road and bridge contributes a lot to the socio – economic development of the communities as road users are their main target for marketing along the road sides, and is essential for transportation of goods and services on a daily basis.

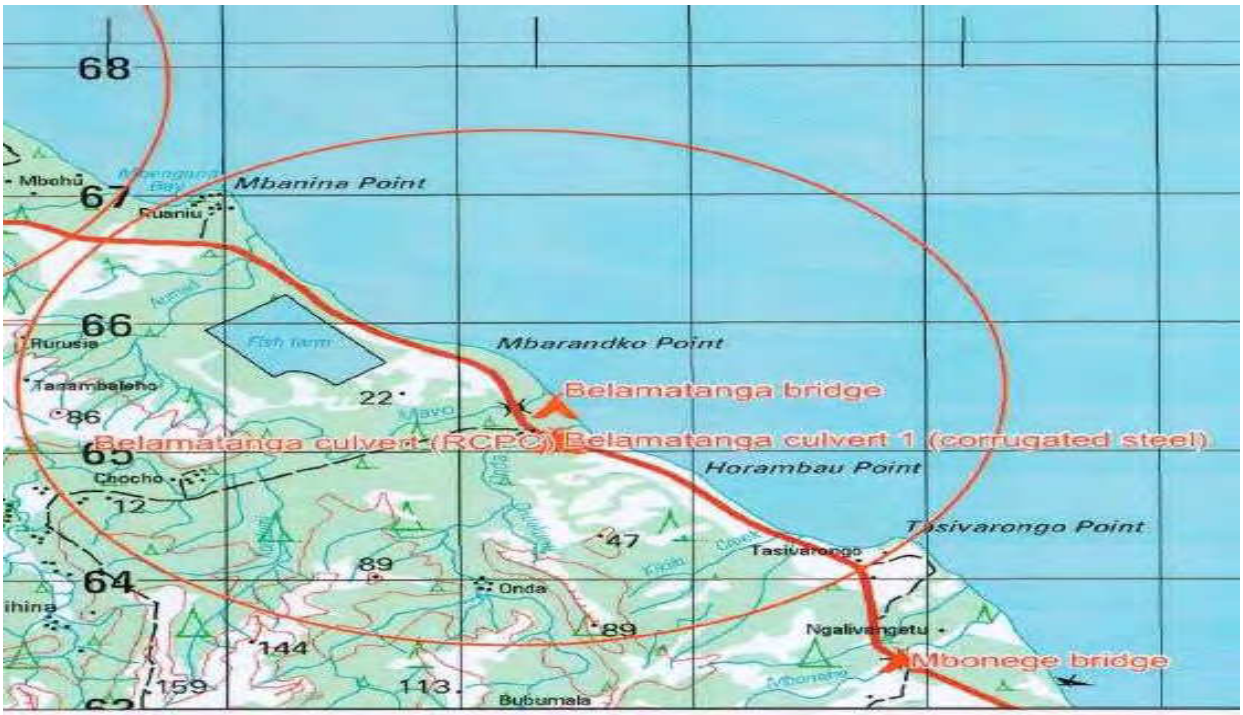


Figure 13. SP07 - Belamatanga Bridge Location Map 1

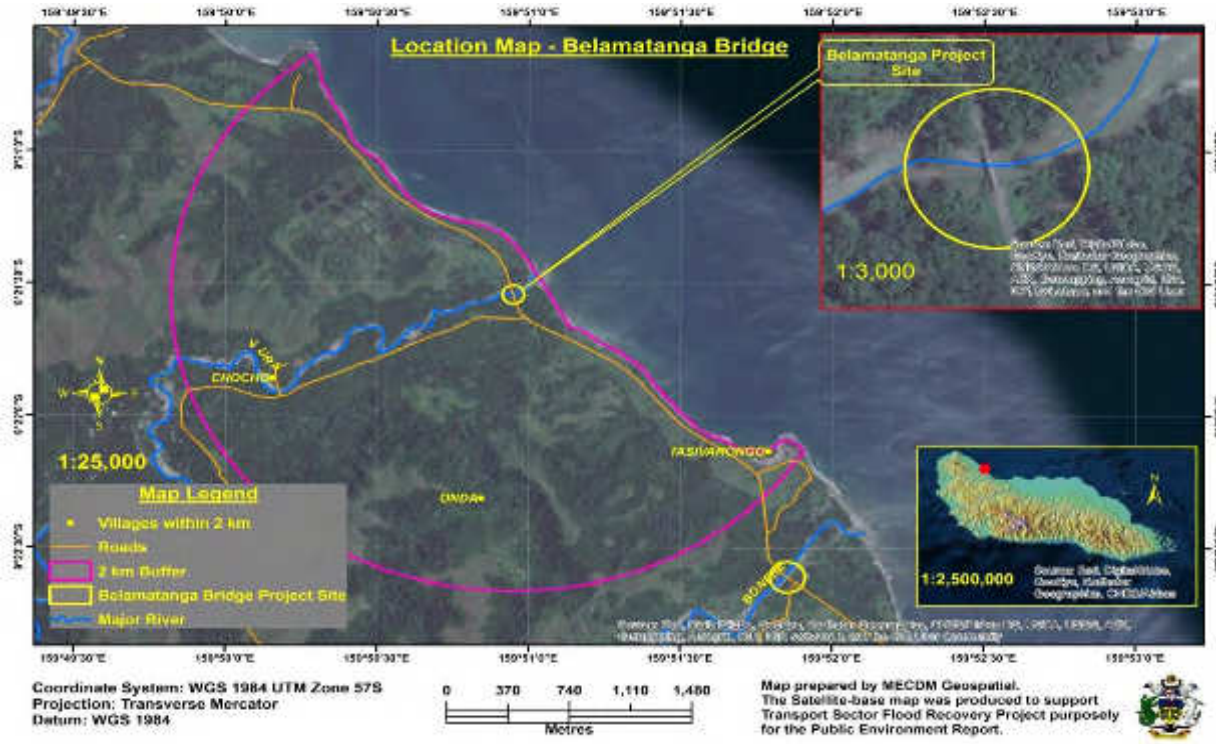


Figure 14. SP07 - Belamatanga Bridge Location Map 2

64 There are no ecologically sensitive or culturally significant area within the Belamatanga Bridge area, since one area of cultural significance was destroyed during the construction of the bridge many years ago. The land in which the bridge was constructed is now under the Commissioner of Lands but was previously owned by the customary land owners.

5.3.8 Belamatanga Culverts

65 The Belamatanga Culverts are located adjacent to each other at the eastern end of Belamatanga Bridge at Chainages 18.2km and 18.3km on co – ordinates, Longitude 159^0 50' 19.25" and Latitude 9^{0}20' 40.221" and Longitude 159^0 49' 44.285" and Latitude 9^0 20' 31.874" respectively, on the north west Guadalcanal road in Guadalcanal Province.

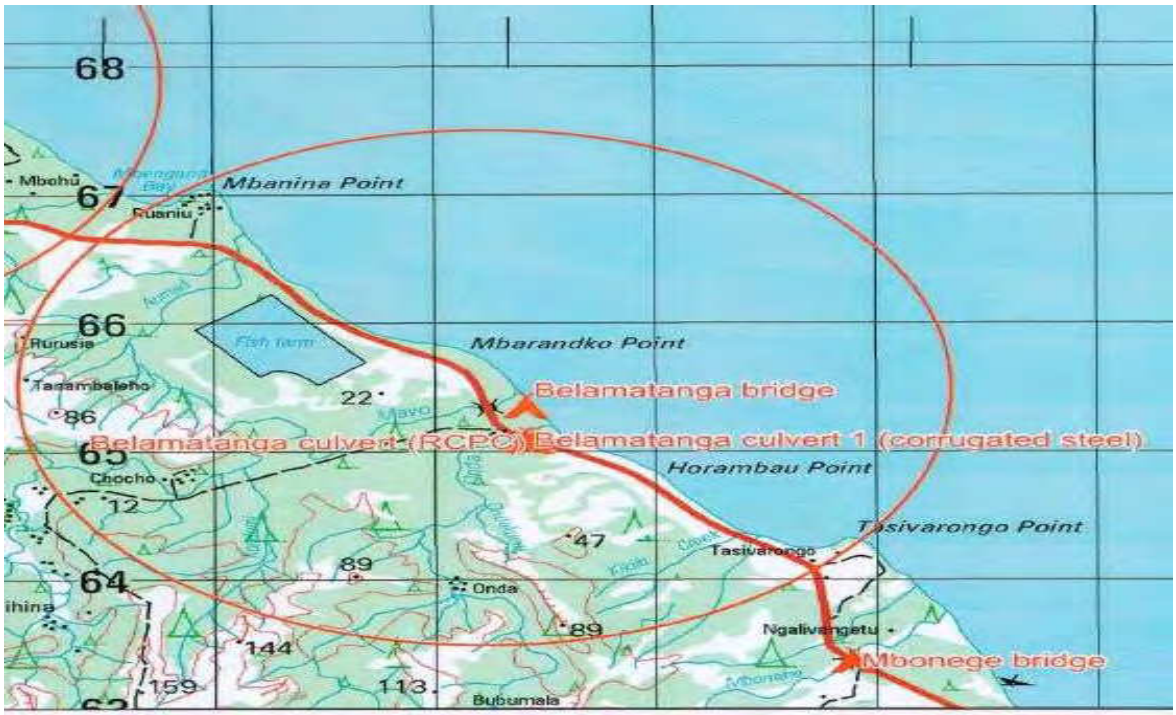


Figure 15. SP08 & SP09 - Belamatanga Culverts 1 & 2 Location Map

66 The Belamatanga Culverts are two culverts with one being a corrugated steel culvert and another one a reinforced concrete box culvert constructed in the 1990's the culverts were badly damaged during the flash floods in 2014 and resulted in affecting part of the road. The land surrounding the culverts is an old coconut plantation and to the west of the culverts is the Belamatanga Bridge about 100m west. There are no residences within the area except that to the east the beach is used for recreational purposes. People from the closest village, Vura, which 2km south of the structure utilize the coconuts and the beach as sources of income. People living in the village rely on the infrastructure for the transportation of goods and services and products to the market in Honiara including social and economic development.

67 There are no ecological sensitive areas and cultural significant areas close to the structures the only site of cultural importance was destroyed during the construction of the road and culverts. The land in which the culverts are located is previously owned by customary land owners but was leased to the and is currently under the Commissioner of Lands as the Perpetual Estate Title Holder.

5.3.10 Mbonege Bridge

68 The Mbonege Bridge is located at chainage 16.4km west of Honiara city at co – ordinates Longitude 1590 50' 56.715" and Latitude 90 21' 19.382", in Guadalcanal Province.

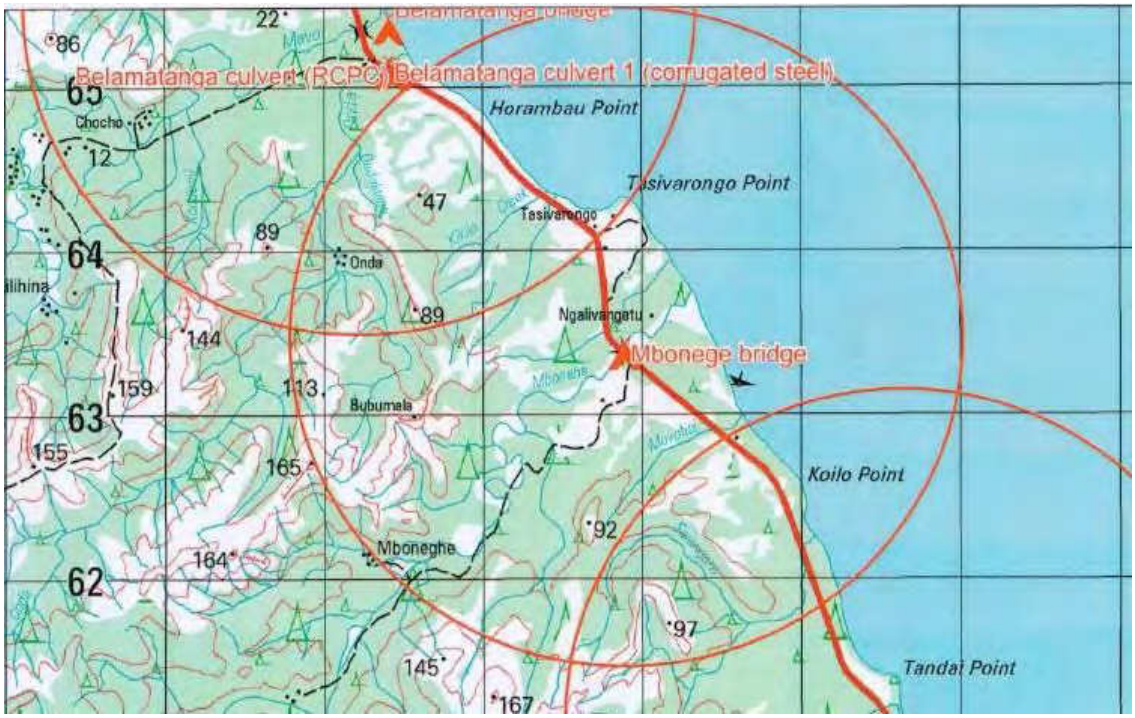


Figure 16. SP10 - Mbonege Bridge Location Map 1

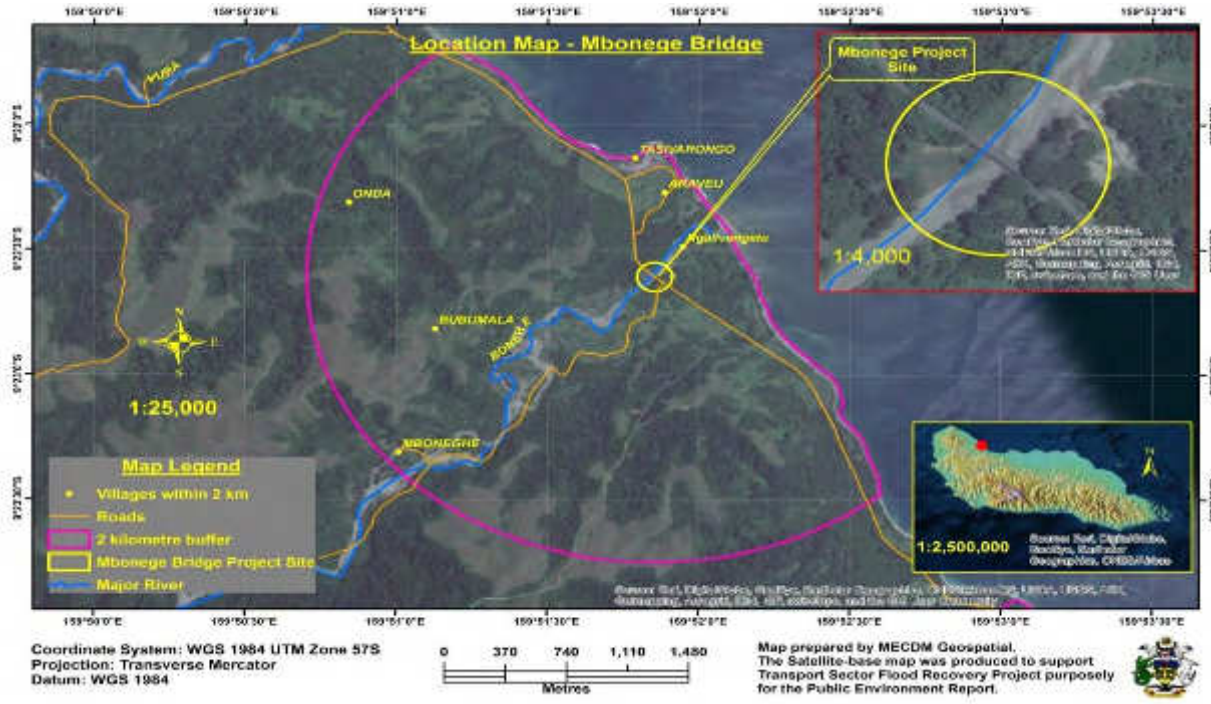


Figure 17. SP10 - Mbonege Bridge Location Map 2

69 Mbonege Bridge was constructed across the Mbonege River it is a high level bridge. The area in which the bridge was constructed is not cultivated but at both the eastern and the western end of the bridge there are thatched and 2 permanent market huts owned by villagers from the villages further upstream and downstream of the bridge. These huts are used by the people to sell their produces on a daily basis. The river itself is mostly used for washing, swimming and recreational purposes by both people from the village and the travelling public. As reported by the community, minor or small scale logging is common upstream.

70 There are no ecological sensitive or culturally significant areas within the specific location, but only remnants from the Second World War in the surrounding areas. The land was purchased and registered to Metropoly Pacific Company for future economic development. This was confirmed by village members during the initial consultation.

5.3.3 SP11 – Turtle Beach Culvert

71 Turtle Beach Culvert is located approximately 13.7Km West of Honiara along the North West Guadalcanal Road at coordinates 159º52'50.31"E longitude and latitude 9º23'53.78"S, in Guadalcanal Province.

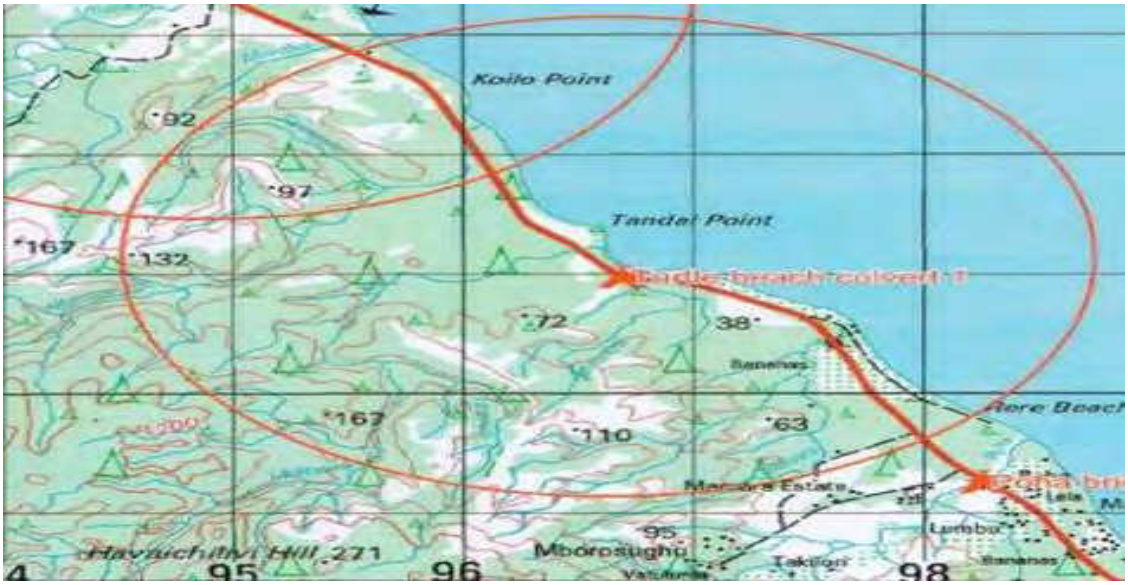


Figure 18. SP11 – Turtle Beach Culvert Location Map 1

Figure 19. SP11 – Turtle Beach Culvert Location Map 2

72 There is only one village within the SP site with family residences scattered from the coast to about 300m inland. The structure has an existing detour on the north and south sides which was constructed as a temporary crossing after the floods in April 2014. Village members appreciate the repair of the structure as road users are their customers and important for their livelihood and socioeconomic development. The stream has not been used for any sort of household activities as the water is filled with debris and rubbish dumped by the public.

73 No ecologically sensitive and protected areas are within the bridge site. A culturally significant or 'tabu' site is located further west of the structure has been identified; however this will not be affected during the construction. The land was purchased and registered to Metropoly Pacific Company for future economic development. This was confirmed by village members during the initial consultation.

5.3.12 Poha High Level Bridge

74 Poha Bridge is located on northwest Guadalcanal road at Chainage 9.3Km west of Honiara on co – ordinates, Longitude 159^0 51' 51.225" and Latitude 9^0 22' 23.006", in Guadalcanal Province.

Figure 20. SP12 - Poha High Level Bridge Location Map 1

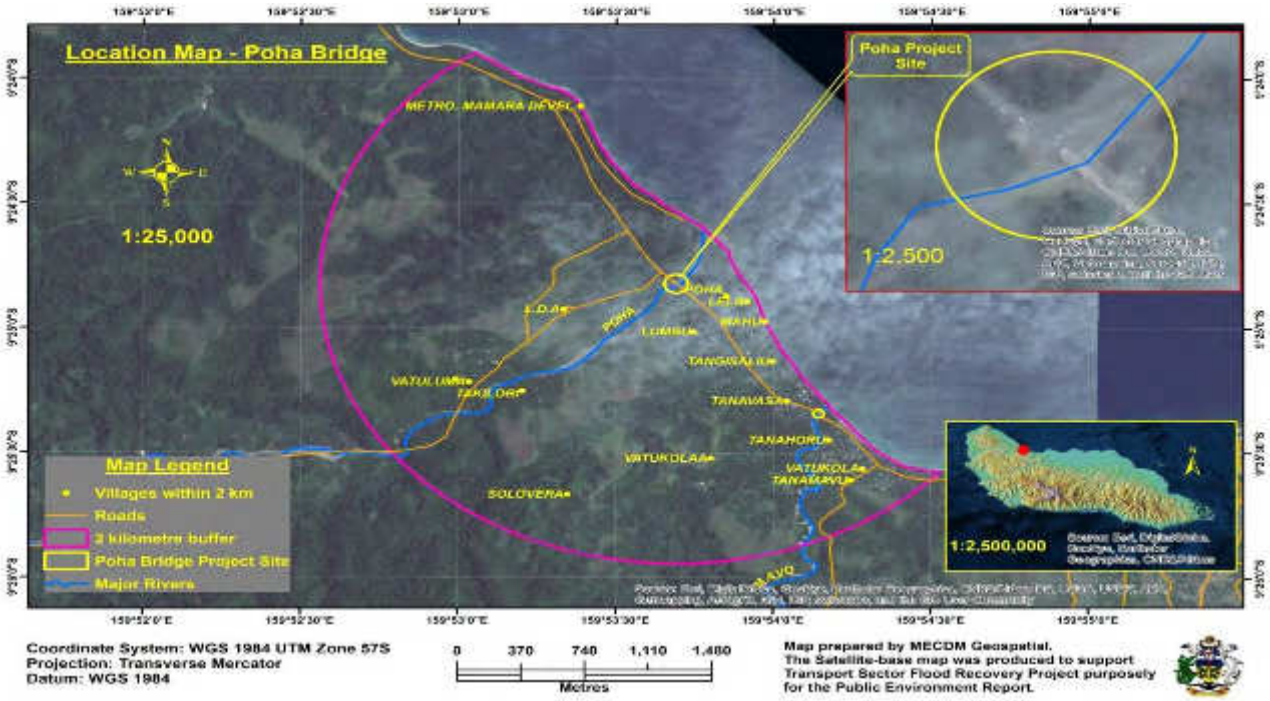


Figure 21. SP12 - Poha High Level Bridge Location Map 2

75 Poha Bridge is a high level bridge constructed over the Poha river in 2012 to replace a causeway. The river is mostly used by people from the surrounding community for swimming, washing and recreational activities. Gravel or aggregate extraction is common as it is one approved site for aggregates to be used for infrastructure development. Within the area are is a village in the eastern side and a village in the western side west of the bridge. The road and bridge is important for transportation of goods and services and is crucial to the socio – economic development of the communities.

76 It was noted during the community consultation that at the western end, east of the bridge is a customary site, an old burial site. But there are no ecologically sensitive and any other culturally significant sites in the area. The land is customarily owned and the upstream is owned by a tribe in which Mr. Michael Tohina is the trustee and the downstream trustee is Mr. Usa Siriako.

5.3.13 Tanavasa Low Level Bridge

77 Tanavasa bridge is situated on the north west Guadalcanal road at chainage 7.9km on co – ordinates, Longitude 1590 53' 41.621" and Latitude 90 24' 36.262", in Guadalcanal Province.

Figure 22. SP13 - Tanavasa Bridge Location Map 1

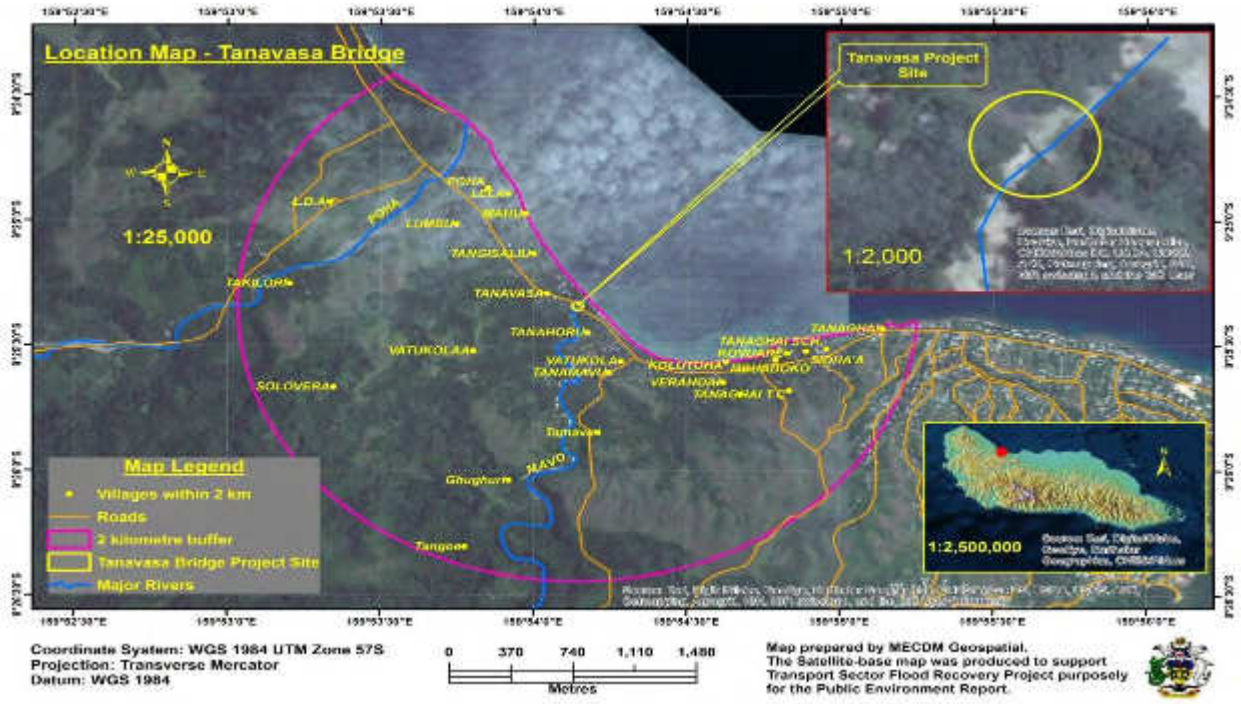


Figure 23. SP13 - Tanavasa Bridge Location Map 2

78 The low level bridge was constructed over the Kohove River at Tanavasa village. At both ends of the bridge less than 100m east and west are villages, from which people residing there used the river for swimming, washing and other activities. People sometimes dug springs beside the river to collect clean drinking water. There are also valuable trees at both ends of the structure including, coconut, breadfruit, sago palm and others.

79 There are no ecologically sensitive or areas of cultural significance within the area of the bridge except for a memorial site at the western end, south side immediately next to the structure on the abutment gabion protection wall. This will be negotiated with the land owners for temporary relocation and reinstalled after completion of the structure. The area and land is customarily owned by a tribe with most of the tribal members residing in the communities at both east and west of the structure.

5.3.4 SP14 – Tanaghai Arch Culvert

80 Tanaghai Arch Culvert is located approximately 5.4km West of Honiara along the North West Guadalcanal Road at longitude 159°54'32.54"E and latitude 9°25'36.71"S, in Guadalcanal Province.

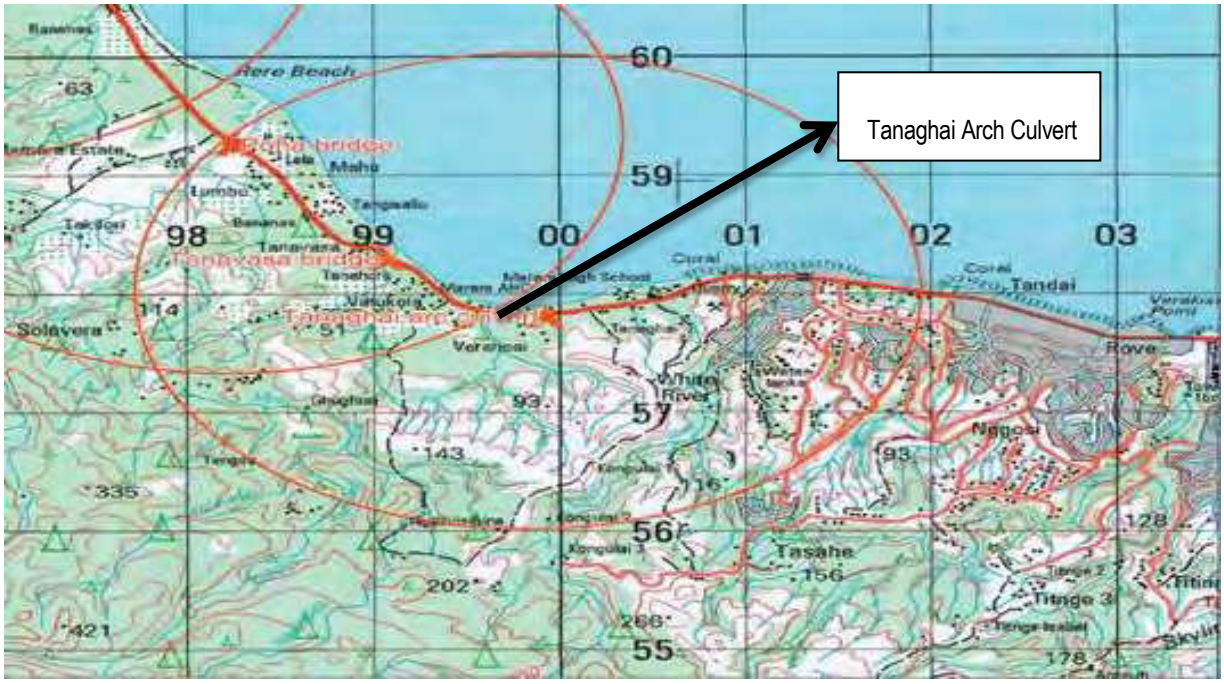


Figure 24. SP14 – Tanaghai Arch Culvert Location Map 1

81 The Tanaghai Arch Culvert is situated in the locality of the Kolotoha Village. The village is densely populated, with several market thatched huts existing in the area adjacent to the main road. The infrastructure is very significant to the people living in the area as it is their only access to the market. Included, that the activities such as marketing on the road side to people travelling along the road is the major source of income for the community. Banana and sago palm, coconut and mango are economically important major sources of income within the SP site.

82 Within the vicinity of the SP area a utility pipe for water source passes through the area. The stream has not been used by the people for any household or recreational activities as it is filled with household and solid wastes.

Figure 25. SP14 – Tanaghai Arch Culvert Location Map 2

83 Furthermore, within the vicinity of the culvert there are no ecologically sensitive and protective areas or areas of culturally significant.

84 The land encompassing the SP site is registered and is customarily owned. Community consultations with the elders confirmed the land is owned by Ghaobata Tribe in which one of the surviving land owners living within the SP site is Mrs. Caroline Salopuka, but the culvert area was already acquired by the Colonial Government.

5.3.5 SP20 – Mberande Bridge

85 Figure 26 below shows the location of the Mberande, Mbalasuna and Kovelau Bridges along North East Guadalcanal Road.

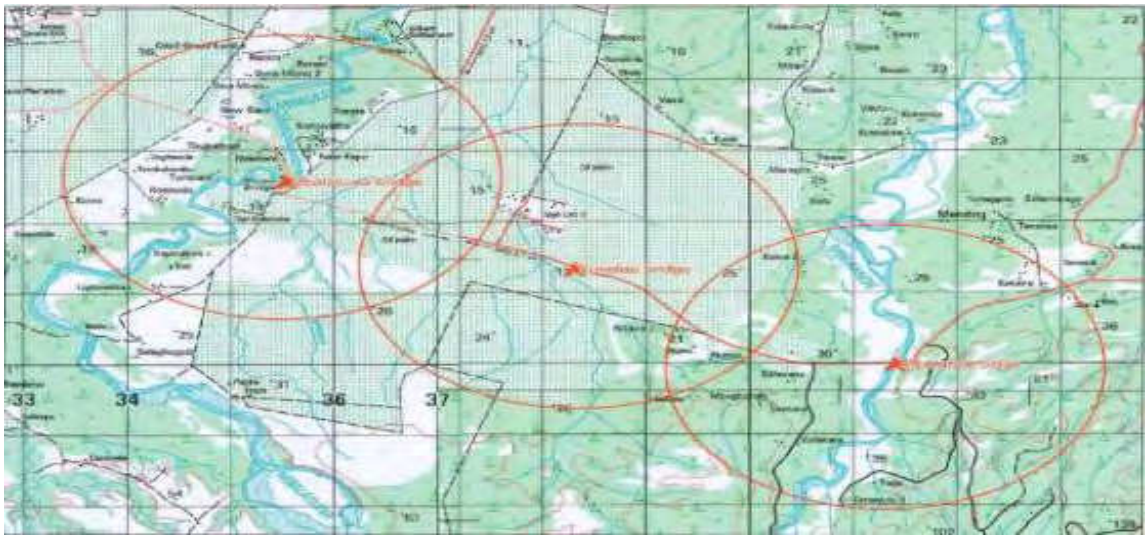


Figure 26. SP20 – Mberande, SP21 – Kovelau and SP22 – Mbalasuna Bridge (from right to left) Location Map 1

86 Mberande Bridge is located approximately at Chainage 43.0 km, East of Honiara along the North East Guadalcanal Road at longitude 160°17'17.69" E and latitude 9°29'47.20"S, in Guadalcanal Province.

87 There are two communities within the Mberande Bridge SP area. One is the Mbegotathi community which constitutes approximately five villages located west of the bridge. While to the east of the bridge is Kekena community which comprises of about four villages. Though villages are located 1.0 km to 2.0 km from the structure, villagers rely mainly on the Mberande River as a source of water for washing and bathing and adjacent streams for drinking water.

88 People from the communities depend highly on the road for transportation of goods and services and socioeconomic development. Agricultural activities including cocoa, coconut and subsistence farming are the main sources of income for the community people including, royalties received from the Guadalcanal Plains Palm Oil Limited on a quarterly basis.

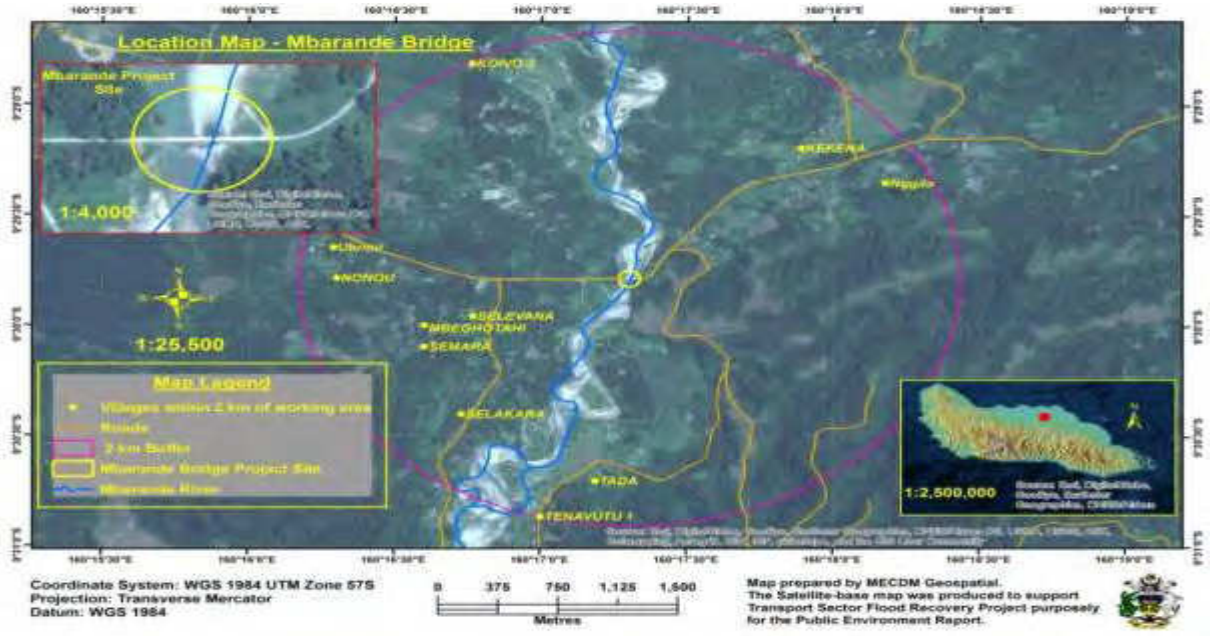


Figure 27. SP20 – Mberande Bridge Location Map 2

89 There are no other protected ecologically sensitive areas within the vicinity of the SP area except for a tabu site at the south and north of the eastern approach of Mberande Bridge. This is located approximately 50 - 100m from the proposed reconstruction site and will not be affected during the implementation phase.

90 The project area is registered as a customary land. Based on consultations, it was found that the area of the SP from the middle of the river to the east is not registered and is owned by the Ghaobata Tribe. While to the west is a tribal land owned but registered as a perpetual estate under four trustees of the land owning Tribal Group, the Lathi Tribe.

91 Based on observation it was noted that the proposed area of works and new bridge construction is not used for agricultural purposes but the river gravel is mined for some labour-based road maintenance works. Also an old bridge pier is located 100m – 150m downstream of the existing structure at the former road and bridge alignment which was destroyed and washed away by the cyclone Namu in 1986.

5.3.6 SP21 – Kovelau Bridge

92 Kovelau Bridge is located approximately 38.6Km East of Honiara along the North East Guadalcanal Road at longitude 160o15'35.98" E and latitude 9o29'3.91"S, in Guadalcanal Province.

93 There is only one village within the vicinity of the Kovelau Bridge called Ndova village which consists of about 15 households. Majority of the people are subsistence farmers and relied on root crops, vegetable gardens, coconut and cocoa for income. Additional incomes are received quarterly through royalty payments from the Guadalcanal Plains Palm Oil Limited (GPPOL). The stream which the bridge crosses is not used for washing, bathing and drinking as people used other streams. There are no ecologically sensitive and protected areas within the SP site as the area was already developed and cultivated by the GPPOL.

Figure 28. SP21 – Kovelau Bridge Location Map 2

94 The land is registered as a customary registered land under four trustees to the east and two surviving trustees to the west but was leased to GPPOL The proposed civil works will not require additional land since it will be on the existing alignment but only about five palm oil trees will be removed. This has been discussed with the GPPOL management and the company had agreed for the removal of the trees as the bridge improvement is seen as very important for the company.

5.3.7 SP22 – Mbalasuna Bridge

95 Mbalasuna Bridge is approximately 35.9Km East of Honiara along the North East Guadalcanal Road at coordinates, longitude 160o14'4.61" E and latitude 9o28'23.79"S, in Guadalcanal Province.

96 There are more than 10 villages surrounding the river but the only closest village is Ndadave village on the west and New Kapu on the eastern side of the SP site. Other villages are located more than 1 km from the bridge. The village people rely mainly on the road for movement of goods and people to and from Honiara and other economic activities. The river is mainly used by people for bathing and washing. Man-made springs within the river bed are used for drinking. There are also coconuts on the road side that is a major source of income for the people.

97 Furthermore, at the proposed realignment area there are some cocoa trees, palm oil trees, banana trees, teak trees and gardens for income generation by the property owners.

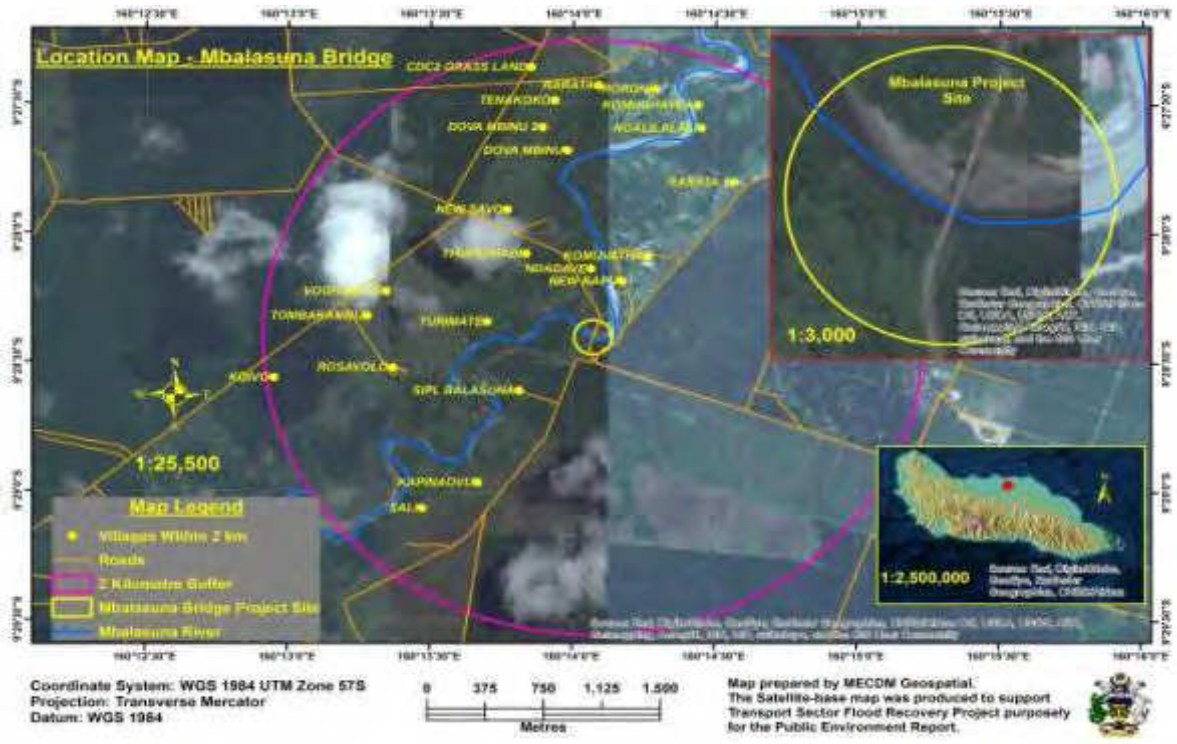


Figure 29. SP22 – Mbalasuna Bridge Location Map 2

98 There are no ecologically sensitive areas and protected areas found within the SP site. The team identified a culturally significant or tabu site is located downstream of the existing structure about 200 m north; however, it will not be affected by the works.

99 The land within the proposed SP site was acquired by the Colonial Government while the surrounding land is customary and is yet to be registered, particularly on the eastern side and partially on the western side. But for half of the western side, the land is not registered but is owned by Mr. Wilson Pitakere as he had purchased it from the customary land owners.

5.3.8 SP24 – Ngalimbiu Bridge

100 Ngalimbiu Bridge is approximately 30.5Km East of Honiara along the North East Guadalcanal Road at coordinates longitude 160o8'42.82"E and latitude 9o27'26.36"S, in Guadalcanal Province.

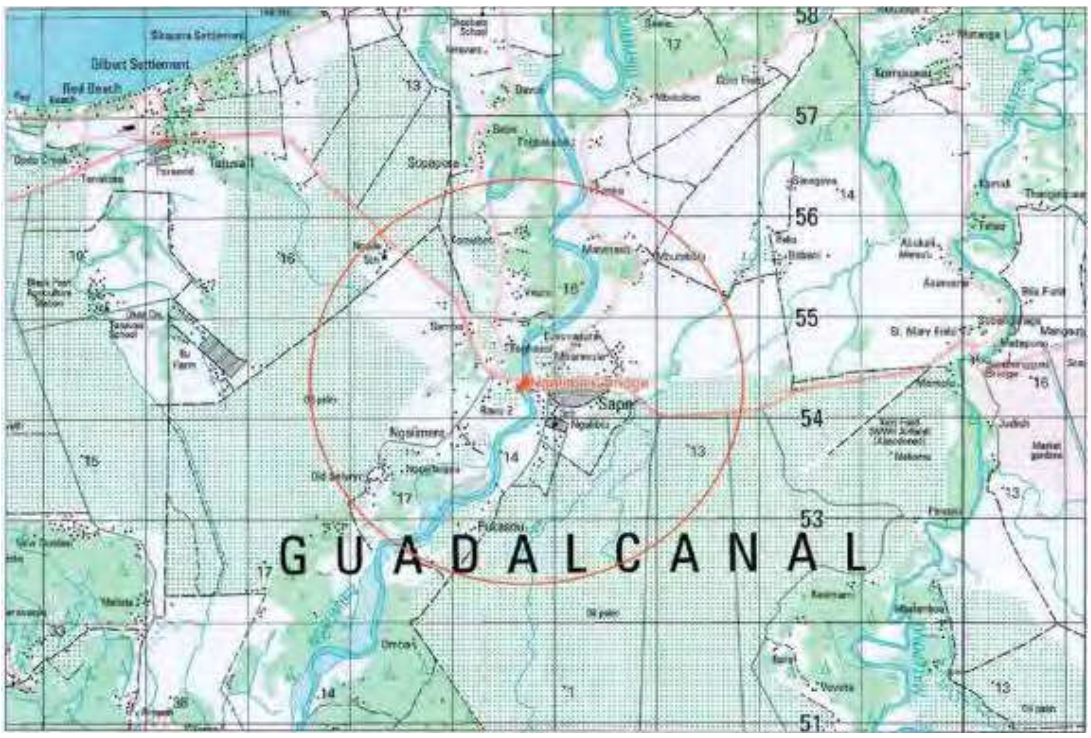


Figure 30. SP24 – Ngalimbiu Bridge Location Map 1

101 The SP area is adjacent to Baravule village and GPPOL executive and labour quarters to the east. While only one family occupied the area to the west of the bridge and about five villages downstream (north) side of the bridge which are approximately 1 km to 2.5 km from the structure. The road is the main and only infrastructure used for transportation of agricultural products to Honiara by the people.

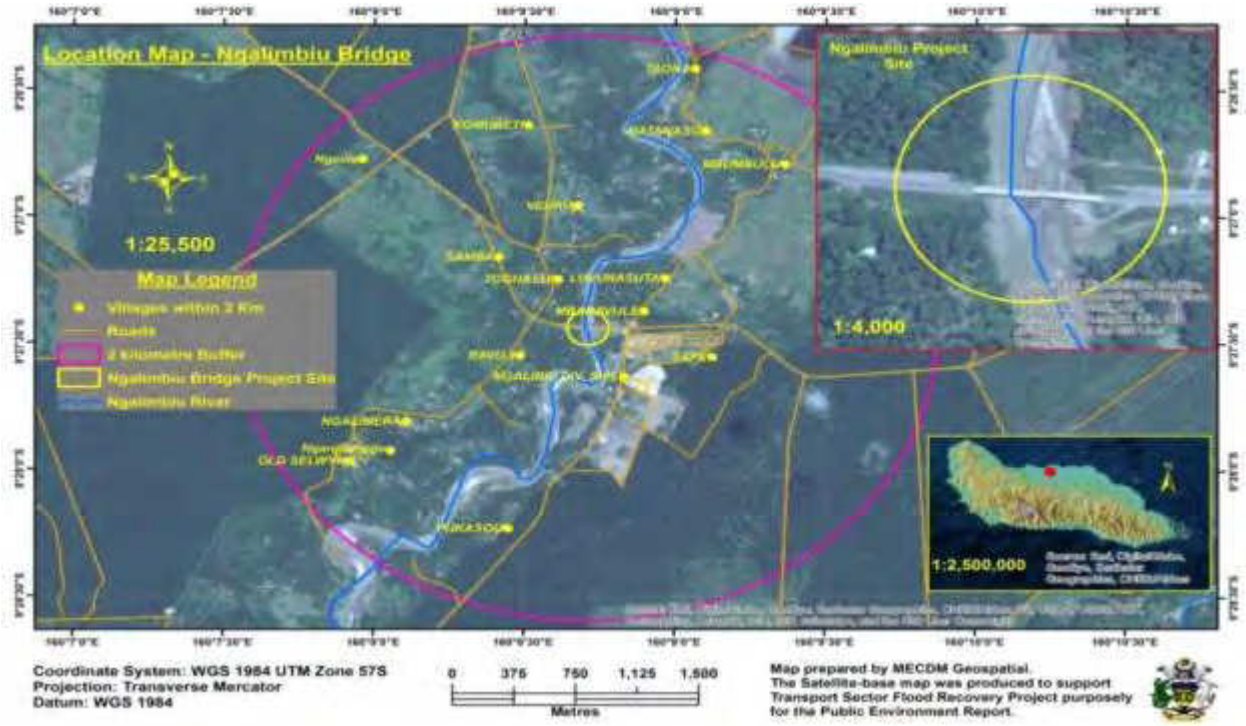


Figure 31. SP24 – Ngalimbiu Bridge Location Map 2

102 There are no ecologically sensitive and protective areas or areas of cultural significant within the SP area. The land to the east is purchased and registered to late Mr. Luke Kakamo. The land to the west is customary owned with the surviving trustee being Mr. Timothy Urobo.

103 The north east road is economically important for the local people and the SIG as it hosts for one of the major income generating activity of the country.

5.4 Need for the Project

104 The Project is to be included for Solomon Island Transport Sector Flood Recovery for the country. The Project is considered recovery works and various repair and re-instatement activities are required to fully rehabilitate all damages done by the April 2014 flood.

105 The East and West Road on Guadalcanal is the key road route and provide access to and from Honiara, not only for the people living immediately along the road and adjacent villages. The Project will improve selected bridges, causeways and culverts up to 49.5 km to the west and 43.0 km to the east of Honiara.

106 If the Project was not done then all the SPs in the east and west are likely to suffer after allowing it to further deteriorate. While overall the TSFRP is expected to increase economic growth and reduce poverty in the project area by (i) improving the accessibility of rural communities to markets, as well as economic and social services; (ii) promoting private sector-led development; (iii) fostering market formation, and facilitating domestic and international trade; and (iv) generating income and job opportunities.

107 This project is required to ensure the continuous and safe transportation of people and goods to and from the capital (Honiara) along the Main Guadalcanal Road.

5.5 Justification for the Project

108 The North East and North West Guadalcanal Road is the only link for people in the communities in both areas. The communities are highly dependent on road infrastructure compared to other mode of travelling such as sea transportation, for most of their day-to-day activities both socially and economically. The road connects from Honiara to as far as Aola in the East and Lambi in the West, this passed through agriculturally productive sites for cocoa and coconut especially in the west while some in the East, including Palm Oil Plantation in the East.

109 Agricultural products for selling at the Honiara Central market such as root crops, vegetables and fruits are mostly transported to Honiara from people living further east and west of the SP sites.

110 People that will benefit from the project not only included the people residing in the villages or communities adjacent to each SP site but the wider community and the country as a whole since one of the major sources of income for the country is Palm oil production in the Guadalcanal North East Plains. Other benefactors include people from East Tasimboko, Ghaobata, Vulolo and Malango Wards of a total population of approximately 30,890 people from the 2009 Census Survey and at present is expected to be near 40,000 people.

111 In the North West Guadalcanal it will benefit a population of 27,080 people from Sahalu and Tandai Wards along with a total population of 3796 people from Savulei Ward as this road is also crucial for their social and economic development.

112 The road and bridges are valuable assets to the communities in the province as it is not only use by adjacent communities but communities living further that travel by boat and board a public transport at specific locations to get to Honiara. Without roads and bridges, services to support socioeconomic activities will remain poor and people in these areas will be unfortunate to carry out such important livelihood activities.

5.6 Proponents Endorsement of the PER

113 The project proponent, MID was given confirmation by the Environment and Conservation Division (ECD) of the Ministry of Environment, Climate Change, Disaster Management and Meteorology (MECDM) to carry out a PER for the Guadalcanal North East and North West Roads Bridges, Culverts and Causeways as part of the Transport Sector Flood Recovery Project (TSFRP) Environmental Assessment tasks after screening of the Development Proposal Application on November 17th 2015.

5.7 Structure of the PER

114 The PER consists of 19 sections: (I) Executive Summary;; (II) Contact Details of the Project Proponent or Applicant; (III) Contact Details of EIA Consultants; (IV) Introduction; (V) Summary Description of the Prescribed Development; (VI) Policy Legal and Institutional Framework; (VII) Description of the Proposed Development; (VIII) Location and Scale of the Prescribed Development; (IX) Description of the Existing Environment; (X) Alternatives; (XI) Climate Change and Disaster Risks; (XII) Social and Poverty Assessment; (XIII) Impact Assessment and Mitigation Measures; (XIV) Environmental Management Plan; (XV) Public Consultations and Information Disclosure; (XVI) Difficulties Encountered; (XVII) Conclusions and Recommendations; (XVIII) References; and (XIX) Appendices.

6 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

6.1 Solomon Islands Environment Legislation and Regulations

115 Environmental impact assessment and management in the Solomon Islands is provided for, under the Environment Act 1998 and the accompanying regulatory instrument, the Environment Regulation, 2008. The Act and Regulations are administered by the Ministry of Environment Climate Change, Disaster Management and Meteorology (MECDM). This administrative body is formed after the national government structure was reorganized in December 2007.

6.2 The Environment Act 1998

116 The Solomon Islands Environmental Policy is vested in the Environment Act of 1998 which makes provision for an integrated system of development control, environmental impact assessment (EIA) and pollution control, including;

- Prevention, control and monitoring of pollution, including regulating discharge of pollutants to air, water or land and reducing risks to human health, and prevention of degradation of the environment;
- Regulating the transport, collection, treatment, storage and disposal of waste and promoting recycling, re-use and recovery or materials in an economically viable manner; and
- Complying with, and giving effect to, regional and international conventions and obligations relating to the environment.

117 Article 4 (1) vests the Environmental Act with considerable power which states that in the event of conflict between the Environment Act and other legislation, the provisions of the Environment Act will prevail. Recent reviews however, noted inconsistencies within the law and how it relates to other legislative platforms (ADB, 2005). The country suffers from a lack of capacity to implement it as there are shortcomings in instituted decision-making and enforcement systems.

118 Part II establishes and defines the powers and role of the Environment and Conservation Division - which has since been re – established within the MECDM. While Part III establishes the requirements for environmental assessments, review and monitoring. This shows that environmental assessment can consist of either a PER or if the development is shown to be of such a nature as to cause more serious impacts then the developer is required to submit an Environmental Impact Statement (EIS) to the MECDM. Activities that require assessment are described as prescribed Activities and are included in the Second Schedule of the Act. Prescribed Activities that are listed in the Schedule that will apply to the TSFRP include:

- Activity 3 Non-metallic industries-extraction of aggregates stone or shingles,
- Activity 9 Public Works Sector -infrastructure developments, airport developments and ports and harbors.

119 Part IV details requirements for pollution control and emissions (noise, odor and electromagnetic radiation) and requirements to permits for the discharge of waste. Article 49(2) requires that any vessels are not to discharge waste into the environment unless the vessel complies with prescribed discharge standards. Noise and interference with antipollution devices are covered under Article 50 (1) while restrictions and emitting unreasonable noise are covered in Article 51 (1).

120 Regulations under the Act are currently being drafted and will cover detailed requirements for Environmental Impact Assessment (EIA). The existing Solomon Islands EIA Guidelines for Planners and Developers (May 1996) pre-date the Environment Act and are not legally binding. In the Second Schedule, the Act lists prescribed developments for which consent, accompanied by an EIA, are required.

121 All prescribed projects require a simple assessment through a “screening” or “scoping”, to see what form of additional assessment is required. Most prescribed projects require a Public Environmental Report (PER), while many major projects such as logging, large agricultural developments, mining, large scale tourism developments, and infrastructure projects will also need a second stage of appraisal (in an environmental impact assessment) which includes technical, economic, environmental and social investigations. All of these are to be presented in an Environmental Impact Statement (EIS).

122 The level of assessment under this IEE has been confirmed acceptable to the, requirements of the Act upon consultation with the ECD during the preparation of the document.

6.3 Environment Regulation 2008 and Environment Guideline 2010

123 The requirements for the EIA are clearly stated in the Environment Regulations 2008 under the Act. The Environment Regulation establishes the procedures for undertaking the environmental assessment of any projects categorized as “Prescribed Activities”.

124 The developer is required to first submit a Development Application following which the MECDM determines whether (i) no further assessment is required, (ii) a PER, or (iii) an EIS where major projects are considered such as logging, large agricultural developments, mining and large scale tourism developments and infrastructure projects. For an EIS, the developer will require to produce the following: (i) technical, (ii) economic, (iii) environmental and social investigations. Both the PER and EIS require Public Consultation. Following approval from the director of ECD under the MECDM, and a Development Consent will be issued.

125 The Environment Impact Assessment guideline 2010 is produced by ECD with the aim of simplifying the procedures in the Act, to provide basic advice and guidance to government officers, planners, developers, resource owners on the environment impact assessment process (MECDM, 2010). It is also designed to administer the second schedule of the Environment Act 1998. The guideline stated the purpose of the EIA, in part to promote environmentally sound and sustainable development via identification of appropriate mitigation measures and to predict, avoid, minimize or offset the adverse significant environmental and social impacts of the development (ECD 2010). It also describes the procedures needed to be undertaken including stakeholders in the EIA process and fees required for the type of development before obtaining the development consent approval.

126 Granting of an EIA approval requires that a project must meet several criteria, including that the development will be carried out in way that is consistent with all relevant environmental policies and regulations, and has reasonable steps in place to minimize any risk of environmental harm (ECD 2010).

127 Solomon Islands do not have emission, water or air quality standards. While environmental standards are not provided in the Regulation, the MECDM usually uses international standards that Solomon Islands is a member example the World Health Organization (WHO) standards are used for water and air quality. While the Guidelines provide for licenses to discharge waste or emissions, the enforcement of these would appear to be difficult without defined standards.

6.4 Wildlife Protection and Management Act 1998

128 The objective of the Act is to regulate the international trade of flora and fauna so as to protect and conserve them for long term sustainability of the country's biological diversity. The Act was developed to meet the obligation of Convention on International Trade in Endangered Species (CITES) signed by the government in year 2007. A similar process equivalent to the CITES was developed to manage the flora and fauna identified in SCHEDULE I (Section 11) on Prohibited Exports of the Act. The section 26 of the act indicates concerns over possession of illegally obtained species of animals, plants and individual from marine and terrestrial environment in the country. Implementation of the Act is slowly improving over the years.

6.5 Protected Areas Act 2010

129 Following the gazette of the act, an advisory committee comprising of NGOs, government agencies and private sector was established to oversee the implementation of the Act. The Protected Areas Act 2010 is an outcome of the Program of Work on Protected Areas (PoWPA) project executed by the MECDM. The objectives of the Act are:

- to establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity;
- to develop, where necessary, guidelines for the selection, establishment and management of protected areas or areas where special measures need to be taken to conserve biological diversity;
- to regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use; to promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings;
- to promote environmentally sound and sustainable development in areas adjacent to protected areas with a view to furthering protection of the protected areas; and
- to rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, such as, through the development and implementation of plans or other management strategies.

130 A number of issues need to be resolved and are equally important during the implementation of the act which includes:

- a proper GIS of past, present and potential PA sites need to be developed which are essential for locating biodiversity sensitive areas and monitoring;
- Food security for livelihood is limited at PA sites. Incentive for livelihood support for PA landowners is vital. Otherwise, landowners will be tempted to exploit resources from PA sites;
- the SIG need to establish a mechanism for trust fund so that there is equal sharing among landowners of PA sites, and
- Each province in the country must develop ordinance for PA systems.

6.6 Mines and Minerals (Amendment) Act 2008

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

132 Part VIII of this Act will need to be complied with in regard to mining and extraction of aggregate. Article 64 requires that Building Material Permits (BMP) be issued for the extraction of building materials. Articles 65-67 outline the format for a BMP application and rights of a BMP holder to enter and extract building materials. Article 68: sets out the obligations on a BMP holder which includes; payment of fees and royalties; operate using good mining practices; report to the Director on the amount removed and sales details; and at closure of the mining area make the area safe. Article 69 exempts government departments, provincial or local authorities from these requirements if they own the area where the mining is being done.

133 The Act defines "building materials" as; clay, gravel, sand and stone used for buildings, roads or other construction purposes.

134 MECDM advise that extraction of materials requires a PER to be prepared. The Mining Act does not specify this as a requirement for a BMP. Approvals of BMPs are via a Board that is convened four times a year for this purpose. The Director of ECD is a member of the reviewing Board and presumably the inclusion of the ECD Director on the Board provides the necessary authority to review and approve the BMP.

6.7 Waters Resource Bill

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

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

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

137 The Act covers all water bodies, rivers, streams whether in a registered or non registered, public or private or customary land in Solomon Islands. The Ministry has the authority to control the use and development of all water catchments and riverbanks. Logging, mining and sands and gravel extraction in water catchments, riverbanks and river beds may be restricted by the Ministry according to the requirements of the catchment management and conservation. Section 21 of the Act provides for the Ministry to recommend to the Board to declare a water body such as a catchment, ground water or flood control zone as a Water Control Area. If approved by the Minister and gazetted, mining and sand and gravel extraction will be prohibited. This also includes any contraction, altering, removing or in any way impede or be likely to impede flow or movement of surface water. This is a very important clause as it may have a direct impact to sand and gravel extraction in the future if the current activities are not managed or sustainable. The Act clearly states that a development must not obstruct, divert or dam the river, if so it must make application to the Minister who upon receiving the request will assess and if agree will issue a license accordingly.

6.8 The Town and Country Planning Act 1979

138 The Town and country planning Act has potential to provide for the consideration of environment sector for conservation of cultural and biodiversity areas. The objective of the Act is to ensure that land is developed and used in accordance with proper polices and a high consideration of the people's welfare. An important limitation of the Act however is that it affects only non-customary land, the physical planning office responsible for enforcing the Act can only advice when it comes to customary land but are not required to follow the mechanism of the Act.

6.9 Provincial Government Act 1997

139 The Provincial Government Act of 1997 provides power to the provinces to create their own legislation in respect of environment and conservation. Its Schedule 3 provides a list of activities for which the provinces have responsibility and have the power to pass ordinances.

140 According to the country's draft 2008 State of the Environment (SOE), a total of eight (8) provincial ordinances related to environmental and natural resources management had already been passed. But these ordinances were passed by five (5) provinces only. Isabel Province passed the most number of ordinances with 3, followed by Malaita Province with 2, and one each for Guadalcanal, Makira, and Temotu.

6.10 Other Relevant Country-based Legislations

141 The country has a number of other legislations which has implications for resource development and management but regulations have not been promulgated under many of these Acts and therefore their implementation is not yet entirely effective.

- **National Parks 1978** Establishes national parks and prohibits fishing and hunting in same without permit; establishes restrictions on activities undertaken within national parks; provides for appointment of park rangers.
- **Wild Birds Protection 1978** Lists scheduled birds (incl. eggs and nests) for protection from being killed, wounded, taken or sold (including skin or plumage); establishes several bird sanctuaries; establishes strict hunting seasons for certain birds.
- **Lands and Titles 1988** Covers the management of land, defines "customary" land, and sets out procedures for land acquisition. This Act is being reviewed and a new draft bill is being circulated for consultation.
- **Forest Resource and Timber Utilization 1991** Governs licensing of felling of trees and sawmills, and timber agreements on customary land; deals with forest declared as State Forest and Forest Reserves and establishes restrictions in same. Forestry Bill 2004 seeks to replace the Act and various amendments. The Bill provides for conservation of forests and improved forest management including establishment of national forests.
- **Wildlife Management and Protection 1998** Provides for the protection, conservation and management of wildlife by regulating the export and import of certain animals and plants; and to comply with obligations under the Convention on International Trade in Endangered Species (CITES).
- **Fisheries 1998** Framework for fisheries management and development including licensing of fishing vessels and processing plants, listing prohibited fishing methods; provides for establishment of Marine Protected Areas (MPAs) and coastal management plans.

6.11 International Agreements and Treaties

142 Solomon Islands is a party to a number of international and regional Multi-lateral Environment Agreements. These MEAs have been instrumental in the development of national environment management strategies to address major environment issues. The country is currently developing major national strategies under the Rio Conventions. This includes the National Biodiversity Strategic Action Plan (NBSAP), the National Adaptation Plan of Action (NAPA) and the National Action Plan to Address Land Degradation (NAP).

6.12 Environmental Management in the Transport Sector

143 The National Transport Plan (2007-2026) prepared by the Transport Policy and Planning Unit (TPPU) of the Ministry of Infrastructure and Development (MID) in June 2006 acknowledged the importance of the environment as the key to the country's economic development, and that "the development of the transport sector needs to be planned and implemented in such a way that minimizes adverse impacts on the environment".

144 The NTP further identifies a number of potential adverse impacts on the environment as follows:

- Marine pollution from shipping;
- Land degradation and pollution of water courses resulting from poor infrastructure design;
- Destruction of landscapes as a result of poor operating practices at quarries and construction sites;
- Air pollution from both road traffic and air transport; and
- Land degradation as a result of inadequate facilities for the disposal of transport-related waste.

145 The NTP adopts four policy interventions to minimize negative environmental impacts associated with development of the transport network as follows:

- Government agencies will review infrastructure design standards and contract specifications to ensure high standards of environmental protection measures including drainage design, management of water courses, slope stabilization, construction camp operation, and borrow pit management;
- Government agencies will work with local businesses to identify appropriate mechanisms for the disposal of transport related waste including mechanisms for funding environmental clean-up programs;
- Government agencies will work with ship owners to identify suitable facilities for the breaking of wrecks and unusable ships; and
- Vehicle testing standards will be strengthened to incorporate more stringent emissions standards particularly targeting gross polluters.

146 The MID's Safeguards Procedures Manual (SPM) sets out the procedures for MID to comply with the Environmental Act and Environmental Regulations. The purpose of the SPM is to guide MID in managing the environmental and social impacts and risks which could arise in the course of implementing the Solomon Islands National Transport Plan (NTP) priority activities. The Central Project Implementation Unit (CPIU) of the MID categorizes these priority activities into three tiers:

- Tier 1 - community-based routine and preventive maintenance through Labor-based equipment supported (LBES) contracts, mainly for roads;
- Tier 2 -machine-based maintenance contracts (MBMC) for roads, wharves, and airfields; and
- Tier 3 - major rehabilitation, reconstruction and/or new construction contracts for roads, wharves, and airfields

147 For our project, Tier 3 is important as there will be some rehabilitation or reconstruction works. These types of activities in compliance with the Environment Act generally require the preparation of an environmental assessment - public environment report (PER) – the level of which is more or less equivalent to an initial environmental examination (IEE) under development partner's requirements, ADB.

6.13 ADB Environment Policy

148 The environment assessment requirements of the TSFRP under the project preparation phase is required to adhere to the ADB's Environment Policy supported by a set of procedural guidelines and various sections of the Safeguard Policy Statement (SPS), 2009. All ADB investments are subjected to screening in order to determine the suitable degree and category of environmental assessment. The screening and categorization of subprojects is carried out at the initial stage of the project preparation.

149 According to the ADB's SPS 2009 projects are classified as follows:

- **Category A:** A project is classified under this category if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An Environmental Impact Assessment (EIA) is required to address significant impacts.
- **Category B:** A project is classified under this category if its potential to cause adverse environmental impacts are less adverse than those of Category A project. These impacts are site specific, few if any of them are irreversible and in most cases mitigation measures can be designed more readily than for Category A projects. An initial environmental examination (IEE) is required.
- **Category C:** A project classified under this category if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.
- **Category FI:** Projects are classified as category FI if they involve a credit line through a financial intermediary or an equity investment in a financial intermediary. The financial intermediary must apply an environmental management system, unless all subprojects will result in insignificant impacts.

150 The assessment (in this case the IEE) of a Category B projects is reviewed by ADB as well as by the executing agency and then cleared by the regulatory agency for environment, which in this case is MECM. MID will officially submit the IEE to ADB for disclosure on the website.

6.14 Recommended Categorization of the Project

151 ADB financed projects also must be implemented in line with the Project Administration Manual (PAM) and comply with the Specific Assurances of Loan and Project Agreements/Covenants. For this project, because it is an emergency project, there is a specific assurance which excludes any subproject that would be categorized as Category B for environment (or social safeguards).

152 ADB's system of environmental categorization is determined according to the likelihood and magnitude of risk associated with a project when it is implemented without mitigation. The overall risks associated with TSFRP sub projects are considered low because the project is confined to causeway/bridge rehabilitation within the existing road network with surrounding areas already impacted by

peri-urban uses, farming, and logging.

153 This Project will rehabilitate the sections of the road and bridges damaged in the bad weather event. The rehabilitation works envisaged for the Project are limited to rebuilding the formation, repairing bridges and culverts, improving drainage systems to ensure pavement performance, and some river training works to reduce flooding. Other streams and rivers along the Project roads will be crossed by either culverts or small bridges. All of these project components can be expected to lead to a range of potentially adverse, but not significant, environmental impacts if implemented without mitigation.

154 It is the most heavily trafficked roads in the country. It does not traverse any primary forests, protected, ecologically sensitive or densely populated areas and will not create any conflicts in resource use or development. No resettlement will be required for the project. The recommendation is that this Project should have an environmental categorization of Category B and does not require a full EIA.

6.15 Environment Policy

155 The MECDM launched the Climate Change Policy on behalf of the Solomon Islands Government. The Policy highlighted steps government would take in helping the country and its citizens to exist and adapt to present imminent climate change and its impacts. The integration of climate considerations within the framework of the national policies and guiding the government and its partners aimed to ensure that the people, natural environment and economy of the country are resilient and able to adapt to the predicted impacts of the climate change. The National Environment Management Strategy (NEMS), 1993 is the primary document for the environment policy in the country. It is outdated; however it is an important document at present time in the absence of an environment policy.

156 The Solomon Islands Environment Act 1998 establishes an integrated system development control, environmental Impact Assessment and pollution control (ECD, 2010). It complies with regional and international conventions and obligations relating to the environment.

7 DESCRIPTION OF THE PROPOSED DEVELOPMENT

157 This section describes the development and provides the concept designs of the development including materials and the type of machines that will be used during construction. The Plans and Drawings of the proposed works are attached as Appendix 2.

7.1 Subprojects

7.1.1 SP01 – Selwyn (Veranaso) Causeway

158 This is a 12-cell causeway constructed in 2012 under the Solomon Islands Road Improvement Sector Project (SIRIP) located 150 m from the sea and 52.6km from Honiara and crosses the Konjuku River. It is 1,000 mm high, 26.6 m long with 4 m long approaches. There is extensive scouring at downstream and upstream side of the western approach which is a result of the April 2014 floods that completely washed away the approach. It is proposed that the existing structure be removed and a new single span bridge be constructed downstream at the location of the old ford. As considered, placing the new bridge away from the existing structure would improve the road alignment and allow for traffic use of the causeway during construction.

Figure 32. SP01 – Selwyn (Veranaso) Causeway

159 Construction machines include excavators, pile driver, concrete mixer and tipper trucks including some manual labour. Oil spillage, grease, diesel and other petroleum products associated with the operation of powered mechanical equipment including sedimentation and siltation are expected at the SP site, however it is considered to be minor and temporary during the construction.

160 The outcome will be a new single span 32 m long bridge with raised approaches and revetments on the upstream side. This will increase conveyance capacity, reduce debris piling during floods and is climate proofed. A concept design of the layout plan is shown in Appendix 2: Option Assessment.

7.1.2 SP02 – Tambea Culvert

161 The site is located on the North West Guadalcanal Road about 46.7 km from Honiara. Due to limited flood conveyance capacity of the existing bridge, the adjacent low-lying land to the west is frequently flooded. An existing 900 mm diameter reinforced concrete piped culvert (RCPC) to the west of the bridge was previously installed to mitigate the impacts of this residual flooding but during the April 2014 floods is became completely buried by silt. During the course of this project's investigations, it has since been determined that the existing culvert serves little useful purpose, primarily because there is no defined channel for it to adequately pass flood waters.

Figure 33. SP02 - Tambea Market Culvert

162 The proposed improvement includes removal of the existing RCBC and construction of a new engineered ford (or causeway) as shown in Appendix 2: Option Assessment. This will reduce flood damage to the road, improve the current road condition and be of low maintenance cost. The market place will either be relocated to a new location or reinstated after construction to its existing location. Both market relocation options are confirmed to be acceptable to the local community.

163 During construction manual labour will be required along with machinery including excavator, grader, compactor, concrete mixer and a tipper truck. Traffic will be interrupted during construction as works will concentrate mainly on the carriageway. The market place will also be temporarily relocated during construction. A work area of approximately 200 m^2 will be required.

7.1.3 SP03 – Sasa Low Level Bridge

164 Sasa Low Level Bridge which crosses the Sasa River is 50m long and 4.5m wide located at Chainage 30.9Km It is a five span continuous structure with 550mm deep reinforced concrete slab supported on 2 400mm diameter steel piers at every 10m interval.

165 Due to high debris build up at the structure in the April 2014 flash floods, the debris had blocked the waterway completely and the eastern approach was washed out. This was repaired by installation of gabions but is failing. The Sasa River is highly mobile and keeps on diverting during heavy flooding and unless the bridge is protected and maintained the waterway will be reduced due to sediment deposits resulting in vulnerable to frequent overtopping of the bridge making it unsuitable for use in the future.

Figure 34. SP03 - Upstream of Sasa Low Level Bridge

166 The proposed improvement works based on the site condition and hydrology of the area is river training works with specific maintenance. This is due to studies showing that the river will slowly divert to the high level bridge west of the low level bridge due to narrow waterway to the bridge. Also changing river bed level due to high debris the river may cease to follow the channel to the low level bridge.

167 During construction manual labour will be required with minimum machinery involving in the transportation of materials to and from site and for reshaping to suitable slope for installation of the gabions. Machinery will include a tipper truck and an excavator for the activities. Traffic will be interrupted during construction by slowing down when approaching the work site but will be controlled to allow for continuous flow of traffic. A work area of less than 200m^2 will be required to store materials, refer to Appendix 2: Option Assessment for a concept design of the works.

7.1.4 SP04 – Aruligo Causeway

168 The Aruligo Causeway is a 6-cell causeway structure which crosses the Toha River. It is approximately 13.4 m long and located 29.3Km from Honiara on the North West Guadalcanal Road. It was constructed under SIRIP in 2012 but its approaches were washed away during the April 2014 floods due to high debris piles which blocked the waterway and caused the water to divert to the one of the approaches, resulting in washing it away.

Figure 35. SP04 - Western Approach of Aruligo Causeway

169 It is proposed that the existing structure will be retained with river training works implemented along the western bank. River bed protection will also be installed on the downstream side of the structure. An undermined area under the structure base slab will also be grouted and appropriate cutoff walls will be constructed to reduce future damage to the structure. Construction works will involve manual labour and machinery for excavation, loading of materials and aggregates to site. This is proposed to have less impact on traffic as works will be mostly concentrated on bank protection, with less time spent on the structure itself.

170 The outcome will be river training on the western bank designed for a 1 in 25 year flood event, bed protection at the western bank and repaired undermined area of the structure base slab, a concept design of the works is in Appendix 2: Option Assessment.

7.1.5 SP05 – CBSI Culvert

171 The CBSI culvert is a single cell culvert with reinforced concrete box culvert and two 600 mm diameter reinforced concrete pipe culverts. The structure is located 26.4Km west of Honiara across Kaha'a stream and is approximately 150 m from the sea. A sinkhole formed above the pipe culverts during the April 2014 floods and had caused the road shoulder to wash out. It was planned that the existing box culvert will be retained but pipe culverts will be replaced with three new box culverts including installation of headwalls and bed protection and raising the approach roads.

Figure 36. SP05 – CBSI Culvert Photo (eastward)

172 During construction, manual labour inputs will be needed as well as construction machines such as concrete mixer, tipper truck for loading of materials including aggregates to site, and an excavator. Traffic will also be affected, thus a detour will be constructed on the downstream side of the existing structure. The outcome will be a new 11 m wide portal bridge that will be for one-in-50-year flood capacity and will have a low maintenance cost. A concept design of the layout plan is shown in Appendix 2: Option Assessment.

7.1.6 SP06 – Tomba Low Level Bridge

173 The Tomba Bridge is a three-span low level bridge which crosses the Tomba River. It is situated 23.6km west of Honiara. It has a 350 mm deep reinforced concrete slab supported on two 400 mm diameter steel piers at every 7 m. It is 21 m long and 4.2 m wide. High debris buildup at the bridge completely blocked the waterway and caused the washing away of both approaches. This was repaired by the installation of gabions after the flood. As planned, the existing structure will be retained with batter protection installed for both approaches by installing sheet piles. Sheet piling provides a flood resilient abutment and batter protection.

Figure 37. SP06 - Tomba Low Level Bridge (Eastward)

174 Works will include the use of manual labour, a crane, and excavator and tipper truck for loading materials to site. Traffic will be affected but a detour will be constructed downstream of the works area during construction. The outcome will be an improved batter protection which is better climate proofed, will ease repair works in the event of future wash outs and will have a low maintenance cost. Shown in Appendix 2: Option Assessment is a layout plan from the concept design for the works.

7.1.7 SP07 – Belamatanga Bridge

175 The Belamatanga Bridge is a two-span structure located 19.9Km west of Honiara which crosses the Mavo River. The bridge is made of composite steel girders and reinforced concrete deck. During the April 2014 floods the western approach gabion protection which was constructed in 2012 under SIRIP was damaged and caused scouring under the pile cap on both the downstream and upstream side of the western approach. Hence, the plan is to retain the existing structure and protection works will be carried out for both approaches. Also spur dykes and groins will be installed at the western bank to direct water flow away from the bank while the eastern approach slab will be protected and rocks placed around the pile caps to reduce scouring under it.

Figure 38. SP07 - Upstream of Belamatanga Bridge

176 Construction works will include manual labour, cranes, tipper trucks and excavators. Traffic will not be impacted as the structure will be retained and works will be focused on protection of the banks and embankments. The outcome will be improved bank and embankment protection that is climate proofed as in the concept design for the works shown in Appendix 2: Option Assessment.

7.1.8 SP08 – Belamatanga Culvert 1

177 This culvert is located 18.3 km west of Honiara at Onda Creek. It is 1.2 m in diameter and constitutes corrugated steel pipes. Fill around the head walls was scoured during the April 2014 flash floods. Planned work includes removal of the existing structure and construction of a new 4 m portal bridge at the existing location.

Figure 39. SP08 - Belamatanga Culvert 1 (SouthWard)

178 Works will involve machines such as a concrete mixer, excavator, and tipper truck for aggregate material transportation and minimal manual labour support.

179 The outcome will be a new 4 m wide portal bridge with raised approach roads that has a one-in-50-year flood capacity, is better climate proofed and will be of low maintenance cost. A typical cross section of this structure is shown in Appendix 2: Option Assessment.

7.1.9 SP09 – Belamatanga Culvert 2

180 The Belamatanga Culvert 2 is located 18.2 km west of Honiara on Onda Creek. The culvert consists of two 600 mm diameter reinforced concrete pipe culverts and 150 m from the sea. There are some signs of damage to the headwalls and the pipe including minor scouring to the road edge. Proposed works include removal of the existing pipe culvert and constructing a 3 m wide box culvert at the existing location.

Figure 40. SP09 - Belamatanga Culvert 2 (Northward)

181 Construction works will involve the use of a concrete mixer, an excavator and a few manual labourers. This will have an impact on the traffic but a detour will be constructed downstream location and rehabilitated when the culvert is completed. The outcome will be a new reinforced concrete box culvert 3 m wide and 1.5 m high that has a one-in-50 years flood capacity, better climate proofed and will have a low maintenance cost. The concept design for Belamatanga Culvert 2 is similar to that for Culvert 1 as shown in Appendix 2: Option Assessment, but with a 3 m wide portal span.

7.1.10 SP10 – Mbonege Bridge

182 The Mbonege Bridge crosses the Mbonege River 16.4 km west of Honiara. It is a two-span steel girder structure with reinforced concrete deck. The bridge is not damaged but the bank protection (gabion protection wall) to the eastern end has been eroded and scoured. This is mainly caused by road surface run-offs. It is proposed that the structure be retained and gabions protection installed at the eastern end as well as improving the road drainage system and removing the old pier.

Figure 41. SP10 - Upstream of Mbonege River (2016)

183 During construction, some machinery will be used, mainly tipper trucks, to load aggregate materials to site and an excavator with manual labour support for the gabion protection wall. The outcome will be an improved embankment protection which is climate proofed and is considered the best option for this location. Shown in Appendix 2: Option Assessment is the layout plan for the proposed works at Mbonege Bridge area.

7.1.11 SP11 – Turtle Beach Culvert

184 The culvert is located 13.7Km west of Honiara across Kao creek and approximately 80m from the sea. It was completely destroyed and washed away during the April 2014 floods and has caused damage to the sealed pavement. A new high reinforced concrete portal was proposed.

Figure 42. SP11 – Turtle Beach Culvert Photo

185 Construction works will include a concrete mixer, an excavator and manual labour. During construction traffic will not be disturbed as there are already detours constructed immediately after the flood in 2014.

186 The outcome will be a new 7 m wide and high reinforced concrete portal bridge design to one-in-100-year flood capacity, low maintenance and better climate proofed structure. A concept design of the layout plan is shown in Appendix 2: Option Assessment.

7.1.12 SP12 – Poha High Level Bridge

187 The Poha High Level Bridge (HLB) located 9.3Km west of Honiara was constructed in 2012 under SIRIP. The April 2014 floods have caused some extensive embankment and abutment failure due to scouring. The eastern abutment pile cap undergo extensive scour resulted in the collapse of the gabion wall protection and exposure of a 100 mm thick concrete slab at the top of batters on both approaches. It was proposed protection works be implemented for the eastern approach, while the western protection slab will be grouted to recover the support slab.

Figure 43. SP12 - Scoured Abutments of Poha High Level Bridge

188 Works will mainly be manual labour with support from an excavator and a tipper truck. Traffic will not be affected as the works will only be carried out under the structure and the structure will be retained. The outcome will be an improved abutment, embankment and bank protection that will improve flood structure. The layout plan for the works at Poha is shown in Appendix 2: Option Assessment.

7.1.15 SP13 – Tanavasa Bridge

189 The bridge is located 7.9km west of Honiara and crosses the Kohove River in the Kakabona Area. It is a single lane bridge which consists of steel girders composite with a reinforced concrete deck. Due to the meandering nature of the river, the western approach was eroded during the April 2014 floods.

Figure 44. SP13 - Woman washing dishes under Tanavasa Bridge

190 The plan is to retain the existing bridge and implement river training works at the western bank and approach. Construction works will involve a few machines but will mostly require manual labour for the river training works. Traffic disruption will be minimal as construction works will be concentrated on bank and road approach protection. The outcome will be river training works at the western bank and approach that is designed for a 1 in 50 year flood event. The layout plan in Appendix 2: Option Assessment is the concept design for the improvement of the structure.

7.1.14 SP14 – Tanaghai Arch Culvert

191 The culvert is located 5.4km west from Honiara and comprises of precast arch panels supported by two sill beams with a floor slab sustained by steel girders attached to the sill beams. A two-cell box culvert extension to the arch culvert was dislodged during the April 2014 floods. There is a utility pipe running alongside the culvert but was damaged after the flood.

Figure 45. SP14 – Tanaghai Arch Culvert Photo

192 Proposed works will include the removal of the old and existing arch culvert and replace it with the installation of a new RCBC. Construction works will involve manual labour and a few machines specifically an excavator, a crane, a concrete mixer and a tipper for loading aggregates to the site. The water will be diverted during the works.

193 The outcome will be a new 3 m wide x 1.7 m high RCBC that can with stand a one-in-100-year flood capacity and will improve flood capacity by reducing the backwater flooding.

7.1.5 SP20 – Mberande Bridge

194 The existing Mberande Bridge is a 10-span continuous reinforced concrete slab low level bridge more than 100m long located 43km from Honiara. The current structure includes a causeway running more than 20m connected to a low level bridge. The concrete deck of the bridge is supported by two circular tube piles at each substructure location.

Figure 46. SP20 – Mberande Bridge Photo (eastward)

195 Proposed works will include reconstructing a new three-span (30 m – 35 m – 30 m) high level bridge 5m downstream of the existing alignment. This new structure will be more resilient to climate change and debris impact and an appropriate sized flood relief structure would also be installed at the existing causeway location and would be designed for a 100-year flood event.

196 The works will cover an area of more than 4,000 m2 and traffic management system will be adopted so that there is minimal disruption to traffic and access roads will be provided to villages during the construction. The existing structure will be used during construction, but will be removed after the completion of the new bridge.

197 Construction works will involve approximately two excavators, dump or tipper trucks for transporting construction materials to the site, and a periodic use of a mobile crane, a pile driver, concrete mixer and a grader. Equipment including generator, construction materials and aggregates will be stored on site during construction. Most of the works will be machine based with up to approximately 20 manual labourers.

198 The outcome will be a new three-span HLB with raised approach roads and a flood relief structure installed at the existing causeway a few meters before the new bridge. This will increase conveyance capacity, reduce chances for debris piling up and causing flood by backwashing in to the surrounding areas, reduce maintenance costs and a better climate proofed structure. A concept design of the layout plan is shown in Appendix 2: Option Assessment.

7.1.6 SP21 – Kovelau Bridge

199 The Kovelau Bridge is located 39 km from Honiara on the North East Guadalcanal Road. It is a reinforced concrete portal structure on steel foundations approximately 7 m long. The western approach is always affected by major floods over the past years including the April 2014 flash floods. Proposed civil works will be to extend the western end by constructing a new single span portal bridge by another 7 m considering its performance during high flood events.

Figure 47. SP21 – Kovelau Bridge Photo

200 The proposed civil works require approximately 200m^2 of land area for storage and mobility of machines. As a result, there will be disruption to traffic during construction hence a detour next to the existing structure to allow continuous movement of vehicles to and from Honiara will be included as a temporary works item.

201 Construction works will include the use of approximately 5–10 manual labourers and machines such as a concrete mixer, an excavator, a pile driver, and frequent loading and unloading of other materials that will be used on site.

202 The end result will be the extension of the western end of the bridge by a 7 m single span portal bridge that will increase flood capacity, will have a low maintenance cost, and increased protection from road approach failure as before. A concept design of the layout plan is shown in Appendix 2: Option Assessment.

7.1.7 SP23 – Mbalasuna Bridge

203 The current low level structure is located 36 km from Honiara. It was constructed as a result of the 1986 Cyclone Namu damage to the high level bridge South (upstream). It is a continuous eight-span reinforced concrete slab low level bridge approximately 120 m long with a three-circular tube pile at each substructure location for support. Proposed works will include raising the road and construction of a new four-span (35 m – 40 m – 40 m – 35 m) bridge at the location of the old high level bridge.

Figure 48. SP23 – Mbalasuna Bridge Photo (eastward)

204 The construction works will cover an area of more than 4,000 m2 due to the realignment of the structure to the location of the old HLB and will involve the removal of more than 100 cocoa trees and four palm oil trees on the eastern approach and a vegetable garden, some timber trees and banana trees on the western end. The existing bridge will be used during construction of the new HLB and will be removed when the new HLB will be opened up to traffic.

205 Approximately 20 workers are required including the use of machines such as excavators, a pile driver, concrete mixer, grader, tipper trucks and materials stock pile at the area.

206 The result will be a new three-span high level bridge with a flood relief structure installed under the western approach road, constructed on the old HLB location south (upstream) of the existing structure with raised approaches. The bridge would be more resilient to climate change and debris impact and is designed for a 100-year flood event. It will increase conveyance capacity, and have a low maintenance cost. A concept design of the layout plan is shown in Appendix 2: Option Assessment.

7.1.8 SP24 – Ngalimbiu Bridge

207 This is a three-span composite structure which consists of steel girders and reinforced concrete decking located 24km east of Honiara. The eastern bank of the river was extensively scoured during the April 2014 floods due to debris piling at the eastern pier which also caused damage to the abutments.

Figure 49. SP24 – Ngalimbiu Bridge Photo (westward)

208 The proposed works will include retaining of the existing structure, installation of gabion protection and improvement of road drainage system out flows. Construction works will be mostly labour intensive for gabion installation and machines such as tipper trucks for aggregate loading to the site, excavator and grader with a portable concrete mixer.

209 The end result will be a retained abutment and bank protection with gabions including improved drainage system and outlets with improved flood proofed structure as shown in Appendix 2: Option Assessment.

7.2 Clearing and Grubbing

210 Clearing and grubbing are required for Veranaso, Aruligo, Tanavasa, Tanaghai, Gold Ridge, Mbalasuna and Mberande to bring the approach roads to acceptable standards. Clearing will be minor for all sites as the areas have already been cleared in the past. Except for Mberande as it has not been by people but by the river. Before commencement of works, the contractor shall determine who the customary owners are and explain the intended actions, clearly delineating which areas are to be cleared and grubbed and which trees will be removed, and seek agreement to the work.

211 All materials and debris resulting from the clearing will be disposed of by burning unless otherwise directed by the Engineer. Materials and debris which cannot be burned, may be buried outside of embankment and structural backfill areas, or disposed of outside the right - of – way and limits of view from the project approved by landowning units and MID Engineers.

7.3 Scour Protection and River Training Works

7.3.1 Scour Protection (Bank and Embankment Protection)

212 The depths of scouring at structures are estimated to be from up to 2- 3m. There is an urgent need to repair and strengthen these scour protection works with additional measures. Installment of protection for will be at both upstream and downstream faces of abutments and approaches. Side slope of the protection works should be at least 1:2 to 1:4 to prevent collapse caused by high flow velocities and debris.

213 There will be scour and erosion protection works using gabion and rip-rap, will be required for upstream of channels and side slopes of proposed channels. This will be done at four subproject sites, that is at: Ngalimbiu Bridge, Poha Bridge; Mbonege Bridge and Belamatanga Bridge.

7.3.2 River Training Works

214 Nearly all rivers running in the area of the project undergo erosion and scouring in flood plains so there are serious river training proposed for five locations namely; Sasa Low Level bridge; Tanavasa Bridge; Tomba Bridge; Aruligo Causeway and Ngalimbiu Bridge.

215 River training works are also required to re-align the river reach further upstream and downstream of the bridge in order to avoid more severe erosion and switching of the channel.

216 The rivers crossed by the Selwyn Bridge have sharp bends upstream of the sites. At these locations it is proposed to re-align the channel by dredging new and straighter channels.

217 The flows under the bridge will become super- critical and additional scour protection will be required for the bridge abutments and riverbed under the bridge using gabion mattresses and concrete facing. The river banks upstream and downstream of the bridge also require additional bank protection using gabion or reno mattresses or a bio-engineering alternative.

7.4 Filling, Shaping and Compaction of Approach Roads

218 The construction of the approach roads will require backfilling, shaping and compaction. Safety consideration approaching the bridges and climate change adaptive measures were integrated in the road approach and bridge designs. Communities will be consulted for additional land requirements at the bridge approach due to widening of Road and a MoA will be signed between the land owners and MID through the MLHS.

7.5 Piling Works

219 Piling works will be carried out at sites for new bridge construction. The works will comprise the supply, delivery, storing, handling, pitching, driving, splicing, testing, withdrawing, trimming and preparing of the piles, welding of toe reinforcement of shoes and shear rings, protective coating and all other ancillary operations necessary for the satisfactory completion of the work. Depending on the Engineer's approval, piling should go down 20 – 30m deep. There is no need for coffer dams as all works will be on a dry river bed. Engineers will be informed in advance if a coffer dam is required.

7.6 Concrete Works

220 Concrete works will be required for repair and reconstruction of all structure that is for abutments, encasement, decking, beams and wing walls will be reinforced concrete. Gravels and cement will be from approved source based on the engineering specification. Concrete samples will be submitted to engineers prior to concreting of any structure. Sand, coarse aggregate and water mixtures shall be at approved proportions. A crusher will be installed 30m from any river bank with proper drainages to avoid direct runoffs to the river.

7.7 Culverts

221 New culverts will be constructed to replace the existing Tanaghai Arch, Belamatanga Culvert 1, Belamatanga Culvert 2,CBSI and damaged Turtle Beach Culverts. The Contractor shall carry out all necessary excavation associated with the laying of the culverts including excavation for the specified foundation or bedding material and shall dispose of surplus material as directed by the Engineer. Included that existing culverts will be required to be removed and replaced with wider portals. The contractor shall carry out all necessary excavation associated with the removal of the culverts and reconstruction of the portals at the specified locations.

7.8 Fords

A new engineering ford will be constructed at Tambea to replace the existing reinforced concrete piped culvert. The Contractor shall carry out necessary excavation works associated with shaping the road laying of precast for the specified foundation or bedding material approved and as directed by the Engineer. That is an engineered ford to cater for the overflow from the adjacent streams and waterways. Surplus materials shall be disposed at appropriate locations directed by the Engineer. All necessary removal of the existing structure by excavation and reconstruction of an engineered ford at the specified location shall be undertaken by the Contractor.

7.8 Road Furniture

222 Road furniture such as guard rails and safety signs will be installed at designated sites approved by the MID Engineers. The Construction will consider installing signs showing bridge ahead, bends, speed limits and guardrails.

7.9 Gravel and Fill Materials

223 The repair and rehabilitation of the East and West Guadalcanal culverts, causeways and bridges will require significant amounts of coronous and river gravel materials for retaining structures and concrete production. Some sections of the road will also require fill to raise the carriageway above frequent inundation levels, to reduce the risk of flooding and road closures in the future.

224 There are known existing sources of coronous and river gravel materials that have been used by MID within the SP area. It is expected that river gravels be extracted from Sasa and Poha rivers on the western side and Lunga and Ngalimbiu rivers on the eastern side. While coronous material and other sites for river gravel will depend on the contractor's approach as additional sites may be needed and will be identified during the detailed design phase of the project. Resource owners will be consulted and an MoA will be signed between them and SIG, in this case MID through the MLHS.

225 The contractor shall be responsible in consultation with, and with the approval of the landowner or local community for locating and establishing all material sources and including all negotiations, arrangements, compensation, royalties and maintenance of the pit to the satisfaction of the Engineer. The contractor will submit details of the pit location, material test results and evidence that an MoA had been signed and in place to the Engineer for approval.

226 The contractor shall provide a material source assessment which shall include an investigation of geological site characteristics and source material properties. The extraction and production operations and plant capacity to process the material will also be provided.

227 The reconstruction works will require more aggregate and sand for new construction sites. There will be a crusher operating on site particularly at the contractor's camp site to crush river materials and segregate specified sizes needed for the works. The crushing location will be 30m away from any water bodies with proper drainage installed to avoid siltation into the surrounding environment.

228 The Contractor will identify sources of coronous and river gravel to be used for the subproject, and will prepare an extraction plan in accordance with the Aggregate Extraction Guidelines prepared for the project. The extraction plan will include a description of the existing environment, the volume of material to be extracted, identification of the impacts of the extraction as well as the means of mitigating adverse impacts. The extraction plan will be reviewed and approved by the MECM and CPIU. All proper environmental permits and clearances from MECM will be secured for this activity.

7.10 Other Materials

229 For most of the SP sites the road approaches to the bridges or culverts will be resealed after the completion of works such as CBSI, Turtle Beach and Tanaghai Arch Culverts. Including Mberande, Kovelau and Mbalasuna as they are on a current sealed road section while Selwyn (Veranaso) Bridge approaches will not be sealed but compacted. From this bitumen will be used for sealing and kerosene for priming of the road before sealing.

230 Bitumen is viscous a black mixture of hydrocarbons obtained naturally or as a residue from petroleum distillation. It is used for road surfacing and roofing. It is regarded as non – ecologically toxic product which presents no danger to the environment.

231 Other hydrocarbons are diesel fuel and petrol including engine oil that will be used by the contractor's Equipment during construction. Accidental leakages or spills might occur and these can be mitigated by adapting the mitigation measures identified in the EMP.

7.11 Construction Force and Equipment

232 This Project works will be part of an International Competitive Bidding (ICB) contract that will require construction workforces of plant drivers, skilled and unskilled labour, crews, concrete construction crews, managers and / or site supervisors, engineers and ancillary staff such as cooks and security guards.

233 For the recovery works subproject, a construction force of more than 60 – 100 people is likely to be required in total with approximately an average of 20 – 25 people per site. The construction workers would be based along different section for up to a year. Employment of residents of villages (skilled and unskilled workers) within the impact areas will be given the priority to minimize hiring of transient workers, and reduce social tension. Contract clauses to this effect will be included.

234 The equipment and plant to be used on the project includes; dump trucks, graders, bulldozers, tracked excavators, front end loaders, vibrating drum rollers, water-trucks and concrete mixers and other equipment as listed in Table 2. Workshops will be required for the maintenance of equipment and vehicles. Staging areas for temporary storage of materials and machinery will also be required at or near each of the crossing construction sites.

235 The main SP office, staging areas and camp site will likely be established at locations closer to SP sites at a location along either the North East or North West Road agreed upon by the local community and land owners or land owning group representatives.

Table 2. Equipment and Machinery to be used for Works

Materials and Equipment			
Item	**Description**	**Item**	**Description**
1	Wheel Loader, 1.8cu.m bucket capacity, 160hp	12	Concrete mixer with weigh batcher, 6 – 7 bags
2	Motor Grader, 160hp	13	Concrete Vibrator, 25 – 40mm, petrol driven
3	Vibrating Roller Single Smooth Drum, 10t, 150hp	14	Concrete Vibrator, 50 – 60mm, petrol driven
4	Mobile Crane, 10t	15	Water Pump, 100mm
5	Tipper truck, 10cu.m, bucket capacity	16	Low bed trailer and truck, 45t capacity
6	Water and truck with Pump, 4500 litres Spray Bucket	17	Bar bender
7	Stone Crusher with vibrating screens, 60t/hr	18	Bar cutter
8	Backhoe excavator with concrete breaker, 100hp	19	Piling Equipment
9	Dump Truck, 6 – 7 cu.m, bucket capacity	20	Welding set, electric, 300 – 400amp
10	Portable Air Compressor, 250 cpm	21	Electricity Generating set, 500KW
11	Plate Compactor, vibrating, 15hp	22	Concrete Batching Plant, minimum 15m^3 / hr

7.12 Waste Materials Generated

236 Waste generated during pre – construction and construction will be debris, spoil and other soild wastes including plastics, cans and paper. Fuel and oil spillage or leakages are also expected to occur during works from machinery and vehicles operating. Waste will be managed as per the EMP.

8 LOCATION AND SCALE OF THE PRESCRIBED DEVELOPMENT

237 The following section provides maps and plans of appropriate scale to who the location of the proposed project, components and activities relative to the existing features and hazard maps of the SP sites. Project implications of the hazard maps are discussed in Section 11: Climate Change and Disaster Risk.

8.1 Proposed Project Activities

238 The table below presents the outline of the proposed activities or works that will be carried out at each site.

Table 3. Proposed Activities for each SP site

SP Sites	Chainage (km)	Proposed Works	Proposed Activities
SP01 Selwyn (Veranaso) Causeway	49.5	A new 32m long single span bridge	1. Site establishment including clearing and grubbing 2. Embankment work 3. Piling works 4. Concrete works on the substructure 5. Concrete works on the superstructure 6. Grading, backfilling and compacting of approach roads and bridge approaches 7. Demolition of existing structure 8. Demobilisation
SP02 – Tambea Mai Culvert	46.7	A 900mm diameter RCPC	1. Site establishment including clearing and grubbing 2. Construction of a temporary detour 3. Demolition of the existing structure 4. Excavation for shaping the ford area 5. Concrete or precast works on the ford 6. Grading, backfilling and compacting of approach roads and bridge approaches
SP03 – Sasa Low Le Bridge	30.9	A 50m long and 4.5m wide low level bridge	1. Site establishment including clearing and grubbing 2. Abutment, embankment and bank protection works 3. Rivertraining Works 4. Demobilisation
SP04 – Aruli Causeway	29.3km	A 6 cell causeway 13.4m long with 4m long approach slabs	1. Site establishment including clearing and grubbing 2. Bed protection works 3. Rivertraining Works 4. Demobilisation
SP05 CBSI Culvert	26.0	New 11m wide portal	1. Site establishment including clearing and grubbing (Minor) 2. Demolition of existing structure 3. Construction of a detour 4. Embankment work 5. Piling works 6. Concrete works on the substructure 7. Concrete works on the superstructure 8. Grading, backfilling, compacting and sealing of road approaches 9. Demobilisation
SP06 – Tomba Low Le Bridge	23.6km	A 21m long and 4.2m wide Low level bridge	1. Site establishment including clearing and grubbing 2. Batter protection 3. Rivertraining Works 4. Demobilisation
SP07 – Belamatai Bridge	19.9km	A 27m span bridge	1. Site establishment including clearing and grubbing 2. Bank and Embankment Protection Works 3. Demobilisation
SP08 – Belamatai Culvert 2	18.3km	A 600m diameter reinforced concrete pipe culvert	1. Site establishment including clearing and grubbing (Minor) 2. Demolition of existing structure 3. Construction of a detour 4. Bedding works 5. Concrete works on the 3m wide box culvert structure 6. Grading, backfilling, compacting and sealing of road approaches 7. Demobilisation
SP09 – Belamatai Culvert 1	18.2km	A 1.2m diameter correugated steel pipe culvert	1. Site establishment including clearing and grubbing (Minor) 2. Construction of a detour 3. Demolition of existing structure

			4. Construction works on the portal bridge 5. Grading, backfilling, compacting and sealing of road approaches Demobilisation
SP10 – Mbonege Bridg	16.4km	A 2 span high level bridge	1. Site establishment including clearing and grubbing 2. Abutment, embankment and bank protection works 3. Improvement of drainage system 4. Demobilisation
SP11 Turtle Beach Culvert	10.0	New 7m wide single span portal	1. Site establishment including clearing and grubbing (Minor) 2. Embankment work 3. Piling works 4. Concrete works on the substructure 5. Concrete works on the superstructure 6. Grading, backfilling, compacting and sealing of road approaches 7. Demobilisation
SP12 – Poha Bridge	13.7	A 2 span 30m long high level bridge	1. Site establishment including clearing and grubbing 2. Abutment, embankment and bank protection works 3. Improvement of drainage system 4. Demobilisation
SP13 – Tanavasa Brid	7.9	An 18m long single span steel girder bridge	1. Site establishment including clearing and grubbing 2. Rivertraining Works 3. Demobilisation
SP14 Tanaghai Arch Culvert	5.0	New 3m Wide x 1.7m High RCBC	1. Site establishment including clearing and grubbing (Minor) 2. Demolition of existing structure 3. Construction of a detour 4. Embankment work 5. Piling works 6. Concrete works on the substructure 7. Concrete works on the superstructure 8. Grading, backfilling, compacting and sealing of road approaches 9. Demobilisation
SP20 Mberande Bridge	43.0	New 30m – 35m – 30m span bridge	1. Site establishment including clearing and grubbing 2. Embankment work 3. Piling works 4. Concrete works on the substructure 5. Concrete works on the superstructure 6. Grading, backfilling and compacting of approach roads and bridge approaches 7. Demolition of existing structure 8. Demobilisation
SP21 Kovelau Bridge	39.0	New 7m wide Portal extension	1. Site establishment including clearing and grubbing (Minor) 2. Construction of a detour 3. Embankment work 4. Piling works 5. Concrete works on the substructure 6. Concrete works on the superstructure 7. Grading, backfilling, compacting and sealing of road approaches 8. Demobilisation
SP22 Mbalasuna Bridge	36.0	New 30m – 35m – 30m span bridge	1. Site establishment including clearing and grubbing 2. Embankment work 3. Piling works 4. Concrete works on the substructure 5. Concrete works on the superstructure 6. Grading, backfilling and compacting of approach roads and bridge approaches 7. Demolition of existing structure 8. Demobilisation
SP24 Ngalimbiu Bridge	24.0	Improved abutment and bank protection	1. Site establishment including clearing and grubbing 2. Abutment, embankment and bank protection works 3. Demobilisation

8.2 Aggregate Required for the Works

239 During the works the contractor will be requiring aggregates for the following civil works:

- Base course
- Subbase
- Engineered fill (embankments)
- Surfacing or sealing
- Surfacing
- Concrete or precast
- Reinforcing
- Rock rip rap
- River training
- other protection works

8.3 Hazard Maps

240 This section provides the some of the natural hazard maps and all photographic image showing the current conditions of the subproject sites for the Project in general, but project implications of the maps are discussed in detail under Section 11. Refer to Figures 50 and 51 and Annex 8.

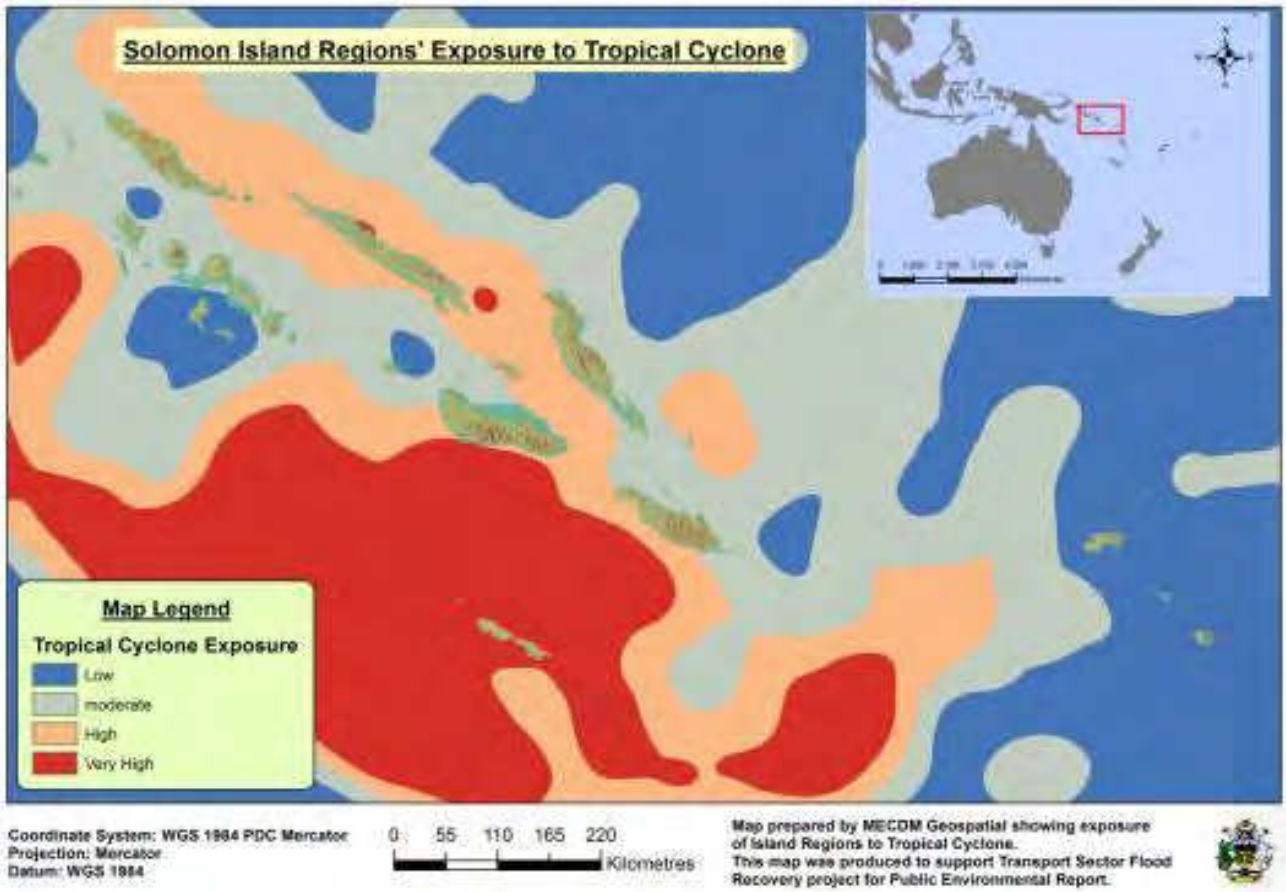


Figure 50. Tropical Cyclone Exposure Map (Solomon Islands)

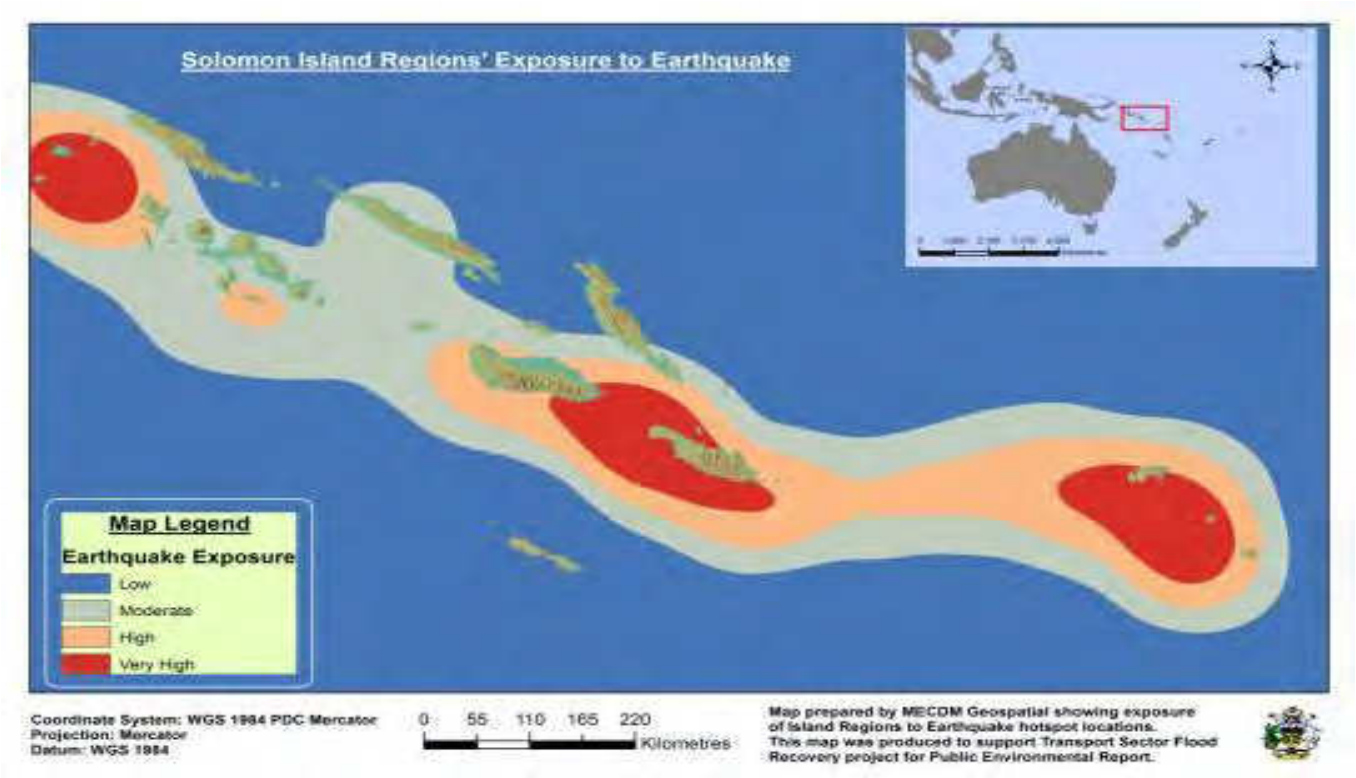


Figure 51. Earthquake Exposure Map (Solomon Islands)

9 DESCRIPTION OF THE EXISTING ENVIRONMENT

241 Guadalcanal is the largest island and occupies a central position in the country at 9°25'S, 159°58'E. It is 160 km long and 45 km wide at the center. The island is of a northwest to southeast trend with a mountainous spine parallel and close to the southern coast. The interior has sheer and ragged peaks including Mt Makarakomburu (2,447 m) and Mt Popomanaseu (2,330 m), the nation's tallest peaks.

242 Guadalcanal has a land area of 5336 km2, amounting to 19% of the country's total land area. It has a population of about 60,275 people, or 14.7% of the country's total population. The population density, 11 persons per km2, is below the national average of 14 persons per km2. Coconut plantations cover 2.1% of the land; they represent over 21% of the total land covered with coconut in Solomon Islands. About 10% of the land in Guadalcanal Province is registered. The province is heavily reliant on the national government for recurrent and development funding.

243 The indigenous people of Guadalcanal are Melanesians who speak 14 different Austronesian dialects. There are two main groups, the Guadalcanal language speaking such as Ghari, Mbirao and Tolo, and Malaita speaking language such as Marau (Are - Are speakers who migrated from Malaita) and Longu.

9.1 Physical Environment

9.1.1 Climate

244 The weather and climate of the Solomon Islands can be explained mainly by the seasonal movement and development of the equatorial trough. From between January to March the trough usually lies close to the south of the country resulting in North Westerly monsoonal winds with heaviest rainfall in most places, having an annual average rain fall between 3000mm to 5000 mm. While the wettest period of the year is between the months of August to November with an average daily fall of 190mm to 330mm. Also the southern sides of the larger islands tend to have a rainfall maximum between June and September. Extreme rainfall usually occurs between the transition months of December and April when the equatorial trough is migrating across the islands. But when the equatorial trough moves to the Northern Hemisphere from May to October the islands are exposed to the South Easterly Trade Winds.

245 Air temperature has very little variation due to the islands proximity to the equator. The temperature is relatively uniform ranging from 220C to 310C throughout the year with an average maximum of 310C and an overall average temperature of 280C in lowland areas and can go even lower as 100C up in the higher mountains of central Guadalcanal during morning hours. While inland temperatures are higher than coastal temperatures, temperature also decreases with altitude. Relative humidity shows slight periodic discrepancy but has marked diurnal variation. Humidity is highest in the morning and frequently reaches 90%.

246 The climate of Guadalcanal is tropical and equatorial tempered by maritime influences. There are two seasons; a north-west monsoon from November to March and a south-east trade wind period between April and October. Temperatures do not vary much through the year, with daytime temperatures ranging from 26 °C to 31 °C, night-time temperatures can drop to 17 °C. Rainfall data indicates that the wettest months tend to be August to November, but all months are wet, averaging between 190 and 330 mm, with July as the wettest month (300 – 400 mm) and November the driest month (200 – 250 mm).

Table 4. Average Temperature of Guadalcanal Province from 2012 - 2013

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Annual
Average Max Temperature °C (°F)	30 (86)	30 (86)	31 (88)	31 (88)	31 (88)	31 (88)	31 (88)	31 (88)	30 (86)	31 (88)	31 (88)	30 (86)	31 (87)
Average Temperature °C (°F)	26 (79)	26 (79)	26 (79)	27 (81)	27 (81)	27 (81)	27 (81)	27 (81)	26 (79)	27 (81)	27 (81)	26 (79)	27 (80)
Average Min Temperature °C (°F)	22 (72)	22 (72)	22 (72)	23 (73)	23 (73)	23 (73)	23 (73)	23 (73)	23 (73)	23 (73)	23 (73)	23 (73)	23 (73)

Source: ClimaTemps.com, 2013 (http://www.solomon.climatemps.com/graph.php)

Table 5. Rainfall in Guadalcanal between 2012 and 2013

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Annual
Average Precipitation mm (in)	100 (3.9)	92 (3.6)	95 (3.7)	154 (6.1)	141 (5.6)	217 (8.5)	277 (10.9)	287 (11.3)	362 (14.3)	214 (8.4)	141 (5.6)	97 (3.8)	2177 (85.7)
Number of Wet Days (probability of rain on a day)	15 (48%)	13 (42%)	13 (43%)	16 (52%)	15 (50%)	18 (58%)	19 (61%)	19 (67%)	23 (74%)	18 (60%)	15 (48%)	13 (43%)	197 (54%)

Source: ClimaTemps.com, 2013 (http://www.solomon.climatemps.com/graph.php)

247 As other countries in the Pacific, the Solomon Islands are exposed to climate variation. The National Adaptation Program of Action (NAPA) shows that surface air temperatures for Auki from 1962 to 2007 and Henderson Field from 1975 to 2006 have increased by about 10C during these periods. Accordingly, adopting the Intergovernmental Panel on Climate Change (IPCC) global assessment, the following changes are expected:

- Global temperatures may rise between 1.10C and 6.40C during the 21st century with the best estimate for temperatures to rise by between 1.80C and 40C;
- Sea levels will rise by 18 cm to 59 cm by 2100 mostly from thermal expansion of the oceans;
- There is a greater than 66% confidence level that there will be more frequent warm spells, heat waves and heavy rainfall; and,
- There is a greater than 66% confidence level that there will be an increase in droughts, tropical cyclones, extreme high tides and storm surges.

248 The effect of this will be increase adaptation costs of engineering structures to climate change.

9.1.2 Air Quality

249 In Solomon Islands the air quality is very good as there are very few industries and a relatively small number of vehicle generating emissions. There are no air quality or emissions standards in Solomon Islands and no monitoring is undertaken. Apart from localized areas of smoke from burning gardening areas, solid household wastes and village cooking fires, air quality is very good.

250 Included, that there are no standard recordings for the measurement for water quality, soil and coastal erosion in the Solomon Islands. During the project construction these measurements will be done on site through regular observations and air quality emissions will conform to machinery design standards. Any on site random water quality assessments should adhere to the ANZECC Guidelines.

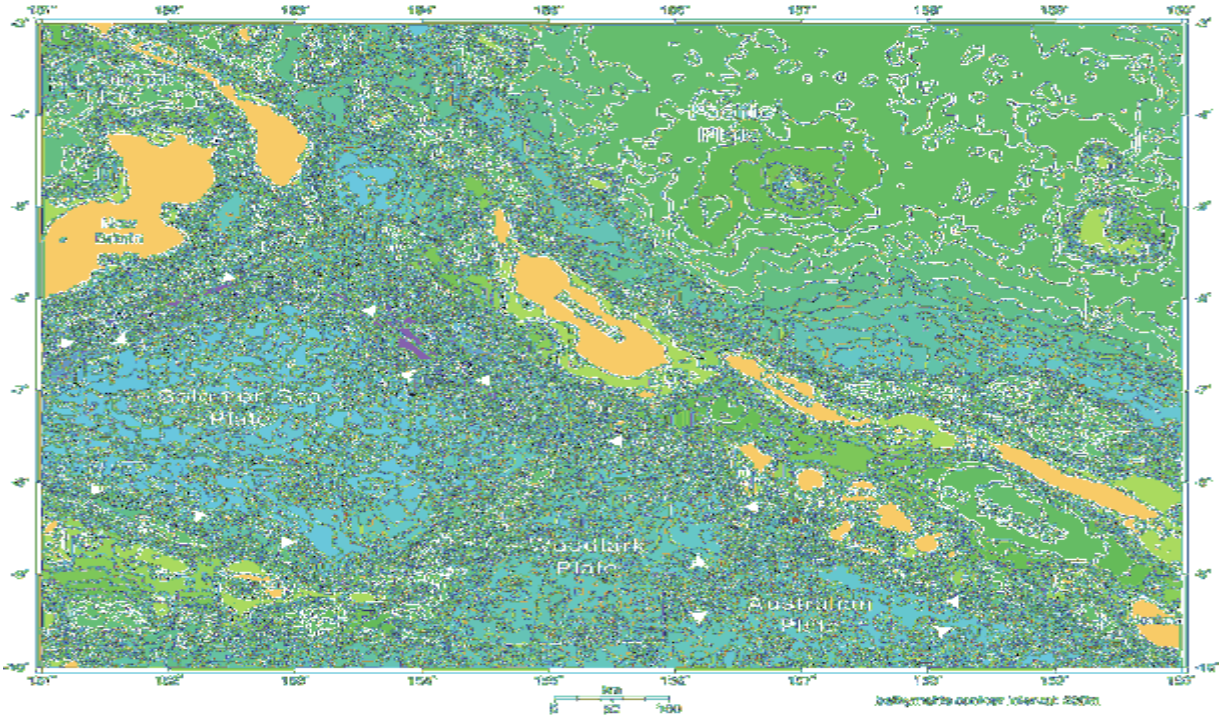
9.1.3 Geology

251 The eastern outer islands of the Solomon Islands are located close to the northern end of Vanuatu, and the western islands are located close to Papua New Guinea. There are 990 islands in total covering a land area of around 28,000 square kilometers. The six main islands are Choiseul, New Georgia, Santa Isabel, Guadalcanal, Malaita, and Makira (Figure 1). These islands are intersected by deep and narrow valleys and are mostly covered with tropical rainforest (Whitmore 1969).

252 Uplifting of plates and irregular volcanic and seismic activity resulted in the formation of the archipelago. Geographically the islands lies along an area of high seismic activity, the Pacific Ring of Fire, which lies between the Pacific and Australian tectonic plates colliding at a highly oblique angle. Geologically the islands are relatively young, and the larger islands are almost entirely volcanic in origin and consist of lava and basalt and surrounded by uplifted coral terraces. Recent volcanic activity has occurred on the western tip of Guadalcanal and the only recorded active volcano in the country is Tinakula in the Santa Cruz Islands.

253 In comparison to Papua New Guinea and New Caledonia, the Solomon Islands is considered geologically "young" (Clarke and Thaman 1993). Based on the islands' geology, Falvey et al,(1991) divided Solomon Islands into three major geological provinces (Pacific, Central and Volcanic) and two minor provinces (Oceanic Volcanic and Oceanic Atoll). The islands of Malaita, Ulawa and northeast Santa Isabel are grouped into the Pacific Provinces, whereas Makira, Guadalcanal, the Florida islands, the southeast Santa Isabel and Choiseul belong to the Central Province. The Volcanic Province consists of the New Georgia group, the Russell islands, the Shortland, northwest Guadalcanal and Savo. The Temotu islands are grouped in the Volcanic Province, while Rennell, Bellona and Ontong Java islands are within the Oceanic Atoll Province.

254 The Solomon Island Subduction Zone are formed by the boundaries of the Pacific, Australian and Woodwark plates. The uplift of plates along the intermittent volcanic and seismic activity has contributed to the island masses which now form the Solomon Islands. The larger islands are dim are almost volcanic in origin and consists of basalt surrounded by uplift coral terraces.



Source: http://walrus.wr.usgs.gov/tsunami/solomon07/images/tectonic_big.gif

Figure 52. Tectonic Plates Map (Solomon Islands)

255 Guadalcanal lies within the NW-SE trending island arc chain. According to Coleman's geological subdivision of islands, Guadalcanal is categorized as part of Central province. The islands of central province are categorized by intensely faulted cores of pre – Miocene basic lavas, in part regionally metamorphosed to low grade overlain by sedimentary succession. The pattern of Marau apilaogoe is due to recent subsidence, the major channels between the islands represent former drowned valleys. The geology of the low land consists of alluvial deposits of gravel, sand and silt dated back to Cenozoic period.

256 The Guadalcanal Plains on the North Coast of Guadalcanal is an area of indication, of the uplifting and tilting of the island undergoing under plating millions of years ago by the presence of reefall limestones, marls and volcanoclastic sandstones. It is one of the largest alluvial plains in the South Western Pacific Region next to PNG and possibly the most fertile land in the country.

257 The plain was produced from eight (8) coalescing river deltas (Lungga, Tenaru, Ngalimbiu, Matepono, Mbalasuna, Mberande, Mbokokimbo and Nggurambusu rivers) which had built sediment pile of 290km in area and up to 50m thick on a subsiding former delta plain since the mid Holocene. The geology of Guadalcanal is made up of alluvial, fluvial and volcanic deposits from the Pleistocene to Holocene period ranging from clay to coarse materials including marls and volcanoclastic sand stones and limestone materials. There is not much formation of recent coral reefs as this is largely affected by the major rivers.

258 The Solomon Islands have several known mineral reserves of gold, bauxite, phosphate, lead, zinc and nickel. Prospecting of some mineral reserves such as nickel was done in Choiseul and Isabel Provinces. While a large scale Gold Mine (Gold Ridge Mines) in the country is in Guadalcanal Province East of Honiara which had been recently closed after the April 2014 floods.

259 The geology of Guadalcanal Province in the vicinity of the Project area is dominated by igneous rocks generated by volcanism during the Oligocene to Pleistocene periods (as shown in Table 9). These mostly comprise basaltic and andesitic lavas and ash deposits with the Tiaro tuff breccias and Gallego andestites the most common rocks along the Project roads. The area also has significant alluvial deposits along the coast and along the river valleys. For most of its length the Main Road passes over alluvial areas, intersecting with volcanic breccias, older rocks, including lime- stones and basic volcanic outcrop further to the west and are dated to the Oligocene to Pleistocene periods.

Table 6. Geological Succession in Vicinity of SP Roads

Age	Rock Types	Thickness (m)	Name
Recent	Coral Reef		
	Alluvial & littoral deposits	100	
Upper Miocene- Pliocene	Volcaniclastic wackes, Pyroclasts, lavas, lutite, limestones	400-600	Lungga Beds
	Lavas, pyroclasts, including some wackes, lutites and limestones; Vesicular augite basalt	1000	Gallego Volcanics & Tiaro Tuff Breccias
?	**Hornblende Microdiorite**	?	Vaturanga Microdiorite

Source: Geological Survey Division (1977)

9.1.4 Seismic Activities and Natural Hazards

260 Due to the islands geographical location, they are very prone to earthquakes, landslides and tsunamis and seismic activity resulting in the uplifting of lands and reefs. As occurred in the Western Province in 2007, an earthquake triggered a tsunami and resulted in the uplifting of some land and reef areas. Likewise, in the 1970's an earthquake affected the populations of Guadalcanal in the Weather Coast area resulted in three new relocation settlements at Aruligo North West of Guadalcanal; New Duidui, New Ghorabau and Vatuloki. The most recent earthquake which triggered a tsunami in Solomon Islands occurred in Temotu Province on 6th February 2013. This earthquake has a magnitude of 8 on the Richter scale which generated a sea level height of .9m – 1.0m.

261 The Solomon Islands is also prone to natural hazards including cyclones, landslides earthquakes and tsunamis. During the last 50 years the major cyclones which have occurred include; Annie (1967), Gisele (1968), Isa (1970), Ida (1972) cyclone Namu(1987) and cyclone Ita(2014) which resulted in many deaths and extensive damage to transport infrastructure. The area experiences constant seismic activity, due to the location of the Solomon Islands archipelago at the junction of two tectonic plates. Both provinces are vulnerable to coastal flooding, tsunamis, earthquakes, landslides and volcanic eruption. In terms of river flooding the provinces are considered to have medium vulnerability. In terms of cyclones, drought they are classified as having low vulnerability.

9.1.5 Topography and Soils

262 The island of Guadalcanal is mostly defined by a central rugged range with high peaks and deep valleys running from east to west directly along the lower southern section of the island whose locality guides most of the island's rivers to the north coast. It is made up of steeply dissected ridges and hill slopes, narrow valleys, shallow-angle coalescing fans and flood plains. The island has been divided into three physiographic regions, namely; Mountain zones, Intermediate or foothill zones and alluvial zones. The mountain zones occupy most of the southern half of the island and resemble patterns of very close dissection with deep, narrow ravines, steep slopes and razor back ridges. Intermediate zones comprise belt of dissected plateau running from the north-west corner of the island westward through the center to form a belt of foothills covered by tropical rainforest.

263 The highest peak on the island and in the country is Mt Popomanaseu standing at a height of 2.31km with the second highest, Mt Tanareirei standing at a height of 2.061km in the central range. Most of the main large rivers on the island mainly flow to the northern part of the island with only a few small ones flowing southward. The rivers on the north coast form the coastal plain which is now widely settled was formed from the materials carried from the ranges by the rivers that had settled and compacted over time.

264 The Solomon groups of islands have twenty-seven (27) soil groups exhibiting a series of fertility depending on the parent material and land use. The basaltic soils are generally rich in nitrogen, phosphorous and organic carbon, but poor in potassium. The most fertile and agriculturally important of all soils found in Solomon Islands are the recent alluvial soils on the northern Guadalcanal plains.

265 The Sediment range from low Miocene through to Holocene, including organic limestones, calcarenite, arenaceous and volcanoclastic material. Apart from the recent alluvial soils, older and more highly weathered soils occur on the hill areas. The alluvial deposits are deep, freely drained yellowish brown to red humus-rich medium to coarse textured soils with limited profile development and reasonable natural fertility. These soils are situated at low elevations in somewhat naturally poorly drained locations.

266 The hills comprise of soils that are older and have weathered to well-structured clays that have somewhat poorer internal drainage. These soils have inclusions of limestone within their profiles and may overlie weathered coralline rock materials. The soils have limited use and where they are retained is overgrown with tropical rainforest and extensive areas of grassland as can be seen in Honiara. Even though the land has limited agricultural use some areas are used for subsistence gardens.

9.1.6 Hydrology

267 Typically, the rivers on Guadalcanal descend to the coastal plain having a northeasterly trend and follow fault fracture lines in their upper sections which are typically steep and torrential. Once they reach the coastal plain, the rivers develop a meandering pattern and closer to the coast where channel bank height decreases the rivers can meander within braided channels with unanticipated damaging effects on road and bridge infrastructure. The major river deltas in Guadalcanal are found along the North East Guadalcanal Road, from which major infrastructure exists.

268 With adequate rainfall and a large infiltration area, considerable groundwater resources are available under the Guadalcanal alluvial plain. Groundwater levels are between 1m to 2m of the surface and during the wet season, the majority of the plain suffers from poor drainage. With groundwater being so close to the surface, groundwater is often used for drinking water either from wells or pumped from boreholes. The Solomon Islands Water Authority (SIWA) maintains several pumping stations on the coastal plain for meeting Honiara's water supply. Groundwater quality is good but being sourced from alluvium that also contains limestone materials which makes the water hard.

269 The river mouths are characterized by beach bar build up which most of the time limit the water flow making the river appear stagnant in some areas, while it is not the case at other locations where the river continuously flows to flash out sand bars. This can be broken through during heavy rains resulting in peak flows, but can be subsequently replaced by beach building processes during intervening periods.

270 Most of the rivers including Konjuku River where Selwyn (Veranaso) Causeway is located, Poha and Tanavasa rivers in north west Guadalcanal. Mberande, Mbalasuna and Ngalimbiu rivers in north east Guadalcanal are commonly used by people from tye surrounding villages for washing, swimming, bathing and even drinking and cooking from adjacent springs. Hence, these waters play a vital role in the lives of the people and a crucial part of their lives.

271 No water quality measurements are available for the SP sites but generally, the water is clean and clear. The rivers and streams are not usually used to dump non - biodegradable wastes and only debris from trees and other vegetation are normally seen in the water after minor flood periods. As the water bodies are commonly used by communities for daily livelihood and recreational activities as for most communities there are no proper water supply.

9.1.7 Coastal Waters

272 The Western Pacific is the center of marine biodiversity which Solomon Islands is part of the major marine and coastal ecosystems. Characterized by highly variable patchy ecosystems that include estuaries, lagoons, beaches, mangroves, coral reef areas, sea grass beds, algal beds and small islands.

273 Coral reefs are narrow, fringing, and intermittently distributed around the high islands, with barrier reefs and expansive inter-tidal reefs not common. The coral reefs are most often associated with either uplifted shores attached to volcanic coastlines or seaward elevated coral limestone beaches. Live corals and calcareous algae are mainly limited to seaward zones below dead reefs included that reef flats are lacking corals and most areas are covered with dead corals.

274 A total of 233 species of algae from the country was reported by Wonersley and Baily comprising of 14 Cyanophyta, 121 Rhodophyta, 27 Phaeophyta and 71 Chorophyta (MECM, 2008). The most common seaweed is Caulerpa racemosa, popular especially in the western province. Seaweed farming was reinforced in 2001 and is gaining momentum until production rose in 2002. Rapid Marine Assessment by TNC in 2004 reported a total of 485 coral species belonging to 76 genera (second highest diversity of coral in the world). Solomon Islands possess a diverse coral reef fish species with at least 82 families, 348 genera, and 1019 species (Green et al, 2004).

275 The island of Guadalcanal are surrounded with extensive coastlines and thereby a coastal zone characterized by different types of ecosystems. These typically are coral reefs, lagoons, mangroves, estuaries, beaches, sea grass beds, algae beds and small island ecosystems. In the Guadalcanal, Marau Sound on the eastern tip of Guadalcanal has the island's largest expanse of fringing reef.

276 Mangroves are abundant and are important components of the lagoon island systems that occur in many parts of Western province. There are 26 mangrove species belonging to 13 families and 15 genera currently known in the Solomon Islands which represent around 43% of the world's known mangrove species. Not much work has been carried out in terms of determining the number of species of sea grasses but around 10 species are currently known. Algae are common occurrences in the different types of coastal ecosystems. There are currently around 233 known species. Within the SP sites there are no known species of mangrove found as most of the sites in the east are inland and those in the west are located far enough, more than 2km from known areas consisting of mangroves.

277 Beaches in most of the islands in the Solomon Islands are made up of unconsolidated sediments such as sand, stones and coral rubbles. These are host to thriving ecosystems comprising of flora and fauna which are adapted to continuous change of the environment due to natural processes including constant motion of sand, gravel and tidal changes and local anthropogenic impacts and other man made processes. The SP site to the east of Honiara are located more than 3Km from the beach while those subprojects in the west are located about less than 500m from the beach.

278 The ecosystems comprises of common plants including common coastal vegetation, insects, birds, aquatic mammals and fish. While vegetation include morning glory (Ipomoea pescaprae); alite (Terminalia cattapa); sea poison tree (Barringtonia asiatica); coconut trees (Cocos nucifera) and other trees, shrubs and grasses. Associated fauna within the ecosystem include burrowing fauna species such as crabs, clams and other invertebrates.

279 Seagrasses grows completely underwater in estuarine and marine environments and commonly in waters less than 10m deep. These are found in environments ranging from the intertidal zone to subtidal zones; along mangrove coastlines, estuaries, shallow embayment as well as coral reef, inter reef and offshore islands situations. Meadows are monospecific and multispecies in one location with up to 6 species present in one location with 54% of all seagrass meadows found in Malaita Provinces and all other provinces has less than12% of the area.

280 Seagrass meadows on the intertidal flats found in Solomon Islands are a crucial part of the marine biodiversity and ecosystems as they provide for habitats; main diet for most marine fauna such as turtles especially green sea turtles (Cheloniamydas) and dugongs (Dugong dugon); breeding and nursey grounds for many other marine fish species; prawns; clams; molluscs and bech-de-mer which is commercially important. The seagrass beds tend to control water movement which makes it easier for suspended materials and sediments to settles slowly. Therefore, benefiting corals by reducing suspended sediments in the water and enhancing photosynthesis included that it makes easier for burrowing fauna species including fish to feed. Seagrasses are equally important in terms of ecosystem interaction with mangrove and coral reefs as they exert a stabilizing effect on the marine and coastal environment resulting in physical and biological support to interacting coastal fauna species communities. In relation to the project seagrass meadows are not common and exist in patches of less than 10m2 as most of the areas are exposed to manmade activities and the major water bodies.

9.1.8 Marine Waters

281 Solomon Islands have very little underwater shelf area as it rises steeply from the deep ocean floor and the islands are surrounded by fringing reefs and barrier reefs. Lagoons, estuaries and other inshore marine waters which are high in biodiversity. These consists of a diverse number of marine species and ecosystems as they supply important sources of nutrients and organic materials to offshore waters through the tidal circulation and hosts for feeding, breeding, nesting and nursery areas for various fish species. Fishing activities in lagoons and estuaries are a major sources of income for most people living along the coast of the islands. These ecosystems serve as sinks of terrestrial runoffs, trapping sediments including pollutants which may damage the fragile ecosystems offshore such as coral reefs.

9.2 Ecological Components

9.2.1 Wetlands

282 There are no wetlands within the sub – projects sites, but there are swampy areas located in the surrounding areas. These areas are a home to burrowing worms and other fauna such as land crabs and even snakes and crocodiles. These areas in the Solomon Islands are significant to some cultural groups as it can be farmed, like for some parts of the Guadalcanal and Malaita Province there are some varieties of staple food such as swamp taro which are specifically planted in such area. However, within the SP locations such areas are not used for any sort of activities and are covered with trees, shrubs and other plants.

9.2.2 Mangroves

283 Mangrove forests are vital coastal ecosystems situated at the boundary of the land and sea that support fisheries production, coastal protection, controls water quality and provide a nursery habitat for fish species and other marine life including birds. The ecosystem also acts as a buffer zone between land and sea and filters sediments, nutrients and other contaminants from land runoffs to the sea in order to maintain the quality of the coastal waters zone and enhance the healthy growth of coral reefs and seagrasses.

284 In the Solomon Islands a mangrove are found in most of the islands and is depended on by most of the people for sustenance. There are 29 confirmed species of mangroves found in the Solomon Islands which accounts for 45% of the worlds mangrove species, but the most common are Rhizophora and Bruguiera. Mangroves covered an area of 64,200ha in the Solomon Islands with the largest areas covered are found in Isabel, Rennell, Shortland, Malaita and New Georgia. Dense mangrove forests are found only at Marau Sound in east Guadalcanal. But, as found there are some mangrove patches along the north west Guadalcanal Road but they will not be affected by the development as they are not located within the SP sites. While to the east, the SP sites are located more than 3km away from the coast and mangrove ecosystems are not found with in the area.

285 According to the Solomon Islands Forest Resource and Timber Act, mangroves are protected species; hence it is required under the proposed development that no mangrove forest shall be cleared by the contractor.

9.2.3 Corals

286 The Pacific constitutes 49% of the worlds coral species and Solomon Islands has recently been recognized as part of the Coral Triangle survey has recorded 494 coral species which put the country as an integral part of the coral triangle. Solomon Islands In the reef and near-shore areas of the western end of the island some 11 common species of hard corals from four families were recorded in 2008. The dominant corals were massive Porites, with digitate Porites (e.g. P. rus) and Monitpora spp. In some areas, the Porites colonies reached a maximum size of up to 50cm. Soft corals and several species of urchins were also recorded.

287 Coral reefs are narrow, fringing, and intermittently distributed around the high islands, with barrier reefs and expansive inter-tidal reefs not common. The coral reefs are most often associated with either uplifted shores attached to volcanic coastlines or seaward elevated coral limestone beaches. Live corals and calcareous algae are mainly limited to seaward zones below dead reefs included that reef flats are lacking corals and most areas are covered with dead corals. Coral reefs provides a habitat for many reef fish species and crustaceans and a breeding and nursery ground. They also provide for protection of the coastal areas as they tend to slow down the velocity and strength of waves and the local population depended on it for income and food sources.

288 Within the SP sites area of interest there are coral reefs located along the coast of North West Guadalcanal existing less than 1km from the road and subproject sites. That is at Selwyn, (Veranaso) Causeway, Tambea Culvert, CBSI Culvert, Belamatanga Bridge and Culverts, Mbonege, Turtle Beach, Poha Bridge, Tanavasa Bridge and Tanaghai Arch Culvert. However, they are mostly dead coral reef flats due to increased sedimentation and siltation from land runoff and increased manmade activities along the coast and inland.

9.2.4 Fisheries

289 Solomon Islands has a highly diverse marine fauna which in 2004 a team led by The Nature Conservancy (TNC) recorded 1,019 fish species which makes Solomon Islands one of the big five (with Australia, Indonesia, Philippines and Papua New Guinea) in reef fish species. The same Marine fauna also include five species of lobsters (P. penicillatus, P.versicolor, P.femorristiga, Penulirus ornatus and the slipper lobster) sharks, three species of pearl oyster (Pinctada margaritifera, P.maxima, Pteria penquin), mangrove oyster, green snail (Turbo marmoratus) , trochus (Trochus niloticus), salt-water crocodile (Crocodilus porosus), coconut crabs (Birgus latro), mud crabs and land crabs, six species of clam (Tridacna crocea, Hippopus hippopus, Tridacna squamosa, Tridacna maxima, Tridacna derasa, and Tridacna gigas), prawns, five species of turtle (Chelonia mydas, Eretmochelys imbricata, Lepidochelys olivacea, Caretta caretta, and Dermochelys coriacea) and marine mammals including dugong (sea Dugon dugon), Dug, whales, porpoises and dolphins. Fish fauna was characterized by 24 common species of reef-associated fishes in nine families. Most individuals were small and flighty; suggesting that fishing pressure on these reef fishes is significant.

290 Freshwater fishes described thus far in the country number around 300 species. The potential aquatic fauna of the rivers in the SP areas covers reptiles, fishes, crustaceans and molluscs. There are more likely to be species of prawns, eels and fish such as flag tails and gudgeons.

291 The local population in Solomon Islands depends heavily on fisheries or marine resources for protein and income. People living along the SP sites especially along the North West Guadalcanal Road rely on fish and shell fish as a major food and income source. Whereas, those communities in the east are further away from the coast and rely on freshwater fish species such as the invasive tilapia. However, it is evident that there is pressure from overfishing, unselective fishing, human induced activities on the coastal environment and increasing population on the fisheries.

9.2.5 Protected Areas and Areas of Conservation Value

292 Legally, not much of the Solomon Islands is under any form of protection, as there is no national law or system for dealing with the establishment and management of protected areas, and a lack of awareness in the rural communities who control most of the land and resources in the country. However, in the last few years, efforts to develop protected areas have increased. The following sites have been under legal protection for a long time: Queen Elizabeth Park (Mt Austen near Honiara) – now mostly degraded, various bird sanctuaries throughout the country, the Kolombangara Ecological Site and the Arnavon Islands Marine Conservation Area. Recently the following have been developed into large conservation areas: East Rennell as World Heritage site (37,000 ha), Tetepari Island (11,000 ha), and the Makira Highlands Conservation Area (63,000 ha). Many smaller community marine conservation areas have also been established in parts of the Western and Choiseul provinces.

293 In Guadalcanal, nine sites in Marau sound were established as Marine Protected Areas. These sites were managed locally by individual tribal groups and communities. Potential sites earmarked are Itina Popomanaseu (30,000 ha) which is profound habitat for birds and Lake Lauvi (35,000ha), wetlands favorable to crocodiles.

294 A profile of Solomon Islands stated there are seven protected areas with a total area of approximately 2,000 ha. Fourteen (14) currently protected areas are in the form of national parks or are gazetted under provincial ordinances. The 37,000 ha World Heritage Site (WHS) located at East Rennell was accepted 1996 and became the first WHS in the Pacific Islands.

295 Since the mid-1970s there have been a number of reports by NGOs and civil society groups identifying sites with ecological value worthy of protection or conservation. There are as many as 30 such sites distributed across the country. There are also a number of bird sanctuaries established under the Wild Birds Protection Act. Unfortunately many of the bird sanctuaries have been degraded by poachers and are considered defunct (UNDP et al., 2002).

296 At present protected areas are in the form of National Parks otherwise are gazetted under the provincial ordinances. Protected areas' Management Systems are now embraced by the Protected Areas Act 2010. This covers not more than 0.5% of land and seascapes of the Solomon Islands. The types of ecosystems and habitats protected include:

- Evergreen forests;
- Montane Forests;
- Lakes, Rivers and Streams;
- Highlands, e.g. Bauro Highlands; and,
- Coastal Areas, e.g. Arnavon Island

297 However, there are a few larger and formally declared protected areas including smaller protected areas that had been set up by communities with assistance from the Government, Non-Government Organizations (NGOs), Resource Owners, and Community Groups. These include Bauro Highlands, an area with transitional forest ecosystems in central Makira which is set up with the assistance from Conservation international. Marine Protected Areas (MPAs) set up by FSPI through its Coral Gardening Project at Marau in Guadalcanal Province, Ngella in Central Province and Langa Langa in Malaita Province. Other sites include the Arnavon Island in Isabel Province and Tetepari Island in the Western Province.

298 In total there are 42 Marine Protected Areas that are managed by NGOs, Government and Communities that are of high ecological diversity (MECM, 2008). However, some of these sites have not been gazetted and there have been disturbances from human induced activities. MPAs in the country are linked through the Solomon Islands Locally Managed Marine Areas (SILMMA) network and a number of NGOs are practically initiating activities of this organization.

299 Solomon Islands is the only country in the Pacific with a Natural landscape World Heritage Site. This is situated at the eastern end of Rennell Island. The Rennell Island also has the largest inland lake in the tropical Pacific, Lake Te Ngano. The East Rennell World Heritage Management Plan has been developed recently for the site.

300 There are no protected and conservation areas plus critical habitats within the vicinity of the SP site that would be affected by the proposed development as the land is already degraded for development.

9.2.6 Wildlife, Rare and Endangered Species

301 According (MECM, 2008) it is said that Solomon Islands have more mammals than any other pacific islands countries. There are 53 known species mostly bats, rats and possum with 20 being endemic, 20 threatened, 3 likely extinct, 3 of the 8 rat species are endemic, 19 of the 41 bat species are also endemic, and 3 bats are critically endemic. The endemic species are restricted to montane forest.

302 The State of Environment (2008), states that 80 reptiles are known in the country which includes marine species. One third is endemic and 5 identified as threatened. The report stated that the prehensile-tailed skink (Corucia zebrata) is the largest skink in the world and is endemic to the Solomon Islands. Solomon Islands is said to have 9 endemic snake species 27 endemic species of lizards. Pickacha et al, 2008 reported an increase from 17 species to a total of 21 frog species for Solomon Islands. Only 2 species are endemic to Solomon Islands, Discodeles malukuna and Platymantis sp.

303 Of the130 species of butterflies, 35 species are endemic to Solomon Islands. There are 25 endemic snail species. It is estimated that Solomon Islands has 14,511 described species and 46,015 total insect species. A total of 31 cicada species were recorded in the country, 30 are endemic to the country.

304 In terms of distribution, there is a relatively high level of island endemism. While Western Province records the largest number of species (41), Choiseul and Guadalcanal Provinces have the highest rate of island endemism with six species being found on only one or two islands. Majority of the endemic species are restricted to montane areas and undisturbed areas. Field observations do not show significant wildlife species within the SP areas.

305 In the Solomon Islands, rare or endangered plant species are not well known due to a lack of assessment work and a low level of plant collections. In terms of the fauna however, the International Union for Conservation of Nature & Natural Resources (IUCN) undertakes a global assessment to classify species at varying risk of global extinction. In 2006 the IUCN Red List identified 65 species of fauna in Solomon Islands which are considered endangered or threatened. This also includes 35 of 44 bat species and all eight of the rat species that occur in the country. The 2006 list includes 26 more bird species considered threatened since 1998. Apart from hosting many endemic bird species many of which can be considered rare, both Western and Choiseul provinces also host nine threatened bird species.

306 There has been no recent assessment of rare or endangered plant or animal species in Solomon Islands. The International Union for Conservation of Nature and Natural Resources (IUCN) undertakes a global assessment to classify species at varying risk of global extinction. Excluding species of 'least concern' which are common and widespread species that are not dependent on conservation efforts and do not qualify for near threatened or threatened status, the 2006 Red List identifies 65 species of fauna in Solomon Islands which are endangered or threatened, including 35 of 44 bat species and all eight of the rat species. There are also two species of giant rat and one species of frog which are listed as extinct. No endemic or endangered species was observed in the locality of the proposed SP sites.

9.2.7 Forests

307 The terrestrial flora of Solomon Islands is heavily influenced by temperature, rainfall and soil type where they are found. The common vegetation types that are commonly recognized are secondary vegetation, grasslands, swamps, lowland rain forest and montane forest. The forest vegetation is mainly a tropical wet-moist rainforest. It makes up 86% of the country's vegetation communities with lowland forest making up the major proportion. Secondary vegetation and crop land account for the remaining proportion.

308 The high level of biodiversity of plants recognized in the country comprises 3,210 vascular plant species which is believed to be an under estimation - an estimate of around 4,500 species is thought to be closer to reality. In general though, despite the high level of diversity, endemism is considered low with no endemic families and only three endemic genera.

309 With the current state of knowledge, the islands with the highest rate of endemism are Santa Cruz and Guadalcanal. The flora consists of 1,941 dicot species, 880 monocot species, 22 species of gymnosperms and 367 species of ferns. Some of the main groups include 20 species of pandanus, 33 species of palm, 277 species of orchid, seven species of ngali nut, 19 species of other nut (cut and alite nut), 11 species of shrub, and 14 species of Eleocarpacae.

310 There two types of forests in Guadalcanal; lowland rain forests and seasonally dry forest not seen in other provinces and grasslands. The SP areas are coastal in the west and more or less flat plains on the eastern side of the province. There is presence of mixture of coastal forest with swamp and a line of rainforest in more than two areas.

311 Communities in the Solomon Islands depend heavily on their rainforest and forest resources for traditional medicine sources, food and income. Within the SP sites common vegetation are regrowths and plantations of cocoa and coconut, and palm oil along the north east Guadalcanal Road these areas had been previously covered with intact lowland forest and coastal forest. It is evident that most of the SP sites and road corridor are highly disturbed by human activities which include subsistence and commercial farming. Therefore, wildlife present are adapted to constantly disturbed environment.

9.3 Social Components

9.3.1 Community and Family Structures

312 Community and Family Structures in Solomon Islands is based mainly on the different tribal group and lineages in each islands. Being part of a group or kinship is a significant aspect of communities and families. In most islands settlements and villages are often established on tribal lands comprising of individual families belonging to one tribe or lineage living adjacent to each other. Each household is occupied mainly by the parents and children and in some cases grandparents who needs care and support from their children.

313 In any family in Solomon Islands men are considered as the household head as they are the ones who often make critical decisions as they are accountable to negotiate and make decisions. Although men make the decisions, women often play a role in these decision making in most cases under which is under little observation. Women are clearly more influential in making decisions affecting their household or families, women affairs, and those involving other relatives who under their care. In Guadalcanal particularly lineages or tribe are tracked matrilineally and men follow their wives when married as land is matrilineally inherited. However, when it comes to decision making and land issues, women are more observatory and do not speak out but men are the ones speaking on behalf of the tribe.

314 Communities existing on the islands have a governing body which constitutes of Village Chiefs, elders and church leaders that ensure peace and stability exists in the communities and families. For all the SP sites in both north east and west Guadalcanal, the Chiefly System still exists but chiefs and elders are not usually active as they are not respected by the young generation. Although Guadalcanal is matrilineal society chiefs and elders are men. In these areas the tribes are ruled by the Paramount Chief of each tribe, village chiefs and elders. Disputes are occasionally sorted out at the village level but in extreme cases nowadays it can be handed over to the Police, for law and order in the communities.

9.3.2 Population and Communities

315 Guadalcanal Province is divided into 22 Provincial Wards spreading over 8 National Constituencies with a population of 93, 613 persons as per the 2009 census survey and a population growth is 4.4% per year. The province makes up 18.15% of the country's population. The beneficiaries of the project include East Tasimboko, Ghaobata, Vulolo and Malango Wards in the North East which accounts for 31,876 persons and comprising of 5862 households. In the North West of Guadalcanal the SP sites spread over two wards, Tandai and Sahalu with a population of 21,424 persons and 3507 households. Villages are collections of scattered households belonging to a family or clan grouping. Most houses are of good condition and have sawn timber walls with corrugated iron roofs. Based on the population and annual growth rate it is estimated that the population at present is 120,386 people.

316 Unlike other provinces in the Solomon Islands Guadalcanal Province have no specific Provincial Capital as most of the administrative issues are administered from Honiara by the Provincial Government from the Provincial Head Office at the Kukum Highway in Honiara. Hence, Honiara received an influx of people from the rural areas in Guadalcanal daily for purposes of accessing banks, hospital and clinics, shops, schools and markets to sell their produce. As found during the 2009 Census Survey, Guadalcanal has an urban population of 15, 241 people which is 16.3% of the total provincial population with an average urban growth rate of 16.2%.

317 The SP sites are located in Ghaobata (21 & 22) and East Tasimboko (18) Wards in the North East of Guadalcanal and Tandai (1) and Sahalu (2) Wards in North West Guadalcanal. During the 2009 Census Survey it was found that the Ghaobata Ward comprised of 9477 people, East Tasimboko Ward comprised of 7438 people, Tandai Ward of 14995 people and Sahalu Ward of 6429 people.

Selwyn (Veranaso) Causeway

318 At the western end of Selwyn (Veranaso) Causeway is the Sisters of Melanesia Convent and to the east is Selwyn College with a total population of 732 people.

Tambea Culvert

Tambea village is part of the Kusika community with a total population of about 850 people in which Tambea village has a total population of approximately 150 people.

Sasa Bridge

There are three villages existing close to the bridge which makes up the Takaboru Community that can be located within 2km to 4km inland from the main road with a total population of more than 1000 people.

Aruligo Causeway

Less than 2km inland or South of the structure are three villages and one Rural Training Centre for disabled people on the coastal side less than 1km from the structure with a total population of more than 670 people.

CBSI Culvert

319 Within the vicinity of the culvert there is only 1 village, Newtounaovo with five (5) households and a population of 34 people.

Tomba Bridge

Surrounding the area are private family households with the only village closer to the bridge located at 2km inland or south of the bridge having the total population of less than 100 people.

Belamatanga Bridge and Belamatanga Culverts 1 & 2

These three structure exists less than 100m away from each other and the only village or community existing within the area is 2km south with a total population of more than 670 people.

Mbonege Bridge

There are no villages closer to the structure only two families construct market huts and bottle shop at each end of the structure with the only existing three villages located 3km inland with a total population of less than 550 people who resides in the village full time.

Turtle Beach Culvert

320 There is only one (1) village within the area of the SP site it has a total household number of 4 and a population of 22 people.

Poha Bridge

East of Poha Bridge is a community of more than300 people but adjacent to the bridge is the Lumbu village with a total population of less than 151 people.

Tanavasa Bridge

At both the eastern and western end of the structure the total number of people residing within the locality of the bridge is about 420 people.

Tanaghai Arch Culvert

321 The only village within the SP area is Kolotoha village with an estimated total population of more than 555 people.

Mberande Bridge

322 Villages surrounding the SP site to the west include Koivo, Tutumu, Ndova, Nonou, Selevana, Kakalao, Mbegotathi, Semara and Selakara with an estimated population of more than 550 people. To the east villages include Ngila, Zion, Kekena, Tada and Tenavutu 1 with an estimated population of more than 600 people.

Kovelau Bridge

323 Ndova Village is part of the Mbegotathi community, within the East Tasimboko Ward in the North East Guadalcanal Constituency. It comprises of about 15 households with a total population of 154 people. The road and bridge is an important asset to the people as it is their only access to important facilities and services.

Mbalasuna Bridge

324 For the Mbalasuna Bridge, there are more than 15 villages within a 2 km radius of the SP site and part of the Ndadave and Mbinu community. The total population within the vicinity of the SP site is more than 1,500 people. From the total population, about 420 people live in Ndova and 56 people occupy New Kapu.

Ngalimbiu Bridge

325 At Ngalimbiu Bridge the communities include the Baravule and GPPOL 1 residential area. Communities also include the villages of Sape and Ngalimbiu.

Table 7. Villages Affected by Ngalimbiu Bridge

Villages Directly Affected	Population	Ward
Baravule	50 (Est.)	Ghaobata
GPPOL 1	200 (Est.)	Ghaobata
Sape	65 (Est.)	Ghaobata
Ngalimbiu	400	Ghaobata

9.3.3 Health

326 Guadalcanal Province has its Provincial Head Quarters situated along the Kukum Highway, in Honiara the capital city of Solomon Islands. Honiara became the capital city of Solomon Islands formally in 1952 with little infrastructure development. It is the main urban center which the North East and North West Guadalcanal Roads run through to the east and west. The city is located on a 22.73Km^2 of land which was acquired by the colonial administration of which 20% is unsuitable for development due to topographical and environmental limitations.

327 The capital city hosts the National Referral Hospital and about nine (9) clinics including private clinics which is not only accessed by people living within the city boundary but also accessed by people from Guadalcanal who needs immediate medical attention. The SP area in the North East and North West of Guadalcanal comprises of 11 primary schools and 4 secondary schools. Including 11 Health Centers and 1 Hospital.

328 For communities living as far as Mberande the only closest medical facility is Good Samaritan Hospital and only those living closer to Ngalimbiu access Grove Clinic.

329 For communities surrounding Selwyn (Veranaso) Causeway the closest health center is Selwyn College Clinic while villages surrounding Tambea Culvert access Visale Clinic. People from the communities surrounding Sasa Bridge, Aruligo Causeway and CBSI Culvert people access Kohimarama Clinic. Whereas, communities surrounding the Tomba Bridge access Tamboko Clinic which is located less than 1km away from the structure. Included that, communities surrounding Belamatanga Bridge, Belamatanga Culverts, Turtle Beach Culvert, Poha Bridge, Tanavasa Bridge and Tanaghai Arch Culvert SP sites access Marara Clinic and other health centers in Honiara. However, severe cases such as women in labor and sick children are transported directly to Honiara rather than the clinics for instant medical attention.

330 The health centers provide treatment services, immunization, outpatients, prenatal and postnatal for mothers and babies including family planning and health awareness. Major health problems are malaria, pneumonia, diarrhea, respiratory infection and various skin diseases.

Figure 53. Health Facility Community Access Map (Saghalu Ward)

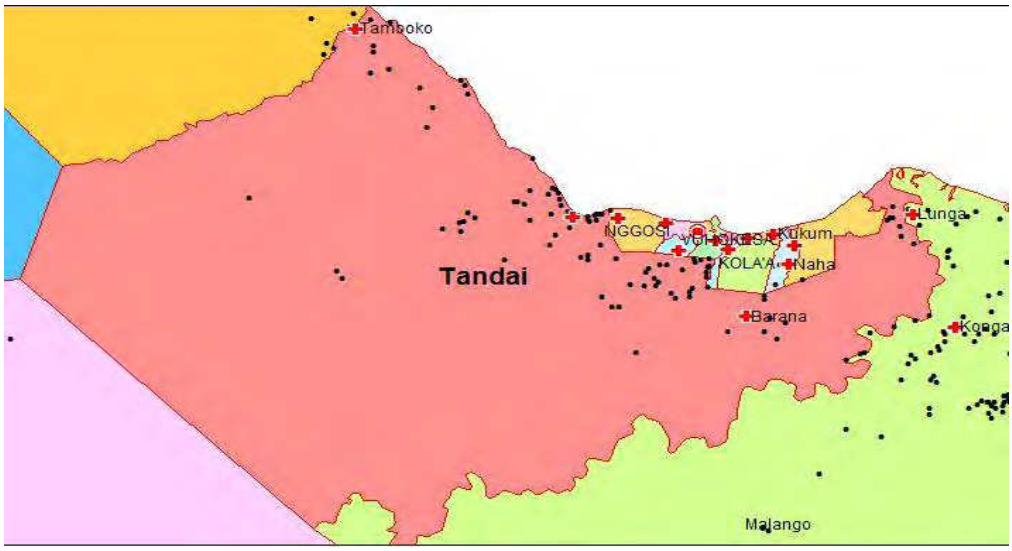


Figure 54. Health Facility Community Access Map (Tandai Ward)

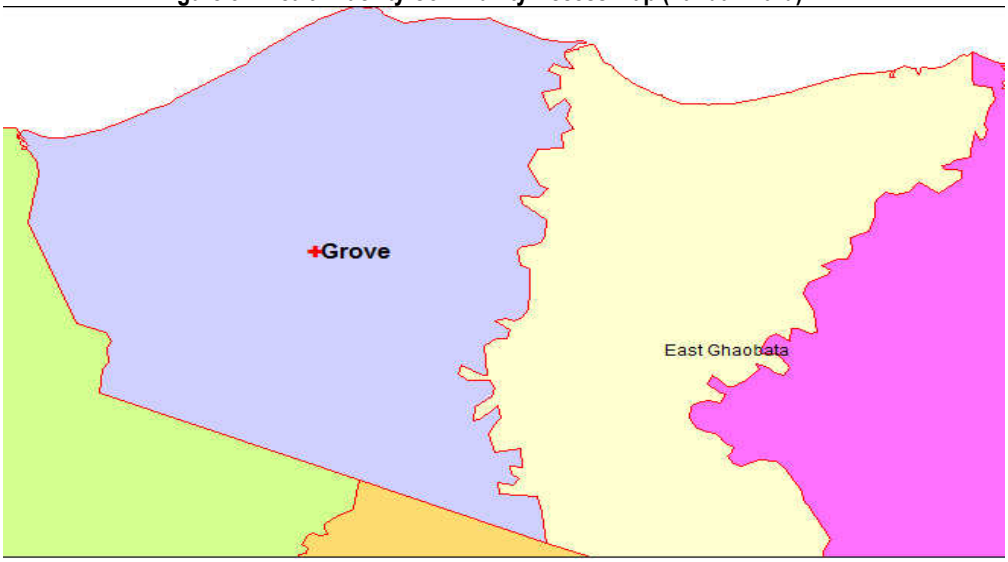


Figure 55. Health Facility Community Access Map (Ghaobata Ward)

Figure 56 Health Facility Community Access Map (Tasimboko Ward)

9.3.4 Education

331 The capital city of Solomon Islands Honiara is the main educational and administration center and includes a number of schools (primary and secondary) that are privately owned, owned by the SIG or Honiara City Council. In Guadalcanal Province there are 32 kindergartens; 74 Primary Schools; 25 Community High Schools; 3 Provincial Secondary Schools; 3 National Secondary Schools and more than 5 Rural Training Centers. These are operated by several education authorities including; Guadalcanal Provincial Education Authority; Church of Melanesia; Roman Catholic Church; Seventh Day Adventist Church, South Seas Evangelical Church.

332 According to the 2009 Census Survey Report Guadalcanal Province has a literacy rate of 82.8%. Females have a literacy rate of 78.1% and males 87.4%. It was also found that about 20% of the population has not attended or completed schooling; 55.2% completed primary school; 17.9% completed secondary school; 3.6% completed tertiary education and 0.8% completed vocational training. In 2009 the school enrolment rate for children ages between 6 and 12 years old is 80.5% which is 2.8% lower than the national enrolment rate of 83.3%.

333 From the socioeconomic survey conducted in May 2015 for all SP sites it was found that 92.94% of children between ages 5 to 18 years of age currently are attending school. This accounts for 53.43% of males and 46.57% of females attending school showing that most male children are attending school compared to few female children. Another survey carried out for the subprojects in July 2015 showed that 10.7% of the population is illiterate; 34.2% attend primary school; 23.6% attended Junior High School; 18.0% attended Senior High School and 3.2% attended Tertiary Education. In most areas more males attended education compared to females as female members of the families are more likely asked by their parents to stop attending school in order to deal with household and family matters. Hence, most female children only reach lower level of primary education.

334 For the SP sites there are a number of schools within the wards that they are located. As such for Sahalu ward in which Selwyn (Veranaso) Causeway, Tambea Culvert, Sasa Bridge, Aruligo Causeway and CBSI Culvert is within there are 5 Primary schools including 1 which is also providing Secondary Education and 1 National Secondary School. In Tandai Ward there are 8 schools but for children living in communities surrounding Tomba Bridge, Belamatanga Bridge and Culverts, Mbonege bridge, Turtle Beach Culvert, Poha Bridge, Tanavasa Bridge and Tanaghai Arch Culvert the schools accessed are Tamboko Primary and Secondary Schools, Tanaghai Primary and Secondary Schools and schools in Honiara due to their proximity to the town. Children in Ghaobata and East Tasimboko Ward in which Ngalimbiu, Mbalasuna, Kovelau and Mberande are located access Ngalimbiu, Nguvia, Tenavatu, Sir Jacob Memorial, Talaura and Ngilo Schools. These schools provide, Early Childhood Education; Primary and Secondary Education for children living in the area. Other schools are within the respective wards but not within the range of the communities surrounding the subproject sites.

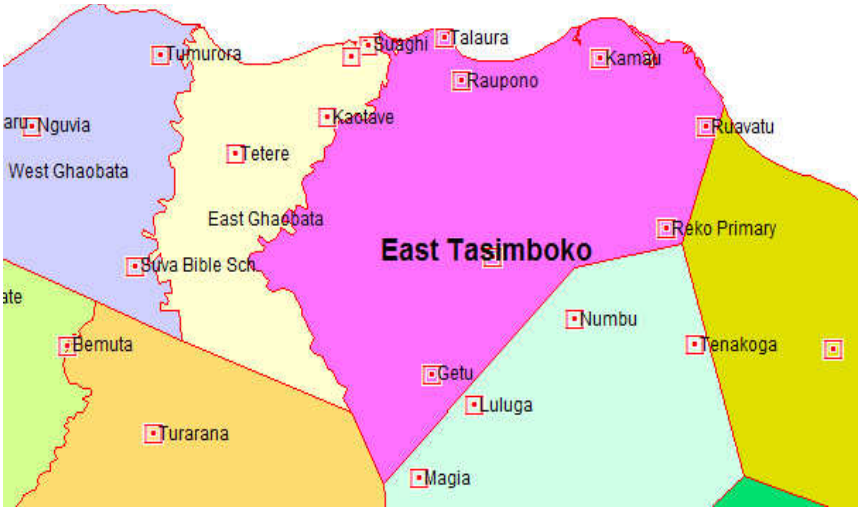


Figure 57. Educational and Schools Access Map (East Tasimboko Ward)

Figure 58. Educational Centers and Schools Access Map (Ghaobata Ward)

Figure 59. Educational Centers and Schools Access Map (Saghalu Ward)

9.3.5 Economic Sectors

335 The economy of the Solomon Islands comprises a mix of subsistence production - on which the majority of the population depends - and a monetized sector, including public services, dominated by large-scale commercial activities, and largely resource development based enterprises. In terms of nearly 100,000 tons of the major export commodities produced in 2000 fish accounts for the largest proportion at 47 per cent, copra accounts for 23 per cent, palm oil accounts for 13 per cent, coconut oil accounts for 4 per cent, and palm kernel and cocoa production account for 5 per cent. Log production was in the order of 536,000 m3 (SIG, 2001).

336 Solomon Islands from the 2009 census had a population of 515,870 dispersed broadly across the archipelago with a population growth rate of 2.3% per year. The population has a broad based age-sex structure with 40% of the population below 15 years of age. With population doubling every 30 years, pressure on available services and natural resources has increased dramatically during the last decade, which will require the Solomon Islands to invest large resources in social infrastructure. It is a culturally diverse country with 120 indigenous languages. Melanesian pidgin is the lingua franca. The population is made up of 93% Melanesian, 4% Polynesian, 1.5% Micronesian, 0.8% Europeans, and 0.3% Chinese.

337 Development has not been uniform across the country and the resulting migration to urban areas has created squatter settlements in and around Honiara. Although it is small in population size and area issues associated with other bigger cities are also found in Honiara. Matters such as rising poverty, inadequate and poor provision of basic urban service, environmental degradation and a rise in the number of informal settlements are also common.

9.3.6 Employment Sectors

338 Most of the economic activities occurred in the services sector that is provision of services by human resources. This involves wholesaling, retailing, banking, restaurants or fast food bars and hotel related business but the rise of the common effects of increase population that is, unemployment, poverty and high cost of living. People from the communities engaged in a variety of economic activities.

339 In Guadalcanal, most of the economic activities revolve around North East and North West Guadalcanal Roads. As it is the main road connecting the communities to the most economically active sector Honiara to further east and west of Guadalcanal. It is also where most feeder roads from villages are served.

340 Along the roads there are thatched market huts for selling produces to road users on a daily basis. The main locations for such economic activities in the east are at Tetere, Gold Ridge Boom Gate Market and Ngalimbiu. While along the North West Guadalcanal Roads the major locations are Kakabona, Aruligo, Sasa and Tambea including more than 20 other thatched huts owned by individuals existing along the road. People not only sell local garden produces such as vegetables and root crops but they are also selling cooked and baked food including goods from shops as well as Betelnut and tobacco products as the main income source for most of the people.

341 Guadalcanal Province accounts for 19.30% of the total employed population of the Solomon Islands. Household income are mostly from home production which is 54%; wages and salaries about 12.6%; 13.5% for self-employment and related businesses; 4% from remittances; rent 1.7% and other benefits 5.1%.

342 In any rural community or village setting home production and self-employment including small businesses operated by individual families is very common in the Solomon Islands. For Guadalcanal Province 35.96% of households are engaged in producing root crops; 33.51% are producing other vegetables and fruits; 6.14% are engaged in livestock farming; 6.84% are selling fish and other sea or marine products; 5.44% are selling handicrafts, wood and shell products; 14.39% are self-employed and 3.16% are engaged in other small business activities.

343 Based on the Individual Household Socioeconomic Survey undertaken at the SP sites, results show that 48% of households are engaged in private and other businesses; 21% in agriculture; 23% earn wages and salaries and 7% in other activities for earned income. Non-earned income reported by households includes received from rent which is 21%; remittance of 3%; land lease 70% while remittance and other sources accounts 9% of the households' income. For the most part people living in the areas depend entirely on the natural and forest resources for livelihood and income generation. As it is evident that food gardens and other crops and fruit trees exist immediately along the road side and next to the subproject sites.

344 From the survey it is clear that employment opportunities in Guadalcanal Province is scarce and limited and that people living with in the SP sites are mostly engaging in agricultural activities and farming, small businesses and self-employed with only a few are working professionally mostly as teachers and working in the medical centers. By improving the infrastructure it will be possible for people to travel to market outlets especially to Honiara to sell their produce and earn income to support their households with basic needs such as food items and clothes including paying for their children's school fees and other family and community obligations.

9.3.7 Infrastructure Facilities

Transport

345 In the Solomon Islands the Transport infrastructure consists of roads and bridges for land transport; jetties, wharves and ports for sea transport and airports for air transport. The road network is sparse and does not reach about three quarters of the rural population. Malaita and Guadalcanal provinces have about two thirds of the total road network including sealed pavements. The main roads serve the densely populated urban center's that is Honiara and provincial headquarters for provinces linking the rural areas to the commercial centers, markets and main ports. The secondary or feeder roads are extensions to the main road networks and serve the provincial centers and rural communities on the main islands. These also connect agricultural areas and villages to wharves and to social services and facilities such as schools, health centers or clinics and market outlets.

346 Second to Malaita Province with a road network of length 258Km is Guadalcanal Province with a total road length of more 200Km which comprises of the North East and North West Guadalcanal Roads which directly links to Honiara and feeder roads connecting to the main roads. Guadalcanal has received assistance for improvement and maintenance of the roads and bridges, causeways and culverts. The roads provided communities with easier access to important facilities and services in Honiara and surrounding areas including expansion of telecommunication services to the rural population. Other forms of transportation include shipping services and boat transfers using OBM powered engines including air transport to the weather coast and east Guadalcanal from Honiara. Transportation by ships and boats to the other parts of the province is regular which include cargo and passenger runs with reasonable fares and freights as they are provided with the Franchise Shipping Scheme by the MID. Also one wharf was constructed in 2012 which is financed by the ADB and implemented by MID.

Water Supply

347 From the 2009 Census Survey Report it was found that 32.9% of the population relies on private, shared and communal stand pipes as main water sources; 54.2% relies on wells, rivers, adjacent springs, streams and other sources; and 12.4% rely on water tanks as the main source of water. These water sources are either owned by individual households or accessed by the whole communities are important to the communities included that some were found to afford bottled water or mineral water from the shops.

348 From the socioeconomic survey conducted in May 2015 for communities surrounding the sites it was found that 63.45% of the rural population rely mainly on rivers and adjacent streams and springs as a main source of water for drinking and washing; 34.5% has access to private and communal water supply or stand pipes; 31.5% access water tanks; 22.7% rely on wells and 17.25% use boreholes as main water sources. Water tanks and water or stand pipes are mostly supplied by the Member of Parliament for the North East and North West Constituencies including Red Cross and World Vision.

349 The communities surrounding Veranaso, Poha and Tanavasa Rivers in the west and Mberande, Mbalasuna and Ngalimbiu Rivers in the east as a main source for swimming and washing and adjacent streams and springs for drinking.

Sanitation

350 Based on the Census Survey Report in 2009, it was reported that 9.8% of the population have access to flush toilets; 9.9% have access to water sealed toilets; 24.7% have access to pit latrines and 55.6% do not have access to proper sanitation. It is evident that sanitation is still an issue in the rural communities throughout the province.

351 From the socioeconomic survey conducted in May 2015 it was found that within the Project catchment area 12.7% access flush toilets; 26.9% access water sealed or pour water toilets; 7.1% access pit latrines and 57.9% access bush, rivers and other areas for sanitation relief. The latter practice is a contributing factor to a number of health hazards caused by poor sanitation in the communities is in need of immediate attention.

Energy

352 In Solomon Islands not all rural communities have access to electricity as a source of energy for lighting. In the past most of the rural population only use kerosene or oil lamps and candles and small kitchen fires as lighting for households and overtime people had access to other sources. In Guadalcanal Province only communities close to Honiara access the main Electricity Grid of about 8.2% as from the 2009 Census Report. Other sources according to the 2009 Census Report are households using their own generator for lighting with 1.3%; solar energy 3.5%; kerosene lamp 82.7%; other sources 3.95% and those with no lighting accounts for 0.3%. For cooking 95.7% use firewood and coconut shell; 3.6% use gas 0.2% use electricity and kerosene stove respectively and only 0.3% use other sources and charcoal.

353 From the Household Socioeconomic Survey carried out in May 2015 at the communities within the SP sites it was found that 1.02% access the national electricity grid; 16.8% use their own generator; 85.7% use solar; 41.3% use kerosene lamp; 8.2% use candle and 102% use other sources. Most of the solar panels that are used by households are supplied by their Member of Parliament as part of the constituency development while others purchase their own solar panels.

Communication

354 In the past it is common that people in the villages either lit fires, blow a conch or beat a drum to signal other communities for relaying of messages in the past. But as time goes on messages are simply passed through the use of radios and now almost all people within the Solomon Islands are using mobile phones due to the enhancement of technologies.

355 For people within the Telecommunication services are provided by the Solomon Telekom and Be mobile - Vodafone in the East and only Solomon Telekom in the west as far as Selwyn College.

9.3.8 Land Ownership

356 Land in Solomon Islands is an important resource to the people as it is the only asset in the custodians of the people. Approximately 87% of land in the country is under customary resource tenure and all forest and other natural resources are owned by the customary land and resource owners. Traditional land and resource management is community based as without land, labour is not valued or off little value due to very few opportunities for non – farm work and few people having capital. Any actions that alienate, degrade, redistribute or otherwise impact on land affects the livelihoods, identity and culture of the people.

357 Though 87% of the land in Solomon Islands is owned by customary tenure, the focus of land administration had been historically on identified alienated lands, which is generally located in the most productive areas with good infrastructure access. The alienated land is subject to registration under the Land and Titles Act of 1988.

358 The Act covers customary land rights which include land owned, used or occupied by a person or community in accordance with current customary usage.

359 Customary land tenure has generally proved efficient to maintain access to land for the majority of the rural population. But this is under extreme pressure to adapt to irreversible changes; population pressure; increasing demand for land for public purposes; greater social mobility and migration; and new expectations from the cash economy.

360 The SP sites are not all customarily owned as found during the initial and follow-up consultations in May and July 2015. Most of the customarily owned land are somehow leased and sold to individuals and companies. That is in the east end of Mbalasuna and Kovelau bridge area were under lease to GPPOL; east end and north of Ngalimbiu Bridge was sold to Mr. Luke Kakamo and western end of Mbalasuna was sold to Mr. Francis Bugotu and Mr. Phillip Kapini along with their sister Mrs. Pitakere. It was found that only Mberande bridge area and Ngalimbiu western end are customarily owned.

361 For SP sites in the North West only Tanaghai Arch Culvert is customarily owned but was declared during the colonial government as a public road. Selwyn (Veranaso) Causeway area is owned by the Anglican Church of Melanesia (ACOM); CBSI Culvert is owned by the Central Bank of Solomon Islands (CBSI), Roman Catholic Church and two other local owners while Turtle Beach Culvert is owned by an International Company called Metropolis Pacific Pte Ltd.

362 In addition, Tambea culvert is owned by Mr. Tommy Chan; Sasa Bridge and Aruligo Causeway area is owned by the Roman Catholic Church; Tomba Bridge area is owned by the Ghaobata Tribe; Belamatanga Bridge and Culverts area is a leased land and the perpetual title holder is the commissioner of lands while Mbonege Bridge area is owned by Metropoly Pacific.

363 However, when it comes to development consultation is required to be done with the customary land owners as it is tradition that the river bed is customarily owned. Customary land owners access land and resources as it is bound to social relationships and expressed as 'rights' to exploit the resources. Relationship based on groups living in the villages manages their own resources and exercise the right to exploit them. The primary rights holders are usually from the line or tribal group and the leaders of the tribal group who are actually from the matrilineal side collectively have the authority to allocate use rights through the spokesperson of the line. The rest of the tribal members have equal rights as the primary right holders to exploit the resources. Secondary rights holders are usually those not of the same tribe but are closely related and had been given the right to exploit the resources by the primary right holders but they will not have any authority in dealing with the land and resources.

9.3.9 Land Use

364 Guadalcanal Province has the second highest population to Malaita Province with an annual population growth of 4.4%. Along the north east and west Guadalcanal Road settlements and villages are located along the road. It is evident that comparing to more than 10years ago settlement patterns and population along the road corridor and coast are increasing compared to inland. The infrastructure attracts the local population as it makes it easier to access important social services and facilities.

365 Due to the increasing population along the road corridor land use in the vicinity of the SP sites follow suit. Land use is mainly subsistence farming for own household consumption and commercial purposes including cocoa and coconut plantation and Palm Oil Plantation along the north east Guadalcanal Road. Subsistence farming usually comprises of banana (Musa sp); sweet potato; cassava; slippery cabbage; green pepper; corn; eggplant; sago palm and swamp taro. While trees adjacent to the SP sites include; cocoa, banana, sago palm, mango, star fruit, alite and other plants. For most people in the communities and villages surrounding the SP sites subsistence farming is the main practice of livelihood.

366 Land in Guadalcanal Province is mostly customary land which is owned not by individuals but by a tribal group through the matrilineal system of inheritance. Except for purchased registered lands that are mostly owned by a family or an individual. Some of the lands within areas of significant development such as the North East Guadalcanal Plains that is occupied by the Guadalcanal Plains Palm oil Ltd (GPPOL), customary lands are registered as Perpetual Estates to land owning group trustees.

367 Along the North East and North West Guadalcanal Road there are settlements, along the coast and rivers and catchment areas. Most of the people reside along the roads and on the coast for ease of access to important services and facilities.

368 Major land uses at the SP sites are subsistence farming, cocoa and coconut plantations and palm oil plantation. People from the local communities, about 80% relied heavily on subsistence farming for cash income and food sources. The main crops planted for both consumption and cash income include; root crops, vegetables, fruits and fruit trees. However, most of the low lying areas are prone to salt water intrusion making it difficult to grow crops and had also affected crops that had been planted. Though adaptive measures had been undertaken often yield is low and most plants are dying out.

9.3.10 Forest Use and Other Natural Resources

369 In Solomon Islands the rural communities rely heavily on their forest and natural resources as they play a very important role in their livelihood. Natural forest covers 2.2million hectares of about 80% of the country's land based areas of which all is in customary ownership and 10% is considered suitable for commercial exploitation. Logging activities including small scale timber milling has been increasing and become increasingly important in the last 40years. Timber and round logs exporting has become one of the country's largest exporter and revenue earner since the 1990s. This had accounted for about 20-35% of the country's foreign exchange earnings, now it had provided closer to half of the country's export revenue earnings.

370 Currently there are 90 logging licenses issued by the Ministry of Forestry and Natural Resources (MFNR) with majority of the license holders being international or foreign companies of which only about 22.5% are operating indicating a significant increase in concessions as provided in the State of the Environment Report which indicated that in the 1990s out of 15 issued licenses only 10 are operating. In the cases of felling trees for local or domestic purposes and not for sale license is not required. But if local forest owners would like to sell timber there are local timber harvesting licenses and community timber harvesting licenses available for communities to cut up to 2000m3 to be harvested per year under the license.

371 Communities living within the proximity of the SP areas in the north east and west of Guadalcanal Province rely heavily on their forestry and natural resources for sustenance and generating income. Other than timber, forest resources are a vital source of fiber, food, firewood, and medicine for rural communities. It has also provided for shelter, shade, wild life habitat and enhancement of soil fertility and a vital social and cultural resource for the communities.

9.3.11 Fishing

372 Solomon Islands has one of the largest Economic Exclusive Zone (EEZ) in the South Pacific Ocean, and the ocean or marine resources are an important source of food and income. However, due to the rapid increase in population, pressure on coastal and marine ecosystems has increased over the years resulting in once abundant and pristine areas being over harvested and polluted. As found, local fishermen and women especially at the north west area had reported that it is much harder to catch reef fish at near shore reefs compared to the past and that fishing are now occurring further from the coast.

9.3.12 Agriculture

373 In Solomon Islands subsistence agriculture is practiced nationally by the local population as it is the main practice to earn a living as a food and income source from surplus. Most of the rural communities are defined as practicing semi – subsistence agriculture as the norm and is the probable definition which includes consumption of produce by the producers (almost all are family based) along with sharing, exchanging (barter system) and selling of food in the local area.

374 More than half of the population depends on Agricultural activities for earning money by growing a range of crops including food crops, vegetables and root crops beside the main cash crops (coconuts, coffee, cocoa and oil palm). Others are also engaged in poultry and piggery farming. Poor infrastructure is one of the most significant impact on the production of copra, cocoa and palm oil (north east) in Guadalcanal Province. There is also timber milling and selling for cash income by local communities to buyers and timber yards in Honiara.

375 Local communities farm a variety of crops for both subsistence and commercial purposes this include vegetables, fruits and root crops such as; slippery cabbage, Chinese cabbages, melon; pineapple, green pepper, tomatoes, eggplant, sweet potato (kumara), cassava, pana, yam, and taro. Others also grow betel nut trees as well as raising pigs and chickens for sale.

376 Most of the rural communities practice shifting cultivation which involves cultivating, harvesting and managing of food from different food sources and environment as the main subsistence food source and production system. The system involve food from cultivation, primary (forest areas) and secondary (fallow areas) forest; marine ecosystems; rivers; plantations, nut groves; swamps and agro – forests around the village and in the bush.

9.3.13 Tourism

377 Guadalcanal Province accommodates the country's capital city, Honiara which received a large number of tourists annually as it is hosts the international sea port and airport including hotels. One of the major attraction to parts of the island are the war relics and memorials found on North East and West Guadalcanal as the island is one of the battle grounds during the World War II.

9.3.14 Other Industries

378 In most islands in the Solomon Islands there is not much industrial development such as in Guadalcanal Province which hosts for the Gold Ridge Mining and Palm Oil Plantations. Also Western Province which hosts the largest and only tuna processing industry in the country. Whereas, other provinces only produce cocoa and copra, and sell fish for income sources.

379 There are no large scale industries operating.

380 Along the SP sites in the north west Guadalcanal Road there is only presence of subsistence farming, timber milling and cocoa and copra production. While the north east of Guadalcanal is the most economically active area on Guadalcanal because of the gold mining and palm oil production. People in these areas depend on the industries for sustenance as a major income source.

9.4 Cultural Components

381 In Solomon Islands culture is a very crucial ideology as it reflects the extent of the differentiation and diversity among the different people living in the islands. People and communities are distinguished by their island, language and features which mostly are Melanesians but also include Polynesian Societies. Within the country Polynesians occupy most islands outside the main Melanesian high islands which include Anuta, Tikopia and Vaeakau – Taumako in the far east Solomons Archipelago; Rennell and Bellona in the far south and Ontong Java and Sikaiana in the far north.

382 It is tradition in the culture of the islands that age old customs are passed down from one generation to the next inorder to form the cultural values believed to be from the ancestral spirits. 'Kastom' as it is called is the principal of the proclamation of traditional values and cultural practices.

383 Special, sacred or restricted sites or "tabu" areas, including elements of the landscape as well as monuments represent the history, lineage and society of different clans, lines and tribes and have local cultural as well as regional historical significance. It is known that bush and forest areas are important for traditional resources and as medicinal sources.

384 Most sacred or tabu sites or sites of cultural significance are registered and recorded by the National Solomon Islands Museum which keeps a register known as the National Tabu Site Register that has a record of more than a thousand sites. Other provinces also record and maintain their tabu sites register but due to lack of monetary fund's recording and registration of such sites are not systematic.

9.4.1 Cultural Sites

385 During the community consultations, communities confirmed that there are no cultural sites in the SP area as the lands were already developed for infrastructure during the colonial government. For some of the sites such as Mberande and Mbalasuna, areas of cultural significant are located about 100 – 200m from the areas that will be utilized during construction and these will not be affected. While at the north west Guadalcanal SP sites the only areas of cultural significance are at Sasa Bridge area about 100m from the eastern end of the bridge. Including north of the western end of Poha Bridge and south of the western end of Tanavasa Bridge a memorial site. There are records of cultural and tabu sites with the Solomon Islands National Museum Registry that are locally maintained and recorded by the Province but due to lack of monetary assistance recording and registration of such sites are not systematic.

9.4.2 Archeological Sites

386 For Guadalcanal Province archeologically sensitive areas are located further up in the mountains and are not close to the present settlements. Overtime it was reported that people from Guadalcanal especially within the SP areas moved from the mountains to the coast hence it is not common to find remains of houses and other artefacts within the area. It was found during the consultations that there are no archeological significant sites within the area for construction and repair of the eighteen (18) sites, as most clearing had been done when the road was formally constructed in the past.

9.4.3 Historic Sites and Resources

387 Guadalcanal as historically known is one of the battlefields during the World War 2 era as found remains of the war are identified along the SP area especially east and west of Honiara. However, this will not be altered or damaged during construction as they are not within the structures vicinity. At the western approach to Poha Bridge on the north side of the Bridge is an ancestral burial site while at Tanavasa there is a monument installed at the Bridge location in memory of the one casualty that was lost during the April 2014 flash floods. Hence, community members and the family were consulted and informed of the works and had agreed for relocation during works and re-installment after works.

388 There are records of historically significant sites with the Solomon Islands National Museum Registry, with some sites being maintained and recorded by the Province but due to lack of monetary assistance recording and registration of such sites are not systematic.

9.4.4 Sacred Sites

389 Within the SP sites there are no records or identification of sacred sites. There had been records of such sites with the National Museum but are not within the SP sites.

9.4.5 Unique Landscape

390 From observation along the SP sites and the North West and east Guadalcanal Roads there are no unique landscape within the SP area. On Guadalcanal unique sites are found on the weather coast and further west and east of the islands as these are somehow not affected and are still preserved. One of the uniqueness of Guadalcanal Province is the major tourist attraction of the Marau Sound especially Tavanipupu Islands and other areas of the weather coast.

10 ALTERNATIVES

10.1 Alternatives to Locations

391 The project scope is to repair and rehabilitate bridges, causeways and culverts along the North East and West Guadalcanal Road at the existing location with minor realignment at Mberande and construction at previous locations at Selwyn (Veranaso) and Mbalasuna. These include construction of two high level bridges at Mberande and Mbalasuna; extension of the Kovelau Bridge by 7m portal on the existing road carriage; bank and embankment protection works at Ngalimbiu; construction of a single span bridge at Selwyn (Veranaso) on a previous alignment; construction of new single portals at Aruligo (CBSI Area), Turtle Beach and Tanaghai (Kakabona) on the existing foot print so as not to cause hindrance to the local community. Hence, it is not viable to consider changes to the location as it will incur costs, require major land acquisition and require clearing of undisturbed environment. The works will integrate climate proofing to make it reliable and feasible in any weather conditions. There is no other realistic alternative to the existing location that will provide the same economic, environmental, and social advantage.

10.2 Alternatives to Technology

392 The contractor will be required to use heavy to light machinery as suitable for each type of works, however it will also be an option to employ local communities involving men and women as well as youths for unskilled labour.

10.3 Alternatives to Design

393 Alternatives to the design of structures are mainly limited by the funds available for utilization, that is for each SP site road approaches will be filled and compacted and incases of sealed areas resealed, extensions will be made in similar design to the existing structure including protection works will be done at areas mostly affected considered as in need of immediate works. The approach roads will be in the right – of – way (ROW), hence no additional land for permanent road will be required except for Mberande. However, land will only be required during construction for temporary detours. This will be negotiated with the community by the contractor with assistance from the project.

394 The recommended option considering the safety, environment, social and economic aspects turn out to be option with the bridges and development of culverts. However, this does not mean, there will be high level bridge at all crossing. There will also be new culverts, abutment approaches rehabilitated at some crossings.

395 In terms of climate proofing for Climate Change Adaptation (CCA) measures were integrated in the design of structures, road approaches and protection works. In this case the following adaptation measures were adopted for the designing of proposed repair and rehabilitation works;

- Improved designs to ensure that impacts of flooding and scouring or erosion at bridge abutments and embankments do not increase locally;
- Increased bridge and culvert sizes to withstand extreme weather conditions and heavy rainfall, and accommodate increased run – offs including coastal flooding and erosion;
- Extension of bridge approaches;
- Road surface compaction;
- Bank and Embankment protection; and,
- Regular inspection and maintenance of roads and bridges.

396 After assessment of the flood damage and impact from the April 2014 flood and the most recent flood in July 2015 including assessment of the vulnerability of the structures and the hydrology and hydraulics study of the rivers and streams along with climate change adaptation and disaster risk management assessment of the SP areas. The engineering options for the sites are as summarized below with the preferred options in accordance to the studies and assessments undertaken.

10.3.1 SP01 – Selwyn (Veranaso) Causeway

397 When selecting the options for the site, consideration was given to remove the causeway and to build a ford structure similar to the one existed prior to the existing structure. With increasing high flood frequencies, the road would become unpassable regularly and make the road dangerous to use. Hence this option was dropped from further consideration and two options are considered feasible for the site they are as follows:

- **Option A: Existing 12-cell + River Training**

398 In this option, the existing structure will be retained with river training work implemented for the western bank although this option improves the resilience to flood damage to the river bank, flooding that is caused by the structure will not be reduced. Also debris will block the cells and increase the upstream flooding. As stated in Section flooding frequency will increase in the future and sever the road.

- **Option B: Construct a New 32m Span Bridge**

399 In this option, the existing structure will be removed and a new single span bridge will be constructed at the old ford location, downstream to the existing bridge. Placing the new bridge away from the existing causeway would improve the road alignment and allow the traffic to use the causeway during construction. This option provides a more resilient structure for the site than the Option A.

400 This option was selected based on providing appropriate waterway opening such that the upstream flood level does not rise above 3.0m and flood the surrounding area. This option involves raising the road to an appropriate level to provide the flood immunity to the surrounding area shows the hydraulics performance of a 32m bridge for a 50 year flood event. As it can be seen from the figure provided in Appendix 2, the flood level at the upstream is approximately 3.0m. By increasing the span length or by raising the bridge soffit level, the upstream flood level could not be altered due to the terrain in which the bridge is located. Therefore, 32m span is an optimum span length for the site. As the proposed bridge is a single span with large opening, the structure will be better protected against debris impact.

SP02 – Tambea Culvert

401 Only one option is considered for the site due to a low point in the existing road's profile which acts naturally as a flood relief unit. The only option is to:

- **Option A: Construct an Engineered Ford**

402 In this option the existing pipe culvert will be removed and replaced with a concrete ford that would be constructed from the western end of the existing Tambea Steel Girder Bridge. Included that, the junction between the main road and the access road to the village will also be improved to reduce flood damage.

403 Based on the site conditions and hydraulic requirement of the site, Option A, a new engineered ford, is considered more suitable for the location.

SP03 – Sasa Low Level Bridge

404 For this SP there are two options considered for the site this include:

- **Option A: Retain existing bridge and river training**

405 In this option, the existing structure will be retained with river training works implemented for the eastern bank that is designed for the 1 in 25 years flood event level. Sheet piling is proposed as it provided a flood resilient abutment and bank protection and if the road is eroded in the event of overtopping repair work can easily be undertaken with minimal cost. Also debris, vegetation and silt in the channel should be removed and maintained to provide an uninterrupted flow in the channel.

- **Option B: Construct a new 2 – 30m Span Bridge**

406 In this option the existing structure will be removed and a new two span bridge constructed at the current bridge location. The structure would increase the conveyance capacity, reduce debris build up and flood frequencies, will have a low maintenance cost and better climate proofed.

407 Based on the site conditions and hydraulic requirements of the site, Option A, river training works with appropriate maintenance is considered a suitable option for the site. Also the option is considered due to the changing river conditions and evidence of the likely migration pattern to the high level bridge due to constriction provided by the existing structure. Also that the changing river bed due to high non – floating debris, the section of the river that is flowing through the bridge might cease to flow and the river channel under the high level bridge would be the primary channel in the future.

SP04 – Aruligo Causeway

408 For this site two options are considered feasible. They are:

- **Option A: Existing 6 Cell + River Training + Bed Protection**

409 In this option, the existing structure will be retained with river training works using sheet piles for the western bank to provide for a flood resilient bank protection and downstream bed protection implemented. The river training work is proposed to be designed for the 1 in 25 years flood event. This also includes grouting of the under base slab and appropriate cut – off walls will be constructed to reduce future destabilizing.

- **Option B: Construct a new 25m span Bridge**

410 In this option the existing structure will be removed and a new single span bridge would be constructed at the existing bridge location including river training works. The new bridge will be designed to a 1 in 100 year flood event and would be more resilient to climate change and debris impact.

411 Based on the site conditions and hydraulic requirements of the site Option A, river training and bed protection works, is considered a suitable option for the site considering high maintenance required to keep the existing structure in service.

SP05 – CBSI Culvert

412 Three options are considered feasible for the site. They are:

- **Option A: Existing 2mW x 1.2mH RCBC + 2 New 2.5m Wide x 2.15m High RCBC**

413 In this option, the existing box culvert will be retained and the pipe culverts removed and replaced with two new box culverts constructed. This will provide a 1 in 25 year flood capacity structure. The headwalls will be replaced and bed protection will be implemented.

- **Option B: Existing 2mW x 1.2mH RCBC + 3 New 2.5m Wide x 2.15m High RCBC**

414 In this option, the existing box culvert will be retained and pipe culverts removed and replaced with three new box culverts constructed. This will provide a 1 in 50 year flood capacity structure. Head walls will be replaced and bed protection will be implemented.

- **Option C: Construct a New 11m Wide x 2.75m High Reinforced Concrete Portal**

415 In this option, the existing structure will be removed and a new single span portal bridge constructed at the existing bridge location. The new bridge will have a 100 year flood conveyance capacity and will be more resistant to climate-related impacts. The structure will be founded on steel piles and will therefore be resistant to Potential River bed scouring.

416 Based on the site conditions and the hydraulic requirements of the site, OPTION C, a new single span portal bridge, is considered a suitable option for the location. Option B is recommended as a better solution for the site considering the site's closeness to the sea and the resistance of the base slab to scour in tidal events.

SP06 – Tomba Low Level Bridge

417 Two options are considered feasible for the site, this include:

- **Option A: Do Nothing**

418 In this option the existing structure would be retained with no additional work needed due to the adequate performance of the emergency work undertaken after the floods in 2014 and no damage or failures were identified during the recent inspections.

- **Option B: Retain Existing Bridge + Improved Batter Protection**

419 In this option the existing structure will be retained with batter protection implemented for both approaches using sheet piles. Sheet piling provides a flood resilient abutment and batter protection and if the road is eroded in the event of over topping, repair work can easily be undertaken with minimal cost.

420 Based on the site conditions and the hydraulics requirements for the site, Option B, batter protection work, is considered a suitable option for the location considering the high emergency repair cost involving gabion installation that was incurred after the April 2014 flood.

SP07 – Belamatanga Bridge

421 Due to the bridge being in good condition and the flood damage being limited to bank and embankment protection only the feasible option for the site is:

- **Option A: Retain Existing Bridge + Improved Bank and Embankment Protection**

422 In this option the existing structure will be retained with batter protection installed at both approaches using spur or groynes at the western end to direct the flow away from the bank. While the eastern embankment would be strengthened to reduce the possibility of losing the approach slab. Also boulders would be placed around the pile cap to reduce scour under the pile cap and railings are recommended to be reinstalled considering the safety of pedestrians.

423 Based on the site conditions and the hydraulics requirements of the site the Option, bank and embankment protection work, is considered a suitable option for the site.

SP08 – Belamatanga Culvert 1

424 Three options are considered feasible for the site. They are:

- **Option A: Replace headwalls**

425 In this option the existing culvert would be retained and the headwalls will be replaced and bed protection installed to maintain the flood capacity of the structure as it is now.

- **Option B: New 4m Wide x 2.5m High Reinforced Concrete Portal**

426 In this option the existing structure will be removed and a new 4m span portal bridge constructed at the existing culvert location that would have a 50 year flood conveyance capacity and would be resilient to the impact of climate change. Also the structure will be founded on steel piles and as such would then be resilient to potential river bed scour.

- **Option C: Construct a New 5.5m Wide x 3.5m High Reinforced Concrete Portal**

427 In this option the existing structure will be removed and a new 5.5m wide portal bridge constructed at the existing culvert location that will have a 100 year flood conveyance capacity and would be more resilient to the impact of climate change. Also the structure will be founded on steel piles and as such be resilient to potential river bed scour.

428 Based on the site conditions and the hydraulic requirements of the site Option B, a new 4m span portal bridge, is considered a feasible option for the location also that the existing steel pipe has a short service life remaining.

SP09 – Belamatanga Culvert 2

429 For this site two options are considered feasible, they are:

- **Option A: New 3m Wide x 1.5m High RCBC**

430 In this option the existing pipe culvert would be removed and a new 3m wide box culvert constructed at the existing culvert location that would have a 50 year flood conveyance capacity and would be more resilient to climate related impacts. Also the road would be raised to provide a minimum 600mm fill above the culvert units.

- **Option B: New 3.5m Wide x 1.75m High RCBC**

431 In this option the existing pipe culvert will be removed and a new 3.5m wide box culvert constructed at the existing culvert location that would have a 100 year flood conveyance capacity and would be more resilient to climate related impacts with the road raised to provide a minimum 600mm fill above the culvert units.

432 Based on the site conditions and the hydraulic requirements of the site, Option A, a new 3m wide culvert, is considered feasible for the site due to the need for replacement of the existing structure.

SP10 – Mbonege Bridge

433 Due to the bridge being in good condition and the flood damage limited to bank and embankment protection the only feasible option for the site is:

- **Option A: Retain Existing Bridge + Improved Bank and Embankment Protection**

434 In this option the existing structure will be retained with batter protection implemented for the eastern approach only including improvement of drainage and outlets with the removal of the old pier.

435 Based on the site conditions and the hydraulic requirements of the site Option A, bank and embankment protection, is considered suitable for the location.

SP11 - Turtle Beach Culvert

436 Three options are considered feasible for the site. They are:

- **Option A: Construct a New 4m Wide x 3.0 High Reinforced Concrete Portal**

437 In this option, a new single span portal bridge would be constructed at the existing bridge location. The new bridge will have a 10 year flood conveyance capacity. The structure will be founded on steel piles and provide a structure resistant against potential river bed scour.

- **Option B: Construct a New 5m Wide x 3.4m High Reinforced Concrete Portal**

438 This option is similar to Option A, but a wider portal is proposed. The new bridge will have a 25 year flood conveyance capacity.

- **Option C: Construct a New 7m Wide x 3.65m High Reinforced Concrete Portal**

439 This option is similar to other options but the proposed span will cover the whole washed out area. The new bridge will have a 100 year flood conveyance capacity and will be more resilient to the impact of climate change.

440 Based on the site conditions and the hydraulic requirements of the site, OPTION C, a new 7m single span portal bridge, is considered a suitable option for the location. Option C is recommended as a best solution for the site considering its flood capacity and closeness to the sea.

SP12 – Poha High Level Bridge

441 The only proposed feasible option for the site is:

- **Option A: Retain Existing Bridge + Abutment, Embankment and bank Protection**

442 In this option the existing bridge will be retained with protection works implemented for the eastern approach only including grouting under the western protection slab to improve support of the slab.

443 Based on the site conditions and the hydraulics requirements of the site Option A, bank and embankment protection, is considered a suitable option for the location.

SP13 – Tanavasa Bridge

For this site two options are considered feasible these are:

- **Option A: Existing Bridge + River Training**

444 In this option the existing structure will be retained with river training works designed for 1 in 50 years flood event implemented for the western bank and approach.

- **Option B: Construct a New 2 – Lane 28m Span Bridge**

445 In this option the existing structure will be dismantled and removed and a new bridge designed for a 100 year flood event and would be more resilient to the impact of climate change will be constructed at the existing location. As the bridge is close to Honiara and greater urbanization of the area is planned it is proposed to replace the existing bridge with a two lane single span 28m bridge.

446 Based on the site conditions and the hydraulic requirements of the site Option A, river training works, is considered a feasible and suitable option for the site considering urbanization around the area, expected increase in traffic volume and increased incidence of flash floods due to changes in the catchment area.

SP14 – Tanaghai Arch Culvert

447 The only option that is considered for the site is:

- **Option A: A New 3m Wide x 1.7m High RCBC**

448 In this option, the existing arch culvert would be replaced with a new box culvert. This would provide a 1 in 100 year flood capacity structure. The headwalls would also be replaced and suitable bed protection implemented.

449 Based on the site conditions and the hydraulic requirements of the site, OPTION A, a new single cell box culvert, is considered a suitable option for the location.

SP20 – Mberande Bridge

450 Two options are considered feasible for the site. They are:

- **Option A: Existing Bridge+ Sediment Removal + River Training**

451 In this option, the existing structure will be retained with river training work implemented. River training work is proposed to be designed for 1 in 10 year level flood event only. The damaged causeway and the damaged piles would be repaired and removal of sedimentation is proposed.

452 Use of sheet piling for river training is proposed. Sheet piling provides a flood resilient abutment and bank protection. If the road is eroded in the event of overtopping repair work can easily be undertaken with minimum cost.

453 In addition to the river training work, debris, vegetation and silt in the channel should be removed and maintained clear to provide uninterrupted flow in the channel.

- **Option B: Construct a New 30-35-30m Span Bridge**

454 In this option, the existing structure would be removed and a new three span bridge constructed 5m downstream of the existing. The downstream alignment was proposed as the existing structure can be used during construction. The bridge can be constructed at the existing location if land acquisition is an issue. This would be decided before detailed design. The new bridge would be more resilient to climate change and debris impact. An appropriately sized flood relief structure would also be installed at the existing causeway location. The bridge would be designed for a 100 year flood event.

455 Based on the site conditions and the hydraulic requirements of the site, OPTION B, a 3-span bridge, is considered a suitable option for the location. Option B is recommended as a best solution for the site considering frequent flood damage to the bridge approach and impact to the traffic.

SP21 – Kovelau Bridge

456 Three options are considered feasible for the site. They are:

- **Option A: Existing + River Training + Bed Protection**

457 In this option, the existing structure will be retained with river training work implemented to strengthen the approach embankment protection.

- **Option B: Existing + Additional 7m Long RC Portal on Western End**

458 In this option, the existing structure would be retained with an additional 7m span portal bridge built on the western end to increase the waterway area.

459 In both options, scour around exposed pile will be repaired.

460 Based on the site conditions and the hydraulic requirements of the site, OPTION B, a single span portal bridge extension, is considered a suitable option for the location. Option B is recommended as the best solution for the site considering its performance during high flood events.

SP23 – Mbalasuna Bridge

461 Two options are considered feasible for the site. They are:

- **Option A: Existing Bridge + River Training + Concrete Pavement**

462 In this option, the existing structure would be retained with river training work implemented. The river training work is proposed to be designed for a 1 in 10 year level flood event. A concrete pavement with embankment protection is also proposed. The bridge blocks during high floods and water breaches the bank. The diverted water flows over the northern approach road. Hence a concrete pavement is proposed to stabilize the road.

- **Option B: Construct a New 30-35-30m Span Bridge**

463 In this option, the existing structure would be removed and a new three span bridge constructed at the old high bridge location. The bridge would be designed for a 100 year flood event. The upstream alignment is proposed as building the new bridge at this location is supported by the community. The new bridge would be more resilient to climate change and debris impact. A flood relief structure would also be installed under the western approach road.

464 Based on the site conditions and the hydraulic requirements of the site, OPTION B, a 3-span bridge, is considered a suitable option for the location. Option B is recommended as the best solution for the site considering frequent flood damage to the bridge approach and impact on traffic.

SP24 – Ngalimbiu Bridge

465 The bridge is in good condition and the flood damage is limited to bank and abutment protection. So the proposed option is:

- **Option A: Retain Existing Bridge + Improved Bank and Abutment Protection**

466 In this option, the existing bridge would be retained with abutment and bank protection implemented. Road drainage and outlets will also be installed. The old pier would also be removed.

467 Based on the site conditions and the hydraulic requirements of the site, OPTION A, bank and abutment protection work, is considered a suitable option for the location.

10.4 Alternatives to Operation

468 The construction works will require the use of heavy machinery such as piling rigs or drivers; excavators; graders; tipper trucks; aggregate crusher and other machinery as and when required. These machines are required for the types of works that will be carried out at each site in order to repair and rehabilitate the infrastructure for provision of continuous access for local communities along the road and adjacent to the SP areas. Detours will be constructed for traffic during construction at some sites such as CBSI Culvert area, so as to allow the flow of traffic during works.

469 The rehabilitated culvert and bridge will operate in as an all-weather road. During operation, maintenance will be undertaken under the machinery based contracts.

10.5 The "No project" Alternative

470 Without the refurbishment, development of new bridges and culverts, the quality of life values of the surrounding communities will not be improved. There is a growing community in the area every year and more people will be adversely affected by the lack of proper access. This will have impacts on being able to safely transport goods to market without damage while communities will become increasingly marginalized in terms of accessing services such as medical facilities, emergency services, banks and commercial outlets.

10.6 Reasons for selection of the proposed subprojects

471 The rehabilitation of the road to an all-weather standard will improve communication and access to services to the communities living in the area. Construction of the SPs is relatively benign as no resettlement is required and there are few adverse environmental or social impacts associated with improving the access. Generally, communities consulted express strong support for the road development.

11 CLIMATE CHANGE AND DISASTER RISKS

11.1 Historic Weather Observations

472 Solomon Islands climate is hot and humid tropical with variation in rainfall and air temperature due to the vertical landscape. The climate is determined by the monsoon trough which normally is varies in length at different locations. Air temperature varies with an average maximum of 30.5o and 26.0o at low lying areas. Although inland temperatures are higher than coastal temperatures, temperature decreases with altitude. Similar to other countries in the South Pacific, Solomon Islands are highly exposed to the impacts of climate change. Air temperature and precipitation had changed dramatically overtime and had led to unexpected experienced extreme climate events resulting in economic losses and loss of life.

473 The National Adaptation Program of Action (NAPA) shows that surface air temperature for Guadalcanal taken at Henderson has increased by 1o C from measurements taken from 1962 – 2007 while the sea level has increased by +0.77mm/yr, according to the International Panel on Climate Change (IPCC). Whereas rainfall varies greatly, data provided by NAPA had shown that droughts will be expected for parts of the country due to more frequent El Nino Southern Oscillation (ENSO) effects and had predicted that there will intense and frequent tropical cyclones. Other impacts of the changes in the current climate and weather conditions include droughts; increased temperatures, coastal erosion and flooding; sea level rise; storm surges; occurrence of pests and diseases and ENSO – related changes to temperature and rainfall.

474 Regardless of deficiency of various practical data in the NAPA report to validate these expectations it will still be wise to adopt the precautionary principle and conclude that climate change will affect Solomon Islands especially the low islands. Therefore, climatic changes are assumed to occur based on the IPCC global assessment. For Solomon Islands it was found that;

- For Honiara minimum and maximum air temperatures have increased by 0.15oC every decade since 1951 and it is consistent with the Global pattern of warming. While global temperatures rises between 1.1oC and 6.4oC during the 21st century with the best estimate for temperature to rise by 1.8oC to 4oC;
- Rainfall however, show no clear trends in annual or seasonal rainfall and no substantial variation yearly since 1950; and,
- Sea level has risen around Solomon Islands since 1993 by 8mm per year, which is somehow larger than the global average of 2.8mm to 3.6mm per year which will be by 2100 rise by 18cm to 59cm as ocean water expands including glaciers and ice sheets continues to melt.

475 It was projected that for Solomon Islands there will be continuous increase in temperature and by 2030 sea and air temperature will increase by 0.4oC to 1.0oC these will result in very hot days and warm nights and decline in cool weather conditions. Average and annual rainfall is projected to be increasing over the 21st century and there will be occurrence of extreme rainfall seasons more often, including less frequent but more intense tropical cyclones.

11.2 Climate Change Impacts

476 Information on the level of risk the SP sites poses in respect of its susceptibility to the effects of climate change and natural disaster were obtained from the MECDM GIS Risk Database which was developed to enable the development of hazard maps for the Solomon Islands. The information obtained is used to determine the types of factors that need to be taken into account during the planning and designing of structures to be more resilient to the impacts of climate change. Which also include measures to mitigate the SP and nearby environment from the effects of such hazards and the effects of the project on the environment due to such usual hazards.

477 According to the hazard maps produced by the ECD GIS Risk database for the SP sites it is clear that the area are at high risk to extreme rainfall and flooding, high risk to tropical cyclones (Figure 50), high risks to earthquakes (Figure 51) and relatively low risk to coastal hazards including sea level rise as most areas are located far enough from the coast in the east. While SP sites along the North West Guadalcanal Road are closer to the coast and are likely to be affected by coastal hazards. Landslide is however mostly occurred inland during heavy unprecedented rainfall. As in April 2014, there were landslides upstream of some of the rivers which resulted in heavy silting after the flood event as it is the result for destruction and damage to most gardens which was covered by silt.

478 In accordance with the Solomon Islands National Infrastructure Investment Plan (SINIIP), south of Guadalcanal is highly exposed to strong winds, storm surges and landslide. Asset loss as a result of cyclones and earthquakes are also high in the eastern part of the island. While the Northern part of the island is always affected by extreme flood events resulting from heavy rainfall as it constitutes the major river systems on the island and most islands in the country. Hence, various adaptation measures, climate change risks and hydrology of rivers to show maximum flood levels were considered and integrated into the design of the structures that are to be constructed under the project as structures along the North East and West Guadalcanal Road are highly at risk to flood due to their location on a flood plain. Climate adaptive measures which include approach road compaction, embankment and bank protection works, and designing of more robust bridge piers and armoring for heavier flooding and extreme events.

11.3 Other Impacts

479 It was also found that damage and destruction to the infrastructure is not all on extreme flood events due to climate change but also due to human induced impacts such as logging and increased agricultural practices closer to catchment areas. That is communities consulted reported flood is usual in this part of the island and climate change only makes it more occasional occurring in periods it normally occurred in the past. As in the past the weather pattern is known as the Ara and Koburu when there is dry season and rainy and windy season along with expected cyclones between the months of November and February and flood is not too often and that destructive. However, this had changed over the years resulting in more destructive unexpected floods. Hence, communities stated that these practices or activities had altered the water catchment and resulted in unstable lands which also trigger landslide upstream resulting in severe destructive flood waters along with silt that covers the gardens and villages. It was also found during the community consultations that logging activities are increasing not only large scale but also by families or land owners. This resulted in increased debris coming down the rivers and streams blocking the structures' water way and backwashing into surrounding areas affecting gardens and villages; activate erosion and scouring and affecting the structures.

480 The incorporated designs will not only adapt to climate induced flood events but will cater for the increasing debris coming down the rivers and streams during floods. This includes increasing the waterway of culverts by widening the structures and raising the height such as the CBSI, Belamatanga Culverts, Turtle Beach and Tanaghai Arch Culverts. Replacing the Mberande and Mbalasuna Low Level bridges with High Level bridges with not too many piers to allow for debris; replacing the Selwyn (Veranaso) Causeway with a single span bridge; replacing the Aruligo Causeway with a bridge, replacing the existing the Tanavasa bridge with a new 2 lane single span bridge; protection of the bank and embankment of Sasa Bridge, Tomba Bridge, Belamatanga Bridge, Mbonege Bridge, Poha Bridge and Ngalimbiu Bridge including river training works, also widening and lengthening of the Kovelau Bridge.

12 SOCIAL AND POVERTY ASSESSMENT

481 Poverty in Solomon Islands does not mean hunger and destitution but rather means households struggling to meet basic household daily needs and expenses specifically those involving cash payments and, constant the increasing demand for household expenditure. As indicated by the analysis of the Household Income and Expenditure Survey (HIES) in 2005 and 2006 by UNDP, it was showed that the average national incidence of basic needs poverty was 18.8% of all households and 22.7% of the population. While for rural areas the rate of basic needs poverty was equivalent to 15.2% of households and 18.8% of the population.

482 Based on the HIES provincial data suggests that the remote or the most densely populated areas holds the highest proportion of poor households are Choiseul, Malaita, Makira and Temotu. On average, rural Solomon Islands households provided substantially more of their own food (58.6%) than those in both provincial urban areas (16.7% and Honiara (8.5%). The greatest difference is found among households in the lowest expenditure quintile: amongst rural families the proportion was 69% compared to 14.5% and 6.9% of provincial urban and Honiara households, respectively. These figures represents both the greater subsistence production and the levels of food security of rural households, as well as the general lack of organized markets in these areas; it also signifies the greater need for cash for food purchases in Honiara and the provincial – urban centers. Households that appear to be the least disadvantaged in terms of the poverty line are those in provincial – urban centers, followed by rural area households.

483 According to the socioeconomic baseline survey undertaken for the SP sites it was revealed that the North East and North West Guadalcanal Road will have positive impacts on the poor and disadvantaged households and its rehabilitation would certainly improve the standard of living of the people within the SP area. It is also expected to contribute to economic growth and poverty reduction by reducing vehicle operating costs, improving accessibility to market opportunities and economic and social services, as well as generating employment opportunities and income.

484 A study conducted to estimate Food Poverty Line (FPL) and Basic Needs Poverty Line (BNPL) from data collected in 2005/2006 Household Income and Expenditure Survey (HIES) concluded that the incidence of basic needs poverty over all households is estimated at 18.8%, accounting for 22.7% of the population. Honiara households recorded a poverty incidence of 24.6% while provincial urban households recorded a poverty rate of 11.2%. The incidence of basic needs poverty was estimated to affect about 32.2% of the Honiara population and only 13.6% of provincial urban population. In rural areas, the basic needs poverty was estimated to be 15.2% of Households and 18.8% of the whole population.

485 According to the HIES, 2006, 22.7% of the total population of Solomon Islands lives under the poverty line. This definition of poverty line counts 1.25 USD (equivalent to 9.96 SBD) per day per capita income1. Considering this definition, the poverty situation in the surveyed area is not encouraging. It seemed from the survey that around 62% of the households live under the poverty line. The situation is worse in Sahalu where 71% of the households seem to live under the poverty line.

486 Significant impact was found to be on the livelihood of the surveyed households due to the 2014 flooding (Table 11). The impact can be measured in terms of income loss, loss of possession, loss of crops and other assets. 71% of the surveyed households lost their income in one way or the other. On average, SBD 5,111 worth of crop was lost per household. Surveyed households also lost an average of SBD 2,654 worth of household possessions or assets. The loss was most severe in East Tasimboko in terms of value of crop and asset loss. Ghaobata also faced severe loss in terms of crop loss. Crop loss in Vulolo was not as severe as these two wards faced, but the loss of assets and possessions was quite significant.

487 Apart from these monetary losses, there were impacts on the social and economic life of the households as shown in the Table 12, which cannot be measured in terms of financial indicators. Access to school, hospitals and other social facilities became difficult. Employment opportunities also became difficult. For around half the households surveyed, access to transport became worse after the flood. For them, travel time increased, travel speeds reduced, travel comfort reduced, and passenger transport quality overall was reduced because of the 2014 flood. Damage of bridges, culverts and causeways can directly be attributed to these.

488 Housing provides shelter and security for family and individuals although it fulfills a variety of other social roles. It is an important aspect for human survival so it is a fundamental basic necessity in life. Within the SP sites as it was found that 44% of houses are traditional thatched houses; 37% are semi-permanent and only 19% are permanent houses. This is not only common in Guadalcanal but the whole of the Solomon Islands. As found from the 2009 Census Survey Guadalcanal Province has one of the highest number of houses made of local materials with 56.1% of the population having the material for walls being traditional materials; 33% of population reported flooring materials being traditional materials and 68.6% reported roofing materials being traditional materials. Although traditional houses are cooler it harbors mosquitoes and contributed to risk of mosquito borne diseases such as malaria and dengue.

[2] http://data.worldbank.org/indicator/SI.POV.DDAY

489 Therefore, housing standard can also be used as a poverty indicator as those who are advantaged economically can afford permanent materials to improve their standard of living. Although compared to the rural communities who 73% dwell in their own homes Honiara has more permanent houses which only 43% of occupants dwell in their own houses, mainly due to the fact that people own the land which they build and reside in rural areas.

490 In Guadalcanal Province not all communities accessed piped water and piped water is mainly communal. Due to untreated water supply people rarely access different sources of drinking water. However, as found majority of the people use springs and streams as well as wells and bore holes. People had also reported that piped water supply are not always functional due to lack of maintenance by the communities hence rivers and streams serve as bathing and washing areas for most of the communities. While drinking and cooking water are normally fetched by women far from the villages. From the Household Survey carried out at the villages along the SP sites in May 2015 it was found that along the SP areas most communities use the available water sources for washing, bathing, drinking and cooking. That is 63.3% of the people use rivers and streams and 34.2% use water tanks. While only 12% have their own private stand pipes; 21% access communal stand pipes; 20.4% of households used wells and 15.3% use boreholes.

491 The communities surrounding Mberande, Mbalasuna, Ngalimbiu, Konjuku (Selwyn), Sasa, Tomba, Belamatanga, Mbonege, Poha and Tanavasa use the rivers for bathing and washing and in some circumstances like in Mberande and Mbalasuna for cooking and drinking in adjacent springs.

12.1 Economic Environment

492 Guadalcanal Province is the center of economic development in Solomon Islands as it is the host of Honiara and services are readily available for people to access. The SP areas in the North East has the Palm Oil Plantations spreading over more than 10km east while in the North West farmers are more engaged in cocoa and coconut production. Based on the data collected people living in the communities produce and sale (i) Cocoa; (ii) coconut or copra; (iii) vegetables; (iv) root crops; (v) fruits; (vi) other crops; (vii) livestock; (viii) poultry; (ix) timber and (x) non – timber products. It was found that most of the people produce root crops which accounts for 72.5% of the total household surveyed; 69.9% of households; 37.2% of households produce and sale fruits; 39.3% produce cocoa; 32.1% produce and sale copra; 21.9% produce and sale other crops; 30.1% produce and sale livestock; 8.7% produce and sale poultry; 6.6% produce and sale timber and 5.6% produce and sale non – timber products.

493 Production of cocoa and copra is not common in the communities surrounding the SP sites along the north east Guadalcanal road as most of the people rely on royalty payments by GPPOL and farming root crops such kumara and cassava including vegetables. However, communities living along the North West Guadalcanal road are dependent on the production of cocoa and copra for their income as well as subsistence farming.

494 In the rural areas of Solomon Islands formal employment is scarce and limited; hence most of the people are engaged in unpaid labour in the subsistence economy and agricultural sector. People living within the SP area and areas further east and west rely mainly on the road and bridges to travel to Honiara or nearest markets to sell their produce which also include cooked food. As can be seen along the roads, selling of barbecue or roast food is now a common practice. As found during the survey, most people sell their produce at the nearest market outlets rather than on farm.

495 It is anticipated that once the bridges are improved, this will connect the roads and there will be an increase in individual household income. Transport services will be reliable and easier for transportation of produces to market outlets including Honiara. Business operators will be transporting their goods and cargo more easily and enhance their services. The community will benefit from easier and reliable access to services and facilities provided in Honiara such as health centers, banks and even schools. This will in turn improve household well-being and income thus the standard of living.

12.2 Socioeconomic Benefits

496 There will be an improved access to Honiara after the repair and rehabilitation of the bridges, culverts and causeways in North East and West Guadalcanal. As found people living within the SP sites and those living further have been experiencing limitations to access important services and facilities such as markets, schools and health centers due to the poor or damaged infrastructure. In some cases people have to carry heavy weights and even cross rivers with their farmed produces including copra and cocoa to get to buying points. Women especially have to walk long distances with their children to reach the nearest health center and schools to have their children immunized and checked regularly, and attend schools. Women also encounter problems with accessing markets to sell their produce due to poor infrastructure resulting in unreliable transport services.

497 It is foreseen, that by improving the bridge infrastructure to enhance connectivity to the rural communities there will be improved access to markets; schools; health centers and other facilities within Honiara and surrounding areas. Also people will be motivated to obtain their own vehicles; access to other resources will be easier; travelling will be improved, comfortable and reliable, and time travel will be reduced.

498 Opportunities will be available for the poor and disadvantaged especially women during construction and after construction, reduction in the number of people walking with loads of produces before travelling to the market and employment will be available as part of road maintenance.

12.3 Potential Negative Impacts and Risks

12.3.1 Conflicts

499 One of the main social risks associated with the project is potential conflict arising between the local land owners or residents of the communities within the SP sites and the contractor. That is if workers abuse the rights of the people and disrespect women and girls in the communities. This may include sexual harassment or abuse; rape; lead on women and girls into sexual relationships; damage properties; theft; drunkenness and disrespecting people, and causing socially related problems with local men and outsiders.

12.3.2 Risk of Spread of Communicable Diseases

500 The transmission of communicable diseases such as Sexually Transmitted Infections (STIs) and Human Immuno – Deficiency Virus (HIV) is likely to occur during the project implementation phase by infected workers or locals. This is possible if workers are engaged in commercial sex or prostitution and sexual relationship with local women and girls, or men. The risk of spreading STIs or HIV associated with the project is related to a number factors, this include; (i) Current knowledge about the risk of spreading the diseases; (ii) period of time the contractor and his workers will be occupying the site and (iii) Engagement of workers in high risk behaviors such as increased alcohol consumption and having multiple partners.

12.3.3 Impacts on Health and Safety

501 Health and safety hazards are also likely negative impacts of the project during the implementation phase caused by machinery and emissions. This include, (i) air pollution; (ii) noise; (iii) contamination of water bodies especially water supply or source; (iv) disposal of waste water; (v) risk of accidents during works at work sites and (vi) traffic and work safety issues. These health and safety issues are dealt with in the Environmental Management Plan (EMP).

12.3.4 Other Social Impacts

502 Construction of contractor's camp can put pressure on the natural resources and infrastructure of adjacent communities that could result in resentment between people and the contractor. To avoid such problems arising in the SP areas, contractor along with the MID should consult the communities for suitable and preferred locations for the camp and negotiate on a lease with the land owning group. This consultation process will be adapted if another camp is needed by the contractor with provision of temporary facilities.

503 Within the camp site the contractor will provide temporary health care facilities; mess and dormitories for workers; a chef or cook and provide meals; water and electricity and telecommunication facility in order to not burden the existing facilities. After the completion of works and all activities relating to the project the contractor is liable to remove the temporary structures and reinstating the land to its pre – project condition.

12.4 Resettlement and Land Issues

504 There will be no land acquisition required for seven of the eight prioritized SP sites as construction works will for the most part be on the existing Main Guadalcanal Road alignment. The only exception is for Mberande in which there will be a minor realignment. Land acquisition matters have been discussed with the land owning groups of both the eastern and western end of Mberande River and are still ongoing as there are some issues relating to the land. In order to avoid such problems it is vital to consult with the communities and land owners regularly to gain their support and approval for the project to continue.

12.5 Gender Assessment

505 Generally women represent near half of the population with a ration of 102males per 100 females, as recorded by WHO in 2009 and the fertility rate of women aged between 15 and 49 years is in the order of 4.6.

506 The Community Sector Program (CSP) reported that 91% of rural population depended on selling goods, agricultural products and handicrafts including woven baskets and that 70% of women produce and sale products and goods at the markets. These informal activities are an important source of income for women. It was also reported in the Demographic Health Survey Data that 54% of women aged 15 years and older are economically active however only 15% of women (compared with 31% of men) are employed formally or paid for working. As found by the UNDP Common Country Assessment study on women's' traders in informal economic activities, two thirds of women are self-employed and that most are engaged in small businesses as it is the sole income earner for half of the female traders. Included that more than three quarters of women spend more than 16 hours per week on income generating activities.

507 That is 38% are engaged in gardening; 21% in food preparations; 15% in crafts and 11% in textile production. Not all the women are well educated with 20% having no formal education and half reaching primary education while a quarter of the women in trading are illiterate.

508 Gender inequalities in education is of major concern almost everywhere in Solomon islands particularly in the villages and rural areas where more males attend formal education than females including males attain higher qualification than females. One main cause of this is when school fees are unaffordable families mostly parents tend to withdraw their daughters rather than sons from attending school and concentrate with household chores or married them off.

509 Violence in the homes or domestic violence and violence against women remains a key issue among families in the Solomon Islands and the country was recorded as having one of the highest rates of violence against women. In 2002, Solomon Islands were ratified under the Convention on the Elimination of All Forms of Discrimination and Violence Against Women (CEDAW). In order to end discrimination against women and the Government responded in support by the Government who also established a national policy to eliminate violence against women.

510 As in most rural Solomon Islands community the women and men in the communities surrounding the SP sites has different roles, needs, perceptions and responsibilities. But there is an equal distribution of labour between men and women with women working longer hours than men in routine tasks to maintain their homes. Women and young girls are usually involved in home- based works and heavily involved in household chores like cooking, washing, collecting firewood, fetching water, cleaning and sweeping, looking after the young children and ensuring education and health needs of the family are met.

511 From the survey undertaken in July 2015 for TSFRP, it was found that women in communities surrounding the SP sites are more involved in household activities with 58.2%, agricultural activities with 47.4% and household industries with 43.4% including trade and business with 35.7%. When it comes to decision making women are more involved in making decisions relating to own family's or household matters with 59.7%' 57.7% claiming women involved in decision making for household financial matters; education and health welfare of children while 55.6% of households claimed women involvement in purchasing of household assets and household daily activities; and other activities only 12.2% of household claimed women are involved in decision making.

512 Women are also involved in selling and producing to meet household income due to the demand of household needs and security for the family. Security is mainly a key responsibility of the household head which in most cases are males to ensure protection of their children and household as a whole. Additional roles played by women specifically taking over the role of the male in a household headed by a female is very demanding, tiring and strenuous for women. Improved infrastructure as stated by women during the Community Focus Group Survey in May 2015 is a key to reducing hardships to women who are carrying out family roles as a mother and father at the same time. That is this will improve transport services making it easier to travel to market outlets and if traffic along the roads increase it is more likely that women will tend to road side marketing than carrying their produces to Honiara most of the time as it is becoming more expensive compared to the past.

513 Sick people, women and children access health centers that are considered the closest. For communities living along the North East Guadalcanal Road up to Mberande they access Clinics at Ngalimbiu for those closer to Ngalimbiu and Good Samaritan Hospital for those living as far as 10Km away including communities surrounding Mbalasuna, Kovelau and Mberande. While communities living surrounding Selwyn (Veranaso) Causeways on the North West Guadalcanal Road access Selwyn College Clinic; those at Tambea access Visale, and communities surrounding Sasa, Aruligo and CBSI access Kohimarama Clinic about 7km away. Communities within the area surrounding Tomba access Tamboko Clinic, and those surrounding Belamatanga, Mbonege, Turtle Beach Culvert, Poha, Tanavasa and Tanaghai Arch Culvert access Marara Clinic and White River or Rove Clinics in Honiara. However, for cases such as women in labour and very sick children including major accidents and injuries are attended to at the National Referral Hospital.

514 Children have equal access to education facilities which include both Primary and Secondary Schools including Early Childhood Education (ECE). For children surrounding in communities surrounding the SP sites in the North East they access Talaura (Primary); Ngilo (Primary); Nguvia (Primary and Secondary) and Ngalimbiu Primary School. Whereas children living in the communities surrounding the SP area along the North West Guadalcanal Road access St Francis Primary School, Visale School Primary and Secondary Schools, Tamboko Primary and Secondary School, Selwyn College; Vulughe (Primary)and Tanaghai (Marara) Primary and Secondary Schools. However, it was found that more males attend school compared to females and as found in the Census Survey Report it was reported that in Guadalcanal Province only 87.1% of females are literate compared to 90.5% of males. As most female members of family are subjected to assist with the household chores as part of the culture of the Solomon Islands, hence if parents cannot afford their children's school fees it is always the female member of the family to be affected by their decisions not considering who is the smartest and willing to be educated. In terms of education attainment 55.2% complete Primary Education; 17.9% completed Secondary Education; 3.6% completed Tertiary Education and 0.8% completed vocational or professional education.

515 The repair and rehabilitation of the bridges, culverts and causeways along the North East and West Guadalcanal will benefit the communities especially those who are highly involving in income generating activities such as women; those that need to access health and education facilities and other services and facilities provided in Honiara. Better accessibility to major services and facilities is

very important to the people residing along the roads and further east and west, for both vehicles and pedestrians, improvement in road safety; immediate service delivery on planned delivery dates to the rural communities for plantation services; and easy transportation of farmed or garden produces by local producers to market outlets particularly Honiara as the main commercial center. The construction activities will also be employing local people involving women and men for unskilled jobs, and road maintenance to follow suit so as to improve rural based income generating activities. These activities will very likely improve the standard of living of the poor and vulnerable families or groups.

13 IMPACT ASSESSMENT AND MITIGATION MEASURES

516 This section provides an assessment of the identified possible negative impacts on the physical and biological environment, social environment including socioeconomic, health, livelihood, and valuable resources. It also identifies mitigation measures to ensure the possible negative environmental and social impacts will be avoided or managed and reduced to an acceptable level.

517 The duration of the impact is measured according to the scope of work and the period of time the works will be carried out including the physical and biological environment of the SP site. But the degree of impact may be negligible, minor, marginal or significant if not mitigated.

13.1 Impacts of Bridge Repair and Rehabilitation Activities

518 Each environmental factor which could be affected by implementation of the project has been addressed, and the scope and importance of each potential environmental impact assessed. The following definitions of significance of impact have been used in the environmental impact screening (ADB, 1997).

- **No impact**: A potential impact is assessed as having no impact if the project activity is physically removed in space or time from the environmental component, or if the impact is so small as to be un-measurable (i.e. negligible). No mitigation measures are required for project activities that will create 'no impact';
- **Minor impact (positive or negative)**: For environmental resources: the project affects a specific group of localized individuals (plants and animals) within a population or a habitat over a short time period (one generation or less), but does not ultimately affect other trophic levels or the population itself; or For social values: activities of resource users or local communities in the project area are not affected measurably beyond a minor disturbance of resource use or local activities, from which recovery is relatively quick;
- **Moderate impact (positive or negative)**: For natural resources: The project affects a portion of a population or habitat and may bring about a change in abundance and/or distribution over one or more generations, but does not threaten the integrity of that population, or any population dependent upon it; or For social values: a short-term effect upon the social and economic well-being of resource users or local communities using the project area may also constitute a moderate impact, but from which recovery is expected within 3-6 months.
- **Major impact (positive or negative)**: For natural resources: The project affects an entire population or species in sufficient magnitude to cause a decline in abundance and/or change in distribution beyond which natural recruitment (reproduction, immigration from unaffected areas) would not return that population or species, or any other populations or species dependent upon it, to its former level within several generations; or For social values: the project affects a subsistence or commercial resource use, business activity, or social behavior to the degree that the well-being of the user or local community is affected over the long term;
- **Unknown impact**: The potential impact of the project will be assessed as being unknown if the magnitude of the effect cannot be predicted for any of the following reasons; (i) the nature and location of the project activity is uncertain; (ii) the occurrence of the environmental component within the study area is uncertain; (iii) the time scale of the effect is unknown; or (iv) the spatial scale over which the effect may occur is unknown. Where possible mitigation measures are identified for impacts categorized as 'unknown impacts'.

519 Determining the scale of impact depends on (i) spatial scale of the impact (site, local, regional, or national / international); (ii) time horizon of the impact (short, medium, or long term); (iii) magnitude of the change in the environmental component brought about by the project activities (small, moderate, large); (iv) importance to local human populations; (v) compliance with international, national, provincial, or district environmental protection laws, standards, and regulations; and (vi) compliance with guidelines, policies, and regulations of Solomon Islands and ADB.

520 Where potential major negative impacts are identified, mitigation measures are developed to reduce them to acceptable levels. Where this is not possible, major negative impacts can act as a trigger for further detailed environmental impact assessment.

521 There are several types of impacts to be considered. Direct impacts are caused by a project activity, and occur at the same time and place and can be created during both project construction and operation. Direct impacts will occur in this project because the work will include new bridges to be built. Indirect impacts, which may include growth-inducing impacts, are caused by a project activity, or the overall project, and while they are later in time or farther removed in distance, they are still reasonably foreseeable.

522 Short-term impacts, like the noise and fumes associated with heavy equipment occur during road construction and are usually without long-lasting effects. Long-term impacts, on the other hand, could affect regional land use and development patterns and even mobility and migration. The project, however, is limited to relatively small-scale bridge and access road construction and the majority to rehabilitation works and maintenance of an existing road. There is little scope for long-term environmental impacts arising from these developments in the SP area.

523 Impacts created during construction activities are dependent on a number of factors including the temporary use of land and its rehabilitation post-construction, 'best practices' being employed during construction activities, coordination and cooperation with local authorities in terms of impact management, and strict enforcement of environmental conditions included in project bid documents and specifications and adherence to a comprehensive EMP.

524 The environmental screening for the project identifies the range of potential environmental impacts that could occur from the construction, rehabilitation and maintenance activities proposed. Where the environmental impact is deemed to be major (or significant) mitigation measures are provided, generally to be incorporated into the project design documents. The summary is based upon the Checklist of Environmental Parameters for Highway and Road Projects in (ADB, 1993).

13.2 Impacts during Preconstruction

525 The potential environment and social impacts for rehabilitating the West and East Guadalcanal bridges and culverts have been identified and its importance assessed. The durations of the impacts are assessed based on the scope of work as well as the physical, biological and social environment in the SP site. Mitigation measures for each potential environment and social impacts are designed to avoid and minimize the impacts. Mode of impacted may be negligible, minor, marginal, and significant based on the impact itself and if it is un-mitigated.

526 Pre-construction impacts are limited to the following activities:

- Identification and demarcation of the approach roads, bridge and culverts;
- Site clearing within the road reserve, borrow pits, quarry sites and materials storage yards;
- Land restrictions;
- Top soil recovery; and
- Transportation of equipment and construction materials (e.g. gravel, coronous, sand, cement, gravel, bridge materials etc.) to the site.

13.2.1 Physical Environment

Landform/Geology/Geo Hazards

527 During the preconstruction phase of project implementation, it is projected that activities attendant to the development will have very little impact on the landform and geologic processes (floods, erosion and deposition). The implementation of these activities would not result to the modification of regime, land transformation and construction.

Soils

528 Site preparation works during the pre-construction stage of the project would involve the establishment of temporary office/camps for workers, geotechnical investigation, survey and minor clearing works on site. The scale of these works is relatively minor and will have no significant impact to the receiving environment because no earthmoving works will be required during the establishment of these camps.

Water Quality

529 Potential contamination of waters may occur as a result of the establishment of the temporary workers facilities and the minor clearing works for geotechnical investigation and survey. Domestic wastewater and solid waste from the camps may inadvertently be discharged/ dumped into the adjacent waters. It is also projected that an increase in turbidity levels of the waters may occur resulting from minor clearing works that will be involved. This impact is temporary in nature and insignificant in scale and any slight increase can be immediately dispersed by dilution from rainfall.

530 Silt traps will be established around areas identified for clearing to prevent siltation of the surrounding waters. Potential contamination to coastal waters and rivers from solid waste, sanitary waste and turbidity from the works above are expected to be minor and temporary.

531 The camp will install proper sanitary latrine and waste collection facilities at the proposed camp site. All solid waste produced at the camp site will be collected and disposed regularly at a designated dump site approved by the communities and CPIU. Chemicals will be stored in secure containers 30m away at raised levels from the rivers or coastline to avoid pollution to these water bodies.

532 Other mitigation approaches includes:

- Development footprint will be provided with effective drainage systems which will avoid direct discharge to rivers or foreshore e.g. sediment settling pond;

- Silt traps will be constructed to prevent siltation of the surrounding waters;
- Chemicals stored in area or compound with concrete floor and weatherproof roof and fire extinguishers;
- Spills will be cleaned up as per emergency response plan; and,
- Air Quality

533 The establishment of the temporary site office/camps and the minor clearing works in the area may cause temporary increases in the concentration levels of Total Suspended Particulates (TSP). The generation of SO2, NO2 and other gaseous materials is an unavoidable impact of the pre-construction and construction works, which is a direct result of the operation of fossil fuel burning equipment, vehicles and machinery. The projected duration of this impact is short-term and is insignificant in scale. Air pollutant concentration can be easily dispersed by the active wind movement.

534 The clearing works will only be undertaken when necessary and will be limited only to the required areas. This will also minimize the risk of the workers contracting upper respiratory diseases as a result of excessive inhalation of dust particles. All vehicles, equipment and appurtenant facilities that will be mobilized into the site will be inspected by third parties who will certify their worthiness for the job. These will likewise be properly maintained during the progress of the Works.

535 The emissions of gaseous compounds impacting air quality from the activities above are expected to be minimal. Development of dust at any stage will be minimized through regular spraying of water at exposed site. Mitigation measures include:

- Provide workers with nose protection equipment e.g. mask;
- Maintain construction and maintenance equipment; and,
- Prohibit use of tools and equipment that causes excessive pollution.

Ambient Noise

536 The activities during the pre-construction phase of project implementation may cause an increase in noise levels in the vicinity of the development works primarily due to the operation of machinery, equipment and vehicles.

537 All equipment, machinery and vehicles will be properly maintained and installed with mufflers. Works will be limited only during day time (7:00AM – 5:00PM) to minimize nuisance to the nearby school and communities. In addition, the work area will be fenced off with appropriate materials that will act as barrier and absorbent of noise to tolerable levels. Access of unauthorized personnel to the work areas will be prevented to avoid exposure to risk of high noise levels. Workers and staff working on areas with high noise levels will be provided with ear muffs or plugs.

13.2.2 Effects of Climate Change and Adaptive Design

538 The construction works at the SP sites will not create any impacts on the rainfall, cause unexpected ground water depletion or emit much carbon into the atmosphere which could affect the risk of or induce climate change.

539 Climate change adaptive designs were integrated into the design of the structures to allow for maximum flood levels and water flow during floods taken into account the hydrology of the rivers and streams. Climate change adaptive designs include;

- Rehabilitation of approach roads and bridge approaches;
- Bank and embankment protection works;
- River training and sheet piling works;
- Construction of high level bridges;
- Replacing of existing culverts with larger single portals; and,
- Replacing of Selwyn (Veranaso) causeway with a single span bridge.

13.2.3 Biological Environment

540 For most of the structures the approaches and approach roads were already cleared in the past except for realignments at Mbalasuna and Mberande Bridges and sites requiring areas for works which will involve the removal of some cocoa trees, sago palm trees, slippery cabbages, teak trees, bananas, coconuts and some root crops including grass and shrubs. It is important to note that for most of the sites there is regrowth partially covering the unsealed approach road sides, and that the Mbalasuna Bridge realignment is at the previous bridge site which had been cleared in the past. Further, the Mberande Bridge realignment is at a location which is usually affected by floods and cleared by locals for gravel extraction. Vegetation at realignment locations is mostly regrowth.

541 There will be minor impacts on terrestrial habitats and flora at the SP areas due to surveying, demarcation of the approach roads, clearance of stock pile areas at the bridge sites At the sites there are enough space for stock piling materials unless a new site is required by the contractor, then that has to take into account in the Contractors Environmental Management Plan.

542 Various plant species found on site are either introduced and invasive species or pervasive native species, which can strive in almost all environmental conditions and can tolerate disturbances. Within the area of impact there is no species of plants or vegetation with conservative values or representative of the original vegetation of the island but are mostly common species in the area and other islands in the country.

543 Identified mitigation measures to minimize the impacts of works on the vegetation and removal of vegetation for the project include:

- Clearing of vegetation during surveying and demarcation activities, particularly of trees along the river banks, slopes and road sides will be minimized;
- The contractor is not required or permitted to clear vegetation or fell trees not required to be removed;
- Construction workers are required to be inducted on the general environmental protection and hazards of each SP site and the need to minimize or avoid unnecessary clearing of vegetation or felling of trees where ever possible; and,
- Under no circumstances is the contractor permitted to fell or remove mangroves.

Establishment of the Construction Camp

544 Establishing of the contractor's camp will create temporary effects such as vegetation clearance and removal and possible unearthing of archeological artefacts or resources. The camp will be sited on an appropriate area, identified through consultation with villagers and land owners as per the Communications Plan so as to limit the impact of clearing and soil tipping on the environment.

13.2.4 Social Environment

Restrictions on Use of Land

545 Infrastructure rehabilitation works normally has direct and indirect impacts on the people living within the vicinity of the area, and restrictions to use of land is common. For the MID, it is a normal exercise to compensate land users or affected persons for their crops, trees or structures if the properties will be affected by the works. The Project will require a resettlement plan which will cover the affected properties and the realignment at Mberande. There will be realignment to previous bridge locations at Mberande and Mbalasuna Bridges which will require additional lands within the existing road corridor. Land owners had been consulted and notified about this realignment and this will be acquired by the MID through the Land Acquisition Process that will be prepared for this project. But initially, MID will negotiate with the land owners on an understanding that MID will acquire the land on a later date but will use the area for the bridge through signing of a Memorandum of Agreement (MoA).

Accidental Discovery of Archeological Artefacts, Sites and Resources

546 Any site clearance, digging and excavation activities undertaken during pre – construction can unearth archeological artefacts, sites or resources. In the event that this might occur, the contractor shall cease works instantly and inform the authorities (National Museum Tabu Register of the Ministry of Culture and Tourism and MECDM).

547 The activities will resume when the authorities have signed – off that the site or artefact or resource have been dealt with appropriately and advise that work shall start.

548 The contractor shall be responsible for complying with the requirements of the authorities and the CPIU shall monitor the compliance.

Contractor Mobilization

549 With the mobilization of the contractor and initial establishment of work sites, construction workers will be present on site and association with local people will occur. Prior to the mobilization of the contractor to the site, CPIU and the project's Community Development Specialist will inform the contractor of such and establish the communications protocol between the project and community as per the projects consultation and Participatory Plan. The contractor will then appoint one member of their staff to be the focal contact person liaising between the village chiefs and elders and the contractor, as well as between the contractor and the CPIU.

550 The presence of construction workers can also lead to risk of spreading of communicable diseases as discussed in detail in Section 14.5.5.

551 Measures identified to minimize disturbance by construction workers and presence of the camp or work sites/ areas include;

- Village protocols will be discussed with workers as part of awareness and mobilization training;
- The contractor is to make sure that actions outside the work site are controlled and village codes and rules of conduct are observed at all times;
- The contractor shall appoint one member of their staff to be the Community Liaison Officer to liaise between the contractor, communities and CPIU;
- Proper and appropriate signage are to be provided and erected at the camp and work sites to prevent unauthorized entry of people include children into the camp or work areas including workshops;
- Provision of adequate information to the general public and people in the vicinity of the work sites including notifying them well in advance of the date of commencement of works, putting up protective barriers if required by the villagers and signage to mark out the work areas;
- Provision of safe access across the work sites for people whose villages and access are temporarily hampered during the repair and rehabilitation works;
- Construction workers should be restricted to the SP boundary, immediate work sites and camp sites; at all times respect village and land owners' boundaries and be aware of village rules and terms of conduct particularly on addressing women and girls including elders; avoid damaging or poaching productive trees and gardens, access to beach or foreshore, access freshwater springs and rivers and streams in order to avoid or reduce risks associated with other social impacts; and
- Implement STIs, HIV/AIDS and reproductive sexual health awareness programme and provide protection and prevention measures for the construction workers and adjacent communities.

13.3. Impacts during Construction

552 Construction impacts include the following activities:

- Earth movements, excavations and stockpiling;
- Operation of borrow pits, quarry sites and cement;
- Stockpiling of construction materials such as sand, gravel, coronous, cement;
- River training, installation of bridge structures and add approach rehabilitation, culverts;
- Install sheet pile, gabion baskets;
- Transportation of construction materials such as sand, cement, gravel, coronous and soils;
- Extraction of river gravel and coronous materials; and,
- Restoration of quarry sites, burrow sites and gravel sites.

13.3.1 Physical Environment

Impacts on Landform/Geology/Geo-Hazards

553 During the construction phase of project implementation, the project will cause some negative impacts on the immediate geologic environment and landform of the site because the works will involve excavation of fill material from within the area. The required volume has been determined during the detailed engineering design phase of the project.

Impacts on Soils and Coastal Erosion

554 Existing patterns of erosion, soil characteristics and topographic conditions will be taken into account in the detailed design of the SP by the contractor. Certain types of road improvements, e.g. road reshaping or widening, can result in increased runoff and/or increased velocities that could lead to loss of soil.

555 The potential impacts on soil, or from erosion, during construction are from (i) sediment contamination of streams, rivers, and the in-shore area including turbidity impacts on the marine environment (including sea-grass beds and reefs) by construction activities; (ii) loss of agricultural soil or soils of productive value; (iii) extraction of materials from streams or rivers and/or borrow pits; (iv) conversion of the existing land uses such as agriculture and grassland for stockpiles of materials; (v) soil erosion and loss of protective vegetation in areas of slopes or un-compacted embankments; and (vi) soil contamination from fuel, chemicals and/or construction material spillage.

556 There will be little loss of soil of agricultural or productive value as the project does not cross any lands currently being used for gardens or plantations. The works will be largely confined to the existing road and immediate right-of-way. Excavation for materials or location of material stockpiles is not permitted on agricultural or potentially productive land (including land identified as garden land).

557 Land between the coast and the SP road will not be used for sourcing gravel and coronous, or location of borrow pits, or stockpiles. Therefore no conversion of land from productive or livelihood uses will occur.

558 Potential soil impacts and coastal erosion will be mitigated by:

- All required materials will be sourced in strict accordance with Government guidelines and the EMP;
- In the event that the contractor causes damage to agricultural land, productive land or gardens, the contractor is solely responsible for repairing the damage and/or paying compensation;
- The side slopes of embankments, including the river bank areas surrounding bridges and approaches will be protected and designs used that protect soils as included in the project specifications in order to reduce erosion. Gabion baskets should be used around bridge abutments to reduce scour and erosion;
- Embankments and in-stream/river activities will be monitored during construction for signs of erosion. Stones and rocks should be kept on hand for work in location of stream and river which can be used in the event that there is bank or channel erosion;
- Gabion baskets or sand bags will be used to both strengthen the road and to prevent coastal erosion where the road passes close to the shore;
- Random and uncontrolled tipping of spoil, or any material, will not be permitted;
- Suitable tip sites will be designated in consultation with land owners and village chiefs. Tip sites will not be permitted on the coastal side of the SP road or on garden land or in areas used for livelihood production by villagers; and,
- Acquisition of all necessary permits or approvals for location of construction camps, material extraction sites and sources of construction materials as per the extraction guidelines from MID and government agencies (such as Provincial Government and MECDM) prior to any construction or erection of camps and extraction of material.

559 It should be noted that a number of the mitigation measures (compacting, installment of gabion baskets or sand bags, drainage and re-vegetation) will provide long-term environmental benefits by reducing soil erosion and sedimentation of surface waters while replacing damaged culverts and providing well-constructed drainage will reduce localized flooding.

Impacts on Water Quality

560 Loose soil and debris during the works may affect water quality through siltation/sedimentation, and increased turbidity of the surrounding channel waters. The operation of heavy equipment will likewise contribute to the sedimentation from silt and mud at the project site especially when erosion and sedimentation rates are exacerbated by accompanying rainfall. Other potential sources of negative impacts include contaminants from fuel and lubricating oil (from heavy equipment, other vehicles and machinery), and the washing of mixers and other vehicles and machinery.

561 Camps, offices and appurtenant facilities will require ample water supply both for drinking and processing. During the construction phase of the project, adequate supply of potable water will be utilized for both domestic purposes.

562 Unsanitary discharge of sewage and other effluents from active Work Areas may potentially cause contamination of nearby water bodies. Mitigation measures will include provision of on-site sanitary facilities either through construction of septic tanks or provision of temporary toilet facilities and implementation of proper sanitation practices among the workers.

563 All hazardous materials, including fuel, required during construction will be kept in a sealed area offsite. In addition, oil and grease traps will be installed in drainage systems of the following areas: workshops, vehicle and equipment maintenance, and fuel storage.

564 The Project has the potential to create some temporary and minor adverse impacts on water quality including (i) increased turbidity and downstream siltation created during the removal of gravels and (ii) an increase in silt loads at culverts and the bridge to be constructed, (iii) construction materials such as small gravels, coronous, sand, and fill, being “washed out” into streams, rivers and to the coast during rain, (iv) hydro-carbon leakage and/or spills from vehicles and plant or workshop/storage locations, and, (v) discharge of waste-water and sewage from work camps to local streams and rivers. In addition to a number of the items employed to mitigate soil impacts and erosion effects above that will also mitigate adverse effects on water quality, the following measures will be included in the engineering design and EMP:

- Sediment controls such as silt fences or other sediment reducing devices (rock dams or silt barriers), to prevent both siltation and silt migration during works being undertaken in the vicinity of streams, rivers and the coast. Extra care and precautions will be taken in areas adjacent to mangrove strands and the inter-tidal zone;
- Minimizing interference with natural water flow in rivers, water courses or streams within or adjacent to work sites. Abstraction from and pollution of water resources will not be permitted;
- Waterways, streams and intertidal areas will be protected from pollution, silting, flooding or erosion as a result of project

activities;

- Sediment control devices will be cleaned and dewatered, discharges will not be to the rivers, sea or intertidal areas. Consultation with land owners and village chiefs will identify suitable land-based areas for settling ponds or discharge areas;
- Solid wastes, debris, spent oil or fuel from construction machinery or plant, construction material, or waste vegetation removed from work sites will not be dumped along the coast, or in or near streams, rivers or waterways;
- Construction activities in the vicinity of streams or rivers, culvert placement and bridge reconstruction, will be undertaken with extreme care of the immediate environment, particularly of the riverbanks. The use of heavy equipment in the aquatic environment will be minimized as far as is practicable;
- Following completion of culvert or bridge works the stream or rive r bed will be returned to its original configuration;
- Under no circumstances is the contractor permitted to fell or remove mangroves;
- Rivers, streams, and the coastal side of the road, as well as villages, will be kept free from debris and any material or waste arising from project works;
- Hydro-carbons, fuel, and other chemicals as required for the works, will be stored in secure containers or tanks located away from the coast, surface waters, or streams. Any spills will be contained and immediately cleaned up as per the requirements of the emergency response plan prepared by the contractor (and approved by CPIU). Any contaminated soil will be handled in consultation with Provincial Development of Works and land owners;
- Construction camps will be equipped with sanitary latrines that do not discharge directly to or pollute surface waters and waterways; and,
- All water, waste-water and other liquids used or generated by project works and activities will be collected and disposed of in an approved manner and in an approved location. Such disposal will not be permitted to cause either pollution or nuisance.

565 The Project also has the potential to create some longer term environmental benefits through rehabilitation of the earth sections and overlaying with properly compacted coronous or other base material.

Impacts on Air Quality and Risk of Climate Change

566 The air quality of the SP area is pristine due to lack of industry and a very small vehicle fleet. The construction activities will have minor and temporary impact on local air quality through emission of exhaust from vehicles and through dust generation from vehicles transporting materials and from exposed stock-piles of material.

567 There are no air quality or emission standards in Solomon Islands, and as the project is not a 'green-fields' development nor is it highly polluting, preparing a baseline for subsequent monitoring is not considered warranted. Overall, the improvement of the crossing will result in reduction of dust emissions as a result of proper compaction and pavement of the road surface approaches to bridges and culverts.

568 There are a number of good engineering practices that can be employed to ensure that any air quality impacts generated during construction are mitigated. These include:

- Construction equipment being maintained to a good standard. The equipment will be checked at regular intervals to ensure they are maintained in working order and the checks will be recorded by the contractor as part of environmental monitoring;
- Prohibition of the use of equipment and machinery that causes excessive pollution (i.e. visible smoke) at the SP site;
- Ensuring that all vehicles transporting potentially dust -producing material are not overloaded, are provided with adequate tail -boards and side-boards, and are adequately covered with a tarpaulin (covering the entire load and secured at the sides and tail of the vehicle) during transportation. This is especially important as there are a number of villages along the road;
- Material stockpiles being located in sheltered areas and be covered with tarpaulins or other such suitable covering to prevent material becoming airborne;
- Damping down of the road, especially in the vicinity of the villages along the road and any roads being used for haulage of materials, during the dry season; and,
- Periodic qualitative air quality monitoring (by observation rather than testing).

569 The project is localized and will at maximum provide a new bridge crossing, culverts, small bridges and rehabilitate the existing main road. Potential impacts on river water flows and flooding can be adequately mitigated through design measures and are unlikely to be affected by climate change. Other Climate Change Adaptive (CCA) measures include:

- Existing culverts will be replaced with larger box culverts and reinforced concrete pipes;
- Construct bridge;

- Improve drainage systems;
- Construction of embankments of a number of places; and,
- Ensure regular maintenance.

570 The Project will not create any impacts on rainfall, unexpected groundwater depletion, or carbon emissions, which in turn could affect the risk of, or induce, climate change.

571 Air quality in the immediate vicinity of the construction area may be affected by the increased activities during project implementation. There will be temporary elevated levels in the concentrations of TSP, SO2, and NO2 as a result of the development in the area due to the use of diesel fed equipment and dust.

572 Human and vehicular activity in the work areas will invariably increase, which would trigger an increase in the level of air contaminants, specifically SO_2 and NO_2. However, the increase is not expected to cause concentrations that will be detrimental to human health as the area is well ventilated by fresh winds.

573 The works to be undertaken in the work site are expected to contribute to dust generation resulting in increased levels of Total Suspended Particulates (TSP). As experienced in other similar Works, the generation of dust if not controlled or mitigated, could increase the TSP concentration to as high as 500 ug/Ncm. These identified impacts are transient, temporary and short-term, thus considered insignificant. The expected adverse impact on the air quality in the area is minimal.

574 Dust generation will be minimized and controlled by regular water spraying of exposed areas to prevent the occurrence of accidents due to limited visibility in work areas. This would also minimize the risk of the workers contracting upper respiratory diseases as a result of excessive inhalation of dust particles.

575 The generation of SO_2, and NO_2 and other gaseous materials is an unavoidable impact of the construction works, which is a direct result of the operation of fossil fuel burning equipment and machinery. The operation of vehicles is also a contributory element in the production of these gases.

576 All vehicles, heavy equipment and appurtenant facilities will be properly maintained during all the Works. Appurtenant facilities will be sited in areas where nuisance to settlement and institutional areas will be minimal. Appropriate methods and equipment will be utilized for the collection; disposal and prevention of dust as a result of the operation of these facilities.

Impacts on Ambient Noise Level

577 The construction works would inadvertently result in increased noise levels in the area. During the Works, the operation of heavy equipment and various construction machinery are primary noise generators. It is projected that noise levels could reach from 65 to 80 dB (A) at peak times.

578 Noise generation is another negative and unavoidable impact of the project, albeit temporary in nature. Construction work will be undertaken only during daytime (7:00 AM to 5:00 PM). Only in extreme instances will work beyond these hours be allowed. Proper information and notification of the concerned community will be conducted to prevent disturbance and nuisance to nearby areas.

579 The operation of heavy equipment and other appurtenant facilities will likewise be limited during daytime. In case operation beyond these hours is required, proper notification and information of the concerned community will have to be conducted to prevent disturbance and nuisance to nearby settlement areas.

580 Vehicles, heavy equipment and other machinery will, at all times be properly maintained and fitted with noise abatement accessories to the extent possible, to minimize excessive noise generation. Whenever possible, buffers and other noise abatement measures will be established in work areas and campsites to minimize, or if at all possible, eliminate nuisance to nearby communities.

Construction Impacts from Aggregate Extraction

581 Aggregate extraction for rehabilitating the road and bridge approaches, gabion baskets and stone pitching will be from four selected sites in the North East and North West Guadalcanal. That is, Ngalimbiu River and Lunga River in the East of Honiara and Poha and Tamboko Rivers west of Honiara. Materials that will be used for gravelling and concrete mixing will be crushed to approved standard sizes according to the Engineer's specification. The Contractor however, is expected and required to extract fill materials from areas that was already approved by the Ministry of Mines and Energy (MME) otherwise, a Building Material Permit (BMP) / Extraction Permit shall be required for a newly identified site including a rehabilitation plan.

582 Extraction activities carried out beside or at the selected river sites for aggregates or gravel will be managed and monitored by the Contractor regularly. That is management of activity by installation of sediment or silt traps downstream of the extraction site for controlling sedimentation or siltation of the surrounding water body.

583 Also construction of settling ponds and embankments of aggregate material around the extraction site to avoid trails of disturbed murky water dispersing in to the river and direct runoffs. If the gravel sites are further away from the rivers, a common drainage along with sediment ponds will be constructed to capture sediment runoff into the surrounding environment and water body.

584 The contractor will be required to identify sources for gravel extraction and prepare a sustainable aggregate or material extraction plan in compliance with the projects aggregate extraction guidelines for all sources of material and spoil that will be used in road works. The aggregate extraction plan or guidelines will include but not be limited to:

- Negotiation and Consultation process to be undertaken with identified customary and registered land owners or trustees;
- Effects of the Extraction on the Environment (Sedimentation, Ecological Disturbance and Slope Stability);
- Site Safety and Community Protection;
- Preparation of Extraction Sites; and,
- Preparation of Extraction Plans and Environmental Assessments for Projects.

585 This aggregate extraction plan will be submitted to the DSC and to CPIU for reviewing and approval, and the planned implementation process will be monitored. The extraction plan will be prepared during the detailed design phase by the Contractor (when the type and quantity of materials to be used are confirmed and approved) and will identify sources of gravel and aggregate that follows the code of practice prepared by MID for gravel extraction. The EMP will also be updated during this period.

586 Extraction of river gravel for infrastructure works has possible effects on the aquatic ecology and hydrological conditions if not controlled. But for the preferred sites and the SP sites the rivers are subjected to recurrent flood events and logically high disturbance systems. Meaning that the ecosystems within the water courses had adapted to adjustable and high water flows, changes in the channel after certain floods and high turbidity. Consequently are likely to be resistant to the disturbances associated with low to moderate gravel extraction. Removal of gravel or materials from the river bed might result in the change of river's morphology, river might widen and flow speeds increase which might result in river bank instability and erosion. This depends entirely on the size of river, volume of material to be extracted and location of extraction. Hence, such extraction of river gravels from the river beds or active channels of rivers changes hydrology altering channels and triggers erosion. It is also common that quarries or borrows pits leaves unusable land, exposed water table, attracts rubbish dumping and reduces visual values.

587 It is that bid and contract documentation of the identified mitigation measures for aggregate extraction from rivers and borrow pits for coronous materials and recommended site specific extraction plan prepared by the Contractor stipulates:

- The maximum amount of materials that should be extracted from each site according to the ability of the river to regenerate materials and potential extraction impact on the existing environment. Since extraction activities have certain limits with which localized or widespread impacts on the environment might occur. This may result from the lack of using erosion or sedimentation control measures and could alter the immediate environment or impact directly upon the flora and fauna;
- Road access to material extraction sites will be negotiated with the land owners purposely to access the river or borrow pits for extraction. But if the land owner is not interested in keeping the road after the activity the Contractor is accountable to reinstate the land to its pre - condition.
- Areas that will not be permitted to be used for gravel or coronous material sources include any rivers or streams and land identified as a protected area including a buffer zone of a protected area, proposed protected area, areas of significant conservation values, ecologically sensitive area and culturally significant area. Also if it inhabits rare or endangered flora and fauna species, it comprises part of the intertidal zone, comprised of a swampy or wet land, or if it includes mangroves;
- Rivers or streams identified as fresh water sources for communities or villages are not permitted to be used as sources for materials. Since extraction activities will cause sedimentation, siltation and increase turbidity of the water body. In instances where there is no other option but the river or stream must be used an alternative water source has to be to constructed or provided such as drilled or dug wells, upstream of the extraction site or works area;
- Dredging and similar operations for extraction of materials from the rivers or streams will not be permitted and use of appropriate machinery such as an excavator or back hoe is accepted;
- The maximum volume of material to be extracted from any river of stream will be managed according to the approved aggregate extraction guidelines and conditions for the extraction plan;
- Extraction of gravel or material from river bends will not be permitted unless if required river training be undertaken immediately after the activity;
- Extraction sites and borrow pits will be located 15m from the right – of – Way (ROW) of roads and extractions that could undermine the roads will not be permitted;
- Restoration of sites and borrow pits will be done following the completion of works in accordance with all applicable standards and specifications;

- Topsoil that is excavated from the top of sites or borrow pits will be saved and reused in re – vegetating the sites and pits to the satisfaction of the DSC and CPIU;
- Other sites for material extraction will not be permitted to operate unless formerly used sites are restored to its pre – condition; and,
- The excavation and restoration of sites and borrow area including their surroundings will be undertaken in an environmentally friendly manner to the approval of the DSC and CPIU. This will be signed – off by the DSC and CPIU before final acceptance and payment under the terms of the Contract.

Disposal of Construction Debris

588 The works would entail the filling, road rehabilitation, drainage, building constructions, etc., Any construction debris that accumulates would have to be piled up in designated areas and dumped at ab approved site permitted by the ECD in consultation with the local community and land owners.

Emergency Response

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

590 The plan will be submitted to CPIU for approval. Implementation of the plan will be monitored by CPIU. Any emergencies, and how they were handled, will be reported in the contractor's monthly progress reports.

591 The CPIU and Contractor will consult with all relevant authorities to ensure that they minimize any disruptions to existing infrastructure and services. This include village water supplies, telecommunications infrastructure and electricity supply wherever applicable.

Effects on Existing Utilities and Services

592 The CPIU and the Contractor will consult with all relevant authorities to ensure that they minimize any disruptions to existing utilities and services. This include village water supplies, telecommunications infrastructure and electricity supply where ever possible.

593 Plans will be obtained from service providers or detailed by village elders showing all underground facilities and / or services in roder to avoid damage or disruption during works.

13.3.2 Biological Environment

Impacts on Flora and Fauna

594 A potential impact of construction activities in respect of reefs is run-off or sedimentation and the re-suspension and transport of particulates by currents to sea-grass and reef areas. All of the rivers within the Project area already go through cycles of floods and emit large plumes of sediments out into near-shore areas. It is considered that the relative effect of short-term increases in sedimentation will be both small and localized, due to the intermittent activity and the small amount of sediment that could be released as a result of the construction activity.

595 Rehabilitation work will directly cause minor degradation of local ecology through the clearance of small areas of vegetation at work sites and ancillary sites such as materials extraction sites, and material stockpiling areas. Construction activities will impact only a narrow band of vegetation at crossing sites.

596 In terms of impacts on fauna, there is potential for construction workers to poach edible animals and birds at the locality in spite of prohibitions and poaching being regulated by Wild Birds Protection Act and Wildlife Management and Protection Act. The contractor will be responsible for providing adequate information to workers regarding the protection of fauna and imposing sanctions on workers trapping, killing or wounding birds or other wildlife.

597 Field observations, research, and consultations indicate that the streams and rivers, particularly at the sites of the crossings (culverts, bridges) have some, but limited aquatic macro-fauna. Construction of the bridges or installment of culverts will create minor, if any, impacts. Where possible, gravel extraction should be confined to the floodplain areas of rivers, rather than the river bed (especially through curves or bends in the river).

598 Measures to be included in the project to ensure protection of flora and fauna within the SP area include:

- Sites for contractor's camps, material storage, borrow pits, and quarries will all be approved by CPIU and will not be permitted in any ecologically important sites or areas valuable for conservation

- Vegetation clearance during construction
- Under no circumstances is the contractor permitted to fell or remove mangroves
- Vegetative cover cleared from the roadside during rehabilitation activities will be kept for slope protection and re-vegetation. Contractors will be responsible for re-vegetation in cleared areas
- The contractor will be responsible for providing adequate knowledge to construction workers in relation to existing laws and regulations regarding illegal logging. Contract documents and technical specifications will include clauses expressly prohibiting the felling of trees, not requiring to be cleared by the project, by construction workers for the term of the project
- The contractor will be responsible for providing adequate knowledge to construction workers in respect of fauna. Contract documents and technical specifications will include clauses expressly prohibiting the poaching of fauna by construction workers and making the contractor responsible for imposing sanctions on any workers who are caught trapping, killing, poaching, or having poached fauna
- Contractor will be responsible for supplying appropriate and adequate cooking fuel in workers camps to prevent fuel-wood collection
- Construction workers will be informed about general environmental protection and the need to avoid un-necessary felling of trees wherever possible.

Impacts on River Structure

599 During construction it will be necessary to carry out excavation works on the bed, bank and floodplain of the stream crossings located within the SP area. Where fords, bridges, culvert, are to be built across streams/rivers, there will be a need to temporarily construct water flows.

600 These activities can destabilize the existing structure of a river, resulting in a higher risk of channel shifts and erosion, particularly of river banks that would lose their vegetation cover, and most particularly during floods. Stockpiled materials, if located within the floodplain, may be eroded and dispersed and patterns of water movements during normal and flood flows affected. Movements of machinery and other activities can be expected to impact riverine fauna and flora, however because the rivers in the area are high-disturbance ecosystems, regularly subjected to flooding and channel shifts, impacts on these are likely to be minimal.

601 Potential impacts on the structure of river habitats, including their channels, banks and floodplains will be mitigated by:

- Material stock-piles and construction camps will not be located within riverbeds or the islands in the center of rivers. Similarly, they will not be located within the current area of floodplain in areas subject to regular flooding (i.e. once per year or more). All land will be rehabilitated to its original or better condition upon completion of the project works;
- Whenever necessary, temporary structures e.g. Coffer dams required to dry out areas of the river during construction will be removed completely after use and the original configuration of the river restored;
- Scour protection will be used as temporary measures , as needed, to ensure temporary structures do not damage river configuration;
- Movements of vehicles and machinery, and hence disturbance, within the riverine habitats will be minimized at all times;
- In the event that the contractor causes damage to the river bank or other structural parts of a river, the contractor is solely responsible for repairing the damage and/or paying compensation;
- The side slopes of embankments, including the river bank areas surrounding bridges and approaches will be protected and designs used that protect soils as included in the project specifications in order to reduce erosion;
- Embankments and in-stream/river activities will be monitored during construction for signs of erosion;
- Re-vegetation of the slope areas with local fast growing species, or other plants in consultation with the land owners and village chiefs, will be carried out incrementally and as quickly as possible after work within any river habitat has been completed; and,
- Spoils, rubbish or any material will not be disposed of within any river system including riverbed, banks or floodplain areas. Suitable tip sites will be designated in consultation with land owners and village chiefs.

Impacts from Gravel and Coronous Extraction

602 Gravel and coronous sources on Guadalcanal close to the SP area include existing areas from which river gravels and highly durable coronous materials were extracted for road works.

603 Large-scale extraction of coronous materials can render the land unusable for other activities because its level has been lowered and topsoil removed. In some cases the water table may be exposed and/or the area used for rubbish. For these reasons rehabilitation of borrow pits is considered central to best practices.

604 Sources of material (gravel and coronous materials etc.) for the SP will be confirmed by the contractor. In order to reduce impacts associated with quarry activities, contract documents will specify that (i) sites must be identified in consultation with MID, local land owners and communities; (ii) existing sites will be used in preference to establishing new extraction sites wherever possible; and (iii) for all sites, contractors will ensure that they acquire Building Material Permit (BMP), before sourcing the material.

605 The contractor will be required to identify sources and prepare a sustainable extraction plan for all sources of material and spoil that will be used in road works. The extraction plan will include but not be limited to:

- Process for negotiation and consultation with land -owners (including the affected community and customary title-holders etc.);
- Environmental effects of extraction (sedimentation, ecological disturbances, slope stability);
- Site safety and community protection;
- Remediation of extraction sites; and,
- Preparation of extraction plans and environmental assessments for projects.

606 The extraction plan will be submitted to CPIU, which will monitor the plan implementation. The extraction plan will be prepared during the detailed design process by the contractor (when quantities and type of materials etc. are known with more certainty) and will identify sources of gravel and coronous materials that adheres to the code of practice prepared by MID for gravel and coronous abstraction. The EMP will also be updated at this time. CPIU will approve and monitor implementation of the extraction plan.

607 Removal of river gravel for construction materials has the potential to interfere with aquatic ecology and hydrological conditions. However, all of the rivers within the SP area are subject to frequent flooding and naturally high disturbance regimes. This means that the ecosystems they contain have had to adapt to variable and high water flows, channel changes and high turbidity and are likely to be resilient to the disturbances associated with moderate gravel extraction. Depending on the size of the river, volume of material to be extracted, and where the material is to be obtained from, removal of gravels could have an effect on the river bed and/or channel morphology, including river widening and increased flow speeds, causing bank instability or erosion.

Site Clearance

608 Any site clearance, digging and excavation activities undertaken during pre – construction can unearth archeological artefacts, sites or resources. In the event that this might occur, the contractor shall cease works instantly and inform the authorities (National Museum Tabu Register of the Ministry of Culture and Tourism and MECDM).

609 The activities will resume when the authorities have signed – off that the site or artefact or resource have been dealt with appropriately and advise that work shall start.

610 The contractor shall be responsible for complying with the requirements of the authorities and the CPIU shall monitor the compliance.

River Training, Bank and Embankment Protection Works

611 River training, bank and embankment protection works is proposed for the SP sites. The works will involve dredging, installation of gabion basket walls and scour protection measures to reduce erosion at the bridge abutments and protect bridge approaches including diverting rivers directly under the structures. This will ensure that the structures function as they were intended and that possible increased flows due to climate change such as more intense and increased rainfall can be accommodated resulting in a net environmental benefit. During works in the rivers and streams protective and mitigation measures to adhere to include;

- Movements of vehicles and machinery and hence disturbance within the rivers and streams will be minimized at all times;
- In the event that the contractor causes damage to the river bank other structural parts of the river or stream, the contractor is solely responsible to repair the damage or paying of compensation;
- The side slopes of embankments including river banks areas surrounding the bridges and approaches will be protected and designs used that protect the soil in order to reduce erosion;
- Embankments and in – stream / river activities will be monitored during construction for sign of erosion;
- Revegetation of slopes with local fast growing plant species or other plants in consultation with the land owners and village chiefs will be carried out incrementally and as quickly as possible following completion of works within any river or streams; and,
- Spoils, rubbish or any material will not be disposed of within any river system including riverbed, banks or flood plain areas. Suitable tip sites will be designated in consultation with the land owners and village elders including villagers.

Impacts on protected areas and other sensitive ecosystems

612 At this stage there are no protected or sensitive areas identified within the SP vicinity although potential sites for protection are found inland but there needs to be commitment from the communities to have these sites declared as protected or sensitive areas. There are also no community marine managed or protected areas in each SP area, but one was located about 1km from Selwyn (Veranaso) Causeway but was already opened and will not be affected by the works.

13.3.3 Social Environment

Impacts on Public Access and Traffic Safety

613 Construction areas will be disregarded off and access roads to adjacent villages constructed in consultation with resources owners when necessary. During the construction of the bridges and road approaches detours will be constructed to allow for traffic and this can be utilized by road users. Impact caused by works on the traffic will only be temporary for approximately four (4) to six (6) months.

614 The Provincial Authorities, Communities and Schools will be notified in advance of the schedule and duration of works. There will be signs and other appropriate safety features used to indicate construction works are ongoing at each site. The project will cause temporary negative impacts due to the presence of contractor's vehicles and machinery including inconvenience and minor disruptions to traffic, local access to and from the villages adjacent to the SP area and along the roads during the construction period.

615 The impacts can be minimized by adapting the identified mitigation measures below;

- The Contractor is required to prepare and submit a Traffic Management Plan detailing the diversions or detours and management measures to the CPIU;
- There must be specific signs and other safety features installed at both sides of the works sites to indicate construction works are undertaken;
- Contract clause specifying that care must be taken during the construction period to ensure that disruptions to access and traffic are minimized and that access to villages adjacent to the SP sites and along the roads are maintained at all times. Provincial Works Department and Authorities and village elders or leaders will be consulted in the event that access to any one particular village has to be disrupted for any time and temporary access arrangement be made on the preference of the villagers;
- Construction vehicles will use local access roads, or negotiate with land owning groups rather than drive across vegetation or agricultural land, to obtain access to material extraction sites. Where local roads are used they will be reinstated to their original condition after the completion of works;
- Construction sites are to be kept free of debris, spoil and any other material generated by the activities at all times and areas designated for disposal and haul routes will be identified in co – ordination and consultation with the local authorities and land owners including communities;
- Provision of adequate protection to the general public in the vicinity of the work site, including advance notice of commencement of works, installing safety barriers if required by villagers and signage or markings of the work areas; and
- Provision of safe access across the work sites to people whose villages and access are temporarily affected during the works.

Impacts on Noise Levels

616 In Solomon Islands there are no noise standards and any noise generated by the project activities will be temporary (i.e. during construction) and intermittent not full time, preparation of a baseline ambient noise levels for subsequent monitoring is not considered.

617 Noise produced during construction would be limited during the day from 6am to 7pm from Mondays to Fridays. It is generally intermittent, reduces quickly with distance and depend very much on the type of works undertaken, location and function of the equipment. It is anticipated that there will be adverse temporary impacts due to the noise of the construction equipment particularly heavy machinery, when construction activities are carried out on or in the vicinity of villages. Clearing of vegetation, bulldozing, compaction equipment, excavation of existing road materials and grading will produce noise to some degree.

618 It is identified that the most sensitive receptors adjacent to the SP sites include villages, schools and health centers. Co – operation between the contractor and the surrounding communities is important and it is the responsibility of the contractor to arrange meetings between these parties and arrange such matters as work schedules (hours of equipment operation etc.), location of work camps and material storage areas and the location of rock crushers.

619 It is therefore, recommended that construction machinery will include standard noise mitigation measures such as restriction of works to daylight hours only is identified as will minimize irritation in order to safeguard the identified sensitive receptors against adverse noise impacts. In the case of schools this works will be undertaken after classes each day.

620 For the safety of workers as direct noise incursion is a health concern they are required to be provided with noise abatement equipment by the Contractor and only work for eight (8) hours a day.

621 Mitigation measures to be included in the project to lessen the impacts of noise levels include;

- Requirements in the EMP and contract documents that all vehicles exhaust systems and noise generating equipment be maintained in good working condition and that regular maintenance of the machinery will be undertaken;
- Construction vehicles and machinery will be fitted with mufflers and other noise abatement equipment;
- Construction activities between 9pm and 6am in or close to villages and schools will be prohibited;
- The contractor will prepare a program of operations or activities that will be approved by the village chiefs and CPIU. The plan will include the days and identifying the days on which there should be no work, and hours of work for each construction activity and classify the types of machines and equipment that will be used;
- Buffers will be established between the work areas and nearby villages or schools as practical as possible;
- Workers will be provided with noise abatement equipment as and when required; and,
- Any grievance raised regarding noise will be dealt with by the contractor instantly through the communications plan.

Impacts on health and safety

622 During construction it is likely that traffic accidents and accidental chemical spillage which can cause bodily harm can occur. Alcohol consumption and inappropriate behavior by construction workers would have to be dealt with by the village authority board or police as it is now a considered option by most of the villages within the SP sites. The construction team of experts would be small comparing to unskilled labour to be drawn from the communities adjacent to the work sites. The workers will be stationed at each site for up to six (6) months or less.

623 It is also that during the construction phase there will be cases of a range of health and safety impacts. These impacts are associated with (i) contamination of local water supplies; (ii) risk of accidents at works sites as mentioned. Air pollution and noise, which are identified as having health and safety aspect and traffic safety issues which had been discussed. There will also be risks of spreading communicable diseases between the construction workers and residence of the area which are considered to be medium to high. These diseases include Sexually Transmitted Diseases (STD), Malaria, air and water borne diseases are also likely to occur. The contractor will need to provide health facilities equipped with medical supplies and condoms for male and females, first aid kits in campsite and work sites, safety equipment for workers and provision for taking a victim to the nearest hospital. The contractor will make sure that adequate drainage system is established throughout the camp site to ensure that disease vectors such as stagnant water bodies and puddles do not form.

624 The contractor will be responsible for providing adequate efficient information to his / her construction workers both local and international in relation to health and safety issues. He / She is also required to conduct an STD and HIV/ AIDS awareness program for the construction team and villages adjacent to the SP sites and if possible other villages.

625 Septic tanks and garbage repositories will be set up at the camp sites and work sites which will be required to be cleared by the contractors to prevent diseases outbreak. Rubbish generated at the camp and works sites will be dumped only at an approved site permitted by the Environment and Conservation Division (ECD) in consultation with the local communities and land owning groups. A Solid Waste Management Plan will be in co – operated in the detailed EMP by the Contractor detailing plans and methods for managing and controlling garbage generated both in and around the camp and works sites.

626 Contractor is to provide adequate signage and security at the construction and camp sites to prevent unauthorized entry by local people including children into the areas. The general public be provided with adequate protection when in the vicinity of the work sites including advanced notice of commencement of works, installation of safety barriers if required by villagers and signage or markings of the work areas will be carried out. It is also required that the contractor provided safety equipment such as safety boots, life jackets or rain coats, helmets, gloves, goggles, Hi-Viz vests and other protective clothing to worker and train them in their use.

627 The identified mitigation measures to reduce and manage waste generated in the camp and work sites with reducing and avoiding health and safety issues include;

- All wastes produced from camp and works sites will be disposed at approved land fill or areas permitted by the ECD in consultation with the local communities and land owners and the contractor must ensure that no site – specific landfills will be established at the construction camps;

- Contractor is responsible to provide waste management and disposal training to his / her workers by providing appropriate waste disposal methods;
- Contractor's workers (permanent or temporary) is not permitted to dump wastes produced by the works in any water bodies or close to the coast and the contractor must ensure that wastes of any sort including waste water is not discharged into rivers or coastal waters and that all wastes are dumped in the right and approved areas;
- The Contractor will ensure that the Construction camps and work sites are kept clean (rubbish free) by providing rubbish bins, and workers be provided with safe drinking water and clean sanitary facilities in the camp;
- The Contractor is requires to recruit an Environmental and Safety Officer (ESO) to address health and issues and liaise with the CPIU and villages regularly;
- The contractor will provide adequate health care facilities including health post and first aid facilities within the construction camp and provide training to construction workers on all basic sanitation, hygiene and health care issues, health and safety matters, and on the specific hazards of their work. Also ensuring that there is proper drainage throughout the camp to make sure that disease vectors such as stagnant water bodies and puddles do not form;
- The contractor will provide all workers with Personal Protection Equipment (PPE) such as safety boots, hiviz or reflector vests, helmets, gloves and protective clothing including goggles if required;
- The Contractor will ensure any borrow pits used for coronous extraction are properly restored to ensure groundwater resources are not contaminated;
- Septic tanks and garbage repositories will be set up at the construction camps sites, which will be regularly cleared by the contractor to prevent outbreak of diseases. The garbage will be dumped only at a site approved by the Provincial Development of Works and Local Land Owners;
- Installation of adequate and appropriate signage and security provided at the work and camp sites to prevent the unauthorized entry of people including children to the work and camp site or workshop area;
- The general public be kept well away from the work sites by installing safety barriers if required by the villagers and signage or marking out of the work areas and notifying the community and general public in advance of the works commencement dates; and,
- Provide a safe access across or around the work site for people whose villages are on the other side of the work site and whose access are temporarily affected during the rehabilitation activities.

Accidental Discovery of Archaeological Resources

628 In consultation with the land owners and the communities or villages surrounding the SP sites it was stated by the local communities that there are no tabu site or areas of cultural significant in the vicinity of the areas. Tabu sites however, are identified more than 100m down stream of Mbalasuna and Mberande rivers and less than 100m upstream of Mberande river but this will not be impacted by the works.

629 Activities such as site clearance, digging and excavation undertaken during both pre – construction and construction can extract archeological artefacts or resources. In the event this might occur, it is required that work ceases immediately and the National Museum Tabu Site Register of the Ministry of Culture and Tourism is contacted and informed of such discovery, and undertake all actions required by the authorities.

630 Works shall not resume until the authorities have signed – off that the site / artefact or resource have been dealt with appropriately, there will not be any other discovery within the area and that work may continue. The contractor will be required to comply with the requirements of the authorities and the CPIU shall monitor their compliance.

Other Social Impacts

631 Other social impacts will be the outcome of additional traffic turning into construction sites during and after works. Alcohol consumption and inappropriate behavior by the public transport passenger or private vehicles would have to be monitored and dealt with by the village committee or police. To avoid or reduce the risk of other social impacts, construction workers should be restricted to work sites either on the road or camp site and have respect to villagers, land owners boundaries; abide by the village rules and terms of conduct particularly when addressing women and elders and avoid damaging fruit or productive trees and gardens, access to the beach, foreshore and freshwater springs without consulting the villagers and land and resource owners.

632 Prior to contractor mobilization to the site, CPIU and the project's Community Development Officer will inform the contractor of such and establish the communications protocol between the project and the community as per the projects communication plan. The contractor will then identify one member of their staff (preferably local) to be the Community Liaison Officer to liaise between the village chief and elders and the contractor as well as the contractor and the CPIU.

633 If the construction workers be permitted to go into the village for any reason the contractor will be responsible for their behavior and if complaints arise concerning their behavior or conduct it will be dealt with accordingly and seriously by the contractor, and issues caused will be addressed and complainant informed. If the complainant is not satisfied with the resolved issue, the worker of concern should be restricted or dismissed from the subproject. Lodgment and resolution of complaints will be monitored.

634 Complaints associated with workers and other social impacts caused by outsiders can be addressed if access to the construction camp is being carefully monitored and permitting of authorized personnel entry is restricted.

635 Direct employment possibilities will also effect with the majority of the workforce would commute from the SP areas. A few skilled work forces may need temporary housing or camp and the provision of water, food, sanitation and other basic necessities during the construction phase.

Health, Safety and Social Disruptions

636 The presence of construction workers and work camps can induce the risk of associated health issues including the spread of diseases between construction workers and residence (population) of the area. Major diseases include malaria, STIs and HIV/AIDS, air and water borne diseases. The contractor will be required to provide health facilities, first aid kits, and safety equipment for workers and provide for transportation of victims to the nearest hospital.

637 There are also reports of child prostitution, commercial sex and sexual relationship by workers associated with logging camps in parts of the country and this activity by the construction workers is prohibited.

638 The contractor will be responsible to provide awareness services for his / her workers in relation to health and safety issues including Sexually Transmitted Infections (STI) and Human Immuno – Deficiency Virus (HIV) / Acquired Immuno Deficiency Syndrome (AIDS) awareness programs for the construction force and villagers. Also provide adequate information to the workers on their codes and conduct on ways to addressing local people particularly women and girls including elderly people.

639 Consumption of alcohol and inappropriate behavior by workers and people will be monitored and dealt with by the contractor and village committee or police.

640 Mitigation measures to reduce and avoid such health, safety and social disruptions include;

- Contractor to ensure workers (permanent or temporary) actions are controlled and village rules or norms are observed by educating them to respect the village protocols including villagers and advising them to abide by their code of conducts;
- Contractor to inform the workers (permanent or temporary) that if village protocols and code of conduct is not observed and situation is beyond their capacity and the village elders to solve, police will be informed of the issues;
- The contractor will be responsible to conduct awareness to his / her workers (permanent or temporary) on STIs and HIV/AIDS, reproductive health and safe sex prior to contractor mobilization;
- The contractor will provide health care facilities including an HIV/AIDS education post and first aid facilities within the construction campsite;
- Construction workers (permanent or temporary) are prohibited to participate in sexual affairs or relationships, practicing commercial sex and exploit children in villages along the roads or within the SP sites; and,
- Construction workers and works will be limited to the works sites and at all times respect village and land owners boundaries, and not to damage gardens and trees that are of value to the people, limit the access to beach, foreshore and freshwater springs or rivers and streams.

641 In consultation with the Guadalcanal Province Health Authority they had indicated that working within the area is a gap worth closing. Guadalcanal Province has also developed links with other service providers including the Ministry of Health who are also working in the area. It was recommended that it will be beneficial for the people of the Province and the Provincial Government if the Provincial Health Authority will be implementing the awareness and prevention aspects of the program aimed at the construction workers and the villagers surrounding the SP sites.

642 The estimated cost to carry the program will be included in the Bidding Document with assumed costs for all required IEC materials and associated costs.

13.4 Impacts during Operation

643 Operational impacts include the following activities:

- Increase number of vehicles passing through the East and West Guadalcanal;
- Labour based and machine based maintenance to road and bridge components; and,

- Increase settlements and developments.

13.4.1 Physical Environment

Air Quality

644 During the operation of the bridge and culvert, it is projected that vehicle and pedestrian traffic will increase. However, the increase is not expected to cause concentrations that will be detrimental to environment. Any equipment and machinery that may be used related to the operation of the facility will be properly maintained and in good running condition.

Noise

645 Once the culverts and bridges are operating, traffic numbers slowly ascend, it is expected to increase in noise levels, dust nuisance, in the area. Therefore the noise impact is slightly significant.

- Proper maintenance of these equipment will be ensured;
- The quietest possible economical equipment and machinery appropriate for the intended use will be selected;
- The noise levels of machinery selected will be measured to ensure that the modelled noise levels will be achieved;
- Equipment and machinery will be well maintained and operated in accordance with manufacturer's instructions, particularly in relation to maximum loads and effective exhaust silencing; and,
- Vehicles to be fitted with effective silencers in accordance with Solomon's Road Worthiness Act for vehicles.

Impact on Air Quality

646 Following the rehabilitation of the road its use will create air pollution such as hydrocarbons, carbon monoxide, nitrous compounds, sulfur dioxide and particulate matter. The current volume of traffic and forecasted traffic growth are such that emissions will be low enough to not have a noticeable effect on ambient air quality. The anticipated levels of traffic (up to 100 vehicles per day in ten years), excessive capacity of the road network, and subsequent lack of congestion and concentration of traffic, are unlikely to result in adverse impacts on air quality. The conclusion in respect of air quality is that the Project roads are likely to continue to operate at well under its design capacity and no significant air quality impacts warranting mitigating actions are anticipated.

647 The Project has the potential to reduce the volume of dust and particulates released into the atmosphere as a result of properly compacting the approaches to bridges.

648 There is a risk that the roads could themselves be affected by changes in rainfall, cyclone frequency and intensity, and sea-level rise. Changes in these climate and physical variables could lead to greater wear scour protection and water release structures such as drains and culverts used in roads and crossings.

Climate Change and Adaptation

649 Although the Project will not have an impact on rainfall, ground water or overall carbon emissions which could induce minor micro climatic changes there is a risk that the structures and bridge approaches could be affected by changes to rainfall and cyclone frequency and intensity that could result in more intense and higher floods. Such changes could result in greater wear on river training, bank and embankment and scour protection works including drainages and culverts.

650 Risks of impacts on the roads and associated structures from climate change will be addressed through routine inspections of the roads as part of the tasks of the Routine maintenance Contractor.

651 In addition to repairing damaged components, one of the responsibilities of the contractor will be to report on cases where drainage and erosion protection structures are failing and to recommend upgrades or additions as required. This approach is adaptive and encompasses a range of issues that might arise through complex interactions between climate and other variables to produce unpredictable changes in hydrology in the area. Climate change will have its own report appended.

River Structure

652 Long term changes in river structure and flow could arise as a result of the project. Most of these are unlikely to be significant in terms of environmental effects because the river systems in the Project area are already high-disturbance regimes often subject to flooding, variable water flows, changing channel beds and major shifts in structure. In general, the design of crossings will tend to oppose some of the natural changes that could be expected over decades through scour protection designed to keep the main channel running through or under the structures.

653 Impacts of river crossings could arise because bridges are not properly maintained and debris collecting against them impeded water movement forcing the river to deviate around them. Floodplains provide several functions that need to be maintained in the area: (i) temporary water storage during floods relieving pressure at the channel(s); (ii) additional space for slowly conveying water downstream; and (iii) water clearing and soil fertilization through unloading silt onto floodplains. These impacts and values can be maintained through good design as follows:

- MID will ensure that all crossing structures are adequately maintained so that debris does not build up causing waters to deviate around the structures stranding them and resulting in severe erosion and loss of land;
- Scour protection is on-going and adaptive to changing river requirements; and,
- Approaches to bridges are designed to be as transparent to flood river flows as possible through use of continuous box culvert structures.

Soils

654 There are unlikely to be any significant impacts on soils during the operation phase of the Project as long as the structures are properly maintained. Gabion baskets will also be used to reduce scour and erosion of river banks around bridge abutments.

655 Increasing awareness about then need to maintain vegetative cover of areas adjacent to the road in terms of both assisting in reducing silt laden run-off to waterways and the inter-tidal area and contributing to the stability of river banks and the foreshore area, can be included as part of the maintenance activities.

Water Quality

656 Potential impacts on water quality or availability of water for domestic or agricultural use are not expected to occur. During operation negative impacts on water quality could be caused by accidental spills.

657 The road rehabilitation activities will not induce accidents and therefore there are unlikely to be any additional incidents over and above those that would occur without the project. No mitigation measures are required.

658 Water quality may show slight improvements after rehabilitation and maintenance due to reduced erosion from improved embankments on the slopes, stabilization by sand bags or gabion baskets, and re-vegetation to prevent soil erosion. Replacing missing or damaged culverts will facilitate passage of high flows and reduce scouring and remove overland flows, ensuring the integrity of the surface of the road and removing a potential hazard from communities.

659 The area of impervious surface is not being significantly increased by the project and therefore increased runoff due to rehabilitation activities will be negligible in the Project area.

13.4.2 Biological Environment

Flora and Fauna

660 The Project is not likely to induce people to the area to poach or hunt timber, flora or fauna. Deforestation is not an impact attributable to the Project because: (i) single selective logging for traditional and/or cultural purposes is permitted; and (ii) logging companies purchase licenses to fell trees within prescribed areas and construct their own roads to provide access to these off road areas. Whether the conditions of a license are adhered to by a logging company should be monitored by Department of Forests and any impact of logging outside of the conditions of a license is beyond the scope of the project. Therefore there will be no impacts on flora and fauna as a consequence of road rehabilitation during the operational phase.

661 There are no rare or endangered fauna that could be impacted by the operation of a rehabilitated road.

Protected Areas

662 There is no MPA adjacent to the project site. Runoffs will be managed as per the water quality mitigation measures outline above. Protected areas are embraced under the protected areas Act 2010.

13.4.3 Social Environment

Noise Effects

663 Even under the most positive situation of increased traffic the ambient noise level after the completion of repair and rehabilitation activities at the SP sites there will not be any sufficient magnitude of noise requiring mitigation. As noise is a function of traffic volume, ambient noise levels will not be appreciate increased due to the low traffic forecast.

664 Maintenance of vehicles to maintain an acceptable level of or to reduce noise emissions is beyond the project scope and it is entirely the responsibility of the vehicle owners.

Access and Traffic

665 Following completion of the works local access and performance of the key route will be improved facilitating the transportation of goods and services between the rural areas and Honiara. There will be improved access to social services and key community facilities including transportation of garden or farmed products to the Honiara Central Market or the nearest market outlets regularly without hindrance.

666 It is therefore, foreseen that the project after the rehabilitation of the structures will encourage families and individuals to purchase vehicles and accessibility by people living further east and west of the SP sites to Honiara will be improved. MID will ensure long term sustainability of the structures through the MBES works.

Impact on Health and Safety

667 Increased traffic volume and improved structures resulting in speeding vehicles can cause accidents to pedestrians particularly old people and children including women. Safety signs showing speed limits and pedestrian would be maintained to avoid accidents. MID with the assistance and co – operation of the village and community elders and chiefs and school administration would continue to provide safety educational awareness talks to communities on the use of the road and maintain appropriate signage in the areas.

Risk of Spreading Communicable Diseases

668 Risk of transmission of communicable diseases during operation of roads and bridges have the potential to pose a threat as a pathway for disease transmission only if they carry a large volume of traffic, including proportions of heavy traffic such as trucks, as the infrastructure are routes that connect cities, towns or large number of villages, especially roads or highways with international borders where improved access to major markets can facilitate international trade, and there is hospitality service industry established that is geared towards large number of truck drivers and mobile populations.

669 Guadalcanal as one of the largest islands in the Solomon archipelago is a populous island and as the host of the country's capital it is connected with almost all the islands in the country and other destinations by air and sea in a daily, weekly to fortnightly and monthly basis through the international and domestic seaport and airport. The main roads of North East and West Guadalcanal serves all the villages along the road and further east and west and it is the main access between the rural areas of the island and Honiara (where commercial sex workers are known to operate). Therefore, in relation to the risk of spreading the communicable diseases during the operation phase is that the infrastructure has the ability to pose although low, risk as a pathway for disease transmission. In any case, even this small risk is considered to be mitigated by implementation of the projects STIs and HIV/AIDS awareness and prevention campaigns.

Land use Restrictions and Land Acquisition

670 Ongoing activities will include maintenance of the road or bridge approaches and clearing of the bridges and culverts off debris. None of these works are expected to require land acquisition or create resettlement impacts during operation. However, it may require and necessary to locate new sources for gravel for the approach roads maintenance which may involve resettlement impacts. In compliance with the loan covenants and specific assurances in the event of any unforeseen land acquisition or resettlement needs, the Government will inform ADB and prepare a resettlement plan according to the relevant laws and regulations and ADB's Policy on Involuntary Resettlement, and all costs will be borne by the MID.

671 The CPIU will ensure that no activity are carried out until ADB and MID has reviewed and approved such resettlement plan.

13.5 Summary of Impacts

672 A range of benefits is expected to arise from rehabilitating and maintaining the East and West Guadalcanal, including increased accessibility to markets, improved living conditions, opportunities for livelihood development, and local poverty reduction. These benefits are expected to reach a wider group of people.

673 The overall level of negative environmental impacts during construction will be small, though there will be some moderate impacts relating to potential effects on river structure, the extraction of gravel and coronous materials. During operations impacts on changes in river structure and increases in sedimentation and turbidity in near shore sea grass and coral reef areas will be small, while for all other environmental concerns the risks are insignificant.

674 The majority of impacts will occur during the civil works (construction) phase, and will be temporary, localized, and readily controlled.

675 Examples of such impacts include temporary impacts in the vicinity of gravel and materials sources, localized water quality deterioration, possible disruption to access to villages, and noise and dust generation.

676 Gardens and fruit trees will be lost but the identified impacts are considered minor by the residents who are willing to contribute to the project.

677 Impacts on the coral reef fauna and flora are considered to be minimal with regard to the influences of increased sedimentation, largely due to the nature of any suspended sediments which would be intermittent, diffuse and short- term.

678 The risk of altering the structure of rivers, including changes in water flows, channel location, banks and flood behavior both during construction and during operations is moderate. The rivers are characterized by high-disturbance regimes already subject to changes in channel location and regularly flood, exporting materials out to sea. The construction works could affect the natural fluctuations in river structure, either constraining them or precipitating change.

14 ENVIRONMENTAL MANAGEMENT PLAN

14.1 Overview and Objectives of the EMP

679 The environmental management plan (EMP) is a tool that is crucial to effective environmental management which identifies mitigation and management measures to avoid, reduce, mitigate or compensate for anticipated adverse environmental impacts identified in the previous sections. The core purpose of the EMP is to provide the Proponent and the Contractors with a practical guide to ensure compliance by all parties with the environmental requirements. This is achieved by the provision of a framework for comprehensive monitoring and control and the issues are addressed accordingly with the sequence of processes, such as pre-construction, construction and operation phases.

680 This document is a highly flexible management tool and it is proposed that the document is reviewed and updated to ensure that the environmental goals and objectives are fitting to existing conditions and activities. The objectives of the EMP are to:

- Ensure all activities are undertaken in accordance with applicable environmental legislation and regulations;
- Integrate environmental considerations into all decision making processes (Inform an environmentally sound and sustainable engineering design process);
- Protect biodiversity of terrestrial and aquatic ecosystem;
- Protect natural features and scenic values;
- Ensure through holistic management appropriate development and protection of the environment;
- Manage the impacts of climate change;
- Provide a framework for continually improving environmental performance and strive for best practice; and,
- Ensure environmental due diligence are met.
- The EMP contains a number of components crucial for effective environmental management with in the project, these include:
- Organizational Responsibilities (for various aspects of the EMP implementation;
- Consultation and Information disclosure;
- Plan for mitigation of impacts during the different phases of the project or construction; and,
- Monitoring.

14.2 Institutional Arrangements and Responsibilities

681 This sub – section of the EMP presents a discussion of the environmental management activities that will be undertaken as part of the overall TSFRP implementation phase. The roles and responsibilities of various agencies in undertaking these activities are then defined and the institutional strengthening activities that will allow for those organizations to fulfil their nominated roles and responsibilities are identified. An environmental monitoring program is also prepared and the cost associated with its implementation has been identifies.

14.2.1 Organization Roles and Responsibilities

682 The overall organizational structure for environmental management for the Project is presented below.

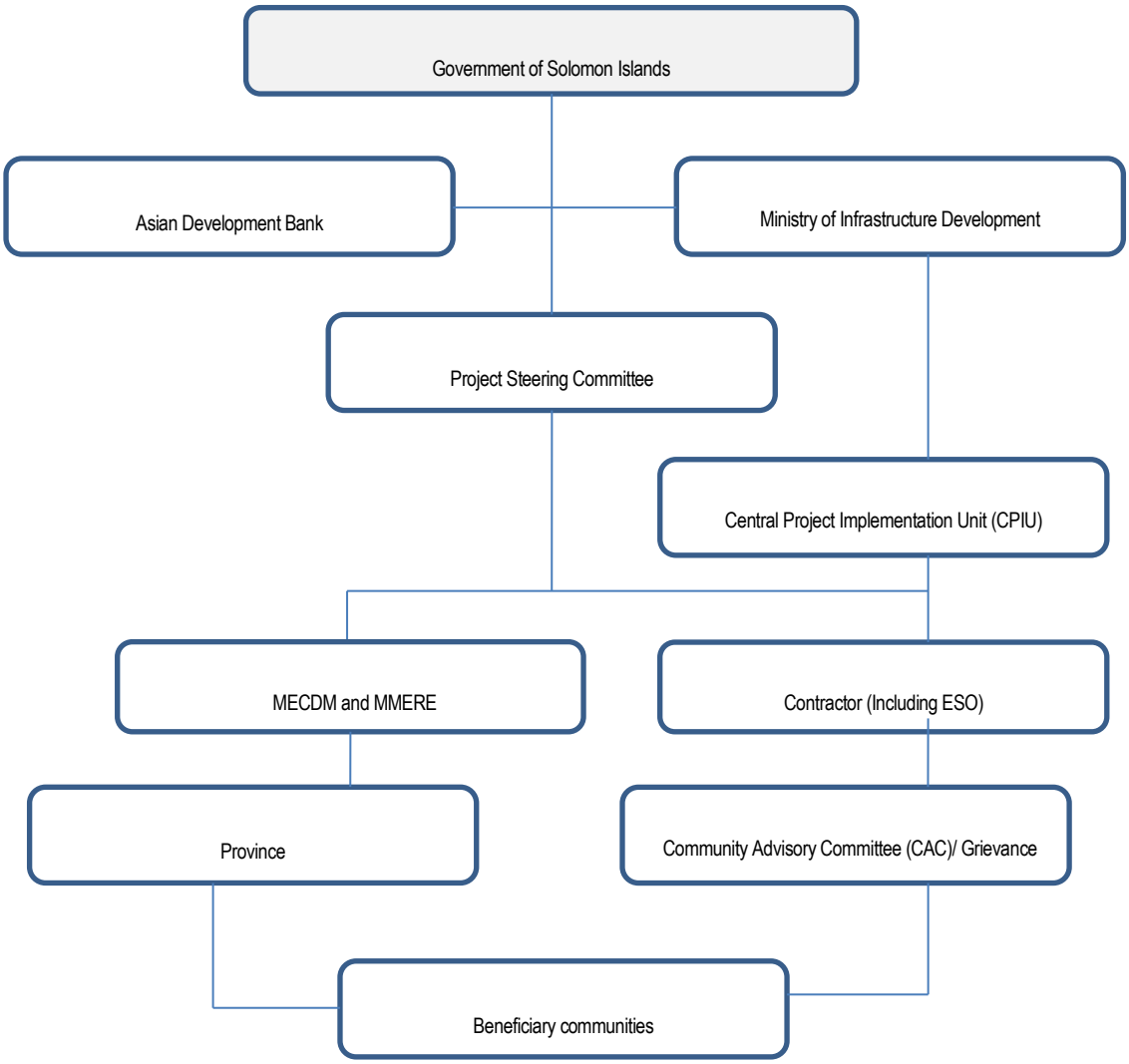


Figure 52. TSFRP Environmental Management Organizational Structure

14.2.2 Role of the Ministry of Infrastructure Development & CPIU

683 The overall management of all monitoring tasks under the CPIU comes under the MID. This covers all aspects of the required activities including coordination with other agencies that have national responsibilities over some of the tasks. MID will exercise its functions through the CPIU which is responsible for general project execution, and which has been tasked with day-to-day project management activities, as well as monitoring. Specialist staffs have been assigned to the CPIU to undertake environmental management and monitoring tasks.

684 In the implementation of environmental management and monitoring tasks specific technical assistance will be provided by environmental specialists that are part of the CPIU. The specialists will assist in all aspects of implementation of environmental assessment and management, internal monitoring and evaluation (M&E), and training of MID and MECDM and other relevant government agencies.

685 The CPIU through its EO will:

- Assess the Public Environmental Reports for other subprojects as required to meet the requirements of the Environment Act 1998 and SPS;
- Prepare a Design Brief containing the design issues that are identified in the EMP for action by the CPIU technical design team;
- Review and revise the EMP as required and extract the construction section from the EMP so that these may be attached to the Bid and Contract Documents;
- Arrange public consultation with the SDO to advise affected communities of the scope and scheduling of the SP to raise awareness within the communities of the likely phasing of events that will occur within their social boundaries;
- Arrange for the PER to be sent to the MECDM and ADB for evaluation. Following approval by the MECDM and the issuing of

the Development Consent the EO will advise the MID and ADB of the approval;

- Evaluate and approve the CEMP that will be prepared by the Contractor as a condition of the contract;
- Following approval of the CEMP, the EO will arrange to induct the contractor to the construction site whereby the details of the CEMP are confirmed with the contractor and the contractor also informs the community of the up-coming works program;
- When the EO considers that the contractor is competent to comply with the conditions of the CEMP, the EO advises the CPIU Project Supervising Engineer (PE) that the contractor may now commence work; and
- The EO will also undertake regular site visits to independently monitor the contractor's compliance with the EMP. Should non-compliant work be identified; the EO may issue a Defect Notice concerning the work. Defect Notices are channeled to the contractor via the PE.

686 The CPIU is responsible for ensuring that the contractor does not commence construction activities until requisite approvals have been received from MECDM, MID, MMERE and/or CPIU.

687 CPIU will prepare and submit to MID, Project Steering Committee, and ADB Quarterly Progress Reports, these will incorporate the main items raised in contractor's monthly reports and the environmental monitoring reports prepared by CPIU environmental specialists and ECD, as well as all other items required by MID and ADB.

688 After completion of construction, MID will be responsible for operations and ongoing routine maintenance.

14.2.3 Role of the Environment & Conservation Division

689 As the national agency responsible for environment and conservation, the ECD will need to be involved in the various aspects of the environmental management activities. Under the requirements of the Environment Act 1998, the ECD will need to review the Public Environmental Report and will assist monitor the progress of the construction activities if consent is given after the PER.

690 The ECD will need to be consulted during the construction phase of the project to ensure that all monitoring requirements are adhered to. The ECD will be tasked also to assist in the auditing of implementation of the EMPs and ensure that environmental management and mitigation of the project is undertaken. The project requires that technical assistance and capacity building will be provided to the ECD through the CPIU.

14.2.4 Role of the Ministry of Mines, Energy and Rural Electrification

691 The Department of Mines and Minerals (DMM) is located within the Ministry of Natural Resources and is responsible for issuing BMP for extraction of sand and aggregate. The contractor will need to abide by the Mines and Minerals Act of 2008 regarding sourcing materials from sites that have approved Building Material Permits. The potential source of gravels/aggregates will be from approved source. A copy of an approved BMP will need to be provided by the contractor and this is to be attached to the CEMP. This is the contractor's responsibility. MMERE with CPIU will ensure all requirements are met by the Contractor.

14.2.5 Role of the Contractor

692 The civil works contractors will be responsible for updating the EMP during detailed design or at construction stage, whenever further engineering information is available. The CPIU will approve the updated EMP before physical earthworks. The contractor will also develop an Emergency Response Plan and Quarry Extraction and Rehabilitation Plan as part of their EMP. Under the supervision of the CPIU, the contractor will undertake its own monitoring. The contractor will also be responsible for implementing all environmental, health and safety actions included in the EMP and relevant clauses in the bidding documents. The contractor will be required to assign an environmental safety officer (ESO) whose responsibilities will include:

- Coordinating with CPIU for updating the EMP;
- Ensuring that the contractor engages a suitable organization to undertake STIs/HIV/AIDS briefings and awareness raising amongst the contractor's employees. Ensuring that the contractor complies with the clauses in the contract and bidding documents in respect of environment, health and safety;
- Coordinating with MID and CPIU in respect of community consultation;
- Participating in monitoring and coordinating with CPIU to ensure that environmental management activities are reported as required;
- Ensuring that the contractor does not commence construction activities until requisite approvals have been received from ECD, MID and/or CPIU; and
- Coordinating and communicating with the contractor's Liaison Officer (LO), as required, to facilitate consultation with the affected villages, various stakeholders, and ensuring smooth implementation of the subproject.

693 As required by the various project documents, and the ADB guidelines, the contractor and MID, through the CPIU, will be responsible for environmental monitoring during construction and post-construction. The CPIU will also be responsible for verifying the monitoring undertaken by the contractor through audits and spot-checks. The outcomes of the monitoring will be included in the overall monthly progress reports to be submitted by the contractor to CPIU and to ECD and ADB. These will also be consolidated and submitted to ADB for review on a designated time period as required.

14.2.6 Role of Other Agencies

Provincial Administration and Communities

694 The provincial government and the communities and churches have authorities in the rural areas especially in the sub project area and will need to be consulted and involved in the environmental management activities of the project. Consultations will be covered under a communications plan which will need to be prepared by the MID/CPIU who will also allocate the responsibility for implementation of the plan to responsible parties to the project. This might be the job of the Community Development Specialist or whoever takes over that role. The contractor will also need to have an officer appointed to take on the role of liaison between the MID/CPIU and the provincial administration and the communities to ensure effective implementation of the project components.

695 Village leaders and organizations will assist in arranging meetings with, facilitating consultation with, and providing information about, affected communities and environmental impacts. An account of the process will be an integral part of the internal monitoring report prepared by CPIU.

696 Communities play an important role in the maintenance of roads and bridge through the Labor Based Works. Therefore, it is important their involvement is strengthened and recognized so that they can feel ownership of the road.

Non-Government Organizations (NGOs)

697 The projects awareness and prevention measures will link in with the existing initiatives where ever possible. There are NGOs that provides information and build links with other organizations in the delivery of awareness and prevention Programmes for STIs and HIV / AIDS which are actively seeking partnership in their program deliveries to the local communities. The organizations has already developed package of instruction, education and communication materials related to STIs and HIV / AIDS and a module or standard workshop for delivery to institutions which could be ideal for delivery to the contractor's construction force prior to construction.

698 The Provincial Health Authorities had developed links with the NGOs working in the SP areas including those who are dealing with issues relating to Gender and Child Exploitation issues.

699 Linking with already established network and the Provincial Government for the implementation of the awareness and prevention aspects of the program aimed at villages with in the SP site and is beneficial.

14.2.7 Community Advisory Committee & the Grievances Redress Mechanism

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

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

During construction

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

703 Affected people are in the first place to discuss their complaint directly with the Chief in their village. If the Chief supports the complaint, both persons take the complaint to the on-site Project Engineer (PE). For straightforward complaints, the PE can make an on-the-spot determination to resolve the issue.

704 For more complicated complaints, the PE will forward the complaint to the Environmental Officer (EO) within the Central Project Implementation Unit (CPIU). The EO has a maximum of two days to resolve the complaint and convey a decision to the AP. The AP and the Chief may if so desired, discuss the complaint directly with the PE/EO. If the complaint of the AP is dismissed, the AP will be informed of their rights in taking it to the next step. A copy of the decision is to be sent to the ECD.

705 Should the AP not be satisfied, the AP may take the complaint to the Permanent Secretary (PS) in the MECDM who will appoint the Director of the ECD to review the complaint. The PS will have 15 days to make a determination. The PS in the MID is to be copied in on the complaint and is to be informed of the decision from the PS in the MECDM.

706 If the AP is dissatisfied with the determination from the PS in the MECDM, the AP may appeal to the National Court. This will be at the APs cost but if the court shows that the PS, or the CPIU have been negligent in making their determination the AP will be able to seek costs.

During Operation

707 The same procedure is followed except that the complaint is now directed to the CPIU. During operation, the same conditions apply; i.e., there are no fees attached to the AP for making a complaint, the complainant is free to make the complaint which will be treated in a transparent manner and the AP will not be subject to retribution for making the complaint.

14.3 Consultation and Disclosure

708 The PER documenting the mitigation measures and consultation process will be submitted to MID, MECDM and ADB and will be available for public review. The affected people and the local communities expressed support for the project as they clearly saw the benefit to the villages along the road, but have not yet signed a memorandum of agreement (MOA) of willingness to contribute material for construction. Further consultation and disclosure will be done during implementation through:

- The project's Communications Plan or the Consultation and Participatory Plan
- Disclosure of a summary of the resettlement plan;
- The preparation and dissemination of a brochure in English and Pidgin (and other languages as required), explaining the project, works required and anticipated timing of the works; and
- Setting up a formal grievance redress committee with a representation from the affected people. The contractor will be responsible for managing the grievance redress program.

709 Information regarding the approved SP and the proposed environmental management measures will be posted at suitable locations at the SP sites.

710 Disclosure will conform to the Public Communications Policy of the ADB: Disclosure and Exchange of Information (March 2005) which requires that environmental assessment reports for ADB projects be accessible to interested parties and the general public. The PER summary as part of ADB project documents will be uploaded onto the ADB website while the PER will be available to the public upon request.

711 The PER Report will be available to the public from MID Resource Centre upon request.

14.4 Environment Monitoring and Reporting

712 Monitoring is a component of impact assessment purposely to combat uncertainties pertaining to unanticipated impacts, to ensure mitigation measures are working and to reassure public on the progress of the development. Progressive monitoring must accompany various stages of the SP activities (preconstruction, construction and operational phase). The Environmental monitoring plan is based on the potential impacts, significance of the impacts and mitigation approaches identified during the scoping and feasibility study. It comprises of parameters to be monitored, frequencies, responsible authorities and cost estimate as per impact. The contractor will require preparing a detail environment monitoring plan based on the EMP outlined in table 27 below and what set out in the contract documents. A review committee which will comprise of MID and MECDM are responsible for monitoring compliance, review contractors monthly monitoring report and suggest ways to improve or strengthen mitigation approaches.

713 The MID and MECDM are required to:

- Review contractors monitoring plan based on contract documents and table 7 below and grant certificate of approval when requirements are met;
- Co-ordinate compliance monitoring programs and submit quarterly monitoring reports; and
- Review contractor's monthly monitoring report and suggest ways to strengthen mitigation approaches.

714 The mode of transportation to the SP site is by vehicle. Mitigation cost incurred by the contractor for implementing the mitigation approaches and recruitment of ESO will be included as item in the bill of quantities. The contractor is required:

- Produce a detail monitoring plan and submit to MID/MECDM for review;
- Execution of all mitigation approaches required under the contract document and contractor's EMP;
- Produce a monthly environment monitoring report to MID/MECDM; and
- Recruit an Environment Safety Officer to manage EMP implementation.

Table 8. Responsiblities for Environmental Management and Monitoring

Project Stage	Responsible Organization	Responsibilities
Feasibility studies and SP review and approval	ADB/CPIU	▪ Review and approval of PER including overall EMP (Table 7); ▪ Review all feasibility study documentation, prepare Board presentation and submit to Board (as required); ▪ Include EMP in PAM; ▪ Provide SP approval to MID; ▪ Provide inputs to monitoring requirements; ▪ Provide inputs to clauses and contract conditions (reflecting safeguards requirements etc.); and ▪ Provide comment on bids (if required).
Detailed Design	Contractor	▪ Prepare detailed design; ▪ Prepare CEMP based on specifics of detailed design; and ▪ Submit CEMP to CPIU for review and approval (revising as necessary if required by CPIU).
	CPIU and MECDM	▪ Review and approve detailed environmental mitigation and management measures including CEMP.
Construction	Contractor	▪ Implementation of CEMP and ▪ Work with MID/CPIU to establish Stakeholder Committees and Grievance Redress Committees.
	CPIU	▪ Supervise contractor's implementation of CEMP and all other contractual obligations; ▪ Enforce contractual requirements; and ▪ Audit construction phase through environmental inspections and review monitoring data; ▪ Submission of quarterly reports; and ▪ Provision of awareness/training to workers and technology transfer to contractor.
	MECDM	▪ Ensure compliance with Government requirements and ▪ Review complicated issues arising from the project.
Operation	MID	▪ Provide budget to undertake environmental monitoring
	CPIU, maintenance contractor	▪ Undertake environmental monitoring and prepare bi-annual reports and ▪ Prepare maintenance reports to adaptively manage environmental risks related to operations (per EMP).
	CPIU; MECDM; ADB	▪ Review Contractor's reports and monitoring reports.

14.5 Environmental Management and Monitoring

14.5.1 Environmental Management Plan

715 This is a summary of the approach in addressing potential environmental impacts, who is the responsible authority for the impacts and the cost involving the impacts for 19 SP sites. The approach to addressing the potential environmental impacts is to mitigate them and/or avoid the impact altogether. The scoping assessments anticipate that the major environmental impact will occur during the constructional phase of the project which includes deterioration to water quality, sedimentation, waste disposal problems and potential oil/fuel spillage.

14.5.2 Environmental Monitoring Plan

716 Monitoring is a vital component of impact assessment to combat uncertainties pertaining to unanticipated impacts, to ensure mitigation measures are working and to reassure public on the progress of the development. Progressive monitoring must accompany various stages of the project this section initially highlights in the table 27 below. Environmental monitoring is as well a very important aspect of environmental management during the construction and operation stages of the project to safeguard the environment. The environmental monitoring plan comprise of surveillance programs to be carried out for 19 SP sites in the country. The PMU in collaboration with the Environment Department will check whether the contractor complies and meeting the provisions of the EMP during the construction. The Government is fully responsible to carry on with the environmental monitoring during the operational phase of the project.

717 The CPIU will coordinate the overall monitoring for the project. Contractors are required to develop an environmental auditing protocol and a comprehensive monitoring plan based on the existing IEE and work capacity to be carried out for the selected sites. The contractor will monitor sites based on selected parameters and produce report to the CPIU for review quarterly.

718 The tender contract will outline the mitigation measures and cost to be incurred prior to their undertakings and appended with the contract specifications. Contractors are required to include mitigation cost as part of procurement expenses in their budget. The contractor will recruit an Environmental Officer to oversee the implementation of its environmental responsibilities.

719 The project's environmental management and monitoring plan is provided in Table 9 below.

Table 9. Environmental Management and Monitoring Plan

IMPACT MITIGATION				IMPACT MONITORING			
Project Activities	**Potential Environmental Impact**	**Mitigation Measures**	**Mitigation Responsibiltiy**	**Mitigation (Cost) (US$)**	**Parameter to be Monitored**	**Frequency and Means of Verification**	**Monitoring Responsibility**
PRE - CONSTRUCTION PHASE							
Land Acquisition & Resettlement	Loss of land and non – land assets by land and properties' owners due to the project	Design road alignment to minimize land acquisition requirements for land owners and ensure land owners confirm that they are willing to participate in the project by signing the MoA.	MID, CPIU, Provincial Government, Contractor	No marginal cost	▪ Number of Affected Landowners and Properties Owners ▪ Area of land required ▪ Inventory of non – land assets ▪ Grievances from the communities either verbal or formal ▪ Signed MoAs	▪ As and when required ▪ Grievance or Complaints Register ▪ Project Progress Report ▪ Before and After	Contractor(s) , CPIU
		Accesses into the project area will either be reconstructed or constructed and all activities will take place within existing Right of Ways.	CPIU, Contractor	No marginal cost			
		Compensate all affected land & properties owners for loss of land and trees in accordance with GOS procedures	CPIU, Contractor	To be incl. in the contract cost			
Climate Change & Adaptation Risks	Risks of increased scouring and erosion including coastal impacts to the infrastructure	Ensure all CCA incorporated into the designs are implemented.	Contractor	To be included in the Contract Cost	Designs and Works implemented	Visual Inspections	CPIU, MID
Surveying and demarcation of centerline	Some minor loss of vegetation during surveying and demarcation of approach roads or bridge approaches	Minimize vegetation removal and clearing to immediate corridor of works	Contractor	To be included in the Contract Cost	Area covered by vegetation and trees and area cleared	During survey,and activities – visual inspections before, during and after	Contractor, CPIU
Site clearance, digging and excavation	Accidental discovery of archeological artefacts or sites, assets and resources	▪ Cease activity immediately ▪ Inform National Museum (Tabu Register) of the Ministry of Culture and Tourism, MECDM ▪ Undertake all actions required by the above	Contractor, National Museum and MECDM	To be included in the Contract Cost	Sites or resources discovered and their protection or preservation	▪ During activities Stop Work Notice issued ▪ Site or Resource discovered dealt with properly	Contractor, National Museum, Archeologists, MECDM and CPIU
	Removal of trees and other valuable or productive plants	▪ Consultation with owner and compensate as per Resettlement Plan Framework and usual MID Process	Contractor, MID, CDS	No marginal cost	No residual of loss and owners' satisfaction with the compensation paid	Following provision of compensation	Contractor, CPIU

IMPACT MITIGATION				IMPACT MONITORING			
Project Activities	**Potential Environmental Impact**	**Mitigation Measures**	**Mitigation Responsibiltiy**	**Mitigation (Cost) (US$)**	**Parameter to be Monitored**	**Frequency and Means of Verification**	**Monitoring Responsibility**
Mobilisation of Contractor, presence of Constructio n workers and association with local people	Social Disruptions	▪ Site office or contractor's camp establishedin consultation with authorities, local community in the vicinity and rightful land owners ▪ Village protocols discussed and initial awareness to workers as part of mobilization ▪ Contractor(s) is to ensure workers actions in and outside the work/camp area are controlled and village rules including code of conduct observed ▪ Ensure proper signage and security at camp, i.e. prohibition of unauthorized persons (especially children) from entering the camp, site office, or work area	Contractor, MID & Village Elders or Chiefs	To be included in the contract	▪ Complaints of incidents between workers and villagers reported verbally or formally and recorded in the Grievance/ Complaints Register ▪ No of children entering the camp ▪ Number and effectiveness of signages	During activities – checkingrecords for complaints, consultations with workers about protocols, issues raised with CDS	CPIU
	Spread of STIs and HIV/AIDS	▪ Implementation of awareness and prevention program – Contractor and his / her workers ▪ Implementation of awareness and prevention program – Community or villages with in the SP areas	Contractor, MID, Ministry of Helath and Medical Services, NGOs, Guadalcanal Provincial Health Authority and Approved Service Provider	To be inlcuded in the Contract	▪ STI or HIV/AIDS prevalence ▪ Increased awareness about transimission and prevention ▪ Posters or Materials based on STIs or HIV/AIDS installed at work sites including in and around the camp or site office	Prior to construction – check contractor's records, consultation with employees and NGO or Service provider	CPIU
CONSTRUCTION PHASE							
Operation of construction plant and vehicles generating emissions	▪ Emmissions or exhaust from vehicles and machinery ▪ Dust from: - aggregate crushing plant; - generated by heavy vehicles transporting	▪ Maintain construction equipment ▪ Prohibit the use of machinery or equipment that produces excessive pollutions (eg. Generates dark fumes) ▪ Ensure that vehicles transporting dust prodducing materials are;	Contractor	To be included in the Contract	▪ Air quality, emissions, dust and particulate matter ▪ Use of tarpaulins ▪ Loading of vehicles ▪ Stockpile areas	Monthly or immediately after complaint – periodic visual inspections; any particulate matter and smoke managed as per	Contractor, CPIU

IMPACT MITIGATION				IMPACT MONITORING			
Project Activities	**Potential Environmental Impact**	**Mitigation Measures**	**Mitigation Responsibiltiy**	**Mitigation (Cost) (US$)**	**Parameter to be Monitored**	**Frequency and Means of Verification**	**Monitoring Responsibility**
	materials to and from work sites; and, - uncovered loads on trucks - Dust from exposed stockpiles	▪ not overloaded; ▪ provided with tail boards and side boards; and, ▪ adequately covered ▪ Material stockpilesare to stored in sheltered areas and properly covered ▪ Dampening down of the road during dry season or no rain				EMMP	
Operaation of construction plant and equipment generating noise	▪ Noise to the surrounding villages and communities ▪ Noise impact on the construction workers	▪ Contruction equipment and vehicles maintained and checked to minimize noise ▪ Contractor will develop a schedule of operations with village chiefs and CPIU to identify days of work and no work and hours for certain activities ▪ Limit noisy construction activities to day time hours, i.e. noisy construction activities prohibited between 8am and 6pm while for work sites adjacent to schools between after classes and 6pm depending on the noise produced or time as agreed to by the School Authority ▪ Agree works schedule with village leaders ▪ Provide workers with noise abatement equipments (ear muffs etc.) ▪ Complaints regarding noise will be addressed by the Contractor	Contractor	To be inlcuded in the Contract	▪ Adherence to agreed schedule of works and time of works ▪ Complaints (No. of logged noise complaints and resolutions) ▪ Workers safety equipment	Monthly or immediately after complaint – reiew Schedule of Construction (ensure the Schedule is being adhered to)	Contractor, CPIU
Potential for contribution to Climate Change	▪ Impacts on rainfall, ground water depletion or carbon emissions not expected	▪ Climate proofing, CRMA,, good design to ensure flooding effectsand scouring & erosion are	Contractor	TO be included in Contract Cost	▪ Tidal, stream or river heights and velocities ▪ Flooding frequency	▪ Visual inspections ▪ Review of rainfall	Contractor, CPIU

IMPACT MITIGATION				IMPACT MONITORING			
Project Activities	**Potential Environmental Impact**	**Mitigation Measures**	**Mitigation Responsibiltiy**	**Mitigation (Cost) (US$)**	**Parameter to be Monitored**	**Frequency and Means of Verification**	**Monitoring Responsibility**
		not locally increased ▪ Design modified to accommodate extreme weather events, increased rainfall and run – off and increased coastal erosion (especially SP sites along the North West road)			▪ Localised erosion	and flooding records	
Site clearance, digging and excavation	▪ Accidental discovery of archeological artefacts or sites, assets and resources	▪ Cease activity immediately ▪ Inform National Museum (Tabu Register) of the Ministry of Culture and Tourism, MECDM ▪ Undertake all actions required by the above	Contractor, National Museum and MECDM	To be included in the Contract Cost	Sites or resources discovered and their protection or preservation	▪ During activities Stop Work Notice issued ▪ Site or Resource discovered dealt with properly	Contractor, National Museum, Archeologists, MECDM and CPIU
River training, Bank and Embankment Protection Works	▪ Removal of trees ▪ Changes to river channels ▪ Disturbances to river and water quality	▪ Compensation for trees removed ▪ Climate proofing to ensure flooding effects and erosion do not increase locally ▪ Design modified to accommodate extremeweather events, increased rainfall and run – offs, including coastal effects (particularly SP sites along the North West Guadalcanal Road) ▪ Works in river areas or flood plains must be undertaken with extreme care and precautionary measures	CPIU (Design), Contractor	To be included in the Contract Cost	▪ Flows, rivers or streams course ▪ Reduced localised flooding ▪ Others as per below		
Works in or adjacent to rivers and streams, and in the vicinity of the coast	▪ Erosion and sedimentation of riverbanks, foreshore ▪ Sedimentation in coastal zone ▪ Effects on river structure which includes: ▪ Changes to river or water flow including level and	▪ Construction works within the vicinity of rivers or streams and coasts including river banks must be carried out with extreme caution ▪ Use of silt or sediment control devices during construction works and extraction activities within the	Contractor	To be included in the Contract cost	▪ Temporary structures removed ▪ Rivertraining /Scour protection ▪ No Stockpiling in or near rivers or streams, river islands, flood plains	▪ Monthly or as required ▪ After event check designs ▪ Visual observations of SP sites or work areas (river and	Contractor, CPIU

IMPACT MITIGATION				IMPACT MONITORING			
Project Activities	**Potential Environmental Impact**	**Mitigation Measures**	**Mitigation Responsibiltiy**	**Mitigation (Cost) (US$)**	**Parameter to be Monitored**	**Frequency and Means of Verification**	**Monitoring Responsibility**
	velocity; ▪ Changes to channel depth, structure & location resulting from excavations and embedding of new structures; and, ▪ Changes to river banks caused by destabilized soil structure due to equipement and heavy traffic, and construction of approaches ▪ Damage to flood plain areas within meandering river systems affecting flood cycles, temporary flood storage, release of flood waters and loss of soil fertility though loss of flood silt ▪ Increased turbidity of water bodies due to gravel extraction and excavation ▪ Increased siltation at SP sites ▪ Construction materials are washed out into rivers/streams, coasts and adjacent areas ▪ Reduction in water quality	vicinity of rivers or streams and coasts, and ensure the devices are cleaned and dewatered. ▪ Temporary structures are to minimize impacts on river or water flow ▪ Temporary structures are to be removed immediately after works and river bed be restored ▪ Side slopes of embankments designed to reflect soil strength and reduce/ avoid increased erosion ▪ River training and scour protection as needed ▪ Minimize size and duration of cleared areas and undertake progressive revegetation of cleared work areas ▪ Avoid clearing activities during rainy season where possible ▪ Incremental bank protection including structures and replanting to improve stability ▪ Normal flood behaviors maintained as closely as possible through careful use of temporary structures and stockpiles ▪ Natural water flows in streams or rivers will not be affected ▪ Use of heavy machinery in the aquatic environments be minimized ▪ Good design used in all construction activities to minimize need for changes to natural			and coast ▪ Flooding frequency ▪ Localized erosion	streams) ▪ Consultation with users	

IMPACT MITIGATION				IMPACT MONITORING			
Project Activities	**Potential Environmental Impact**	**Mitigation Measures**	**Mitigation Responsibiltiy**	**Mitigation (Cost) (US$)**	**Parameter to be Monitored**	**Frequency and Means of Verification**	**Monitoring Responsibility**
		gradients ▪ Stones and rocks kept on hand and used in the event of bank or channel erosion ▪ Gabion baskets or rock rip – rap to be used for embankments ▪ No discharges to the rivers/streams or surface waters ▪ No dumping of spoil in rivers or streams ▪ Spoils or stockpiles will not be located near or on slopes within 15m of rivers/ streams ▪ Placement of diversion ditches around stockpiles ▪ Abstraction from, or pollution of water resources and coastal waters is not permitted ▪ Debris, spent fuel or oil and waste material is not to be dumped in or near rivers/ streams and coasts ▪ All waste materials generated during works and chemicals used will be stored in secured containers away from the coast, surface waters or rivers				
Gravel or Aggregate EXtraction	▪ Extraction of river gravels from the river beds or active channels of rivers changes hydrology, alters channels and causes erosion ▪ Extraction from quarries or borrow pits leaves unusable land, exposed water table, attracts rubbish dumping and reduces visual values	▪ Existing quarries will be used where ever possible and appropriate ▪ Extraction from ecologically sensitive areas (inter – tidal flats, swampor mangrove areas) and productive or farm lands is prohibited ▪ Suitable sites is to be identified in consultation with MID, land	MID, Contractor, CPIU	To be included in the contract	▪ Materials only obtained from designated sites (locations and method) as per extraction plan ▪ Rehabilitation of site is conducted as per extraction plan	▪ Monthly – visual inspection ▪ Review of extraction plan	Contractor, CPIU

IMPACT MITIGATION				IMPACT MONITORING			
Project Activities	**Potential Environmental Impact**	**Mitigation Measures**	**Mitigation Responsibiltiy**	**Mitigation (Cost) (US$)**	**Parameter to be Monitored**	**Frequency and Means of Verification**	**Monitoring Responsibility**
		owners and local community ▪ Alternative / upstream water sources must be arranged for rivers currently used by communities as a water source ▪ Preparation and Implementation of extraction plan (with limits to the amount extracted from any one source) in accordance with the guidelines ▪ Extraction from rivers will be identified by consultation with MID, chiefs and communities and according to the approved extraction plan ▪ Approved machinery only to be used (dredging is not permitted) ▪ Extraction activities is not permitted at river bends or other sensitive areas ▪ Permits for material extraction must be obtained from the Ministry of Mines, Energy and Rural Electrification (MMERE) ▪ Extraction sites are to be rehabilitated after the activity ▪ Topsoil is to be preserved and replaced during rehabilitation of quarry site ▪ Crusher to be located approximately 30m from any water bodies				
Run – offs, discharges, generaion of liquid wastes	▪ Increased siltation at SP sites ▪ Constrcution materials washed out into rivers/	▪ Use of silt control devices ▪ Dishcarges to rivers/streams or surface waters is prohibited ▪ Discharges to settling ponds or	Contractor	To be include in the Contract Cost	▪ Discharge of waste as per waste management plan ▪ Occurrence of	Monthly – visual inspection of SP sites and rivers/streams or	Contractor, CPIU

IMPACT MITIGATION				IMPACT MONITORING			
Project Activities	**Potential Environmental Impact**	**Mitigation Measures**	**Mitigation Responsibiltiy**	**Mitigation (Cost) (US$)**	**Parameter to be Monitored**	**Frequency and Means of Verification**	**Monitoring Responsibility**
	streams ▪ Soil contamination from fuels or chemicals	discharge areas determined in consultation with landowners and local communities ▪ Natural water flow of rivers/ streams will not be interfered with ▪ Abstraction from and pollution of water resources is prohibited ▪ Diversion ditches is to be placed around stockpiles ▪ No liquid wastes is to be dumpes in the water ways ▪ Construction works in areas of rivers especially riverbanks will be carried out with great care ▪ Use of heavy machinery in the aquatic environment is to be minimized ▪ Discharge zones for culverts and drains is to be identified and protected ▪ After completion of works all areas particularly rivers/streams are to be restored to pre – conditions as quickly as possible ▪ Spoils and stockpiles will not be located near the coast, onslopes or within 15m of rivers/streams			erosion	work areas	
Construction activities causing unintentional disruptions or damage to existing infrastructure and services	▪ Interference with the existing infrastructure such as: ▪ contamination or disruption of water supply through breaking of pipelines or exposing water table during works; ▪ Disruption or damage to telecommunication services;	▪ Consult with responsible authorities and communities to minimize physical impacts on public infrastructure and disruption or damage to services ▪ Any water supply pipelines or other infrastructure services likely to be affected by the project will be re – routed and / or re –	Contractor	To be included in the Contract Cost	▪ Services damaged and rehabilitated / reinstated ▪ Services re – routed ▪ Service disruptions	As required - visual instpection and consultation with service providers	Contractor, CPIU

IMPACT MITIGATION				IMPACT MONITORING			
Project Activities	**Potential Environmental Impact**	**Mitigation Measures**	**Mitigation Responsibiltiy**	**Mitigation (Cost) (US$)**	**Parameter to be Monitored**	**Frequency and Means of Verification**	**Monitoring Responsibility**
	and, ▪ Disruption or damage to electricity supply.	instated ▪ If water tables are exposed during construction they must be rehabilitated					
Accidental spills of hazardous substances and need for emergency response	▪ Oil and other hazardous chemicals are spilled into the environment resulting in pollution ▪ Hydrocarbon leakage or spills from construction camps and workshops ▪ Accidents placing people at risk	▪ Detailed Emergency Response Plan (ERP) (as part of EMP) prepared by Contractor to cover hazardous materials / oil storage, spills and accidents ▪ Chemicals will be stored in secured containers away from the coast and water bodies or surface water ▪ Chemicals stored in area or compound with concrete floor and weather proof roof ▪ Spills will be cleaned up as per ERP ▪ Ensure all construction vehicles and plant are well maintained ▪ Accidents reported to Police and MID within 24 hours	Contractor, CPIU (to approve ERP)	To be included in the Contract Cost	▪ EMP and ERP ▪ Ensure storage sites are using existing concrete base ▪ Spills cleaned and area rehabilitated	▪ Monthly or after event or as required – review and approval of ERP ▪ Visual inspection of storage facilities ▪	Contractor, CPIU
Intrusion into precious ecology, disturbance of marine and terrestrial habitats, effects on flora and fauna	▪ Impacts on fisheries and fishery grounds ▪ Direct impacts on coral reefs, mangroves and sea grass beds ▪ Run – offs and rivers carry disturbed and turbid waters to coral reefs and offshore ▪ Terrestrial habitats become fragmented ▪ Workers poaching animals and birds for food or feathers, etc ▪ Ecologically sensitive or	▪ There are no significant fisheries within or is likely to be affected by the subprojects ▪ Mangroves are not permitted to be felled, removed or damaged ▪ Vegetation clearance to be kept to minimum, avoid felling of road – side trees where ever possible ▪ Contractor responsible for information and sanctions regarding harm to wild life and felling of trees not required to be cleared ▪ Camp, equipment and stockpiles	Contractor	To be included in the Contract Cost	▪ Check fr poaching and unnecesary vegetation clearance ▪ Progress of re – vegetation of work areas ▪ Adequate fuel supplies in camp ▪ Training of workers in information ▪	▪ Spot inspections ▪ Monthly – visual inspection of camp and work sites ▪ Re – vegetation activities as per EMP ▪ Consultation with villagers and workers	Contractor, CPIU

IMPACT MITIGATION				IMPACT MONITORING			
Project Activities	**Potential Environmental Impact**	**Mitigation Measures**	**Mitigation Responsibiltiy**	**Mitigation (Cost) (US$)**	**Parameter to be Monitored**	**Frequency and Means of Verification**	**Monitoring Responsibility**
	protected areas affected	not to be located in ecologically significant or sensitive areas ▪ Water depth maintained at water crossings to allow migrating species to move up / down the rivers/stream ▪ Progressive re – vegetation to be carried out in all areas disturbed by the project with fast – growing and native species ▪ Contractor to supply sufficient cooking fuel to avoid use and felling of trees by workers					
Encroachment or intrusion into cultural significant areas and historical sites	▪ Impacts on culturally or historically significant sites and cultural values ▪ Tabu areas will be affected by the subproject	▪ No culturally or historically significant areas and tabu sites located within the SP areas or close enough to be affected by the works ▪ Accidental discovery of archeological artefacts, sites or resources will be dealt with as per provisions	Contractor, National Museum and MECDM	To be included in the Contract Cost	Sites or resources discovered and their protection or preservation	▪ During activities Stop Work Notice issued ▪ Site or Resource discovered dealt with properly	Contractor, National Museum, Archeologists, MECDM and CPIU
Presence of vehicles and equipment in villages, use of people's land for access to construction sites Traffic and safety Issues	▪ Traffic and access disrupted during construction ▪ Traffic safety affected	▪ Contractor will prepare a Traffic Management Plan (TMP) ▪ Notify villages in advance of schedule and duration of works ▪ Consultations and care taken to minimize disruption to access ▪ Install temporary access or detour to affeced communities where required ▪ Disposal sites and haulage routes identified in consultation with the communities and land owners ▪ Signage used and installed at appropriate areas in the vicinity of	Contractor, Villages (through the CDS)	To be included in the Contract Cost	▪ No. of accidents or events ▪ Maintenance of access ▪ Signages installed ▪ Road free of materials and debris ▪ Haulage routes rehabilitated	▪ During activities – visual inspections ▪ Consutaltions with local communities and workers ▪ Review of TMP	Contractor, CPIU

IMPACT MITIGATION				IMPACT MONITORING			
Project Activities	**Potential Environmental Impact**	**Mitigation Measures**	**Mitigation Responsibiltiy**	**Mitigation (Cost) (US$)**	**Parameter to be Monitored**	**Frequency and Means of Verification**	**Monitoring Responsibility**
		works ▪ Access through people's land will be negotiated with the land owners and restored after completion of works ▪ Safe access across work sites be provided for the public and communities ▪ Community awareness ascertain village concerns regarding traffic management matters (eg. Determine if they need speed bumps in villages which are close to the road)					
Presence of Construction Workers	▪ Various social impacts include: ▪ Social Disruptions ▪ Possibility of conflicts or resentments between people from the surrounding villages/ communities and workers ▪ Spread of communicable diseases including STIs and HIV / AIDS ▪ Children are potentially exposed to exploitation ▪ Impacts on general health and safety	▪ Village protocols discussed and workers awareness as part of the mobilization process ▪ Contractor to ensure workers' actions and work sites are controlled and village rules including code of conduct is adhered to ▪ Signage and security,i.e. prohibition on unauthorized people (especially children) entering the camp, site office and works yard ▪ Workers to respect village and land owners' boundaries ▪ STIs and HIV / AIDS awareness program through approved service provider for workers and communities within the SP site ▪ A Communication and Cmplaints Plan will be used for liaison and correction among the	Contractor, Chiefs or Elders, MID, CPIU and Approved Service Provider	To be included in the Contract Cost plus Costs for program (already identified)	▪ STIs and HIV/ AIDS awareness campaign implemented ▪ ESO and CLO recruited ▪ Training implemented ▪ Provision of safety equipment to workers ▪ Signage and security to prevent unauthorized people from entering the camp, work sites and yards ▪ Signage installed as required and appropriately	▪ As required ▪ Monthly or after complaint – ESO recruited ▪ Training records ▪ Staff records ▪ Visual inspections ▪ Consultation with villagers ▪ Checking of complaints register ▪ Consultation with workers and ensure training	Contractor, CPIU and CDS as required

IMPACT MITIGATION				IMPACT MONITORING			
Project Activities	**Potential Environmental Impact**	**Mitigation Measures**	**Mitigation Responsibiltiy**	**Mitigation (Cost) (US$)**	**Parameter to be Monitored**	**Frequency and Means of Verification**	**Monitoring Responsibility**
		stakeholders ▪ Contractor to appoint an ESO and a CLO ▪ Contractor to provide health facilities and 1st Aid Post in site office and work sites, and to provide safety equipment for workers ▪ Contractor to provide adequate and safe drinking water in camp ▪ Protection for the public in vicinity of work sites and safe access across work sites provided ▪ Roads and SP sites to be kept free of rubbish and debris ▪ No damage to property and resources ▪ Contract documents will include provisions for ensuring poor and local women encouraged to be encouraged to participate in workforce and will receive fair wages ▪ No child labour or children allowed to work					
Waste generated at construction camps	▪ Dumping of solid wastes or rubbish at or in surrounding areas ▪ Contamination of local water supplies by waste disposed or from construction camps ▪ Discharges of waste water or sewage from camps into rivers and streams	▪ Contractor is to prepare a Waste Management Plan (WMP) as part of its EMP ▪ All wastes from work sites to be disposed of in approved land fill or areas ▪ No wastes is to be dumped in or stored close to streams, or the coast (inlcuding mangrove areas) ▪ Contractor ensures wastes are not discharged into the	Contractor, CPIU (To approve Plan)	To be included in the Contract Cost	▪ Waste Management – visual inspection that solid wastes is disposed of as per EMP and WMP ▪ Provision of sanitary facilities ▪ No direct discharges to streams and rivers ▪ Regular removal of wastes	▪ Monthly, as required and spot checks – visual inspection ▪ Review of Waste Management Plan (WMP)	Contractor, CPIU

IMPACT MITIGATION				IMPACT MONITORING			
Project Activities	**Potential Environmental Impact**	**Mitigation Measures**	**Mitigation Responsibiltiy**	**Mitigation (Cost) (US$)**	**Parameter to be Monitored**	**Frequency and Means of Verification**	**Monitoring Responsibility**
		surrounding water bodies or rivers and that all wastes are disposed of in approved appropriated sites ▪ Adequate drainage and proper handling of sewage and other liquid wastes to prevent pools that could encourage or breed disease vectors ▪ Site office and works yard will have sanitary latrines ▪ Rubbish bins are to be provided on site and no site specific landfill at camp ▪ As part of training and awareness contractor will provide sufficient information on appropriate waste disposal methods			▪		
Site office and works yard and use of water electricity supplies	▪ Stress on resoruces and exisitng infrastructure	▪ Site office and works yard located, if possible, in areas better supplied with infrastructure and services ▪ Contractor to supply temporary facilities, i.e. health post, accomodation, water and electricity, telecommunications and sanitation in the camp and site office	Contractor	To be included in the Contract Cost	▪ No. of concerns raised and resolution ▪ Service supply to camp and office ▪	Ongoing – consult with villages along the SP road to monitor environmental concerns	
OPERATIONS PHASE							
Operation of vehicles generating emmisions	▪ Hydrocarbons, Carbon Monoxide, Notrous compounds, Sulphur Dioxide and particulate matter increase through increased traffic	▪ Forecasts ontraffic level indicate that emmisions will be low and will not have a noticeable impact on the air quality ▪ Lanscape along the road sides to reduce dust impacts	TPPU, Routine Maintenance Contract	To be included in the Contract Cost	▪ Air quality ▪ Particulates and smoke ▪ No. of complaints ▪ Incidents logged with resolution	▪ Monthly or as required – consultation and visual observations ▪ Complaints	Contractor, CPIU
Routine and ongoing	▪ Constriction of water flows	▪ Maintenance of structures to	TPPU, Routine	To be included	▪ Satisfaction with	▪ As required or as	MID, TPPU, ADB

IMPACT MITIGATION				IMPACT MONITORING			
Project Activities	**Potential Environmental Impact**	**Mitigation Measures**	**Mitigation Responsibiltiy**	**Mitigation (Cost) (US$)**	**Parameter to be Monitored**	**Frequency and Means of Verification**	**Monitoring Responsibility**
maintenance	through structures blocking water ways ▪ The need for gravel for on – going road maintenance leads to acquisition of new source areas affecting properties	ensure river debris does not collect and result in damage to bridge abutments, banks or land through altered flow patterns (see below) ▪ MID will negotiate with resource owners and prepare an MOU acceptable to all parties	Maintenance Contract	in the Contract Cost	MOUs	per PSA – MOUs ▪ Routine maintenance records ▪ Visual inspections ▪ As per monitoring framework included in PSA	
Placement of culverts and bridges	▪ Alterations to river flow ▪ Constriction of water flows through structures blocking water flow ▪ Restriction of natural meandering of streams ▪ Restriction of natural flood cycles by filled approaches to bridge or culverts (including temporary storage of flood waters and their release along flood plains) ▪ Reduced top dressing of flood plain agricultural areas through restricted flood plain movements	▪ Proper maintenance of structures to ensure river debris does not collect and result indamage to banks and land ▪ River training and scour protection works ▪ Good design to ensure normal flood behavior is maintained as closely as possible through use of transparent structures and relief culverts on bridge approaches	MID / TPPU, Routine Maintenance Contractor	To be included in the Contract Cost	▪ Erosions ▪ Flooding patterns ▪ Culverts and bridge abuments cleared of debris	▪ Twice a year for 3 years,i.e. mid term and post eval ▪ Monitoring check designs ▪ Visual assessments review of flooding ▪ Patterns / records	MID / TPPU, ADB
Improved access to previously inaccessible or hard to reach rural areas	▪ Hunting and poaching increases	▪ Lack of thorugh route access and low traffic volumes means it is unlikely that there will be any impacts on Flora and Fauna ▪ There are no rare or endangered species that could be affected by operation ▪ There are no protected or ecologically sensitive areas in or near the SP sites	TPPU; Routine Maintenance Contractor	To be included in the Contract Cost	▪ Increases in hunting activities ▪ Reduced sightings of fauna	▪ Twice a year for 3 years, i.e. mid term and post eval. ▪ Monitoring – Visual assessment ▪ Consultations	MID/ TPPU, ADB
Spread of	▪ Roads act pathways for	▪ At expected traffic volumes risk of	TPPU, Routine	To be included	▪ Health Status of	▪ Twice a year for 3	MID / TPPU, ADB

IMPACT MITIGATION				IMPACT MONITORING			
Project Activities	**Potential Environmental Impact**	**Mitigation Measures**	**Mitigation Responsibiltiy**	**Mitigation (Cost) (US$)**	**Parameter to be Monitored**	**Frequency and Means of Verification**	**Monitoring Responsibility**
communicable diseases	spreading communicable diseases such as STIs and HIV/AIDS as it connects villages, communities, towns and cities	spread of such diseases are not expected	Maintenance Contractor	in the Contruction Cost	people ▪ No. of cases of STIs, etc	years, i.e. mid term and post eval. ▪ Monitoring – Consultations with villagers and road users ▪ Review of Health Records (STIs data etc.)	
Increased Traffic	▪ Increased traffic increases noise nuisance for residents along the road ▪ Increased traffic volumes and higher speeds leads to road accidents	▪ Low traffic forecasts and the low population density means that ambient noise levels will not significantly increase ▪ General road safety will be improved through providing a shoulder and widening within the ROW at bridge approaches along with the installation of proper signages ▪ Working alongside the Police to carry out enforcement of traffic regulations once structures are repaired and rehabilitated ▪ Awarenes raising through villages meetings will beneeded to create road safety programs ▪ Ongoing community awareness ascertain village concerns regarding traffic calming & management matters	MID / TPPU, Local police	To be included in the Contract Cost	▪ Accidents and collisions ▪ Safety issues discussed in schools ▪ Effectiveness of traffic calming measures	▪ Twice a year for 3 years, i.e. mid term and post eval. ▪ Monitoring – Consultations and visual observations ▪ Complaints ▪ Collect road accident data	MID / TPPU, ADB
Climate Change & Adaptation	▪ Risk of Climate Change on Infrastructure	▪ Risks of impacts on the structures and approaches from climate change will be addressed through routine inspections of the structures as part of the tass of	TPPU, Routine Maintenance Contractor	To be included in the Contract Cost	▪ Tidal, stream / river heights and velocities ▪ Flooding frequency ▪ Localized Erosion	▪ Visual ▪ Review rainfall and flooding records	Contractor, CPIU

IMPACT MITIGATION				IMPACT MONITORING			
Project Activities	**Potential Environmental Impact**	**Mitigation Measures**	**Mitigation Responsibiltiy**	**Mitigation (Cost) (US$)**	**Parameter to be Monitored**	**Frequency and Means of Verification**	**Monitoring Responsibility**
		the Routine Maintenance Contractor ▪ In addition to repairing damaged components one of the responsibilities of the Contractor will be to report on cases where drainage and erosion protection structures are failing and to recommend upgrades or addition as required. This approach is adaptive and encompasses a range of issues that might arise through through complex interactions between climate and other variables to produce unpredictable changes in the areas hydrology					

15 PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

15.1 Consultation Activities Undertaken

720 Two consultations were carried out in the formulation of this application at all subproject sites. The initial consultation was undertaken in May 2015 and a follow-up consultation was made from July 2015 to August 2015. The initial community awareness and consultation was undertaken from 14 May 2015 to 31 May 2015, with the aim to make the communities within the surrounding areas of the SP sites aware of the TSFRP. During these initial informational meetings, communities were also inquired on the degree of damage caused by the April 2014 flash floods; landowners were identified; basic community data was collected; information on impacts of climate change as viewed by the community were identified; significant environmental impacts that will likely to occur during the construction phase were identified; and community perspectives on the proposed designs of structures were also taken into consideration.

721 A follow-up community consultation was undertaken from 27 July 2015 to 13 August 2015 at selected SP sites which aimed at collecting more community based information; make communities aware on Land Acquisition and Resettlement Plan (LARP) Procedures; discuss environmental impacts of construction works and display concept engineering designs in order to make people aware of the areas that will be affected during construction works. The number of stakeholders consulted and date of consultation are presented in the table below. In summary all stakeholders consulted were very happy with the TSFRP going ahead and were particularly happy that consultation and information sharing with them has been undertaken, unlike in previous projects.

Figure 53. SP02 - Tambea Culvert Community Consultation at Kusika Village

Figure 63. SP23 – Mbalasuna Bridge Communtiy Consultation at Ndadave

Table 10. Community Consultation Attendance Record of May 2015

Date	Village/Crossing	No. of People (Initial Consultation)
30/05/2015	Mberande East	26
30/05/2015	Mberande West	31
14/05/2015	Kovelau	7
30/05/2015	Mbalasuna	12
18/05/2015	Gold Ridge	28
29/05/2015	Ngalimbiu	13
21/05/2015	Selwyn	67
20/05/2015	Tambea	28
24/05/2015	Sasa	32
24/05/2015	Aruligo	62
27/05/2015	CBSI	9
28/05/2015	Belamatanga Bridge & Culverts	17
28/05/2015	Mbonege	24
22/05/2015	Turtle Beach	13
31/05/2015	Poha	8
27/05/2015	Tanavasa	19
26/05/2015	Tanaghai	34
Total	**17 Villages**	**430**

Table 11. Community Consultation Attendance Record of July - August 2015

Date	Village/Crossing	No. of People (Followup Consultation)
12/08/2015	Mberande East	14
12/08/2015	Mberande West	40
11/08/2015	Kovelau	10
3/08/2015	Mbalasuna	22
1/08/2015	Gold Ridge	19
10/08/2015	Selwyn	6
27/08/2015	Tambea	27
4/08/2015	Tomba LLB	8
5/08/2015	Belamatanga Bridge & Culverts	21
6/08/2015	Mbonege	10
30/08/2015	Tanavasa	3
31/07/2015	Tanaghai	20
Total	**12 Villages**	**200**

15.2 Results of Consultation

722 During preparation of the PER consultations were held with villages within immediate vicinity of the SP sites. The meetings were "open" in that anybody with an interest in the Project was invited to participate, for smaller villages, a group of villages was invited to attend a meeting. The meetings were well attended and some interesting information was provided, which has been incorporated into the description of the existing environment and assessment of impact sections of the PER.

15.2.1 Main Issues Raised

723 The main issues raised during the village meetings can be distilled into common themes:

- Food Gardens (for consumption and marketing); Cocoa and Coconut Plantations including Palm Oil Out growers had been affected. Hence, production is very low immediately after the flash flood but is slowly recovering.
- Water supply sources have been affected for some communities while other communities that do not have water supply confirmed flood affected springs and streams used as main sources of water for drinking and cooking.
- Most of the communities lack proper and hygienic sanitary facility.
- Rivers have very low banks resulting in water flooding everywhere.
- Most of the communities affected by the flood did not receive assistance.
- One community recorded death in the 2014 flood while others recorded deaths and casualties in previous floods.
- Villages had been flooded with some properties, possessions and houses destroyed during flood.
- Infrastructures damaged during the flash floods had been repaired and restored back and services along the road had improved after 1-3months after the flood.
- Access to schools, health centers, banks, shops and markets is most of the time hindered during heavy rains and floods.
- Land availability and accessibility is not a problem except for Mberande and Mbalasuna.
- There are some tabu sites and war relics surrounding the vicinity of structures but are more than 10meters away. The only two sites with tabu area closer to the structure are Poha West and Mberande East.
- Communities proposed improved and rehabilitation of drainage system; crossings to be double(2)lanes and be disability friendly and culverts and bridges should be designed with assistance from communities and be increased in size and higher for most of the crossings.
- Project to consider rehabilitating the roads as well.
- Compared to less than five years ago traffic volume on the road had increased dramatically.

724 The probable benefits after the project identified by the communities include: (i) Improvement of most damaged structures; (ii) Improved crossing should be accessible all year round; (iii) Access to services will be much easier and safer; (iv) Consistent and improved access to services even when it is flooding; and (v) Public Transport services are consistent in all situations for emergency and most of the time.

725 The community consultations also identified some negative impacts including: (i) Exposure to different culture and risks of increasing Sexually Transmitted Infections including HIV; (ii) Increased Criminal activity and social issues including alcohol consumption; marijuana smoking; domestic violence and child abuse; (iii) Possibility of girls and women having relationships with construction workers; (iv) General environmental pollution which include water pollution from excavation in in rivers and streams and oil leaks; air pollution from heavy machinery plant; noise pollution; waste from works left on site; (v) Increased traffic and speeding along the road as contractors work against time frame; (vi) Outsiders coming into the village with very knowledge of the culture and custom of the area; and (vii) Issue with land for construction and improvement of structures.

726 Other points taken into consideration during the consultation are as follows: (i) Most of the bridges were too low and many piles(posts) and when floods carry debris water passages were blocked and debris piles build up water pressure resulting in structures collapsing or water diverting into surrounding areas causing damage to the villages(washing away houses and covering the whole area with silt(mud) from upstream); (ii) Some culverts and causeways are very small and cannot cater for the amount of water and debris during floods; (iii) Not only bridges, culverts and causeways need improvement drainage systems along the roads also need improvement as to where water should be drained as many drains has no proper out let and tend to flood whole area if blocked or outlet not properly excavated

727 Further consultation will be undertaken with identified stakeholders and communities in respect of options for the works. The following steps will be taken:

- Negotiations will be held with landowning groups and community leaders for formalizing ease of access to SP sites and sites for material extraction by signing MOAs, MID will be leader.
- During the design and pre-construction phase contract negotiation and documentation will be rectified to contain specific billable items for provision of ongoing STI, HIV/AIDs awareness and mitigation, social issues including alcohol consumption, marijuana, domestic violence, gender, and child abuse awareness and education procedures and establishment and maintenance of a Community Advisory Committee.
- Before construction, a pre-contractor mobilization awareness will be conducted in all affected communities in the SP sites to be carried out by the contractor
- Social and Economic baseline studies for M&E will be undertaken by the project staff
- In the construction phase Contractor will continuously carry out awareness in STI, HIV/AIDS; Social Relates Issues including gender, child abuse and domestic violence. While project team will be monitoring social and environmental impacts ongoing.
- A specific communications plan will be documented to address community awareness and education.

15.3 Measures Suggested During Consultation

728 Some measures to minimize negative impacts were discussed during the meetings, these included; (i)restricting access of the workers to the immediate road through construction of gates and/or fences along the villages;(ii)the village committee creating additional village by-laws and rules(including bans)to try and minimize the negative social impacts;(iii)establishing a police post in the area to provide reinforcements to elders and chiefs for dealing with issues of law and order;(iv)making sure the construction workers know the village rules and codes of conduct and obey them;(v)the project running a health(including STIs and HIV) and traffic awareness program in conjunction with responsible village authority;(vi)project conducting an awareness based on gender, domestic violence, child abuse and other social related issues;(vii)banning children from going into construction camp;(viii)imposition of fines on workers who break rules and insisting the contractor remove all machinery and plant, waste and re-in state lands to original condition at the completion of the project.

15.4 Project Response to Issues Raised

729 Some measures to minimize negative impacts were discussed during the meetings, these included:(i) community to confirm with land owners to allow ease of access to land(ii) project will be carrying out awareness on STI, HIV/AIDs, Social related issues including gender, domestic violence and child abuse;(iii) Project will consult all landowning groups for availability of land before construction and resolve issues;(iv)project will consider proposed options for structures as to what is best for the site.

15.5 Further Disclosure

730 Further information disclosure will be done during the implementation through: (i) The project's Consultation and Participatory Plan along with the TSDP's Communication Plan; 9ii) The preparation and dissemination of a brochure in English and Pidgin (and other languages as required), explaining the project, works required and anticipated timing of the works; and, (iii) Setting up a formal grievance redress committee with a representation from the affected people. The CPIU in association with the contractor will be responsible for managing the grievance redress program.

731 Information regarding the approved SP and the proposed environmental management measures will be posted at suitable locations at the respective SP site. Disclosure will conform to the Public Communications Policy of the ADB: Disclosure and Exchange of Information (March 2005) which requires that environmental assessment reports for ADB projects be accessible to interested parties and the general public. The project's SIEE as part of ADB project documents will be uploaded onto the ADB website while the IEE will be available to the public upon request.

732 Further public consultation will be arranged prior to construction commencement to both alert the local communities to the possible threats and opportunities of the construction phase and to provide the opportunity for the people to emphasize their concerns, as expressed above, directly to the Contractor.

16 DIFFICULTIES ENCOUNTERED

733 This report has been prepared using available data and information gathered during the site visits to the SP sites. However, it was found that there are difficulties encountered when collecting available documented data and information as there are some gaps between available data and current conditions. Like, data gaps that had been identified in the National Census Survey Report of 2009, that there are newly established settlements found for which there are no records of village, names and population record on the statistics record. This resulted in inconsistency with the national statistics data collected in 2009 or even village names are there but population is not recorded. Also maps needed to be inserted in the documentation of this report to identify location of the SP sites are not available and provided by the MID/ CPIU GIS Unit. Hence, it was requested to the MECDM GIS Department with completed End User Agreement for their Approval which may take some time along with the preparation of the maps requested. This may lead to the delay in finalizing and submitting the report to the responsible authorities for reviewing and approval for issuance of its purpose. Similarly, contacting key and contact people is difficult as they live in the villages which the mobile network coverage is not always efficient and to send information regarding the proposed project and visiting teams or meeting with them including need for discussion of some issues usually depends on the mobile network coverage and travelling long hours to get to their place which is about 2 to 3 hours.

17 CONCLUSIONS AND RECOMMENDATIONS

734 It is concluded that the potential environmental impacts that would arise during the phases (pre – construction, construction and operation) of the project will be relatively minor and localized and acceptable provided that the mitigation measures set out in the EMP are incorporated into the design and implemented properly.

17.1 Findings

735 Key findings are summarized below;

- The project route does not traverse any protected areas or areas of conservation value, including primary forests, terrestrial reserves or community managed marine protected areas. The Project will not create any impacts on cultural or tabu sites and does not pass through densely populated areas. A screening has been undertaken and not identified any significant negative or adverse environmental impacts;
- The environmental assessment found no endangered terrestrial, marine or freshwater species likely to be affected by the Project activities. All the SP sites in the east are located more than 10km inland while the SP sites in the west are closer to the coast but the coast especially at the river mouths are greatly impacted by sedimentation and deposition over time. The impacts on flora are minor as most of the areas were cleared under past construction activities and are already disturbed;
- The potential impacts on terrestrial wild life including rare and endangered species is considered to be insignificant and the project does not encroach upon any national or locally recognized areas;
- Possible impacts on the social environment are likely to be low provided MID and the Contractor adhere to standard health and safety practices and co – ordinate closely with the nearby communities who themselves had offered their support towards the project;
- Tabu sites existing more than 50m to 100m away from the Mberande and Mbalasuna SP sites will not be affected during the construction activities as they are not within the construction limits, whilst there are no other tabu sites identified at the other SP areas; and,
- Suitable climate change adaptation and resilience need to be considered during the design and planning phase to incorporate resilience into the project. This includes measures to mitigate the project and its nearby environment from the effects of climate change and its hazards and the project impacts on the environment due to such prevailing hazard.

17.2 Conclusions

736 Terrestrial habitats occurring at the project sites are secondary regrowth and are common in the coast and East and West Guadalcanal plains.

737 There are no protected areas or marine protected area, archeological or cultural sites, rare or endangered flora and fauna to be affected by the SP activities. The rapid environment assessment found no endangered terrestrial and marine species likely to be affected. Most of the coastal areas especially at the mouth of the rivers are largely impacted by sedimentation and deposition overtime.

738 The Director of ECD will be requested to grant development consent in writing to MID after reviewing and accepting the PER. Monitoring contractor's compliance to the EMP will be undertaken by CPIU and ECD. Monitoring reports will be submitted to MID and ADB.

739 Mitigation measures were developed to avoid and minimize potential environment and social impacts of the project. These measures are incorporated in the design process of proposed bridges and culverts. Based on the screening exercise, the Project does not traverse any protected area, tabu or cultural site, endangered or rare species in the subproject.

740 The impacts during the preconstruction, construction and operation phase of the project are minor and moderate. All impacts incurred during these phases will be mitigated to avoid or minimize the potential impacts. To ensure these mitigation approaches are implemented, the approaches will be included in the contract documents as part of contractor's EMP.

741 The Director of ECD will be requested to grant development consent in writing to MID after reviewing and accepting the PER. Following the requirements of the EMP, the contractor will be required to provide a detailed CEMP based on the model set out in this report. Monitoring contractor's compliance with the EMP will be undertaken by CPIU and ECD. Monitoring reports will be submitted to MID and ADB.

742 From the screening exercise and community consultation, it is concluded that the level of assessment required meets the ADB and SIG requirements. Therefore no further assessment is required and that the Project complies with the environmental Categorization of Category B.

17.3 Recommendations

743 The recommendations of this PER are: (i) the PER be accepted by MECDM and ADB as the statement of subproject's environmental effects and how they will be mitigated; (ii) Contractor be assisted by CPIU to prepare an CEMP based on the generic model included in this PER; and, (iii) the subprojects impacts and mitigation thereof, be monitored as per the monitoring plan.

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APPENDICES

APPENDIX 1 – Environment Screening Checklist

ECD ENVIRONMENT SCREENING CHECKLIST

SECTION 1: REQUIRED INFORMATION

This section presents the various information required to be submitted by the project proponent as attachments to the IEE / PER Report.

SECTION 2: GENERAL INFORMATION

2.1 Project Title: Transport Sector Flood Recovery Project (TSFRP)
2.2 Project Location: Guadalcanal Province

Attachments	Remarks
▪ Topographic map (scale 1:50,000) indicating project site (road alignment, location of bridge/s, and other components etc.) and significant landmarks, or straight line diagram of the project showing water bodies and other relevant areas to be traversed vital in the evaluation of the project	Map of Guadalcanal Island
▪ Preliminary engineering design/drawings on the road, bridges, airstrip and wharfs and other appurtenances/components	Preliminary Engineering Information
▪ Proposed schedules of activities (construction stage)	2015/2016

2.3 Proponent: Ministry of Infrastructure Development (MID)
Contact Person: Mike Qaqara
Address: MID – CPIU
P O Box G8Suite 207
Hyundai Mall
Honiara
Solomon Islands
Tel / Fax #: +677 21322 / 22262
Email: MQaqara@mid.gov.sb

SECTION 3: PROJECT DESCRIPTION

3.1 Project Type

Repairs and reconstruction of bridges, causeways and culverts in North West and North East Guadalcanal was prioritized under the Transport Sector Flood Recovery Project. The scope of works will include repairs and reconstruction of 3 high level bridges and 5 small stream crossings; 1.6km of bridge approach roads; 80m of cross culverts; 1km of bridge and approach road protection works; and 300m of river training works.

3.2 Total Project Cost: ……

Funding Source: Asian Development Bank (ADB)

3.3 Material Requirements

Location of Approved Gravel Sites:

a) **North East – Lunga, Ngalimbiu and Mbalasuna Rivers**
b) **North West – Poha, Tamboko and Sasa Rivers**

Location of Coronous Material Sites:

a) **Green Valley, Honiara**

3.4 Manpower and employment

How many people will be employed by the project?

During the Pre – Construction and Construction Period : **>100people**

During the operation and maintenance: **>50people**

3.5 Construction Schedule

How long will the pre – construction or construction period take? **12+months**

SECTION 4: DESCRIPTION OF SUBPROJECT SURROUNDINGS

Components / Parameters	Yes	No	Remarks
What is the general elevation of the SP areas? • <100masl • 100 – 300masl • 301 – 500masl • 501 – 1000masl • 1001 – 1500masl • >1500masl (To determine elevation refer to the topographic map where th elevation per contour line is indicated)	✓		(Indicate the area per elevation range or estima the % to total area) • The SP sites are situated in areas les than 100m above sea level.
Slope and topography of the area: • Terrain is flat or level (0 – 3% Slope) • Gently sloping to undulating (3 – 8% Slope) • Undulating to rolling (8 – 18% Slope) • Rolling to moderately steep (18 – 30% Slope) • Steeply Sloping (30 – 50% Slope) • Very steep to mountainous (>50% Slope)	✓		(Indicating the area per slope category or estimate the % to total area) • The terrain is flat or level (0 – 3% Slop ○ In the North West the 14 structures are situated in areas almost a flood plain while in the east all the structures are on a flood plain. The flood plain comprises of igneous and alluvial. Including tuff breccias, microdiorite, limestone and basalts.
Are there areas in the site where indication of soil erosion is occurring? If 'Yes' what activities are causing soil erosion?	✓		Causes of erosion: Soil erosion is mostly high at the river banks an bridge abutments including approaches where there are no gabion protection walls. ✓ Heavy rains ✓ Unstable slopes ✓ Others, pls. specify
Do you know of landslide occurring or that has occurred at the site?	✓		Causes of landslide: [ ] Earthquake [ ] Unstable slopes [ ] Earth moving [ ] Others, pls specify There has been a landslide upstream of Aruligo Stream and Belamatanga River in 2014. This might have happened to other rivers with simila topographic and geographic condition.
Has the area experienced any flooding during the wet season or cycle? If 'Yes', when was the last time the area was flooded What caused the flooding?	✓		Periods of flooding: Almost frequently through th year but mostly during the wet seasons from October to April. Causes of flooding:

Components / Parameters	Yes	No	Remarks
			✓ [ ] Low area elevation ✓ [ ] Poor drainage ✓ [ ] Water logged • Poor drainages affected the road surfaces and resulted in pools of water at some areas. • Rivers had very low banks • Bridge approaches are scouring and banks are eroding thus gabion protection walls had collapsed. • Debris piling at structures had caused rivers to divert and flood surrounding areas
Soil type of the area: [ ] Sandy Soil [ ] Clayey Soil [ ] Sandy Loam Soil	✓		Other Soil Types: The soil comprised mostly of basalts; hornblend microdiorite; pyroclasts; volcaniclastic wackes; tuff breccias; igneous rocks and alluvial
Is there an access road going to the SP site? If 'Yes' What is its distance to the site ……. Km.	✓		The structures are located North West and Nort East of Guadalcanal which is west and east of Honiara City. To the west structures SP sites ar located from Chainage 5.3km to 50.0km. While the east at Chainage 24.0km to 43.0km and up Chainage 30.5km at Gold Ridge Bridge. The structures are mostly bridges with culverts and causeways.
Are there existing structures or development around the proje site? If 'Yes', please list them in the space below or in the opposite space.	✓		There are economic activities existing around th SP sites. In the east GPPOL and Gold Ridge Mines are the major companies operating in the area. Farmers and local communities depend o the road for transportation of their products to th market on a daily basis live along the roads and improvement of the bridges is seen as very important for economic development.

What is the present land use of the area?

✓ [ ] Prime Agricultural Land (Coconut, Cocoa, Cultivated Gardens, Betelnut, Schools, Clinics, Settlements)

[ ] Others, pls specify

✓ Large Scale Commercial farming of Palm Oil in North East Guadalcanal, along the North East Road

4.2 Biological Impacts

Screening Questions	Yes	No	Description (Quality of resources, vegetatio and habitat)
Terrestrial			
Will agricultural land or plantation forest be affected?	✓		Agricultural land will be affected as there will be realignment done for areas where there will be new structures constructed.
Will a declared or proposed protected area be affected?		✓	There are no declared or proposed protected areas with in the vicinity of the SP area. Except one area which is 1km from Veranaso Causeway but it was already re –opened and th project will not have any impact on.
Will a community / traditional conservation area be affected?		✓	
Will riverbank habitat be affected?	✓		As there will be demarcation for work area and realignment at some sites thus, vegetation and some fruit trees will be removed.
Will the buffer zone of a protected area be affected?		✓	
Will a mangrove or wetland area be affected?		✓	There are no mangrove or wetland areas within the locale of the SP area.
Will primary forest be affected?		✓	
Will secondary forest be affected?		✓	
Are there any rare or endangered species (terrestrial or aquati known to inhabit the area?		✓	
Is the area important for biodiversity protection?		✓	
Will the proposal increase access to protected areas or areas important for biodiversity conservation?		✓	
Will any culturally or historically important sites or resources be affected?		✓	
Marine			
Will the project affect any MPA?		✓	The only closest MPA to one of the SP sites is approximately 1km from Veranaso Causeway but was already opened for harvesting.
Will the project affect any buffer zone of the MPA?		✓	
Are there any endangered coral species likely to be affected?		✓	
Are there any endangered reef fish, pelagic fish, reptiles, etc likely to be affected?		✓	
Potential Magnitude of Impact			
Approximate loss of agricultural land or plantation forest area.	✓		Realignment at Mbalasuna to the old bridge site will affect agricultural land and farm.
Approximate loss of riverbank habitat area.	✓		Realignment at some sites will require removal some trees, shrubs and other plants including commercial crops and fruit trees within the vicinity of the sub –project sites. Further consultation will be carried out with the affected persons when the detailed designs are ready.
Approximate loss of buffer zones.		✓	
Approximate loss of primary forest.		✓	
Approximate loss of secondary forest.		✓	
Approximate loss of mangrove or wetland area.		✓	
Approximate loss of coral reef area.		✓	

If answer is 'Yes' to the above answers, please provide examples of these species (common or local name) in the table provided below.

Birds & Other Wild Life	Trees & Other Important Vegetation	Fishery Resources

	Coconut Cocoa Palm Oil Mango Sago Palm Banana	

4.3 Climate Change

Screening Questions	Yes	No	Remarks
Is the project area subject to hazards such as earthquakes, floods, landslides, tropical cyclone winds, storm surges, tsunami or volcanic eruptions and climate change?	✓		SP Sites: • North West – are subjected to flooding, cyclone winds and storm surges because of their proximity to the coast. • North East – are subjected to mostly flooding as they are on a flood plain. Climate change impacts are also considered as one of the major hazard. Hence, detailed design will take in to consideration raising the structures and increasing the length also protection for the river banks and bridge abutments.
Could changes in precipitation patterns or evaporation rates over the lifespan of the project affect its sustainability and cost (i.e. increased landslides increased maintenance cost)?		✓	
Does the project use or depend on resources which could be affected by climate change such as precipitation, wind (permafrost melting, increased soil moisture content in the subgrade)?		✓	
Are there any demographic or socioeconomic aspects of the project and project area (e.g. Population growth, settlement patterns) that increase the vulnerability of the project and surrounding projects?	✓		There has been increasing land use patterns upstream of the SP areas. This include; logging activities, agriculture and settlements.
Could the project potentially increase the vulnerability of the surrounding area (i.e. by increasing runoff, encouraging settlement in earthquake zones)?		✓	

4.4 Information on Environmental Impacts

What is the predominate type of vegetation to be affected? • Road side vegetation comprising mostly of trees, palm trees, and grass including shrubs which overtime have overgrown the area. **What is the estimate of total area of this type of vegetation to be affected?** • The area will be determined during demarcation and clearing of the work area. **What is the proportion of the affected area of the total area of this type of vegetation?** • The type of vegetation in the area is common and had covered the road sides.
Are there any other ongoing impacts or proposals which could increase the significance of these loss i.e. cumulative impacts? • Regular vegetation control is carried out through the Machine Based Contract under TSDP for the North East and North West reaching as far as Km 43 and nothing for the remainder of the road to Km 50.
What is the estimate of total area of mangroves to be affected? • No mangroves within the vicinity of the SP area. **What is the proportion of affected area of total mangrove area at this location?** • N / A **What is the viability of the total mangrove area (at this location) in respect of the loss? Briefly explain.** • N / A
Are there any other ongoing impacts or proposals which could increase the significance of these loss i.e. cumulative impacts? • N / A
What is the estimate of total area of riverbank habitat to be affected? • There will be realignment at some sites including scour protection and river training works to attain maximum

safety approaching the bridge. **What is the proportion of affected area of total riverbank habitat at this location?** • More than 250m^2 will be required for realignment at specific areas for realignment but this is yet to be confirmed. However, there will be removal of vegetation during the pre – construction phase only for the area for road corrido **What is the viability of the river bank habitat (in this location) in respect of the loss?** • The vegetation comprises of coconuts, cocoa, palm oil and other fruit trees.
Are there any other ongoing impacts or proposals which could increase the significance of this loss i.e. cumulative impact' • Shifting cultivation
What is the estimate of total area of coral reef to be affected? • **N / A** **What is the proportion of affected area of coral reef habitat at this location?** • **N / A** **What is the viability of the coral reef area (in this location) in respect of the loss? Briefly explain.** • **Very few marine fauna and flora exists because of overfishing and pressure from the increasing population. Intertidal flats and reefs are flanked with mostly dead corals.**
Are there any other ongoing impacts or proposals which could increase the significance of these loss i.e. cumulative impacts? • Increasing population for this province, from the last census survey carried out in 2009 the population has an alarming 4.4% growth per annum.
General Comments: Construction will have some minor impacts on water bodies due to waste and hydrocarbons which will likely to have an impact on the water chemistry. TSFRP will develop an EMP as part of the PER report to guide and monitor the environment and social impacts. There will be no land required except for the realignment at Mberande, Mbalasuna and Selwyn including work area of about 10mx20 at each sides of a structure. Consultations will be carried out when the detailed designs are finalized.

SECTION 5: PROJECT CATEGORIZATION FOR ENVIRONMENTAL IMPACTS

Based on the definition of impacts in ADB's SPS (2009) and Operations Manual, what is the category?

[ ] Category A – Significant Environmental Impact, a full EIA / EIS is required

✓ **[ ] Category B – Non – significant Environmental Impact, an IEE / PER is required**

[ ] Category C – No Environmental Impact, No Assessment is required but due diligence report to be prepared

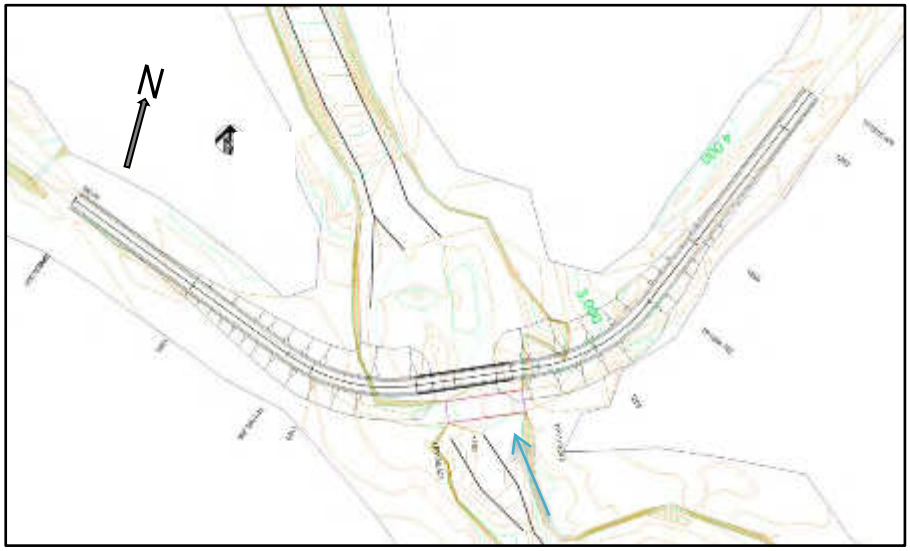
The prioritized SP sites under TSFRP are categorized as Category B.

APPENDIX 2 – OPTION ASSESSMENT

A 2.1 SP01 – Selwyn (Veranaso) Causeway

Option A: Existing 12-cell + River Training

Option B: Construct a New 32m Span Bridge

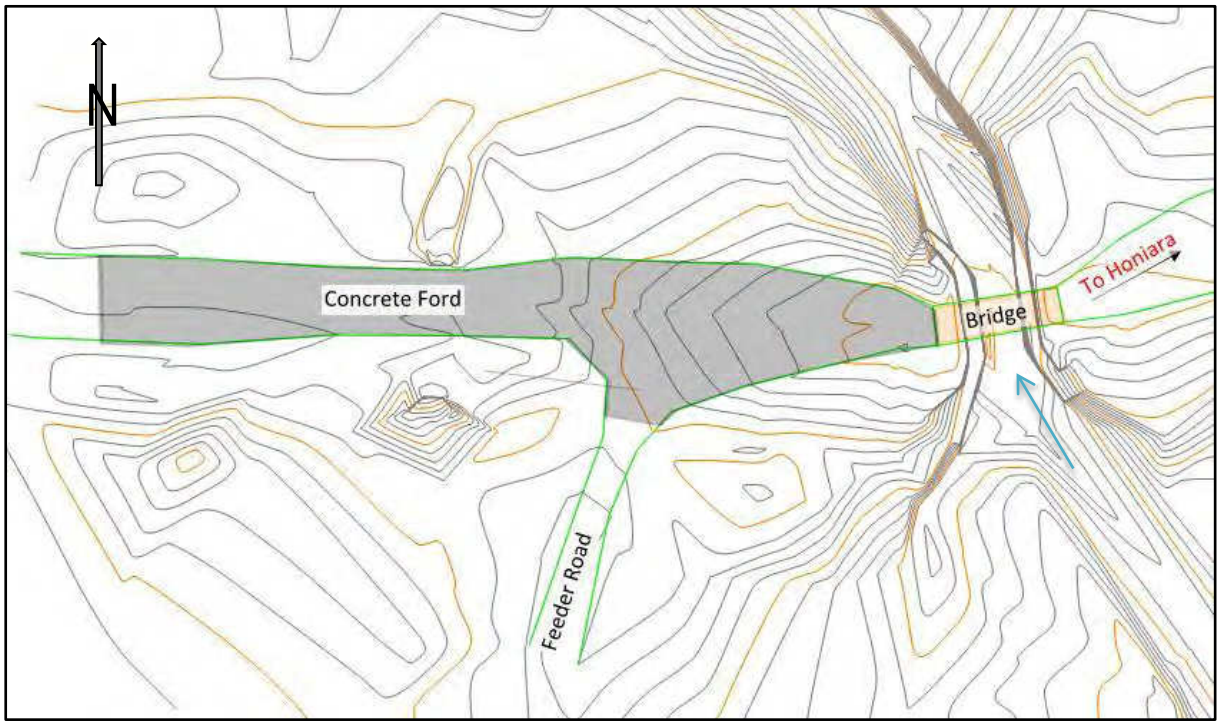


Option Assessment

Options	Description	Advantages	Assessed Risk
Option A: Existing 12-cell + river training	Construct revetment at th left bank of upstream and downstream	• Reduce the bank erosion • Minimal impact to the traffic during construction	• Conveyance capacity (<1:2 YEAR) will not improve and debris build-up against the structure causing flooding during future extreme flood events. • Damage to road during overtopping • Tidal and sea level rise may also cause the structure to be non-trafficable frequently in the future. • Backwater flooding • High risk to community. • High impact to river morphology and environment • High Maintenance
Option B: Construct a new 32m Span Bridge	Raise the road and construct a new single span bridge. Demolish existing causeway. Construct revetment.	• Increased conveyance capacity (>Q50). • Reduce debris build-up and floodin frequencies. • Better climate proofed structure. • Existing structure can be used for traffic during construction.	• Impact to the traffic during construction. • Low Maintenance

A 2.2 SP02 – Tambea Culvert

Option A: Construct an Engineered Ford

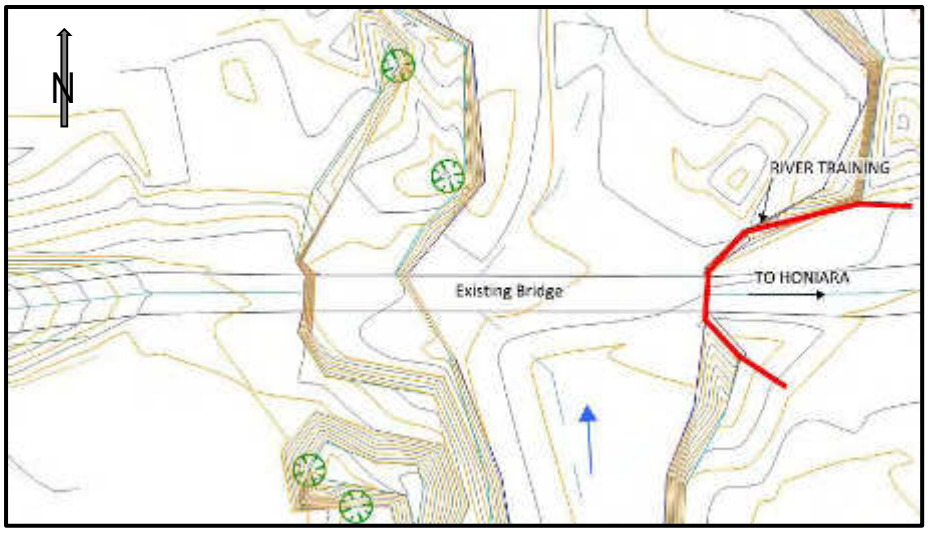


Option Assessment

Options	Description	Advantages	Assessed Risk
Option A: Construct an engineered ford	Remove existing RCP culvert and construct concrete ford	• Reduce flood damage to road • Improve road condition • Low maintenance	• Subject to flooding during heavy rain event. • Floods the market

A 2.3 SP03 – Sasa Low Level Bridge

Option A: Existing Bridge + River Training



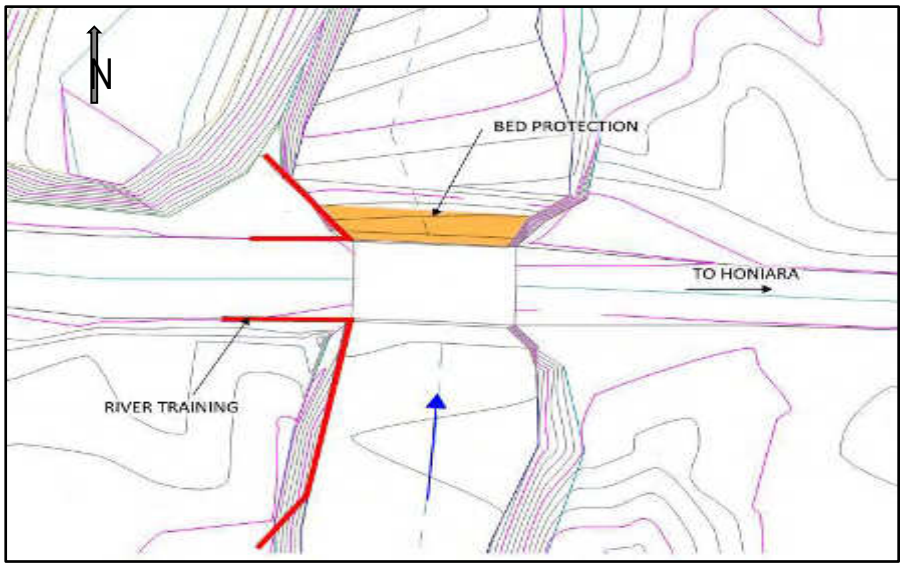
Option B: Construct a New 2 - 30m Span Bridge

Option Assessment

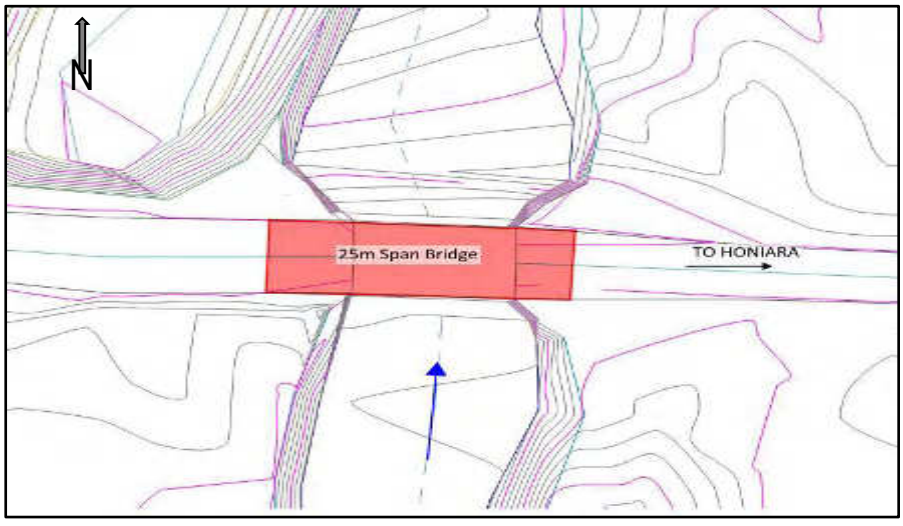
Options	Description	Advantages	Assessed Risk
Option A: Existing 12-cell + river training	Construct river training at eastern end	• Reduce the bank erosion • Minimal impact to traffic during construction	• Debris build-up against the structure causing overtopping during future extreme flood events. • Damage to road during overtopping • High risk to community • High impact to river morphology and environment. • High Maintenance
Option B: Construct a new 2-span Bridge	Raise the road and construct a new 2-span bridge. Construct river training.	• Increased conveyance capacity • Reduced debris build-up and flooding frequencies. • Low Maintenance • Better climate proofed structure.	• Impact to the traffic during construction.

A 2.4 SP04 – Aruligo Causeway

Option A: Existing Bridge + River Training + Bed Protection



Option B: Construct a New 2 - 30m Span Bridge

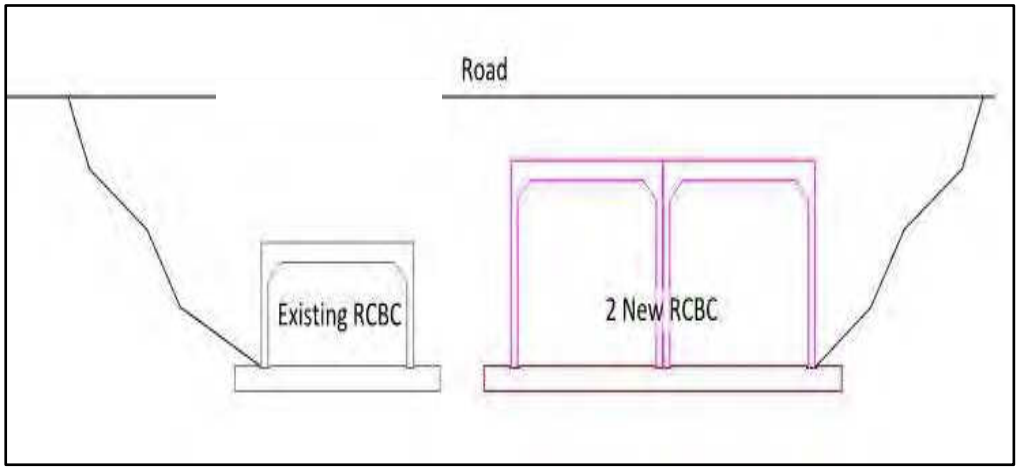


Option Assessment

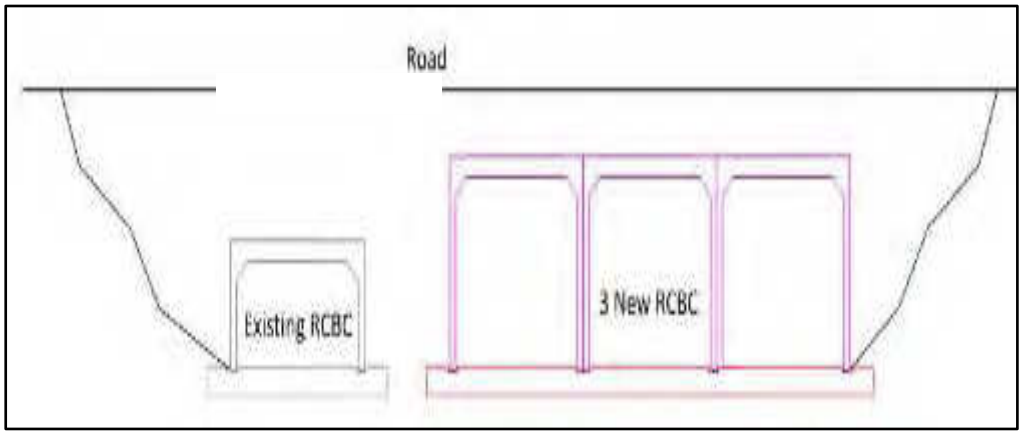
Options	Description	Advantages	Assessed Risk
Option A: Existing 12-cell + river training + bed protection	Construct river training at western end and downstream bed protection. Repair undermined area	• Reduce the bank erosion • Minimal impact to the traffic during construction	• Debris build-up against the structure causing overtopping during future extreme flood events. • Damage to road during overtopping • High impact to river morphology and environment • High Maintenance
Option B: Construct a new single span Bridge	Raise the road and construct a new single span bridge. Construct river training.	• Increased conveyance capacity • Reduce debris build-up and flooding frequencies. • Low Maintenance • Better climate proofed structure.	• Impact to the traffic during construction.

A 2.5 SP05 – CBSI Culvert

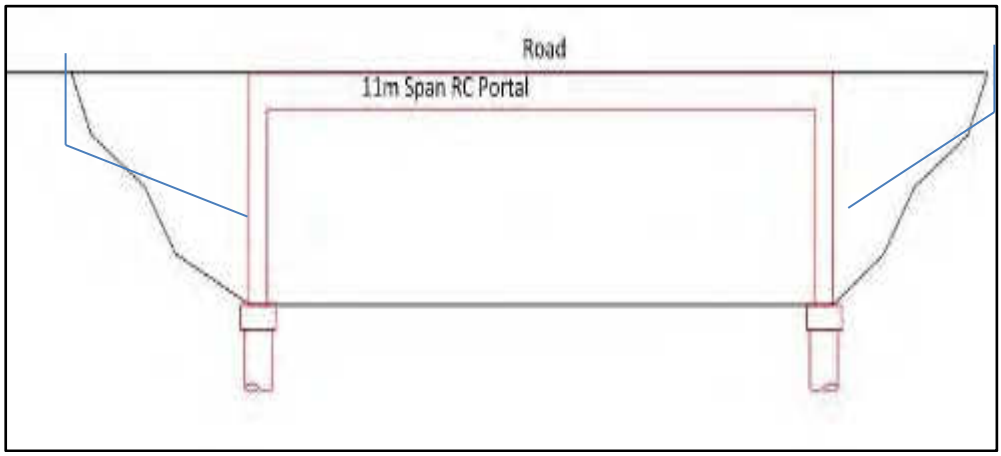
Option A: Existing 2mW x 1.2mH RCBC + 2 New 2.5m Wide x 2.15m High RCBC



Option B: Existing 2mW x 1.2mH RCBC + 3 New 2.5m Wide x 2.15m High RCBC



Option C: Construct a New 11m Wide x 2.75m High Reinforced Concrete Portal



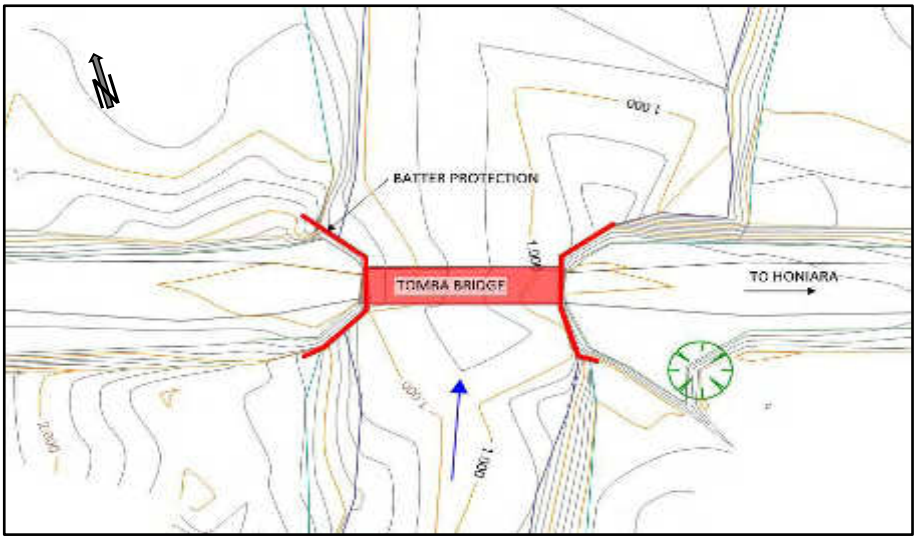
Option Assessment

Options	Description	Advantages	Assessed Risk
Option A: Option A: Existing 2mW x 1.2m RCBC + 2 New 2.5m Wide x 2.15m High RCBC	Remove pipe culverts and install new RCBC	• 1 in 25 year flood capacity	• Construction requires water diversion • Impact to traffic during construction • Overtopped during extreme flood events • High Maintenance
Option B: Existing 2mW x 1.2mH RCBC 3 New 2.5m Wide x 2.15m High RCBC	Raise the road and construct a new single span bridge. Construc river training.	• 1 in 50 year flood capacity • Low Maintenance	• Construction requires water diversion • Impact to traffic during construction
Option C: Construct New 11m Wide Porta	Construct a new single span port bridge.	• 1 in 100 year flood capacity • Low Maintenance • Better climate proofed structure.	• Impact to traffic during construction.

A 2.6 SP06 – Tomba Bridge

Option A: Do Nothing

Option B: Retain Existing Bridge + Improved Batter Protection

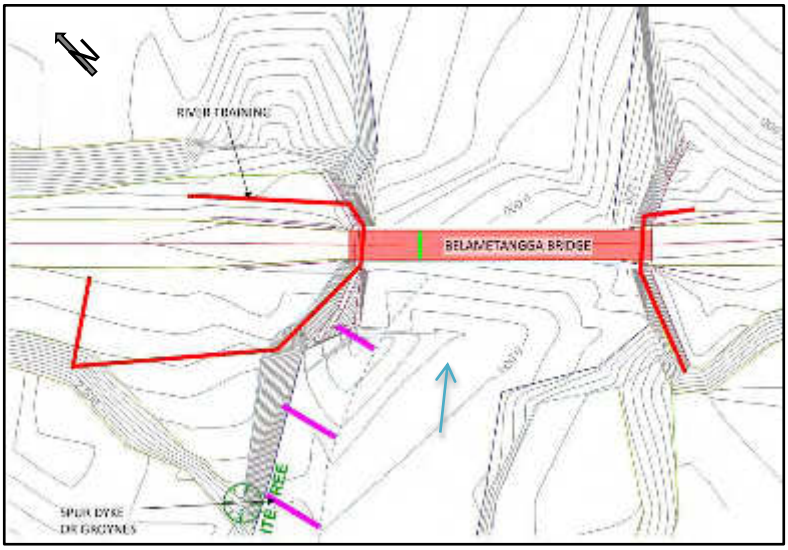


Option Assessment

Options	Description	Advantages	Assessed Risk
Option A: Do Nothing	Retain existing structure	• No impact to the traffic during construction	• Debris build-up against the structure causing overtopping during future extreme flood events. • Damage to road during overtopping • High Maintenance cost
Option B: Improved Batter Protection	Retain existing structure, remove gabion protection and install sheet piling wall	• Better climate proofed structure than existing one • Repair work can be done easily in the event of future washout • Low Maintenance	• Debris build-up against the structure causing overtopping during future extreme flood events. • Damage to road during overtopping • Impact to the traffic during construction.

A 2.7 SP07 – Belamatanga Bridge

Option A: Retain Existing Bridge + Improved Bank and Embankment Protection



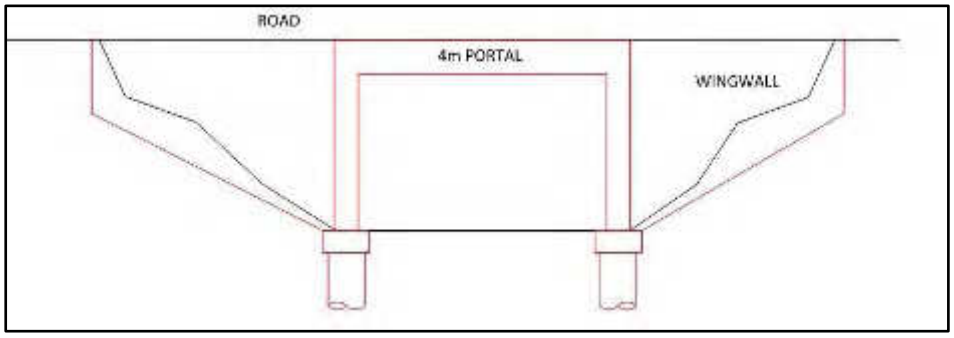
Option Assessment

Options	Description	Advantages	Assessed Risk
Option A: Improved Bank and Embankment Protection	Retain existing structure, install gabion protection and spur dyke or groynes for bank protection. Install rock around pile cap	• Better climate proofed structure	• Debris build-up against the structure causing pier to fail • Medium maintenance cost

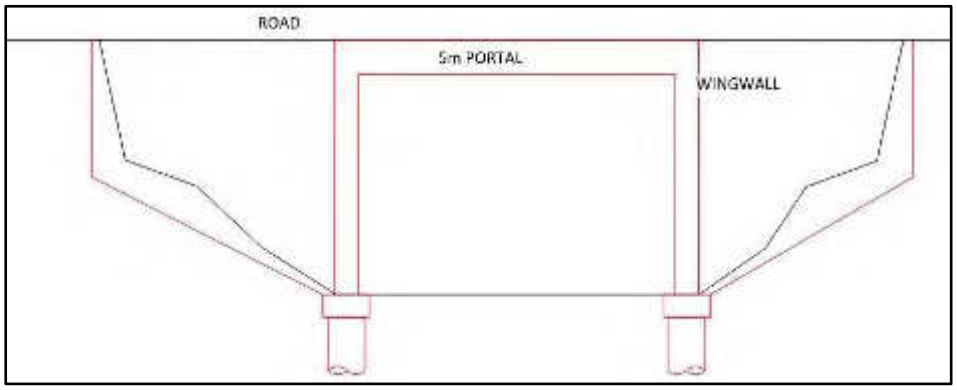
A 2.8 SP08 – Belamatanga Culvert 1

Option A: Replace Headwalls

Option B: New 4m Wide x 2.5m High Reinforced Concrete Portal



Option C: Construct a New 5.5m Wide x 3.5m High Reinforced Concrete Portal



Option Assessment

Options	Description	Advantages	Assessed Risk
Option A: Replace Headwall	Retain existing structure and replace headwalls	• Low cost • Minimum impact to traffic during construction	• Remaining life span of the steel pipe culvert is low and failure of the pipe will disrupt traffic • Low conveyance capacity • High Maintenance
Option B: Construct a New 4m Wide Portal	Raise the road and construct a new single span portal bridge.	• 1 in 50 year flood capacity • Low Maintenance • Better climate proofed structure.	• Impact to traffic during construction
Option C: Construct a New 5.5m Wide Portal	Construct a new single span portal bridge.	• 1 in 100 year flood capacity • Low Maintenance • Better climate proofed structure.	• Impact to traffic during construction.

A 2.9 SP09 – Belamatanga Culvert 2

Option A: New 3mW x 1.5mH RCBC

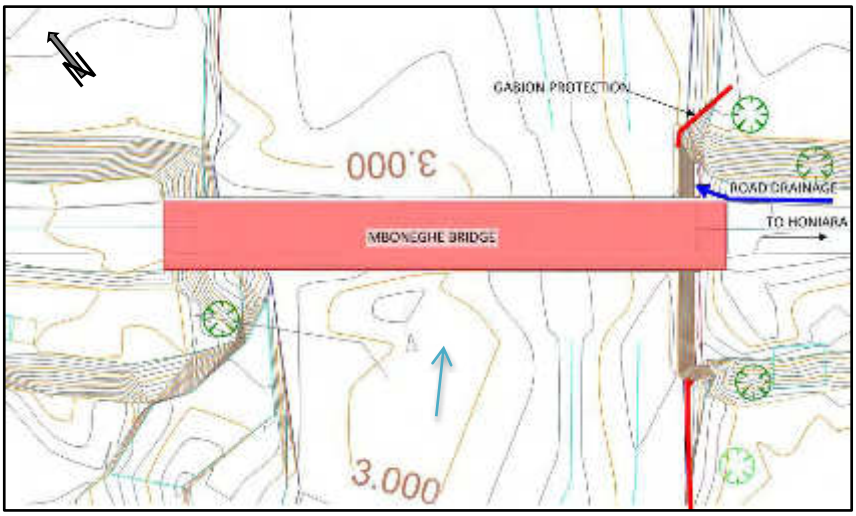
Option C: New 3.5mW x 1.75mH RCBC

Option Assessment

Options	Description	Advantages	Assessed Risk
Option A: New 3mW x 1.5mH RCBC	Raise the road and construct a new culvert structure	• 1 in 50 year flood capacity • Better climate proofed structure. • Low Maintenance	• Impact to the traffic during construction
Option B: New 3.5mW x 1.75mH RCBC	Raise the road and construct a new culvert structure	• 1 in 100 year flood capacity • Better climate proofed structure. • Low Maintenance	• Impact to the traffic during construction.

A 2.10 – Mbonege Bridge

Option A: Retain Existing Bridge + Improved Bank and Embankment Protection

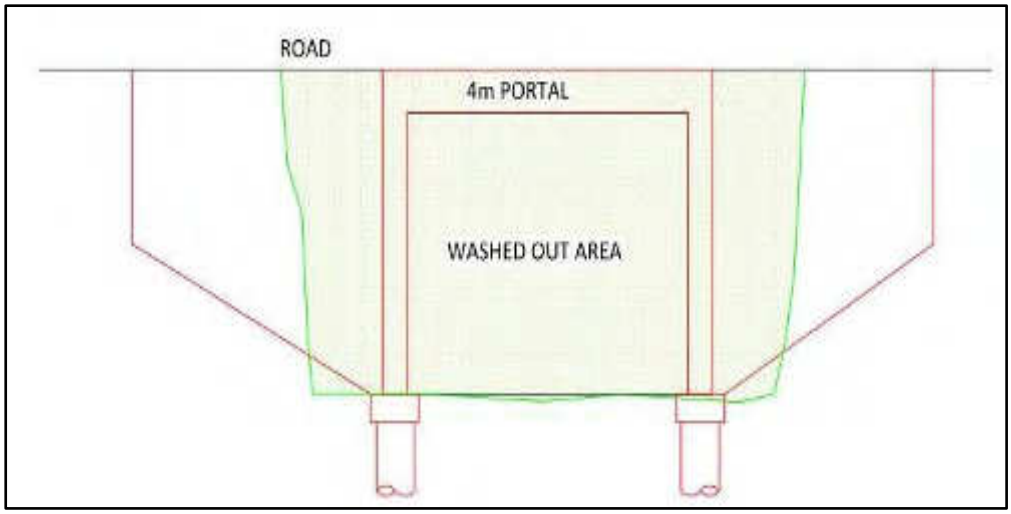


Option Assessment

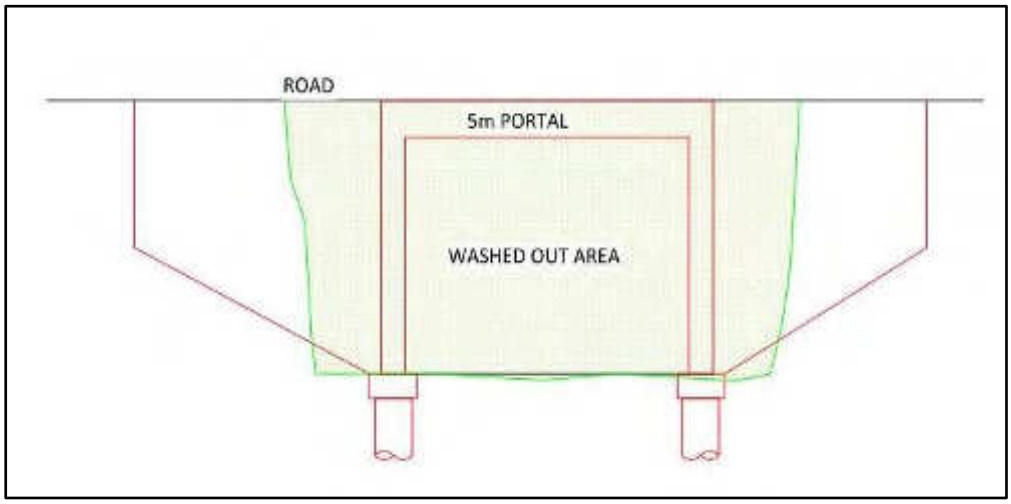
Options	Description	Advantages	Assessed Risk
Option A: Improved Bank and Embankment Protection	Retain existing structure, install gabion protection and improve road drainage. Remove old pier.	• Improved climate proofed structure	

A 2.11 SP11 - Turtle Beach Culvert

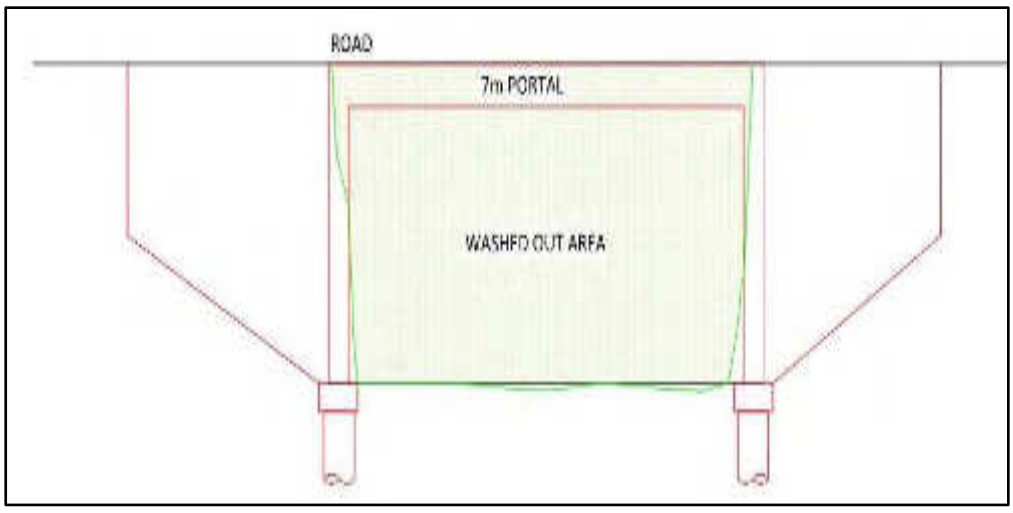
Option A: Construct a New 4m Wide x 3.0 High Reinforced Concrete Portal



Option B: Construct a New 5m Wide x 3.4m High Reinforced Concrete Portal



Option C: Construct a New 7m Wide x 3.65m High Reinforced Concrete Portal

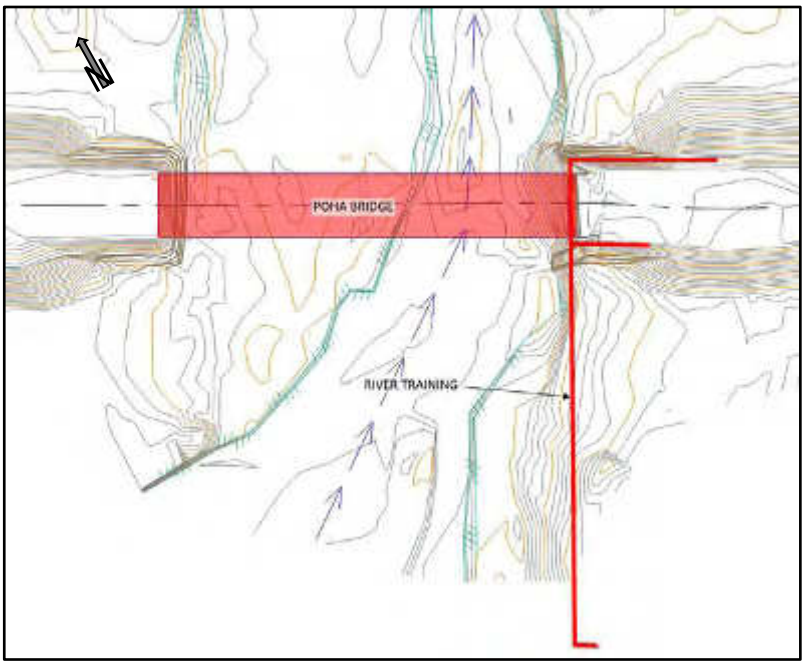


Option Assessment

Options	Description	Advantages	Assessed Risk
Option A: Construct New 4m Wide Portal	Construct a new single span portal bridge.	• 1 in 10 year flood capacity	• Overtopped during extreme flood event • Extensive damage during extreme flood event • High Maintenance
Option B: Construct New 5m Wide Portal	Construct a new single span portal bridge.	• 1 in 25 year flood capacity • Reduced debris build-up and flooding frequencies.	• Overtopped during extreme flood event • Extensive damage during extreme flood event • Medium Maintenance
Option C: Construct New 7m Wide Portal	Construct a new single span portal bridge.	• 1 in 100 year flood capacity • Covers the washed out area • Low Maintenance • Better climate proofed structur	• . Raised road profile to accommodate the portal height • Minor damage during extreme flood events

A 2.12 SP12 – Poha High Level Bridge

Option A: Retain Existing Bridge + Abutment, Embankment and Bank Protection

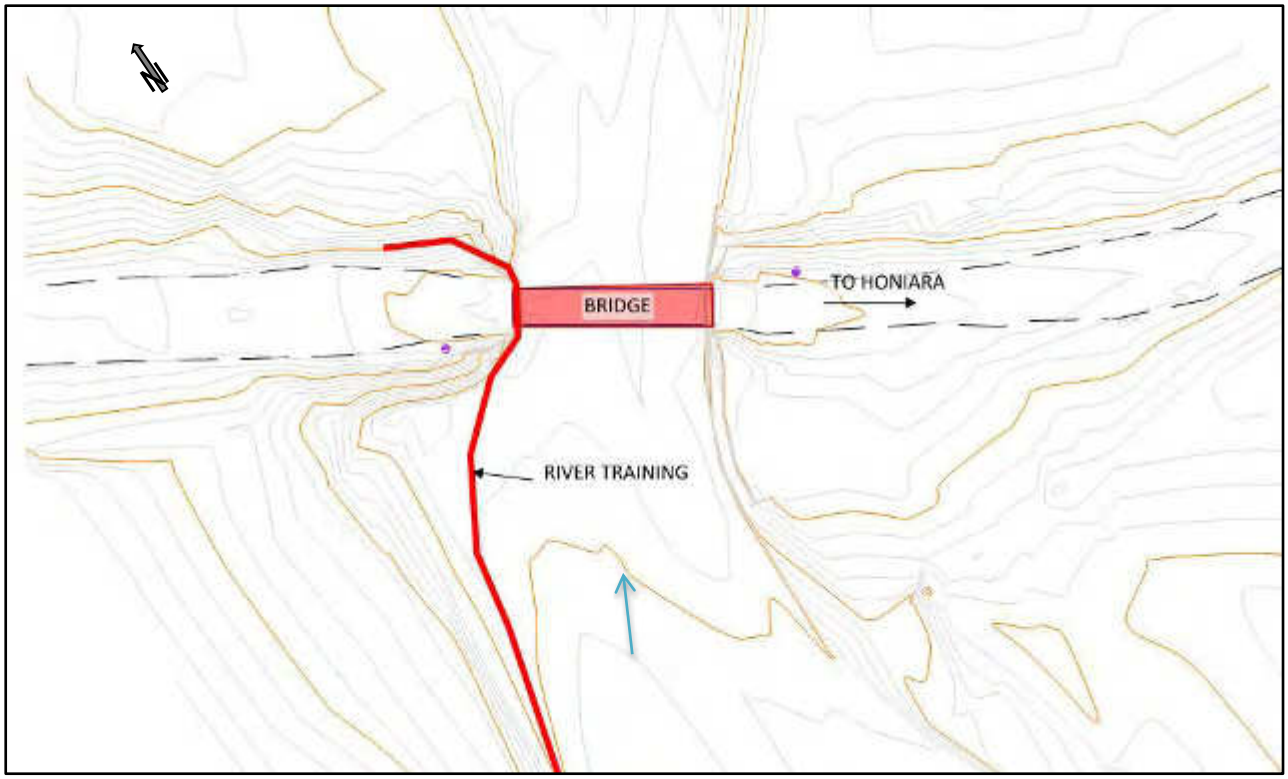


Option Assessment

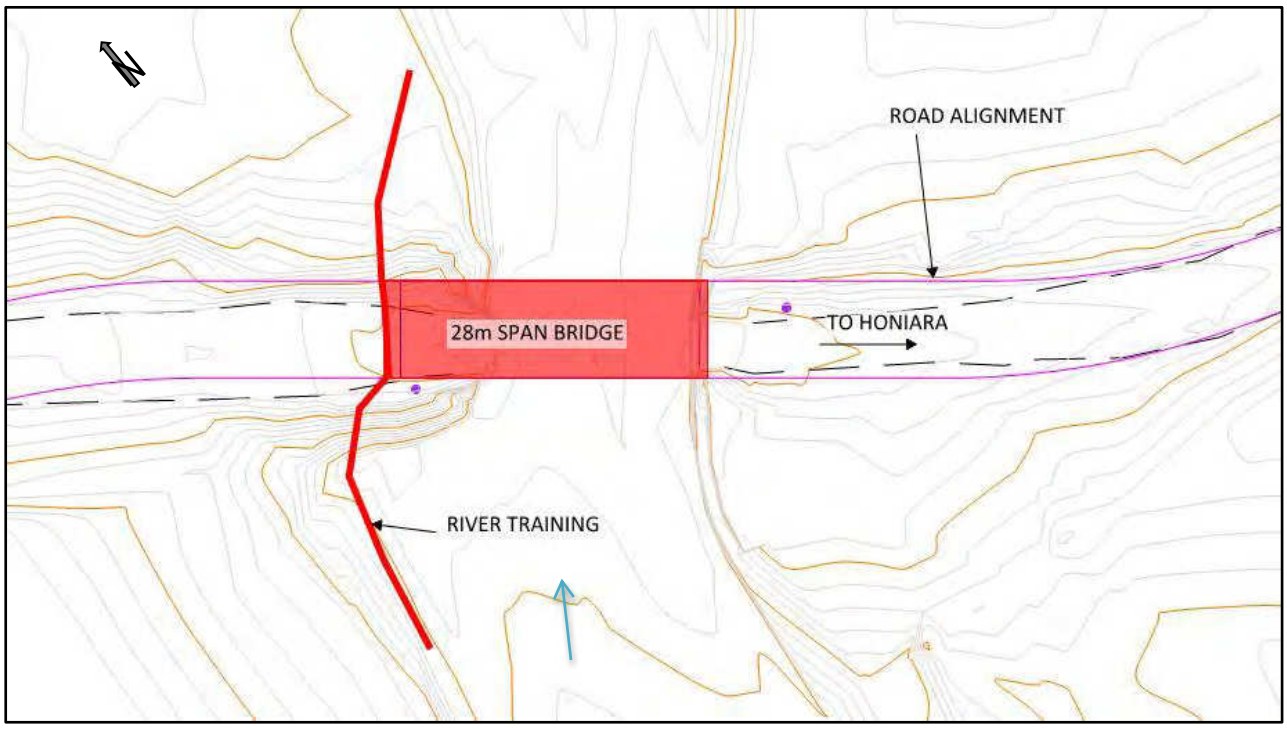
Options	Description	Advantages	Assessed Risk
Option A: Improved Abutment, Embankment and Bank Protection	Retain existing structure, install gabion protection and improve road drainage	• Improved flood proofed structure	• Improper sand mining may alter the flow pattern and impact the bridge protection and bank scouring

A 2.13 SP13 – Tanavasa Bridge

Option A: Existing Bridge + River Training



Option B: Construct a New 2 lane 28m Span Bridge



Option Assessment

Options	Description	Advantages	Assessed Risk
Option A: Existing Bridge + River Training	Construct river training on western bank and approach	• Reduces the bank erosion • Minimal impact to traffic during construction	• Overtopped during future extreme flood events. • Damage to road during overtopping • High impact to river morphology and environment • High Maintenance
Option B: Construct a new single span Bridge	Raise the road and construct a new single span bridge. Construct river training.	• Increased conveyance capacity • Reduced upstream flood height • Provide better service to future traffic demand • Low Maintenance • Better climate proofed structure.	• Impact to traffic during construction.

A 2.14 SP14 – Tanaghai Arch Culvert

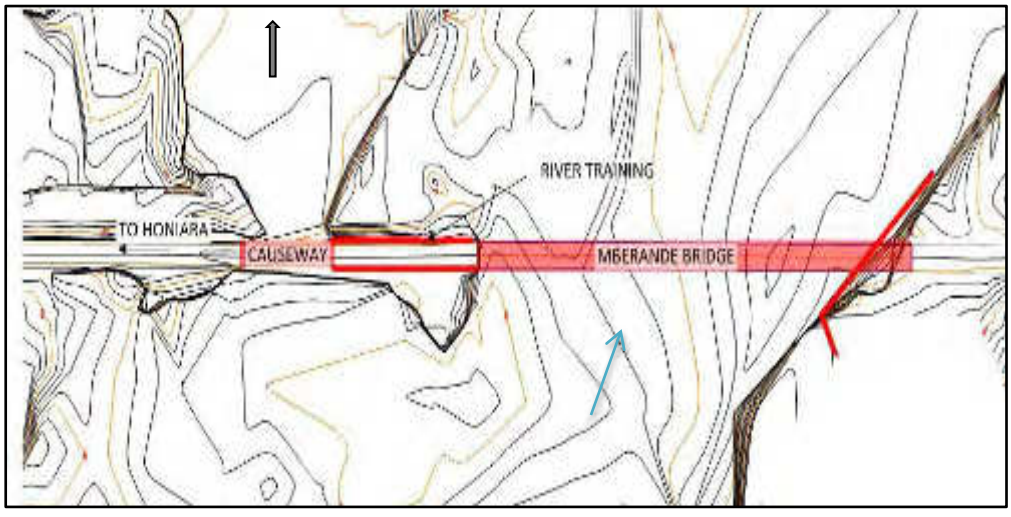
Option A: A New 3m Wide x 1.7m High RCBC

Option Assessment

Options	Description	Advantages	Assessed Risk
Option A: Option A: A New 3m Wide x 1.7m High RCBC	Remove arch culverts and insta a new RCBC	• 1 in 100 year flood capacity • Improved flood capacity means reduced backwater flooding	• Construction requires water diversion • Impact to traffic during construction

A 2.15 SP20 – Mberande Bridge

Option A: Existing Bridge+ Sediment Removal + River Training



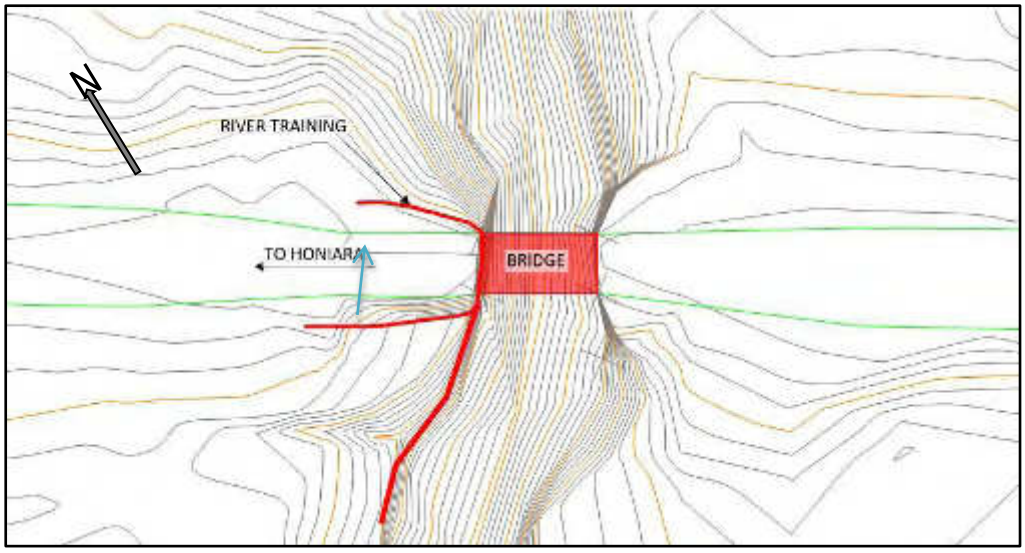
Option B: Construct a New 30-35-30m Span Bridge

Option Assessment

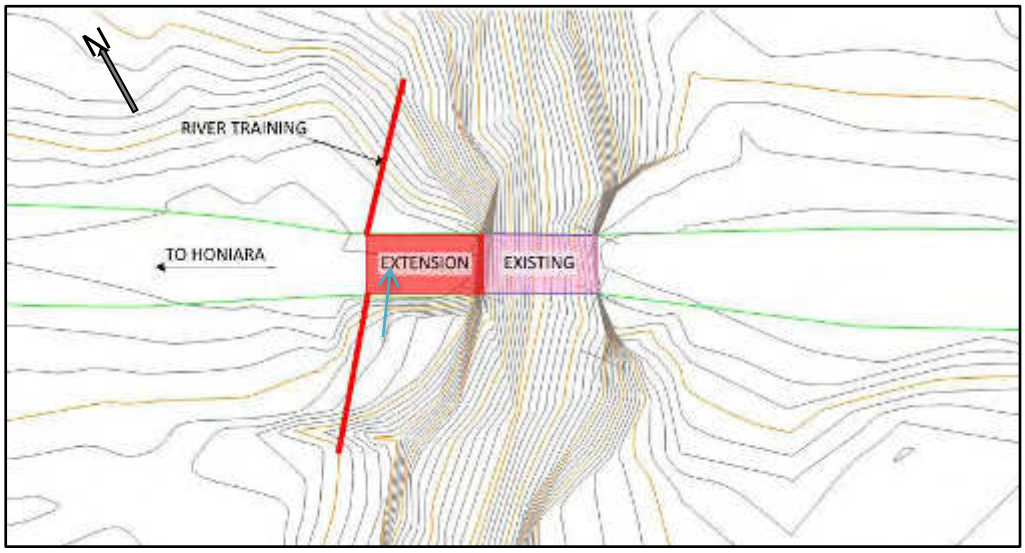
Options	Description	Advantages	Assessed Risk
Option A: Existing Bridge+ Sediment Removal + River Training + Repa Piles	Construct river training remove sediment and repair causeway.	• Reduces bank erosion • Minimal impact to the traffic during construction	• Debris build-up against the structure causing frequen overtopping. • Damage to road during overtopping • High risk to community. • High Maintenance
Option B: Construct a new 3-span Bridge	Raise the road and construct a new 3-spar bridge with a flood relie structure.	• Increased conveyance capacity • Reduced debris build-up and flooding frequencies. • Low Maintenance • Better climate proofed structure.	• Impact to traffic during construction.

A 2.16 SP21 – Kovelau Bridge

Option A: Existing + River Training + Bed Protection



Option B: Existing + Additional 7m Long RC Portal on Western End

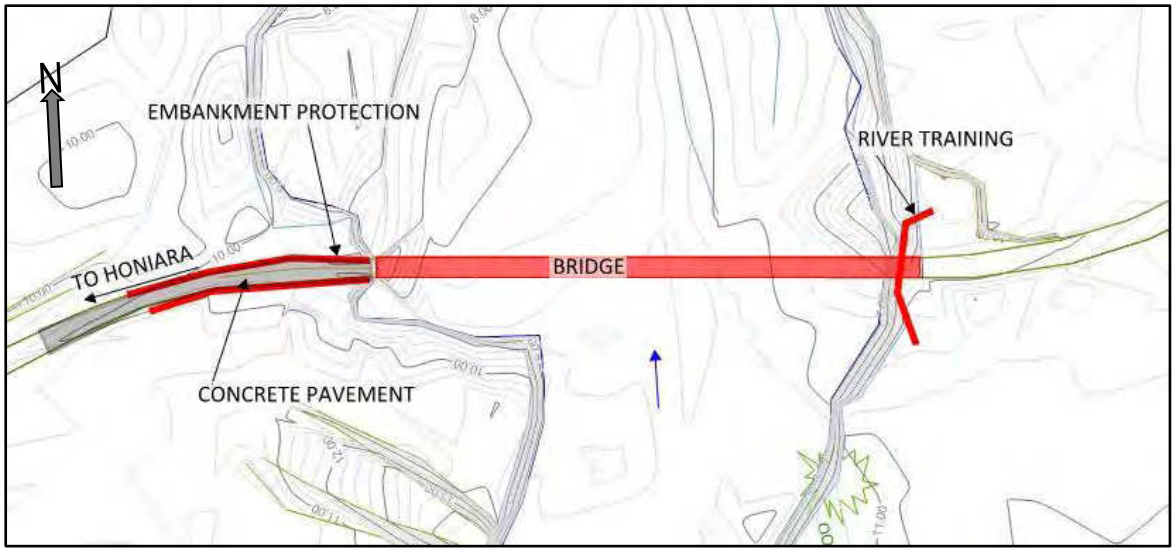


Option Assessment

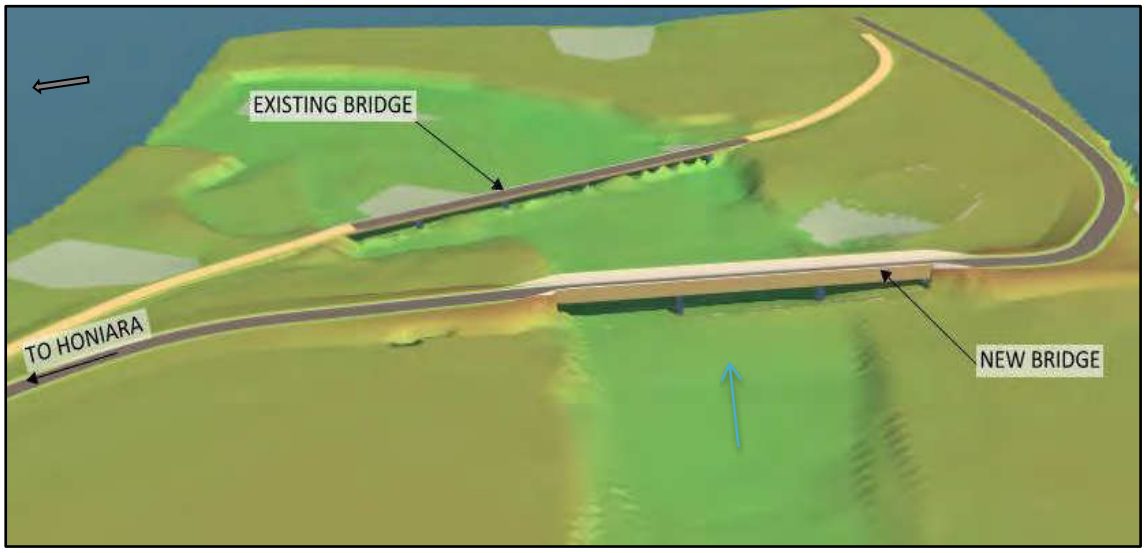
Options	Description	Advantages	Assessed Risk
Option A: River Training	Construct upstrea river training with embankment protection	• Minimum impact to traffic during construction.	• Overtopped during extreme flood events • Extensive damage during extreme flood events • High Maintenance
Option B: Construct New 7m Wide Portal Extension	Construct a new single span portal bridge.	• Increased flood capacity over Option A • Low Maintenance • Increased protection from approach road failure	• Overtopped during extreme flood events • Extensive damage during extreme flood events • Medium Maintenance

A 2.17 SP23 – Mbalasuna Bridge

Option A: Existing Bridge + River Training + Concrete Pavement



Option B: Construct a New 30-35-30m Span Bridge

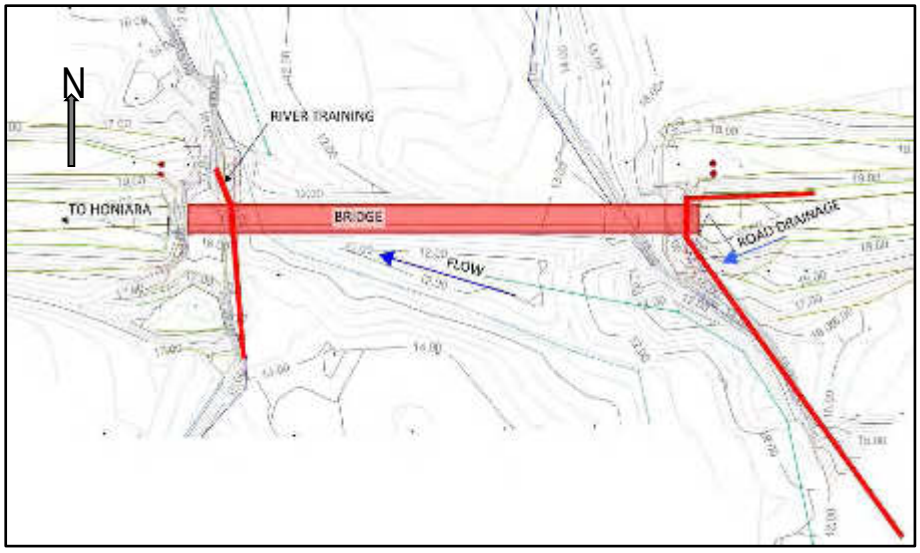


Option Assessment

Options	Description	Advantages	Assessed Risk
Option A: Retai Existing Structur + River Training Concrete Pavement	Construct river training embankment protectio and concrete pavemer	• Reduces road erosion • Minimal impact to traffic during construction	• Debris build-up against the structure causing frequer overtopping. • High impact to river morphology and environment • High risk to community. • High Maintenance
Option B: Construct a new 3-span Bridge	Raise the road and construct a new 3-spar bridge with a flood relie structure.	• Increased conveyance capacity • Reduces debris build-up and flooding frequencies. • Low Maintenance • Better climate proofed structure	• Extreme flood events may damage western approac road

A 2.18 SP24 – Ngalimbiu Bridge

Option A: Retain Existing Bridge + Improved Bank and Abutment Protection

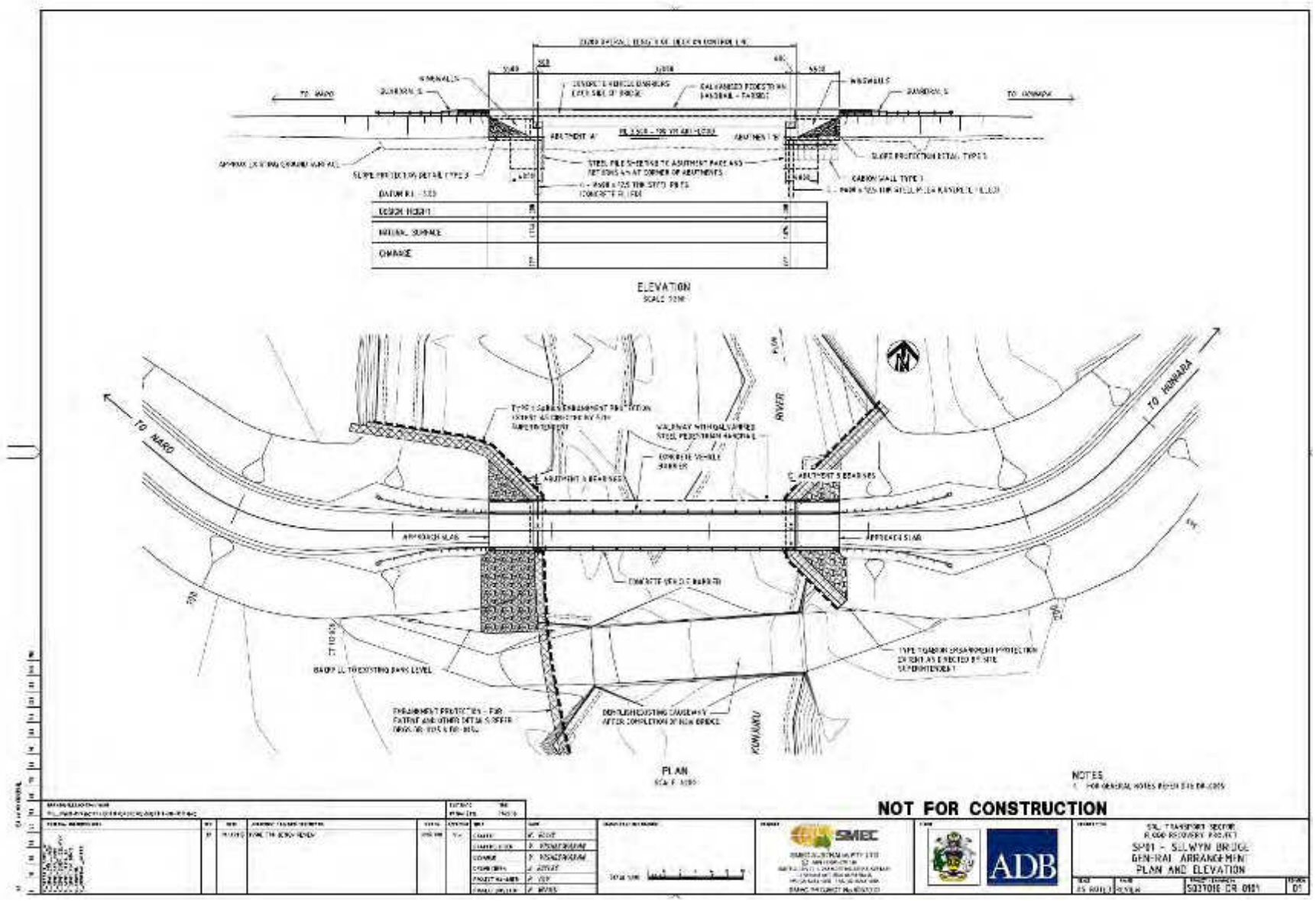


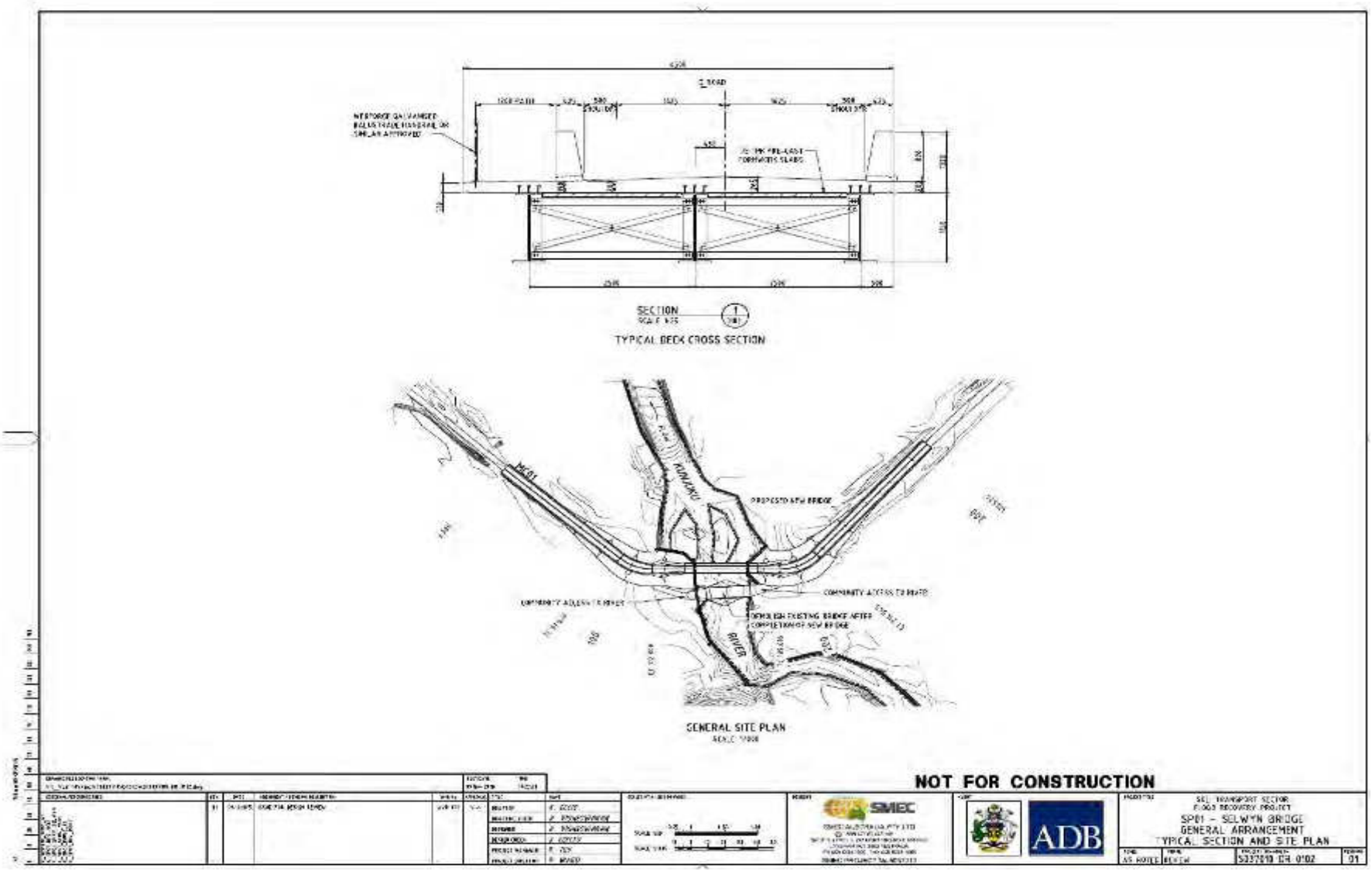
Option Assessment

Options	Description	Advantages	Assessed Risk
Option A: Improved Abutment and Bank Protection	Retain existing structure, install gabio protection and improv road drainage	• Improved flood proofed structure	• Bank protection may be damaged due to changing direction of river flow.

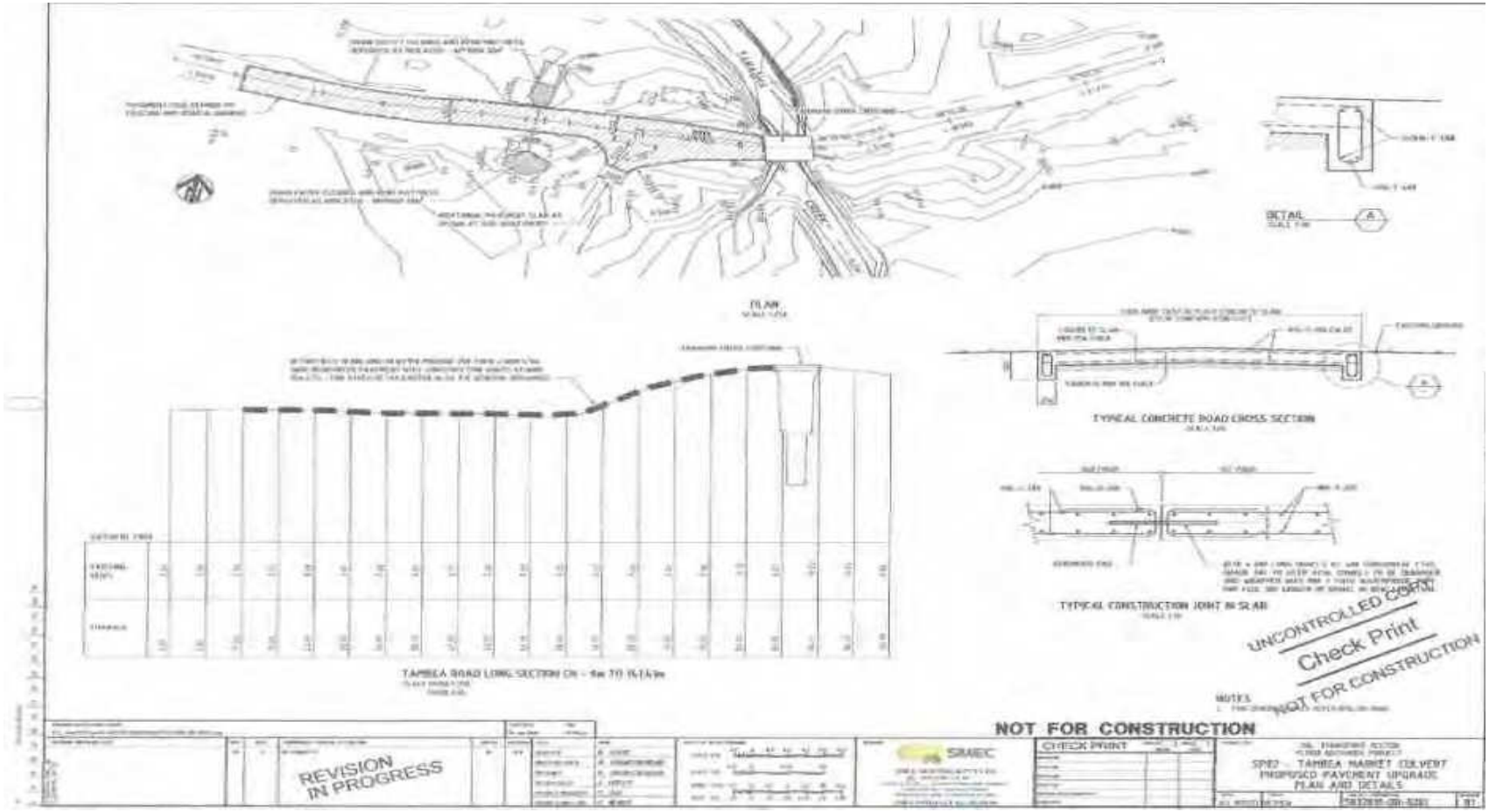
APPENDIX 3 – Drawings

A 3.1 SP01 – Selwyn (Veranaso) Bridge

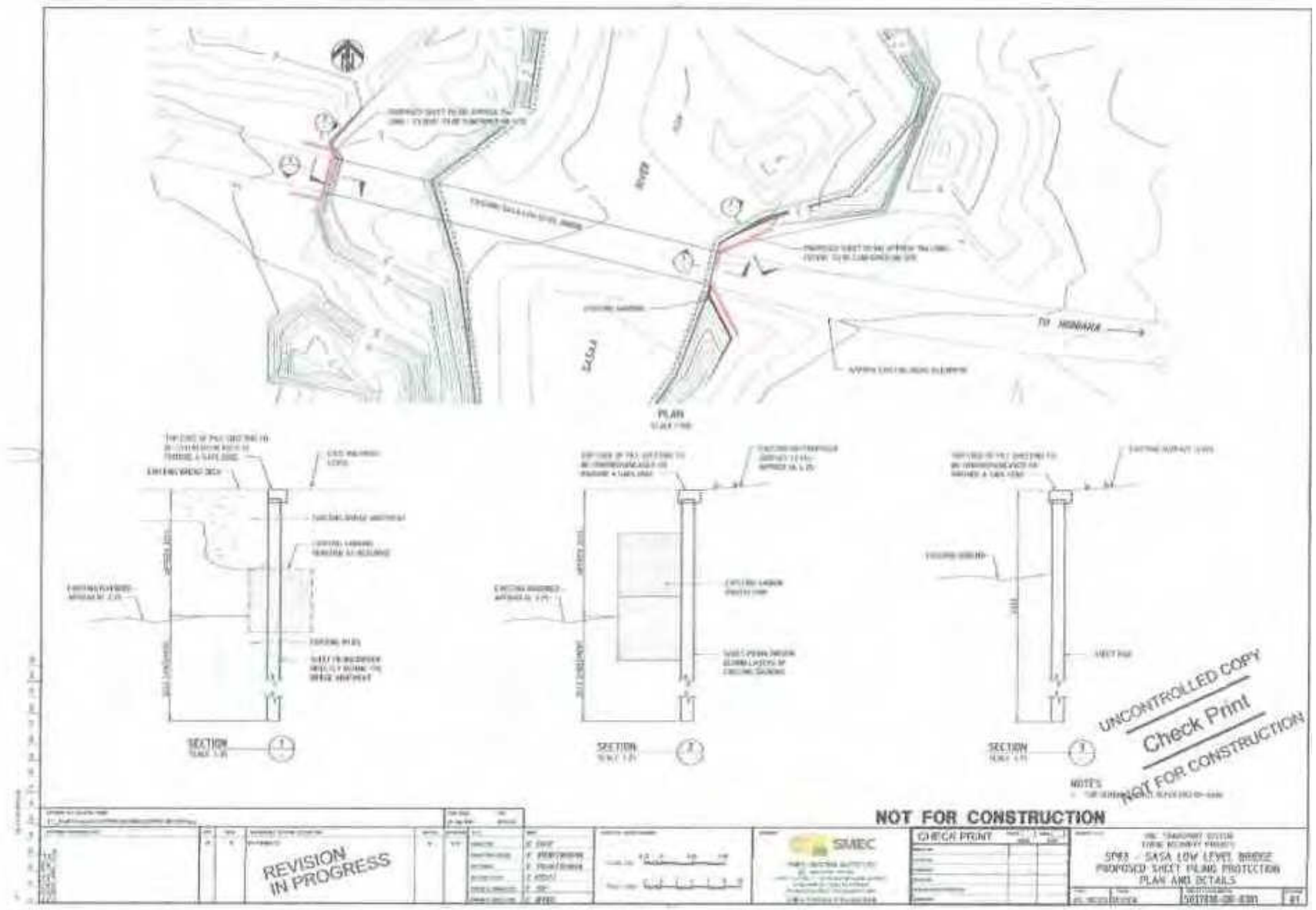



TYPICAL DECK CROSS SECTION
GENERAL SITE PLAN
NOT FOR CONSTRUCTION
SMEC
ADB
SPB1 – SELWYN BRIDGE
GENERAL ARRANGEMENT
TYPICAL SECTION AND SITE PLAN

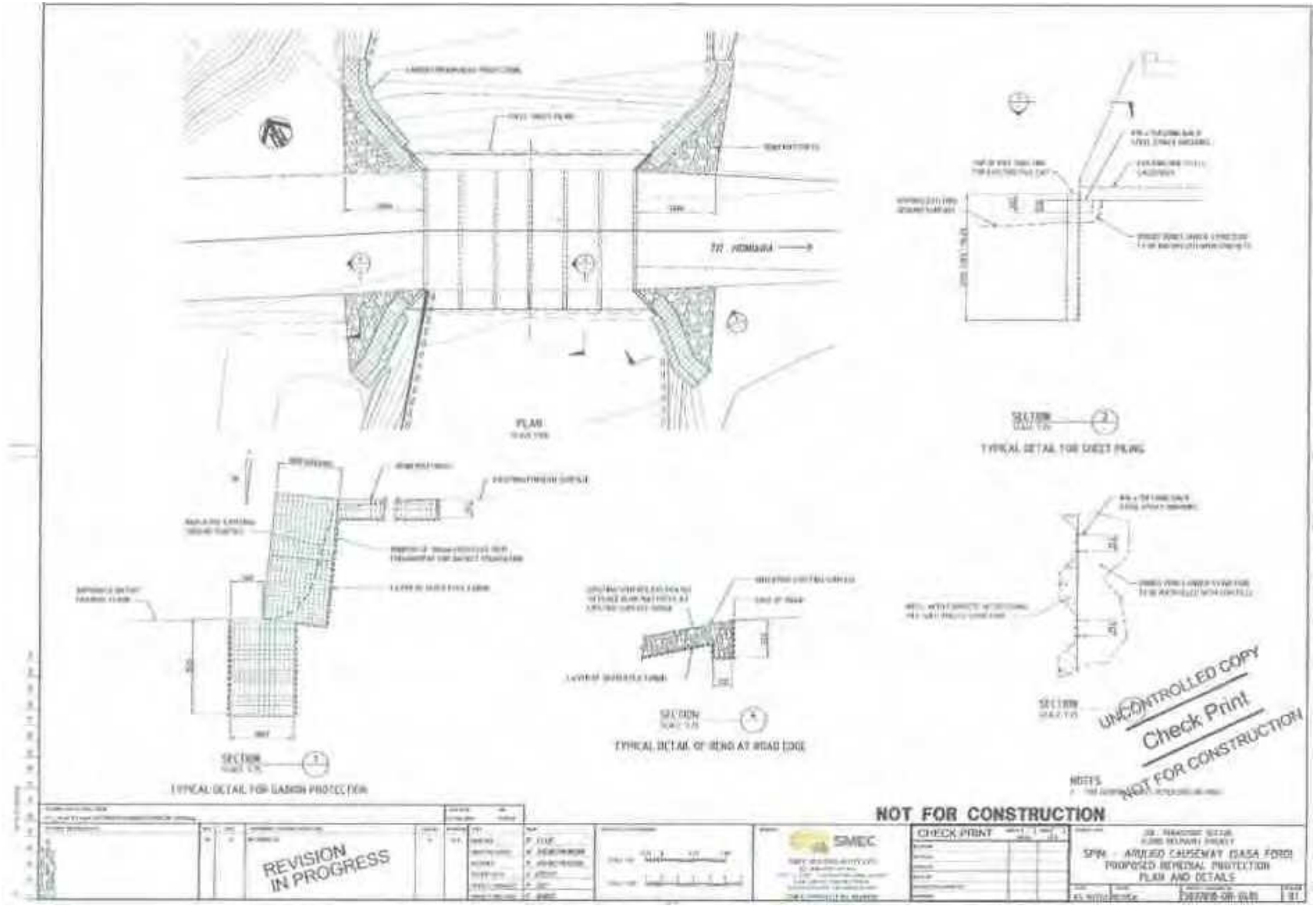
A 3.2 SPO2 – Tambea Culvert



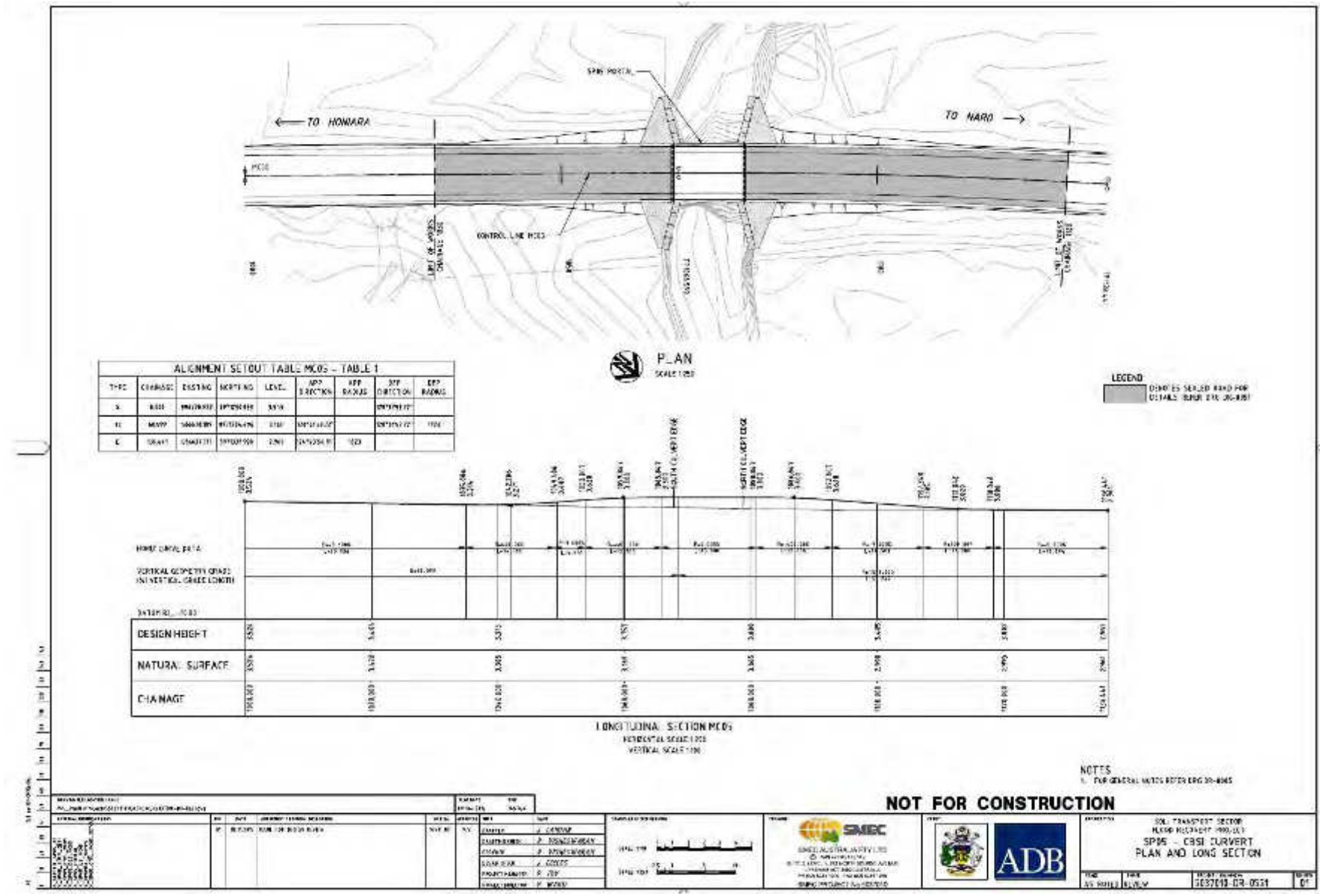
A 3.3 SP03 – Sasa Low Level Bridge

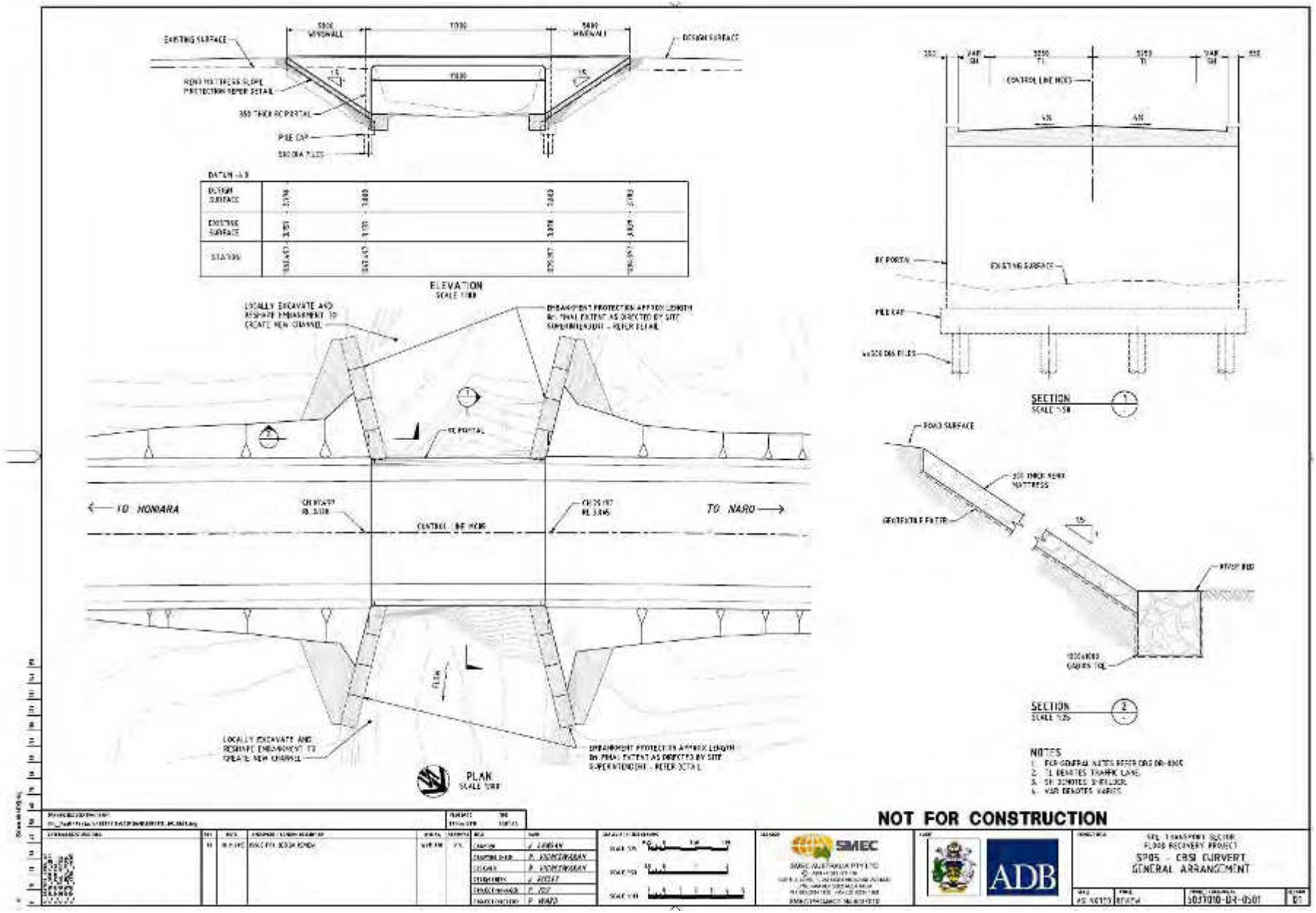


A 3.4 SP04 - Aruligo Causeway

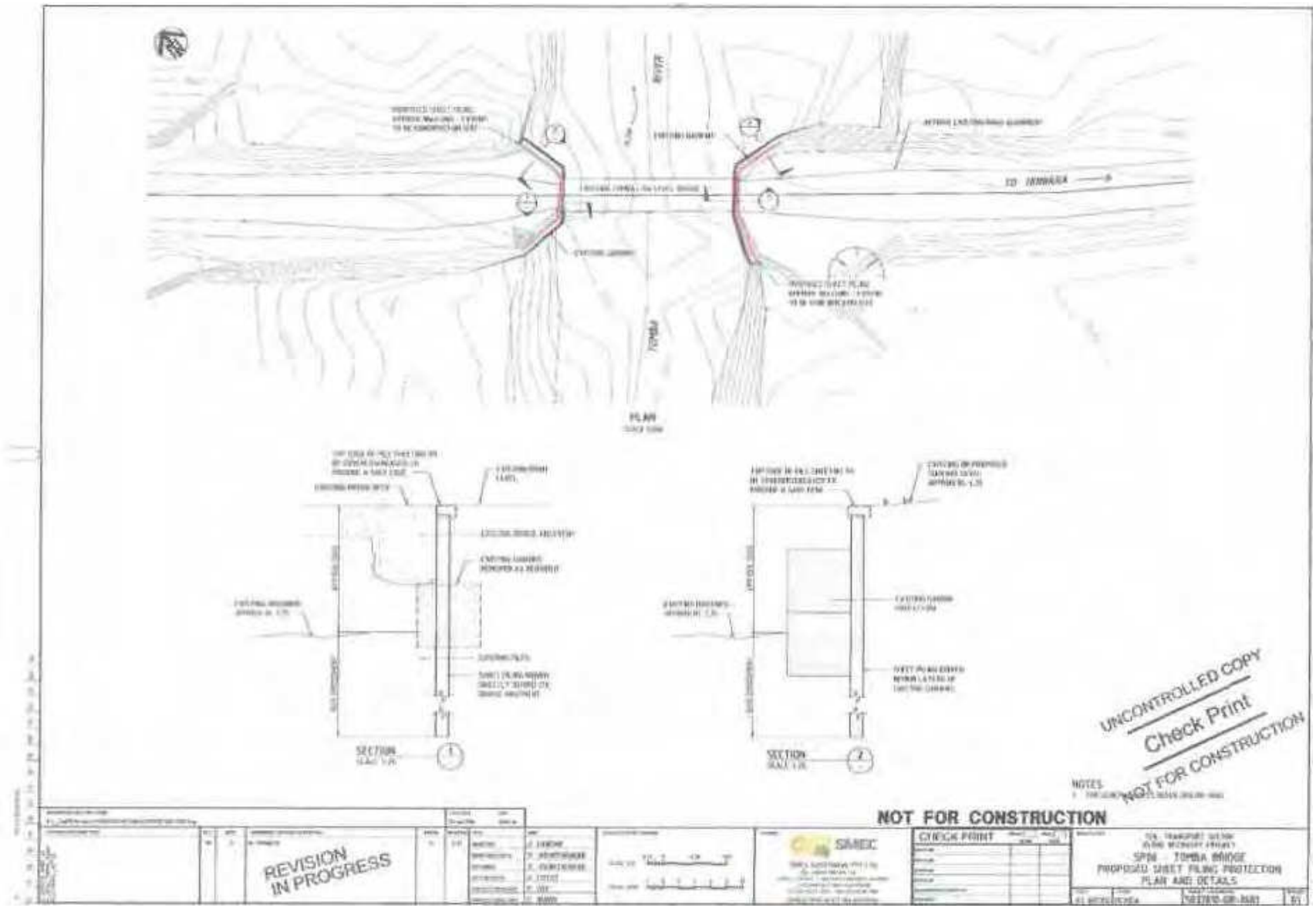


A 3.5 SP05 – CBSI Culvert

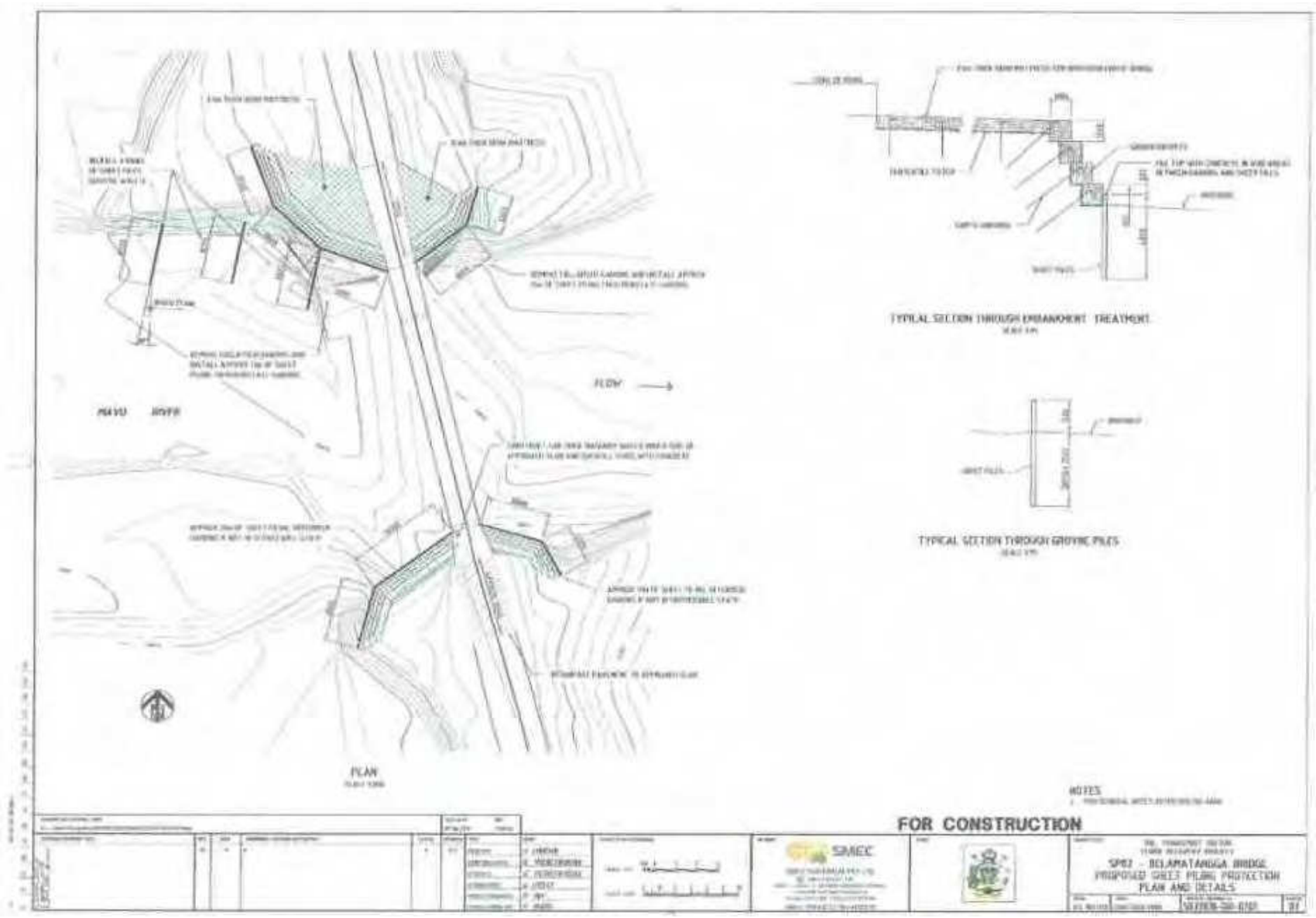



ELEVATION
SECTION
SECTION
PLAN
TO HONIARA
TO NARO
NOT FOR CONSTRUCTION
SMEC
ADB
SP05 - CBSI CURVERT
GENERAL ARRANGEMENT

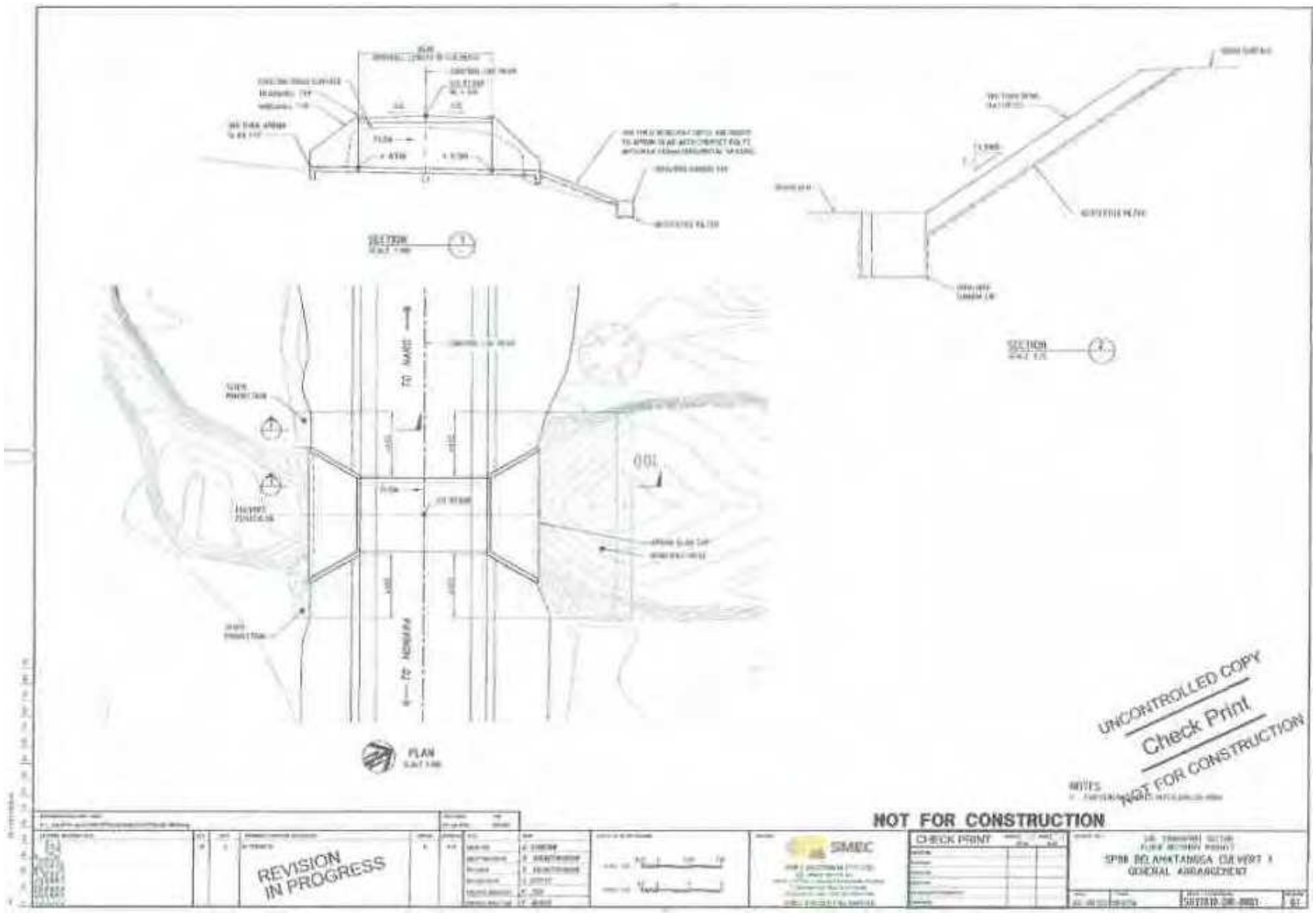
A 3.6 SP06 - Tomba Low Level Bridge



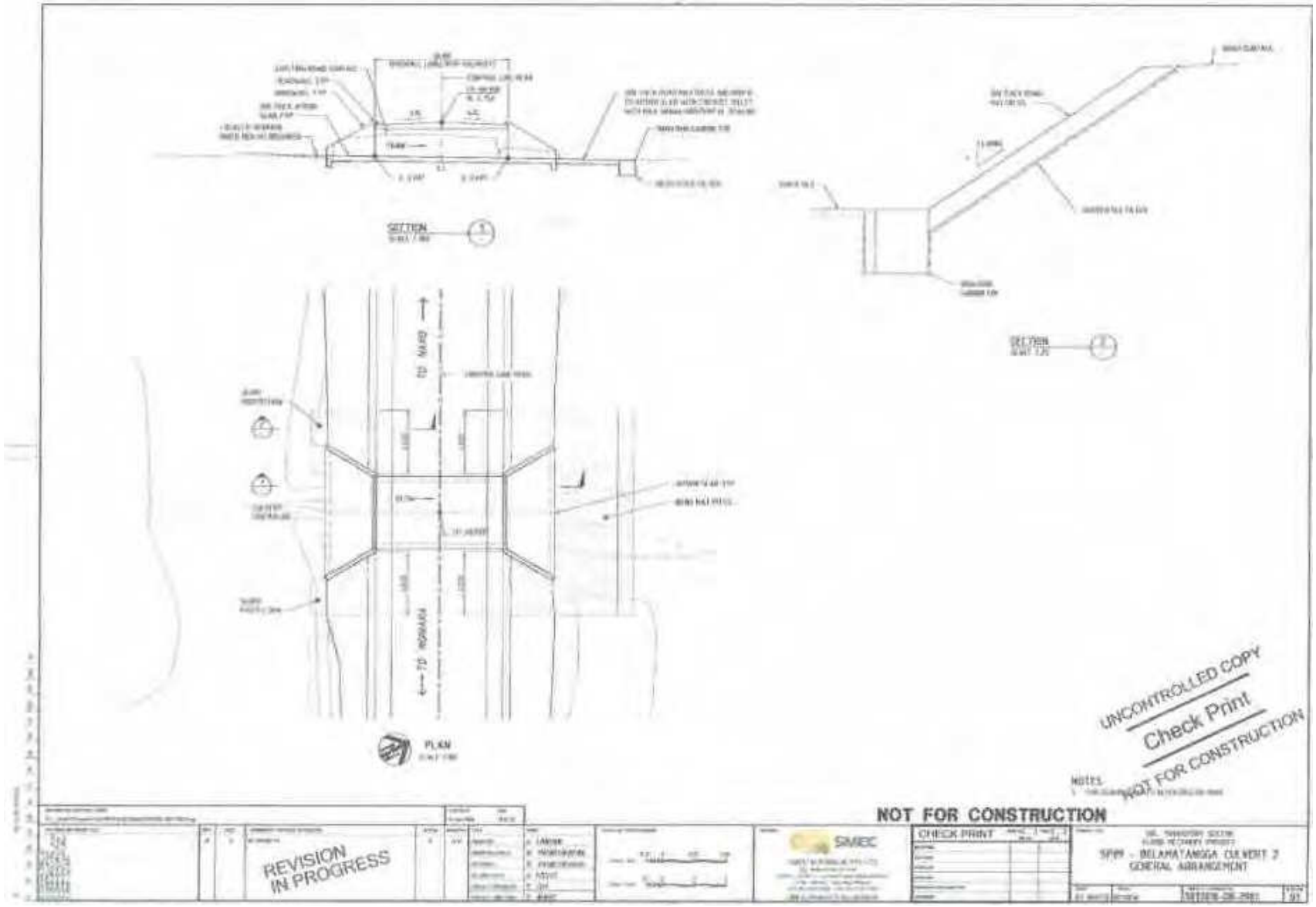
A 3.7 SP07 – Belamatanga Bridge



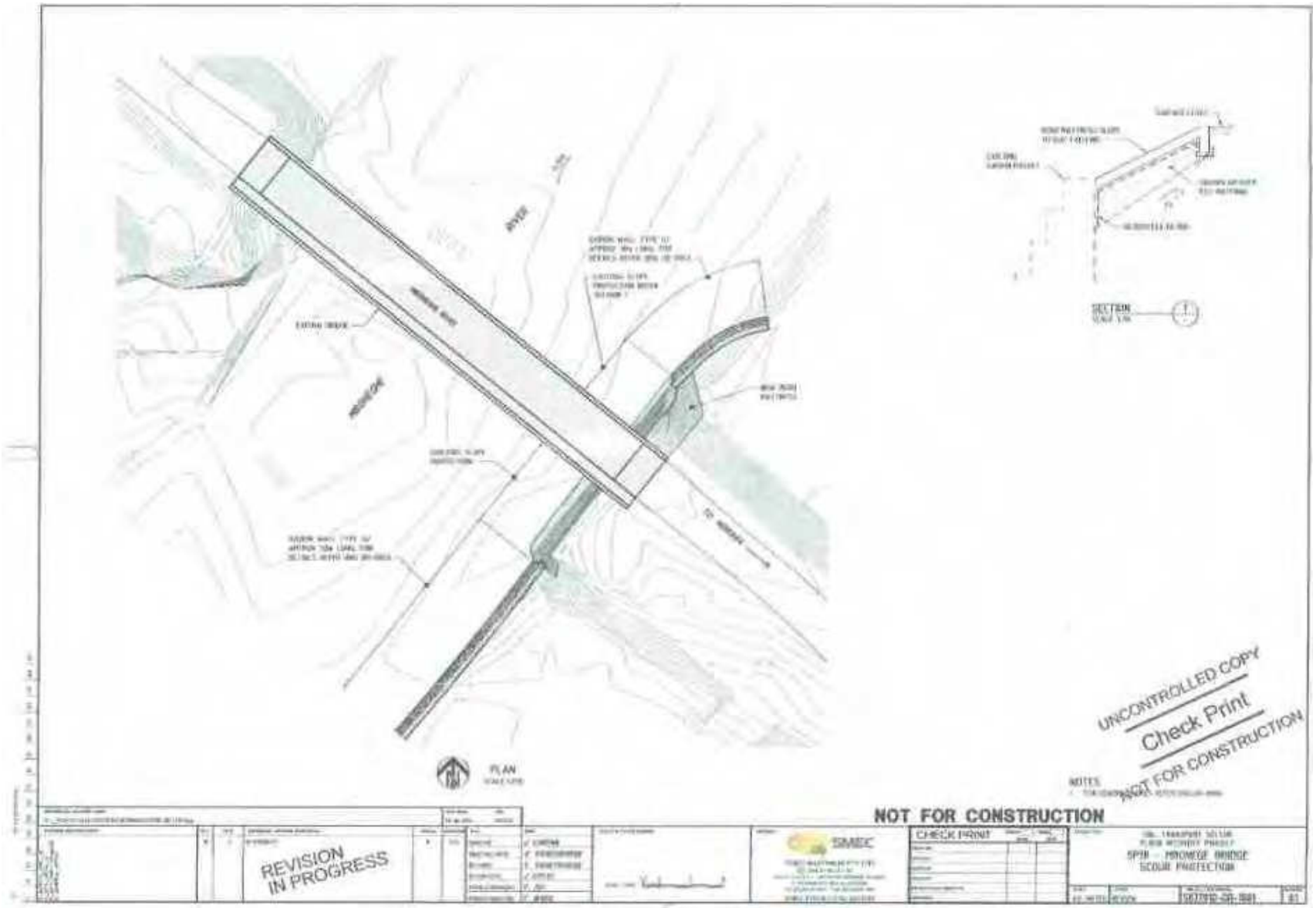
A 3.8 SP08 – Belamatanga Culvert 1



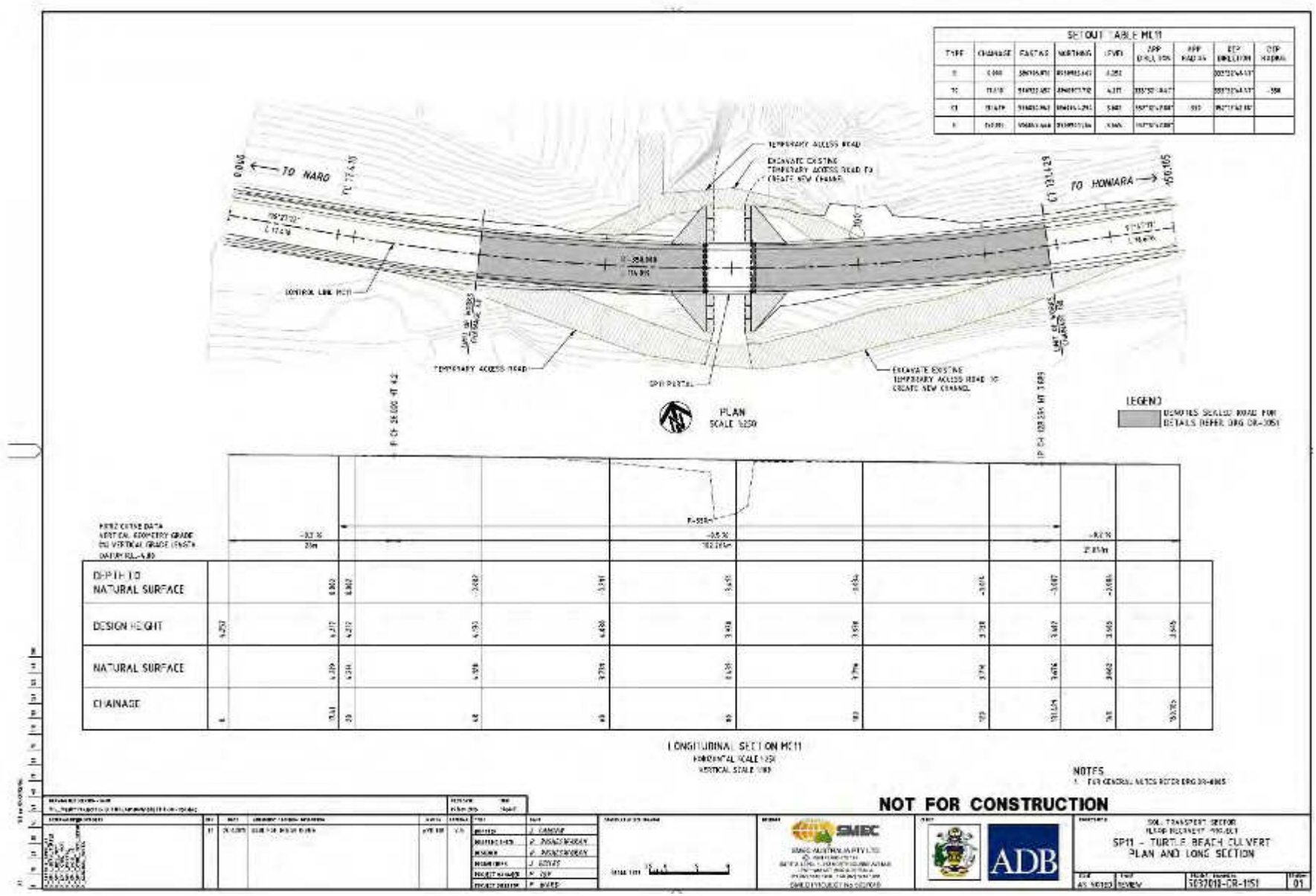
A 3.9 SP09 – Belamatanga Culvert 2

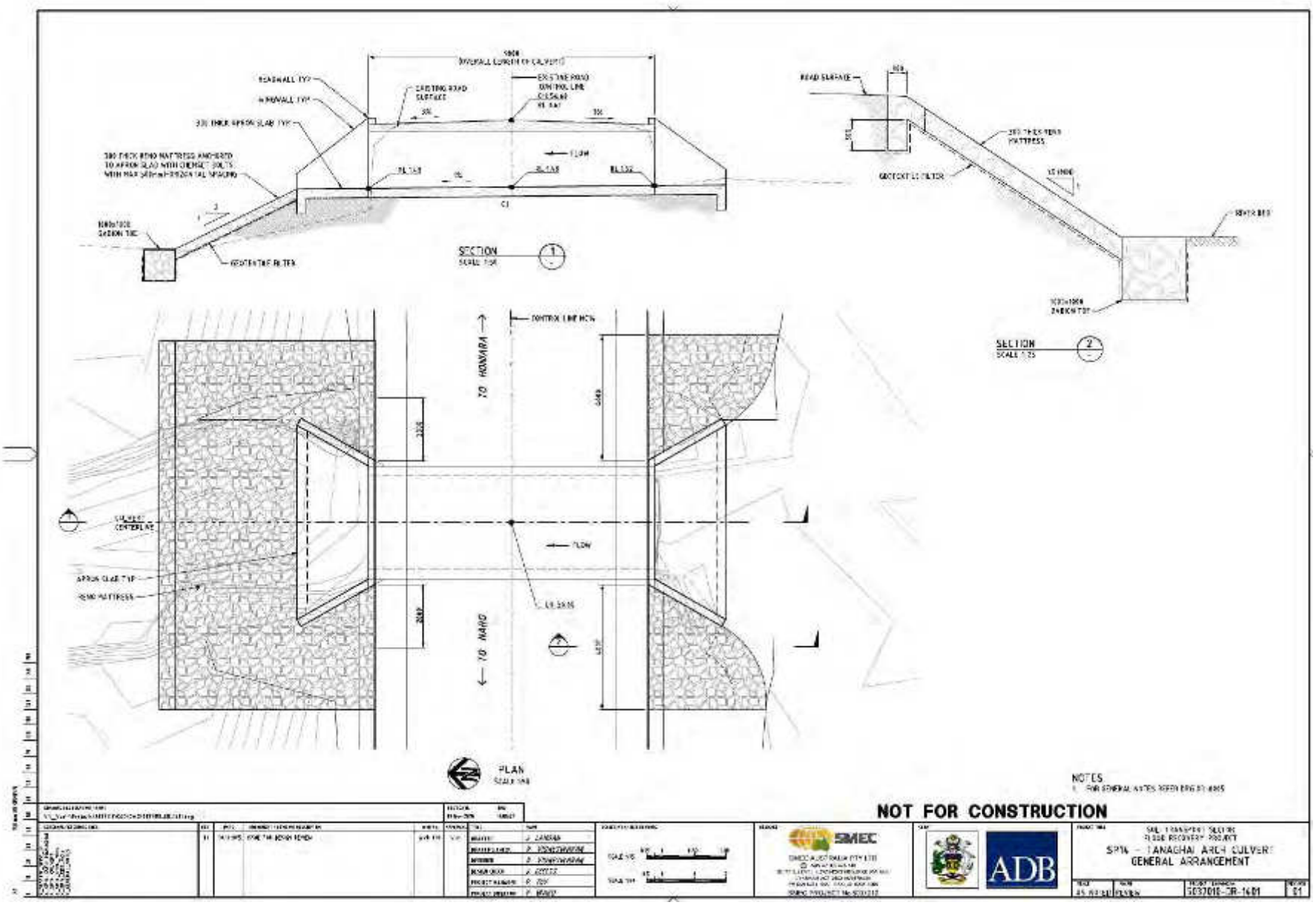


A 3.10 SP10 – Mbonege Bridge

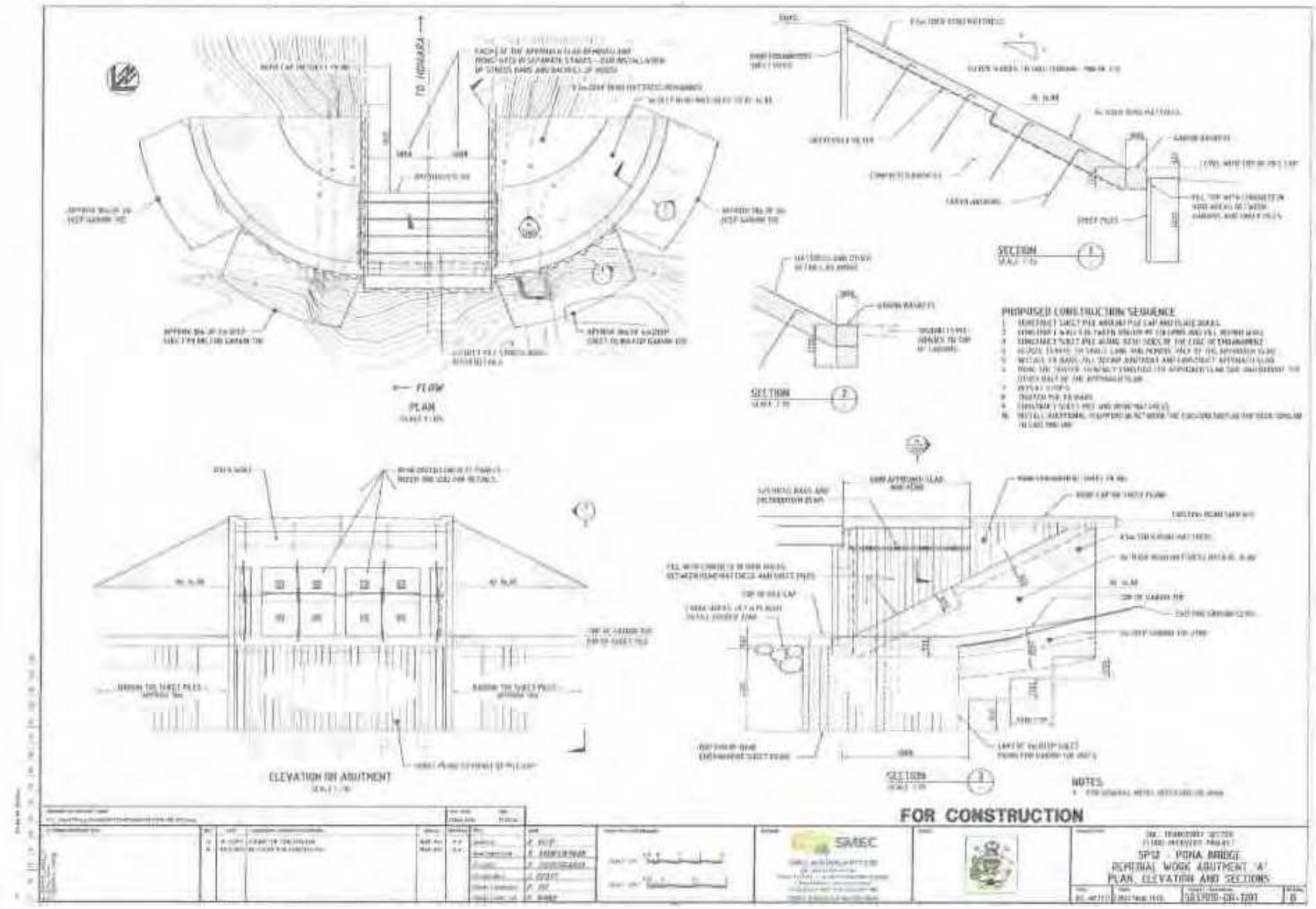


A 3.11 SP11 – Turtle Beach Culvert

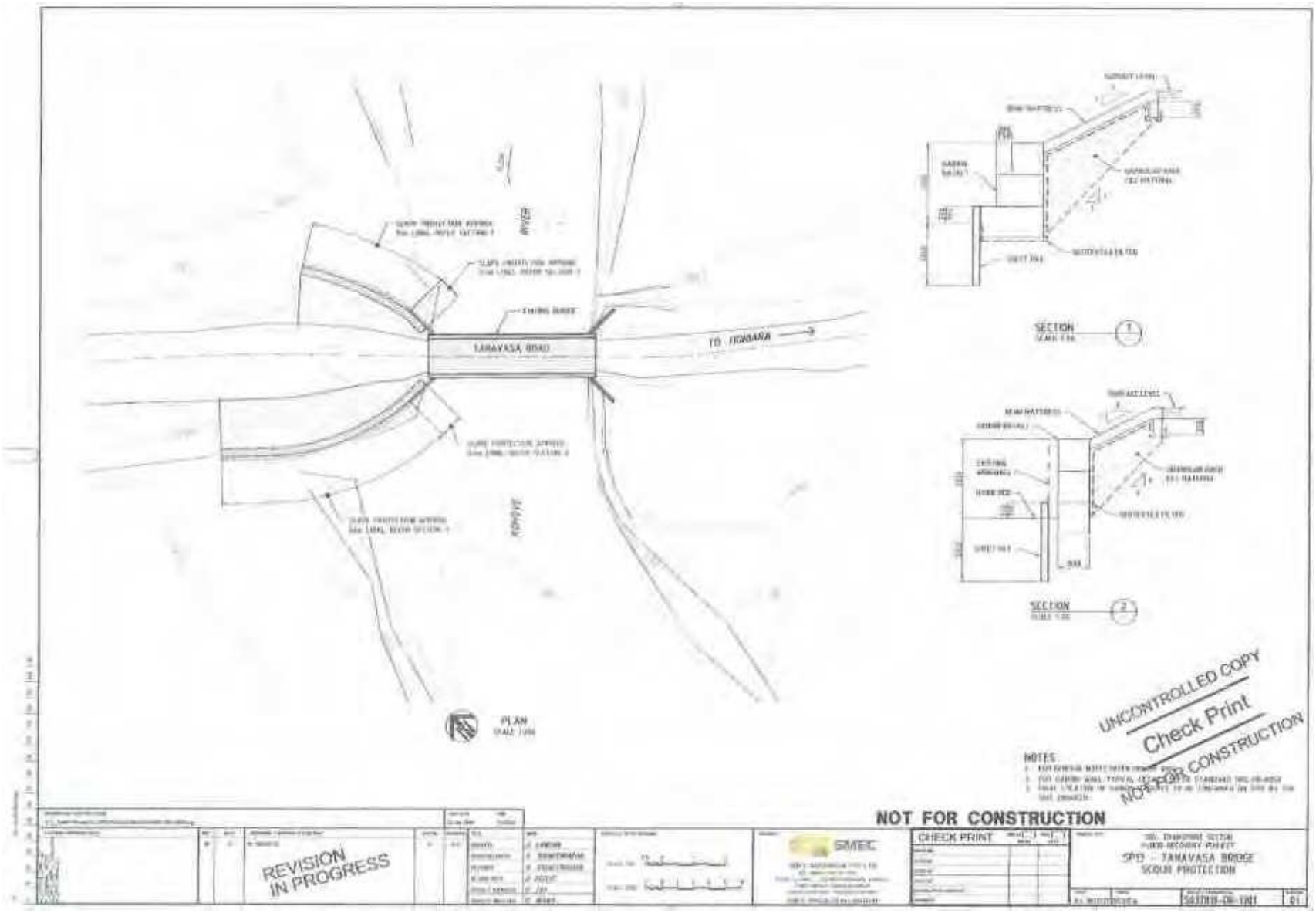



SECTION
SECTION
PLAN
TO HONIARA
TO KAKU
NOT FOR CONSTRUCTION
NOTES
SMEC
ADB
SPN - TANAGHAI ARCH CULVERT
GENERAL ARRANGEMENT

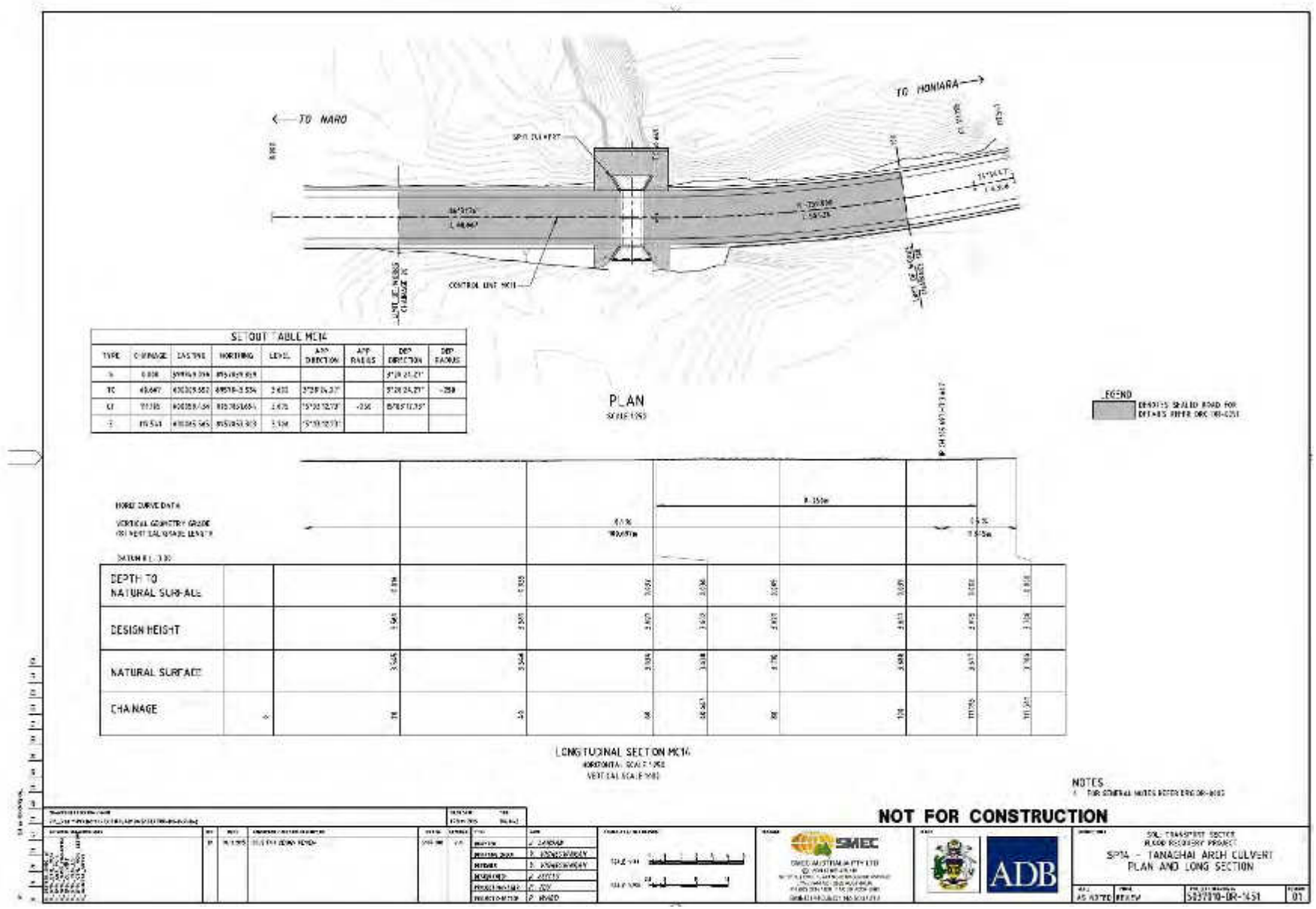
A 3.12 SP12 – Poha High Level Bridge

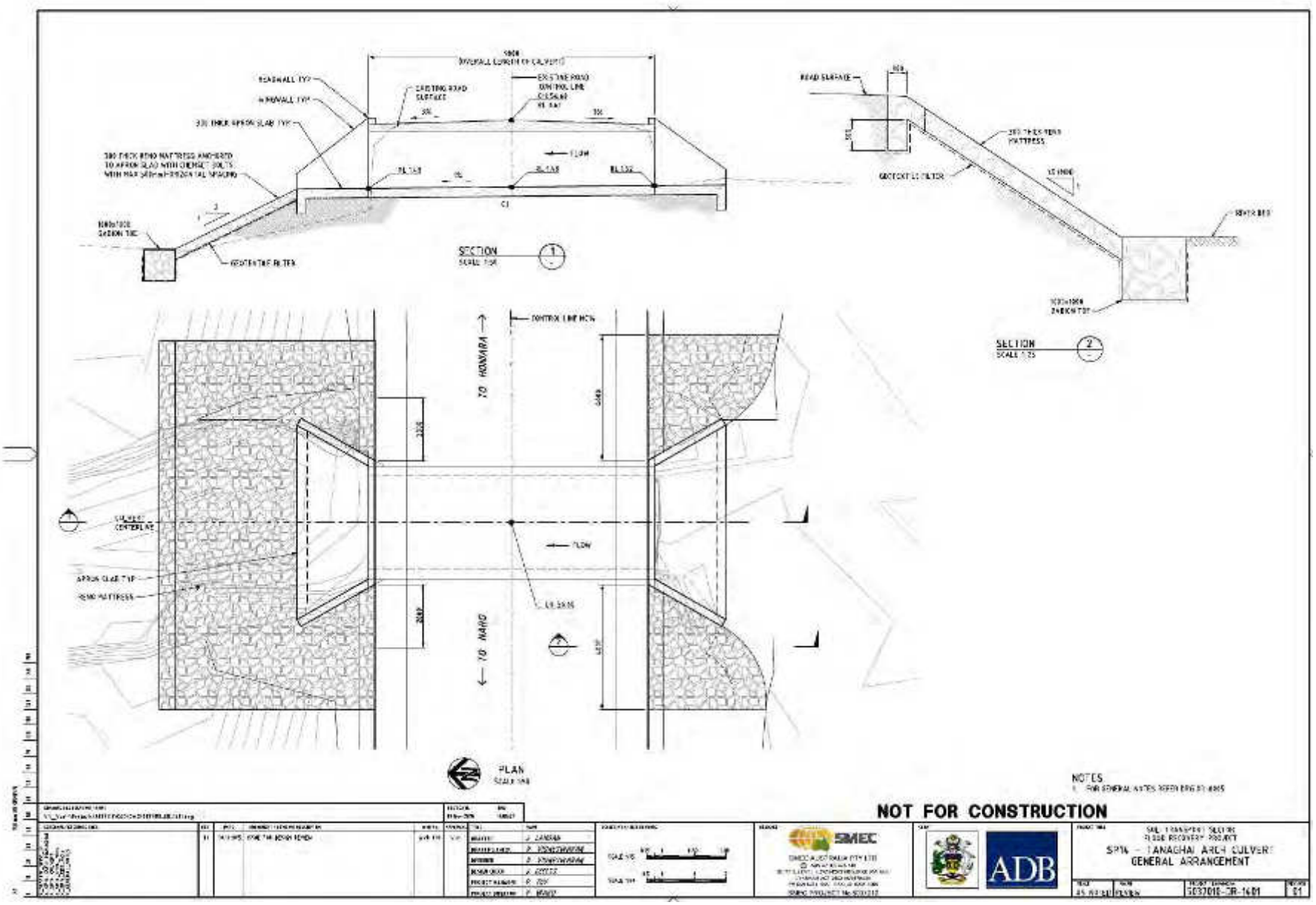


A 3.13 SP13 – Tanavasa Bridge

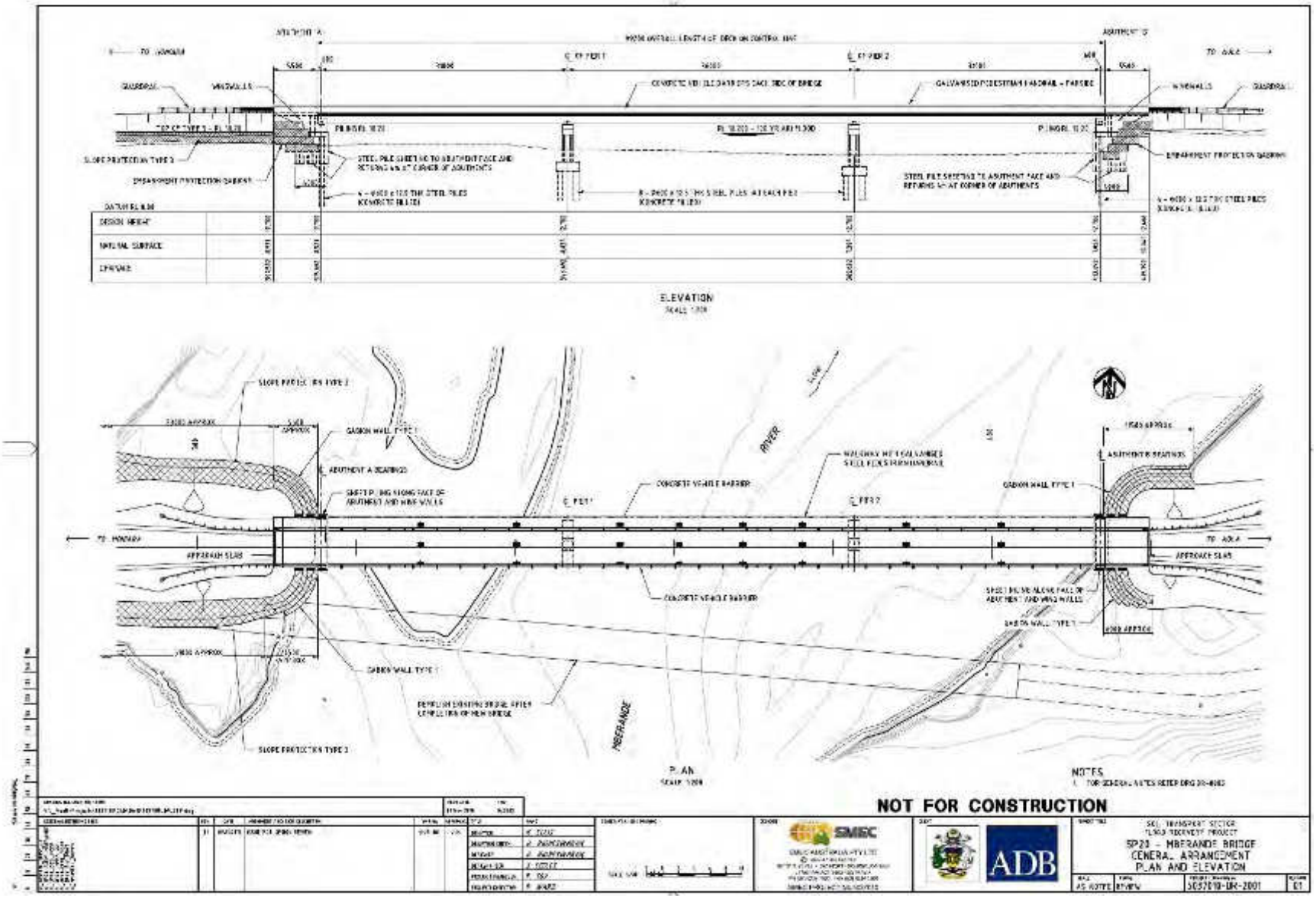


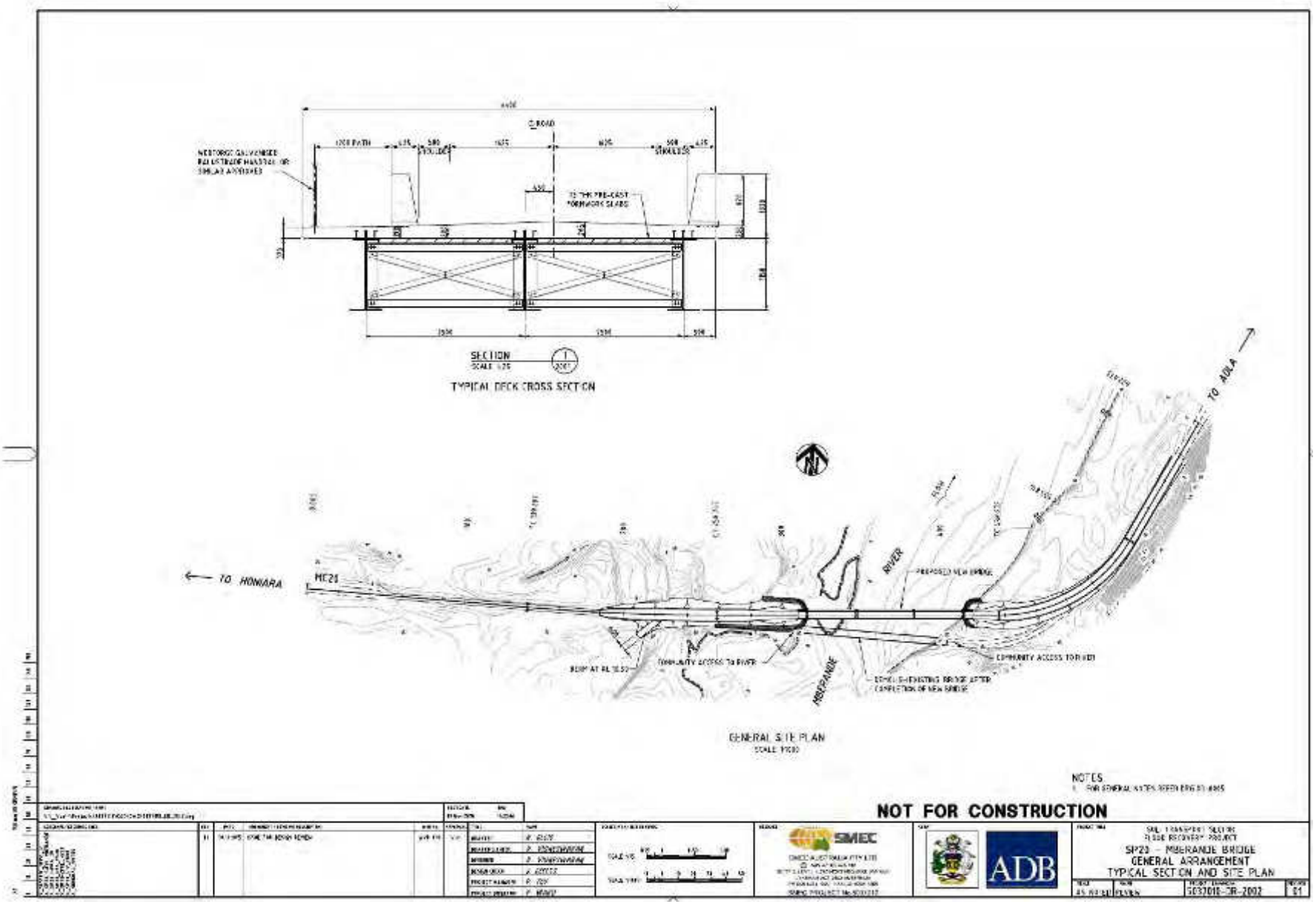
A 3.14 SP14 – Tanaghai Arch Culvert

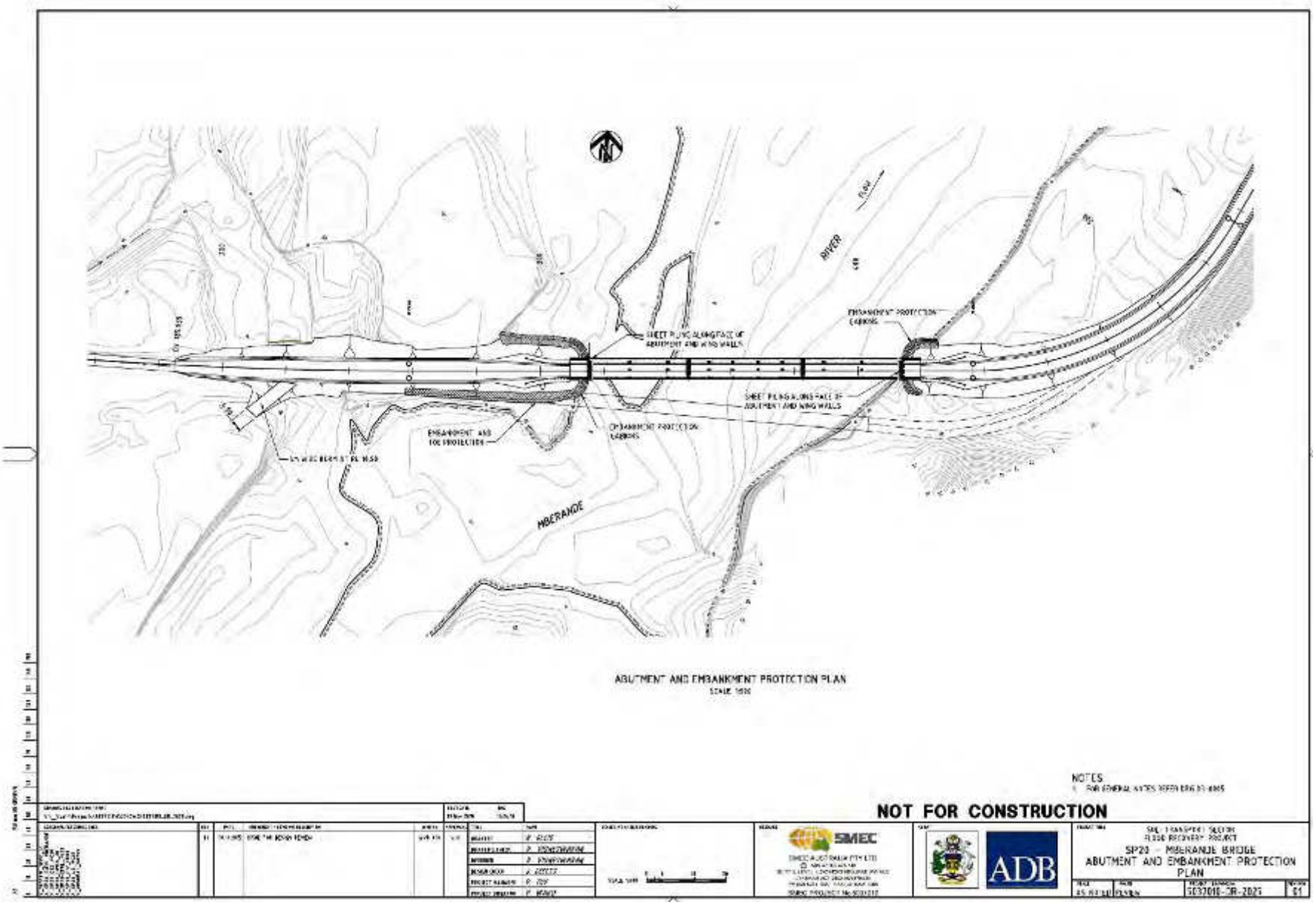



SECTION
SECTION
PLAN
TO HONIARA
TO KAKU
NOT FOR CONSTRUCTION
NOTES
SMEC
ADB
SPN - TANAGHAI ARCH CULVERT
GENERAL ARRANGEMENT

A 3.15 SP20 – Mberande Bridge




SECTION
TYPICAL DECK CROSS SECTION
TO HONIARA
TO ADLA
RIVER
GENERAL SITE PLAN
NOTES
NOT FOR CONSTRUCTION
SMEC
ADB
SP23 - MBERANDE BRIDGE
GENERAL ARRANGEMENT
TYPICAL SECTION AND SITE PLAN


RIVER
MBERANJE
ABUTMENT AND EMBANKMENT PROTECTION PLAN
NOTES
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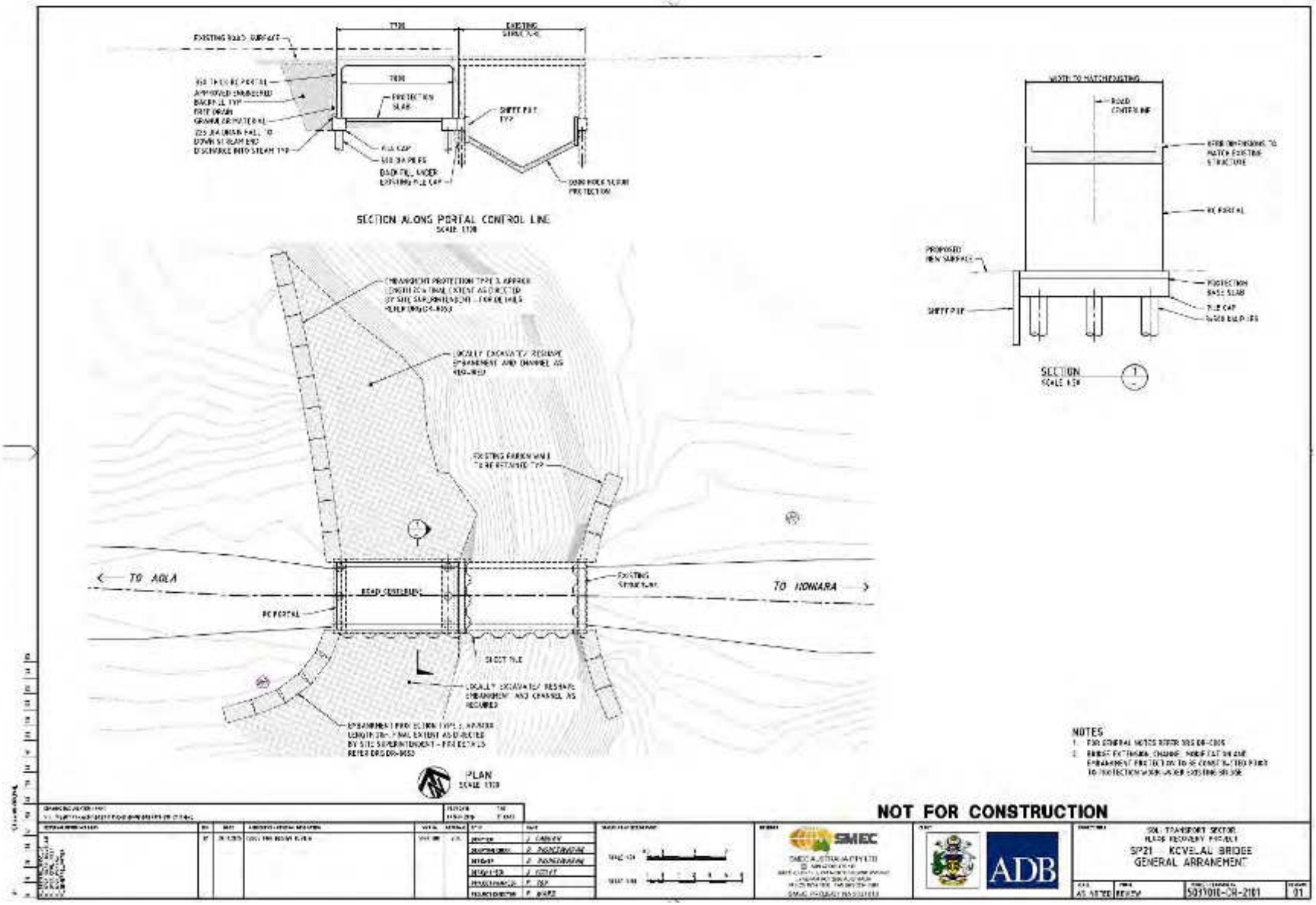
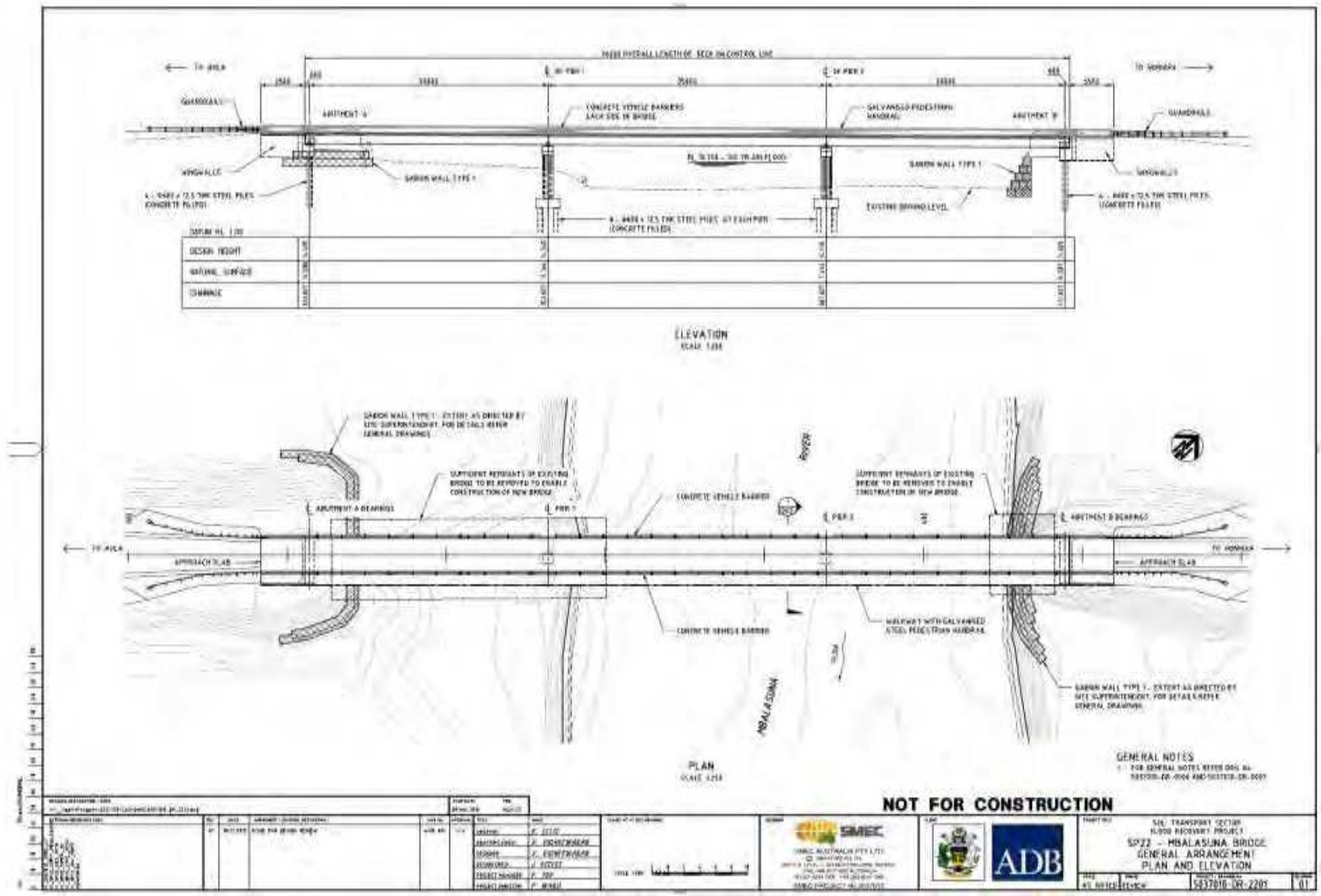
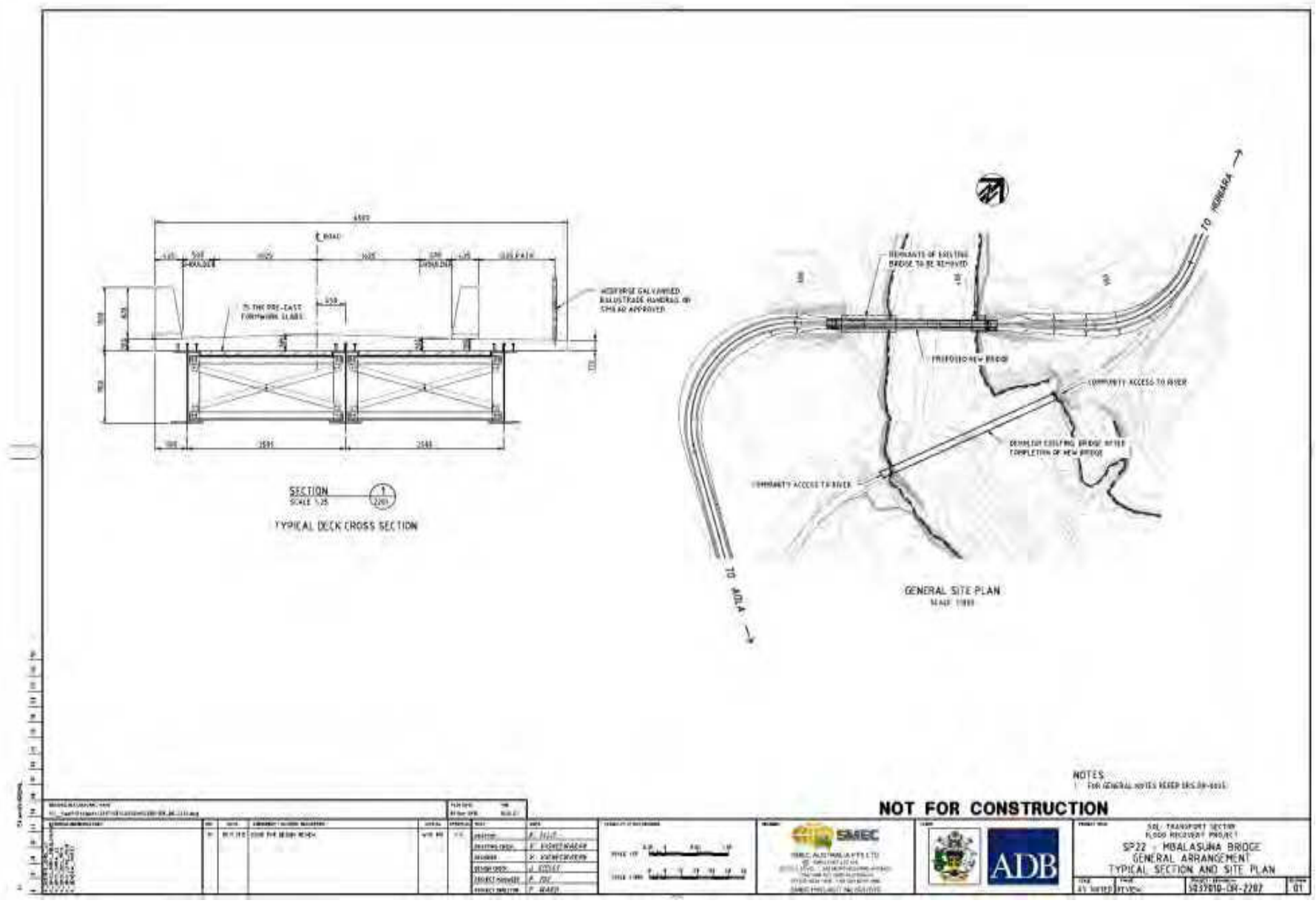
SMEC
ADB
SP23 – MBERANJE BRIDGE
ABUTMENT AND EMBANKMENT PROTECTION PLAN

A 3.16 SP21 – Kovelau Bridge

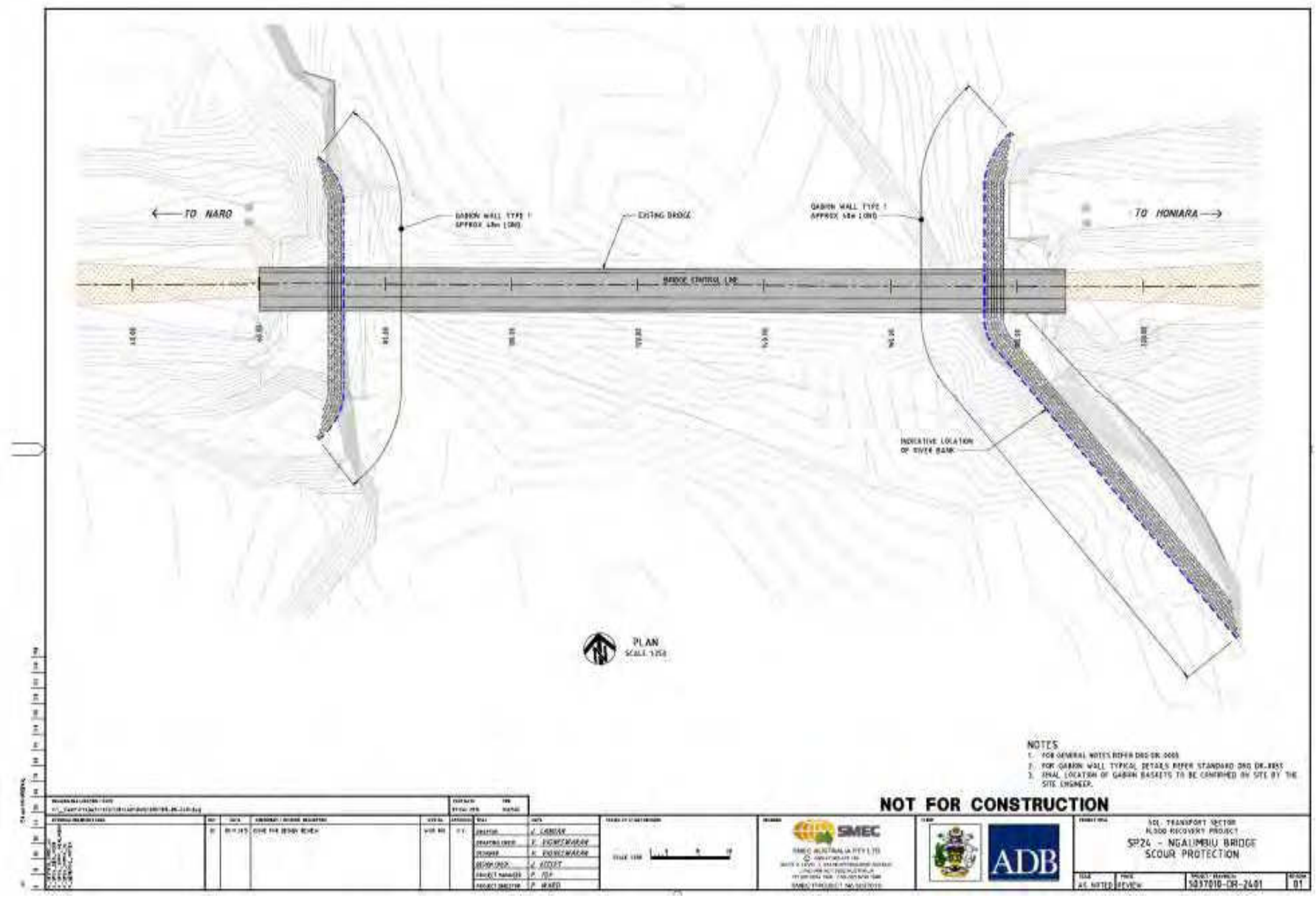


A 3.17 SP23 – Mbalasuna Bridge




SECTION
TYPICAL DECK CROSS SECTION
TO HERBARA
REMNANTS OF EXISTING BRIDGE TO BE REMOVED
PROPOSED NEW BRIDGE
COMMUNITY ACCESS TO RIVER
COMMUNITY ACCESS TO RIVER
TO AOLA
GENERAL SITE PLAN
NOTES
NOT FOR CONSTRUCTION
ADB
SP22 - MBALASUNA BRIDGE
GENERAL ARRANGEMENT
TYPICAL SECTION AND SITE PLAN

A 3.18 SP24 – Ngalimbiu Bridge



APPENDIX 4 – Multilateral Agreements of Solomon Islands

Convention or Treaty	Status	Purpose / Aim	Agency Responsible
Regional MEAs			
Pollution Protocol for Dumping	Ratified on 10th September 1998	Prevention of Pollution of the South Pacific Region by Dumping	Marine Division / ECD
Pollution Protocol for Emergencies	Ratified on 10th September 1998	Co – operation in combating Pollution Emergencies in the South Pacific Region	Marine Division/ ECD Project: National Pollution Prevention Plan
Natural Resources & Environment of South Pacific Region (SPREP Convention)	Ratified on 10th September 1998	Protection of Natural Resources and Environment of th South Pacific Region in terms of Management and Development of the Marine and Coastal Environment i the South Pacific Region	ECD
Waigani Convention on Hazardous & Radioactive Wastes 1995	Ratified on 7th September 1998	Bans the importation of Hazardous and radioactive Wastes into Forum Island Countries and to Control the Trans – Boundary Movement and Management of Hazardous Wastes within the South Pacific Region	ECD
Chemicals, Wastes and Pollution			
Liability for Oil Pollution Damage	Ratified	Strict Liability of Ship Owner for Pollution Damage to a coastal state within a certain amount	Marine Division
Marine Pollution Convention (London	Ratified	Prevention of Marine Pollution by Dumping of Wastes and Other Matter.	ECD / Foreign Affairs
Desertification (UNCCD)	Acceded on 16th Apr 1999	Agreement to Combat Desertification amd Mitigate the Effects of Drought in Countries experiencing Drought and Desertification.	Agriculture Division / ECD Project: National Action Plan on Land Degradation and Drought; National Capacity Self – Assessment (NCSA)
POPs Convention (Stockholm)	Acceded on 28th July 2007	Protection of Human Health and Environment from Persistent Organic Pollutants.	ECD / Environmental Health Division Project: National Implementation Plan
Biodiversity			
CITES	Instrument of Ratification being prepared.	Regulations and Restrictions of Trade in Wild Animals and Plants through a Certification System of Imports and exports.	ECD
World Heritage Convention	Acceded on 10th Jun 1992	Protection of sites of Outstanding Universal Values: Solomon Islands currently has East Renelle Island as a World Heritage Site.	Museum / ECD
Convention on Biological Diversity (UNCBD)	Ratified on 3rd Octob 1995	Conserve Biological Diversity through the sustainable use of its components ans the fair and equitable sharir of the benefits arising out of utilizing genetic resources	ECD Project: NCSA; National Biodiversity Strategy and Action Plan; International Waters Program; 3rd National Report
Catagena Protocol on Biosafety	Acceded on 26th October 2004	Protection of Human Health and the Environment from possible adverse effects of the products of modern biotecnology, especially living modified organisms whil maximizing its benefits.	ECD Project: National Biosafety Framework
Climate			
Montreal Protocol	Acceded on 17th Jun 1993	Allows phase out of substance that deplete the ozone layer according to a fixed implementation schedule.	ECD / Energy Division
Ozone Layer Convention (Vienna)	Acceded on 17th Jun 1993	Protection of the Ozone Layer through Inter – Governmental Co – operation on Research , Systemat Observation of the Ozone Layer and the Monitoring of Chlorofluorocarbons (CFCs) productions.	ECD / Energy Divisions

Convention or Treaty	Status	Purpose / Aim	Agency Responsible
Climate Change (UNFCC)	Ratified on 28th December 1994	Sets an overall framework for Inter – Governmental efforts to tackle challenge posed by Climate Change.	Climate Change Division: National Adaptation Plan of Action; Second National Communication on Climate Change; NCSA
Kyoto Protocol	Ratified on 13th Marc 2003	Reduce Greenhouse gases especially CO_2 for the 39 Industrial / Developed countries by an average of 5.2% by 2012.	Meteorology Division, MECM

CITES – Convention on International Trade in Endangered Species
ECD – Environment and Conservation Division
MECDM – Ministry of Environment, Conservation and Meteorology
NCSA – National Capacity Self Assessment
SPREP – South Pacific Regional Environment Programme
UNCBD – United Nations Conventions on Biological Diversity
UNCCD – United Nations Convention to Combat Desertification
UNFCC – United Nations Framework Convention on Climate Change

APPENDIX 5 – Related Legislation

Act	Date	Main Objective
River Waters	1973	Control of River Waters for Equitable and Beneficial use and establishes activities for which permits are required.
National Parks	1978	Establishes National Parks and Restrictions on use and provides for appointment of Park Rangers.
Wild Birds	1978	List scheduled birds for protection and establishes bird sanctuaries and strict hunting season for several birds.
Agriculture and Livestock	1982	Applies to agricultural and livestock industries and defines noxious weeds and their control.
Forest Resource and Timber Utilization	1991	Governs licensing of felling of trees and sawmills and timber agreements on customary lands. Establishes State Forest and Forest Reserves and Management Systems. The Forestry Bill 2004 seeks to replace the Act and provide more control in conservation of forests and improved forest management.
Fisheries	1998	Framework for Fisheries management and development, including licencing of fishing vessels and processing plants. Lists prohibited fishing methods, provides for establishment of Marine Protected Areas (MPAs) and coastal management plans.
Provincial Government Act	1997	The Provincial Government Act of 1997 gives power to the Provinces to make their own legislation including Environment and Conservation. Schedule 3 of the Act provides a list of activities for which the provinces have responsibility to pass ordinances. The State of the Environment Report (2008) shows that eight (8) Provincial Ordinances have been passed which include: ▪ One (1) Environmental Protection Ordinance ▪ Six (6) Wildlife and Wildlife Mangement and Conservation area ordinances, and, ▪ One (1) Marine and Freshwater Ordinance.
Labor Act	1978	This Act dealt with employment of workers. Part IX Care for Workers, requires the Employer under: ▪ Article 65: to provide workers with ration. ▪ Article 66: to protect workers and dependents from Malaria. ▪ Article 67: to provide workers with an accessible supply of clean, non – polluted water for drinking, washing and for other domestic purposes. Water supplies may be inspected by a Health Officer. ▪ Article 68: requires the Employer to make sufficient and proper sanitary arrangements for workers. ▪ Article 69: requires the Employer to provide accomodation for the worker and his family if they are not conveniently located to the work place. ▪ Article 70: requires the Employer to provide medical care at the work place. ▪ Article 71: states that depending on the circumstances the Employer may be required to provide medical facilities.
Safey at Work Act	1996	This Act consists of Four (4) parts: ▪ Part II: Article 4 states thata it is the duty of every Employer to ensure the health and safety at work of his employees. ▪ Article 6: states that it is the duty of the Employer to provide a safe workplace for persons other than his employees. ▪ Articles 7 and 8: requires manufucturers, suppliers of tools and equipment and suppliers of chemicals and other hazardous substances substances to ensure that these are safe and without health risks. ▪ Article 12: states that any Employer who operates unsafe machinery or substancces and is injured will be responsible for damages. ▪ Part III: Article 15 requires the Employer to protect people from dust, fumes, etc. ▪ Article 16 provided for limits to exposure to dust and fumes. ▪ Articles 17, 18, 19 and 20 require Employers to comply with the operating

Act	Date	Main Objective
		requirements for: i. Pressure and vacuum systems; ii. Machinery; iii. Dangerous machinery; and, iv. Electrical Installations. ▪ Articles 21 and 22 require work places to have fire protection and to take precautions against edxplosions.
The Safety at Work (Pesticide Regulations)	1983	This Regulation is included as a component within the Safety at Work Act and deals with the following: ▪ Article 3: Requires the formation of a Pesticides Registration Advisory Committee. ▪ Article 4: Requires a Register of Pesticides to be maintained. ▪ Article 13: Shows that all pesticide containers are to be labelled with the following: i. The trade name of the pesticide. ii. The net weight and ISO approved name of the active ingredient, together with its formulation. iii. Directions for use and what the pesticide is to be used for. iv. Hazard label regarding storage and handling and safety equipment required for application. v. Minimum withholding periods prior to harvest. vi. First Aid treatment. vii. Name of manufacturer and registration number of the pesticide. ▪ Article 15: Shows that no unlabelled pesticides can be imported, while Articles 16 states that pesticides cannot be sold, supplied or used other than in the original container. ▪ The First Schedule classifies pesticides into 4 hazard levels depending on their oral and dermal toxicity as follows: i. Ia – Extremely hazardous; ii. Ib – Highly hazardous; iii. II – Moderately hazardous; and, iv. III – Slightly hazardous.

APPENDIX 6 – Common Species of Coral and Reef Fish in Solomon Islands

Group	Group / Family	Scientific name	Common name
Coral	Pocilloporidae	*Pocillopora verrucosa*	
		P. damicornis	
		Seriatopora sp.	
		Stylophora sp.	
	Poritidae	*Porites sp.*	
		P. rus	
		P. cylindrica	
	Acroporidae	*Acropora millepora*	
		A. pulchra	
		Monitpora spp.	
	Favids	*Goniopora spp.*	
Soft corals		*Sarcophyton sp.*	
Echinoderm	Beche-de-mer	*Holothuria atra*	Lollyfish
	Urchin	*Echinometra sp.*	Urchin
		Diadema sp.	Urchin
Algae	Blue-green	*Symploca ap.*	
	Green algae	*Halimeda discoidea*	
		Halimeda cf opuntia	
		Caulerpa sp.	
	Red algae	*Jania sp*	Coralline turf
		Lithothamnion sp.	Coralline crust
	Brown algae	*Padina sp.*	
		Acanthophora sp.	
Fish	Butterflyfish	*Chaetodon trifasciatus*	Butterflyfish
		C. vagabundus	
		Heniochus varius	Bannerfish
		H. monoceros	
	Parrotfish	*Scarus sordidus*	Parrotfish
		S. spinus	
		Scarus spp. Juveniles	

Group	Group / Family	Scientific name	Common name
	Surgeonfish	*Acanthurus lineatus*	
		A. pyroferus	
		Ctenochaetus striatus	
	Wrass	*Anampses spp.*	
		Hemigymnus melapterus	
		Halichoeres sp.	
		Labroides dimidiatus	Cleaner Wrasse
	Scolopsid	*Scolopsis bilineatus*	Monacle bream
	Damselfish	*Chrysiptera sp.*	
		Stegastes spp.	
		Abedefduf seafasciatus	Sergeant major
		A. sordidus	Sergeant major
		Amphiprion percula	Orange clownfish
	Goatfish	*Mulloides flavolineatus*	
		Mulloides bilineatus	
		Parupeneus multifasciatus	
	Snapper	*Lutjanus fulviflamma*	Moses perch
	Moorish Idols	*Zanclus cornutus*	Moorish idol

APPENDIX 7 – Red List Categories of IUCN for Fauna and Flora

Category	Definition
Least concern	Common and widespread species not dependent on conservation efforts and not assessed to be near threatened or threatened.
Low risk	A species is dependent on conservation efforts to prevent it becoming threatened with extinction.
Near threatened	A species does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying or is likely to qualify for a threatened category in the near future.
Vulnerable	Same definition as previous category of "threatened". Species is likely to become endangered unless circumstances threatening its survival are improved or a species is considered to be facing a high risk of extinction in the wild.
Endangered	A species with few in number or its habitat is threatened and evidence indicates that the species is considered to be facing a very high risk of extinction in the wild.
Critically endangered	A species is considered to be facing an extremely high risk of extinction in the wild.
Extinct in the wild	When it is known that a species can only survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range.
Extinct	When there is no reasonable doubt that the last individual has died. A species is presumed extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), and through out its historic range have failed to record an individual.
Data deficient	When there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A species in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat but does not discount that the habitat of a species could be threatened; investigation and assessment is required.

Common Name	Scientific Name	Red List Classification
Crocodile	Crocodilus porosus	Least concern
Waisure ground thrush	Zoothera margaretae	Near threatened
Chestnut-bellied pigeon	Ducula brenchleyi	Vulnerable
Pied monarch	Monarcha barbata	Near threatened
Chestnut-bellied monarch	Monarcha castaneiventris	Least concern
Solomons' broad-billed flycatcher	Myiagra ferrocyanea	Least concern
Banue-Makira starling	Aplonis dichroa	Least concern
Yellow-bibbed lory	Lorius chlorocercus	Least concern
Tristram's honey-eater	Myzomela tristrami	Least concern
Waimisimisi midget	Diacaeum tristrami	Least concern
Ghakou honey-eater	Meliarchus sclateri	Not listed
Duchess lorakeet	Vini margarathae	Not listed

APPENDIX 8 – Hazard Maps

Figure A8.1. Flood Hazard Map (SP01 – Selwyn (Veranaso) Causeway)

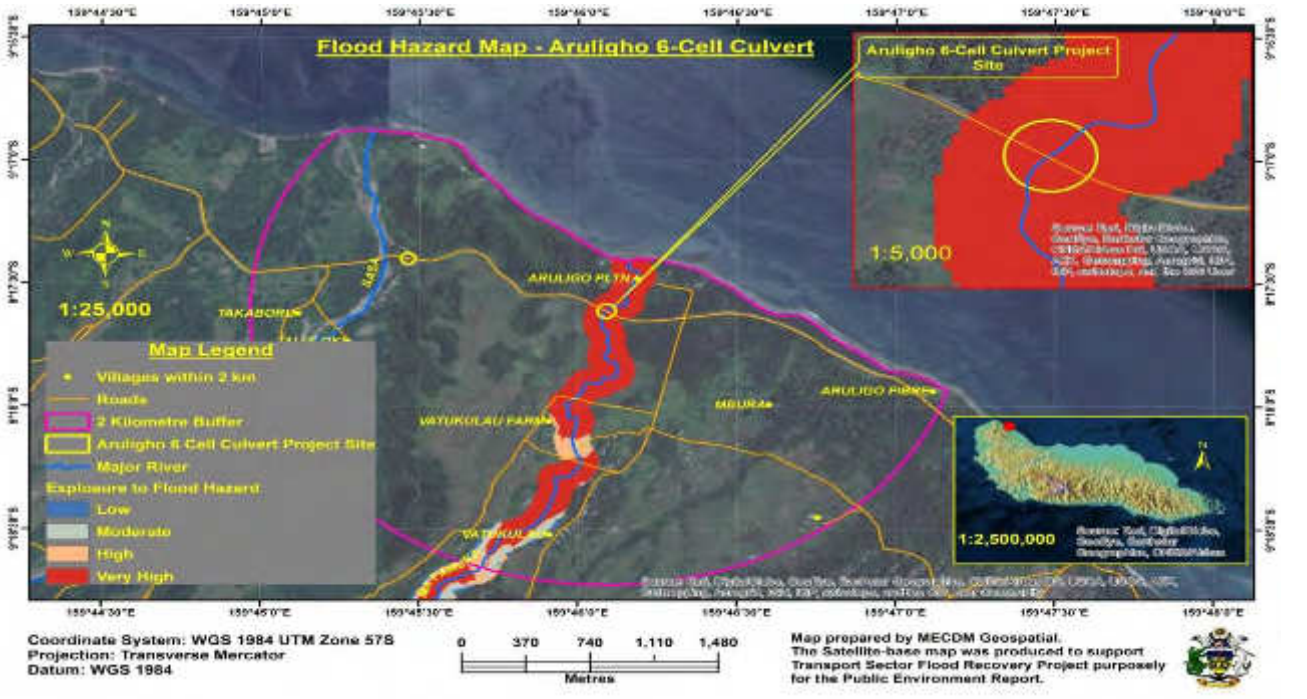


Figure A8.2 – Flood Hazard Map of Aruligho Causeway

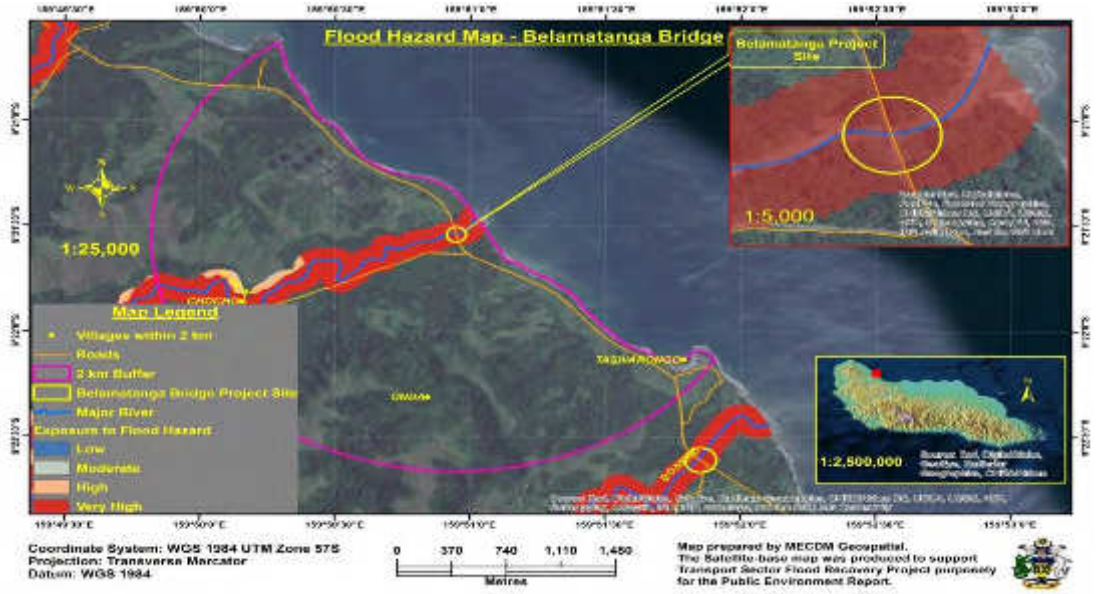


Figure A8.3. SP04 - Flood Hazard Map of Belamatanga Bridge

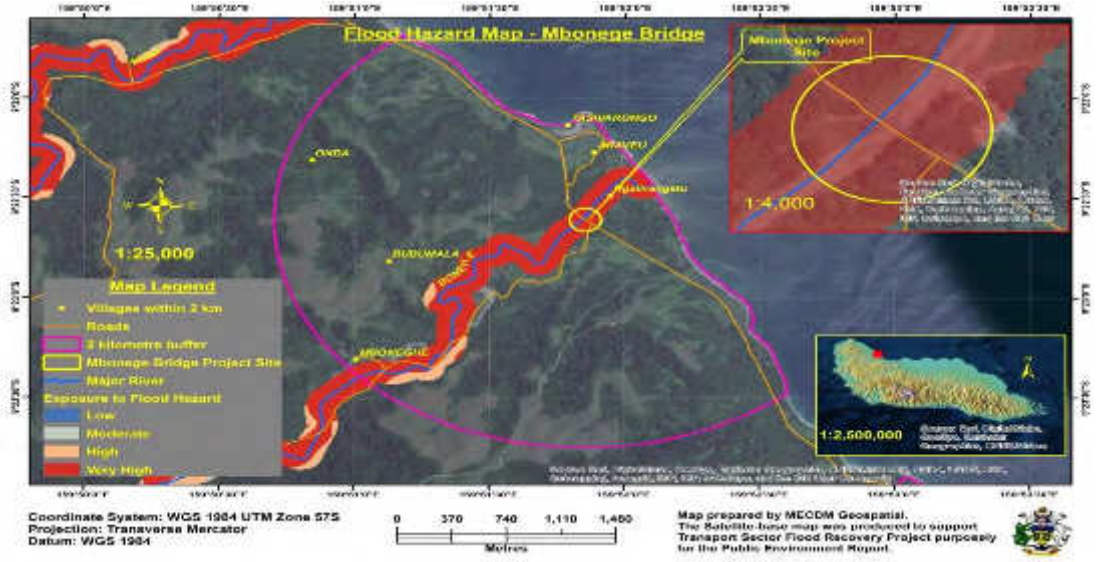


Figure A8.4. SP10 - Flood Hazard Map of Mbonege Bridge

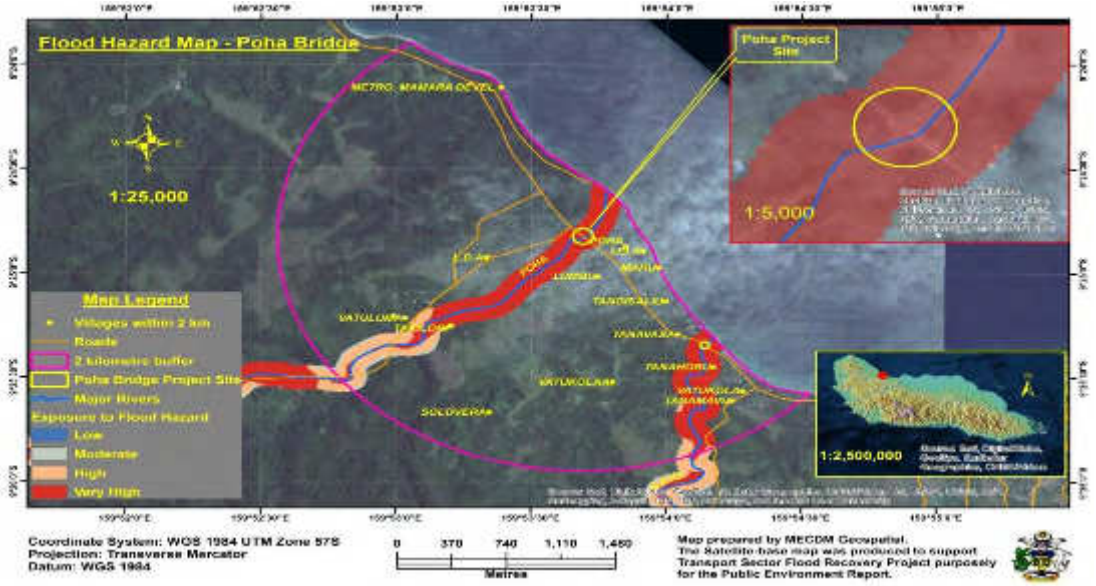


Figure A8.5. SP12 - Flood Hazard Map of Poha Bridge

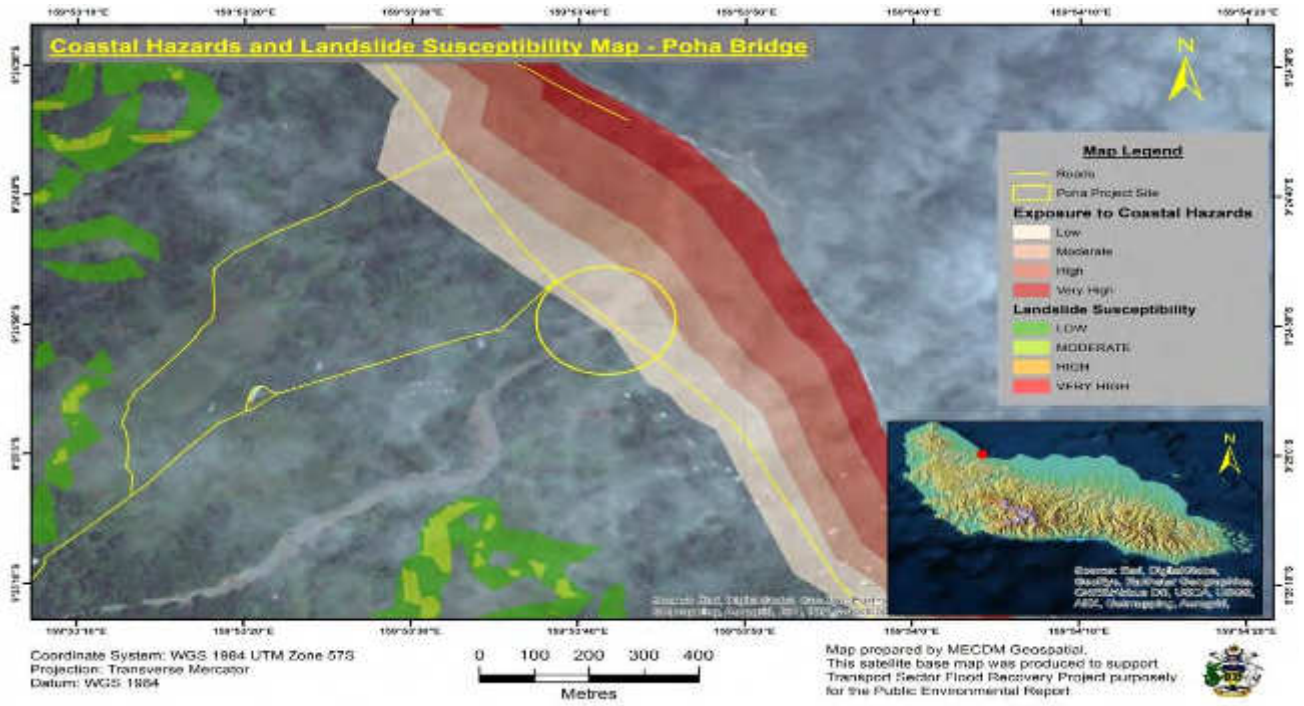


Figure A8.6. SP12 - Coastal Hazard and Landslide Susceptibility Map of Poha Bridge

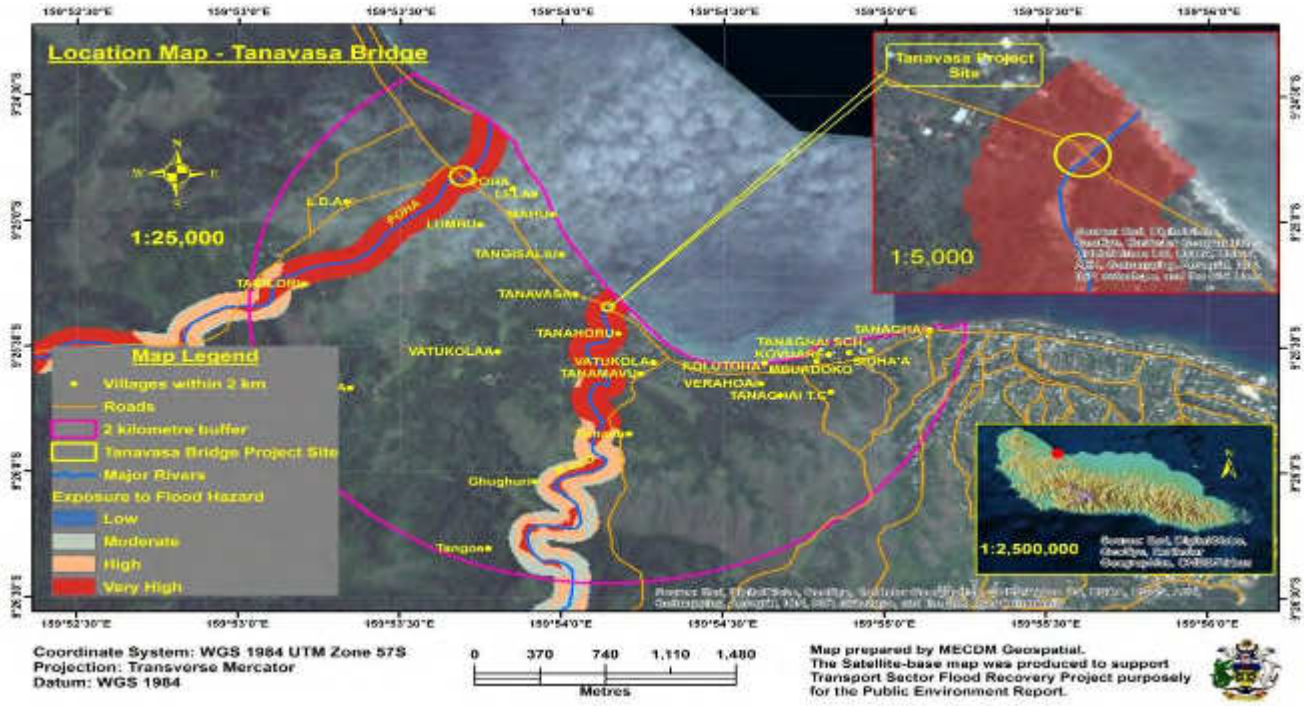


Figure A8.7. SP13 - Flood Hazard Map of Tanavasa Bridge

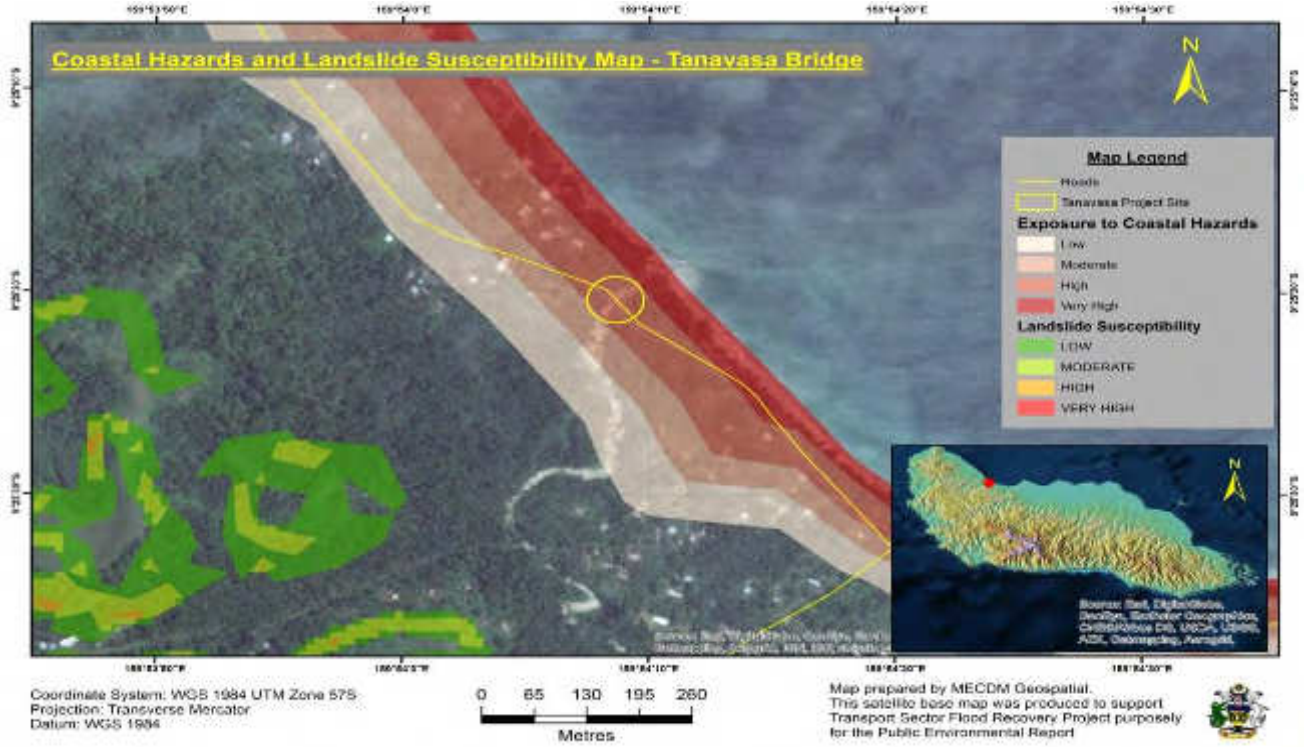


Figure A8.8. SP13 - Coastal Hazard and Landslide Susceptibility Map of Tanavasa Bridge

Figure A8.9. Coastal Hazard and Landslide Susceptibility Map (SP14 – Tanaghai Arch Culvert)

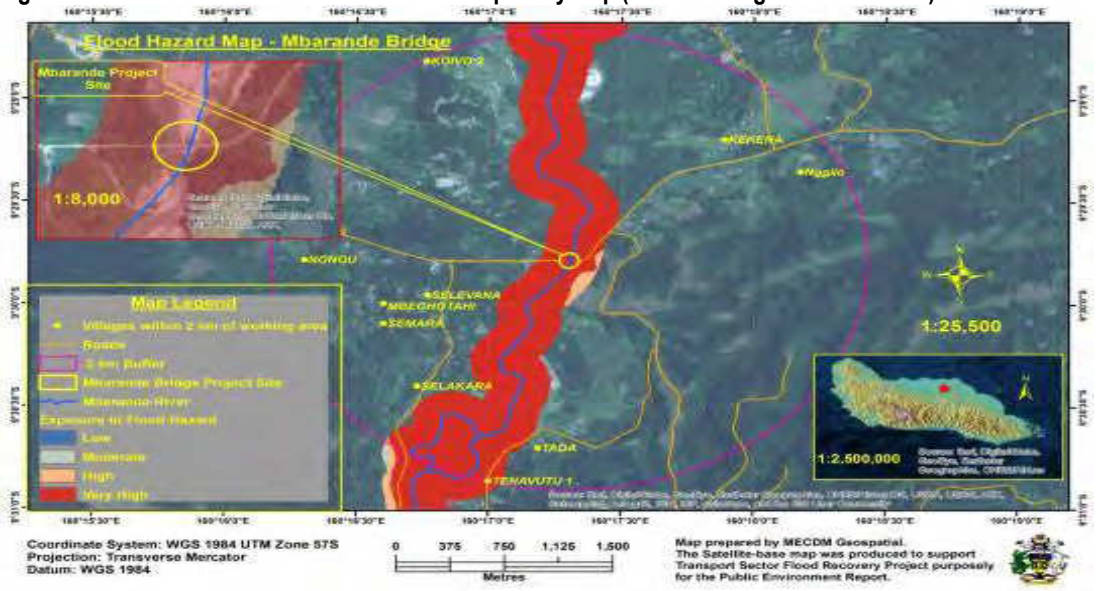


Figure A8.10. Flood Hazard Map (SP20 – Mberande Bridge)

Figure A8.11. Costal Hazard and Landslide Susceptibility Map (SP20 – Mberande Bridge)

Figure A8.12. Coastal Hazard and Landslide Susceptibility Map (SP21 – Kovelau Bridge)

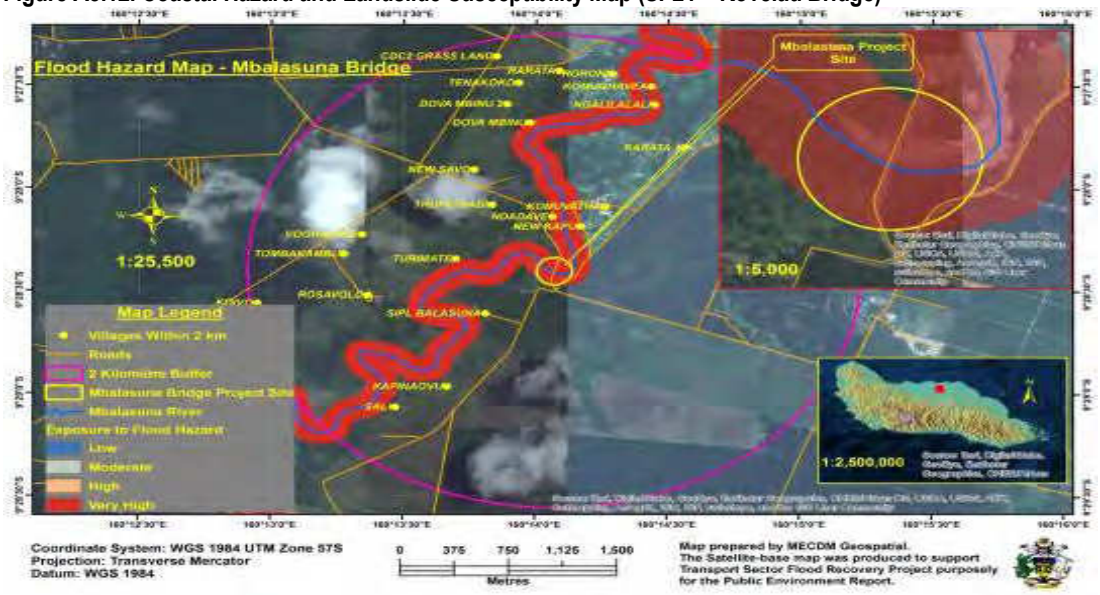


Figure A8.13. Flood Hazard Map (SP23 – Mbalasuna Bridge)

Figure A8.14. Coastal Hazard and Landslide Susceptibility Map (SP 23 – Mbalasuna Bridge)