Ministry of Infrastructure Development
Solomon Islands

PREPARATORY SURVEY REPORT
ON
THE PROJECT FOR UPGRADING
OF
THE KUKUM HIGHWAY (PHASE 2)

FINAL REPORT

November 2020

JAPAN INTERNATIONAL COOPERATION AGENCY
CTI ENGINEERING INTERNATIONAL CO., LTD.

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Preface

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrusted the survey to CTI Engineering International Co., LTD (CTII).

CTII held a series of discussions with the officials concerned of the Government of the Solomon Islands, and conducted field investigations. Study was continued in Japan based on the results and findings of the discussions and field investigations. This report was finalized, which compiles the result of the study.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Solomon Islands for their close cooperation extended to the survey team.

November 2020

Kiyoshi AMADA
Director General,
Infrastructure Management Department
Japan International Cooperation Agency

Summary

(1) Situation of the Solomon Islands

Roads in Honiara City, the capital of the Solomon Islands located in the Guadalcanal Island are experiencing severe obstruction of smooth traffic flow due to rapid increase of vehicles and compounded by deterioration of existing pavement. Despite continuous efforts by the Solomon Islands Government (SIG), the stretch from Honiara City to the international airport on the Kukum Highway particularly observes severe traffic congestion, which further worsens during the rainy season because the roads are inundated by rainwater due to insufficient drainage systems. Furthermore, provision of zebra crossings to facilitate pedestrians to cross the road is minimal, making the road vulnerable to traffic accidents.

To remedy the situation, the SIG made a request to the Government of Japan (GOJ) for a Grant Aid Assistance to upgrade approximately a 10-km section of the highway, between the city municipal office and Honiara International Airport. In response, GOJ implemented "the Project for Upgrading of the Kukum Highway–Phase 1" (Phase 1).The project scope included improvement of a 3-km section of the highway towards the east from the municipal office and provision of bus bays and facilities for pedestrian crossings (underground crossings and overhead bridges) in a 0.6 km section of the road to the west from the municipal office. Improvement of these sections was identified to have higher urgency and priority from aspects of prevailing conditions of rainwater drainage, pavement, traffic volume and safety.

As Phase 1 could only undertake improvement of 3 km stretch of the initially requested 10 km stretch, the remaining 6.3 km of the highway, from the Ministry of Fisheries and Marine Resources to the international airport, still needed improvement against drainage, pavement and traffic volume/safety. Therefore, reducing road maintenance cost and ensuring stable transportation by developing a sound flood management and drainage facilities and further mitigating negative impacts to socio-economic activities needed to be conducted urgently. These items are planned to be included in the "Project for Traffic Survey of Master Plan in Honiara City".

The SIG has several development plans on the road sector. The National Development Plan (NDS: 2016-2035) emphasizes improving transportation services and road networks. Upgrading the major highway is given high priority in the Medium-Term Transport Action Plan (2017-2021) in the National Transport Plan. The "Project for Upgrading of the Kukum Highway (Phase 2)" in the Solomon Islands (hereinafter referred to as "Project") is to upgrade pavement and road furniture. This preparatory survey was conducted for one of the top priority projects of the city in response to the requests from the SIG.

(2) Requested Scope

The initial project scopes requested by the SIG to the GOJ for under the Grant Aid Assistance are shown in Table-1.

Table-1 Initial Project Scope Requested by SIG

Road Improvement:	Phase 2 : 5 km 4 lane, 1 km 2 lane, Phase 3 : 4.5 km 4 lane
Road Pavement:	Phase 2 : 5 km 4 lane, 1 km 2 lane, Phase 3 : 4.5 km 4 lane
Road Furniture:	Phase 2 : 6 km, Phase 3 : 4.5 km

However, the analysis conducted in Japan based on the information and data accumulated during the 1st field survey in the SIG indicated that the project cost to implement all the above-mentioned scopes will exceed the budget sealing of the grant aid assistance of the GOJ.

Based on such situation, the Team reviewed and studied the project scope through discussions with JICA and the Ministry of Foreign Affairs of Japan and optimized the scopes such that the entire section (L=6.3 km) requested by the SIG can be improved under the budget sealing. Approval from JICA and the Ministry of Foreign Affairs of Japan on the revised project scope was finally obtained. The scopes approved are composed of the upgrading section and overlay section as shown below.

Overlay Section

- From the beginning point to Sta. 2.3 km (L=2.3 km):
  Asphalt overlay and installation of drainage facilities for flooding mitigation. Performance period of asphalt pavement is 3 years.

Upgrading Section

- From Sta. 2.3 km to the end point (L=4.0 km):
  Upgrading the section by improved pavement, drainage facilities, structures, and road ancillaries, etc. Performance period of asphalt pavement is 10 years.

The Team proposed the above revised project scopes to the MID to which the MID agreed. Figure 1 shows the project area and classification of the improvement scopes.

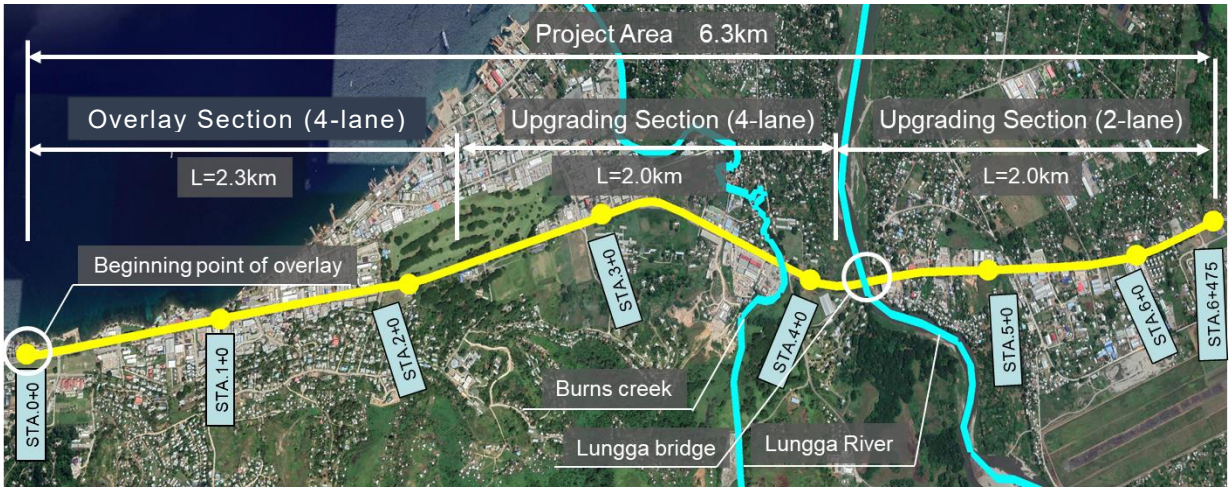

Figure-1 Project Area and Improvement Scopes

(3) Preparatory Survey Schedule

In order to implement the Project efficiently and effectively under Japanese grant aid assistance, the Preparatory Survey was conducted as follows;

- October to December 2019: Consultation and discussion on IC/R and execution of first field survey
- December 2019 to August 2020: Performance of outline design and cost estimation in Japan
- July 2020: Outline design consultation and discussion, conducting Stakeholders' meeting (SHM), obtaining approval from MID on the project scope
- August 2020: Consultation and discussion on the draft final report

(4) Contents of the Project

Contents (Design elements and work items) of the project concluded by the study are as shown in Table-2.

Table-2 Contents of the Project

Item			Overlay Section (Beginning point–2.3 km)	Upgrading Section (2.3 km–End point)
Design Element	Objective Length		2.3 km	4.0 km
	Design Speed		50 km/h	50 km/h
	Road Width	4-lane	22.0-25.0 m	23.0 m
		2-lane	—	16.0 m
	Carriageway Width	4-lane	3.0-3.5 m	3.5 m
		2-lane	—	
	Median Width (0.5 m inner shoulder included)	4-lane	2.4-4.0 m	4.0 m
		2-lane	—	2.0 m
	Shoulder Width	4-lane	0.5-1.5 m	0.5 m
		2-lane	—	
	Footpath Width	4-lane	2.0m	2.0 m
		2-lane	—	
Work Item	Asphalt Pavement		t=5 cm	t=10 cm
	Roundabout		2 locations	
	Drainage		7.5 km	
	Cross Drainage		19 locations	
	Gravity Wall		120 m	
	Retaining Wall		54 m	
	Street lights		4 km	
	U-Turn exclusive Lane		1 location	
	Handrail		860 m	
	Bus Bay		19 locations	
	Road Ancillary		Entire section	
	Lungga Bridge Repair		1 location	

(5) Project Implement Schedule and Project Cost

The implementation period of the Project is estimated to be 5.0 months for detailed engineering design (including bidding of construction works), and 24 months for construction work.

The project cost to be borne by the recipient country is estimated to be about 2.96 million US Dollar.

The cost to be borne by the Japan's Grant Aid is not shown in this report due to the confidentiality.

(6) Project Evaluation

Relevance

1) Approximately 240,000 residents of the project area (Honiara City and Guadalcanal Province) are direct beneficiaries of the Project.
2) The Project will contribute to mitigating the traffic congestion and improving travel environment as well. It is expected that movement of people and logistics will be smooth and thereby contribute to mitigating traffic congestion and facilitating domestic logistics.
3) The Project will eliminate disruption of highway network due to flooding and improve the lives of the residents.
4) Negative impact on environmental and social conditions by the project is low.

(7) Effectiveness

1 Quantitative Effect

The Quantitative effects are shown in Table-3.

Table-3 Quantitative Effects

Index	Current Value (as of 2019)	Design Value (as of 2023)	3 years after Project Completion (as of 2026)
Average Travel Speed* (km/h)	33	50	50
Volume of Passengers (person / year)	2.2 million	2.7 million	3.1 million
Volume of Cargo (t / year)	658,760	870,000	900,000
Traffic Disruption (hours/year)	24	0	0

*Of the project section (approximately 6.3 km)

2 Qualitative Effect

The prospective effects are;

(1) Improvement of disaster prevention functions by increasing drainage capacity
(2) Economy enhancement brought from traffic congestion mitigation and reducing transportation costs by improvement of road condition
(3) Improvement of traffic safety and accessibility for road users by providing street lights, sidewalks and pedestrian crossings

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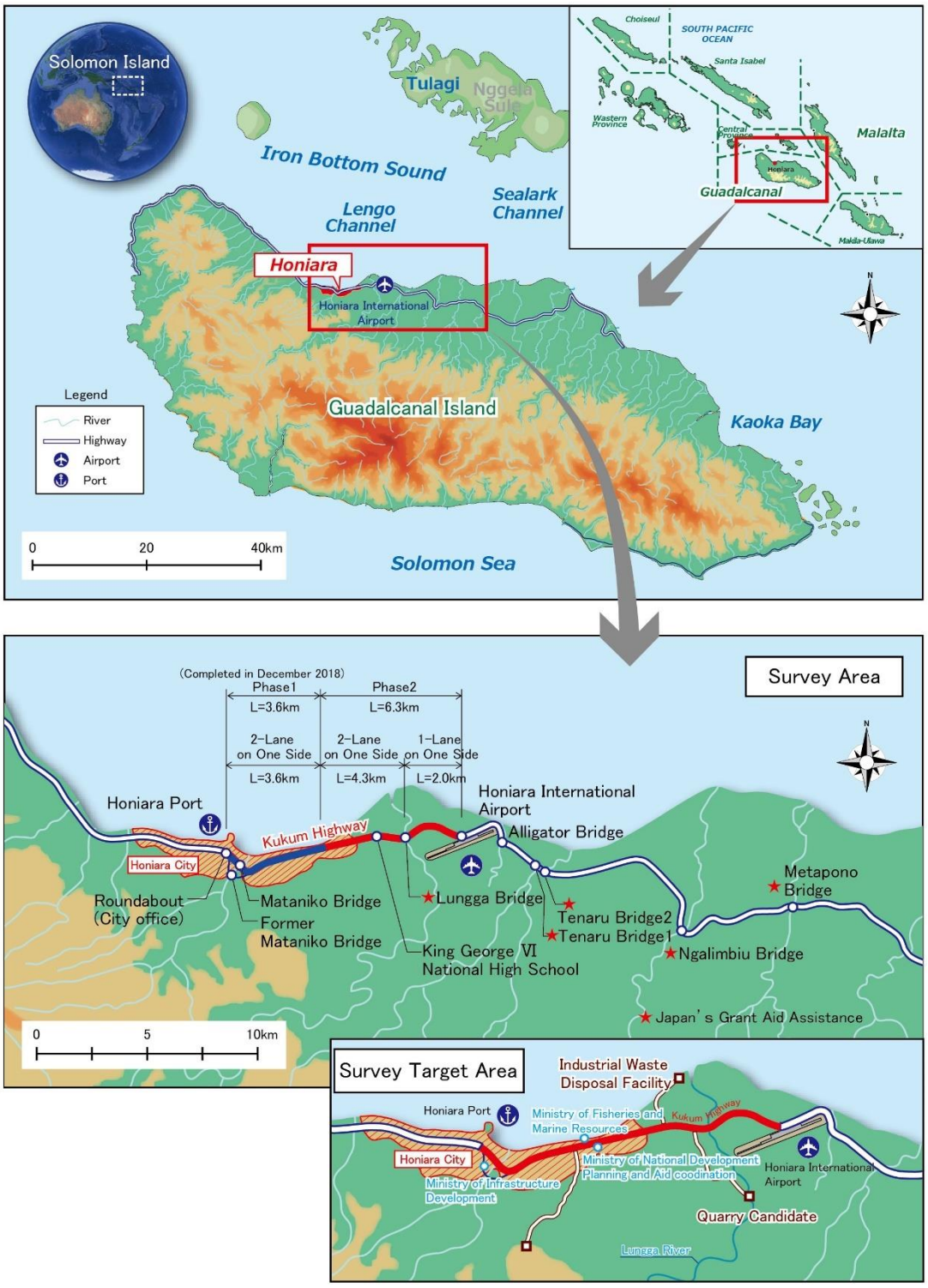
[Appendices]

Project Location



Project Area (Phase 2 Section)

Perspective

● 4-Lane Section

● 2-LaneSection

● Roundabout

List of Tables and Figures

List of Abbreviations and Acronyms

AASHTO	:	American Association of State Highway and Transportation Officials
ADB	:	Asian Development Bank
AGO	:	Attorney General's Office
AH	:	Affected Household
APs	:	Affected Peoples
ARAP	:	Abbreviated Resettlement Action Plan
ART	:	Antiretroviral Therapy
ASTM	:	American Society for Testing and Materials
BNPL	:	Basic Needs Poverty Line
CAC	:	Community Advisory Committee
CBR	:	California Bearing Ratio
CLAC	:	Customary Land Appeal Court
CLO	:	Community Liaison Officer
COL	:	Commissioner of Lands
CPIU	:	Central Project Implementation Unit of MID
D/D	:	Detailed Design
DOD	:	Discussion on Outline Design
EA	:	Environmental Assessment
EAC	:	Environmental Advisory Committee
ECD	:	Environment & Conservation Division
EIA	:	Environmental Impact Assessment
EIA	:	Environmental Impact Assessment
EIS	:	Environmental Impact Statement
EMP	:	Environmental Management Plan
E/N	:	Exchange of Notes
ESAL	:	Equivalent Single Axle Loadings
FHWA	:	The Federal Highway Administration
FPL	:	Food Poverty Line
FTE	:	Fixed Term Estate
G/A	:	Grant Agreement
GDP	:	Gross Domestic Product
GOJ	:	Government of Japan
GRC	:	Grievance Redress Committee
GRM	:	Grievance Redress Mechanism
HH	:	Household
HIES	:	Household Income and Expenditure Survey
IA	:	Implementing Agency

List of Abbreviations and Acronyms

IC/R	:	Inception Report
IEE	:	Initial Environmental Examination
IMF	:	International Monetary Fund
IOL	:	Inventory of Lost assets
JHS	:	Japan Highway Standards
JICA	:	Japan International Cooperation Agency
JIS	:	Japan Industrial Standards
LAR	:	Land Acquisition and Resettlement
LARP	:	Land Acquisition and Resettlement Plan
LOS	:	Level of Service
LTA	:	The Land and Titles Act
MID	:	Ministry of Infrastructure Development
MBMC	:	Machine Based Maintenance Contracts
MECM	:	Ministry of Environment, Climate Change, Disaster Management
MFMR	:	Ministry of Fisher and Marin Resources
M/D	:	Minutes of Discussion
MLHS	:	Ministry of Lands, Housing and Survey
MLIT	:	Ministry of Land, Infrastructure, Transport and Tourism
MOA	:	Memorandum of Agreement
MOU	:	Memorandum of Understanding
NCHRP	:	National Cooperative Highway Research Program
NIC	:	National Identity Card
NOL	:	No Objection Letter
NTP	:	National Transport Plan
O/D	:	Outline Design
PAFs	:	Project Affected Families
PAPs	:	Project Affected Persons
PLHIV	:	People living with HIV
PS	:	Permanent Secretary
RAP	:	Resettlement Action Plan
REP	:	Regional Energy Program
PER	:	Public Environmental Report
ROW	:	Right of Way
SBD		Solomon Islands Dollar
SIG	:	Solomon Islands Government
SINU	:	Solomon Islands National University
SPM	:	Safeguards Procedures Manual

List of Abbreviations and Acronyms

SU	:	Safeguard Unit
S/V	:	Supervision
T/N	:	Technical Notes
TOL	:	Temporary Occupancy Licenses
UNAIDS	:	United Nations Programme on HIV/AIDS
UNDP	:	United Nations Development Programme
WB	:	World Bank
WBGT	:	Wet Bulb Globe Temperature
WHO	:	World Health Organization

CHAPTER 1. BACKGROUND OF THE PROJECT

1.1 Background

Roads in Honiara City, the capital of the Solomon Islands located in the Guadalcanal Island are experiencing severe obstruction of smooth traffic flow due to rapid increase of vehicles and compounded by deterioration of existing pavement. Despite continuous efforts by the Solomon Islands Government (SIG), the stretch from Honiara City to the international airport on the Kukum Highway particularly observes severe traffic congestion, which further worsens during the rainy season because the roads are inundated by rainwater due to insufficient drainage systems. Furthermore, provision of zebra crossings to facilitate pedestrians to cross the road is minimal, making the road vulnerable to traffic accidents.

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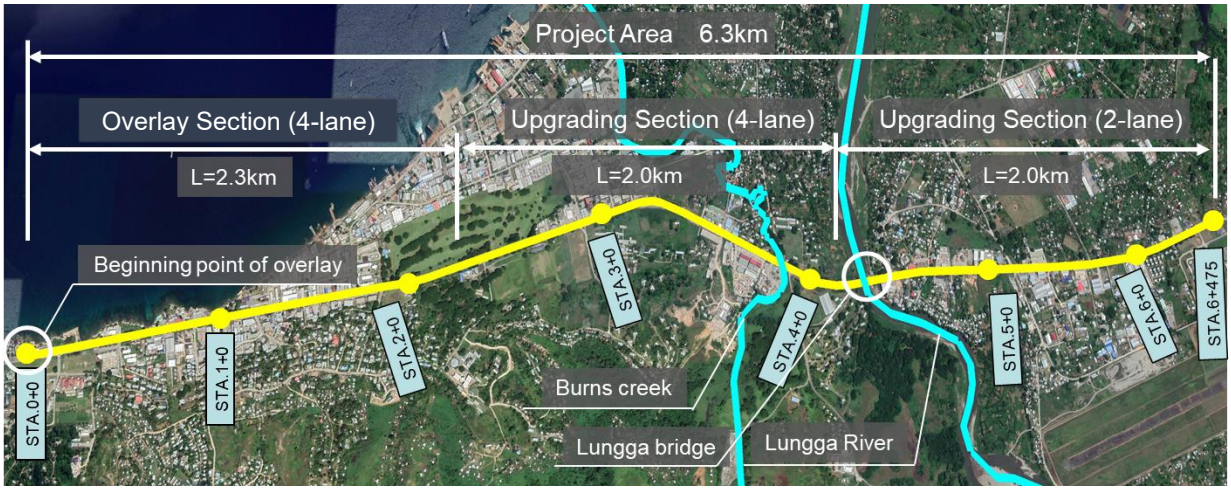


Figure 1.1 Project Area and Improvement Scopes

1.3 Natural Condition Surveys

To secure required quality of planning, design, construction planning and cost estimation of the Project, natural condition surveys (engineering surveys/tests) were carried out. Outlines of the surveys/tests are shown in Table 1.2.

Table 1.2 Natural Condition Survey

Category	Purpose	Item	Method
1. Installation of Observation Well and Groundwater Monitoring	Grasping of monthly groundwater level	● Installation of Observation Wells ● Groundwater level	Observation with well sounder
2. Meteorological Survey and Hydraulic/Hydrological Survey	Collection of hydrological data for drainage/ Hydraulic/Hydrological Analysis	● Temperature, rainfall amount, seasonal pattern of rainfall	By subcontractor
3. Topographical Survey	Collection of topographical information/data for planning, design and construction work of the target road	● Verification of topographic maps ● Additional plane survey ● Sectional survey ● Tentative benchmark installation ● River survey	By subcontractor
4. Aerial Photography by Drone	Grasping of Land Usage Status and Creation of a base map for environmental survey	● Aerial Photography	Aerial Photography by Drone
5. In-Situ CBR Testing of Subgrade Soil	Collection of geological information/data for planning, design and construction work of the target road	● Exploratory drilling and In-Situ CBR testing ● Test of materials for embankment, base course, asphalt pavement aggregate and concrete aggregate	By subcontractor
6. Subgrade Soil Survey			
7. Material Test			
8. Underground utility survey	Grasping of situation of buried objects for planning, design and construction work of the target road	● Buried objects	By subcontractor
9. Additional Subgrade Soil Survey	Information/data collection for design of box culverts	● Boring and Standard penetration test	By subcontractor
10. Measurement of Road Surface Temperature	Information/data collection for pavement design	● Road Surface Temperature	Measurement with laser thermometers

1.3.1 Installation of Observation Well and Groundwater Monitoring

Groundwater level was measured using observation wells installed in the project target area in order to understand the potential impact on road pavement. The details are described in Section 2.2.3.6.6 .

1.3.2 Meteorological Survey and Hydraulic/Hydrological Survey

Meteorological Survey and Hydraulic/Hydrological Survey were conducted in the project target area in order to study possible effects on implementation of the Project. The details are described in Section 1.4.1.1.3 .

1.3.3 Topographical Survey

(1) Outline/Purpose

Topographical Survey of the project target area was conducted in order to obtain necessary topographical data for road design and construction.

(2) Results

Topographical map, profiles and cross section drawings based on the results of the topographical Survey were used for the outline design. The survey results of the Lungga river and the Burns Creek were used for flood inundation simulation and determination of vertical alignment of the road.

1.3.4 Aerial Photography by Drone

Aerial Photography using a drone was conducted in order to grasp pattern of current land use and to create a base map for an environmental and social consideration survey. The photos are used in this report and related documents.

1.3.5 In-Situ CBR Testing of Subgrade Soil

In-Situ CBR Testing was conducted at 35 points in the project target area. The test results were used to understand basic characteristic of subgrade soil and as reference values before results of a laboratory CBR test are available.

1.3.6 Subgrade Soil Survey

(1) Outline/Purpose

Purposes of a subgrade soil survey are:

- to understand soil constants for design of pavement and structures.
- to confirm conditions of the target area and to consider potential issues of the construction.

1) Laboratory CBR test

a) **Survey Point**

The survey points are shown in Figure 1.2.

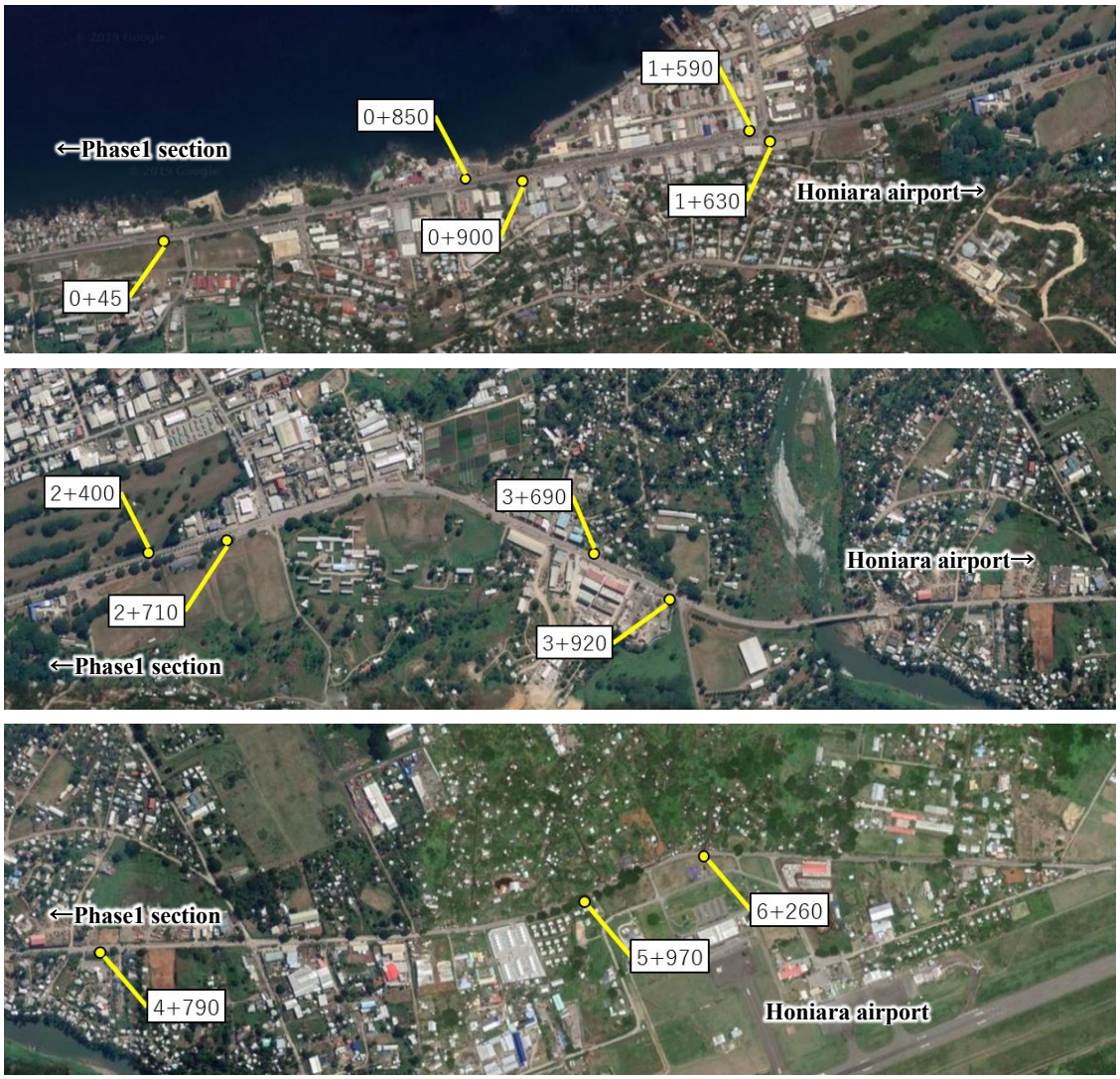


Figure 1.2 Survey Points

b) **Survey Results**

The test results are shown in Table 1.3

Table 1.3 Result of Laboratory CBR Test

SAMPLE ID	CHAINAGE (KM)	REFERENCE	SOIL CLASSIFICATION	FIELD MOISTURE CONTENT (%)	SPECIFIC GRAVITY	COMPACTION		CBR VALUE (%)		IN-SITU CBR (%)
						MDD (t/m^3)	OMC (%)	@5mm	@2.5mm	
CBR9 LAY. 1	6+260	ASHPHALT PAVEMENT		3.0		2.05	5.5			133
CBR9 LAY. 2			SANDY GRAVEL	2.2		2.15	7	91		33
CBR9 LAY. 3			GRAVELLY SILT	10.7		1.56	24	4		20
CBR10 LAY. 1	3+690	GRAVEL SHOULDER	SANDY SILT	3.8		2.13	8.7	95		348
CBR10 LAY. 2			SANDY GRAVEL	8.3		1.97	12.3	5		51
CBR11 LAY. 1	3+20	GRAVEL SHOULDER	SANDY GRAVEL	1.7		2.11	7.5	92		145
CBR11 LAY. 2			SANDY GRAVEL	3.5		1.96	10.7	31		51
CBR12 LAY. 1	2+400	ASHPHALT PAVEMENT	SANDY GRAVEL	2.4		2.11	9.1	56		147
CBR12 LAY. 2										37
CBR12 LAY. 3			SILTY SAND	4.0		1.75	17.3	33		22
CBR13 LAY. 1	1+590	CONCRETE SIDE WALK	GRAVELLY SAND	2.0		1.96	11.9	36		20
CBR13 LAY. 2			SILTY GRAVELLY SAND	8.6		1.80	15.0	32		16
CBR14 LAY. 1	0+850	ASHPHALT PAVEMENT	SANDY GRAVEL	1.6		2.06	7.4	56		112
CBR14 LAY. 2			GRAVELLY SAND	2.2		1.96	9.5	30		69
CBR14 LAY. 3			GRAVELLY SAND	3.0		1.82	14.2	59		36

SAMPLE ID	CHAINAGE (KM)	REFERENCE	SOIL CLASSIFICATION	FIELD MOISTURE CONTENT (%)	SPECIFIC GRAVITY	COMPACTION		CBR VALUE (%)		IN-SITU CBR (%)
						MDD (t/m^3)	OMC (%)	@5mm	@2.5mm	
CBR1 LAY. 1	0+45	ASHPHALT PAVEMENT	SANDY GRAVEL	8.6		2.03	11.2	117		118
CBR1 LAY. 2			SANDY GRAVEL	9.0		1.67	19.4	70		52
CBR2 LAY. 1	0+990	ASHPHALT PAVEMENT	SANDY GRAVEL	4.6		2.08	9.5	128		176
CBR2 LAY. 2			GRAVELLY SAND	7.4		1.96	12.6	2		29
CBR3 LAY. 1	1+630	GRAVEL SHOULDER	SANDY GRAVEL	3.2		2.11	8.4	45		65
CBR3 LAY. 2			SANDY GRAVEL	8.2		1.92	12.8	18		14
CBR3 LAY. 3				8.5		1.63	19.0		7	10
CBR4 LAY. 1	2+710	ON SOIL	SANDY GRAVEL	1.6		2.13	9.0	51		34
CBR4 LAY. 2			SANDY GRAVEL	3.4		2.09	9.8	46		42
CBR5 LAY. 1	3+150	ON SOIL	SANDY GRAVEL	5.3		1.82	13.4	12		9
CBR5 LAY. 2			SANDY GRAVEL	6.6		1.94	11.2	18		19
CBR5 LAY. 3			GRAVELLY SAND	9.2		1.76	17.0	4		9
CBR6 LAY. 1	3+920	GRAVEL SHOULDER	SANDY GRAVEL	8.0		2.18	9.0	23		275
CBR6 LAY. 2			SANDY GRAVEL	6.9		1.98	11.1	18		49
CBR7 LAY. 1	4+790	ON SOIL								13
CBR7 LAY. 2			SANDY GRAVEL	18.2		1.64	19.0		31	24
CBR8 LAY. 1	5+970	SIDEWALK SOIL	SANDY GRAVEL	1.9		2.11	9.1	62		34
CBR8 LAY. 2			GRAVELLY SILT	7.0		1.69	18.2		4	12

1.3.7 Material Test

Tests of materials which will be used for the construction of the Project (for embankment, base course, asphalt pavement aggregate and concrete aggregate) were conducted and the results were reflected in the design of the project road.

1.3.8 Underground Utility Survey

Underground utility survey was conducted in order to consider relocation of buried objects in the project target area and the results were used in the project road design.

1.3.9 Additional Subgrade Soil Survey

Additional Subgrade Soil Survey was conducted in order to design the box culvert installed at a place where the Burns Creek intersects the road. The details were described in Section 2.2.3.7.2 .

1.3.10 Measurement of Road Surface Temperature

Measurement of Road Surface Temperature was conducted in order to collect necessary information for the pavement design. The results are shown in Table 2.18.

1.3.11 Other Surveys

(1) Outlines

Outlines of the surveys conducted in addition to natural condition surveys are shown in Table 1.4.

Table 1.4 Outlines of Other Surveys

Category	Purpose	Item	Method
1. Road/Drainage Inventory Survey	Collection of basic data and drainage information for planning, design and construction of the target road.	● Basic road information (Width, obstacles etc.) ● Drainage direction ● Shape of drainage facilities ● Flow end	Collection and sorting of existing data, Analysis based on hearing and visual contact
2. Axle Load Survey	Collection of necessary information for pavement design	● Axle Load	By Portable axle load scale
3. Bridge Inspection	Visual Inspection for examination of structural integrity of bridges	● Damage/Degradation level	By Camera for visual inspection (Giraffe)
4. Simple Traffic Volume Survey	Survey for estimation of future traffic volume	● Traffic Volume (12 hours)	By Manual Count
5. Pedestrian Count Survey	Survey for preparation of traffic safety measures	● Number of crossing pedestrians during morning/evening peak time.	

(2) Survey Results

1) Road/Drainage Inventory Survey

Road/Drainage inventory survey was conducted in and around the project road area and the results were used in the project road design. Purposes of this survey are:

- to understand current situation of area which will be affected from implementation of the Project.
- to collect necessary information for planning/design of drainage facilities in O/D stage.
- to verify the topological survey results.

2) Axle Load Survey

The details are described in Section 0.

3) Bridge Inspection

The details are described in Section 2.2.3.10 .

4) Brief Traffic Volume Survey

The details are described in Section 2.2.3.3.5 .

5) Pedestrian Count Survey

The details are described in Section 2.2.3.8.2 .

1.4 Environmental and Social Considerations

1.4.1 Study on Environmental and Social Considerations

In general, environmental and social considerations is conducted to evaluate the impacts from a development project to natural environment and social conditions in and around the project area. Potential impacts to various parameters, such as fauna, flora, ambient air, ambient water and noise/vibration, resettlement, are studied through screening and scoping, and monitoring and application of mitigation measures accordingly before, during and after implementation of the Project are suggested.

1.4.1.1 Study on Initial Environment Examination (IEE)

1.4.1.1.1 Project Components and Category of Environmental and Social Considerations

The outline of the project components is as given below. As the project component is improvement of the existing road, the Project is estimated to see neither a large-number of resettlement nor major impacts to natural environment. Therefore, the environmental category of the Project is classified as [B] by JICA.

Summary of the Project Component
➢ Road improvement of 6.3 km from the Ministry of Fisheries to Honiara airport ・ 4-lane road overlay of 2.3 km from the Ministry of Fisheries ・ 4-lane road improvement of 2.0 km from the 2.3 km point to the Lungga Bridge ・ 2-lane road improvement of 2.0 km from the Lungga Bridge to Honiara Airport ➢ Ancillaries (road furniture) ・ Drainage, Bus station, Street Lights, Traffic signboards and Pavement markings ➢ Proposal ・ Assessment of the Lungga Bridge and the repair plan

1.4.1.1.2 Project Component that Impact the Environment

The project components that may likely impact the environment adversely are as follows:

1) Construction work for road improvement and ancillaries
2) Extraction of natural resources such as gravel and soil
3) Disposal of existing road materials
4) Treatment of surface drainage during and after construction
5) Land acquisition

1.4.1.1.3 Baseline of Environmental and Social Considerations

(1) Natural Environment

1) Topography

Guadalcanal Island including Honiara City is located at 9° 30’ south latitude and 160° east longitude. It is one of the six major islands of the Solomon Islands and also one of the volcanic islands forming the central group of islands. Located on the north side of San Cristobal Trench, it is on a plate that sinks in the northeast and has been active since the late Miocene about 8 million years ago.

Guadalcanal Island is about 148 km long and 50 km wide, facing northwest and southeast. The physical environment of Guadalcanal Island consists of two of the country's highest peaks (Mt. Popomanase, elevation 2,330 m and Mt. Makarakonburu, elevation 2,447 m), rugged mountains, and a productive area on the northeast coast known as the Guadalcanal Plain.

2) Geology

Geology of the project area consists of Honiara Reef limestones and Alluvial. In general, it is said that an alluvial stratum is not consolidated yet and can be soft or weak because it is considered a stratum in a new era, less than 20 thousand years. There is a possibility that the target area including coral limestone is not solid ground. Therefore, sufficient considerations must be given to the construction even in the case of rehabilitation of the existing roads.

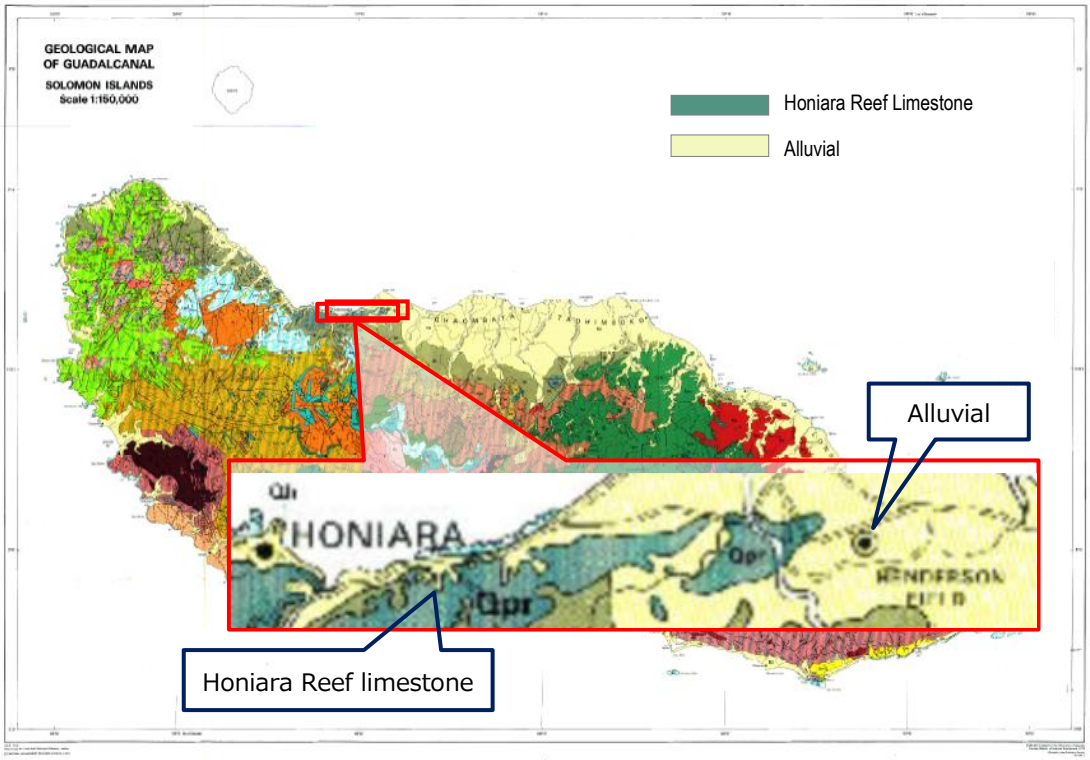


Figure 1.3 Geology Map on Guadalcanal Island

3) Weather condition

Weather condition data was obtained from the Meteorological Service Division under the Ministry of Environment Climate Change Disaster Management and Meteorology. There are two meteorological station around the Project area, the Honiara City station, and the Honiara International Airport station. The data obtained are shown in Table 1.5.

Table 1.5 Obtained Metrological Data

Parameter	Monitoring frequency	Obtained observation period
Temperature (°C)	every 3 hours	Honiara: February 2016 to December 2019 Honiara Airport: January 2016 to December 2019
Humidity (%)	Daily at 14:00 pm	Honiara: January 2016 to December 2019 Honiara Airport: January 2016 to December 2019
Rainfall (mm)	Daily (mm/day)	Honiara: January 1954 to September 2019 No data: January 1975 to July 1979 Honiara Airport: January 1954 to September 2019
Wind direction and speed	every 3 hours	Honiara: January 1970 to January 2019 Honiara Airport: September 2010 to July 2016 Both monitoring data are missing on long period

a) Air Temperature

Honiara City station and the Honiara International Airport station observe and record air temperatures every 3 hours at 2:00, 5:00, 8:00, 11:00, 14:00, 17:00, 20:00 and 23:00. Data collected between 2016 and 2019 from both the stations show similar trends in that there is no significant difference. Figure 1.4 and Figure 1.5 respectively show the results of temporal changes of air

temperature in the Honiara and Honiara Airport station from 2016 to 2019. As can be understood from Figure 1.4 and Figure 1.5, the average and maximum temperatures during daytime exceeds 30°C. Figure 1.6 and Figure 1.7 respectively show the results of seasonal changes of air temperature in the Honiara and Honiara Airport station from 2016 to 2019. As the results, the air temperature is constant throughout the year as shown in Figure 1.6 and Figure 1.7.

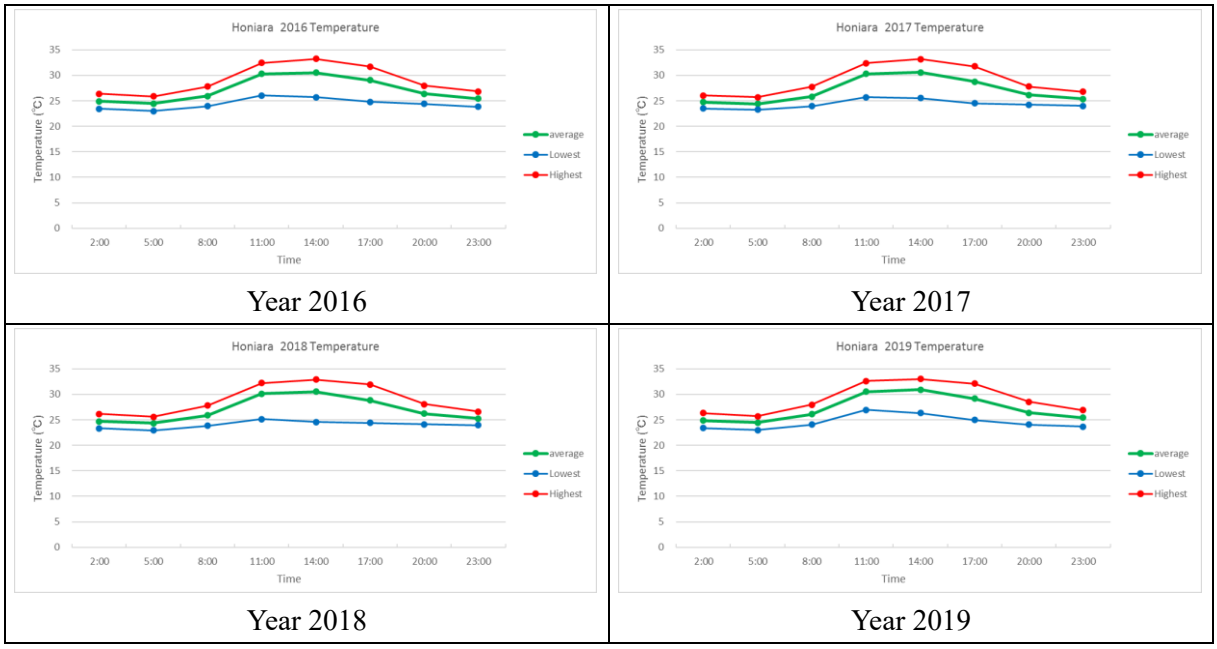


Figure 1.4 Temporal Change of Air Temperature at Honiara Station

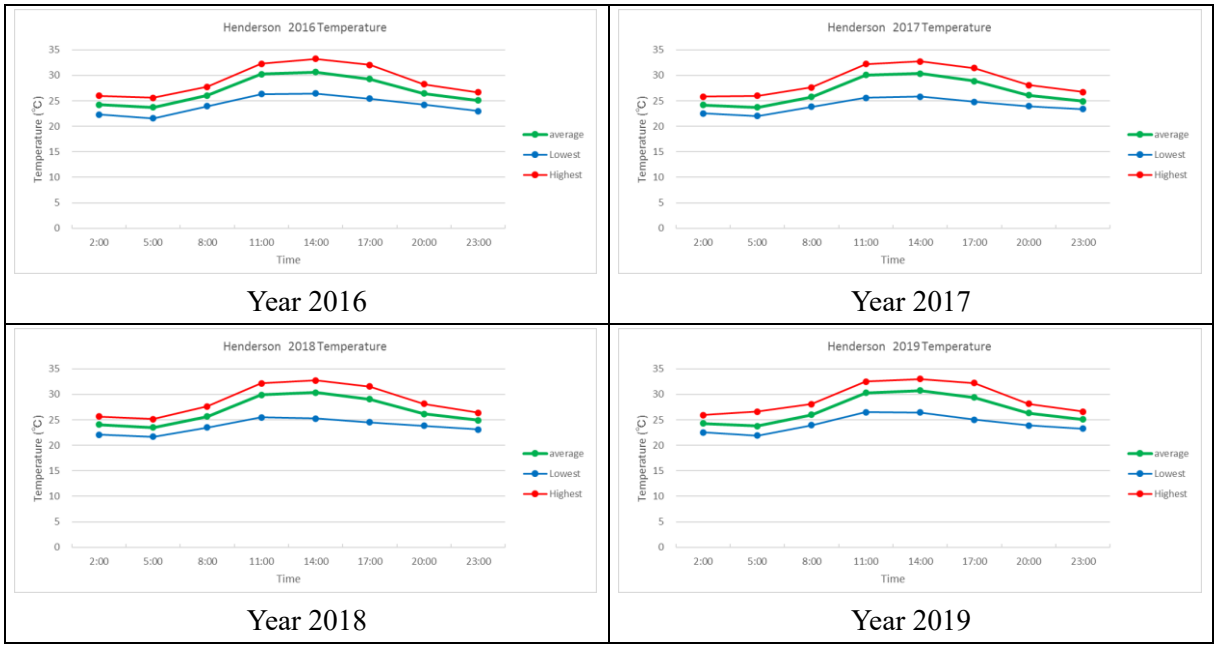


Figure 1.5 Temporal Change of Air Temperature at Honiara Airport Station

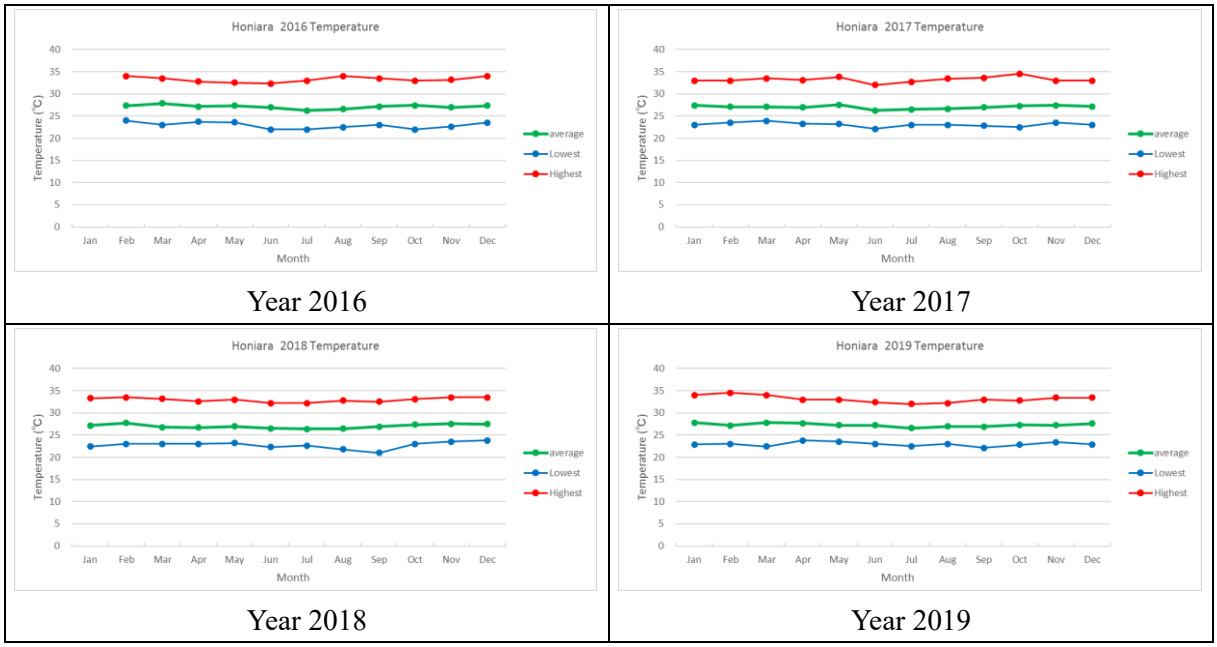


Figure 1.6 Seasonal Change of Air Temperature at Honiara Station

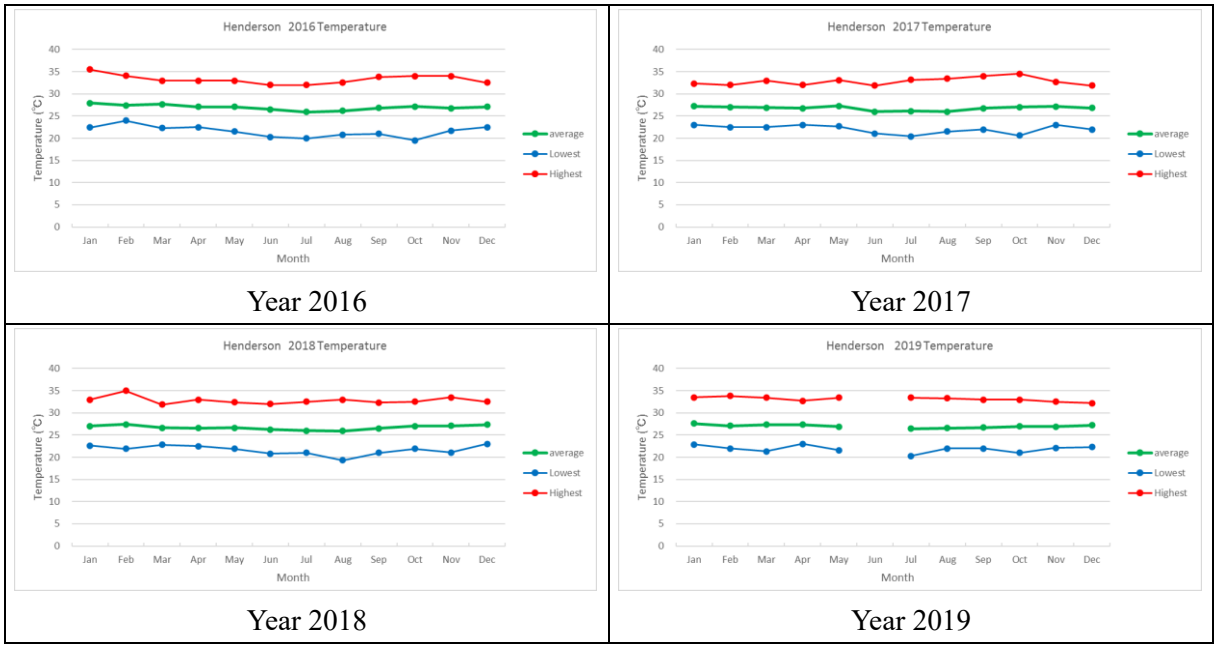


Figure 1.7 Seasonal Change of Air Temperature at Honiara Airport Station

b) **Relative humidity**

Relative humidity of Honiara and Honiara Air Station form year 2016 to 2019, humidity is measured and recorded daily at 14:00. Obtained data are illustrated in Figure 1.8 and Figure 1.9. Both stations have a mean relative humidity of about 70% and is constant throughout the year.

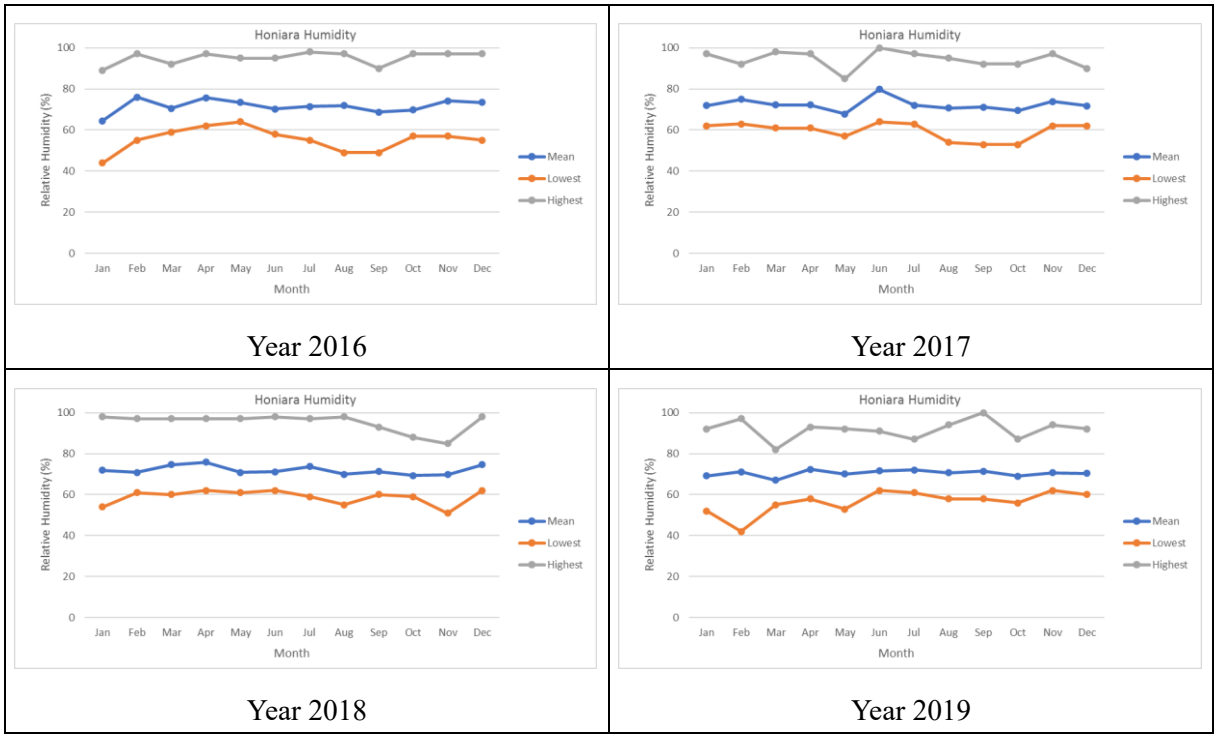


Figure 1.8 Relative Humidity of Honiara

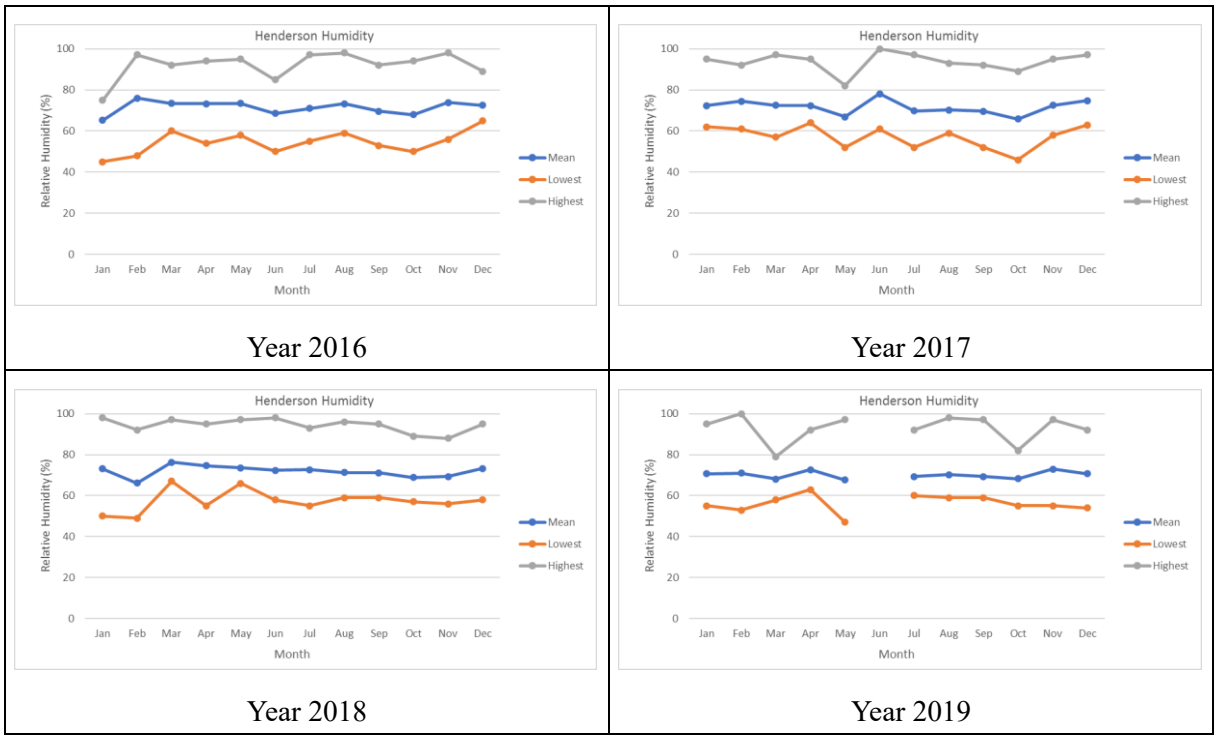


Figure 1.9 Relative Humidity of Honiara Airport

The discomfort index (DI) is a function of temperature and humidity. Table 1.6 shows the relation between the DI and its evaluation (how it is felt) with respect to the values. DI is commonly calculated using the formula given in the table. Honiara City is hot and sweaty with its DI value as 81.4. The DI value is calculated from the daytime average temperature (30°C) and humidity (70%).

Table 1.6 Discomfort Index and Feeling

Discomfort Index	Evaluation
～55	Cold
55～60	Chilly
60～65	Neutral
65～70	Comfortable
70～75	Not hot
75～80	Slightly hot
80～85	Hot and sweaty
85～	Irresistibly hot
Discomfort index = 0.81 × T+0.01 × H × (0.99 × T－14.3)+46.3 Where; T=daytime average temperature, H= humidity	

c) **Rainfall**

Monthly rainfall from 1955 to 2019 in Honiara station is shown in Table 1.7. The highest recorded annual rainfall is 2,916 mm (in 1967) and average yearly rainfall is 2,072 mm based on the monitoring data in Honiara from 1955 to 2018. Monthly rainfall data for the past three years (2017-2019) is presented in Figure 1.10.

Monthly rainfall from 1975 to 2019 in Honiara Airport station is shown in Table 1.7. The highest recorded annual rainfall is 2,845 mm (in 1976) and average yearly rainfall is 1,946 mm based on the monitoring data in Honiara from 1975 to 2018. Monthly rainfall data for the past three years (2017-2019) is presented in Figure 1.10. October to April receives most of the rainfall. Although there is occasional rainfall from May to October the period is relatively dry.

Table 1.7 Monthly Rainfall in Honiara

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1955	126	131	608	116	175	78	42	7	76	69	136	579	2142
1956	403	490	341	150	51	73	15	27	12	72	119	91	1845
1957	142	369	313	113	187	62	54	87	80	172	97	159	1834
1958	186	88	195	641	123	339	23	46	67	186	53	204	2150
1959	371	241	306	290	130	59	95	194	211	98	159	395	2550
1960	193	308	603	329	74	102	153	61	133	137	94	130	2317
1961	163	174	316	174	107	63	213	123	143	148	245	121	1991
1962	202	311	117	344	473	109	61	69	64	165	98	287	2300
1963	183	206	406	187	41	37	95	142	190	275	115	165	2041
1964	239	81	298	157	186	42	65	47	38	192	133	109	1586
1965	375	396	374	114	150	109	306	121	68	117	88	169	2387
1966	32	200	248	141	57	48	16	48	26	53	392	286	1547
1967	565	304	636	181	215	88	113	139	67	377	168	64	2916
1968	424	319	198	193	24	65	176	97	141	133	138	138	2045
1969	289	362	215	181	135	153	96	95	80	96	108	276	2087
1970	169	561	270	333	132	120	53	81	211	197	120	285	2530
1971	236	110	456	328	96	110	89	82	85	158	130	447	2327
1972	956	298	360	205	158	268	103	118	104	76	39	179	2863
1973	82	219	364	108	84	70	90	128	31	246	130	245	1797
1974	232	474	222	139	73	89	53	117	72	-	-	-	1473
1975	-	-	-	-	-	-	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	-	-	-	-	-	-	-
1977	-	-	-	-	-	-	-	-	-	-	-	-	-

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1978	-	-	-	-	-	-	-	-	-	-	-	-	-
1979	-	-	-	-	-	-	-	36	76	36	201	200	1968
1980	182	503	407	24	59	40	62	96	188	73	189	84	1908
1981	361	266	66	93	24	10	96	89	64	84	27	132	1312
1982	351	179	353	352	150	41	118	271	124	89	63	156	2247
1983	153	323	211	99	128	36	91	73	178	96	84	201	1673
1984	90	211	380	223	125	31	38	45	60	172	330	291	1996
1985	304	171	557	144	113	53	154	270	78	143	340	182	2509
1986	273	182	263	251	366	40	84	116	141	9	208	37	1969
1987	94	231	114	84	60	0	66	30	63	98	166	299	1305
1988	318	409	123	78	33	104	95	139	130	198	453	549	2631
1989	244	483	152	247	207	146	34	36	72	65	71	171	1929
1990	231	71	333	160	168	53	112	48	123	42	74	274	1688
1991	274	275	235	151	189	140	144	154	139	75	35	16	1828
1992	91	423	109	117	61	46	68	35	24	131	100	155	1361
1993	62	233	131	188	60	112	98	96	33	41	43	168	1264
1994	258	364	344	140	174	201	73	97	19	55	18	98	1841
1995	76	98	344	152	151	40	41	71	129	260	15	175	1552
1996	149	162	369	154	91	93	109	134	71	218	124	517	2190
1997	188	306	583	74	35	61	5	112	151	98	36	45	1692
1998	264	240	396	56	130	46	22	273	115	25	182	351	2098
1999	350	601	179	119	221	78	43	114	99	189	226	364	2584
2000	212	181	304	245	429	94	44	68	25	51	-	28	1679
2001	-	417	244	203	148	123	-	35	48	192	118	198	1727
2002	196	306	236	105	120	45	232	33	181	237	226	163	2078
2003	201	95	284	102	73	178	167	-	-	-	-	-	1100
2004	49	303	275	217	72	169	56	31	35	269	140	123	1738
2005	334	250	72	300	86	21	47	64	77	106	203	94	1653
2006	271	287	293	107	60	88	139	89	20	234	167	106	1862
2007	46	187	219	219	136	181	114	107	79	70	310	294	1961
2008	569	318	269	548	203	77	202	50	114	40	124	222	2736
2009	509	497	439	183	165	20	148	97	146	175	52	72	2504
2010	254	172	558	120	112	49	99	90	94	43	291	325	2208
2011	303	299	145	188	123	89	77	152	62	211	90	410	2148
2012	307	425	315	232	125	243	166	55	77	98	29	467	2537
2013	219	222	594	214	87	91	108	96	96	190	34	99	2052
2014	646	254	302	952	91	44	31	63	20	84	21	135	2643
2015	353	220	216	160	323	127	219	12	62	29	111	253	2083
2016	59	382	180	265	96	30	103	68	59	65	391	210	1908
2017	289	465	240	407	96	185	50	43	181	67	205	363	2591
2018	489	125	629	184	104	81	74	85	168	55	62	397	2451
2019	301	285	125	171	92	61	121	133	158				1448
												Max	2916
												Ave	2072
												Min	1264

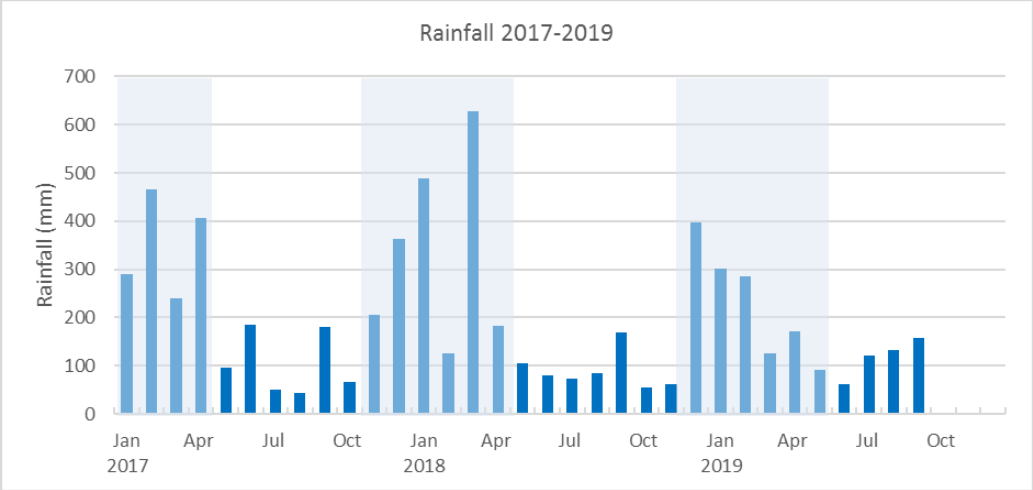


Figure 1.10 Monthly Rainfall in Honiara City

Table 1.8 Monthly Rainfall in Honiara Airport

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1975	257	117	345	94	190	41	105	96	52	129	264	245	1937
1976	832	470	426	275	55	95	132	102	91	137	134	95	2845
1977	300	230	331	98	120	139	167	113	254	61	268	52	2132
1978	125	179	68	153	119	25	100	77	114	54	133	125	1272
1979	352	615	54	126	47	142	82	25	43	52	186	171	1896
1980	170	442	405	31	74	87	64	84	114	29	105	90	1695
1981	294	222	68	108	36	16	103	176	75	107	52	189	1446
1982	361	209	334	317	201	79	123	314	146	123	20	118	2346
1983	121	284	159	138	148	51	108	70	163	74	107	251	1675
1984	212	169	280	272	174	49	60	31	69	165	267	279	2028
1985	260	184	462	99	99	52	120	124	44	123	333	330	2231
1986	205	274	342	200	455	22	74	105	138	7	224	79	2124
1987	23	293	137	53	92	1	69	22	50	52	138	264	1195
1988	238	337	166	184	27	37	106	137	101	209	384	712	2639
1989	357	422	206	318	159	72	22	24	63	39	44	102	1828
1990	281	101	181	112	171	35	93	40	117	19	59	333	1542
1991	200	239	201	149	170	126	114	139	162	129	80	43	1752
1992	86	431	101	75	30	26	60	42	42	59	112	109	1174
1993	37	221	125	133	47	98	89	76	41	42	60	225	1195
1994	259	346	244	177	139	238	92	70	24	43	12	28	1671
1995	106	74	312	111	167	26	64	89	73	217	17	71	1327
1996	161	199	321	175	102	91	46	173	69	169	146	517	2169
1997	185	242	564	186	14	27	13	83	148	39	55	37	1591
1998	255	220	333	86	165	46	21	97	195	26	249	410	2101
1999	321	609	133	75	228	60	77	236	248	114	180	206	2487
2000	191	187	331	294		107	53	87	53	83	265	373	2023
2001	104	421	186	159	140	118	87	23	66	231	97	226	1857
2002	109	254	198	101	86	61	223	74	136	245	190	57	1734
2003	191	29	253	93	30	174	114	66	20	63	204	76	1313
2004	95	281	235	197	50	118	92	33	34	220	198	248	1802
2005	210	147	53	222	72	48	70	69	86	117	137	171	1400
2006	354	377	327	92	109	109	125	105	10	233	144	116	2100
2007	71	135	224	100	82	194	70	138	88	46	225	178	1550
2008	540	367	291	458	158	77	188	52	102	93	168	114	2607
2009	406	600	436	179	111	37	153	89	149	157	52	109	2480

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2010	169	179	410	77	110	32	135	72	125	97	426	290	2121
2011	231	316	131	168	135	64	73	189	30	251	182	272	2041
2012	265	398	321	173	54	75	190	108	49	160	27	575	2395
2013	150	202	641	230	72	68	105	74	35	234	22	126	1960
2014	663	210	287	553	105	46	45	99	45	103	41	164	2358
2015	268	217	190	235	324	132	252	28	85	31	274	433	2470
2016	125	693	499	317	80	31	104	93	35	31	328	138	2474
2017	282	403	166	382	30	161	61	40	118	57	168	445	2313
2018	504	190	518	178	93	72	112	139	122	37	70	361	2395
2019	379	287	156	193	27	69	155	158	171	-	-	-	1595
												Max	2845
												Ave	1946
												Min	1174

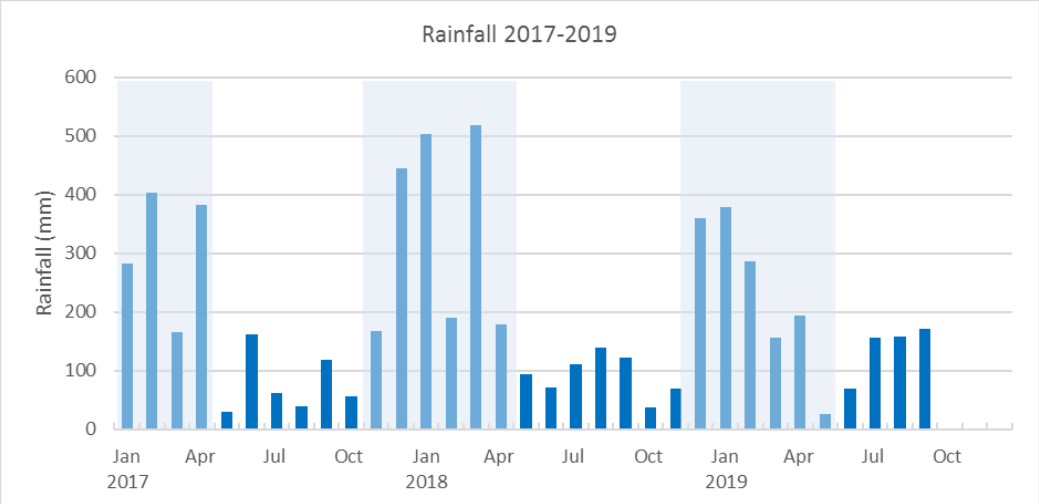


Figure 1.11 Monthly Rainfall in Honiara Airport

d) Wind direction and wind speed

Data on wind direction and speed for around one week in January 2017 and June 2018 were obtained from Honiara station. Significant seasonable change was not found in the data. Northerly winds (from sea side) blow in daytime and southerly winds (from mountain side) blow in nighttime.

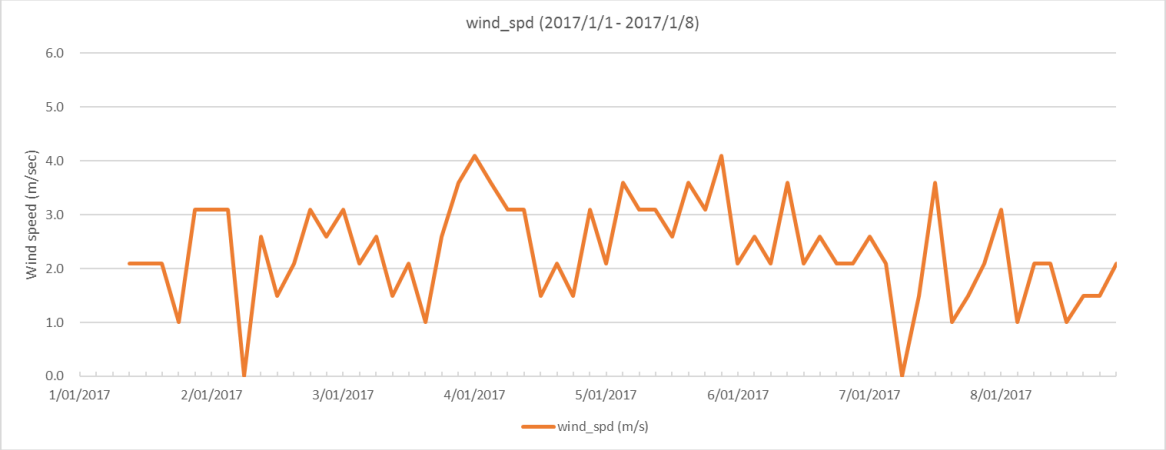


Figure 1.12 Monitoring Data on Wind Speed in Honiara (January 1-8, 2017)

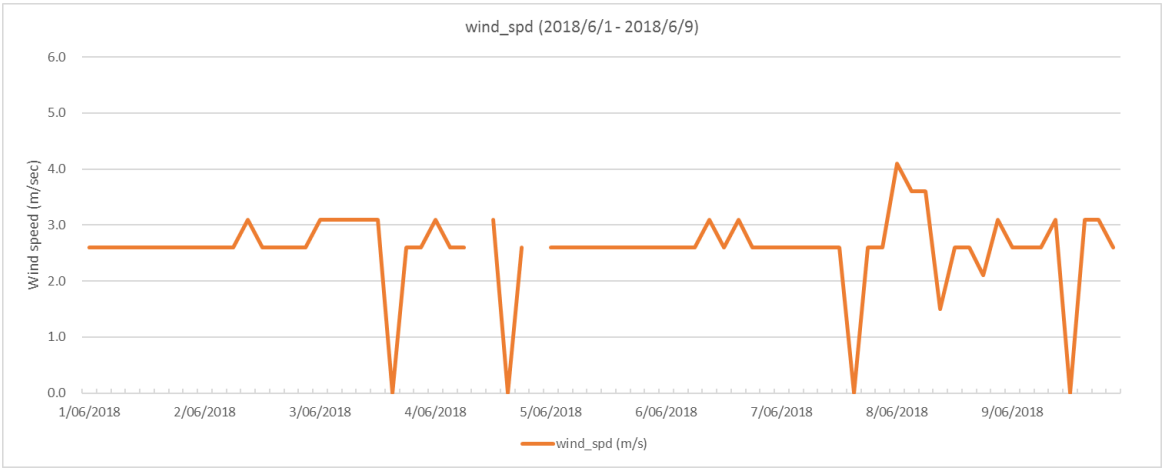


Figure 1.13 Monitoring Data on Wind Speed in Honiara(June 1–9, 2018)

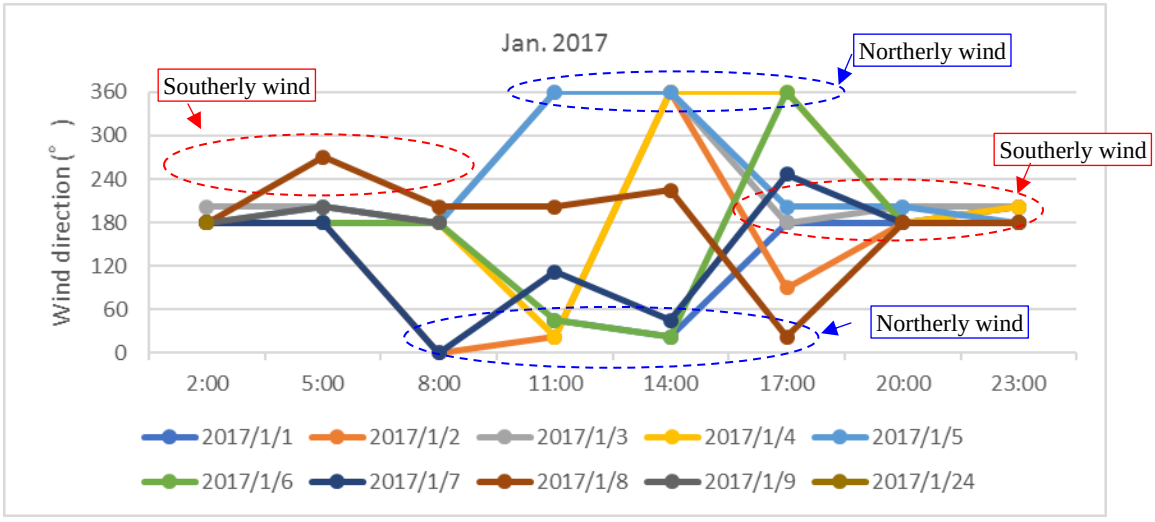


Figure 1.14 Monitoring Data on Wind Direction at Honiara in January 2017

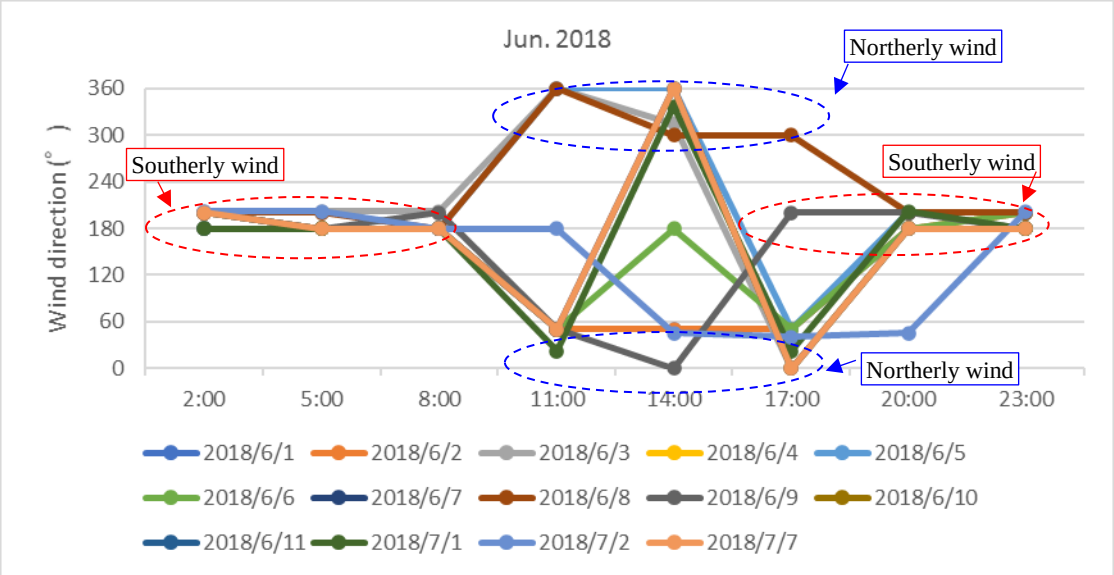


Figure 1.15 Monitoring Data on Wind Direction at Honiara in June 2018

Honiara Airport shows the most recent data available for July 2016 (see Figure 1.16 and Figure 1.17). The average wind speed is 2.79m/sec and significant seasonable change was not found in the data in July 2016.

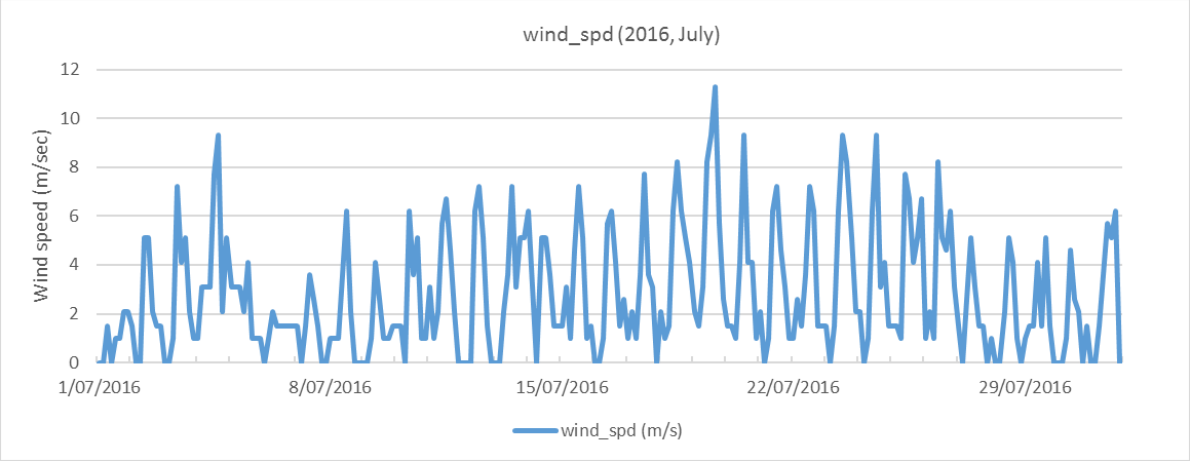


Figure 1.16 Wind speed at Honiara Airport on July 2016

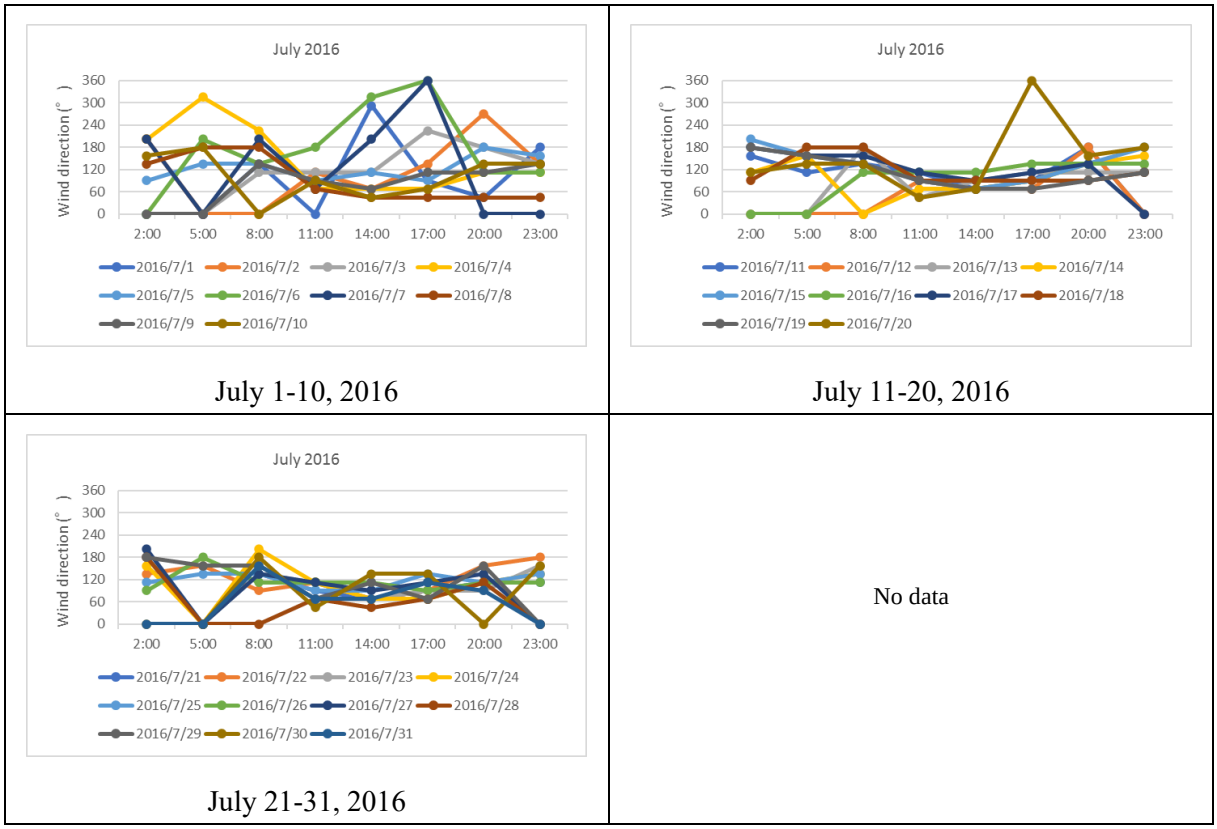


Figure 1.17 Monitoring Data on Wind Direction at Honiara Airport in July 2016

e) **Cyclones**

The Solomon Islands is hit by cyclones on average 1-2 times a year. Recently, Tropical Cyclone Harold caused great damage to Guadalcanal Island including Honiara City and other states in April 2020.

4) Ambient air

As statistical data on ambient air of the target area was not found, the JICA Survey Team (Team) planning observation of the ambient air. The monitoring plan is shown in Table 1.9. A Noise/vibration was also planned at the same points.

Table 1.9 Monitoring Plan on Ambient Air

Parameter	Method	Frequency	Monitoring point
SO2, NO2, CO	Passive detector (Gastech)	1 time in daytime (1-6 hour) 1 time in nighttime (1-6 hour)	Total 7 points. ・4 points in the 4-lane section ・2 points in the 2-lane section ・1 place in a temporary office area beside the airport
PM2.5, PM10	Potable sensor	1time/hr－24hr	
Wind direction and speed	Potable sensor	1time/hr－24hr	
Temperature and humidity	Potable sensor	1time/hr－24hr	

Figure 1.18 Monitoring Point on Ambient Air/noise

5) Water Quality in River, Channel

a) **River and Chanel**

Lungga River, the largest river in Guadalcanal, the Burns Creek, and other several water channels are located in the project area. These water channels basically transport domestic sewage. But when it rains, not only road drainage but also runoff from the inland side merges into these channels, often causing overflow and inundation of the surrounding areas.

b) **Water Quality**

Discharge from road surface is planned to be connected to existing channels and creeks. The Team measured water quality of three rivers/channels where organisms live. The parameters measured are shown in Figure 1.19.

Table 1.10 Outline of Water Quality Monitoring

Parameter	Method	Frequency	Measurement point
Temperature (°C)	Portable sensor	1 time	Total 3 points ・Water channel near the Ministry of fishery ・Burns creak ・Lungga river
pH (－)	Portable sensor	1 time	
DO (mg/L)	Portable sensor	1 time	
Turbidity (NTU)	Portable sensor	1 time	
COD (mg/L)	Test Kit	1 time	

Figure 1.19 Monitoring Points on Water Quality

		
Water Channel	Burns creak	Lungga river

Figure 1.20 Pictures on Monitoring Points of Water Quality

6) Noise and Vibration

As statistical data on noise and vibration of the target area were unavailable, the Team obtained these data by measuring the noise and vibration at the points. The monitoring Outline are shown in Table 1.11.

Table 1.11 Outline of Noise and Vibration Measure Monitoring

Parameter	Method	Frequency	Monitoring place
Noise	Noise meter	10min/hr-24hr (at mountain side) 10min/hr-24hr (at Sea side)	Total 7 place. ・4 places in the 4-lane section ・2 places in the 2-lane section ・1 place in a temporary office area beside the airport
Vibration	Vibration level monitor	10min/hr-24hr	

7) Protected Area

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

8) Ecosystems and Endangered Species

a) Terrestrial Habitats

Most of the major islands in the Solomon Islands are of volcanic origin and are covered with dense tropical rainforest, rivers and streams. The terrestrial ecosystems include tropical moist forests, montane forest and secondary vegetation, grassland and savanna, swamps, lowland rain forest, and cropland. Forests make up 86% of the country's vegetation communities with low altitude forest accounting for the vast proportion of this. Croplands and bushes account for 10% of the vegetation communities. In Guadalcanal, there are two types of forests which are not found in other provinces and this includes the lowland rain forests and seasonally dry forests, in addition to grasslands. The grasslands on north and northwest area of Guadalcanal are presumed to be the result of repeated burning preventing the re-establishment of secondary forest.

The project area is coastal and it traverses areas of what would have once been lowland coastal forest along the Kukum Highway, small pockets of freshwater swamps at the Burns Creek and even smaller pockets of riverine vegetations near the mouth of rivers.

Honiara is developed for township and the only specific terrestrial habitat protected by the Government is the Botanical Garden which is situated at Rove, 4.5km west from Honiara City and outside of the project area of influence.

b) **Coastal Habitat**

The area is highly built-up, highly disturbed and sections of the northern coast, in addition to residential areas, have been developed for industrial, LC Berths, reclamations and thus the quality of coastal habitat is degraded and very low.

The project is considered to influence the coral reefs that are distributed intermittently along the coast. The dominant coastal ecosystems are narrow dead fringing coral reefs consisting of rocks, rubbles, sand and silt benthic environment and massive dead corals. The coral reef around the Project site is not in a good habitat environment, since there is an urban area behind it, and it is affected by turbidity of water flowing from rivers and domestic wastewater.

Back-reef can be observed in the inland area but without sea weeds as the area has already been developed. Most of the coastal water is polluted by human induced activities and development resulting in very few marine life forms inhabiting the water.

Coastal Area near MFMR

Sandy Rock in Coast

c) **Terrestrial Flora**

The geographical location of the Solomon Islands, its tropical climate and mountainous topography provide the islands with rich and diverse flora, habouring over 7,000 species of Vascular plants. While diversity is high, endemism is low, with no endemic families and only three endemic genera. Endemism of species is not accurately known but is thought to range from 10% of fern species to 80% of pandanus species. The islands with the highest rate of endemism are Santa Cruz (Temotu) and Guadalcanal. The main groups of flora include 20 species of pandanus, 33 species of palms, 277 species of orchids, seven species of ngali nuts, 19 species of other nuts (cut nut and alite nut), 11 species of shrubs, 14 species of Eleocarpacae trees and 340 species of ferns. With the current unsustainable logging of forest in the country, the coverage of primary forest has declined rapidly, and such has threatened the biodiversity. Forest accounted for approximately 90% of the Solomon Islands land area in 2016, with 55% of this area undisturbed. Annual tree cover loss in the Solomon Islands has increased dramatically between 2001 and 2017, particularly 2013–2017.

The vegetation along the project area is largely degraded and remains scattered in the gardens and reclaimed bushes. Vegetation along the project road are composed of flowering plants, shrubs, Christmas trees and palm trees. Fruit trees such as mango trees including coconut trees and bananas are also found along the highway. There are also shade trees such as rain trees immediately on the roadside. At the Panatina area, there are strands of banana trees owned by people at the Panatina culvert landward side.

d) **Seagrass/Marine Flora**

In the Solomon Islands marine flora is dominated by sea-grass meadows which usually occur in shallow near-shore areas particularly in lagoons and in the vicinity of river mouths. Other marine flora (marine macroalgae) also share the same ecosystem and are usually located further offshore within the back-reef area and are dominated by coralline encrusting algae, Halimeda discoidea and Halimeda sp., Padina, and blue-green algal turf. The seagrass and other marine flora are threatened by existing developments/activities occurring on both land and sea.

e) **Terrestrial Fauna**

The Solomon Islands is possibly the only country in the South Pacific Region with more land animals and a high level of endemism (UNDP et al., 2002). This level of endemism comprises of 223 species of birds (173 residential terrestrial species and 50 other species of shore/sea birds and visitors), 52 mammals, 61 species of reptiles (25 are endemic), and 17 species of frogs. In terms of distribution, there is a relatively high level of island endemism. 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.

The forests of Guadalcanal are known to support very high levels of bird and vertebrate endemism. Terrestrial fauna includes a large number of birds (about 50 species) including the yellow-legged pigeon (Columba pallidiceps), thick-billed ground dove (Gallicolumba salamonis), white-headed fruit dove (Ptilinopus eugeniae), crested cuckoo dove (Reinwardtoena crassirostris), chestnut-bellied imperial pigeon (Ducula brenchleyi), as well as the abundant forest kingfishers. Reptiles include the large Discodeles frog which is common in the grasslands and lowlands.

As the northern coast of Guadalcanal Island is being developed for Honiara Township, the development also acts as a pathway for introducing the domesticated plant and animal species which later invaded the area. Biologically, these introduced plant and animal species can have a great impact on naturally occurring species and can become destructive following environmental changes. The invasive species are not indigenous but can rapidly colonize an ecosystem and out competed the original species. Most of the invasive species are serious threat to significant aquatic and terrestrial ecosystem in the Solomon Islands.

f) **Marine Fauna**

The Solomon Islands as part of the Coral Triangle in the Pacific Region is considered as one of the focus of Marine Biodiversity. The marine and coastal ecosystems include beaches, mangroves, sea

grass beds, algal turfs, coral reef areas, estuaries and lagoons. Coral reefs are narrow, fringing and occasionally distributed around the high islands. The coral reefs are most often associated with either uplifted shores attached to volcanic coastlines or seaward elevated coral limestone beaches.

As recorded in a Rapid Marine Assessment carried out by The Nature Conservancy in 2004, the Solomon Islands reported one of the highest diversities of fish, with at least 82 families, 348 genera, and 1019 species (Green et al, 2004). Also 485 species belonging to 76 genera of corals with some new species recorded. A different study reported a total of 233 species of algae comprising of Cyanophytes, Rhodophytes, Phaeophytes and Chlorophytes (MECM, 2008).

Other studies into seaweeds found that the most common and economically significant seaweed is Caulerpa racemosa, also known as sea grapes, and very popular especially in the western province for consumption. Seaweed farming was reinforced in 2001 and is gaining momentum until production rose in 2002 (MECM 2008). Also19 species of sea cucumber and the main species of crayfish or lobster in the area, the double-spinned ornate lobster (Panulirus pencillatus), P. femoristiga, painted coral lobster (P. veriscolor) and the spiny lobster (P. ornatus). There are 6 giant clam shell species, 3 pearl oyster species, 3 green snail species and 2 trochus species. Marine fauna also include several species of salt-water crocodiles, coconut crabs, mud crabs and land crabs, prawns, five species of turtles, and marine mammals including dugongs, whales and dolphins.

Around Honiara the dominant marine ecosystems are narrow dead fringing coral reefs consisting of rocks, rubbles, sand and silt benthic environment, massive dead corals and halimedes algae. Landward of which are developed back-reef and very little to no sea weed patches as the area had already been developed. Most of the coastal water is polluted by human induced activities and development resulting in very few marine life forms inhabiting the water. Fauna includes various fish species, molluscs, crustaceans, sea urchins, sea stars and sea cucumbers. As the population of the city continues to grow solid wastes from households, shops, offices and market outlets boost leading to major coastal and marine pollution. Along the Kukum Highway the coast is used as a rubbish dump crammed with varieties of wastes biodegradable and non-biodegradable including sewerage outlets. Compared to the past fishing activities had reduced but still practiced by some residence along the highway.

g) **Alien Species**

In 2008, it was recorded in the State of the Environment Report that there are 11 invasive plants; 1 micro-organism and 2 aquatic vertebrates/invertebrates. Invasive plants include the usual invasive species such as: Acacia fanersiana (Ellinton's curse); Lantana camara, Makania macrantha (mile a minute vine); Mimosa invasa and Mimosa pudica (Sensitive mimosa); Eichhornia crassipes (Water Hyacinth) and others. These plants have either arrived as agriculture, forestry or as garden ornamentals. The microorganism is Phytophera colocasiae (Taro leaf blight), while fish include Tilapia and the mosquito fish. The Cane Toad (Bufo marinus) is also included in the list. Fire ants (Wasmania auropunctata) are now established within the Solomon Islands but have not been noted as an invasive species nor is the Paper Mulberry (Broucessonetia papyrifera) which has established

itself along roadsides in Guadalcanal and Honiara itself. The Giant African snail is also an invasive species affecting most parts of Honiara.

h) **Rare and Endangered Species**

There has been no recent assessment of rare or endangered plant or animal species in the 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 the 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.

Field observations did not show any significant wildlife species and endemic or endangered species within the Kukum Highway and surrounding areas, and no significant habitats remaining in the area as it has already been developed.

9) Hydrometeor

Tide level data for a period of 2010 to 2017 was collected. The biggest difference between the daily maximum and minimum tidal height within this period was recorded in January 2017, where the difference reached 88 cm (highest tide; 1.093 m, lowest tide; 0.206 m) (refer to figure below).

Groundwater level was measured by the Team by digging a well at the project area. The result is provided in Section 2.2.3.6.6 .

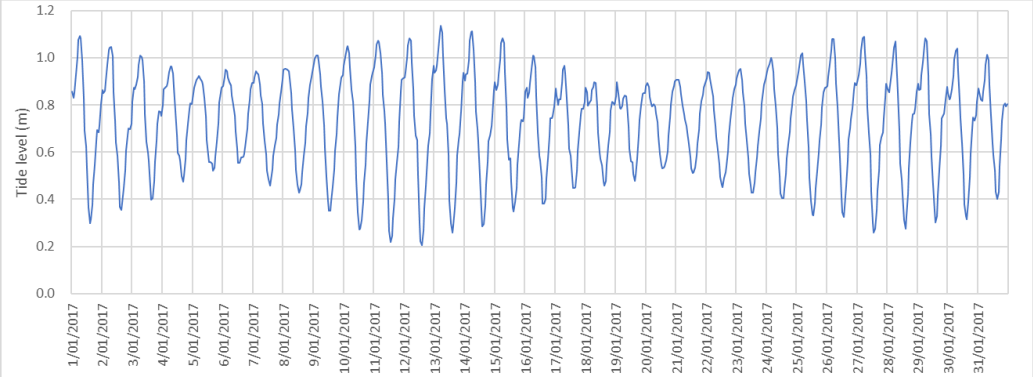


Figure 1.21 Tide Level Change (January 2017)

(2) Social Environment

1) Poverty Rate

The UNDP's report on Household Income and Expenditure Survey (HIES) estimates the Food Poverty Line (FPL) and Basic Needs Poverty Line (BNPL) from data collected through the survey in 2005/2006. This is necessary to estimate poverty lines to provide some measure of hardship, assess the basic costs

of a minimum standard of living, and measure the numbers of households and proportion of the population in the Solomon Islands, that are deemed unable to meet these needs. Poverty lines were calculated for Honiara, provincial-urban, and rural households and it was found 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.

A food poverty line (FPL) was calculated from actual food expenditure patterns recorded for households and basic needs poverty line (BNPL) was estimated, including the FPL plus an allowance for essential non-food expenditure (such as housing/shelter, clothing, utilities, school fees, other education related costs, health, and transport). The results show that in Honiara, households spent 24% more on non-food items than food items each week, compared with households in rural areas, in which non-food basic needs expenditure amounted to 44% of food expenditure. Such findings indicate that basic needs costs are much higher in urban areas. Based on the analysis of the HIES data, the FPL for the country as a whole was estimated to be SBD 182.87 per household per week and the BNPL was estimated to be SBD 265.77 per household per week. Based on the estimation of the poverty lines, the study showed that for both measures (BNPL and FPL), and for both population and households, poverty incidence is highest in Honiara

2) Ethnic Minorities and Indigenous Peoples

The population is estimated to be 515,870 (2009 census) and 609,883 in 2015 census. 95% of its population is indigenous Melanesians, with small groups of people from China, Europe, Micronesia (1.2%) and Polynesia (3.1%) living there. Communities are relatively isolated and have diverse languages, culture and traditions. For this reason, regional governance systems, including family ties, are often more important than national political institutions.

For reference, the latest census was conducted in November 2019 and the results have not yet been published.

3) Local Economy

In the Solomon Islands the working age population were engaged in paid work and others have been undertaking unpaid work. The total number of paid employed people consisted of 17,454 people of which 11,309 males and 6,145 females. The non-labor force is 24,686 and they are those being full time students, those engaged in home duties, the retired, the disabled, and all those who did not work and were not unemployed (did not look for and were not available for work) for various reasons. Simultaneously, about two-thirds of the labour force is employed in the agriculture, forestry and logging, as well as fishing and aquaculture, with females showing a slightly higher rate of involvement than males.

According to the 2009 Census, the number of people in Honiara of working age, i.e. 12 years and older has accounted for 52.7% male and 43.1% female. Most of the people are engaged in economic activities

particularly 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. Some people living in Honiara especially those residing in informal settlements are engaged in a variety of economic activities.

The Kukum Highways is an important route as most of the economic activities revolve around the main highway connecting the most economically active sector of the city to Henderson in the east and White River to the west. It is also where most feeder roads from residential areas are linked to the main highway. Along the project road at the Kukum Highway there are shops and shopping center (Panatina Plaza), eateries, mini-markets clinic, gas stations, Banks & ATMs, High schools, University and police station are situated. From Panatina area through to Ranadi is more of industrial zone and the area is one of the busiest. Towards the end of the project road is the Domestic and International Airports and also shops and eateries.

Since the majority of the people living in Honiara depend on money for living, most of the settlers (squatters) along the project road are involved in sale of market produce by buying agricultural produces from indigenous Guadalcanal people and reselling the products at the Honiara Central Market and the Fishing Village Market. Accordingly, the most common economic activity practiced by most people living along the project road include the selling of cooked food during the night and betel nut vending all throughout the day. These are street markets of which one main betel nut market outlet is situated at the Kukum area and a market for garden produces at the Fishing Village. A betel nut market area is situated King George Sixth area where is operates seven days are week during day and night time.

4) Land Use

a) **Authority of Land Use**

The target area was categorized to “Registered land” on both of Honiara City and Henderson area.

b) **Distribution of Land Use**

The roadside on the Kukum Highway is mainly used for schools and commercial facilities, and residential areas are located behind such facilities. Detailed condition of land use is surveyed.

5) Water Use

In the Honiara, especially along the Kukum Highway, water is supplied by the tap water network. Well water and stored water of rainwater are also used.

6) Social Infrastructure Facility (Hospital and School)

Honiara as the main educational and administration center has schools (primary and secondary) that are privately owned or owned by the Government and the Honiara City Council. There are nine hospitals/clinics in Honiara, including the National Referral Hospital and private clinics. Residents are provided with a range of basic urban services such as water, electricity, roads and garbage collection.

The Kukum Highway running east and west in Honiara is the main road for road users to access schools, offices, hospital and health centers and other public facilities.

a) **School**

Solomon Islands National University (SINU)- Kukum Campus is located on the project road. This campus accommodates School of Natural Resources and Applied Sciences, Business and Management, School of Nursing & Allied Health Sciences and School of Technology and Maritime Studies. Ranadi Campus hosts institutes of Maritime and Fisheries Studies and School of Education and Humanities is in Panatina Campus.

There are kindergarten schools, primary schools and secondary schools within the affected area of the Project. The schools that accept students from these areas include Woodford International Secondary School and Kukum SDA School are in the west of the Project area. The King George Sixth School, Perch Christian School and Burns Creek SDA School are within the vicinity of the road. Other Schools situated inland include Panatina Community High School, Betikama SDA College and Lungga Primary and Secondary School. Those in kindergarten and primary schools walk daily to schools but some in the secondary level have to use motorized transport services.

b) **Hospital/ Clinic**

Residents along the project road can access medical institutions within an hour using standard transportation methods. There are three private medical clinics along the road and in case of emergency, a patient will be transported to the National Referral Hospital.

c) **Church**

People in Honiara and the Solomon Islands is predominantly Christian having Church headquarters to expedite religious activities. In the vicinity of the project area, there are six (6) church headquarters and churches namely; South Seas Evangelical Church (SSEC); United (Methodist) Church; Roman Catholic Church (Lungga); Jehovahs Witness Kingdom Hall, and the Seventh Day Adventist Church (SDA) at the Burns Creek and an Anglican Church Parish at Lungga.

d) **Lifeline**

Basic urban services such as water and electricity supply and garbage collection vary between residential areas, formal and informal residential area. Residents have access to the internet services and communication facilities and connected to the electricity grid with electrical power lines column and lighting along the highway. Water pipes run underground for water supply to most parts of Honiara, and the main port facility is located to the west of the sub-project area.

e) **Other Facilities**

Other facilities and services along the project road are Panatina Plaza, AJ City, Honiara International Airport, Henderson Court, the KG and Panatina Campus Sports Ground, including apartments and accommodations, three fuel depots (Didao Refilling Station, Sol Gas and GTL) and Hot Bread Bakery Shop.

Transport services along the highway includes heavy to light vehicles, privately owned vehicles, public transport include buses and taxis, and government vehicles. Along the highway there are designated bus bays or bus stops for public access whilst there is no provision for taxi stands hence taxis just parked anywhere along the road.

Public transportation services are provided by buses, taxis and flatbed trucks. Flatbed trucks are commonly used by people travelling out of Honiara and hired for various purposes such as transportation of agricultural products to the market.

For people living in the central and eastern parts of Honiara the highway serves as the main route for accessing other facilities located to the west of the project area including the main sea port, bank facilities, National Referral Hospitals, schools and a main market.

7) Social Institutions

The community of the Solomon Islands has a traditional governance system, with each island having a highly influential tribal chief, community leader. These tribal leaders live and are highly respected with each tribal group in their respective communities. By contrast, the leaders of the central government are independent people, but because they belong to each constituency, most have no direct connection or relationship with tribal groups.

Against this background, parliamentarians, who represent the people, do not regard national issues as local or traditional issues, and many local residents tend to respect local traditional leaders more.

8) Culture and Heritage

There are no historical sites in the vicinity of the project area as the land was already altered for development. Eastern end of the Lungga Bridge has previously stored World War I remains, however, due to recent development occurring in the area has disturbed and destroyed those pieces of history. There are wrecks from World War II at the Iron Bottom Sound, west of Honiara City, containing numerous shipwrecks and airplane wrecks and is considered as a heritage site as it is regarded as the scared waters. Honiara city as a developed area has no potential natural resources within the proposed site for construction. Most of the resources are destroyed for development of the city years ago.

9) Landscape

The project area is already developed, and there are no scenic spots along the Kukum trunk line. The Kukum Highway has roadside trees and a small amount of vegetation in medians.

10) HIV/Malaria

a) **HIV**

The HIV survey of the Solomon Islands is reported in Global AIDS Monitoring 2018 by National HIV/STI Program with the Ministry of Health and Medical Services.

According to the report, the first HIV case in the Solomon Islands was in 1994, and since then, the incidence of HIV has declined each year. The United Nations Programme on HIV/AIDS (UNAIDS) classified the Solomon Islands as a country with a low prevalence of HIV, with an estimated

prevalence of 0.002%, and unchanged since 2010 (UNAIDS 2012). Despite the low prevalence of HIV, the data show a consistently high number of people infected with sexually transmitted diseases nationwide.

At the time of the survey, 100% of the people infected with HIV in the Solomon Islands (12 out of 12 (8 men, 4 women)) were registered for Antiretroviral Therapy (ART) and in 2016, 77% (10 out of 13) were registered with ART. The Solomon Islands are currently implementing a test-and-treat strategy to prevent AIDS-related deaths in Person(s) Living with HIV (PLHIV), and treat all HIV-positive patients regardless of viral load or CD4 count.

b) **Malaria**

According to WHO World Malaria Report 2019, the risk of malaria in the Solomon Islands is high, and the risk of morbidity is about 13%. This figure is also high in Papua New Guinea (18%), but it can be seen that other countries are significantly higher than those in Vanuatu (0.4%), Cambodia (2.4%) and other Southeast Asian countries.

For reference, on average in Africa, morbidity risk is around 23%.

Table 1.12 Malaria Morbidity and Mortality Risk (2018)

WHO region Country/area	Population at Risk	Cases			Deaths		
		Lower	Point	Upper	Lower	Point	Upper
WESTERN PACIFIC							
Solomon Islands	646,327	75,000	86,343	101,000	12	109	180
Papua New Guinea	8,606,324	1,096,000	1,587,573	2,180,000	180	3,124	6,060
Vanuatu	292,675	900	1,167	1,600	-	0	-
Cambodia	11,491,692	235,000	272,272	320,000	42	265	430
SOUTH-EAST ASIA							
Bangladesh	17,352,837	11,000	12,021	13,000	0	26	44
Indonesia	267,670,549	933,000	1,034,866	1,154,000	140	1,785	2,930
Myanmar	31,966,116	88,000	108,815	131,000	14	172	300

Source: WHO （World Malaria Report 2019）

11) Labor Environment

In the Labor Act (enacted 1996, Chapter 73) of the Solomon Country, there is Part VI “Employment of Woman”, in the Sections 38 to 44 mainly describe conditions related to night work, prohibition of employment in mines, measures and penalties for pregnant women.

- 38. INTERPRETATION
- 39. PROHIBITION OF EMPLOYMENT OF WOMEN AT NIGHT
- 40. RESTRICTION ON EMPLOYMENT OF WOMEN IN MINES
- 41. SUSPENSION OF PROHIBITION
- 42. MATERNITY LEAVE
- 43. RESTRICTION OF DISMISSAL OF FEMALE WORKER
- 44. PENALTY

Part VII, "Employment of Children and other Young Persons," provides measures and penalties regarding the employment of children.

- 45. INTERPRETATION
- 46. EMPLOYMENT OF CHILDREN UNDER 12
- 47. EMPLOYMENT OF PERSONS UNDER 15
- 48. EMPLOYMENT OF PERSONS UNDER 16
- 49. EMPLOYMENT OF PERSONS UNDER 18
- 50. REGISTER OF YOUNG PERSONS
- 51. PRESUMPTION OF AGE
- 52. PENALTY

In addition, the Solomon Islands, which belong to the tropical region, tend to be hot and humid, and due consideration should be given to the working environment.

(3) Others

1) Traffic Accident

Information on traffic accidents can be obtained from the Solomon Traffic Police. The details are mentioned in Section 1.4.1.7.4 .

2) Trans-boundary Impacts or Climate Change

The Solomon Islands is an island nation located in the South Pacific Ocean, and even the closest neighboring countries have a distance of 800 km or more. Therefore, no impact of the Project on neighboring countries is expected.

3) Unexploded Ordnance (UXO)

In the Solomon Islands, there are still cases where unexploded ordnance can be found. Although the target area of the Project has been developed, the UXO survey will be conducted because the road design is planned to expand the road area. In addition, the method of unexploded ordnance processing will be summarized.

1.4.1.2 The System and Administration on Environmental and Social Consideration

1.4.1.2.1 Laws Relevant to Environmental and Social Consideration

Major laws and regulations related environmental and social consideration are below.

(1) Environmental Act 1998

This is a basic law of environment in the Solomon Islands and the contents are shown in Table 1.13. Second Schedule shown in Table 1.14 is a list of projects which is required to conduct EIA. The Project falls under (9) Public works sector and (b) infrastructure developments and EIA must be conducted in the Project.

Table 1.13 Summary of Environmental Act 1998

Chapter	Main Contents
PART I PRELIMINARY	・Explanation of definition
PART II ADMINISTRATION	・Basis of establishment of relevant organization ・Basis of power and function on relevant organization
PART III DEVELOPMENT CONTROL, ENVIRONMENTAL IMPACT ASSESSMENT, REVIEW AND MONITORING	・Basic policy and action on EIA ・Basic procedures and requirement on EIA
PART IV CONTROL OF POLLUTION	・Responsibility and penalty for pollution control ・Explanation for license on various activities
PART V MISCELLANEOUS	・Miscellaneous
FIRST SCHEDULE (Section 13)	・Procedure regarding to Advisory committee
SECOND SCHEDULE (Section 16) PRESCRIBED DEVELOPMENTS	・Regulation of target on EIA ・Target developments on total 10 categories

Table 1.14 Summary on Second Schedule (Prescribed Developments)

Target on EIA	
(1) FOOD INDUSTRIES	(6) CHEMICAL INDUSTRY
(2) IRON AND STEEL INDUSTRIES	(7) TOURISM INDUSTRY
(3) NON-METALLIC INDUSTRIES	(8) AGRICULTURE INDUSTRY
(4) LEATHER, PAPER, TEXTILE AND WOOD INDUSTRIES	(9) PUBLIC WORKS SECTOR
(5) FISHING AND MARINE PRODUCT INDUSTRY	(10) OTHER
Details on the (9)	
(9) PUBLIC WORKS SECTOR	(a) landfills (b) infrastructure developments (c) major waste disposal plants (d) soil erosion and siltation control (e) hydropower schemes (f) reservoir development (g) airport developments (h) waste management, drainage and disposal systems (i) dredging (j) watershed management (k) ports and harbours

(2) The Environmental Regulation 2008

It regulates details of The Environmental Act.

(3) Environment Impact Assessment Guideline 2010

It is a guideline including case studies of The Environmental regulation and The Environmental Act.

(4) Customary Land Records Act [Cap 132]

It regulates regarding records on customary land

(5) Land and Titles Act [Cap 133]

It regulates regarding title and trading of land.

(6) Safeguard Procedure Manual

The Safeguard Procedure Manual was prepared by the MID with the ADB. The basic policy on environmental and social consideration follows the ADB or WB policy. Therefore, contents of the manual have high consistency with JICA guideline. The team confirmed that the MID also will follow this manual as a meeting result.

1.4.1.2.2 Administrative Divisions Relevant to Environmental Protection

(1) The Ministry of Environment Climate Change and Disaster Management and Meteorology

Supervision of environmental administration works is managed by the Ministry of Environment Climate Change and Disaster Management and Meteorology, which consists of four divisions and one office as shown below:

- Environment & Conservation Division
- Climate Change Division
- Meteorological Services Division
- Corporate Services Division
- Disaster Management Office

(2) Environment & Conservation Division (ECD)

The ECD in the Ministry of Environment Climate Change and Disaster Management and Meteorology have main responsibility to manage IEE and/or EIA. Establishment of ECD is regulated in Environmental Act, Implementation of EIA is main objective of ECD. Main roles of ECD are as follows, more concretely ECD conduct the receive/ evaluation of Public Environmental Report and activities in Table 1.16 with MID.

- Environmental impact assessment
- Environmental auditing
- Protected area management and development
- Biodiversity planning and conservation
- Waste management and pollution prevention
- Environmental planning
- Invasive species management
- Environmental awareness and education
- Biological safety or biosafety
- International trade in wildlife
- Biodiversity and bio-prospecting research
- Chemicals management
- Sustainable development issues

(3) Environment Advisory Committee (EAC)

The EAC is established under EIA process, the role of EAC is to comment on the publication and to receive any disagree within thirty days of the publication of the decision.

(4) Safeguard Office

The safeguard office is in the MID and has responsibility on environmental and social consideration. The Central Project Implementation Unit (CPIU) is established in the safeguard office.

1.4.1.2.3 Environmental Standard

At the survey in November 2019, the Solomon Islands has no specific environmental standards although Environmental Act 1998 describes "(a) comply with any prescribed standard for the discharge of waste or the emission of noise, odour or electromagnetic radiation from such premises" on Part IV section 36 "Occupiers of premises to take certain measures". The Team, the ECD and the MID confirmed that assessment of environmental monitoring/impact is conducted by referring to environmental standards on a donor country or other international standards.

1.4.1.2.4 Gap Analysis on EIA Process

In the Project conducted by the MID as the developer, it is confirmed that the EIA process/assessment is conducted in accordance with the Safeguard Procedure Manual and other relevant regulations. Significant gap was not found among JICA environmental and social consideration policy and relevant regulations in the Solomon Islands including the Safeguard Procedure Manual, as shown in Table 1.15.

Table 1.15 Gap Analysis Among JICA Policy and Regulations in the Solomon Islands

No.	Category	JICA Guidelines	Laws and Regulations of the Solomon Islands	Gap with JICA Guidelines	Project Policies to the Gaps
1	Underlying Principles	1. Environmental impacts that may be caused by projects must be assessed and examined in the earliest possible planning stage. Alternatives or mitigation measures to avoid or minimize adverse impacts must be examined and incorporated into the project plan.	Environmental Act 1998 -Project to be conduct EIA is require making PER or EIS including assessment to environment.	**No significant Gap.** it's support by EIA process.	The Project shall comply with Solomon's EIA process.
		2. Such examinations must be endeavored to include an analysis of environmental and social costs and benefits in the most quantitative terms possible, as well as a qualitative analysis; these must be conducted in close harmony with the economic, financial, institutional, social, and technical analyses of projects.	Environmental regulation 2008 - EIS require to including below items, it's required various assessment ・social impact on the surrounding communities where the prescribed development is to be located; ・employment opportunities for Solomon Islanders and in the case where the prescribed development is to undertaken is a rural area, employment opportunities for members of the surrounding communities; ・provide a health impact assessment;	**No significant Gap.**	The multi assessment such as social, economic, environmental impact etc. with alternative plans are considered in the Project.

No.	Category	JICA Guidelines	Laws and Regulations of the Solomon Islands	Gap with JICA Guidelines	Project Policies to the Gaps
			・provide a gender impact assessment; ・state whether any of the above would have short term or long term harmful effects on the environment		
		3. The findings of the examination of environmental and social considerations must include alternatives and mitigation measures and must be recorded as separate documents or as a part of other documents. EIA reports must be produced for projects in which there is a reasonable expectation of particularly large adverse environmental impacts	Environmental Act 1998 -EIS have to indicate the consequences of not implementing or carrying out the prescribed development. -EIS and PER have to indicate reasonable alternative development	**No significant Gap.**	The Project shall comply with Solomon's EIA procedure.
		4. For projects that have a particularly high potential for adverse impacts or that are highly contentious, a committee of experts may be formed so that JICA may seek their opinions, in order to increase accountability.	Environmental Act 1998 - PER and EIS will be open to the public and if there is objection, Environmental Advisory Committee (EAC) will be organized.	**No significant Gap.**	The Project shall comply with Solomon's EIA procedure.
2	Information disclosure	1. EIA reports (which may be referred to differently in different systems) must be written in the official language or in a language widely used in the country in which the project is to be implemented. When explaining projects to local residents, written materials must be provided in a language and form understandable to them.	Safeguard Procedure Manual -Social and environmental studies and mitigation plans are disclosed through various means accessible and in a language understandable.	**No significant Gap.**	Since official language is English in Solomon Islands. Necessary documents shall be prepared in English. Stakeholder meetings will be organized in Pidgin (Pijin) language, if required.
		2. EIA reports are required to be made available to the local residents of the country in which the project is to be implemented. The EIA reports are required to be available at all times for perusal by project stakeholders such as local residents and copying must be permitted.	Environmental Act 1998 Environmental Impact Assessment Guidelines 2010 -The regulation requires "Public Display" for report and collection of comment.	**No significant Gap.**	MID will follow the publication process.
3	Examination of Measures	1. Multiple alternatives must be examined in order to avoid or minimize adverse impacts and to choose better project options in terms of environmental and social considerations. In the examination of measures, priority is to be given to avoidance of environmental impacts; when this is not possible, minimization and reduction of impacts must be considered next. Compensation measures must be examined only when impacts cannot be avoided by any of the aforementioned measures.	Environmental regulation 2008 - Form-1 of PER/ EIS shown in the regulation suggest describing the mitigation etc.	**No significant Gap.**	Alternative plans for implementation of the project shall be considered, and the results will be reflected to IEE Report (PER).

No.	Category	JICA Guidelines	Laws and Regulations of the Solomon Islands	Gap with JICA Guidelines	Project Policies to the Gaps
		2. Appropriate follow-up plans and systems, such as monitoring plans and environmental management plans, must be prepared; the costs of implementing such plans and systems, and the financial methods to fund such costs, must be determined. Plans for projects with particularly large potential adverse impacts must be accompanied by detailed environmental management plans.	Environmental Impact Assessment guideline 2010 -Developer will prepare Environmental Management Plan (EMP), and ECD or other relevant public authority have power to order inspection.	**No significant Gap.**	The team shall propose environmental management plan.
4	Scope of Impacts to be Assessed	1. The impacts to be assessed with regard to environmental and social considerations include impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil, waste, accidents, water usage, climate change, ecosystems, fauna and flora, including trans-boundary or global scale impacts. These also include social impacts, including migration of population and involuntary resettlement, local economy such as employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups such as poor and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children's rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety.	Environmental regulation 2008 - In Division 2 of the regulation shows the concrete items for considering environmental and social impacts	**No significant Gap.**	The Team will conduct the Scoping based on baseline survey in accordance with JICA guidelines.
		2. In addition to the direct and immediate impacts of projects, their derivative, secondary, and cumulative impacts as well as the impacts of projects that are indivisible from the project are also to be examined and assessed to a reasonable extent. It is also desirable that the impacts that can occur at any time throughout the project cycle should be considered throughout the life cycle of the project.	Environmental regulation 2008 - In Division 2 of the regulation, it suggests considering the long-term impact.	**No significant Gap.**	The team shall propose environmental monitoring plan after project.
5	Compliance with Laws,	1. Projects must comply with the laws, ordinances, and standards	Environmental Act 1998	**No significant Gap.**	Project will be implemented

No.	Category	JICA Guidelines	Laws and Regulations of the Solomon Islands	Gap with JICA Guidelines	Project Policies to the Gaps
	Standards, and Plans	related to environmental and social considerations established by the governments that have jurisdiction over project sites (including both national and local governments). They must also conform to the environmental and social consideration policies and plans of the governments that have such jurisdiction.	Application form of the Project		according to Solomon's law and relevant regulations. Assessment of environment and social consideration will follow JICA policy and relevant law, guidelines in Solomon Islands
		2. Projects must, in principle, be undertaken outside of protected areas that are specifically designated by laws or ordinances for the conservation of nature or cultural heritage (excluding projects whose primary objectives are to promote the protection or restoration of such areas). Projects are also not to impose significant adverse impacts on designated conservation areas	Environmental Act 1998 -collaborate with relevant public authorities in assisting in the conservation and management of world heritage properties Safeguard Procedure Manual -Not use any coastal areas identified as being part of a protected area (including the buffer zone of a protected area)	**No significant Gap.**	Project is to upgrade the existing road, works in protected area is not planned.
6	Social Acceptability	1. Projects must be adequately coordinated so that they are accepted in a manner that is socially appropriate to the country and locality in which they are planned. For projects with a potentially large environmental impact, sufficient consultations with local stakeholders, such as local residents, must be conducted via disclosure of information at an early stage, at which time alternatives for project plans may be examined. The outcome of such consultations must be incorporated into the contents of project plans.	Environmental Act 1998 - There is the system of "Public display" to obtain comment from public. Safeguard Procedure Manual -The PER Team must undertake a process of consultation with the people who would be affected by the project and the project stakeholders.	**No significant Gap.**	MID will hold stakeholder meeting and public consultation at early stage of preparatory survey. Furthermore, MID will make consensus through the activities such as stakeholder meeting, public consultation and public display of PER.
		2. Appropriate consideration must be given to vulnerable social groups, such as women, children, the elderly, the poor, and ethnic minorities, all members of which are susceptible to environmental and social impacts and may have little access to decision-making processes within society.	Safeguard Procedure Manual -The proponent with the PER Team must ensure that the public, including affected people, women and vulnerable groups, have the opportunity to participate fully in the consultation process.	**No significant Gap.**	MID arranges public consultation without distinction between vulnerable and non-vulnerable groups.
7	Ecosystem and Biota	1. Projects must not involve significant conversion or significant degradation of critical natural habitats and critical forests.	Environmental Impact Assessment guideline -Guidelines suggest avoiding significant impact to environment by screening process	**No significant Gap.**	Project is to upgrade the existing road, without affecting protected area.
		2. Illegal logging of forests must be avoided. Project proponents etc. are encouraged to obtain certification by forest	The Forest Resources and Timber utilization Act [Cap 40] -Any person, who fells trees and the removes timber, is required	**No significant Gap.**	MID shall take license for removing timber for project

No.	Category	JICA Guidelines	Laws and Regulations of the Solomon Islands	Gap with JICA Guidelines	Project Policies to the Gaps
		certification systems as a way to ensure the prevention of illegal logging.	to take a license authorizing the from Commissioner of Forest Resources.		implementation, if necessary.
8	Involuntary Resettlement	1. Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, effective measures to minimize impact and to compensate for losses must be agreed upon with the people who will be affected.	Safeguard Procedure Manual -Ascertain if all affected assets and sources of income or livelihoods have been identified, valued, and directly replaced or compensated.	**No significant Gap.**	Affected area and land acquisition shall be minimum.
		2. People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported by project proponents etc. in a timely manner. Prior compensation, at full replacement cost, must be provided as much as possible. Host countries must make efforts to enable people affected by projects and to improve their standard of living, income opportunities, and production levels, or at least to restore these to pre-project levels. Measures to achieve this may include: providing land and monetary compensation for losses (to cover land and property losses), supporting means for an alternative sustainable livelihood, and providing the expenses necessary for the relocation and re-establishment of communities at resettlement sites.	Safeguard Procedure Manual -Assess the timeliness of cash payments and if the amounts meet the replacement cost standard Division 2, Part V of Low on Land and Titles Act [Cap133] -The assessment of compensation will be conducted by the high court in accordance with Solomon's law	**No significant Gap.**	Compensation and livelihood assistance will be provided to improve or at least restore their status as of now for living, income opportunities and production. The compensation will be made based on official rate by Ministry of Land, Housing and Survey as following to law on Solomon Islands.
		3. Appropriate participation by affected people and their communities must be promoted in the planning, implementation, and monitoring of resettlement action plans and measures to prevent the loss of their means of livelihood. In addition, appropriate and accessible grievance mechanisms must be established for the affected people and their communities.	Safeguard Procedure Manual - To hold community consultation and to prepare the RAP are recommended. Division 2, Part V of Low on Land and Titles Act [Cap133] -The grievance mechanisms is described as "Appeal" system.	**No significant Gap**	An effort shall be made to minimize claim and land acquisition. Action for any claim shall follow the Land and Titles Act [Cap133], because the claim will happen from the land owners or relevant organization under Solomon's law.
		4. For projects that will result in large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. In preparing a resettlement action plan, consultations must be held	Safeguard Procedure Manual -Preparation of Land Acquisition and Resettlement Plan is required based on scale of project	**No significant Gap**	Abbreviate RAP with MID shall be prepared

No.	Category	JICA Guidelines	Laws and Regulations of the Solomon Islands	Gap with JICA Guidelines	Project Policies to the Gaps
		with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP 4.12, Annex A			
9	Indigenous Peoples	1. Any adverse impacts that a project may have on indigenous peoples are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, effective measures must be taken to minimize impacts and to compensate indigenous peoples for their losses.	Safeguard Procedure Manual -Safeguard procedure manual principle shows to protect the indigenous peoples. Land and Titles Act [Cap133] -Indigenous People is handed equally as "Solomon Islander"	**No significant Gap**	If impact to indigenous peoples will be estimated, required measures according Safeguard Procedure manual in Solomon Islands will be taken.
		2. When projects may have adverse impacts on indigenous peoples, all of their rights in relation to land and resources must be respected in accordance with the spirit of relevant international declarations and treaties, including the United Nations Declaration on the Rights of Indigenous Peoples. Efforts must be made to obtain the consent of indigenous peoples in a process of free, prior, and informed consultation.	Land and Titles Act [Cap133] -Indigenous People is handled equally as "Solomon Islander"	**No significant Gap**	Indigenous Peoples are not included in the Project area..
		3. Measures for the affected indigenous peoples must be prepared as an indigenous peoples plan (which may constitute a part of other documents for environmental and social consideration) and must be made public in compliance with the relevant laws and ordinances of the host country. In preparing the indigenous peoples plan, consultations must be made with the affected indigenous peoples based on sufficient information made available to them in advance. When consultations are held, it is desirable that explanations be given in a form, manner, and language that are understandable to the people concerned. It is desirable that the indigenous peoples plan	Land and Titles Act [Cap133] -Indigenous People is handled equally as "Solomon Islander"	**No significant Gap**	Indigenous Peoples are not included in the Project area..

No.	Category	JICA Guidelines	Laws and Regulations of the Solomon Islands	Gap with JICA Guidelines	Project Policies to the Gaps
		include the elements laid out in the World Bank Safeguard Policy, OP4.10, Annex B.			
10	Monitoring	1. After projects begin, project proponents etc. monitor whether any unforeseeable situations occur and whether the performance and effectiveness of mitigation measures are consistent with the assessment's prediction. They then take appropriate measures based on the results of such monitoring.	Environmental Act 1998 -The Act regulates that monitoring and prevention measures are made so that discharge of pollution is minimum.	**No significant Gap.**	Environmental monitoring plan shall be prepared, and mitigation measure at construction stage shall be concerned.
		2. In cases where sufficient monitoring is deemed essential for appropriate environmental and social considerations, such as projects for which mitigation measures should be implemented while monitoring their effectiveness, project proponents etc. must ensure that project plans include feasible monitoring plans.	Environmental Regulation 2008 -It is suggested in this regulation that Public Environmental Report (PER) includes monitoring plan, and the PER report must be open to the public have to publish using Newspaper in Solomon.	**No significant Gap.**	The Project shall comply with the process of EIA in Solomon Islands.
		3. Project proponents etc. should make efforts to make the results of the monitoring process available to local project stakeholders.	Environmental Regulation 2008 -The monitoring results will be published through Publication of PER.	**No significant Gap.**	PER shall be published, and Stakeholder meetings shall be organized.
		4. When third parties point out, in concrete terms, that environmental and social considerations are not being fully undertaken, forums for discussion and examination of countermeasures are established based on sufficient information disclosure, including stakeholders' participation in relevant projects. Project proponents etc. should make efforts to reach an agreement on procedures to be adopted with a view to resolving problems.	Environmental Act 1998 -Environmental Act regulated "Appeal" system after publication of PER to receive any comment	**No significant Gap.**	The Project shall comply with the process of EIA in Solomon Islands.

1.4.1.3 Procedure on Environmental Assessment

Environmental Assessment Procedure was regulated in Environmental Act 1998, and the detailed procedure is explained in the Environmental Regulations 2008 and the Environmental Impact Assessment Guidelines 2010.

1.4.1.3.1 Procedure on Environmental Assessment

The procedure/flow on Environmental Assessment is explained in the Environmental Impact Assessment Guidelines 2010 as shown in Figure 1.22. The MID shall promote the EIA procedure as the developer.

EAC : Environmental Advisory Committee
EIA : Environmental Impact Assessment
EIS : Environmental Impact Statement
PER : Public Environmental report

Figure 1.22 EIA Flow Chart

EIS and PER in Environmental Guideline were described below.

Environmental Impact Statement (EIS)	:	A detailed report presenting the results of an environmental impact assessment.
Public Environmental Report (PER)	:	A brief report presenting the results of a preliminary environmental assessment of an existing or proposed development.

1.4.1.3.2 Procedure

The number of working days required for each EIA procedure was regulated in the Environmental Act 1998, and it is summarized in the Environmental Impact Assessment Guidelines 2010, as shown in

Table 1.16. The Project is required to prepare the PER and to take procedures below except Step 9 to 12 in Table 1.16.

Table 1.16 Days Required for each EIA Procedure

Step	Title	Details of Actions	Time frame (days)	Stakeholders involved in each action
1.	Proposal Application	The developer lodges a proposal application to the ECD with an application fee of $200. The proposal application should be a formal letter outlining detail description of the proposed development. Act 17(1) & Reg 6	na	Developer
2.	Screening	ECD decides whether or not EIA is required by screening the proposal applications. In the case where EIA is not required, go to step 13. Conversely once an EIA is required, then go step 3	15	ECD & Developer
3.	Scoping	ECD after considering the application within 15 days requires the developer to carry out an EIA study. Scoping is where major impacts of the proposed development are identified and highlighted. ECD will then advise the developer of the type of information required and will decide whether PER or EIS is required of the developer. Act 17(2) and Reg 7		ECD & Developer
4.	EIA Study	The developer carries out studies to collect and prepare the environmental information (report) required by ECD. If the developer is preparing a PER go to step 5 or EIS go to step 9.	na	Developer
5.	Submission of PER and Development application	The developer prepares and submits PER and the development application (Form 2 in Environment Regulations 2008) with a development application fee. Act 17(2a),30	na	Developer
6.	1 st Review of PER	ECD reviews the application to determine the nature of the proposal and whether the PER complies with the ACT. If the PER does not fulfill the requirements of the Act, ECD may advice the developer to submit further information or details. If the PER meets the Act requirements, go to Step 7. Act 21,29and Reg 8 (a)(b)(c)	10-review 5-decision	ECD
7.	PER : Public Display/participation	ECD will publish the PER document such that it is made available to the public and convene a meeting that ensures public participation. The notice of the meeting (form4 in Environment Regulation 2008) will be published in the newspaper and posted in public places in the communities, which will be likely affected. Any cost associated with the publication of the Notice or PER will be borne by the developer. Act 22(1,2),30 and Reg 11& 12	30	ECD, relevant organization, provincial government, developer, resource owners/users, public.
8.	2nd PER Review	The PER will be reviewed again by ECD taking into consideration any objections and information received during the Public display meeting or after the meeting. ECD may after the review: 1. Approve (step 13) 2. Reject- developer may appeal to advisory committee (step 14) 3. Deferred for approval- ECD may require an EIS from developer (step 9) Act 22(3), Reg 8(e),13	15	ECD
9.	Submission of EIS and Development Application	Developer prepares and lodges the EIS and development application with development application fee. If the EIS meets the requirements of the Act, go to Step10. Act 17(2b) and 30	na	Developer
10	1st EIS Review	ECD reviews the application to determine the nature of the proposal and whether the EIS complies with the ACT.	10-review	ECD

Step	Title	Details of Actions	Time frame (days)	Stakeholders involved in each action
		If the EIS does not fulfill the requirements of the Act, ECD may advice the developer to submit further information. If the EIS meets the Act requirements, go to Step 11. Reg 8 (a)(c)	5-decision	
11.	EIS Public Display and Participation	The ECD will publish the EIS document such that it is made available to the public and convene a meeting that ensures public participation. The notice of the meeting shall be published in the newspaper and posted in public places in the communities, which will be likely affected. Any cost associated with the publication of the Notice or EIS will be borne by the developer. Act 24(1)(2),30 and Reg 11 & 12	30	ECD, Any person, relevant organization, provincial government, developer
12.	2nd EIS Review	The EIS will be reviewed again by ECD taking into consideration any objections and information received during the Public display meeting or after the meeting. ECD may after the review: 1. Approve (step 13) 2. Reject- developer may appeal to advisory committee (step 14) Act 24(3), Reg 8e	15	ECD
13.	Approval	The development consent is issued to the developer with conditions (form 5 of Environment Regulation 2008). The fees for development consent vary depending on the type of prescribed development. The decision of ECD shall be published in the newspaper having wide circulation in the Solomon Islands or in any other forms of public notices as approved by ECD. Act 24(3a) and Reg 14,16	5	ECD
14.	Appeal 1	The developer or any person(s) who disagrees with any decision of the Director may within 30 days of publication of the decision appeal to the Environment Advisory committee (EAC) in writing, stating clearly the grounds of appeal. The appellant shall pay an appeal fee. Act 32(1)(2)(3)(4)(5) and Reg 18	30	Developer/ Any person
15.	Appeal 2	If again any person disagrees with the EAC's decision, he or she may within 30 days from such decision appeal to the Minister who will make the final decision. Act 32(7)	30	Developer/ Any person
16.	Monitoring	ECD or any relevant public authority may at any time, whether before or after a development activity has been completed, monitor or cause to be monitored, all or any of the environmental aspects of the implemented development activity. Ref: Act 31	na	ECD/ Other relevant public authority

Note : Non-target activity under the Project

1.4.1.4 Consideration of Alternative Plan

The Project has few alternative plans of which road design will have a major impact on environment, because the Project will improve the existing road without significant change of road alignment. Therefore, alternative plans of the Project are considered in terms of technical requirements and C/P requests.

Table 1.17 Alternative plan

Item		"0 option	Plan-1	Plan-2	Plan-3	Plan-4
Contents	Summary	・No implement the Project	・All section improves	・All section improves, but the quality in 5 years	・Overlay finishing in parts	・All section improves to 4 Lane
	Section 1 (4 Lane section) Start.: MoFMR End: Lungga Br.	・No improvement work	・10-year durable pavement	・5-year durable pavement	・Combine overlay work in part of section 1	・10-year durable pavement
	Section 2 (Lungga Br.) Lungga Br. improvement	・No proposal	・Propose improvement plan	・Propose improvement plan	・Propose improvement plan	・Construction 2 Lane bridge (Total 4 Lane)
	Section 3 (2 Lane section) Start.: Lungga Br. End: Honiara AP	・No improvement work	・10-year durable pavement	・5-year durable pavement	・10-year durable pavement	・10-year durable pavement with 4 Lane
Land use	Land use on surrounding	・Commercial/ school in roadside				
	Consistency with urban development	・The project is improvement work on existing highway, consistency with urban development is high.				
Technical issue	Forecasting of traffic	・The traffic volume are more than 1,000viechles/h in 2 Lance section, it will be required to 4 Lane as possible as soon.				・Traffic demand will be satisfied by 4 Lane
	Technical issues	・There are damage on the surface, it's a factor for hindering traffic	・The road quality is same of Japanese standard	・Road durable period is short, it will be required improvement work in earlier at all section.	・The road quality in all section can be maintain, but a part section is only overlay work.	・The road quality is same of Japanese standard
	Ratio of Project cost	―	1.0	0.96	・0.71	1.3
Env. & Soc. Consideration	Natural environment	・No impact	・Need to cut down trees along the road	・Same as left column	・Same as left column	・Same as left column
	Social environment	・No impact	・Need to relocate some of kiosks at bus station near Lungga Bridge	・Same as left column	・Same as left column	・On 2 Lane section, some of street vender/ shops might be transferred with widening work
Recommended plan and the reason		・× ・There are damage on the surface, it's a factor for hindering traffic.	・△ ・It's satisfied technical issues and C/P request, but the project budget exceed.	・× ・The service life is short, it is concerned as a grant aid project, and the project cost will be exceeded.	・○ ・The project is implemented improvement work in C/P requested section though some section apply overlay work. And the cost is within project budget.	・△ ・It's satisfied technical issues and C/P request, but the project budget exceed so much.

1.4.1.5 Scoping

Scoping results based on the information collected in November and December 2019 are shown in Table 1.18. From this scoping, the Team conducted additional surveys and information collection, and then re-assessed environmental impacts of the Project.

Table 1.18 Scoping Result

Category	No.	Impact Item	Assessment		Reason / Remarks
			Pre-Construction Phase Construction Phase	Operation Phase	
Pollution	1	Air pollution	B-	B±	**Construction Phase:** Emission of dust and exhaust gas will increase due to construction equipment operations and traffic congestion in construction site. **Operation Phase:** In the future, the total amount of air pollutant caused by vehicle exhaust gas will increase. However, because of improved traffic efficiency, the amount may be reduced compared with no project (without condition).
	2	Water pollution	B-	B-	**Construction Phase:** Turbid water will be generated during rainfall periods. **Operation Phase:** The project is planning to discharge flood water to channel or river, temporally the load will be increase.
	3	Waste	B-	D	**Construction Phase:** Construction waste caused by construction and demolition works, and general waste from construction office will be generated. **Operation Phase:** Generation of solid waste is unlikely to occur.
	4	Soil pollution	D	D	Because materials that may cause soil pollution such as heavy metal and toxic organic matter will not be used in the construction and maintenance works, soil pollution is unlikely to occur.
	5	Noise and vibration	B-	B±	**Construction Phase:** Construction equipment operation will cause noise and vibration. **Operation Phase:** There are estimated on both impact of increase by traffic volume and traveling speed, and decrease by improvement of road surface condition.
	6	Ground subsidence	B±/ D	D	**Pre-Construction Phase:** The pier of Lungga bridge may be subsiding due to scouring and or land subsidence. **Construction Phase, Operation Phase:** Cause groundwater withdrawal will not be included, ground subsidence is unlikely to occur.
	7	Offensive odors	D	D	Because materials and equipment that may cause offensive odors will not be used in construction and maintenance works, considerable offensive odors are unlikely to occur.

Category	No.	Impact Item	Assessment		Reason / Remarks
			Pre-Construction Phase Construction Phase	Operation Phase	
	8	Bottom sediment	B-	B-	**Construction Phase:** It might be sedimented by turbidity water discharge to river/ channel at raining. **Operation Phase:** The flood water is planning to discharge to river/ channel, the load of turbidity in rivers might be increased temporarily.
Natural Environment	9	Protected areas	D	D	No protected area around project site
	10	Ecosystem	B-	D	**Construction Phase:** Felling of roadside trees will be required in construction phase. However, Impact on urban ecosystem created around roadside will be very limited. **Operation Phase:** If there is coral at the estuary of the drainage destination, it might be affected by the accumulation of turbid water.
	11	Hydrology	C-	D	**Construction Phase:** No construction work to be affected to groundwater. If there is aquifer near surface, it's might be affected. **Operation Phase:** No affected impact
	12	Geographical features	B-	D	**Construction Phase:** There is possibility to affect to environment by alignment of drainage line. Existing quarry site and borrow pit will be used for aggregate. **Operation Phase:** Existing geographical features will not change considerably.
Social Environment	13	Resettlement/ Land Acquisition	B-	D	**Pre-Construction Phase:** Simple business stores including kiosk, container shops, parasol shops on roadside will be removed temporarily or relocated **Operation Phase:** Additional resettlement and land acquisition will not be required.
	14	Impoverished/ Poor people	B±	D	**Construction Phase:** Disturbance in daily activities of street vendors which include impoverished people is likely to occur. Construction might create job opportunities to the poor as unskilled labor. **Operation Phase:** Considerable impact only on impoverished people is unlikely to occur.
	15	Ethnic minorities and indigenous peoples	D	D	Because the project is located in developed areas, considerable impact on ethnic minorities or indigenous peoples is unlikely to occur.
	16	Local economies, such as employment, livelihood, etc.	B±	B+	**Construction Phase:** Business activities of several offices, shops and street vendors on roadside might be closed or suspended. Construction will create job opportunities to local people as unskilled labor. **Operation Phase:** Reduction of travel time by mitigated traffic jam will contribute to local economies.

Category	No.	Impact Item	Assessment		Reason / Remarks
			Pre-Construction Phase Construction Phase	Operation Phase	
	17	Land use and utilization of local resources	D	B+	**Construction Phase:** No negative issues. **Operation Phase:** Improved transportation and reduction of flood will contribute to effective utilization of local resources.
	18	Water usage	C-	D	**Construction Phase:** If there is an aquifer on the surface, it might be impact during the construction of the drainage facility. **Operation Phase:** Considerable impact on water rights and its usage is unlikely to occur.
	19	Existing social infrastructures and services	B-	D	**Pre-Construction Phase:** Relocation or protection of utilities (service lines) such as water and sewer pipes, electric cable, telephone line and gas pipe will be required. **Construction Phase:** Temporary traffic congestion, shift of bus and taxi stations, and disturbance of access to roadside facilities will occurred. **Operation Phase:** No negative issues.
	20	Social institutions such as social infrastructure and local decision-making institutions	D	D	There are local communities, but no negative issues. **Construction Phase:** It is no negative issue to local communities, but it's required to advance announcement and it should be carefully manage the land boundary on construction.
	21	Misdistributio n of benefits and damages	C-	C-	Because the project lies in a developed area, considerable misdistribution of benefit among local people is unlikely to occur. However, misdistribution of benefit between relocated and remaining business stores may occur.
	22	Local conflicts of interest	C-	C-	Because the project lies in a developed area, considerable impact due to local conflict is unlikely to occur. However, local conflict between relocated and remaining business stores may occur.
	23	Cultural heritage	D	D	There are no cultural heritages around Kukum highway.
	24	Landscape	B-	D	**Construction Phase:** Loss of vegetation and construction work will change the landscape. **Operation Phase:** Significant impact to landscape is unlikely to occur.
	25	Gender	D	D	**Construction Phase:** Since construction work is performed in accordance with the labor law of Solomon State, it is assumed that there will be no particular impact on gender. **Operation Phase:** Gender impact is not expected as a result of the improvement of the Kukum highway

Category	No.	Impact Item	Assessment		Reason / Remarks
			Pre-Construction Phase Construction Phase	Operation Phase	
	26	Children's rights	D	D	**Construction Phase:** Since construction work is performed in accordance with the labor law of Solomon State, it is assumed that there will be no particular impact on children's rights. **Operation Phase:** Since the design is made in consideration of access to schools, etc., it is assumed no significant impact to the children's right.
	27	Infectious diseases such as HIV/AIDS	D	D	HIV patients are registered and treated, and are unlikely to flow in as workers, with no impact.
	28	Working conditions (including occupational safety)	B-	D	**Construction Phase:** There is a possibility of heat stroke due to the hot environment. **Operation Phase:** Road operation will not have impacts on working conditions.
Other	29	Accidents	B-	D	**Construction Phase:** Labor accident, including tumble accident may involve pedestrians and street vendors **Operation Phase:** It is expected that the reduction in traffic congestion will reduce driver stress, but will have little effect on the accident rate.
	30	Trans-boundary impacts or climate change	D	D	Trans-boundary impacts such as climate change are unlikely to occur.
	31	UXO	C±	D	**Construction Phase:** If remined un-developed area, UXO might be found. **Operation Phase:** No impact that survey was completed at operation phase

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)
D: No impact is expected
* Impact Items refer to "JICA Guidelines for Environmental and Social Considerations April 2010"

1.4.1.6 Survey Plan on Environmental and Social Considerations

The survey plan is shown in Table 1.19.

Table 1.19 Method and Contents of the Survey

Category	No.	Impact item	Assessment		Monitoring item/parameter	Method
			Pre-Construction Phase Construction Phase	Operation Phase		
Pollution	1	Air pollution	B-	B±	1.Ambient air quality 2.Air environment standard 3.Affect of construction 4.Forecasting traffic condition in future	・Exsiting data ・Measurement of PM, NO_2 etc in roadside ・Confirmation of construction contents and the method ・Prediction of pollution load based on future traffic
	2	Water pollution	B-	B-	1.Water quality 2.Water enviromnetal standard 3.Influence by construction	・Survey of exsting data ・Water quality survey to dishcrage channel/river ・Confirmation of exsting discharg esystem on road side ・Confirmation of construction method and components
	3	Waste	B-	D	1.Treatment method of waste around construction site	・Hearing to staff ・Survey of similar countermeasure
	4	Soil pollution	D	D	1.No need survey because no use any materials to be occur soil pollution	-
	5	Noise and Vibration	B-	B±	1.Noize and vibration 2.Environmental standard 3.Hospital and school 4.Influence by construction	・Survey of exsting data ・Measuerment of noise level on road side ・Predict of nosie level based on future traffic ・Confirmation of construction method and components
	6	Ground subsidence	B±/ D	D	1. Elevention of pire level	・Survey on exting data ・Measurment of pire level
	7	Offensive odor	D	D	1.No need survey because not estimate occur offensive odor	-
	8	Bottom sediment	B-	B-	1. Watre quality on flood	・Water quality monitoring

Category	No.	Impact item	Assessment		Monitoring item/parameter	Method
			Pre-Construction Phase Construction Phase	Operation Phase		
Natural Environment	9	Protected areas	D	D	1.No need survey because no protected area around Kukum highway	-
	10	Ecosystem	B-	C-	1. Rare species 2.Number of tree 3.Coral survey at esturly	・Survey of exsting data ・Hearing from redidentials
	11	Hydrology	C-	D	1.Infulence of construction 2.Affect of flood	・Survey of exsting data ・Hearing from redidentials
	12	Geographical features	B-	D	1. Current situation	・Simple survey
Social Environment	13	Resettlement/ Land Acquisition	B-	D	1.Scale of resettlement 2.Preparation of abbreviated resettlement action plan	・Survey of related regulations ・Survey of socila economic ・Survey of resttelment cost ・Hearing of stakeholders ・Survey of similar countermeasure
	14	Impoverished /Poor people	B±	D	1.Living conditions of affected residents	・Survey of social economic ・Survey of exsting data ・Survey of similar countermeasure
	15	Ethnic minorities and indigenous peoples	D	D	1.No need survey because no Ethnic minorities and indigenous peoples to be affected	-
	16	Local economies, such as employment, livelihood, etc.	B±	B+	1.Living conditions of affected residents 2.Economic condition around target area 3.Situation of vehicles and pedestrians crossing the road	・Survey of social economic ・Survey of exsting data ・Field survey ・Survey of similar countermeasure

Category	No.	Impact item	Assessment		Monitoring item/parameter	Method
			Pre-Construction Phase Construction Phase	Operation Phase		
	17	Land use and utilization of local resources	D	B+	1.Land use of target area 2.Social economic condition	・Field survey ・Survey of exsting data ・Hearing to steakholders ・Survey of similar countermeasure
	18	Water usage	C-	D	1.Groundwater level 2.Practical watere use	・Monitoring of groudwater level ・Hearing to steakholders
	19	Existing social infrastructures and services	B-	D	1.Utilities condition on road side 2.Situation of vehicles and pedestrians crossing the road	・Field survey ・Survey of exsting data ・Hearing of stakeholders ・Survey of similar countermeasure
	20	Social institutions such as social infrastructure and local decision-making institutions	D	D	1.No need survey because it's a improvement work on existing road, then no impact to existing local society	-
	21	Misdistribution of benefits and damages	C-	C-	1.Living conditions of affected residents 2.Preparation of abbreviated resettlement action plan	・Survey of social economic ・Survey of exsting data ・Survey of similar countermeasure
	22	Local conflicts of interest	C-	C-	1.Living conditions of affected residents 2.Preparation of abbreviated resettlement action plan	・Survey of social economic ・Survey of exsting data ・Survey of similar countermeasure
	23	Cultural heritage	D	D	1.No need survey because no cultural heritage to be protected around Kukum highway	-
	24	Landscape	B-	D	1.Distribution of tree 2.Procedure related to tree cutting	・Field survey ・Survey of exsting data ・Hearing of stakeholders

Category	No.	Impact item	Assessment		Monitoring item/parameter	Method
			Pre-Construction Phase Construction Phase	Operation Phase		
	25	Gender	D	D	1.National gender policy in Solomon Islands	・Survey of exsting data
	26	Children's rights	D	D	1.Suvery for schooling and employment	・. Labour law ・Survey of exsting data ・ Hearing of stakeholders
	27	Infectious diseases such as HIV/AIDS	D	D	1.HIV/ AIDS prevalence	・Survey of exsting data ・Hearing of stakeholders
	28	Working conditions (including occupational safety)	B-	D	1.Labour condition 2.Possibility of heat stroke	・Survey of exsting data ・Hearing of stakeholders ・Survey of similar countermeasure
Others	29	Accidents	B-	D	1.Number of traffic accidents	・Survey of exsting data ・Hearing of stakeholders ・Survey of similar countermeasure
	30	Trans-boundary impacts or climate change	D	D	1.No need survey because it's not estimat trans-boundary impacts or climate change	-
	31	UXO	C±	D	1.UXO survey company 2.Cost of UXO treatment 3.Un-developed area	・Hearing to UXO survey company ・Survey of un-developed area

1.4.1.7 Survey Results of Environmental and Social Considerations

The Team evaluated environmental and social considerations based on the information collected at the beginning stage of the Survey and other additional surveys/investigations.

1.4.1.7.1 Pollution

(1) Air pollution

1) Environmental Quality Standard on Ambient Air

As the Solomon Islands has no air pollution standard value, assessment on EIA can be conducted based on standards of donor's country or international standards. Table 1.20 shows Japanese environmental standards on ambient air.

Table 1.20 Air Environmental Standard in Japan

Parameter	Evaluate condition	References
Suspended Particulate Matter (SPM)	The daily average for hourly values shall not exceed 0.10 mg/m^3, and hourly values shall not exceed 0.20 mg/m^3	Particle size of 10 micrometers or less of particulate matter (PM) are called suspended particulate matter (SPM) Due to the smaller particle size, they tend to deposit on the lungs and trachea when inhaled, affecting the body. Air pollution due to suspended particulate matter (SPM) has become severe due to the rapid increase in urban traffic.*2
Fine Particulate Matter (PM2.5)	Annual average shall not exceed 15 µg/m^3, and daily values shall not exceed 35 µg/ m^3	Smaller particle size of 2.5 micrometers or less of the suspended particulate matter (SPM) are called fine particulate matter (PM2.5). It is easier to reach deep into the lungs than suspended particulate matter (SPM), and is thought to have a greater impact on health.*2
Nitrogen dioxide (NO_2)	The daily average for hourly values shall be within the 0.04-0.06 ppm zone or below that zone	Nitrogen oxides (NOx) are generated when fuel is burned at a high temperature and nitrogen and oxygen in the fuel and air are combined. The pollution sources are variety from Industrial plants, power plants, automobiles and homes etc. Air pollution caused by nitrogen oxides (NOx) emitted from automobiles has become a problem in urban area, and efforts are being made to reduce emissions through regulations such as exhaust gas control. Effects on the human: high concentration of nitric oxide (NO_2) has an adverse effect on respiratory organs such as throat, trachea and lungs.*2
Sulfur dioxide (SO_2)	The daily average for hourly values shall not exceed 0.04 ppm, and hourly values shall not exceed 0.1 ppm	Sulfur oxides (SOx) such as sulfur dioxide (SO_2) are generated when burning fuels such as oil and coal. In Japan, in the era of economic growth, air pollution caused by sulfur oxides (SOx) contained in emission gas from industrial plants and the like progressed, creating a serious problem. Sulfuric oxide (SOx) is one of causes of acidity-rain. As a result of various measures and regulations, its concentration is currently decreasing.
Carbon monoxide (CO)	The daily average for hourly values shall not exceed 10 ppm, and average of hourly values for any consecutive eight-hour period shall not exceed 20 ppm	It is known that carbon monoxide binds to hemoglobin in blood to inhibit the function of transporting oxygen, and to prolong the life of methane in the atmosphere, which is a greenhouse gas.*1
Photochemical oxidant (Ox)	Hourly values shall not exceed 0.06 ppm	Photochemical oxidants (Ox) are generated when nitrogen oxides (NOx) and volatile organic compounds (VOC) emitted from automobiles and plants are exposed to ultraviolet light to cause a photochemical reaction*2

**1 : Web site of the National Institute for Environmental Studies.*

**2 : Web site of the Environmental Restoration and Conservation Agency.*

Table 1.21 shows the WHO guideline value with comparison of Japanese standards. In case a different measurement unit is used, they are converted to same measurement unit under the condition at a temperature of 20°C and one atmosphere pressure.

Table 1.21 WHO Guideline Value

Parameter	Guideline value*1	Guideline value as reference	Env. Standard in JP
Particulate Matter (PM10)	20 μg/m^3 annual mean 50 μg/m^3 24-hour mean no guideline 1-hour mean	no require unit convert	No value annual mean 100 μg/m^3 24-hour mean 200 μg/m^3 1-hour mean
Fine Particulate Matter (PM2.5)	10 μg/m^3 annual mean 25 μg/m^3 24-hour mean	no require unit convert	15 μg/m^3 annual mean 35 μg/m^3 24-hour mean
Nitrogen dioxide (NO_2)	40 μg/m^3 annual mean 200 μg/m^3 1-hour mean	0.0209 ppm annual mean 0.1045 ppm 1-hour mean	0.04 - 0.06 ppm 24-hour mean
Sulfur dioxide (SO_2)	20 μg/m^3 24-hour mean 500 μg/m^3 10-minute mean	0.0075 ppm 24-hour mean 0.1875 ppm 10-minute mean	0.04 ppm 24-hour mean 0.1 ppm 1-hour mean
Carbon monoxide (CO)	No guideline value	no value	10 ppm 24-hour mean 20 ppm 8-hour mean
Ozon (O_3)	100 μg/m^3 8-hour mean	0.0500 ppm 8-hour mean	0.06 ppm 1-hour mean

*1 : Air Quality Guidelines Global updated 2005, WHO

Environmental standards applied to the Project was determined considering the following points.

1. WHO guideline value is relatively strict value.
2. Value of ambient air quality differ by 3% between at a temperature of 20°C and 30°C.
3. The observation unit with short time measurement is preferable because the purpose of monitoring is to assess impacts during construction.
4. Carbon monoxide is not applied to the Project because impacts of construction are not expected, and it is not applied to WHO guideline.
5. Ozon (or Photochemical oxidant) is not applied to the Project because impacts of construction are not expected.

Table 1.22 Air Environmental Standard Applied to the Project

Parameter	Standard value	Apply	Reason
Suspended Particulate Matter (SPM)	200 μg/m^3 1-hour mean	Japan	1 hour-mean evaluation can be done by Japanese standard
Fine Particulate Matter (PM2.5)	25 μg/m^3 24-hour mean	WHO	WHO apply more strict value
Nitrogen dioxide (NO_2)	200 μg/m^3 1-hour mean (0.1045 ppm 1-hour mean at 20℃)	WHO	1 hour-mean evaluation can be done by WHO value
Sulfur dioxide (SO_2)	0.1 ppm 1-hour mean	Japan	1 hour-mean evaluation can be done by Japanese standard
Carbon monoxide (CO)	20 ppm 8-hour mean	Japan	No value in WHO
Photochemical oxidant (Ox)	0.06 ppm 1-hour mean	Japan	1 hour-mean evaluation can be done by Japanese standard

2) Current condition of Ambient Air

No statistical air pollution data was found in and around the target area. The Team conducted air quality monitoring activities at the points shown in Figure 1.23.

Figure 1.23 Monitoring Points for Air Pollution and Noise

The monitoring results are shown in Table 1.24. Although accuracy of this survey cannot be guaranteed because it is based on a simple sensor, etc., the ambient air conditions were estimated to be generally good. The summary of equipment shown in Table 1.23. Nitrogen dioxide and Sulfur dioxide were measured for around 5 hours. Estimated detection limit on NO_2 and SO_2 are 0.06 ppm and 0.4 ppm respectively.

Table 1.23 Summary of Monitoring Equipment

Parameter	Equipment	Display
Particulate Matter （PM10）	Portable measurement device	Minimum display 1 μ g/m3
Fine Particulate Matter （PM2.5）		Minimum display 1 μ g/m3
Nitrogen dioxide （NO_2）	Passive tube	Minimum display 0.3 ppm/hr
Sulfur dioxide （SO_2）		Minimum display 2 ppm/hr

Table 1.24 Results of Air Monitoring

Parameters	Measuring points							Environmental Standard
	#1	#2	#3	#4	#5	#6	#7	
Particulate Matter （PM10）	16.9	19.4	25.8	17.5	34.8	26.8	17.9	200 μg/m^3 1-hour mean
Fine Particulate Matter （PM2.5）	13.0	14.3	20.2	15.4	27.9	23.1	17.3	25 μg/m^3 24-hour mean
Nitrogen dioxide （NO_2）	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	200 μg/m^3 1-hour mean （0.1045 ppm 1-hour mean at 20℃）
Sulfur dioxide （SO_2）	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	0.1 ppm 1-hour mean

3) Prediction of Air pollution on Construction Phase

Estimated impacts in the construction phase are as follows:

1. Lane restriction: Increase in exhaust gas with fuel consumption caused by traffic congestion due to lane restriction during construction (Negative impact)
2. Operation of construction vehicles: Increase in exhaust gas with fuel consumption caused by operation of construction vehicles (Negative impact)
3. Transportation of construction vehicles: Increase in particulate matter due to dust hoisting of construction vehicles transporting soil and stone during construction (Negative impact)

For improvement works of the 4-lane section, 4-lane operation will be kept during the works although the lane width is planned to be decreased. Therefore, traffic congestion is expected to be minimized. Furthermore, considering that the traffic volume is over 1,000 vehicles per hour, the impact of construction vehicles is relatively low. For the soil and sand used in this project (approximately 38,000 m^3 of soil and sand and approximately 51,000 m^3 of crushed stone), average 40 trucks/day are operated by assuming of the construction period (280 days of operation/year, 2 years) and using of 4t-trucks. The number of operated trucks is over 5 vehicles per hour, which is about 0.5% compared to general traffic vehicles.

As the effects (NO_2, SO_2) due to fuel, the results of NO_2 was not detected, below the standard values. SO_2 was also not detected, but it did not evaluate whether its value is below the standard values or not. Recently, due to improvement in the fuel quality of automobiles, sulfur dioxide in automobile exhaust gas has not been a serious problem, and in Japan, the sulfur dioxide emission from automobile emission measurement stations is 100% achieved. Therefore, in the present situation where nitrogen dioxide is below the standard value, it is assumed sulfur dioxide value is also below standard value.

On the other hands, regarding particulate matter, construction vehicles may pass through areas on quarries and are more likely to wind up dust than ordinary vehicles. In addition, at the hearing of the construction status of Phase 1, there were opinions from residents about raising dust of construction vehicles.

Based on these facts, the impact on air pollution during construction is determined as shown in Table 1.25.

Table 1.25 Impact and Countermeasure on Construction Stage

Parameter	Standard value	Impact/Countermeasure
PM10	200 μg/m^3 1-hour mean	There are dust effects. For this reason, contractors take measures to control dust (spraying asphalt emulsion etc.) and carry out regular monitoring. Evaluation is [B-] and mitigation measures need to be implemented.
PM2.5	25 μg/m^3 24-hour mean	
NO_2	200 μg/m^3 1-hour mean (0.1045 ppm 1-hour mean at 20℃)	The impact is assessed to be negligible or minor. Correct the rating to [D].
SO_2	0.1 ppm 1-hour mean	

4) Prediction of Air pollution in Operation Phase

During the operation phase, in addition to the current situation, it is expected that traffic volume will increase because traffic congestion will be reduced due to improvement of road surface conditions and flood mitigation. This will affect amount of fuel consumption, and consequently change of exhaust gas amount will have a positive and negative impact on air pollution.

1. Increase in traffic volume: Increase in exhaust gas with fuel consumption due to increase in the number of vehicles (Negative impact).
2. Improvement of road surface conditions: Reduction of exhaust gas caused by improved fuel efficiency due to increase in travel speed using roads with improved surface (Positive impact)
3. Enhancement of discharge function: By reducing of flood with enhanced discharge function, exhaust gas will decrease due to increase of travel speed and fuel efficiency (Positive impact)

The above-mentioned "1" is a matter that occurs regardless of whether or not construction has been implemented or not, and the positive impacts of "2" and "3" will be added by the implementation of the Project. Thus, the impact on air pollution during operation phase can be expected to be reduced when compared without the project. In comparison before and after the Project, it is expected that there will be positive and negative impacts, and that there will be no or only minor impact on air pollution. The evaluation is corrected to [D].

(2) Water pollution

1) Environmental Standard on Water Quality (River)

As the Solomon Islands has no water quality standard value, the assessment on EIA can be conducted based on standards of donor's country or international standards. Table 1.26 shows the Japanese Environmental standards on river water quality.

Table 1.26 Water Quality Standard on river

Item		Standard value				
Class	**Water use**	**pH**	**BOD_5**	**SS**	**DO**	**Total coliform**
AA	Water supply class 1, conservation of natural environment, and uses listed in A-E	6.5-8.5	1 mg/l or less	25 mg/l or less	7.5 mg/l or more	50 MPN/100 ml or less
A	Water supply class 2, fishery class 1, bathing and uses listed in B-E	6.5-8.5	2 mg/l or less	25 mg/l or less	7.5 mg/l or more	1000 MPN/100 ml or less
B	Water supply class 3, fishery class 2, and uses listed in C-E	6.5-8.5	3 mg/l or less	25 mg/l or less	5 mg/l or more	5000 MPN/100 ml or less
C	Fishery class 3, industrial water class 1, and uses listed in D-E	6.5-8.5	5 mg/l or less	50 mg/l or less	5 mg/l or more	-
D	Industrial water class 2, agricultural water, and uses listed in E	6.0-8.5	8 mg/l or less	100 mg/l or less	2 mg/l or more	-
E	Industry water class 3, and conservation of environment	6.0-8.5	10 mg/l or less	Floating Matter such as garbage should not be observed	2 mg/l or more	-

The classification of the target rivers is presumed as follows:

1. Water channel near MoF (Class C);
   The main usage is discharge channel, but it can be found small fish.
2. Burns creak (Class C);
   The main usage is discharge channel, but it can be found small fish.
3. Lungga river (Class A);
   It has not been used as drinking water source in the target section, but the river is used a playing spot such as bathing for local people.

2) Current Condition of Water Quality

As statistical water quality data of target channel/river could not be found, the Team conducted water quality monitoring (Figure 1.24) taking into account the following points for simple measurement:

- Water temperature, pH, DO and turbidity were measured by sensors.
- The turbidity is evaluated by SS according to Japanese standards, but it is measured by the sensor as NTU. Thus, it cannot be directly compared and evaluated.
- As COD is measured based on color change in the test kit, it is considered as reference values.

Figure 1.24 Monitoring Point for Water Quality

The results of water quality at three sites shown in Table 1.27 are low in DO and high in COD, and it is estimated that some pollution occurs. In addition, pH is acidic and there is concern about the effects of domestic wastewater.

Table 1.27 Results of Water Quality Monitoring

Parameter	Environmental standard		Monitoring place		
	Class A	Class C	Water channel (Class C)	Burns Creek (Class C)	Lungga river (Class A)
Temp. (℃)	no regulation	no regulation	37	32.1	31.8
pH (-)	6.5-8.5	6.5-8.5	5.4	6.3	6.5
DO (mg/L)	7.5 mg/L or more	5.0 mg/L or more	3.2	2.9	2.6
Turbidity (NTU)	25 mg/L or less as SS	50 mg/L or less as SS	0	16.7	12.8
COD (mg/l)	2.0 mg/L or less as BOD	5.0 mg/L or less as BOD	20	32	5

Note : ;Exceed value of Japanese Environmental standards

In the Project, the flooded water will be promptly drained to surrounding waterways and rivers including the Burns Creek and the Lungga River. For this reason, a large amount of inundation will flow into waterways and rivers as compared with conventional road surface drainage, and may affect the existing water quality. In order to study the effect of draining the inundation into rivers and drains, the Team investigated river water quality during rainfall. The results are shown in Table 1.28.

When it rains, the river water quality is pH neutral due to rainfall. In addition, an increase in turbidity is confirmed, which is thought to be due to increase in flow rate.

Table 1.28 Results of Flood Water Quality

Parameter	Environmental standard		Monitoring place		
	Class A	Class C	Water channel (Class C)	Burns Creek (Class C)	Lungga river (Class A)
			2020/03/14	2020/03/14	2020/03/14
Temp. (℃)	no regulation	no regulation	31.7	27.9	26.2
pH (-)	6.5-8.5	6.5-8.5	7.5	7.4	8.0
DO (mg/L)	7.5 mg/L or more	5.0 mg/L or more	2.6	0.9	7.5
Turbidity (NTU)	25 mg/L or less as SS	50 mg/L or less as SS	24.4	95.5	110
COD (mg/l)	2.0 mg/L or less as BOD	5.0 mg/L or less as BOD	20	22	20

Note : ▭ ; Exceed value of Japanese Environmental standards

3) Prediction of Water Quality Pollution in Construction Phase

Generally, water quality pollution in the construction phase is not predicted. However, when sprinkling water to prevent dust from rolling up, the minimum amount of water will be used to prevent it from flowing out of the construction site. If there is a risk of discharge to outside the site, mitigation measures such as using sandbags will be taken.

When rain falls, turbidity water might be into rivers temporarily, the contractor should take measures of mitigation such as cover sheet on soil. If oil leaks from construction vehicles, there is a concern about the effect on the environment. Therefore, it is necessary to inspect construction vehicles on a daily basis and maintain appropriate operating conditions. These mitigation measures will be specified in Terms of Reference (TOR) on the tender document. By conducting these mitigation measures or management, the environmental impact will be minimized and assessed to negligible or minimal.

4) Prediction of Water Quality Pollution in Operation Phase

When rain falls, drainage volume load of surrounding drainage channels will increase due to the improved road drainage, but no significant impact on environment is expected. In the vicinity of the Burns Creek, since a large amount of rainfall collected from the hinterland is quickly discharged, it is expected that the temporary drainage load of the Burns Creek will increase.

As a result of the survey, the existing turbidity during rainfall of the Burns Creek and the Lungga River was high. Even if road surface drainage flows into the river, it is predicted that the water quality will not deteriorate significantly due to road surface drainage and the impact will be minor. In addition, it is confirmed that the estuary of the Lungga River is not designated as a protected area, and has no coral to be protected.

Therefore, it is evaluated that the increase in water volume and turbidity caused by rainfall is negligible.

(3) Waste

1) Waste Management in Construction Phase

Waste from the exiting road materials will transferred to a registered waste treatment area (Ranadi dumping site, around 15,000 m^2) as designated by the MID (as the developer) in the construction phase. Ranadi dumping site was used for household waste by Honiara City Council and its capacity is enough for the Project.

Road materials contain no toxic materials and the waste is expected to use as landfill materials. Therefore, environmental impact of waste materials disposed properly is minimal.

In addition, general waste such as household waste, office waste and human waste at the construction office or construction site are handled in compliance with laws of the Solomon Islands. As for the human waste treatment, septic tanks will be installed in the construction supervision office, and simple toilets will be connected to sewers operated by Solomon water or treated with septic tanks. Therefore, the impact of general waste associated with the construction is insignificant.

2) Waste Management in Operation Phase

Any solid waste will not be generated in the operation phase because the construction office will close. The impact to environment is negligible.

(4) Soil Pollution

1) Construction Phase

When materials and equipment containing chemical substances are used during construction or in the construction supervision office, it is required to store them in a building with concrete foundation. At present, the Project is planned to use no harmful substances, materials and equipment. However, when oil used for heavy machines is stored, a concrete foundation building will be built to prevent scattering due to wind and rain, and to prevent soil penetration due to leakage.

2) Operation Phase

As environmental impact is not estimated in the operation phase, any surveys and prediction are not necessary.

(5) Noise

1) Noise Standard

Nosie level standards in the Solomon Islands was not found. The standard is considered based on Japanese standards shown in Table 1.29 and Table 1.30.

Table 1.29 Noise Standard on Roadside Area

Area category	Standard value	
	Daytime (6:00 - 22:00)	Nighttime (22:00 - 6:00)
Area on 2 lane road in area A.	Less than 60 dB	Less than 55 dB
Area on more than 2 lane road in area B, and Area C	Less than 65 dB	Less than 60 dB
Area A: Residential area only Area B: Mainly residence use Area C: Mixing use on residence, commercial and factory		

Table 1.30 Noise Standard on Area Adjacent to Highway

Time		Standard value
Daytime	6:00 - 22:00	Less than 70 dB
Nighttime	22:00 - 6:00	Less than 65 dB

The regulation value of noise at construction site is shown in Table 1.31.

Table 1.31 Regulation Value on Construction Site

Type of regulation/ Sector	1st Sector	2nd Sector
Noise level	Not over 85 dB at the boundary of construction site	
Working hour	Not working on 19:00 - 7:00	Not working on 22:00 - 6:00
Working time	10 hours in a day	14 hours in a day
	Within 6 days	
Working day	No work on Sunday and Holiday	
1st Sector: The area of especially require calm condition for preservation of good residential condition. 2nd Sector: The area except 1st-Sector in designated areas		

In the Project, the road purpose is “Highway” and the area category is “2nd Sector”. The target area is assessed in consideration of these issues and noise level standard shown in Table 1.32 is applied to the assessment.

Table 1.32 Nosie Level Standard on the Kukum Highway Project

Category/ Time	Regulated value	
	Daytime (6:00 - 22:00)	Nighttime (22:00 - 6:00)
Construction Phase	Less than 85 dB	Avoid unnecessary work
Operation Phase	Less than 70 dB	Less than 65 dB

2) Current Noise Level

As statistical noise level data of the target area was not found, the Team conducted a noise level monitoring as a baseline survey. The results of the baseline survey shown in Table 1.33 and Figure 1.25 show the same trend along highway. The noise levels, generally, begin to decline from peak time of 17:00 and are minimized at around 4:00. The noise levels during daytime is approximately 70 dB.

Table 1.33 Results of Noise Monitoring

#	Monitoring place	Measuring date	Average of L50/ ( ) in maximum value	
			Average at daytime (6:00-22:00)	Average at nighttime (22:00-6:00)
#1	Infront of MFMR & SINU	2019/11/25-11/26	68.6 (71.5)	54.7 (60.7)
#2	Infront of Medical center (Maromaro)	2019/12/6-12/7	67.2 (70.4)	60.1 (66.9)
#3	Infront of Marine School	2019/11/28-11/29	69.5 (71.8)	64.0 (71.8)
#4	Infront of KGVI School	2019/11/29-11/30	64.3 (66.7)	55.2 (59.5)
#5	Infront of Old Taj Mahal (Lungga Cross Road)	2019/12/2-12/3	66.8 (69.0)	51.8 (57.2)
#6	Infront of Henderson Police Residence	2019/12/3-12/4	62.4 (67.0)	52.5 (56.8)
#7	Henderson (Outside of Dalgro Stockpiling Area)	2019/12/4-12/5	47.6 (55.0)	43.3 (46.1)

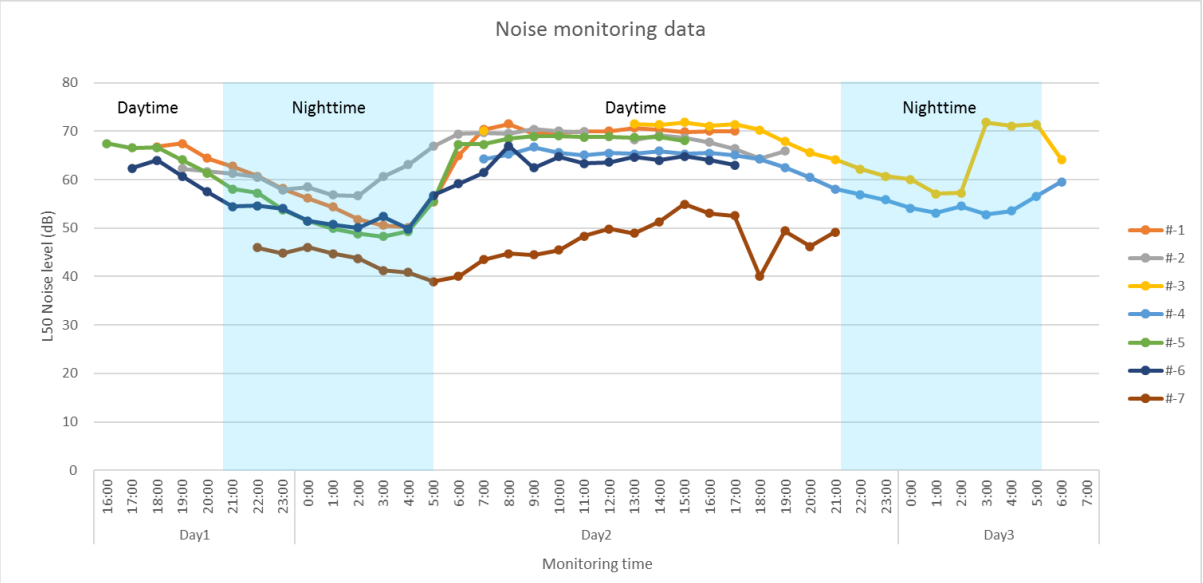


Figure 1.25 Variation of Noise Level

3) Prediction of Noise Level in Construction Phase

Predicted impacts at the construction phase are as follows:

1. Lane restriction: Reduction of noise level with decrease of vehicles speed caused by traffic congestion due to lane restriction during construction (Positive impact)
2. Travelling of construction vehicles: Increase of noise level by traveling of construction vehicles (Negative impact)
3. Operation of construction vehicles: Increase of noise level by operation of construction vehicles (Negative impact)

For improvement works of the 4-lane section, 4-lane operation will be kept during the works although the lane width is planned to be decreased. Therefore, traffic congestion is expected to be minimized. Furthermore, considering that the traffic volume is over 1,000 vehicles per hour, the impact of construction vehicles is relatively low.

On the other hand, the operation of construction vehicles might generate noise under demolition works. The noise levels of each work type are shown in Table 1.34.

Table 1.34 Noise level data

Work type	Unit	Characteristic	Evaluation	Lw_{Aeff} (dB)	ΔL (dB)
Excavation work	Soil excavation	Fluctuation	L_{AS}	104	5
Embankment work (Filled-up ground, Subgrade)	Embankment (Filled-up ground, Subgrade)	Fluctuation	L_{AS}	108	5
Slope stability work	Slope stability (Fill)	Fluctuation	L_{AS}	100	5
	Slope stability (Excavation)	Fluctuation	L_{AS}	111	5
Slope splaying work	Slope splaying	Fluctuation	L_{AS}	103	3
Planting work	Borrow material splaying	Fluctuation	L_{AS}	101	-
Cast in place wall work	Concrete work using pumping car	Fluctuation	L_{AS}	108	5
Cast in place curvet work					
RC Structural work					
Structure demolition work	Structure demolition	Impact	$L_{A, Fmax S}$	120	8
	Structure demolition (Crusher)	Fluctuation	L_{AS}	[105]	[5]
	Structure demolition (mobile crusher)	Fluctuation	L_{AS}	111	3
Asphalt pavement work	Upper/ lower subbase course	Fluctuation	L_{AS}	102	6
Concrete paving work					
Asphalt pavement work	Pavement/ Subbase	Fluctuation	L_{AS}	101	6
Concrete paving work	Concrete paving	Fluctuation	L_{AS}	104	5

[ ] : Reference value

Source: Environmental Impact Assessment Technique for Road Project (2), No. 153 Technical note of National Institute for Land and Infrastructure Management

Noise level by operation of construction vehicles is estimated by the following formula:

$$L_{Aeq} = L_{Aeq^*} + \Delta L$$

$$\Delta L = 10log_{10}\{(10^{L_{Aeq,R}/10} + 10^{L_{AeqHC}/10})/10^{L_{Aeq,R}/10}\}$$

L_{Aeq} : Current noise level

$L_{Aeq,R}$: Equivalent noise level calculated from current traffic volume by ASJ formula

$L_{Aeq,HC}$: Equivalent noise level calculated from traffic volume construction vehicles by ASJ formula

Inhere, $L_{Aeq,R}$ apply current noise level, and $L_{Aeq,HC}$ apply the data on Table 1.34. As the results, the noise level will equally value with noise level by construction vehicles.

Furthermore, distance attenuation of noise level from sound source is calculated by a formula below, and the results is shown in Table 1.35.

$$L_r = L_w + log_{10}\left(\frac{Q}{4\pi r^2}\right)$$

L_r : Noise level on distance r

r : Distance from sound source

Q : Directivity coefficient of sound source (Inhere apply "2")

Considering distance from a sound source, noise levels of most construction works except demolition work are less than the standard values. Regarding impact to school along the Kukum Highway, it will be estimated to be lower the standard value because classrooms of King Gorge IV High School have more than 60 m distance from the roadside.

As the results of assessment, the evaluation is [B-] for the impact on noise level. But the contractor is required to conduct mitigation measures such as using low noise construction vehicles, maintaining vehicles properly and not conducting demolition work with other work at the same time. The method on countermeasure will be specified in TOR on the tender document

Table 1.35 Prediction Results of Noise Level

Category	Excavation work	Cast-in-place	Asphalt paver work	Demolition work
Current noise	75 (based on current monitoring results)			
Nosie on each work	109	113	108	128
Δ L	34.0	38.0	33.0	53.0
Laeq	109.0	113.0	108.0	128.0
Distance from sound source (m)	**Estimated noise level after attenuation (dB)**			
5	87.0	91.0	86.0	106.0
10	81.0	85.0	80.0	100.0
20	75.0	79.0	74.0	94.0
30	71.5	75.5	70.5	90.5
50	67.0	71.0	66.0	86.0
80	63.0	67.0	62.0	82.0

: Over the standard level of 85dB

Source: JICA Survey Team

4) Prediction of noise level in operation phase

Impacts on noise level in the operation phase are estimated as follows:

1. Increase in traffic volume: Increase of noise level due to increase of the number of vehicles (Negative impact), this impact will occur without the Project.
2. Improvement of road surface condition: Reduction of noise level due to the improved road surface condition (Positive impact)
3. Increase in traveling speed: Increase in noise level with increase in traveling speed (Negative impact) and decrease of exposure time (Positive impact)

The increase in traffic volume "1" are estimated based on the baseline survey (Table 1.36). As the results of estimation of future traffic volume, it will increase to 124 % for the 2-lane section and 117% for the 4-lane section at the project completion in 2023, and will be 148% for the 2-lane section and 134% for the 4-lane section in 2030.

Table 1.36 Future Traffic Volume

Year	2 Lane section		4Lane section	
	Daily traffic volume (Veh/day)	Peak traffic volume (Veh/hour)	Daily traffic volume (Veh/day)	Peak traffic volume (Veh/hour)
2019	14,587	1,092	36,114	2,801
2020	15,394	1,152	37,554	2,913
2021	16,245	1,216	39,051	3,029
2022	17,144	1,283	40,607	3,150
2023	18,092	1,354	42,226	3,275
2024	19,093	1,429	43,910	3,406
2025	20,149	1,508	45,660	3,542

Year	2 Lane section		4Lane section	
	Daily traffic volume (Veh/day)	Peak traffic volume (Veh/hour)	Daily traffic volume (Veh/day)	Peak traffic volume (Veh/hour)
2026	20,977	1,570	48,237	3,741
2027	21,839	1,635	50,960	3,953
2028	22,736	1,702	53,837	4,176
2029	23,670	1,772	56,876	4,411
2030	24,643	1,844	60,086	4,660
2031	25,997	1,946	62,523	4,849
2032	27,425	2,053	65,060	5,046
2033	28,932	2,165	67,699	5,251

The impact to noise level with change of traffic volume is calculated by using the following model[1];

$$L_{Aeq,T} = 10 \times log_{10}\left(10^{L_{AE}/10} \times \frac{N_T}{T}\right)$$
$$= L_{AE} + 10 \times log_{10}\frac{N_T}{T}$$

The calculated noise levels are increment of 1.3% for 25% traffic volume increment, and increment of 2.4 % for 50% traffic volume increment. Other impacts of "2", "3" are also very small. Therefore, the final evaluation is corrected to [D].

(6) Vibration

1) Vibration Standard

As vibration level standards in the Solomon Islands are not found. Generally, standards of donor's country can be applied to vibration assessment. In Japan, vibration issues are controlled not under environmental standards but under Vibration Act. The standard values for vibration in Japan are shown in Table 1.37 and Table 1.38.

Table 1.37 Regulation Values of Vibration in Specific Construction Area

Items/Sector	1st Sector	2nd Sector
Level of vibration	Not over 75 dB at the boundary of construction site	
Working hour	Not working on 19:00 - 7:00	Not working on 22:00 - 6:00
Working time	10 hours in a day	14 hours in a day
	Within 6 days	
Working day	No work on Sunday and Holiday	
1st Sector: The area of especially require calm condition for preservation of good residential condition. 2nd Sector: The area except 1st-Sector in designated areas		

[1] ASJ RTN-Model 2013

Table 1.38 Regulation values on Traffic Vibration

Area/Time	Regulation value	
	Daytime (6:00 - 22:00)	Nighttime (22:00 - 6:00)
Primary area	Less than 65 dB	Less than 60 dB
Secondary area	Less than 70 dB	Less than 65 dB
Primary area : The area of especially require calm condition for preservation of good residential condition. Secondary area: Mixing use on residence, commercial and factory		

The regulation values for vibration shown in Table 1.39 will be applied to the Project.

Table 1.39 Regulation Value of Vibration in the Kukum Highway Project

Category/Time	Regulation value	
	Daytime (6:00 - 22:00)	Nighttime (22:00 - 6:00)
Construction phase	Less than 75 dB	Avoid unnecessary work
Operation Phase	Less than 70 dB	Less than 65 dB

2) Current Vibration Level

Statistical vibration level data of the target area could not be found, the Team conducted vibration level monitoring as a baseline survey.

Table 1.40 Results of Baseline Survey on Vibration

#	Monitoring place	Monitoring date	Ave. L50 /（max value）	
			Average on daytime (6:00-22:00)	Average on nighttime (22:00-6:00)
#1	Infront of MFMR & SINU	2019/12/5-12/6	30.4 (33.3)	15.3 (22.3)
#2	Infront of Medical center (Maromaro)	2019/12/7	31.6 (36.9)	22.0 (27.2)
#3	Infront of Marine School	2018/11/28-11/29	31.6 (34.3)	16.1 (24.9)
#4	Infront of KGVI School	2019/11/29-11/30	36.0 (40.6)	22.8 (28.4)
#5	Infront of Old Taj Mahal (Lungga Cross Road)	2019/12/2-12/3	32.6 (36.5)	17.9 (28.5)
#6	Infront of Henderson Police Residence	2019/12/3-12/4	37.2 (49.6)	15.4 (21.0)
#7	Henderson (Outside of Dalgro Stockpiling Area)	2019/12/4-12/5	16.8 (19.8)	11.4 (12.3)

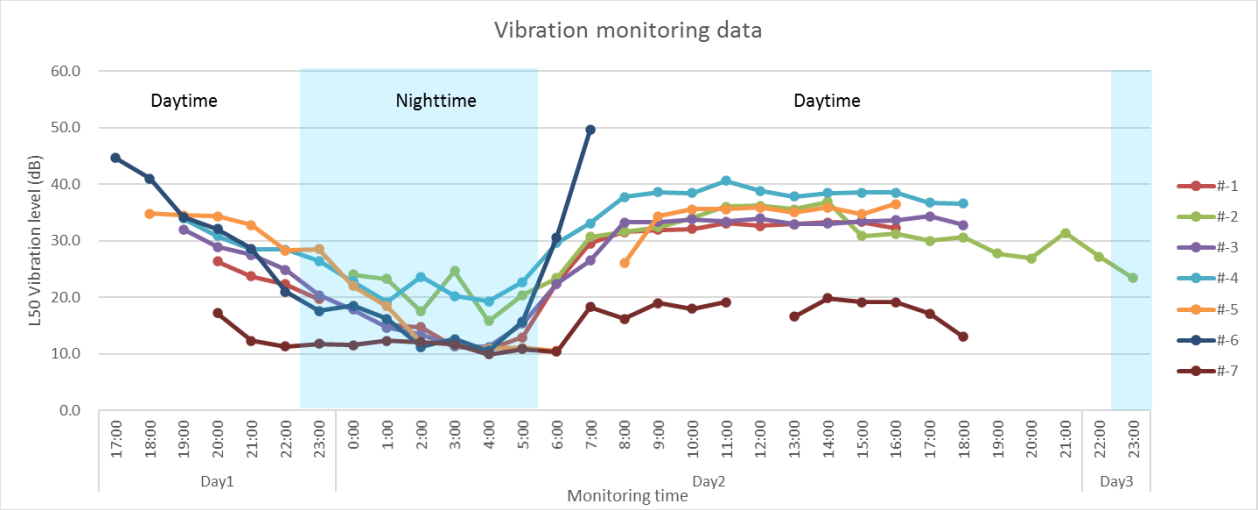


Figure 1.26 Monitoring Results on L50 Vibration

3) Prediction of Vibration Level in Construction Phase

Predicted impacts in the construction phase are as follows:

1. Lane restriction: Decrease of vibration level with reduction of vehicle speed caused by traffic congestion due to lane restriction during construction (Positive impact)
2. Travelling of construction vehicles: Increase of vibration level by traveling of construction vehicles (Negative impact).
3. Operation of construction vehicles: Increase of vibration level by operation of construction vehicles (Negative impact)

Regrading item “1”, for improvement works of the 4-lane section, 4-lane operation will kept during the works although the lane width is planned to be decreased. Therefore, traffic congestion is expected to be minimized. Furthermore, considering that the traffic volume on "2" is over 1,000 vehicles per hour and that buss and track account for 15%, the impact from construction vehicles is relatively low.

Regarding item “3” on operation of construction vehicles, embankment and subgrade work might have impacts to environment. The vibration levels of each work-unit are shown in Table 1.41. As shown in the table, the maximum vibration level is 69 dB for embankment work, which is lower than the reference value. The effect will be further reduced, considering distance attenuation of the vibration level. Therefore, the impact of vibration level during the construction phase is insignificant and the evaluation is corrected to [D].

Table 1.41 Vibration Level

Work type	Unit	Vibration level (dB)
Excavation work	Soil excavation	54
Embankment work (Filled-up ground, Subgrade)	Embankment work (Filled-up ground, Subgrade)	69
Structure demolition work	Structure demolition work	52
Asphalt pavement work	Asphalt pavement work	68
Transportation work in site (un-pavement)	Transportation work in site (un-pavement)	57

Source: Environmental Impact Assessment Technique for Road Project (2), No. 153 Technical note of National Institute for Land and Infrastructure Management

4) Prediction of vibration level in operation phase

Impacts on vibration level in the operation phase is estimated as follows:

1. Increase in traffic volume: Increase of vibration level due to increase in the number of vehicles (Negative impact), this impact will also occur without the Project.
2. Improvement in road surface condition: Reduction of vibration level with the improved road surface condition (Positive impact)
3. Improvement in road surface condition-2: Increment of traveling speed with improvement of road surface condition will increase vibration level of traveling (Negative impact) and reduce exposure time (Positive impact).

The impact of vibration level on the operation phase is estimated to have both negative and positive impacts, and the impacts may be small or negligible. Therefore, the final evaluation is corrected to [D].

(7) Land Subsidence

1) Pre-construction Phase

The possibility of subsidence of the Lungga Bridge and the land subsidence affecting the bridge were not confirmed by a land survey.

2) Construction Phase

There is no large amount of water intake during the construction phase. The current groundwater level is about 2 m below the ground level, and there is no possibility of excavation to these aquifers during construction. There are no issues causing land subsidence.

3) Operation Phase

During construction of the Project, groundwater level will be checked, and the road will be constructed using an appropriate construction method. Therefore, any land subsidence will not occur in the operation phase.

(8) Offensive Odor

Materials and equipment that may cause offensive odors will not be used in the construction and maintenance works; occurrence of offensive odors is not estimated.

(9) Bottom Sediment

1) Construction Phase

Generally, bottom sediment in the construction phase is not predicted.

When rain falls, turbidity water might flow into rivers temporarily; thus, the contractor is required to take measures of mitigation such as covering sheets on soil. By conducting these mitigation measures, the environmental impacts can be minimized and are assessed to be negligible or minimal.

2) Operation Phase

Generally, impact of bottom sediment is not predicted on the operation phase.

When rain falls, drainage volume load of surrounding drainage channels will increase due to the improved road drainage. In the vicinity of the Burns Creek, since a large amount of rainfall collected from the hinterland is quickly discharged, it is expected that the drainage load of the Burns Creek will also increase temporarily.

As a result of the investigation, turbidity of water quality of the Burns Creek and the Lungga River during rainfall was high (refer to Table 1.28). Even if the road surface drainage flows into the river, it is expected to hardly affect current condition of the bottom quality. Therefore, the impact can be estimated to be minor. In addition, it is confirmed that the estuary of the Lungga River is not designated as a protected area, and has no coral to be protected. Therefore, it is evaluated that the increase in water volume and turbidity caused by rainfall is negligible.

1.4.1.7.2 Natural Environment

(1) Protected Area

There are 90 protected areas in the Solomon Islands based on the protected areas disclosed by authority on Protected Planet®. Most of the areas in the Solomon Islands are marine protected areas, and they are not found in the vicinity of the Project area. As the project area and its surrounding area have been developed, there is no protected area and important habitat.

Source: https://www.protectedplanet.net/

Figure 1.27 Protected Area in the Solomon Islands

(2) Ecosystem

1) Current Condition

The project area and its surrounding area have been developed, and there are no rare organisms or unique ecosystems to be protected along the Kukum Highway. In addition, no ecosystems such as rare organisms and corals to be protected are confirmed in the drainage canals and rivers including estuaries. There are street trees and fruit trees of neighboring residents along the highway.

2) Pre-construction Phase

The number of plants that are expected to be pruned/cut down for construction is shown in Table 1.42. Total of 96 trees will be cut for the construction in the project area including the median strip. Regarding the trees to be felled, the policy is to plant an equal number of trees from the viewpoint of carbon offset.

The MID as the developer will complete these road tree pruning/cutting and planting efforts before the construction of the Project. The Team will monitor the progress before start of construction.

The cost of cutting is 500-1,000 SBD depending on the size of the trees. The estimated cost is about 70,000 SBD (920,000 JPY).

Table 1.42 Affected trees

Diameter of Tree	No,	Cost（SBD）
15 – 30 cm	13	**72,000**
30 - 50cm	54	
50 cm～1 m	17	
More than 1 m	12	
Total	**96**	

3) Operation Phase

The impact to ecosystem is estimated to be small or negligible in the operation phase. Although rain discharged water will flow into the Lungga River and others, the water does not include toxic substance. In the vicinity of estuary of the river, there is no coral to be protected. Basically, the discharge amount from the road is relatively small compared with the total amount discharged from sub-basin. Therefore, the impact is negligible, and the results are reasonable as [D].

(3) Hydrology

1) Current Condition

In the Project, issues of hydrology to be considered are impact to groundwater during construction and the existing waterways, such as rivers/creek, to which rainwater from roads will be discharged.

2) Construction Phase

According to the survey conducted at three sites, current groundwater level is more than 2 m below from the ground level, and there is no possibility of excavation to aquifers.

3) Operation Phase

As the amount of discharged water from roads is relatively small compared with the total amount of that from sub-basin, the impact is negligible.

(4) Geographical Features

1) Current Condition

Basically, a large part of the target area is used as roads because the Project purpose is an improvement work on the existing road and the road alignment will not be changed significantly. At a part of the east side of the Lungga Bridge, embankment is planned to install bus stops and bypasses. Soil and stone used in the Project will be acquired from riverbed of the Lungga River designated by the developer, MID. As a result of the site visit, it was confirmed that the planned quarry site is used in the airport refurbishment project and supply amount of soil/stone from the upstream is sufficient. The assessment target is shown in Figure 1.28. MID, the project developer, will be responsible for obtaining of permission for quarrying.

Embankment section for installing bus stops and bypasses

Quarry spot

Figure 1.28 Locations that may Affect Topography and Geology

2) Construction Phase

The embankment is planned on a slope beside the Lungga Bridge. At present, waste have been illegally dumped at this place. In the Project, embankment work will be conducted after removing the waste. There is no ecosystem to be considered and the amount of embankment is small. Therefore, it is assessed that the impact is very small or negligible to environment.

Regarding the digging and quarrying, in the target Lungga River area, a nearby area has been used even in another project, and it has been confirmed that there is a sufficient amount of soil and stone. Also, considering the actual situation of usage in other projects and the current state of rivers, the supplying amount from upstream is sufficient. The usage amount in the Project (assumed 38,000 m^3 of soil and sand, 51,000 m^3 of gravel) has no significant impact to environment. The assessment result is reasonable on [D].

3) Operation Phase

There are no factors affecting geographical features in the operation phase.

1.4.1.7.3 Social Environment

(1) Resettlement/ Land Acquisition

1) Current Condition

The Kukum Highway is currently the main road that connects the east and west centering on Honiara, and there are many shops along the road. Land acquisition for the construction estimated from the road surface map is as follows. The buildings that are expected to be relocated are shown in Table 1.44. One residential building is in the relocation target, but this is a vacant house. Therefore, no resettlement will occur.

Table 1.43 Land Acquisition and Lease

Ownership		Lease		Purchase		Total Land for Acquisition (m^2)
Category	Number of Ownership	Number of place	Affected area (m2)	Number of place	Affected area (m^2)	
SIG (Solomon Islands Government)	5	4	663	4	606	1,269
Individual	10	6	132	10	452	583
Corp	8	4	258	8	1,056	1,314
Joint	8	5	320	7	360	680
under confirmation	4	4	28	1	16	44
Total	35	23	**1,400**	32	**2,490**	**3,890**

Table 1.44 Buildings on Assuming to compensation

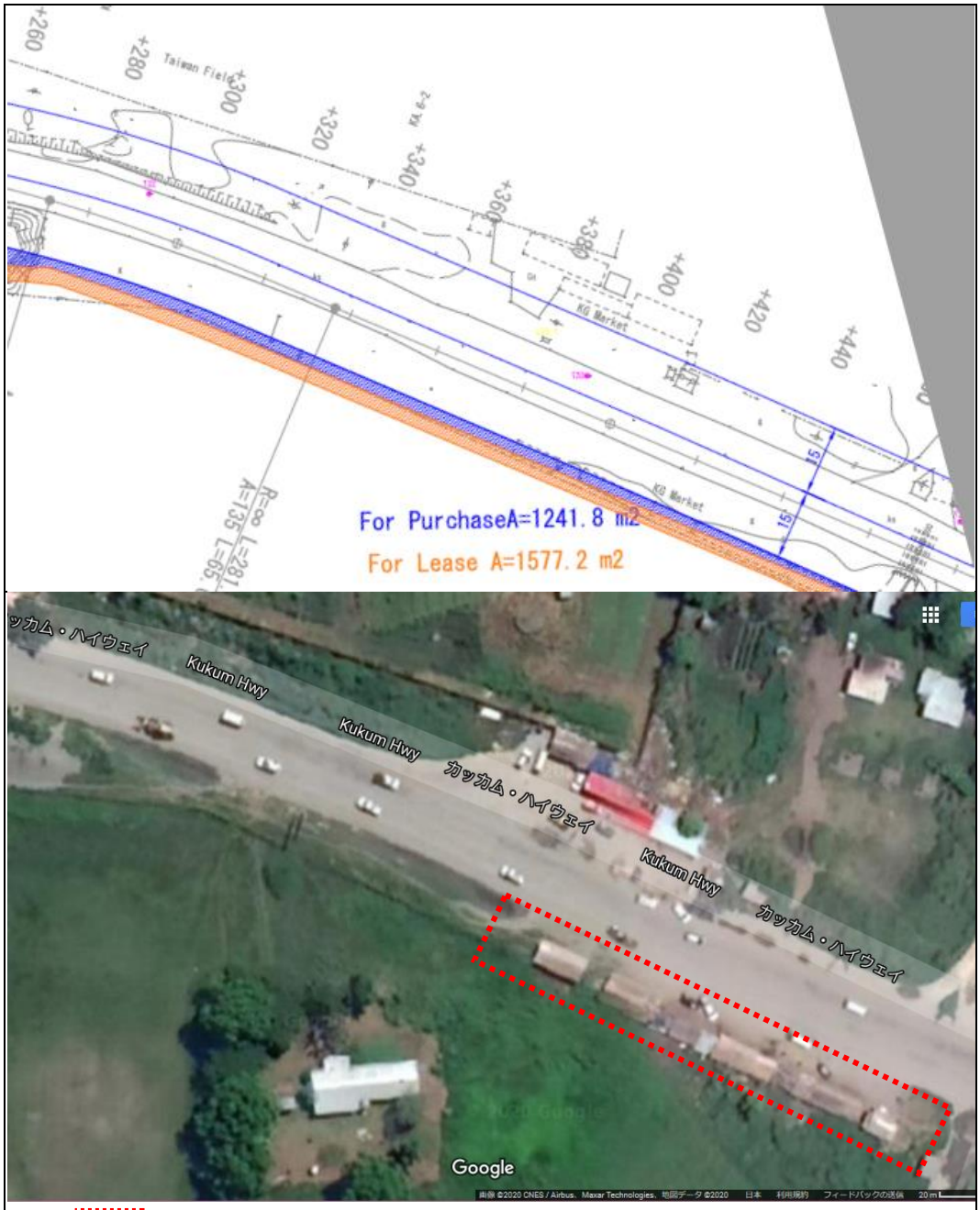
Type of Facilities	Number of owners	Affected Area (m2)
Canteen	22	570.5
Market hut	65	764.6
Residential	1	36.0

2) Pre-construction phase

The land acquisition and lease along the Kukum Highway should be conducted in advance because the contractor should promptly carry out the work.

The MID is responsible for the implementation of the land acquisition as the developer. The area of land acquisition is approximately 3,890 m^2 for the construction.

In addition, some street vendors will need to be moved due to the land acquisition. Compensation for the street vendors who need to move is also under MID's responsibility. The part of the resettled area is shown in Figure 1.29.



Note: ▭ Street vendors to be need relocate
Source : Google Map®

Figure 1.29 Street Vendors required to Relocate in King George VI Market

The cost of land acquisition estimated is shown in Table 1.45.

Table 1.45 Cost of Land Acquisition

	Number of Land acquisition (Place)	Total Area (m2)	Compensation cost (SBD)
Land Acquisition	35	3,890	3,521,978

Note: Rate of 1SBD=13.115 (JICA rate in July 2020)

In addition, land for temporary yards, plants and offices is planned near Honiara International Airport, and a temporary land lease of approximately 35,000 m^2 is required. The construction supervision office is planned to be built at a site of the airport and the site is currently used by Dalgro co. ltd. The MID has a responsibility for this land acquisition including related negotiations.

Note: ▭ Construction office place
Source: Google Map®

Figure 1.30 Planned Site for Construction Office

3) Construction Phase

Some street vendors along the road will need to relocate during the construction. These temporary relocations shall be conducted before the construction or according to the construction schedule. A part of the target place is shown in Figure 1.31.

Note: Street vendor required to relocate temporarily
Source: Google Map®

Figure 1.31 Temporary Resettlement in Construction Phase

4) Operation Phase

There are no factors affecting land acquisition during the operation phase.

(2) Impoverished/Poor People

1) Current Condition

According to a household survey by UNDP, 24.6% of Honiara households are below the poverty line. As a characteristic of urban areas, the survey results show that spending on non-food items is higher than in rural areas. In addition, the survey shows the food poverty line (FPL) SBD 182.87/week and basic needs poverty line (BNPL) 265.77/week per household. If converted the FPL and BNPL as an average of 4.5 weeks per month, FPL = SBD 823/month and BNPL = SBD 1,195/month, respectively.

The results of the social survey in 333 households under the Project are shown in Table 1.46. As the results, it can be confirmed that the average income of households along the Kukum Highway exceeds SBD 1,000/week and over the poverty line. On the other hand, in more detail, looking at the income situation by individual household (Reference Table 1.47), 25 households are below SBD 800/month, and 39 households are located between SBD 800 and 1,200/month. In particular, 14 households answered that their monthly income is "SBD 0". Households with low income tend to have a small number of household members and have a short stay history of less than one year at the address at the time of the survey.

Table 1.46 Households Income in Project Area

	Monthly Household Income (SBD)	Monthly Household Expenses (SBD)	Total Number of Household Members:	No. of Household Members at Present
Total Amount	1,780,256	759,432	2012	1749
Average Amount	5,314	2,267	6	5

Table 1.47 Number of Households based on Income

Monthly income ($)	Number of households	Average of number of members
0 ≦100	14	1.0
100 ≦200	2	1.0
200 ≦500	6	2.0
500 ≦800	3	2.0
800 ≦1,200	39	2.6
1,200 ≦2,000	56	3.8
2,000 ≦3,000	52	4.8
3,000 ≦4,000	35	6.0
4,000 ≦5,000	38	6.9
5,000 ≦10,000	59	8.7
10000<	31	13.9

2) Pre-construction Phase/Construction Phase

Land acquisition and lane restrictions will be required during construction. Specifically, the KGVI Market, the bus stop at the east side of the Lungga Bridge, and street vendors operating their shops in Henderson area will need to be temporarily relocated. These street sellers are likely to be in common with the low-income households above, and measures by the MID are required.

On the other hand, employment of simple labor is likely to occur for the construction, and the overall assessment remains as [B±].

3) Operation Phase

In the operation phase, the south side of the KGVI market may be unavailable and impacts on street vendors livelihoods in this area are expected; thus, measures by the MID are required in the operation phase. The evaluation is corrected to [B-].

(3) Ethnic Minorities and Indigenous Peoples

1) Current Condition

The target area has been developed and there are no target ethnic minorities or indigenous peoples.

2) Pre-construction Phase/ Construction Phase

There are no target ethnic minorities and indigenous peoples, so there is no impact.

3) Operation Phase

There are no target ethnic minorities and indigenous peoples, so there is no impact.

(4) Local Economies (Employment, Livelihood, etc.)

1) Current Condition

Employment and livelihoods related to the Kukum Highway will be expected to be affected as shown below:

a. Bus and taxi business using the Kukum Highway
b. Business owners with stores (shops, gas stations) along the Kukum Highway
c. Distributor/Sales staff at the market along the Kukum Highway

2) Pre-construction Phase/ Construction Phase

Estimated impacts during the construction phase are shown below:

a. Bus and taxi business using the Kukum Highway

Based on the basic construction policy of the Project, lane improvement work is planned to construct lanes one by one without completely close. For this reason, basically it is assessed that the impact to bus and taxi business will be minor though temporary traffic congestion may occur near the construction site.

b. Business owners with stores (shops, gas stations) along the Kukum Highway

As mentioned above, the improvement work of the Kukum Highway will be conducted, keeping a 4-lane operation. Therefore, there will be no significant impact as accesses on foot or by vehicle will not be completely blocked during the work.

c. Distributor/Sales staff at the market along the Kukum Highway

The street markets along the highway, Fishing village, King George VI, Burns Creek, Lungga and Henderson, are subject to temporary restrictions during construction. However, these street vendors may be hired as unskilled workers for construction.

The other hands, the King George VI Market has street markets on both the north and south sides of the road, and in particular, the south market is in need of resettlement. Compensation for the store and staff will be implemented by the MID.

3) Operation Phase

In the operation phase, traffic congestion is predicted to be reduced due to improvement of road surface condition. Expected positive impacts on the development of the regional economy are as follows:

1. Improvement of road surface condition: As the road surface condition is improved, the traveling speed becomes stable and traffic congestion is alleviated. (Positive impact)
2. Improvement of road surface condition 2: From the effect of the above impact 1, efficiency and punctuality of cargo transportation of imports and exports from Honiara Port (Positive impact) are improved.
3. Strengthening drainage function: Road closures due to flood during rainfall is reduced (Positive impact).
4. Installation of safety equipment such as night lights and guardrails: Traffic safety at night and for pedestrians is improved (Positive impact)

In addition to the above positive impact,

5. Relocation of KG market: Relocation of livelihoods in KG market is required. (Negative impact)

Given the above, the overall evaluation is [B±]

(5) Land Use and Utilization of Local Resources

1) Current Condition

The majority of land within is Honiara City Boundaries are either crown land (government owned) or registered estates and Land which is outside of Honiara City Boundaries are either customary or privately owned. Land in Honiara is about 22.73km2 and of which about 65% of it is being developed, 1.5 % is yet to be developed as it is privately owned. Another 13.5% the land is occupied by informal settlements.

One of the major lands uses on the Island of Guadalcanal is the Honiara City. It occupies a large part of the north-west coastal side of the island. Guadalcanal Provincial office and Honiara City's Government and Administrate Headquarters is situated in Honiara,

and Honiara International Airport is located east of Honiara, outside the HCC boundaries, The largest open-air food market is in Honiara CBD, two smaller markets exist on the eastern side of the town, Fishing village Market and Henderson Market and at White River on the western side of the town. There are also numerous smaller, and often illegal, markets that operate in villages, associated with schools and health clinics, as well as along the Main Road and other major routes.

There are around 30 informal settlements located within the City boundary in Honiara plus 6 others which have trespassed into customary land. Approximately 35% of the total population of Honiara lived in the unplanned informal settlements. These settlements lack adequate services such as water and electricity supply. Along the Kukum Highway and at the start of the project road section is one of the settlements known as the Fishing Village. Other settlements along the subproject road include KG, Burns Creek, Lungga, Sun Valley and Henderson. While this area is immediately outside of the town boundary and falls under the jurisdiction of Guadalcanal Province, it is issued to the COL under perpetual estate title.

The use of land for small scale farming and gardening particularly for root crops and vegetables is common in areas around Burns Creek and Betikama which is East of Honiara before the Lungga Bridge. Harvests from the farms are sold either at Burns Creek Market, Lungga Market, Fishing Village Market or the Honiara Central Market.

Some of the people residing in Honiara and along the project road are also engaged in making what is commonly known as ‘sup-sup garden’ in their back yards of agricultural products such as cassava, slippery cabbage, Chinese cabbage and tomatoes. Others tend to farm lands within Honiara that are considered unfitting for development.

2) Construction Phase

During the construction, car lanes are planned to be maintained while leaving the existing roads, and no large-scale land acquisition is planned. Therefore, no significant impact on land use and local resource use is expected.

3) Operation Phase

This project is a rehabilitation of existing roads, no major changes in road alignment and access are expected from the viewpoint of land use and local resource use. On the other hand, it is expected that economic activities will be promoted, and the use of local resources will be contributed by the improvement of road surface condition and the reduction of flood damage. The evaluation is [B+] without change.

(6) Water Usage

1) Current Condition

In the Honiara, especially along the Kukum Highway, water is supplied by the water network. In addition, there are cases where well water and rainwater storage water are used.

2) Pre-construction phase/Construction Phase

During the construction, it is necessary to relocate the water supply line and distribution pipes, and the relocation of them will be carried out by the MID as the developer before the construction. In addition, no impact on aquifers and rainwater is expected. The evaluation is "D".

3) Operation Phase

No impact on water use is expected in the operation phase.

(7) Existing Social Infrastructures and Services

1) Current Condition

Existing social infrastructure has lifelines such as electricity and water supply. Table 1.48 shows each management organization.

Table 1.48 Management Organization of Lifelines

#	Category	Organization	Relocation
1	Water supply	Solomon Water	Need
2	Telephone	Telekom	Need
3	Electric power	Solomon Power	Need

There are also hospitals, schools, churches and shops along the Kukum Highway.

2) Pre-construction Phase/Construction Phase

Predicted impacts in the pre-construction phase/construction phase are as follows:

1. Relocation of infrastructure facilities: Relocation of lifelines is required, and the MID as the developer should complete the relocation before construction (Negative impact)
2. Restriction of access to facilities along the road due to traffic restrictions: Accessibility to facilities along the road decreases during construction (Negative impact)

As a basic construction policy, the construction is planned with consideration that access to various facilities will not be completely closed, and the evaluation remains as [B-].

The estimated cost for the relocation is shown in Table 1.49.

Table 1.49 Relocation cost of lifelines

Items	Estimated cost (SBD)
Water supply line in underground	13,868,000
Telephone/Communication line in underground	
Power cable in underground	
Telephone/Communication line and pole	

3) Operation phase

Predicted impacts in the operation phase are as follows:

1. Clarification of bus stops: Convenience of some of bus stops is improved, including expansion of the bus stop area (Positive impact)
2. Improvement of pedestrian crossings: Convenience and safety of access to various facilities along the road are improved (Positive impact)
3. Relocation of lifeline: Due to this relocation, it will be relocated from directly under the road to the footpath, etc., so maintenance and management of future lifeline equipment will be improved (Positive impact).

As described above, it is judged that accessibility and safety to various facilities will improve after the Project, and the impact on social infrastructure and social services themselves is judged to be minor, and the evaluation remains as [D].

(8) Social Institutions (Social Infrastructure and Local Decision-making Institutions, etc.)

1) Current Condition

In addition to the governmental governance system, there is traditional governance systems supporting local communities led by tribal chiefs, etc. and the systems remain in other islands and villages. However, in Honiara City, social Institutions are operated according to constituencies of the Honiara City Council.

2) Pre-construction Phase/Construction Phase

Lane restrictions will be conducted during the construction, but no direct impact on the local community is expected.

However, in the Solomon Islands, influence of local communities is assumed to be large, and it is required to explain handling of land boundaries, possibility of temporary restrictions of access to the main road and other issues to the affected communities before the construction period.

3) Operation Phase

In the operation phase, it will be the same as the existing lanes, so no impact on the local communities is expected.

(9) Misdistribution of Benefits and Damages

1) Current Condition

The project road is basis of economic activities for residents and access to various facilities around Honiara. There are several street markets along the road.

2) Construction Phase

Predicted impacts in the construction phase are as follows:

1. Lane restriction: Accessibility to various facilities decreases for all users who use the Kukum Highway (Negative impact)
2. Land acquisition: Temporary relocation of the street markets is required in the King George area (Negative impact)

As mentioned above, since the negative impacts is expected, the evaluation is corrected to [B-].

3) Operation Phase

Predocted impacts in the operation phase are shown below.

1. Improvement of the Kukum Highway: Convenience of the users of the Kukum Highway is improved, such as improvement of the road surface and enhancement of drainage function (Positive impact)
2. Relocation of stores of King George market: Some stores of King George market are expected to be permanently relocated (Negative impact). However, the MID will compensate for permanent relocation.

As mentioned above, since positive and negative impacts are expected, the evaluation is corrected to [B-].

(10) Local Conflicts of Interest

1) Current Condition

Currently, there is no particular conflict of interest in the project area.

2) Construction Phase

It is not expected that there will be conflicts of interest in the construction phase.

3) Operation Phase

It is not expected that there will be conflicts of interest in the operation phase.

(11) Cultural Heritage

1) Current Condition

Currently, there is no cultural heritage in the project area.

2) Pre-construction Phase/ Construction Phase

There are no cultural heritage sites to be required special consideration in the construction phase.

3) Operation Phase

There are no cultural heritage sites to be required special consideration in the operation phase.

(12) Landscape

1) Current Condition

There are roadside trees and vegetation in the median along the project roads.

2) Pre-construction Phase/ Construction Phase

The vegetation along the main road will be removed before the construction, which will have a negative impact on the landscape.

3) Operation Phase

In the operation phase, it will be a landscape road with less vegetation compared to the current situation.

(13) Gender

1) Current condition

The Solomon Islands has the Ministry of Women, Youth, Children and Family Affairs that focuses on issues of women, adolescents, children and families who are generally have social vulnerabilities. The following three policies and one plan are published on the Ministry's website:

1. National Gender Equality and Women's Development Policy 2016-2020
2. A National Strategy for the Economic Empowerment of Women and Girls
3. National Policy to Eliminate Violence Against Women and Girls 2016-2020
4. Women, Peace and Security National Action Plan 2017-2020

These publications include policies/plans on agriculture/fishily and economic strengthening/independence support for women in rural areas, and policies on gender equality. The action was further deepened by the 1998 National Policy for Women and the 2010 Gender Equality and Women's Development Policy (GEWD), and further activated by National Gender Equality and Women's Development Policy 2016-2020 made on 2015.

Table 1.50 shows the number of participants by gender in the stakeholder meeting and the two public consultation meetings held by the Project. At the public consultation

meeting, the ratio of males and females was roughly half, and it is estimated that the participation of females was not restricted.

Table 1.50 Number of Participants by Gender

Meeting	No. of Males	No. of Females
Stakeholders Meeting	20	7
Henderson Consultation	23	20
KGVI Consultation	21	19
Total participants	**64**	**46**

In addition, about 79% of the questionnaires answered that there is no difference between males and females regarding equal opportunities in the social environment survey of the Project.

Table 1.51 Questionnaire about Equal Opportunity between Males and Females

	Answer	No. of Answer	%
1	None	260	78.8
2	To go high school	18	5.5
3	To go college	10	3.0
4	Job category	19	5.8
5	Wage	8	2.4
6	Working style (part time job only)	7	2.1
7	Others, specify	8	2.4
Total		**330**	**100**

2) Construction Phase

There are no gender issues to be required special consideration in the construction phase.

3) Operation Phase

There are no gender issues to be required special consideration in the operation phase.

(14) Children's Rights

1) Current Condition

There are kindergartens, elementary schools and junior high schools in the areas affected by the Project.

2) Construction Phase

Predicted impacts in the construction phase are shown below.

1. Temporary relocation of bus stop: Decrease in convenience due to temporary relocation of bus stops used for commuting (Negative impact)
2. Lane restrictions: Increase in commuting time due to traffic congestion (Negative impact)

Although it is difficult to quantitatively evaluate any of these effects, it is considered that no significant impact for children's right. In addition, regarding the possibility of child labor, the Project will prevent occurrence of child labor for the construction by describing compliance with the Solomon Labor Law and prohibition of infringement of children's rights in the conditions of bidding or local construction. Therefore, the evaluation remains as [D].

3) Operation Phase

Predicted impacts in the operation phase are as follows:

1. Traffic improvement: Reduction of commuting time by improving traffic congestion (Positive impact)
2. Improvement of bus stop: The bus stop on the Lungga Bridge is planned to be designed based on the opinions of the MID and stakeholders, improving convenience of attending school (Positive impact).
3. Strengthening drainage function: Reduction of commuting time by reducing lane close/traffic congestion due to floods (Positive impact)
4. Maintenance of incidental facilities: Safety will be improved by the maintenance of pedestrian crossings, guardrails and night lights (Positive impact)

Although the rehabilitation of the Kukum Highway is expected to have a positive impact as mentioned above, the impacts from the perspective of children's rights will not be significant; thus, the evaluation remains as [D].

(15) Infectious Diseases such as HIV/ AIDS

1) Current Condition

The estimated prevalence of HIV in the Solomon Islands is as low as 0.002%, and infected persons are registered. On the other hand, the risk of malaria is as high as 13%, so it is necessary to be careful. These countermeasures will be managed strictly in occupational safety and health management.

2) Construction Phase

HIV is appropriately managed, and its risk is low although it is expected that the number of workers will increase during the construction. On the other hand, since the risk of malaria is 13%, it is necessary to take measures such as preparing mosquito sprays and lotions at workers' rest areas. Wearing long sleeves is one of the measures, but considering the hot and humid climate, it is recommended to use mosquito sprays or preventive antimalarial drugs. These countermeasures will be strictly managed in occupational safety and health management.

As described above, the necessity of measures for workers should be considered, but factors that worsen infectious diseases such as HIV/AIDS are not assumed, and the evaluation is [D].

3) Operation Phase

There are no factors affecting HIV or malaria in operation phase.

(16) Working Conditions (including Occupational Safety)

1) Employment of Women and Children

In the implementation of the Project, the employment of men and women will be handled without any difference, and the labor law of the Solomon Islands (Labour Act, enacted 1996, Chapter 73) will be fully understood and the rights of women and children will be respected.

2) Occupational Safety

As a result of the survey, the average daytime temperature is 30°C and the humidity is 70% in the project area, showing little change throughout the year. There is a Wet Bulb Globe Temperature (WBGT) value as a guideline for the evaluation of heat stress in a hot environment, and the WBGT value is originally calculated by three kinds of temperatures of natural wet-bulb temperature, black-ball temperature and dry-bulb temperature. The WBGT value can be calculated from the relationship (Reference Table 1.52). The WBGT value in the project area is “29”. According to

Table 1.53, a WBGT value of “29” is a level at which work with a low metabolic rate is permissible, and it is necessary to make an appropriate working environment (rest in a cool place, facilities for cooling a body such as a shower, and intake of water and salt etc.) during construction.

Table 1.52 WBGT Value and Relationship During Temperature and Humidity

Temperature (℃) \ Humidity (%)	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
40	29	30	31	32	33	34	35	35	36	37	38	39	40	41	42	43	44
39	28	29	30	31	32	33	34	35	35	36	37	38	39	40	41	42	43
38	28	28	29	30	31	32	33	34	35	35	36	37	38	39	40	41	42
37	27	28	29	29	30	31	32	33	34	35	35	36	37	38	39	40	41
36	26	27	28	29	29	30	31	32	33	34	34	35	36	37	38	39	39
35	25	26	27	28	29	29	30	31	32	33	33	34	35	36	37	38	38
34	25	25	26	27	28	29	29	30	31	32	33	33	34	35	36	37	37
33	24	25	25	26	27	28	28	29	30	31	32	32	33	34	35	35	36
32	23	24	25	25	26	27	28	28	29	30	31	31	32	33	34	34	35
31	22	23	24	24	25	26	27	27	28	29	30	30	31	32	33	33	34
30	21	22	23	24	24	25	26	27	27	28	29	29	30	31	32	32	33
29	21	21	22	23	24	24	25	26	26	27	28	29	29	30	31	31	32
28	20	21	21	22	23	23	24	25	25	26	27	28	28	29	30	30	31
27	19	20	21	21	22	23	23	24	25	25	26	27	27	28	29	29	30
26	18	19	20	20	21	22	22	23	24	24	25	26	26	27	28	28	29
25	18	18	19	20	20	21	22	22	23	23	24	25	25	26	27	27	28
24	17	18	18	19	19	20	21	21	22	22	23	24	24	25	26	26	27
23	16	17	17	18	19	19	20	20	21	22	22	23	23	24	25	25	26
22	15	16	17	17	18	18	19	19	20	21	21	22	22	23	24	24	25
21	15	15	16	16	17	17	18	19	19	20	20	21	21	22	23	23	24

Table 1.53 WBGT value and Physical work stress

Work Category	Example of Physical work stress	WBGT value			
		Person acclimated to heat (℃)		Person non-acclimated to heat (℃)	
0. Rest	・Rest	33		32	
1. Light	・Sitting with light manual work with hands or hands and arms and driving. Standing with some light arm work and occasional walking.	30		29	
2. Moderate	・Sustained moderate hand and arm work, moderate arm and leg work, moderate arm and trunk work, or light pushing and pulling. Normal walking. Moderate lifting.	28		26	
3. Heavy	・Intense arm and trunk work, carrying, shoveling, manual sawing, pushing and pulling heavy loads, and walking at a fast pace. Heavy materials handling.	No airstream 25	Feel airstream 26	No airstream 22	Feel airstream 23
4. Very heavy	・Very intense activity at fast to maximum pace.	23	25	18	20

As described above, the necessity of taking measures for workers should be considered, but factors that worsen the working environment are not assumed and the evaluation is [D].

1.4.1.7.4 Others

(1) Accidents

1) Current Situation

The practical accident information was obtained from the Honiara Traffic Police. It has the number of accidents by each district but does not include specific data where accidents occurred. The Team collected more detailed information through the stakeholder meetings and public consolation. The results are shown in Figure 1.32 to Figure 1.34.

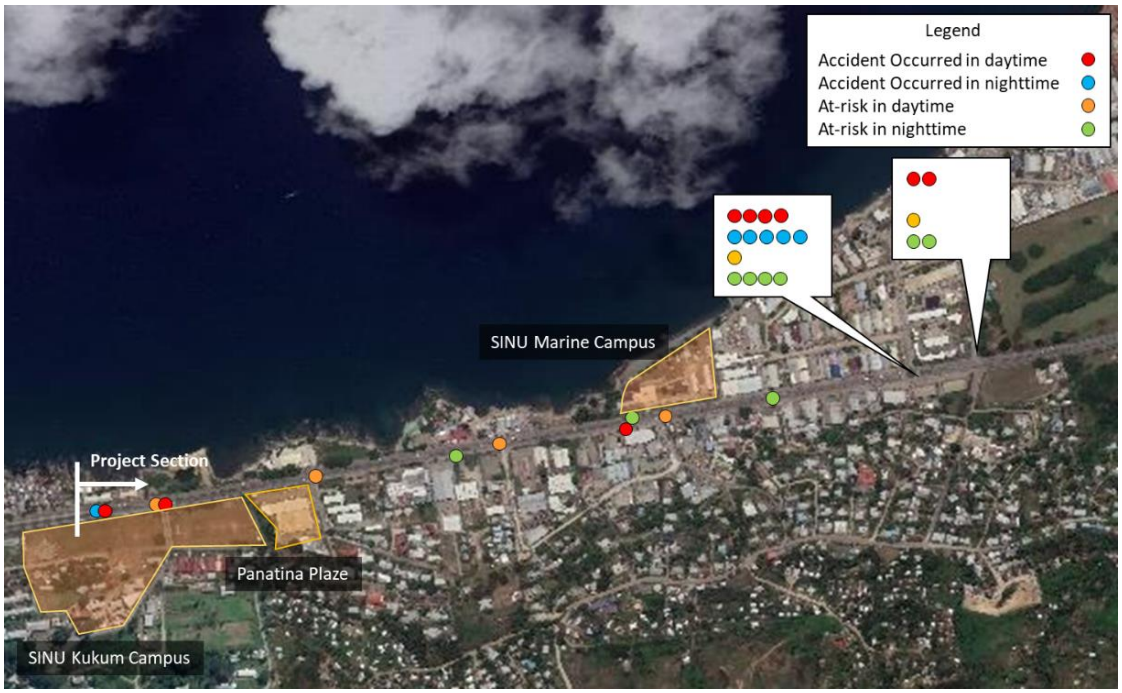


Figure 1.32 Section from MOFMR to Golf Course

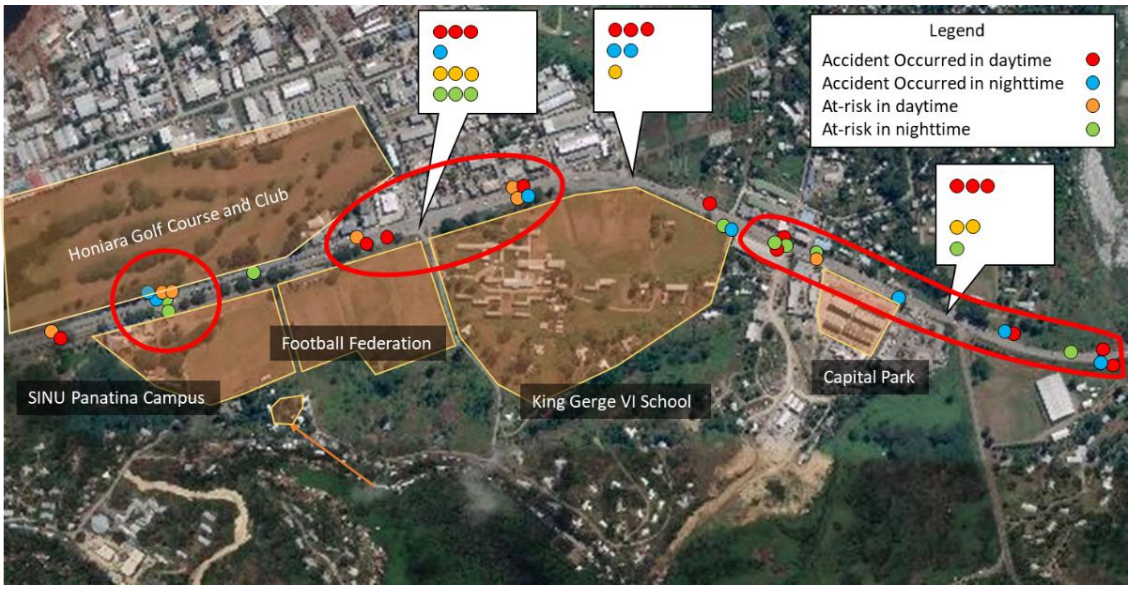


Figure 1.33 Section from Golf Course to Lungga Bridge

Figure 1.34 Section from Lungga Bridge to Honiara International Airport

2) Construction Phase

Predicted impacts in the construction phase are as follows:

1. Lane restriction: Reduction of the number of accidents by decrease of travel speed (Positive impact)
2. Barricade on construction area: There is a possibility of accidents caused by poor visibility or confusion of drivers due to such as barricade and lane change for the construction (Negative impact).

The contractor should take measures such as traffic guide and signboard to mitigate an effect of lane restriction, and should separate lanes for vehicles and for pedestrians using safety guards etc. in order for safety of pedestrians. In addition, the contractor shall apply high visibility methods, such as reflective tape or lights, at night to identify the construction area.

3) Operation Phase

Predicted impacts in the operation phase are as follows:

1. Increase in traffic volume: Increase in traffic volume with economic development and relatively increase in the number of accident (Negative impact), this impact will also occur without the Project.
2. Increase in traveling speed: Improvement of surface condition will lead to increase of accidents caused by increase of traveling speed and decrease of accidents caused by traffic congestion (Negative and Positive impact).
3. Installation of guardrails: Guardrails will reduce the number of car accidents involving people (Positive impact).

4. Installation of lights: Installation of lights will reduce the number of accidents in nighttime (Positive impact).
5. Installation of sign boards: Signboards including crossing belt will be expected to reduce accidents by enhancing drivers' awareness (Positive impact).

Considering improvement of the existing road, the impacts is not significant although there are both positive and negative impacts.

(2) Trans-boundary Impacts or Climate Change

The project purpose is a rehabilitation of the existing road. The evaluated air pollution is low, and it is geographically estimated that there is no cross-border impact. The impact of the Project on amount of carbon dioxide, which is one of the factors of climate change, is also estimated to be minimal.

(3) UXO

1) UXO Survey

There are several private companies including LBS which can conduct an UXO survey. Unit cost of UXO survey generally vary depending on size of a survey area. The total cost for an UXO survey by local company is shown in Table 1.54. Furthermore, MID show the other survey unit cost of UXO survey as SBD 10/m^2.

Table 1.54 Cost for UXO Survey

#	Survey area	Total Cost	Unit cost (USD)	Unit cost (SBD)
1.	$0m^2$ - $100m^2$	USD 1,400	USD 14/m^2	SBD 168/m^2
2.	$0m^2$ - $1,000m^2$	USD 11,400	USD 10-12/m^2	SBD 120-145/m^2
3.	$0m^2$ - $10,000m^2$	USD 62,700	USD 6-7/m^2	SBD 70-80/m^2
4.	$0m^2$ -$100,000m^2$	USD 360,000	USD 4-5/m^2	SBD 50-60/m^2
5.	More than $100,000m^2$		USD 3/m^2	SBD 36/m^2

Note: Unit cost is calculated by JICA Survey Team

2) UXO Treatment

UXO treatment is implanted by Explosive Ordnance Disposal (EOD) team of the Royal Solomon Islands Police Force (RSIPF). The cost of UXO treatment is not required regardless of private land or government sector.

EOD had improved skills of UXO treatment supported by USA, and its skill level achieved "Explosive Ordnance Disposal Level III Certification" in February 2019. EOD treated more than 30,000 UXO including of 79 land mines from 2011 to 2018[2].

[2] Article 7 Report- 1 January 2004 to 31 December 2017, Convention on the prohibition of the use, stockpiling, production and transfer of anti-personnel mines and their destruction

3) Assessment of Un-developed Area

The Team determined the project scope, the target area, the road alignment and areas needed temporarily for the construction. The UXO survey of un-used land areas in past among these land areas will be conducted as un-developed areas. The un-developed area is 80,000 m^2, and the survey cost is estimated at SBD 800,000, SBD 10/m^2 of unit cost. The survey will be conducted by the MID as the developer before the construction. The final evaluation is corrected to [B-].

1.4.1.8 Environmental Impact Assessment

Environmental impact was assessed based on the results of the baseline survey and monitoring.

Table 1.55 Assessment Results

Category	No.	Impact Item	Scoping		Assessment results		Reason / Remarks
			Pre-Construction Phase Construction Phase	Operation Phase	Pre-Construction Phase Construction Phase	Operation Phase	
Pollution	1	Air pollution	B-	B±	B-/D	D	**Construction Phase:** The assessment result for PM is [B-], but the impact by SO_2, NO_2 is D. **Operation Phase:** There are both impact of positive/ negative, but the impact is negligible, final assessment is correct to [D]
	2	Water pollution	B-	B-	B-	D	**Construction Phase:** Turbid water will be generated during rainfall periods. However, conduct measure such as sheet cover etc. by contractor, the impact will be very limited. **Operation Phase:** Discharged water amount from road section is relatively so small compare with water amount of the sub-basin, the impact is negligible.
	3	Waste	B-	D	D	N/A	**Construction Phase:** The waste is treated follow regulation, the impact will be very small. **Operation Phase:** Considerable generation of solid waste is unlikely to occur.
	4	Soil pollution	D	D	N/A	N/A	Because materials that may cause soil pollution such as heavy metal and toxic organic matter will not be used in the construction and maintenance works, soil pollution is unlikely to occur.
	5	Noise and vibration	B-	B±	B-/D	D	**Construction Phase:** Noise level will slight increase at demolition work, it's required countermeasure. The impact of vibration level is predicted to negligible. **Operation Phase:** The impact of noise and vibration is very small, the assessment is corrected to [D].
	6	Ground subsidence	B±/ D	D	D	N/A	**Pre-construction phase:** As the survey results, ground subsidence unlikely to occur.

Category	No.	Impact Item	Scoping		Assessment results		Reason / Remarks
			Pre-Construction Phase Construction Phase	Operation Phase	Pre-Construction Phase Construction Phase	Operation Phase	
	7	Offensive odors	D	D	N/A	N/A	Because materials and equipment that may cause offensive odors will not be used in construction and maintenance works, considerable offensive odors are unlikely to occur.
	8	Bottom sediment	B-	B-	D	D	**Construction Phase:** At the raining period, turbidity water might be into river, the impact to bottom sediment by turbidity are unlikely to occur. **Operation phase:** It's not estimate to significant impact o bottom sediment.
Natural Environment	9	Protected areas	D	D	N/A	N/A	No protected area around project site.
	10	Ecosystem	B-	C-	B-	D	**Pre-Construction Phase, Construction Phase:** Felling of roadside trees will be required in construction phase. However, Impact on urban ecosystem created around Kukum highway will be very limited. **Operation Phase:** Impact on ecosystem at discharged river is very limited.
	11	Hydrology	C-	D	D	D	**Construction Phase:** Considerable impact on ground water by excavation works is unlikely to occur. **Operation Phase:** Drainage system for rain water will not estimate significantly.
	12	Geographical features	B-	D	D	N/A	**Construction Phase:** The impact of the embankment work is limited.
Social Environment	13	Resettlement/ Land Acquisition	B-	D	B-	D	**Pre-Construction Phase:** Permanent land acquisition and temporary land lease will occur. Street vendors will need to be moved. **Operation Phase:** No additional resettlement or land acquisition is required at the operation phase, and no impact is expected.
	14	Impoverished/Poor people	B±	D	B±	B-	**Construction Phase:** As a result of a social survey, there are 25 households below the poverty line, including 14 households with no income, and are likely to be affected by the relocation of the street market. However, there is a possibility that jobs will be created as simple workers. **Operation Phase:** The KG market needs to be permanently relocated, which is expected to affect the poor who operate stores in the market.
	15	Ethnic minorities and indigenous peoples	D	D	N/A	N/A	Impact is not expected

Category	No.	Impact Item	Scoping		Assessment results		Reason / Remarks
			Pre-Construction Phase Construction Phase	Operation Phase	Pre-Construction Phase Construction Phase	Operation Phase	
	16	Local economies, such as employment, livelihood, etc.	B±	B+	B±	B±	**Construction Phase:** The KG market requires relocation. The relocation will raise affecting livelihoods. However, there is a possibility that jobs will be created as simple workers. **Operation Phase:** A positive impact on the local economy due to improved road conditions and a negative impact due to the relocation of the KG market are expected.
	17	Land use and utilization of local resources	D	B+	D	B+	**Pre-Construction Phase:** No negative impact **Operation Phase:** Improving transportation and reducing flooding will contribute to the effective use of local resources
	18	Water usage	C-	D	D	D	**Construction Phase:** There is no possibility of aquifer excavation and no impact is expected. **Operation Phase:** Using of water resources are not expected on operation phase, and there are no adverse effects.
	19	Existing social infrastructures and services	B-	D	B-	D	**Pre-Construction Phase:** It is necessary to relocate and protect utility facilities such as electric wires, communication lines and water pipes. **Construction Phase:** Access to facilities along the road will be impaired by occurrence of traffic congestion, relocation of bus stop and taxi stand, etc. **Operation Phase:** Impact is not expected
	20	Social institutions such as social infrastructure and local decision-making institutions	D	D	D	D	**Pre-Construction Phase:** Although there is a local community, the impact such as divides the local community is not expected. **Construction Phase:** Although no direct impact on the local community is expected, Contractor should provide proper guidance to local communities before the construction and construction should be carried out with due consideration given to land boundaries. **Operation Phase:** Impact is not expected
	21	Misdistribution of benefits and damages	C-	C-	B-	B-	**Pre-Construction Phase:** Negative impacts are expected from decrease of convenience due to lane restrictions and the relocation of the street market. **Operation Phase:** Remain negative impact regarding to relocation of street market.
	22	Local conflicts of interest	C-	C-	D	D	**Construction Phase:** No negative impact. **Operation Phase:** No negative impact.

Category	No.	Impact Item	Scoping		Assessment results		Reason / Remarks
			Pre-Construction Phase Construction Phase	Operation Phase	Pre-Construction Phase Construction Phase	Operation Phase	
	23	Cultural heritage	D	D	D	D	No negative impact.
	24	Landscape	B-	D	B-	D	**Construction Phase:** The landscape will be deteriorated by the removal of street trees and construction work. **Operation Phase:** No negative impact.
	25	Gender	D	D	D	D	No negative impact.
	26	Children's rights	D	D	D	D	No negative impact.
	27	Infectious diseases such as HIV/AIDS	D	D	D	D	**Pre-Construction Phase:** HIV patients are registered and treated, and impact is not assumed. However, measures against malaria are required. **Operation Phase:** No impact related to infectious diseases
	28	Working conditions (including occupational safety)	B-	D	D	D	**Construction Phase:** Although heat stroke measures is need due to the hot environment, but there are no factors that worsen the working environment. **Operation Phase:** No negative impact.
Others	29	Accidents	B-	D	B-	D	**Construction Phase:** The impact is limited, but safety measure will be conducted. **Operation Phase:** The impact is limited.
	30	Trans-boundary impacts or climate change	D	D	N/A	N/A	**Construction Phase:** Trans-boundary impacts such as climate change are unlikely to occur. **Operation Phase:** Trans-boundary impacts such as climate change are unlikely to occur.
	31	UXO	C±	D	B-	D	**Pre-Construction Phase:** 80,000m2 of UXO survey is conducted. **Construction Phase, Operation Phase:** Not estimate any impact

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)
D : No impact is expected
N/A : Impact assessment isn't conducted because the item was categorized into D in scoping phase.
* Impact Items refer to "JICA Guidelines for Environmental and Social Considerations April 2010"
The updated assessment results were show in red color based on monitoring results.

1.4.1.9 Major Mitigation Measures and Cost

Major mitigation measures and the cost based of the assessment results as shown in Table 1.56.

Table 1.56 Major Mitigation Measures and Cost

Category	No.	Impact item	Mitigation Measures	Cost (US$)
Pollution	1	Air pollution	**Construction Phase:** ・Contractor shall conduct countermeasure for dust such as splaying asphalt emulsion and watering. ・Contractor shall put in effort to reduce exhaust gases from construction machinery with appropriate maintenance and using to electric machinery. ・Contractor shall put in effort to reduce dust by maintaining clean road and controlling velocity of construction machinery. ・Contractor shall be explaining the construction plan to residence living around the site and supervising consultant in advance. ・Supervising consultant shall be reviewing the construction method with contractor referring to residence's opinions, if need.	**Construction Phase:** The cost shall be including to construction contract
	2	Water pollution	**Construction Phase:** ・Construction work near river shall be conducted in the dry season as possible. ・Contractor shall cover ground by sheet etc. at the heavy raining. ・Contractor shall maintain proper construction machinery to avoid oil and fuel leakage. ・Contractor shall manage the oil and fuel properly. ・Cleaning machinery in river is prohibited. ・Supervising consultant shall consider proper drainage plan in advance. ・Contractor shall be plant grasses and flowers on road slopes and pit in order to prevent soil runoff. ・Contractor and supervising consultant shall be monitoring the occurring condition of dirty water and review the construction method, if needed.	**Construction Phase:** The cost shall be included in the construction contract
	3	Waste	**Construction Phase:** ・Contractor shall conduct proper waste management ・Contractor shall prepare toilet and waste management space in construction site ・Contractor shall collect separately solid waste materials ・Contractor shall consider reuse and recycle of construction waste ・Contractor and supervising consultant shall be monitoring the waste treatment method and improve the treatment method, if needed.	**Construction Phase:** The cost shall be included in the construction contract
	4	Noise and Vibration	**Construction Phase:** ・Contractor shall make construction plan to avoid concentrating many construction machineries for long near residential area ・Contractor shall maintain proper condition of the construction machineries to avoid abnormal noise ・Construction work in night is prohibited near residential area	**Construction Phase:** The cost shall be included in the construction contract

Category	No.	Impact item	Mitigation Measures	Cost (US$)
			・Contractor shall select the low noise machinery as possible ・Contractor and supervising consultant shall explain construction plan to residence around the site in advance ・Contractor and supervising consultant shall be monitoring the noise, vibration with residence's opinion and reviewing the construction method, if needed.	
Natural environment	1	Ecosystem	**Pre-Construction Phase, Construction Phase:** ・・Developer (MID) are completed felling before construction ・・Developer (MID) are completed planting of same number of trees.	**Pre-Construction Phase:** Estimated cost of cut of tree Around 72,000 SBD
Social Environment	1	Resettlement/ Land Acquisition	**Pre-Construction Phase** ・Abbreviated resettlement action plan shall be prepared and implanted properly **Construction Phase** ・The detailed design consultant will provide a temporary land lease plan with the construction schedule to the owner and related parties, and the MID will take out the borrowing according to the construction schedule.	**Pre-Construction Phase** Land acquisition for construction office yard Around 500,000 SBD Resettlement cost 6,579,000 SBD
	2	Impoverished/Poor people	**Construction Phase:** ・Disclose information on construction plans and off-limits areas, etc. to ensure safety for street vendors that belong to the poverty zone ・Actively employ the poor who need relocation	The cost shall be included in the construction contract
	3	Local economies, such as employment, livelihood, etc.	**Pre-Construction Phase** ・Abbreviated resettlement action plan shall be prepared and implanted properly **Construction Phase:** ・Contractor shall conduct fair employment when hiring local residents as a simple worker for construction work. ・Contractor and supervising consultant shall explain construction plan to residence around the site in advance	The cost shall be included in the ARAP and construction cost
	4	Land use and utilization of local resources	**Pre-Construction Phase** ・Abbreviated resettlement action plan shall be prepared and implanted properly	The cost shall be included in the ARAP and construction cost
	5	Existing social infrastructures and services	**Pre-Construction Phase** ・Consult with the owners of existing infrastructure facilities such as telephone poles, water pipes, and optical cables to implement with develop relocation and protection plans. **Construction Phase:** ・Contractor shall conduct traffic control to avoid traffic jam ・Consultants for detail design shall consider temporary land use in construction phase by sharing the construction plan among Stakeholders and related organizations in early stage	**Pre-Construction Phase** Relocation cost for infrastructures by MID Around 13,868,000 SBD **Construction Phase:** The cost is included in the construction contract or miscellaneous expenses

Category	No.	Impact item	Mitigation Measures	Cost (US$)
	6	Misdistribution of benefits and damages	**Pre-Construction Phase** ・Abbreviated resettlement action plan shall be prepared and implanted properly **Operation Phase** ・MID and ECD shall be monitoring living condition of affected people and shall take countermeasure, if needed	The cost is included in the resettlement budget
	7	Local conflicts of interest	**Pre-Construction Phase** ・Abbreviated resettlement action plan shall be prepared and implanted properly **Operation Phase** ・MID and ECD shall be monitoring living condition of affected people and shall take countermeasure, if needed	The cost is included in the resettlement budget
	8	Landscape	**Construction Phase:** ・Supervising consultant and contractor shall consider minimizing cutting of trees under the construction plan. ・Contractor shall plant green grasses along the roadside and slope on road.	The cost is included in the construction contract
	9	Working conditions (including occupational safety)	**Construction Phase:** ・Supervising consultant and contractor shall conduct preventive countermeasures on accident before construction. ・Contractor shall sprinkle water as a countermeasure for dust ・Contractor shall prepare toilet and dumping site in construction site. ・The contractor shall take measures against heat stroke of workers, such as taking appropriate breaks. ・Contractors take measures against malaria, such as preparation of mosquito spray.	The cost is included in the construction contract
Others	1	Accidents	Construction Phase: ・Supervising consultant and contractor shall conduct preventive countermeasures on accident before construction. ・Contractor shall prepare traffic control and setting of traffic signboard for prevention accident	The cost is included in the construction contract
	2	UXO	Pre-Construction Phase: ・Conduct UXO survey on un-developed area	Pre-Construction Phase: UXO survey (MID) Around 800,000 SBD

1.4.1.10 Environmental Monitoring Plan

Conducting monitoring activities is to obtain basic information for assessment of environmental impact. The monitoring results will be used for considering the construction method and mitigation measures, if necessary. The environmental monitoring plan is shown in Table 1.57.

Table 1.57 Environmental Monitoring Plan

Category	Environmental Item	Monitoring Item/ Parameter	Responsible Person and Organization	Location	Method	Frequency
Pollution	Air pollution	**Construction Phase:** ・PM10、PM2.5	Contractor	Construction site	Visual observation and interview of pedestrians Instrumental analysis	Visual observation: Daily Interview: Monthly or as needed Instrumental analysis: Pre-Construction Phase 1 time Construction Phase: Daily 2 times per day during construction
	Water pollution	**Construction Phase:** ・Turbid water and drainage conditions	Contractor	Construction site	Visual observation	During rainfall
	Waste	**Construction Phase:** ・Disposal methods of construction and general waste	Contractor	Construction site and disposal site	Visual observation and meeting with contractor	Visual observation: Daily Meeting: Monthly or as needed
	Noise and vibration	**Construction Phase:** ・Noise level	Contractor	Construction site	Interview to local residents and pedestrians Instrumental measurement	Interview: Monthly or as needed Instrumental measurement: Pre-Construction Phase 1 time Construction Phase: Daily 2 times per day during construction
Natural environment	Ecosystem	**Pre-Construction Phase :** ・Confirmation of planting	Supervising Consultant	Construction area	Hearing to MID and survey	1 time
Social Environment	Resettlement / Land Acquisition	**Pre-Construction Phase:** ・Progress of resettlement action plan	MID	Construction area	Site survey and meeting with PAPs	Monthly or as needed

Category	Environmental Item	Monitoring Item/ Parameter	Responsible Person and Organization	Location	Method	Frequency
		Operation Phase: Hearing from owner that received compensation	MID	Construction site	Hearing and Meeting	Each half year, 2 years
	Poor people	**Construction Phase:** ・ Activity conditions of street venders	Supervising Consultant	Construction site, especially KG market	Visual observation	Daily
	Local economies, such as employment, livelihood, etc.	**Pre-Construction Phase:** ・ Progress of resettlement action plan	MID	Construction site	Site survey and meeting with PAPs	Monthly or as needed
		Construction Phase: ・ Business activity around construction site ・ Employment situation of unskilled labor	Supervising Consultant/ Contractor	Construction site	Site survey and interview of local people and unskilled labors	Monthly or as needed
	Land use and utilization of local resources	**Pre-Construction Phase:** ・ Progress of resettlement action plan	MID	Construction site	Site survey and meeting with PAP	Monthly or as needed
		Operation Phase: ・ Condition of land use ・ Condition of business activity	MID	Construction site	Site survey and interview of local people	Monthly or as needed for 2 years after completion
	Existing social infrastructures and services	**Pre-Construction Phase:** ・ Relocation status of existing infrastructure facilities	MID	Construction site	Site survey and meeting with facility organization	Monthly or as needed
		Construction Phase: ・ Condition of traffic congestion around construction site	Supervising Consultant/ Contractor	Construction site	Visual observation	Daily

Category	Environmental Item	Monitoring Item/ Parameter	Responsible Person and Organization	Location	Method	Frequency
		Operation Phase: ・ Crossing conditions of pedestrians	MID	Construction site, especially King George VI National High School	Site survey and interview of local people	Monthly or as needed for 2 years after completion
	Misdistribution of benefits and damages	**Pre-Construction Phase:** ・ Progress of resettlement action plan	MID	Construction site	Site survey and meeting with PAPs	Monthly or as needed
		Operation Phase: ・ Living situations of Project Affected Persons (PAPs)	MID	Construction site, especially King George VI National High School	Site survey and meeting with PAPs	Monthly or as needed for 2 years after relocation
	Landscape	**Construction Phase:** ・ Status of tree felling ・ Status of Planting works	Contractor	Construction site	Visual observation and meeting with contractor	Daily
	Working conditions (including occupational safety)	**Construction Phase:** ・ Workplace situations ・ Implementation status of accident prevention measures	Contractor	Construction site	Visual observation and meeting with contractor	Daily
Other	Accidents	**Construction Phase:** ・ Implementation status of accident prevention measures	Contractor	Construction site	Visual observation and meeting with contractor	Daily

1.4.1.11 Stakeholder Meeting

The team held stakeholder meetings and public consultations in order to carefully build a consensus of the compensation with local residents and the PAPs. The meetings/consultations are listed in Table 1.58.

Table 1.58 Stakeholder Meetings and Public Consultations

No.	Meetings	Date	Venue	No. of Attendance
1	Stakeholder Meeting	December 3, 2019	Bethel Conference Room	Total 21, 12 females, 9 males
2	Public Consultation	December 3, 2019	Henderson Field	Total 43, 20 females, 23 males
3	Public Consultation	December 4, 2019	KGVI Market	Total 40, 19 females, 21 males
4	Stakeholder Meeting	August 12, 2020	Holiday Resort Conference Room	21 PAPs, 2 females, 19 males
5	Stakeholder Meeting	August 12, 2020	Holiday Resort Conference Room	21 PAPs, 12 females, 9 males
6	Public Consultation	August 14, 2020	Lunga Market	52 PAPs, 37 females, 15 males
7	Public Consultation	August 14, 2020	Henderson Market	45 PAPs, 32 females, 13 males
8	Stakeholder Meeting	August 19, 2020	Holiday Resort Conference Room	13 PAPs, 3 females, 10 males
9	Stakeholder Meeting	August 19, 2020	Holiday Resort Conference Room	28 PAPs, 9 females, 19 males

The 1st stakeholder meeting was held on 3rd of December 2019 for explanation of the construction schedule and outline of the project. The result of meeting is compiled in Table 1.59.

Table 1.59 Summary of Stakeholders Meeting

Date	3rd December 2019 (Tuesday) AM 10:00-12:00
Venue	Bethel Conference Room
Agenda	1. Project background 2. Summary of Project 3. Discussion 4. Announcement of Cut-off date
Language	Local language/ English
Participant	Total 27 participants (Man: 20, Women: 7) Organized by MID, JICA Team. LBS (Local consultants)
Major discussion/ Recommendation	1. · Solomon Water representative inform the project team that SW is planning to improve the existing sewer lines by replacing them with new ones. 2. · Asked if the Cost of design for relocation of sewer line and required land under the project can be met by MID. 3. · The Project to consider design and construction management of utilities during construction. 4. · Propose for a meeting with the Kukum Highway Project Team in 2020, with the Utilities Providers. 5. · Cost of Utilities relocation will be met by SIG through MID. 6. · Concern with buildings on the road reserve. 7. · Propose for a bus bay at KGVI and Henderson Area.

	8. · Consider bus stops or bays to not obstruct feeder roads. 9. · Asked if HCC and MID could regulate public buses operation along the highway and in Honiara. 10. · Parking space to be allowed at market areas. 11. · Asked for Relocation of KGVI Market. 12. · Propose for new markets east of Honiara. 13. · Improve current drainages along the whole project road. 14. · Need for proper signages, pedestrian crossings, foot paths and traffic lights at certain locations including provision for bicycles. 15. · Consider underpass or overhead crossing at school locations such as KGVI and Perch School areas. 16. · Disposal site owned by Golf Club is still available for dumping of waste materials from the project. 17. · MID to implement Road and Traffic Act and Regulations.

1.4.2 Land Acquisition and Resettlement

1.4.2.1 Necessity on land acquisition and resettlement

Although this project is a rehabilitation of existing roads, there is not enough land for 4-lane construction from KGVI to the Lungga Bridge section, and land acquisition is necessary for safe road design. In addition, the east area of the Lungga Bridge (Henderson area) is a two-lane design taking into consideration the four-lane widening in future, and is designed with consideration on reduction of construction costs when changing from 2-lane to 4-lane, and the road design include safety curve. For this reason, it is necessary to acquire a wider land than on existing roads.

1.4.2.2 Framework on Low System of Land Acquisition and Resettlement

1.4.2.2.1 Legal System of the Solomon Islands

The legal system for land acquisition and resettlement in the Solomon Islands is as follows. Land ownership, land acquisition, and related procedures are summarized in the Land and Titles Act (LTA). The system for resettlement is summarized in the Safeguards procedures manual.

(1) Land and Titles Act (LTA)
(2) Safeguards procedures manual

(1) Legal Framework and Land Acquisition in the Solomon Islands

1) Land ownership system

In Solomon Islands, 87% of land is under customary tenure. Inheritance of customary land ownership or user rights differs with custom from island to island. Guadalcanal, Isabel, Central, Makira & Ulawa, and Western provinces typically practice matrilineal inheritance of land and the remaining provinces practice patrilineal inheritance. The remaining land is considered “alienated” and is subject to registration under the Land and Titles Act (the Act or LTA). Within Honiara City Council and provincial capital boundaries, land is owned by the state and is held in the perpetual estate title on behalf of the government by the Commissioner of Lands (COL). The COL enters into 50 year

fixed term estate (FTE) agreements with individuals or shorter term temporary occupancy licenses (TOL). A TOL is valid for a period of one to two years, and permanent structures or improvements are not permitted on this land.

The LTA governs the government's compulsory acquisition of land as well as purchase or lease of land through agreement.

2) Compulsory Land Acquisition

In the LTA Sections 71 to 85 deals with compulsory acquisition of land for public purposes. Under section 71, the Minister makes a declaration that land is required for a public purpose. The declaration (including a plan or description of boundaries) is published and notice is required to be given to the landowner in case of registered land (section 72), and to all people or groups with an interest in the land for unregistered or customary land (section 73). Within three months of the date of the declaration (provided the declaration is not appealed), the person(s)/group with an interest in the land must make a claim for compensation to the COL. Under section 79 (2) the COL can either offer to pay the claim, or reject it. If the offer is accepted by the claimant, the COL has three months from the date of acceptance of the offer, to pay the claim. If the claim for compensation is rejected, or the claimant is dissatisfied with the offer by the COL, the claimant has three months with which to lodge an appeal with the High Court.

3) Registration of Acquisition Land

Sections 60 through 70 in the Act deal with purchase or lease of customary land (through agreement) by the COL or any Provincial Assembly. The process starts with an appointment of an Acquisition Officer for land purchase or lease. The Acquisition Officer demarcates the boundary and agrees with landowners for the purchase or lease of the land required. The Acquisition Officer publishes a notice, holds a public hearing and prepares necessary reports. The agreement is reached with respective landowners, and it is implemented by the COL, including payment of the compensation, taking possession of the land, and registration of the land in the name of acquiring entity.

4) Calculation Method of Assets and Compensation Expenses

Section 83 of the Act sets out the criteria for assessing compensation for land acquired compulsorily, and includes such things as (i) condition of land concerned; and (ii) any other matters and circumstances considered relevant, including assessment of any diminution in value to owner/occupier of contiguous. Section 84 of the Act deals with compensation for customary land, and provides for transfer or grant of other land or estate (along with terms and conditions), to person(s) or group, in lieu of payment of compensation. Sub-section 4 says that such compensation is for the benefit of all people in the group, in the tradition of customary usage.

5) Timing of Payment of Compensation Cost

If the claimant accepts the COL payment, COL will pay the compensation within 3 months from the date of acceptance.

(2) Procedures for Involuntary Resettlement in the Solomon Islands

Procedures for resettlement follow the MID Safeguard Procedure Manual. It is designed to balance the development and development by avoiding/minimize the environmental and social impacts of infrastructure development as much as possible. This manual is categorized into infrastructure repair (Tier 1), maintenance (Tier 2), and restoration work (Tier 3).

Involuntary resettlement procedures are below:

a. Scoping to make preliminary assessment of the area's suitability and features
b. Identification of landowners, land boundaries and issues concerning the area through social scoping by identifying the boundaries and use of the land, recording fixed assets, ownership of land and issues that might hinder LAR;
c. Information disclosure through community consultations, individual consultations, stakeholder meetings;
d. Establishment of CAC and GRC by appointment of community representatives by the communities. The committee members will be informed and trained on the roles and functions of the committee;
e. The Social impacts and measures to mitigate them are identified through the ARAP by undertaking surveys at the communities and each households;
f. Planning of the LAR find measures to avoid, minimize offset and compensate for the impacts and to improve or at least restore the standard of living and livelihood of PAPs/ PAFs to pre – LAR levels;
g. The CAC or GRM will disclose the LARP at the project site to all PAPs/PAFs in a timely manner at an accessible place and language understood by PAPs/PAFs and other stakeholders;
h. Execute LAR by providing compensation and other entitlements to the PAPs/PAFs before works and economic displacement; and,
i. Monitor the implementation of the LAR and its impacts on the PAPs/PAFs.

1.4.2.2.2 JICA Policy on Involuntary Resettlement

JICA policy on involuntary resettlement is as follows.

The key principle of JICA policies on involuntary resettlement is summarized below.

1. Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.
2. When, population displacement is unavoidable, effective measures to minimize the impact and to compensate for losses should be taken.
3. People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.

4. Compensation must be based on the full replacement cost[3] as much as possible.
5. Compensation and other kinds of assistance must be provided prior to displacement.
6. For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP 4.12, Annex A.
7. In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.
8. Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.
9. Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.

Above principles are complemented by World Bank OP 4.12, since it is stated in JICA Guideline that "JICA confirms that projects do not deviate significantly from the World Bank's Safeguard Policies". Additional key principle based on World Bank OP 4.12 is as follows.

10. Affected people are to be identified and recorded as early as possible in order to establish their eligibility through MID initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits.
11. Eligibility of Benefits include, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying.
12. Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based.
13. Provide support for the transition period (between displacement and livelihood restoration.
14. Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc.
15. For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared.

In addition to the above core principles on the JICA policy, it also laid emphasis on a detailed resettlement policy inclusive of all the above points; project specific resettlement plan; institutional framework for implementation; monitoring and evaluation mechanism; time schedule for implementation; and, detailed Financial Plan etc.

[3] Description of "replacement cost" is as follows.

Land	Agricultural Land	The pre-project or pre-displacement, whichever is higher, market value of land of equal productive potential or use located in the vicinity of the affected land, plus the cost of preparing the land to levels similar to those of the affected land, plus the cost of any registration and transfer taxes.
	Land in Urban Areas	The pre-displacement market value of land of equal size and use, with similar or improved public infrastructure facilities and services and located in the vicinity of the affected land, plus the cost of any registration and transfer taxes.
Structure	Houses and Other Structures	The market cost of the materials to build a replacement structure with an area and quality similar or better than those of the affected structure, or to repair a partially affected structure, plus the cost of transporting building materials to the construction site, plus the cost of any labor and contractors' fees, plus the cost of any registration and transfer taxes.

1.4.2.2.3 Comparison of JICA Guidelines and Legal System of the Solomon Islands for Land Acquisition and resettlement.

Table 1.60 summarized the comparison between the JICA guidelines and legal systems of the Solomon Islands for land acquisition and resettlement.

Table 1.60 Gap Analysis for Land Acquisition and Resettlement

No.	JICA Guidelines	Laws and Regulations of the Solomon Islands	Gap with JICA Guidelines	Project Policies to fill in the Gaps
1	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. (JICA GL)	Safeguard Procedure Manual -It is required to consider alternative plan and minimize to social impact.	**No significant Gap.**	Affected area and land acquisition shall be minimum.
2	When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken. (JICA GL)	Safeguard Procedure Manual -Safeguards specialists are to ensure that impact on social and LAR are avoiding and minimizing where feasible.	**No significant Gap.**	Affected area and land acquisition shall be minimum.
3	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels. (JICA GL)	Safeguard Procedure Manual -Ascertain if all affected assets and sources of income or livelihoods have been identified, valued, and directly replaced or compensated Division 2, Part V of Low on Land and Titles Act [Cap133] -The assessment of compensation will be conducted by the high court in accordance with Solomon's law.	**No significant Gap.**	Compensation and livelihood assistance shall be provided to improve or at least restore their status as of now for living, income opportunities and production.
4	Compensation must be based on the full replacement cost as much as possible. (JICA GL)	Safeguard Procedure Manual -Compensation includes non-land assets, transfer allowances and business disruption allowances for affected persons.	**No significant Gap.**	Project follow to Safeguard Procedure Manual
5	Compensation and other kinds of assistance must be provided prior to displacement. (JICA GL)	Safeguard Procedure Manual -The Solomon Islands Government through the COL pays the full amount for purchase or the advanced payment	**No significant Gap.**	Project follow to Safeguard Procedure Manual
6	For projects that entail large-scale involuntary resettlement, resettlement action plans must be	Safeguard Procedure Manual -The final as well as draft LARP in a timely	**No significant Gap.**	Large-scale involuntary resettlement is not

No.	JICA Guidelines	Laws and Regulations of the Solomon Islands	Gap with JICA Guidelines	Project Policies to fill in the Gaps
	prepared and made available to the public. (JICA GL)	manner, in an accessible place and a form and language understandable to affected persons and other stakeholders.		required in the Project.
7	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. (JICA GL)	Safeguard Procedure Manual -The manual is suggested consultation and negotiation to land owner.	**No significant Gap.**	The public consultation after preparing Daraf ARAP shall be organized
8	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. (JICA GL)	Safeguard Procedure Manual -The LARP in a timely manner in language understandable to affected persons and other stakeholders.	**No significant Gap.**	The public consultation will be organized in Pidgin (Pijin) language, if required.
9	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans. (JICA GL)	Safeguard Procedure Manual -CPIU engages a third party monitor.	**No significant Gap.**	The public consultations were organized before baseline survey
10	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities. (JICA GL)	Safeguard Procedure Manual -The grievance mechanisms is established including establish a Community Advisory Committee	**No significant Gap.**	Project shall comply with Safeguard Procedure Manual
11	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits. (WB OP4.12 Para.6)	Safeguard Procedure Manual -The end of the census is the cut-off date. -The safeguards team, the CAC publicize the cut-off date in the project site.	**Minor Gap.** Cut-off date is after end of census.	The public consultations were organized before baseline survey, and announce the cut-off date.
12	Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP4.12 Para.15)	Low on Land and Titles Act [Cap133] -Land ownership is stipulated in the Land and Titles Act, including handling customary land.	The right on APs not have formal right is not clearly described.	MID will compensate all APs on project.
13	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WB OP4.12	Safeguard Procedure Manual -If necessary, resettlement site is prepared.	**No significant Gap.**	ARAP shall be provided.

No.	JICA Guidelines	Laws and Regulations of the Solomon Islands	Gap with JICA Guidelines	Project Policies to fill in the Gaps
	Para.11)			
14	Provide support for the transition period (between displacement and livelihood restoration). (WB OP4.12 Para.6)	Safeguard Procedure Manual -Safeguard Team communicate to affected community	**No significant Gap.**	MID shall take responsibility for relocation
15	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc. (WB OP4.12 Para.8)	Safeguard Procedure Manual -Safeguard Procedure Manual requires poverty and vulnerability analysis of PAPs	**No significant Gap.**	Asset of PAPs shall be evaluated.
16	For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared. (WB OP4.12 Para.25)	Safeguard Procedure Manual -Safeguard Procedure Manual has one of criteria of which is 200 affected people	**No significant Gap.**	Since affected people are less than 200, the ARAP shall be prepared.

1.4.2.2.4 Land Acquisition and Resettlement Policy of the Project

The SIG will use the Project Resettlement Policy (the Project Policy) for the specifically because existing national laws and regulations have not been designed to address involuntary resettlement according to international practice, including JICA's policy. The Project Policy is aimed at filling-in any gaps in what local laws and regulations cannot provide in order to help ensure that PAPs are able to rehabilitate themselves to at least their pre-project condition. This section discusses the principles of the Project Policy and the entitlements of the PAPs based on the type and degree of their losses. Where there are gaps between the legal framework for resettlement and JICA's Policy on Involuntary Resettlement, practicable mutually agreeable approaches will be designed consistent with Government practices and JICA's Policy.

The project policy on land acquisition and resettlement is as follows:

- Land acquisition and involuntary resettlement will be avoided where feasible, or minimized, by identifying possible alternative project designs that have the least adverse impact on the communities in the project area;
- Where displacement of households is unavoidable, all PAPs (including communities) losing assets, livelihoods or resources will be fully compensated and assisted so that they can improve, or at least restore, their former economic and social conditions;
- Compensation and rehabilitation support will be provided to any PAPs, that is, any person or household or business which on account of project implementation would have his, her or their;
- Standard of living adversely affected;
- Right, title or interest in any house, interest in, or right to use, any land (including premises, agricultural and grazing land, commercial properties, tenancy, or right in

annual or perennial crops and trees or any other fixed or moveable assets, acquired or possessed, temporarily or permanently;

- Income earning opportunities, business, occupation, work or place of residence or habitat adversely affected temporarily or permanently; or
- Social and cultural activities and relationships affected or any other losses that may be identified during the process of resettlement planning;
- All affected people will be eligible for compensation and rehabilitation assistance, irrespective of tenure status, social or economic standing and any such factors that may discriminate against achievement of the objectives outlined above. Lack of legal rights to the assets lost or adversely affected tenure status and social or economic status will not bar the PAPs from entitlements to such compensation and rehabilitation measures or resettlement objectives;
- All PAPs residing, working, doing business and/or cultivating land within the project impacted areas as of the date of the latest census and inventory of lost assets(IOL), are entitled to compensation for their lost assets (land and/or non-land assets), at replacement cost, if available and restoration of incomes and businesses, and will be provided with rehabilitation measures sufficient to assist them to improve or at least maintain their pre-project living standards, income-earning capacity and production levels;
- PAPs that lose only part of their physical assets will not be left with a portion that will be inadequate to sustain their current standard of living. The minimum size of remaining land and structures will be agreed during the resettlement planning process;
- People temporarily affected are to be considered PAPs and resettlement plans address the issue of temporary acquisition;
- Where a host community is affected by the development of a resettlement site in that community, the host community shall be involved in any resettlement planning and decision-making. All attempts shall be made to minimize the adverse impacts of resettlement upon host communities;
- The resettlement plans will be designed in accordance with Solomon Islands National Involuntary Resettlement Policy and JICA's Policy on Involuntary Resettlement;
- The Resettlement Plan will be translated into local languages and disclosed for the reference of PAPs as well as other interested groups;
- Payment for land and/or non-land assets will be based on the principle of replacement cost;
- Compensation for PAPs dependent on agricultural activities will be land-based wherever possible. Land-based strategies may include provision of replacement land, ensuring greater security of tenure, and upgrading livelihoods of people without legal land titles. If replacement land is not available, other strategies may be built around opportunities for re-training, skill development, wage employment, or self-employment, including access to credit. Solely cash compensation will be avoided as an option if possible, as this may not address losses that are not easily quantified, such as access to services and traditional rights, and may eventually lead to those populations being worse off than without the project;
- Replacement lands, if the preferred option of PAPs, should be within the immediate vicinity of the affected lands wherever possible and be of comparable productive capacity and potential. As a second option, sites should be identified that minimize

the social disruption of those affected; such lands should also have access to services and facilities similar to those available in the lands affected;

- Resettlement assistance will be provided not only for immediate loss, but also for a transition period needed to restore livelihood and standards of living of PAPs. Such support could take the form of short-term jobs, subsistence support, salary maintenance, or similar arrangements;
- The resettlement plan must consider the needs of those most vulnerable to the adverse impacts of resettlement (including the poor, those without legal title to land, ethnic minorities, women, children, elderly and disabled) and ensure they are considered in resettlement planning and mitigation measures identified. Assistance should be provided to help them improve their socio-economic status;
- PAPs will be involved in the process of developing and implementing resettlement plans;
- PAPs and their communities will be consulted about the project, the rights and options available to them, and proposed mitigation measures for adverse effects, and to the extent possible be involved in the decisions that are made concerning their resettlement;
- Adequate budgetary support will be fully committed and made available to cover the costs of land acquisition (including compensation and income restoration measures) within the agreed implementation period. The funds for all resettlement activities will come from the Government;
- Displacement does not occur before provision of compensation and of other assistance required for relocation. Sufficient civic infrastructure must be provided in resettlement site prior to relocation. Acquisition of assets, payment of compensation, and the resettlement and start of the livelihood rehabilitation activities of PAPs, will be completed prior to any construction activities, except when a court of law orders so in expropriation cases. (Livelihood restoration measures must also be in place but not necessarily completed prior to construction activities, as these may be ongoing activities);
- Organization and administrative arrangements for the effective preparation and implementation of the resettlement plan will be identified and in place prior to the commencement of the process; this will include the provision of adequate human resources for supervision, consultation, and monitoring of land acquisition and rehabilitation activities; and,
- Appropriate reporting (including auditing and redress functions), monitoring and evaluation mechanisms, will be identified and set in place as part of the resettlement management system. An external monitoring group will be hired by the project and will evaluate the resettlement process and final outcome. Such groups may include qualified NGOs, research institutions or universities. Monitoring reports shall be forwarded directly to the JICA.

1.4.2.3 Scope of Resettlement Impact

1.4.2.3.1 Scope

The planned land acquisition is shown in Table 1.61. The affected area is 3,890 m^2, 50% of which is the Government land. Affected facilities with land acquisition are shown in Table 1.62. One person will be affected but the person is not living the house. Therefore, resettlement is not required in the Project.

Table 1.61 Land acquisition

Ownership		Lease		Purchase		Total cost (SBD)
Category	Number of Ownership	Number of place	Affected area (m2)	Number of place	Affected area (m^2)	
SIG (Solomon Islands Government)	5	4	663	4	606	615,789
Individual	10	6	132	10	452	498,509
Corp	8	4	258	8	1,056	1,531,812
Joint	8	5	320	7	360	852,443
under confirmation	4	4	28	1	16	23,425
Total	35	23	**1,400**	30	**2,490**	3,521,978

Table 1.62 Affected Facility

Type of Facilities	Number of owners	Area (m2)	Total cost (SBD)
Canteen (m^2)	22	570.5	713,736
Market Hut (m^2)	65	764.6	500,777
Residential (m^2)	1	36.0	57,800
Total	88	1,371.0	1,272,313

1.4.2.3.2 Census

An interview survey was conducted to 333 families in the project target area. The results are shown below.

(1) Family's Structure Survey

1) Household Heads

Basic information of household heads is shown below. The average age of household heads is 41, the oldest age is 87 and the youngest age is 20. The 26% come from Guadalcanal Island including Honiara city, 70% come from other Islands and household heads who are foreign national are 4%.

Table 1.63 Age of Household Heads

Age	Male	Female	Total	%
0-14	0	0	0	0.00
15-24	8	3	11	3.44
25-59	234	45	279	87.19
60+	23	7	30	9.38
Total	265	55	320	100.00

Table 1.64 Origin of Household Heads

Place of Origin	Male	Female	Total	%
Honiara City	54	0	54	15.84
Guadalcanal Island	34	4	38	11.14
Other Island	189	46	235	68.91
Other Country	0	14	14	4.11
Total	277	64	341	100.00

Table 1.65 Education attainment of Household Heads

Educational Attainment	Male	Female	Total	%
No formal education	23	0	23	7.1
Kindergarten or ECE	0	0	0	0.0
Pre-school	2	0	2	0.6
Primary School (Completed)	32	0	32	9.9
Primary School (Incomplete)	28	0	28	8.7
Secondary School (Forms 1-3)	65	0	65	20.1
Secondary School (Forms 4-5)	49	0	49	15.2
Secondary School (Form 6)	35	0	35	10.8
Secondary School (Form 7)	9	0	9	2.8
Vocational school or RTC (Completed)	6	0	6	1.9
Vocational school or RTC (Incomplete)	0	0	0	0.0
Tertiary (Completed)	27	26	53	16.4
Tertiary (Incomplete)	0	21	21	6.5
Others	0	0	0	0.0
Total	276	47	323	100

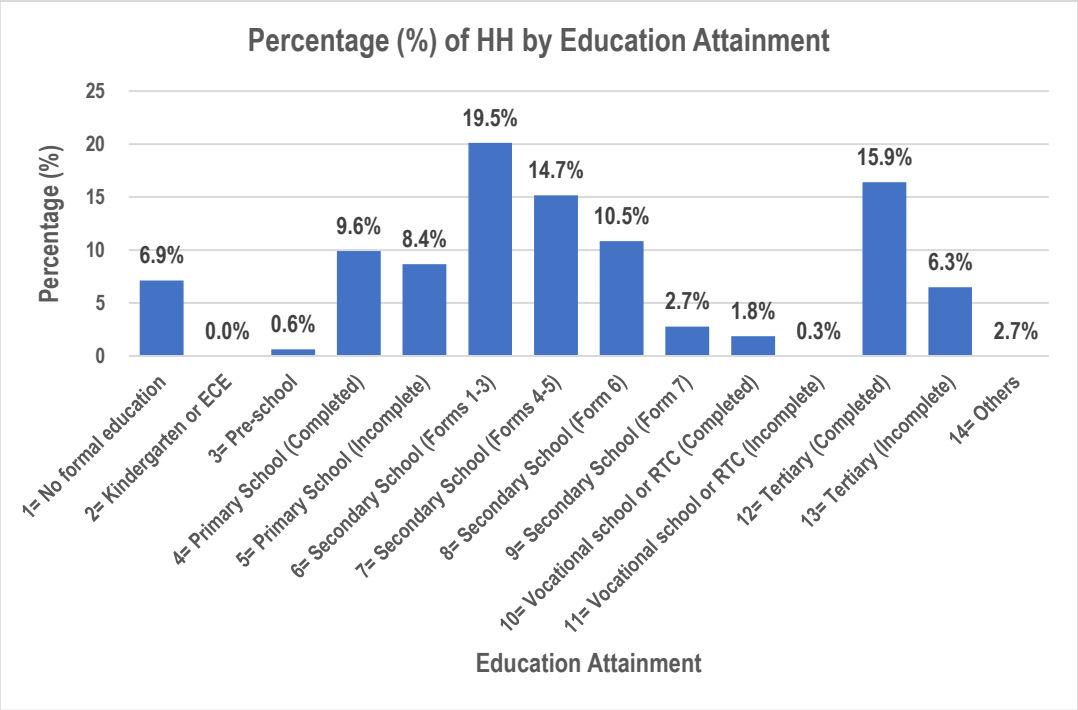


Figure 1.35 Education Attainment of Household Heads

2) Summary of Family

The total number of family members are 1,887 (Male 927, Female 960). The education levels of them are shown in Figure 1.36.

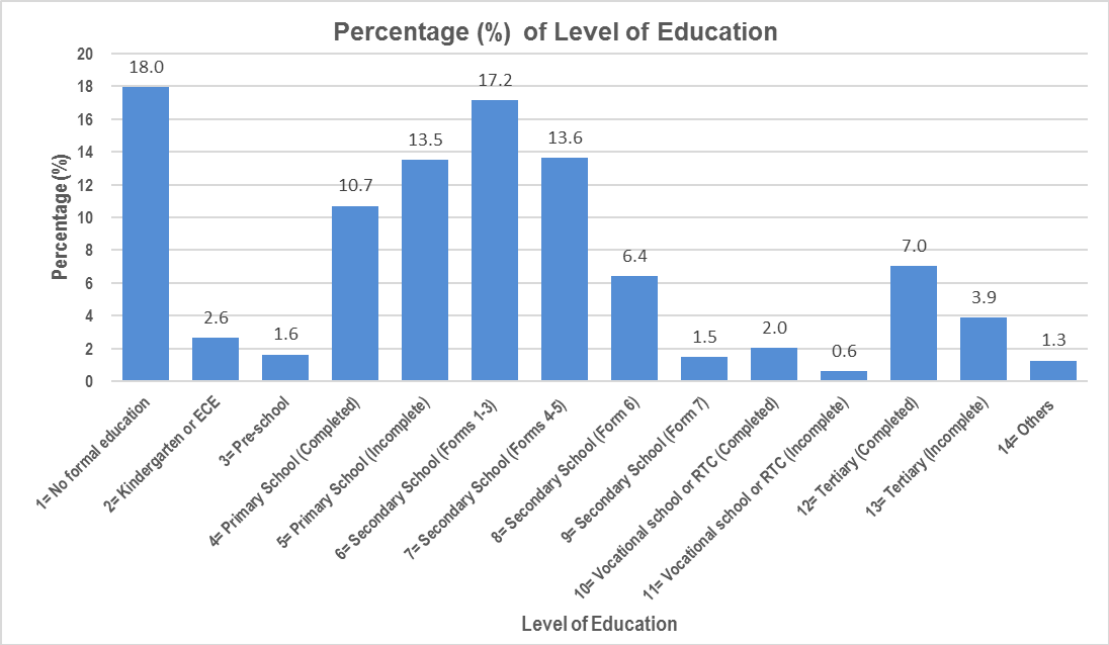


Figure 1.36 Current Education Levels

(2) Property and Land Survey

1) Land and Facility

The survey results regarding land and facilities on 333 families are below. The 250 families answered they have their own land and 154 families of them have land titles.

Table 1.66 Rights of Land and Facility

Type of proof of ownership / occupation	No. of Answer	
	Land	Structure
None	31	25
Title (Registered information based on Land Title Act)	154	139
Deeds of Sales/Mortgage	8	8
Contract	38	41
Tax declaration	0	0
Application form	8	5
Others	11	8
Total	250	226

Table 1.67 Acquisition of Land and Facility

Way of Acquisition	No. of Answer	
	Land	Structure
Purchased	76	67
Inherited	0	19
Given	63	54
Allocation from Government	63	51
Others	6	1
Total	208	192

Regarding a rental contract of land or facilities, by a written document is around 50% and by a verbal agreement is also around 50%.

Table 1.68 Type of Contract on Land and Facility

Type of agreement	No. of Answer	
	Land	Structure
Written contract	43	40
Verbal agreement	43	28
Others, specify	4	3
Total	90	71

2) Property

A survey on fixed properties designated in the questionnaire was conducted. As the results, 28% of the families have own car and 24% of families have bicycles as mobilities. The possession rate on refrigerator, television and wind fan are around 30 to 45% and the possession rate of air conditioner or washing machine is less than 10%.

Table 1.69 Home Assets

Home assets	Minibus	Truck	Car	Motorboat	Motorbike	Tricycle	Bicycle	Refrigerator	Television	Electric fan	Air-conditioner (Cooler)	Washing machine	Landline phone	Computer/ Laptop	Media player
Number of possession	24	61	96	19	11	5	81	108	149	152	15	29	75	206	234
%	7.2	18.3	28.8	5.7	3.3	1.5	24.3	32.4	44.7	45.6	4.5	8.7	22.5	61.9	70.3

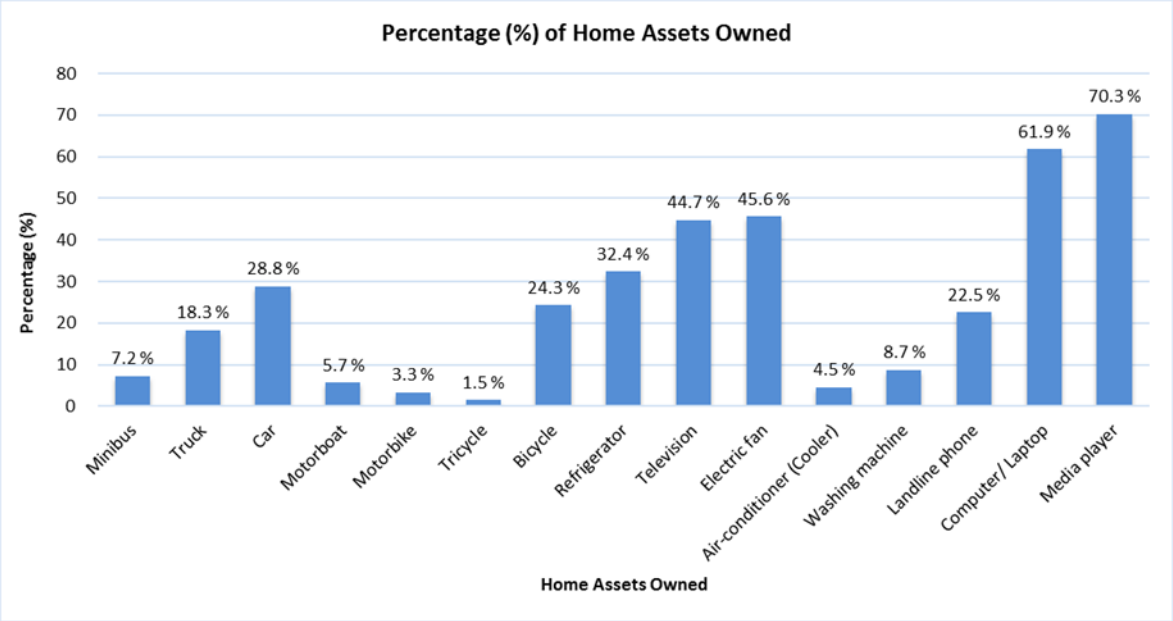


Figure 1.37 Home Assets

(3) Livelihood Survey

The occupation on household heads are shown in Table 1.70 and Figure 1.38. 28% of household heads answered “no-job” and their age vary from in their twenties to sixties.

Table 1.70 Occupation on Household Heads

Job	Primary Occupation				Secondary Occupation			
	Male	Female	Total	%	Male	Female	Total	%
No-job	96	0	96	28.7	138	0	138	41.8
Farmer	25	0	25	7.5	0	0	0	0.0
Hired farm worker	4	0	4	1.2	4	0	4	1.2
Fisherman	15	0	15	4.5	2	0	2	0.6
Skilled labor	81	0	81	24.3	47	2	47	14.2
Unskilled labor	0	0	0	0.0	3	0	3	0.9
Profession	8	0	8	2.4	4	1	4	1.2
Driver	7	0	7	2.1	16	0	16	4.8
Housekeeper	3	0	3	0.9	5	0	5	1.5
Business owner	2	1	3	0.9	5	2	5	1.5
Personal Business with fixed shop	4	1	5	1.5	4	0	4	1.2
Street vendor	21	0	21	6.3	18	0	18	5.5
Government employee	11	31	42	12.6	31	15	46	13.9
Pensioner	0	0	0	0.0	0	1	1	0.3
Others	0	24	24	7.2	0	37	37	11.2

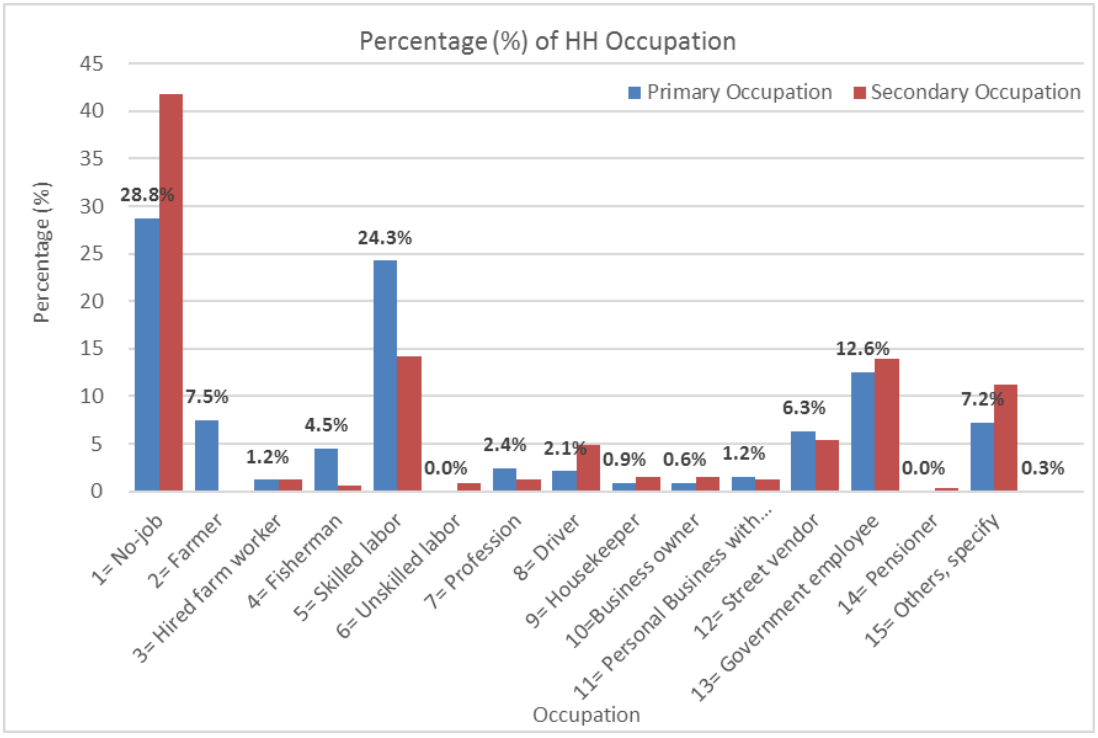


Figure 1.38 Occupation on Household Heads

Table 1.71 Age of Household Heads Answering No-job

Age	<30	<40	<50	<60	60+
Number of Answer	8	29	30	16	11

According to the household survey by UNDP, the Food Poverty Line (FPL) is SBD 182.87/week and the Basic Needs Poverty Line (BNPL) is 265.77/week per household. If the FPL and BNPL are converted to an average of 4.5 weeks per month, FPL is SBD 823/month and BNPL is SBD1,195/month.

The results of the social survey on the 333 households under the Project is shown in Table 1.72. As the results, it is confirmed that the average income of households along the Kukum Highway exceeds SBD 1,000/week and over the poverty line. On the other hand, in more detail, looking at income by individual household (Table 1.73), income of 25 households are below SBD 800/month and income of 39 households are between SBD 800 and 1,200/month. In particular, 14 households answered that their monthly income is "SBD 0". Households with low income tend to have a small number of household members and have a short stay history of less than one year at the address at the time of the Survey.

Table 1.72 Households Income in the Project area

	Monthly Household Income (SBD)	Monthly Household Expenses (SBD)	Total Number of Household Members:	No. of Household Members at Present
Average Amount	5,314	2,267	6	5

Table 1.73 Number of Households Based on Income

Monthly income ($)	Number of households	Average of number of members
0 ≦100	14	1.0
100 ≦200	2	1.0
200 ≦500	6	2.0
500 ≦800	3	2.0
800 ≦1,200	39	2.6
1,200 ≦2,000	56	3.8
2,000 ≦3,000	52	4.8
3,000 ≦4,000	35	6.0
4,000 ≦5,000	38	6.9
5,000 ≦10,000	59	8.7
10000<	31	13.9

(4) Vulnerable groups

Although there is no definition of vulnerable groups in the Solomon Islands, there is the Ministry of Women, Youth, Children and Family Affairs which aims at protecting the rights of women and children who are generally vulnerable to social vulnerabilities and supporting their financial independence. The Safeguard Procedure Manual of MID states that "the vulnerable groups are the poor and female heads of households, widows, the elderly, persons with disabilities, and children." However, there is no mention that special consideration is required. Although a certain number of poor people are included in the

target area of the Project, it cannot be confirmed that women's social advancement is being violated.

1.4.2.4 Specific measures for compensation and support

1.4.2.4.1 Compensation for losses

The affected land area and facilities, and the compensation fee are shown in Table 1.74 to Table 1.76. The MID will conduct negotiations and management of the compensation.

Table 1.74 Land Acquisition and Compensation

Ownership		Lease		Purchase		Total cost (SBD)
Category	Number of Ownership	Number of places	Affected area (m^2)	Number of places	Affected area (m^2)	
SIG (Solomon Islands Government)	5	4	663	4	606	615,789
Individual	10	6	132	10	452	498,509
Corp	8	4	258	8	1,056	1,531,812
Joint	8	5	320	7	360	852,443
under confirmation	4	4	28	1	16	23,425
Total	35	23	**1,400**	30	**2,490**	3,521,978

Table 1.75 Facility and Compensation

Type of Facilities	Number of owners	Area (m^2)	Total cost (SBD)
Canteen	22	570.5	713,736
Market Hut	65	764.6	500,777
Residential	1	36.0	57,800
Total	88	1,371.0	1,272,313

Table 1.76 Other Assets and Compensation

Type of non-land assets	Number of owners	Area (m2)	Total cost (SBD)
Car park	8	382.0	152,815
Fence	28	2,393.1	771,887
Total	36	2,775.1	924,703

Table 1.77 Trees and Compensation

Type of non-land assets	Number of owners	Number of tress (pc)	Total cost (SBD)
Banana	3	99	1,485
Mango	1	1	50
Bread Fruit	1	1	50
Coconut	1	1	120
Total	6	102	1,705

1.4.2.4.2 Entitlement Matrix

The entitlement matrix with impacts, losses and compensations is shown in Table 1.78.

Table 1.78 Entitlement Matrix

Impact	Application	Entitled PAPs	Entitlement
Loss of use of land through temporary occupation by the project including any damages within land used temporarily.	Alienated land (FTE, etc.) required during works.	Landowners/users of the land Land title holder.	- Rent as negotiated with landowner. All temporary use of land will be through a written agreement with the land title holder and land will be returned to the landowner after the rehabilitation of the land to its original state or better condition. - Compensation will be made at full replacement cost for any damages within land used for or by the project.
Permanent loss of various types of land (other than residential)	Alienated land required for the project works.	Lease-holders, tenants and users of land.	- Cash compensation, at replacement cost, to landowner(s) as agreed between MID and landowner(s).
Loss of gardens, trees, crops, perennials, and/or productive trees/plants.	Standing crops, trees in the ROW or road corridor.	Owner(s) of crops or trees.	- Compensation at replacement cost as determined by the Forest Division for timber trees and the Department of Agriculture for crops or productive plants/trees.
Partial or total removal of temporary structures (market huts or commercial structure).	Structure in ROW or road corridor.	Owner(s) of structure	- Compensation for structures affected or removed at replacement cost without deductions for salvaged materials, and assistance in locating suitable alternative housing or commercial building.
Temporary impact during construction.	Temporary use of land outside the construction limit (ROW) or road corridor during construction.	Owner(s) of land	- All temporary use of lands outside the ROW to be through written agreement between the landowner and the contractor. The Land will be returned to owner after rehabilitation to original preferably better standard.
Affected Vulnerable Households		Vulnerable households losing assets to the Project.	- In addition to the standard package, vulnerable PAPs households will receive a one-time additional special assistance agreed with MID.
Unforeseen or unintended impacts.	Any impact identified during implementation.	Concerned PAPs.	Determined as per the spirit of this ARAP.

1.4.2.5 Complaint Handling Mechanism

1.4.2.5.1 Organization and Procedure

For efficient dealing with the PAFs or affected properties' owners resettlement concerns, the MID has adopted a simple and acceptable, transparent and effective Grievance Redress Mechanism (GRM).The Grievance Redress Mechanism (GRM) was prepared to fulfill both SIG legislation and donor partner agencies requirements to resolve and address issues raised during the course of project implementation by the MID. This is in according to the MID Safeguards Procedures Manual (SPM).

For effective implementation of the GRM, a Community Advisory Committee (CAC), will be established by the MID Safeguards Unit to resolve issues at the local or community level.

1.4.2.5.2 Grievance Redress Committee

While a Grievance Redress Committee (GRC) comprising of the MID - PS, Director CPIU, safeguards personnel (and Project Engineer, Contractor during implementation) and a third party arbitrator appointed by the PS will be set up to resolve issues at the ministry level if the issues cannot be resolved at the local level.

The GRC would be the tool to ensure proper presentation of grievances, and impartial hearings and transparent decisions. As already mentioned, a GRC does not possess any legal mandate or authority to resolve LAR issues, rather acts as an advisory body or facilitate to try to resolve issues, for example, relating to value of compensation for affected properties. GRC will include at least one female member to participate in the hearings if the aggrieved person is a female.

The GRC shall comprise of 7 or more members which will include at least 1 or 2 females as contact persons for the community is proposed to be formed at the project area. In case of the absence of any of the members during the decision-making process, an appropriate candidate will be nominated by the original representative. However, at least five members should execute a session for grievance resolution with a MID representative being the chairperson. Composition of a GRC under the Project is proposed to include the following members:

Table 1.79 Member of Grievance Redress Committee

#	Member	Position
1.	Permanent Secretary, MID	Chairman
2.	Director, CPIU - MID	Member
3.	Commissioner of Lands, MLHS	Member
4.	Social Safeguards Officer, CPIU - MID	Member
5.	Community Development and Gender Specialist, CPIU - MID	Member
6.	Community Liaison Officer in the SU, CPIU/MID	Member
7.	Social Safeguards Specialist, Project Team	Member
8.	CAC Representative of PAFs	Member
9.	Complainant	Member

1.4.2.5.3 Proposed Measures to Address Grievance

Grievances will be addressed through the following steps:

a. Complainant(s) raises a concern or an issue with the contractor's Community Liaison Officer (CLO);

b. Contractor informs the CAC and will try and resolve it at the project level;

c. If not resolved this will be taken up with the project's safeguards officer;

d. Complainant(s) first discuss their complaint with their CAC representative. If the CAC representative supports the complaint both persons take the complaint to the project office. Straightforward complaints will be resolved by determination of issues locally on the spot. All such issues must be recorded by the project staff;

e. If not resolved the issue will be taken up with MID job manager or the CPIU Director;

f. If not resolved this will be reported by the CPIU Director to the PS – MID that is If the complainant is not satisfied with the outcome, the complaint is next discussed by the complainant and the CPIU/MID assisted by the Safeguards Manager, Community Advisory Committee members, and the head of the land owning group (in respect of customary land). The Safeguards Manager will record all complaints (date, complainant, grievance, attempts to resolve the complaint, and outcomes) and have a maximum of two days to resolve the complaint and convey a decision to the complainant. If the complaint is dismissed, the complainant will be informed of their rights in taking it to the next step. A copy of the decision is to be sent to the next level of authority;

g. If not resolved, MID PS will refer and request for a third party arbitrator as part of the GRC but should the complainant not be satisfied with the decision of the CPIU/MID, depending on the nature of the complaint, the complainant may take the complaint to the MLHS, who will appoint the COL to review the complaint. The MLHS will have 15 days to make a determination; and,

h. If not resolved it can be appealed in the national courts that is if a satisfactory conclusion cannot be obtained through this process, the complainant can take the matter to the courts (Magistrates Court, High Court or CLAC). This will be at the complainant's own expenses or cost but if the court shows that the government ministries have been negligent in making their determination, the complainant will be able to seek cost compensation.

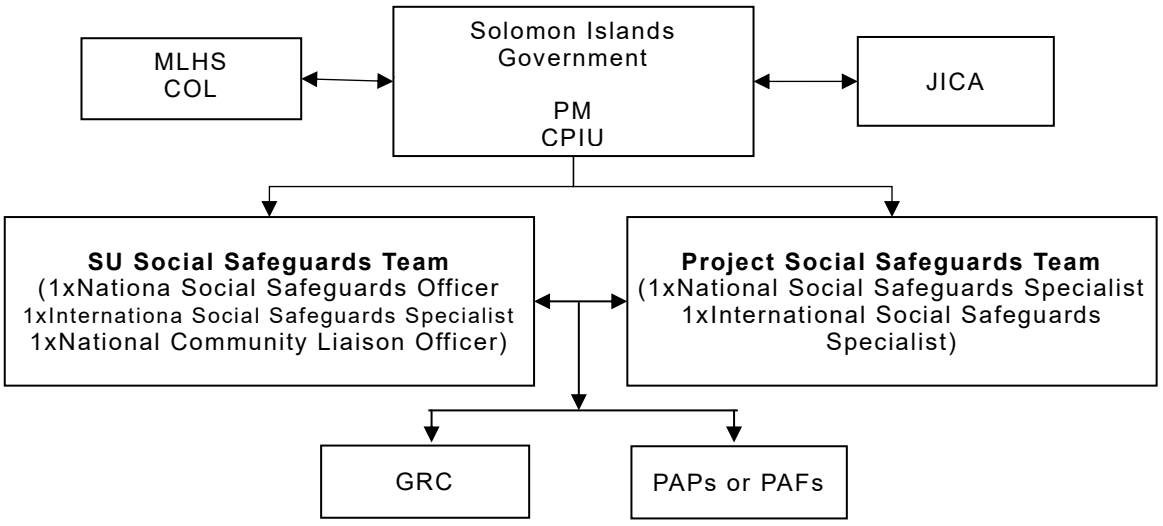
Mention should be made, in the event of grievances that cannot be resolved at the local level, the MID will hold the compensation amounts in escrow or trust account. Compensation will be paid in full upon final resolution of the case in the courts or other forum, in accordance with the entitlements of the PAFs or affected persons.

1.4.2.6 Implementation System for Resettlement

1.4.2.6.1 Organization Chart and Personnel with Responsibility

The CPIU of the MID will have overall responsibility to implement the ARAP by managing the land acquisition and resettlement aspects under the Project. The existing SU of CPIU will train and provide guidance to strengthen the capacity of national staff in the process of planning, implementation and monitoring the social safeguard activities. The Safeguards Unit Social Safeguards Team will make sure that the compensations and entitlements under the ARAP are fully provided to the PAPs/ PAFs prior to the commencement of construction activities. The Project Manager, assisted by the Social Safeguards Team, will play the major role to ensure that all relevant safeguard plans are implemented in line with the ARAP. Following the award of the civil works contract, the social safeguard teams will arrange a briefing to the contractors to raise their awareness on safeguard requirements.

The ARAP Implementation organization chart and the responsibilities of responsible authorities to implement the ARAP is as shown in Figure 1.39.



MLHS : Ministry of Lands, Housing and Survey
COL : Commissioner of Land
PM: Project Manager
CPIU : Central Project Implementation Unit of MID
SU: Safeguard Unit
GRC: Grievance Redress Committee
PAPs / PAFs: Project Affected Persons / Project Affected Families

Figure 1.39 Implementation Organization on ARAP

Table 1.80 Responsibility of Implementation Organization

Authorities	Roles and Responsibilities
Executing Agency (EA) MID	· Overall execution of the Project · Directs the CPIU · Endorse the ARAP and forward to JICA for approval. MID at appropriate time will disclose the ARAP on its respective websites · Provides funds for land acquisition and resettlement · Liaises with JICA
CPIU/MID	· Manages the social and resettlement aspects of the projects · Works with project team on all matters dealing with resettlement and consultations · Organizes effective public consultation and disclosure of resettlement planning documents in appropriate languages · Ensures that effective monitoring of resettlement is conducted and reported to funding agencies · Ensures that the grievance redress system is effective in addressing PAPs/PAFs concerns · Liaises with JICA on all matters relating to resettlement and submits regular reports.
MLHS/COL	· Support to the MID in carrying out land acquisition activities · Support the MID to identify landowners or lease-holders, prepare declarations and notices as required, and undertake land acquisition survey
JICA	· Review and approve all resettlement documentation as required under their respective policies · Disclose ARAP on respective websites · Provide guidance as required based on progress reports and supervision missions

1.4.2.6.2 Arrangement Mechanism Among Relevant Divisions and Sectors

The MID will negotiate with the leaseholders and no construction works commence without agreement from the leaseholder. The MID normally engages in discussion with the title holder or its representative and, if there is a disagreement, the MID reviews the design and then re-starts the discussion with the leaseholder until an agreement is reached. This same consultative approach on the design will be followed by the MID under this Project.

Furthermore, the MID through the Implementing Agency had adopted and practiced the use of a Memorandum of Understanding (MOU) and/ or Memorandum of Agreement (MOA) for use of land. That is negotiating with the land and properties owners for temporary or permanent clearance and use of land for infrastructure development and only paying compensation for non – land assets. Compulsory acquiring land is not normally practiced as it takes time and often triggers issues among customary land owning groups as most of the lands within the country for development are customarily owned.

1.4.2.7 Schedule (Compensation and Resettlement)

Implementation schedule of the ARAP broadly consists of resettlement activities. Time frame for implementation of the ARAP will be done before the project implementation in a way that commencement and progress of civil works is not adversely affected. The ARAP will be updated and resubmitted to the client and JICA for approval if there will be any changes or amendments made after the demarcation of affected lands based on the detailed design and other associated tasks before the payment. The SU social safeguard team of CPIU with assistance from the Projects safeguards team will co-ordinate the land acquisition and resettlement aspects and policies before the actual start of the implementation of resettlement plan. MID/CPIU will begin the implementation process of ARAP immediately after its approval by the aid donor. Grievances or objections (if any) will be addressed as per the grievance redress procedure adopted in this ARAP.

The steps for the delivery of compensation for all eligible PAPs or PAFs will as follows:

- **Invoice Preparation:** Invoices for each of the eligible PAPs/ PAFs will be prepared by CPIU. This document will entail the entitlements of each PAPs/ PAFs to receive the amount indicated in the invoice.
- **Money paid to Local Banks:** The money from the MID will be remitted to a bank in Honiara City. A bank account will be opened by the CPIU to deposit the amount of compensation on behalf of the PAPs/ PAFs.
- **Payment Procedure:** Each PAPs/ PAFs will receive a cash/cheque for the whole amount of compensation from the MID - CPIU. The PAPs/ PAFs shall sign a deed of settlement acknowledging the receipt of the whole compensation and a waiver attesting that he/she has no longer any pending claim over the affected property. To show proof of PAPs/ PAFs receiving compensation a photograph shall be taken during the handover of cash or cheque to PAPs/ PAFs for project documentation.
- **Identity of Person:** PAPs/ PAFs must show or present their National Identity Card (NIC) or Passport or any other document to show proof of identity during the time of receiving the compensation cash or cheque.

1.4.2.8 Cost and Fund Source

All funds required for compensating the affected land, structure and trees, including providing various allowances will be allocated by the government. The MID will ensure that adequate funds are available for carrying out resettlement according to the budgets provided in the ARAP. The CPIU will coordinate allocation of funds, approval of payments, and delivery of funds, monitoring of progress and reporting.

The entire resettlement for the impacts due to the Kukum Highway Road Upgrade will require a total of SBD 6,871,770.5 Contingency expenses is 10% of the total expenses and administration fee is 5% of the total cost. Administrative work required to compensate a small number of affected households under the project is a very negligible task which can

easily be handled by the SU social safeguard team. Engaging a large administrative force therefore will not be required; rather a contingency fund provided in the budget can meet the administrative cost for compensating this small number of PAPs.

A summary of the total cost of implementing the ARAP presenting allowances for losses under this project are shown in the table below.

Table 1.81 Summary Resettlement Budget

Category	Type of Facilities	Number of owners	Affected items	
			Area /Items	Compensation fee (SBD)
Land	Land Acquisition (m^2)	35	3,890.0	3,521,977.9
Facility	Canteen (m^2)	22	570.5	713,736.4
	Market Hut (m^2)	65	764.6	500,776.5
	Residential (m^2)	1	36.0	57,800.0
Assets	Car park (m^2)	8	382.0	152,815.2
	Fence (m^2)	28	2,393.1	771,887.8
Trees	Banana (pc)	3	99	1,485.0
	Mango (pc)	1	1	50.0
	Bread Fruit (pc)	1	1	50.0
	Coconut (pc)	1	1	120.0
Sub-Total				5,975,452.6
Contingency expenses		10 %		59,545.3
Administration fee		5 %		298,772.6
Total				6,578,803.6

1.4.2.9 Monitoring System and Format by MID

Monitoring of all resettlement and consultation tasks and reporting to JICA will be conducted by the Safeguard Unit established in the CPIU, assisted by the project social safeguards team. Internal monitoring will include reporting on progress of the activities as indicated in the implementation schedule with particular focus on public consultations, land purchase (if applicable), determination of compensation, record of grievances and status of complaints, financial disbursements, and level of satisfaction among PAPs/PAFs.

The CPIU/MID will submit progress reports on land acquisition and the ARAP to JICA on regularly, and the findings will be incorporated into the progress reporting of the CPIU. JICA will specifically check the progress of any resettlement and land acquisition undertaken for subsequent investments projects.

Table 1.82 Report frequency

Progress	Duration	Frequency of report
Pre-, construction stage	Nov. 2020 to Jun. 2023	Quarterly
Operation stage	Jul. 2023 to Jun. 2025	semi-half year

External monitoring is not essential under this project. Provision of external independent monitoring therefore is not included in the institutional setup of ARAP implementation. Resettlement monitoring reports will be sent to JICA along with regular progress reports on semi-annually. The monitoring reports will be posted on JICA website, and relevant information from these reports will be disclosed in the project areas.

The monitoring indicators that will be used to monitor the ARAP implementation by MID is shown in Table 1.83. The CPIU/MID, with assistance from the SU and the project safeguards team will prepare a compliance report after delivery of compensation. Based on the compliance report, JICA will issue a NOL (no objection letter) to commence civil works.

Table 1.83 Indicators for Monitoring

Aspect	Indicators
ARAP implementation	General and overall compliance of resettlement activities with the ARAP, including payment of compensation: (i) full payment to be made to all affected persons before commencement of works; (ii) adequacy of payment to replace affected assets; and The level of satisfaction of PAPs/PAFs with various aspects of the ARAP process.
Consultation, disclosure and grievance redress	Public information distribution and consultation procedures conform to the process established in the ARAP; The participatory process and various mechanisms as well as measures taken, both in terms of the quality and meaningfulness of this process, and the extent that primary stakeholders actively participate in the process; The disclosure of the ARAP, whether PAPs know their entitlements and whether they have received all of their entitlements; and Monitor the effectiveness of the grievance mechanism, types of grievances, if and how resolved, and satisfaction of PAPs with the process.
Gender issues	The institutional and staffing mechanisms; Aggregation and dis-aggregation of gender sensitive data; Women's representation and participation in the detailed planning and execution process; Gender inclusiveness such as technical training to both men and women; Delivery of replacement leases or land titles in the names of both husband and wife; Whether compensation has been delivered to both husband and wife, together; and The effectiveness of livelihoods programs for restoring and developing women's income and living standards.
Vulnerable groups issues	Categorization of the propriety and effectiveness of various entitlements, programs and activities and methods of delivery for various vulnerable households and groups, and the need for adjustment or additional measures.
Transparency	How information is distributed and to whom, in order to make sure that all PAPs have the proper information and access to knowledge; Functioning of decision-making bodies and how this information is properly recorded and made available to all PAPs/PAFs.

1.4.2.10 Public Consultation

1.4.2.10.1 Implementation of Public Consultation

The MID and the Team held the 1st briefing public consultation for residents in Honiara and Henderson on December 3, 2019 and December 4, 2019, respectively. Table 1.84 and Table 1.85 show the outline of each meeting.

At the 1st Public consultation, MID with Project explained the outline of the project and census survey will be conducted, and declared that the cut-off date will be December 3, 2019.

Table 1.84 1st Public consultation in Henderson

Date	3rd December 2019 (Tuesday) PM 15:00~17:00
Venue	Henderson Field
Agenda	1. Project summary 2. Discussion on traffic accident and measure 3. Announcement of Cut-off date
Language	Pijin
Participants	Total participants: 43, (Male: 23, Female: 20) Organization: MID. Support; JICA Team, Local consultant
Major discussion/ Recommendation	* Asked about the maintenance of the road and drainages after the completion of the project? →MID and Project representatives responded that the Road and drainages will be maintained by MID. * MID to consider relocation of market stalls or vendors along the road section. * Asked about the project time frame and scope. → Project Rep explained that the project time frame is to deliver the project before the 2023 SP Games. * Inform the participants that there will be impacts on some land and non - land assets along the road section. Particularly those that are in the road corridor or within the 32m right-of -way (ROW). * Who will be responsible to compensate for lost assets or land: → MID will be responsible and not the Project will only identify affected families or households and present it to MID. * Participants express support towards the projects to reduce traffic jam (time consuming and lateness to work and school for children). * Why only 2 lanes from Lungga Bridge? → From MFMR office to Lungga Bridge it will be 4 lanes and 2 lanes from Lungga Bridge to Henderson. MID has considered 4 lanes and this will be catered for in the current road design to make room for future road upgrades. * Replace existing drainages to larger sizes. * Need for proper signages, pedestrian crossings, foot paths and traffic lights at certain locations including provision for bicycles. * Climate Change and weather patterns should be considered in the design.
Activity	JICA Team conduct exercise to finding traffic dangerous points along the project road especially from the Ranadi Round-about to Henderson.
Statement of Cut - off Date	The declaration of Cut - off was done and declared as the 3rd of December 2019. From this date no further developments are to be made along the Kukum Highway up to Henderson.

Table 1.85 1st Public consultation in Honiara

Date	4th December 2019 (Wednesday) AM 10:00~12:00
Venue	KGVI Market

Agenda	1. Project summary 2. Discussion on traffic accident and measure 3. Announcement of Cut-off date
Language	Pijin
Participants	Total participants: 40, (Male: 21, Female: 19) Organization: MID. Support; JICA Team, Local consultant
Major discussion/ Recommendation	*Proposed a need for pedestrian crossings at KGVI School, Burns Creek School, Perch School and proper signages at specific locations along the road, foot paths and traffic lights at certain locations including provision of paths for bicycles or cyclists. *Notify the team that some of the lands within the road corridor had been sold by MLHS to some people and they already had the registered land titles. *The resumption of lands by the MLHS or SIG to make way for the project is not fair to the people. *Asked if the project would relocate the market huts at KGVI? → Project team will take note and inform MID. *Is the Project Scope and time frame realistic? → The project scope and time frame may change but it depends on MID, but the current plan is to complete the construction before 2023. *Who will pay for impacts on land and properties? → MID will be responsible and not the project. Project will only identify affected families or households and present it to MID. *Participants express support towards the projects to reduce traffic jam (time consuming and lateness to work and school for children). *Asked the project to consider designing larger drainages compared to the ones constructed for the Phase 1 of the project. * Replace existing drainages to larger sizes. * Climate Change and weather patterns should be considered in the design.
Activity	·JICA Team conduct exercise to finding traffic dangerous points along the project road especially from the Ranadi Roundabout to Henderson.
Statement of Cut - off Date	·The declaration of Cut - off was done and declared as the 3rd of December 2019. From this date no further developments are to be made along the Kukum Highway up to Henderson.

1.4.2.10.2 Public Consultation for ARAP Explanation

The MID and the Team organized public consultations for ARAP explanation after finalizing the project design based on the interview survey and social census. The public consultations were held total six times shown in Table 1.86. As the results of those consultations, all affected people agreed to proposed compensation from MID basically.

Table 1.86 Public Consolation for ARAP Explanation

#	Date	Place	Number of participants (Except organizer)
1	10:00am, 12th August 2020	Holiday Resort Conference Room	21 PAPs, 2 females, 19 males
2	1:30pm, 12th August 2020	Holiday Resort Conference Room	21 PAPs, 12 females, 9 males
3	10:00am, 14th August 2020	Lunga Market	52 PAPs, 37 females, 15 males
4	1:00pm, 14th August 2020	Henderson Market	45 PAPs, 32 females, 13 males
5	10:00am, 19th August 2020	Holiday Resort Conference Room	13 PAPs, 3 females, 10 males
6	1:30pm, 19th August 2020	Lunga Market	28 PAPs, 9 females, 19 males

Table 1.87 Public Consultation for ARAP-1

Title	Project for Upgrading of the Kukum Highway (Phase 2)		
Date	12th August 2020	Time:	10:00am
Venue	Holiday Resort Conference Room		
Purpose	To update and inform the Project Affected Persons about the project and its social and environmental impacts. Including impacts on their land and non - land assets.		
Participants	Participated organization; 3 MID, 3 LBS (local consultant), 2 JICA Team & 1 CTII Rep		
	Total participants: 21 PAPs, 2 females, 19 males		
Agenda (summary)	1. Opening remarks 2. Introduction of Attendees 3. Project Scope and Time frame 4. Potential Project Impacts 5. Impacts on Land / Non - Land Assets 6. Discussion/ AOB 7. Closing remarks		
Issues and Discussion	1. PAPs request for private valuation of their properties. (Florence) ❖ For SIG/ MID, MLHS will do the valuation of assets or properties, and PAPs are urged to co-operate for valuation of assets. 2. MID team to arrange for a time to meet with the Guadalcanal Province Planning Board and to formally request a copy of the GP Planning Scheme. (Benedict Tova, GP) ❖ Will discuss with MID for a meeting with GP. 3. Concern Burns Creek area heavy flooding during heavy raining times (Design of drainage and proper culverts). (Chief. Satu) ❖ Noted MID and CTII will discuss on this. 4. MID to discuss with the COL - MLHS, concerning the existing road from Lungga Bridge to Henderson. MID must ensure that this road be declared a Public Road and Gazetted, as from records there are no proper acquisition of this land and declaration for it to be a public road. (Benedict Tova, GP) ❖ Will be recommended to the MID for upper level discussions. 5. Asked for proper footpaths as some people are using the footpaths for parking, and pedestrian crossings must be considered for schools along this highway. (Male rep) ❖ Noted, MID to consider this with the engineer for design. 6. MID to consider upgrading the old Lungga road to assist in the sufficient utilization of the proposed round - about at Lungga Cross Road. That is buses or taxis can drop off their passengers along this road and travel directly to the roundabout to head back to town. If not, there will still be traffic jam for Lungga Bus bay because of the attitudes and behaviours of these drivers. G /Province will declare Lungga to Henderson Land as Town Land since it was recorded as Agricultural Land. (Benedict Tova, GP) ❖ Noted, and will propose that to MID for discussion with the donor and designer. 7. U-turns should be considered for fuel stations and access roads particularly the one for Betikama School. (L Kakai, KGVI Rep). ❖ Noted and will be forwarded to MID. 8. All participants are asking MID to arrange for awareness programs to be carried out for all public transport drivers and the public to inform them of the following: a) Road and Traffic safety, b) Meanings of road signages as some drivers and pedestrians are not educated; c) Road care - people to take ownership of this public property. ❖ Noted and will be taken up with MID.		

Note	■ Most PAPs are requesting to see the final valuation of their assets particularly land. However, it was made clear to them that final valuation of assets will be done by MLHS Valuation Unit when the design is final. ■ All are supportive and cooperative with the project and would like to see it eventuate in the following year. ■ PAPs also request for another meeting when the design will be finalized.
Statement of Cut - off Date	It was emphasized during the meeting that a cut-off date notice was issued by MID in July 2020. Stating that no new developments should be made along this road after December 3rd 2019, such developments will not be considered and recorded by MID for compensations.

Table 1.88 Public Consultation for ARAP-2

Title	Project for Upgrading of the Kukum Highway (Phase 2)		
Date	12th August 2020	Time	1:30pm
Venue	Holiday Resort Conference Room		
Purpose	To update and inform the Project Affected Persons about the project and its social and environmental impacts. Including impacts on their land and non - land assets.		
Participants	Participated organization; 2 MID, 3 LBS (local consultant), & 1 CTII Rep		
	Total participants: 21 PAPs, 12 females, 9 males		
Agenda (summary)	1. Opening remarks 2. Introduction of Attendees 3. Project Scope and Time frame 4. Potential Project Impacts 5. Impacts on Land / Non - Land Assets 6. Discussion/ AOB 7. Closing remarks		
Issues and Discussion	1. Asked if MID will also compensate for loss of business during construction period as some people depended very much on these markets for income. (Josephine Shanel & P Savusi). ❖ MID will only do replacement cost of structures. But will take note of your concern and forward it to MID for upper level discussions. 2. Asked if compensations will only be on the structures? ❖ Yes, MID will only compensate for the structures, and if there will be additional compensations that is up to MID but the team cannot answer to that at present. 3. MID must ensure that there will not be further encroachments by road side vendors after compensations are done for this project, as this will cost the government. Asked if MID can consider not planting trees in the median strips as this may be the cause of damage to the existing sealed roads? Asked MID to pay fair compensations to all APs? Inform the team that the fence adjacent to the road (his property) is on the legal land boundary and enquire if MID is going to compensate for removing the fence and re-installing it, and what about land encroachments? (Dr. D Sikua) ❖ Thank the Dr. Sikua for his contribution it is noted and will be forwarded to MID. Inform the all attendees, that after the compensations all APs must remove their structures or market huts. MID do not encourage any person to reconsider building within the road corridor after this project. If you do so you will not be compensated for your loss in the future. ❖ MID will arrange for surveyors to survey each affected property that had been identified and legal boundaries are not clear for confirmation of boundaries. Your property is noted and will also be considered. ❖ Compensations as did under the phase 1 project are done to remove and re-install structures particularly fences by PAPs. That is removal and re-installment are done by the owners and not the contractor or MID. 4. If MID is considering to get the MLHS surveyors to confirm boundaries that will be very good. As this will also help with the identification of some access roads to		

	properties when these lands are subdivided as some people are encroaching into other's land to access their properties. 5. What will happen to access roads to properties during construction? (Josephine Shanel) ❖ All access roads will be used, however if there will be a need to close an access road during works the contractor will discuss with the PAP and will for alternatives. 6. According to the design there will be improvements to the drainage system. But does MID consider improving the drainage outlets along this road section. That is maintaining these drainages all the way to the coast? As this had been non operative and when it rains it floods the whole area? MID to check further down along the drainages as some people had planted trees in the drainages which resulted in the blockages. MID should divert the drainages to drainages along the access roads constructed by Levers SI Ltd. (Dr. Sikua, P Savusi, Kylie Afuga & J Shanel) ❖ Thank all participants for their concern, will forward it to MID. ❖ Urge attendees to let inform family members and public know that throwing rubbish in the drainages are also causing issues to the existing drainages and that this is not encouraged if people wanted to see the drainages being efficient during heavy rains. 7. Proposed if MID could assist, with negotiation with the PMO for Marketing Venue at his Henderson property. This was already discussed with the SPM but no response since then. See this as will be very helpful to the road side vendors? (Dr. D Sikua) ❖ Noted and will be taken up with MID. 8. What about those vendors who are renting from market hut owners? (Joachim) ❖ Market hut owners must discuss this with their tenants. MID will only pay for the structures and it is each owner's responsibility to discuss this with their tenants. That is when compensations are paid and when structures are expected to be removed. 9. Appreciate MID for the approach taken in informing all road side vendors, particularly women. Stated that it is very important for them to know and be informed to prepare for removal of their market huts. (Joan Tangi)
Note	■ PAPs are happy with the project and are supportive since MID will be compensating for their structures. ■ MID to continue update them on the project. ■ Another consultation is proposed after the design will be finalized. ■ All PAPs agreed to remove their market huts and canteens from the road reserve when MID will give instructions to confirm date.
Statement of Cut - off Date	It was emphasized during the meeting that a cut-off date notice was issued by MID in July 2020. Stating that no new developments should be made along this road after December 3rd 2019, such developments will not be considered and recorded by MID for compensations.

Table 1.89 Public Consultation for ARAP-3

Title	Project for Upgrading of the Kukum Highway (Phase 2)		
Date	14th August 2020	Time	10:00am
Venue	Lunga Market		
Purpose	To update and inform the Project Affected Persons about the project and its social and environmental impacts. Including impacts on their land and non - land assets.		
Participants	Participated organization;1 MID, 2 LBS (local consultant) & 1 CTII Rep		
	Total participants: 52 PAPs, 37 females, 15 males		
Agenda (summary)	1. Opening remarks 2. Introduction of Attendees 3. Project Scope and Time frame 4. Potential Project Impacts 5. Impacts on Land / Non - Land Assets		

	6. Discussion/ AOB 7. Closing remarks
Issues and Discussion	1. Requested if each market hut owner can value their own properties? (male attendee) ❖ MID will do the valuation of properties, but if market hut owners wanted to value their own properties they would have to agree with MID on the price. 2. MID should also upgrade the old Lungga road to assist with easing traffic, the busbay is causing traffic. Median strip with no U-turn at this location will be good – (Male attendee). ❖ Concern is noted. 3. MID should also compensate all canteens for the loss of business during construction period. (Vendors) ❖ Noted and will be discussed with MID. 4. Can MID consider paying the Compensations first before we remove our structures or tables? (Female vendor) ❖ Noted and will be discussed with MID. ❖ Those owning tables are recorded, but it is not confirmed by MID if you will be compensated for your loss. MID will discuss this at the management level and get back to you. 5. It is good that drainages will be improved and roads will be upgraded, all PAPs agreed to remove their market huts or tables from the roads once compensation is paid directly to them on time and notice of confirmation to move will be issued by MID to confirm the date. After all the vendors do not own the road and the MID is very thoughtful to compensate people to move out of their own land. (Male attendee) 6. Continuous consultation and awareness by MID are important for all road users and road side vendors. Appreciate MID for taking the time to do this very informative discussion with the public. (All attendees)
Note	■ PAPs are supportive and had agreed to remove their structures and move out of the road corridor. ■ Appreciate MID for the awareness and consideration for compensation. ■ All PAPs rendered support for the project to move forward.
Statement of Cut - off Date	It was emphasized during the meeting that a cut-off date notice was issued by MID in July 2020. Stating that no new developments should be made along this road after December 3rd 2019, such developments will not be considered and recorded by MID for compensations.

Table 1.90 Public Consultation for ARAP-4

Title	Project for Upgrading of the Kukum Highway (Phase 2)		
Date	14th August 2020	Time	1:30pm
Venue	Henderson Market		
Purpose	To update and inform the Project Affected Persons about the project and its social and environmental impacts.		
Participants	Participated organization; 1 MID, 2 LBS (local consultant) & 1 CTII Rep		
	Total participants: 45 PAPs, 32 females, 13 males		
Agenda (summary)	1. Opening remarks 2. Introduction of Attendees 3. Project Scope and Time frame 4. Discussion 5. Statement of Cutoff Date 6. Closing remarks		
Issues and Discussion	1. Who will be responsible for market venues after moving out from the road? (Female/Male attendees). ❖ MID is not responsible for market outlets or venues, but will discuss this with MID to take this up with the responsible ministry.		

	2. MID should consider compensating all road side vendors for the loss of business during construction period. (Male / Female attendees) ❖ MID will only compensate structures such as market huts or canteens and bonbon market huts but not tables and stalls as these are mobile structures. Table vendors compensation is not yet confirmed by MID as there will be need to discuss this at a higher level and if there will be any confirmation of compensation or no compensation the team will inform you. 3. Compensation must be done first before removal of structures. (All attendees). ❖ Concern is noted and will be discussed with MID 4. MID to consider improving culverts and drainages outlets, this will improve the drainage system in this road section, without the drainage outlets working the drainage system will fail. (Male attendee). ❖ Noted and will be discussed by MID with the responsible engineer. 5. All road side vendors agreed to move out of the road corridor upon confirmation of date from MID and acknowledges MID for the awareness and having the time to discuss the project with the public. (All attendees rep)
Note	■ All PAPs are supportive of the project and rendered support to MID. ■ Fair compensation for all vendors is requested.
Statement of Cut - off Date	It was emphasized during the awareness that a cut-off date notice was issued by MID in July 2020. Stating that no new developments should be made along this road after December 3rd 2019, such developments will not be considered and recorded by MID for compensations.

Table 1.91 Public Consultation for ARAP-5

Title	Project for Upgrading of the Kukum Highway (Phase 2)		
Date	19th August 2020	Time	10:00am
Venue	Holiday Resort Conference Room		
Purpose	To update and inform the Project Affected Persons about the project and its social and environmental impacts. Including impacts on their land and non - land assets.		
Participants	Participated organization; 2 MID, 2 LBS (local consultant), 1 CTII Rep		
	Total participants: 13 PAPs, 3 females, 10 males		
Agenda (summary)	1. Opening remarks 2. Introduction of Attendees 3. Project Scope and Time frame 4. Potential Project Impacts 5. Impacts on Land / Non - Land Assets 6. Discussion/ AOB 7. Closing remarks		
Issues and Discussion	1. Asked if MID will be compensating PAPs on a fair price? (Male attendee) ❖ Yes, MID will try and make the prices as fair as possible so as not to dissapoint the PAPs. However, if you are not happy with the valuation you can discuss this with MID. For land especially, MID encoruages PAPs that are not happy with the compensation price to get a private valuer at their own cost and discuss with MID on the prices or rates. ❖ It is important for people to take note that, you are encroaching on the road reserve. MID is trying its best to compensate all of you fairly to remove your structures from its land. Therefore, requests your support and cooperation. 2. Asked for compensation of all structures before removal? (Male attendee) ❖ Noted and will inform MID. 3. Asked if all market huts are recorded? ❖ Yes, all market huts are recorded. These are from KGVI Market to Henderson. 4. Asked if all road side vendors will be compensated, as this will also affect their livelihood? (Rose Kola)		

	❖ All road side vendors who owns market houses will be compensated. But not those with tables and umbrellas. However, the team had recorded all road side vendors and had taken photos of each tables and had their owner's names recorded. MID has not yet given a definite answer on this so at this stage it is not confirmed if table owners will be compensated. MID through the CPIU safeguards unit will continue to update and inform you if anything changes. ❖ Also list of PAPs will be updated and given to MID. ❖ MID is taking this approach of compensation as it is the Policy of the Aid Donor to compensate those that the project will have impact on their livelihood or for their loss. It is important to take note that based on the law (Road Act) the Director of MID, CE have the right to remove your property without compensations. The safeguards team is working to ensure that you are satisfy with your compensation and MID is free from any grievances from your side to continue the project. 5. Asked how compensations are made? ❖ MID compensate structures in the road corridor which is 32m across, 16m from the road center line. ❖ Land titles registers are obtained from the MLHS, so if people are claiming to having owned the land without a registered title no compensations will be paid the only compensation will only be for the loss of what you build on the land. ❖ Land title holders will be compensated for the land. 6. Stated that PAPs are grateful that MID is informing them first hand on the issue to help them prepare for dismantling of their structures. Appreciate MID for taking such approach. 7. Inform all PAPs that after the compensation and the project is completed no one is encouraged to build market huts along the road as MID will not be responsible to compensate you for your loss in the future. Also, that all their concerns will be forwarded and discussed with MID.
Note	■ PAPs are supportive and cooperative. ■ PAPs would like to see compensation cost and discuss with MID before dismantling of structures. ■ All PAPs agreed to remove their market huts and canteens from the road reserve when MID will give instructions to confirm date.
Statement of Cut - off Date	It was emphasized during the meeting that a cut-off date notice was issued by MID in July 2020. Stating that no new developments should be made along this road after December 3rd 2019, such developments will not be considered and recorded by MID for compensations.

Table 1.92 Public Consultation for ARAP-6

Title	Project for Upgrading of the Kukum Highway (Phase 2)		
Date	19th August 2020	Time	1:00pm
Venue	Lunga Market		
Purpose	To update and inform the Project Affected Persons about the project and its social and environmental impacts. Including impacts on their land and non - land assets.		
Participants	Participated organization; 2 MID, 3 LBS (local consultant) & 1 CTII Rep		
	Total participants: 28 PAPs, 9 females, 19 males		
Agenda (summary)	1. Opening remarks 2. Introduction of Attendees 3. Project Scope and Time frame 4. Potential Project Impacts 5. Impacts on Land / Non - Land Assets 6. Discussion/ AOB 7. Closing remarks		
Issues and Discussion	1. Asked if the Bonbon market at Henderson is in the road reserve or not? (Viviane)		

	❖ From the map obtained from MLHS, the road side market is in the road corridor, reason for only compensating you for the loss of your structure and not the land. 2. MID should also compensate all canteens for the loss of business during construction period? (Male attendee) ❖ Noted and will be discussed with MID. 3. KG market houses were removed due to COVID -19 by SIG through MHMS, will this project not be responsible for our market houses that had been removed first, after this project is recording all market house along the project location that are still remaining. (Road side vendors, KGVI) ❖ Noted and will be discussed with MID, however since it was MID who removed the market huts it is important that you consult with the authorities responsible for removing your market huts due to covid-19. 4. Compensation must be done first before removal of structures, market stalls. (Female reps). ❖ Noted and will be discussed with MID. 5. Will there be any consideration for compensation due to the above impact caused by Covid-19 as this had greatly affected our family needs and bills to be paid. Can MID have any solution to this or repatriate people to their respective villages if our only source of income will be affected for the purpose of the road? Important to consider loss of business or consider vulnerability. Is there any other venue that the SIG or MID can negotiate with the owners for road side vendors to use? ❖ MID understands that this will greatly affect your income generating activities, and apologizes for that. ❖ MID is taking this approach of compensation as it is the Policy of the Aid Donor to compensate those that the project will have impact on their livelihood or for their loss. It is important to take note that based on the law (Road Act) the Director of MID, CE have the right to remove your property without compensations. The safeguards team is working to ensure that you are satisfy with your compensation and MID is free from any grievances from your side to continue the project. ❖ Your concerns will be discussed with MID, to see if there is any other government body that can be responsible for your concern, particularly finding a new market venue. As MID do not encourage people to build market huts along the road after the road upgrade. 6. Some names recorded are not of those who owned the market huts? ❖ Noted and will check to confirm.
Note	■ All PAPs agreed to remove their market huts and canteens from the road reserve when MID will give instructions to confirm date. ■ Supportive of the project and appreciate MID for the consultations.
Statement of Cut - off Date	It was emphasized during the meeting that a cut-off date notice was issued by MID in July 2020. Stating that no new developments should be made along this road after December 3rd 2019, such developments will not be considered and recorded by MID for compensations.

1.4.2.11 Others

1.4.2.11.1 Draft Monitoring Form

The draft monitoring form used to report the monitoring results from the implementation agency (MID) to JICA during pre-construction phase to operation phase is shown in below:

Modification of the monitoring form is not limited.

(1) Environmental Monitoring Form

1) Monitoring form for Pre-construction Phase

Draft-environmental monitoring forms for Pre-construction phase are as follows.

1. Process of EIA

#	Items	Date	Contents/ Note
1	Submittal of PER		
2	1st PER Review		
3	Public Display		Name of Newspaper
4	2nd PER Review		
5	Appeal-1		
6	Appeal-2		
7	Approval on PER, EIA		

2. Approval for construction

#	Items	Approved organization	Approved date	Validity of approval	Contents/ Note
1	Project approval				
2	Project construction office site				
3	Quarry license				
4	Soil excavation license				
5	Discharge license of waste				
6	Discharge license of wastewater				
7	Discharge license of air pollution				
8	Usage of dumping site				

3. Pre-Works for construction

#	Items	Concerned organization	Start date of the work	End date of the works	Progress/ Note
1	Cutting/ relocation of tree				
2	Relocation of Water pipe	Solomon water			
3	Relocation of Electric line/poles	Solomon Power			
4	Relocation of Communication line	Telekom			

2) Monitoring form for Construction Phase

Draft-environmental monitoring forms for the construction phase are as follows.

1. Monitoring for Mitigation measures

#	Category	Parameters	Method	Monitoring frequency	Measuring results				Reference value	Note	Performer of measurement
					Duration/Day on measuring	Monitoring place	Average	maximum			
1	Air pollution	PM10	Sensor	2times /day							Contractor
2		PM2.5	Sensor	2times /day							Contractor
3		Dust	Hearing to residents	Monthly							Contractor
4		Spray asphalt emulsion	Record of usage of asphalt emulsion	If necessary							Contractor
5	water pollution	Turbidity	Visible observation	At raining							Contractor
6	Waste	Situation	Visible observation	Daily							Contractor
7		Amount	Record	Monthly							Contractor
8	Noise/ Vibration	Noise	Sensor	2times /day							

3) Monitoring form for the Operation Phase

Monitoring during the operation phase is planned to understand the actual situation (accident situation, etc.) including hearings on the livelihoods of affected persons and hearings for crossing. These monitoring will be recorded in the following social monitoring forms: 4)-1. Public consultation and 4)-3. Implementation of supporting of livelihood.

4) Social Environment Monitoring Form

The draft-social monitoring forms are as follows.

1. Public consultation

#	Date	Place	Participants (Men, Women)	Purpose of public consultation/ Major comment	Organization
1					MID
2					MID
3					MID
4					MID
5					

The public consultation is not limited to the explanation for ARAP. The purposes of the public consultation are including a hearing from residents, explanation of the construction schedule, a hearing regarding changes of traffic etc.

2. Progress of resettlement

#	Contents	Amount	unit	Progress (unit)	Progress (%)	Estimated finishing date	Organization
1	Implementation of Census		Families				Local consultants
2	Approval on ARAP	1	doc				MID
3	Finalize of RAP list	1	set				Local consultants
4	Land acquisition -1	800	m2	400m2	50%	xxth Dec 2020	MID
	Land acquisition -2		m2				MID
	Land acquisition -3		m2				MID
	Land acquisition -4		m2				MID
	Land acquisition -5		m2				MID
	Land acquisition -6		m2				MID
5	Land lease-1	600	m2	0m	0%	Duration from Mar to Sep 2021	MID
	Land lease-2		m2				MID
	Land lease-3		m2				MID
	Land lease-4		m2				MID
	Land lease-5		m2				MID
	Land lease-6		m2				MID
6	Total involuntary resettlement	30	Persons	20	66%	Jan. 2021	MID
	Resettlement on Poor person	15	Persons	15	100%		MID
7	Compensation of assets -1		SBD				
	Compensation of assets -2						
	Compensation of assets -3						
	Compensation of assets -4						
	Compensation of assets -5						
8							
9							

3. Implementation of supporting of livelihood

#	Items	Contents	Date of implementation	Results	Note
1					
2					
3					
4					

4. Grievance / Complaints from Affected Persons (APs)

#	Contents	Date of complaint	Response	Date of response	Note
1					
2					
3					
4					
5					
6					
7					
8					
9					

(2) Environmental Check List

The environmental check list is prepared based on the survey results as of 10th August 2020.

10th August 2020

Table 1.93 Environmental Check List

Category	Items	Check items	Yes :Y No : N	Environmental Social Consideration (The reason for Yes/No, Evidence, Mitigation measures etc.)
1. Permission/ Explanation	(1) EIA and Environmental permission	(a) Environmental assessment report (EIA report) are prepared, or not (b) EIA report is approved by government of Solomon, or not (c) Approval for EIA reports is required with incidental conditions? If there are incidental conditions, will those conditions satisfy? (d) Other permission is required or not?	(a):N (b):N (c):N/A (d):N	(a) EIA report is necessary as Public Environment Report. The PER is under preparation at the August 2020, and it will be submitted on September 2020. (b) It will be approval after submission. (c) It is before submission. (d) MID is required to take approval regarding quarry, construction and waste dumping.
	(2) Explanation to stakeholders	(a) The project contents and the impact including information disclosures is taken consensus among stakeholders or not? (b) The recommendation from residences are including in this project design or not?	(a):Y (b):Y	(a) The stakeholder meeting including related organization and major shop owner was held as for explain the summary of the project on December 2019. Also, public consultation meeting was held to residence along Kukum highway. On August 2020, project team will plan to hold stakeholder meeting and public consultation after finalizing the project contents and construction area. Furthermore, publication of PER is obligation under the process of EIA, the PER will be published in local Newspaper. (b) The road design considering safety and drainage.
	(3) Consideration of alternative plan	(a) Alternative plan including of Environmental and Social impact of the project are considered or not?	(a):Y	(a) The project team considered view point of technical issues and environmental social impact, against the five alternative plans including non-implementation of the project.
2. Pollution measure	(1) Air quality	(a) Are there any impact of air pollutants emitted from vehicles? Is it consistent with the environmental standards of the country? (b) In the case of exceeding of air quality standard around target area already, the project will be deteriorated more the air quality or not. And is there any countermeasure for air quality will taken?	(a):N (b):Y	(a) No environmental standard in Solomon Islands. The impact to air quality will not be exceeded the environmental values compare with Japanese environmental standard or WHO guideline value. (b) Project will take mitigation measure to PM (Particular Matter) such as spray an asphalt emulsion though the impact is estimated to not exceed environmental standard.
	(2) Water quality	(a) The water quality in the downstream area will be deteriorated due to soil runoff from exposed topsoil such as embankments and cuts or not? (b) Will the drainage from the road surface pollute groundwater and other water sources? (c) Is the drainage from the parking/service area, etc. consistent with effluent standards in Solomon Islands? In addition, will the discharge produce water bodies that do not apply to the environmental standards in Solomon Island?	(a):N (b):N (c):N	(a) Soil runoff are not expected. (b) The drainage from road surface is not expected to groundwater because to the drainage will discharge to water channel and rivers immediately. (c) No plans to construct parking etc.

Category	Items	Check items	Yes :Y No : N	Environmental Social Consideration (The reason for Yes/No, Evidence, Mitigation measures etc.)
	(3) Waste	(a) Will the waste from the parking/service area properly treated and disposed in accordance with the regulations of the Solomon Islands?	(a):N	(a) No plans to construct parking etc.
	(4) Nosie and Vibration	(a) Will noise and vibration from vehicles match the standards in Solomon Islands?	(a):Y	(a) No environmental standard regarding Noise and vibration in Solomon Islands, and significant impact is not expected.
3. Natural Environment	(1) protected area	(a) Is the project area located in a protected area specified by the law in Solomon Islands or international treaty? Will the project affect the protected area?	(a):N	(a) In the project area is not including protected area.
	(2) Ecosystem	(a) Project area is including primeval forests, tropical natural forests, ecologically important habitats (coral reefs, mangrove swamps, tidal flats, etc.) or not? (b) Project area is including habitats of valuable species that need protection under the laws in Solomon Islands and international treaties or not? (c) If significant impacts on the ecosystem are concerned, will measures be taken any mitigation measure to reduce the impact on the ecosystem? (d) Any measures will be taken for block the movement routes of wildlife and livestock, divide habitats, and traffic accidents of animals or not? (e) Development of roads will be cause deforestation, poaching, desertification, and wetland drying due to development? Furthermore, is there a possibility that alien species (which did not previously live in the area), pests, etc. may be introduced and the ecosystem may be disturbed? Are there any countermeasures against them? (f) In the case of constructing a road in an undeveloped area, will the natural environment be greatly damaged by new area development?	(a):N (b):N (c):N (d):N (e):N (f):N	(a) No nature and ecosystem to be protected, in target area because the project is improvement work on existing road. (b) No valuable species to be protected in target area because the project is improvement work on existing road. (c) No significant impact to ecosystem (d) No occur to block the movement routes of wildlife and livestock, divide habitats, in target area because the project is improvement work on existing road. (e) No deforestation in target area because the project is improvement work on existing road. (f) No plan to development of un-developed area because the project is improvement work on existing road.
	(3) Water environment	(a) Alteration of topography and new construction of structures such as tunnels adversely will affect surface water and groundwater flow or not?	(a):N	(a) It is not expected to significant impact to surface water and groundwater flow because the project is not planning to great alternation of topography or construction of tunnels.
	(4) Topography/ Geology	(a) There is a poor-geological location that could cause landslides or landslides on the route or not? If so, appropriate construction methods will be taken as countermeasures? (b) Will earth collapse and landslides occur due to civil engineering work such as embankment and cutting? If so, appropriate countermeasures will be taken to prevent landslides and landslides?	(a):N (b):Y (c):N	(a) No poor-geological location (b) Only small amount of embankment work is planning at the Lungga Bridge, then landslides are not expected. (c) Soil outflow is not expected

Category	Items	Check items	Yes :Y No : N	Environmental Social Consideration (The reason for Yes/No, Evidence, Mitigation measures etc.)
		(c) Will soil runoff occur on the embankment place, cuts place, dumping site, and quarry sites? If so, any appropriate countermeasures will be taken to prevent soil outflow?		
4. Social Environment	(1) Resettlement	(a) Involuntary resettlement occurs with the implementation of the project or not? If so, the project will be taken efforts to minimize the impact of relocation? (b) Resettled residents can be given appropriate explanations regarding compensation and livelihood reconstruction measures before the resettlement or not? (c) Resettlement plan will be prepared based on social survey on resettlement, compensation for the re-acquisition price, and livelihood re-construction measure after the resettlement? (d) The compensation be paid before relocation? (e) Compensation policy is formulated in a document? (f) The resettlement plan care to vulnerable groups, such as women, children, the elderly, the poor, ethnic minorities, and indigenous peoples? (g) Is it possible to obtain the agreement before resettlement from the target resettled residents? (h) Is there system in place to properly implement resettlement? Are sufficient implementation capabilities and budgetary measures taken for resettlement? (i) Monitoring activities is planned for impact by relocation? (j) Has a grievance redress mechanism been established?	(a):Y (b):N (c):Y (d):Y (e):Y (f):Y (g):Y (h):Y (i):Y (j):Y	(a) The project was designed to minimize impact of involuntary resettlement. (b) The project will plan to explain the compensation based on draft-ARAP on August 2020 (c) Affected peoples were extracted and a detailed survey was conducted to determine the extent of the impact. (d) Payment is made within 3 months after application in accordance with Solomon Islands regulations (e) Summarized on Safeguard Manual by MID (f) The measure will include in ARAP (g) It is planning to taken agreement regarding resettlement and compensation at the public consultation on August 2020 (h) MID has appropriate system and enough budget measures are taken. (i) MID will conduct monitoring (j) Grievance redress mechanism has been regulated in Safeguard manual
	(2) Livelihood	(a) In case of road is constructed by new development, will there be any impact on the existing transportation and the lives of the residents around existing road? Also, will there be occur major changes in land use, livelihoods and unemployment? The design/plan is considering the mitigation of these effects or not? (b) The project will adversely affect the lives of other residents? Will impact reduction consideration be made as necessary? (c) Is there a risk of illness (including infectious diseases such as HIV) due to population influx from other areas? Will appropriate public health considerations be made as necessary? (d) Will the project adversely affect road traffic in the surrounding area (increase of congestion and traffic accidents etc.)? (e) The target roads will prevent the movement of residents?	(a):N (b):N (c):N (d):N (e):N (f):N	(a) The project is improvement work of existing road, it is not new development. (b) Although the project is improvement work of existing road, compensation is required based on ARAP to APs such as street vendors (c) The risk of HIV is low in Solomon Islands (d) Significant impact to traffic is not expected (e) Significant impact to movement on residents is not expected (f) Impact is not expected on sunlight obstruction or radio interference

Category	Items	Check items	Yes :Y No : N	Environmental Social Consideration (The reason for Yes/No, Evidence, Mitigation measures etc.)
		(f) Does the road structure (overpass, etc.) cause sunlight obstruction or radio interference?		
	(3) Cultural heritage	(a) There are a possibility that the project will damage archeologically, historically, culturally, and religiously valuable heritage sites and historical sites or not? Also, are measures taken under the law on Solomon Islands taken into consideration?	(a):N/A	(a) The impact to cultural/ historical valuable etc. are not expected
	(4) Landscape	(a) In the case of there is a landscape to be requires special consideration, it will be adversely affected or not? If there is impact, it will necessary measures be taken to the impact?	(a):N/A	(a) No landscape to be protected especially
	(5) Ethnic minority, indigenous people	(a) Considering to reducing the impact on the ethnic minorities , indigenous people's culture and lifestyle? (b) The rights on land and resources for minority and indigenous people are respected?	(a):N/A (b):Y	(a) No ethnic minorities in the target area (b) Regulated the Customary land
	(6) Working environment	(a) In the project, law/ regulation regarding work environment will compliant? (b) Are the safety considerations for the personnel involved in the project, such as the installation of safety equipment related to the prevention of occupational accidents, and the management of hazardous substances are considered? (c) Are software measures planned and implemented for people involved in the project, such as the formulation of a safety and health plan and safety training for workers (including traffic safety and public health)? (d) Will appropriate measures be taken to prevent security personnel involved in the project from violating the safety of project personnel and local residents?	(a):Y (b):Y (c):Y (d):Y	(a) Legal compliance will be included in the contract with contractor (b) Safety consideration is carried out under the responsibility of the contractor. Use of harmful substances is not expected (c) Contractors will regularly provide workers with safety education including traffic safety, public health, and work in hot environments. (d) Education and training for security staff is also included in (c) and supervised by the contractor.
5. Others	(1) Impact on construction	(a) There are mitigation measures prepared for pollution (noise, vibration, muddy water, dust, exhaust gas, waste, etc.) during construction? (b) Construction will negatively affect the natural environment (ecosystem)? Are mitigation measures prepared for the impacts? (c) Construction will negatively affect the social environment? Are mitigation measures prepared for the impacts?	(a):Y (b):N/A (c):N	(a) Asphalt emulsion will be sprayed as a mitigation measure against dust. (b) The impact to natural environment (ecosystem) is not expected. (c) The impact to social environment is not expected.
	(2) Monitoring	(a) Monitoring activities will plan/implement by contractor for items may have an impact within the above environmental items?	(a):Y (b):Y (c):Y (d):N	(a) Monitoring activities proposed in this report will be implement (b) Selection of parameters and measurement frequency are set according to the degree of environmental impact

Category	Items	Check items	Yes :Y No : N	Environmental Social Consideration (The reason for Yes/No, Evidence, Mitigation measures etc.)
		(b) How decide the items, methods, frequencies, etc. of monitoring plan? (c) Contractor's monitoring system (organization, personnel, equipment, budget, etc. and their continuity) will established? (d) The method and frequency of reporting from the developer, contractor to the competent authorities is regulated?		(c) It will be described in contract (d) It will be described in PER
6. Note	Referring of other environmental check list	(a) If necessary, also add the relevant check items from the forestry checklist and evaluate (for cases involving large-scale logging) (b) If necessary, add the relevant check items from the checklist for transmission lines/distribution (for cases involving the construction of transmission/transformation/distribution facilities).	(a):N (b):Y	(a) The project is not including large-scale logging (b) The project is not expected to transformation facilities, but it is necessary relocation of communication line in advance
	Note on environmental check list	(a) If necessary, check the impact on transboundary or global environmental issues. (When factors related to cross-border treatment of waste, acid rain, ozone depletion, global warming, etc. are considered)	(a):N	(a) No cross boundary environmental impact is expected

CHAPTER 2. CONTENTS OF THE PROJECT

2.1 Basic Concept of the Project

2.1.1 Objective of the Survey

The objectives of the Preparatory Survey are to

- understand the background, purpose, and scope of the Project under the Grant Aid Assistance Scheme of Japan;
- study the feasibility of the Project in terms of effectiveness, technical and economic justification;
- conduct outline design for minimum requiremenets and optimize scope and scale of the Project in order to achieve the objectives of the assistance;
- estimate the project cost; and
- propose contents and implementation/maintenance plans as well as critical points to be undertaken by the SIG in order to achieve the outcome and targets of the Project.

2.1.2 Project Outline

The outline of the Project is summarized in the Table below.

Table 2.1 Project Outline

1. Targets	To improve the Kukum Highway to enhance traffic safety and disaster resiliency of the highway by mitigating traffic congestion and enhancing drainage capacity
2. Scope of the Project	• Rehabilitation of the road from the Ministry of Fisheries and Marine Resources to the Lungga Bridge (4 lanes, 4.3 km) and from the Lungga Bridge to Honiara International Airport (2 lanes, 2.0 km including the road of the Lungga Bridge) * Rehabilitation of the Lungga Bridge is not included. • Rehabilitation of drainage facilities • Rehabilitation of bus bay
3. Location	Honiara City and Guadalcanal State
4. Implementing Agency	Ministry of Infrastructure Development (MID)

The Survey mission is to examine viability of the Project and not a commitment of actual implementation.

2.2 Outline Design of the Japanese Assistance

2.2.1 Planning Policy

2.2.1.1 Technical Approach to Flooding

The objective of the Project is to enhance traffic safety and disaster resiliency of the highway by mitigating traffic congestion and enhancing drainage capacity. One of the major issues of the highway is inundation at Burns Creek during heavy rainfall. Application of comprehensive measures can resolve the flooding issue around the Burns Creek and the Lungga River, but the project scale would be considerably exceed the budget sealing. Therefore, the road improvement plan was formulated focusing on keeping the road surface above the water level of a 10-year return period flood. To attain this, the road elevation is raised, and existing drainage facilities replaced.

2.2.1.2 Policy Responding to Roadside Facilities for the Pacific Games 2023

Plan for access to roadside facilities of the Pacific Games 2023 is not covered in the Outline Design (O/D) because the plan of these facilities is on-going and approved-final design drawings were not available. Therefore, this will be discussed with the MID in the Detailed Design (D/D) stage.

2.2.1.3 Project Area

The objective stretch (start and end points) of the Project is approx. 6.3km. It begins at the Ministry of Fisheries and Marine Resources and ends at Honiara International Airport (Refer to Figure 1.1).

2.2.1.4 Typical Cross Section

As initially requested by the SIG, 4-lane improvement from the beginning point to before the Lungga Bridge including 2.3 km overlay section and 2-lane improvement from the end of the Lungga Bridge to Honiara International Airport are to be made. The 2-lane improvement however takes the plan that envisages widening in future to 4-lanes into consideration. Typical cross sections of each section are shown in Figure 2.1 to Figure 2.3.

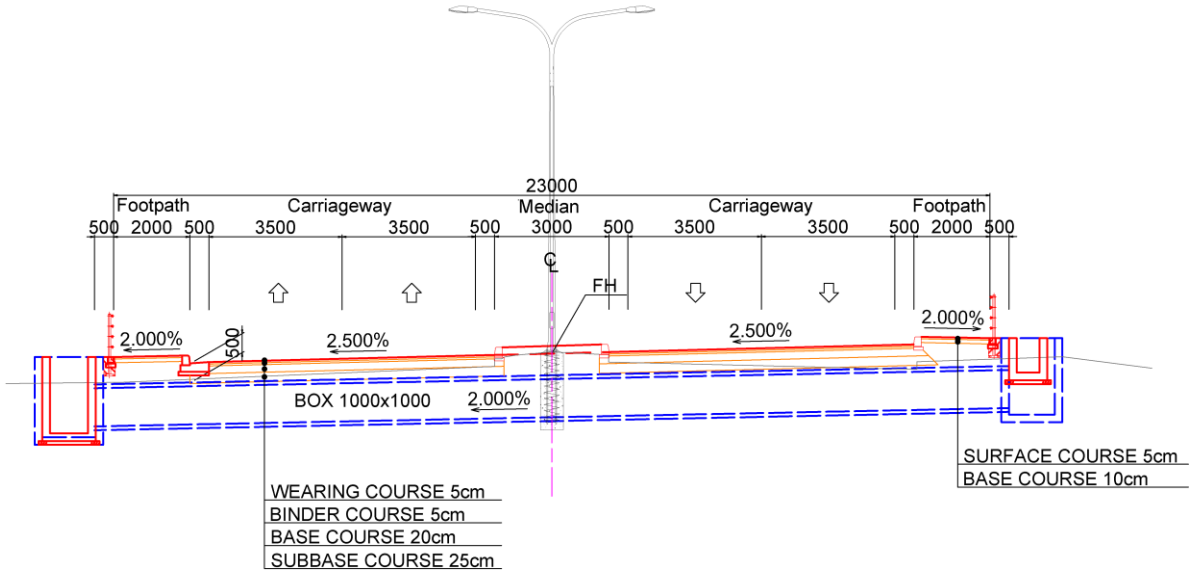


Figure 2.1 Typical Cross Section (4-lane Section)

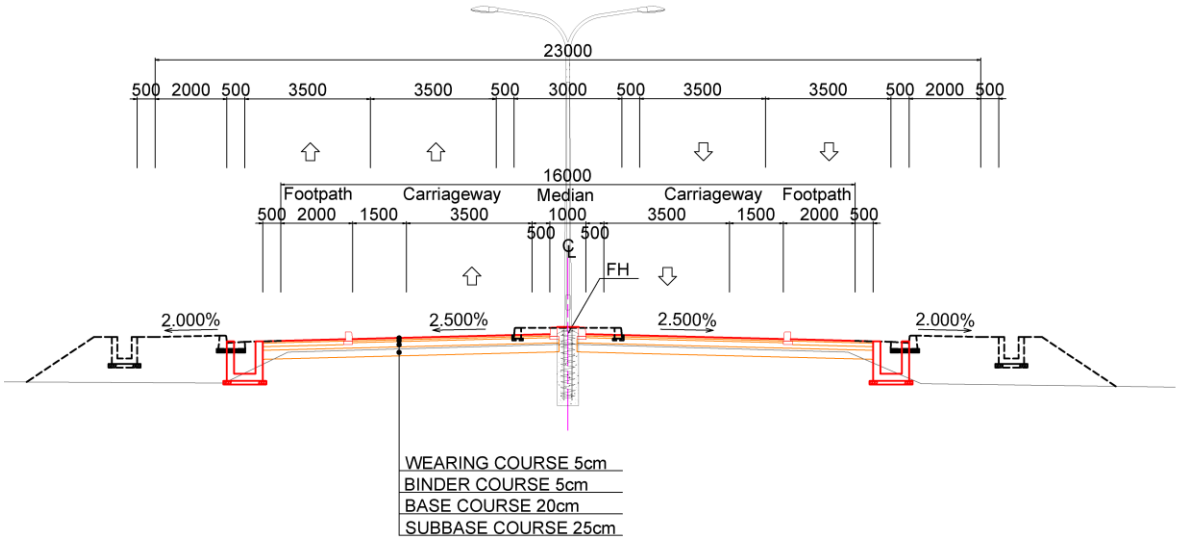


Figure 2.2 Typical Cross Section (2-lane Section)

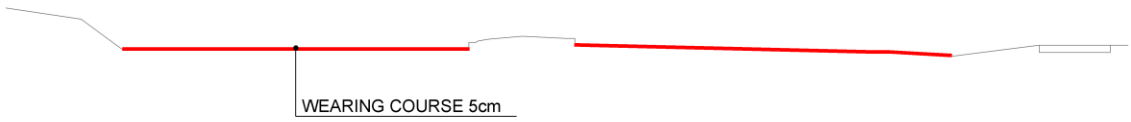


Figure 2.3 Typical Cross Section (Overlay Section)

The dimensions shown in the upper level in Figure 2.2 illustrates the planned cross section elements after widening to 4-lane carriageway.

The MID says it has plans to widen the carriageway in the 2-lane section after the Lungga Bridge to 4 lanes. To avoid the potential impact (demolition of improved road area) to the roads constructed under this project, during widening in the future, the pavement of the carriageway is extended (1.5m) to the shoulder of the road. The design policy is explained in section 2.2.3.3.4 .

2.2.1.5 Lungga Bridge

As initially mentioned in this report, improvement of the Lungga Bridge is not included in the project scope. However, investigation conducted under the Survey has identified some damages on the bridge. Repair of these damages will be undertaken. The details are mentioned in 2.2.3.10 .

2.2.1.6 Bus Bay

Bus bays will be provided at the same location as the existing ones. The shoulder width will be widened to secure the required width for the bays. Construction of bus shelters are not included in the Project. MID agrees on this matter.

2.2.1.7 Maintaining Consistency with the Greater Honiara Transport Master Plan Study (GHTMPS)

This Phase 2 project is designated as a short term/mid-term project in the Greater Honiara Transport Master Plan Study (hereinafter referred to as “GHTMPS”) currently undertaken by JICA. In order to maintain consistency with the GHTMPS, the future traffic volume that was estimated in the GHTMPS shall be applied in the planning of the Project.

2.2.1.8 Project Target Year

The target year of the project is set to year 2033,that is 10 years after completion of the Project, since this Project is designated as a short term/mid-term project in the GHTMPS. Owing to this and as already mentioned before, the performance period of the pavement is set to 10 years at the upgrading section and 3 years at the overlay section.

2.2.1.9 River and Drainage Planning

To reflect hydrologic characteristics of the project area in the road planning, hydrological/hydraulic analysis was carried out. Output from the analysis, issues and challenges to be addressed, and measures and recommendations to enhance road functions for the near future are provided. The details are described in 2.2.3.5 .

2.2.2 Design Policy

2.2.2.1 Current Conditions and Issues

2.2.2.1.1 Traffic Congestion

Traffic congestions are prominent at three locations on the Kukum Highway including Phase 1 project area. Figure 2.4 to Figure 2.6 shows the severity of traffic congestion at these locations.

Figure 2.4 City Council to Hospital (Phase 1 Section)

Figure 2.5 Around Fishing Market (Phase 1 Section)

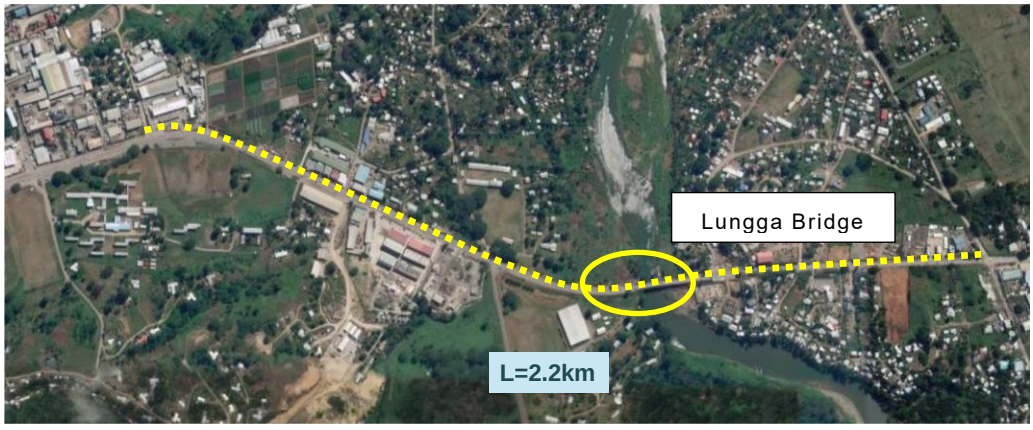


Figure 2.6 Approach Section to Lungga Bridge

Three factors (causes) mainly contribute to these traffic congestions. They are, 1) Small-sized roundabout, 2) Excessive median openings, 3) deterioration of pavement structure.

(1) Cause 1: Mini-Roundabout

US guideline on roundabouts, "Roundabouts: An Informational Guide Second Edition (NCHRP Report 672, FHWA)", explains general roundabout design guide is based on the statistical data (Figure 2.7). Most roundabouts along the objective section of the project has an inscribed diameter of about 18m. According to this guideline, they are classified into "Mini- Roundabout". The capacity of these roundabouts is not sufficient with respect to the current traffic volume (15,300 vehicle/day).

A roundabout generally works best under low traffic volume roads. Since Kukum Highway is one of the arterials in Honiara and its future traffic volume is expected to increase significantly, a small roundabout is not suitable for the highway.

Daily traffic volume at the roundabout is approx. 15,300 vehicle/day as of August 2019

Roundabouts: An Informational Guide

Exhibit 1-9
Roundabout Category Comparison

Design characteristics of the three roundabout categories.

Design Element	Mini-Roundabout	Single-Lane Roundabout	Multilane Roundabout
Desirable maximum entry design speed	15 to 20 mph (25 to 30 km/h)	20 to 25 mph (30 to 40 km/h)	25 to 30 mph (40 to 50 km/h)
Maximum number of entering lanes per approach	1	1	2+
Typical inscribed circle diameter	45 to 90 ft (13 to 27 m)	90 to 180 ft (27 to 55 m)	150 to 300 ft (46 to 91 m)
Central island treatment	Fully traversable	Raised (may have traversable apron)	Raised (may have traversable apron)
Typical daily service volumes on 4-leg roundabout below which may be expected to operate without requiring a detailed capacity analysis (veh/day)*	Up to approximately 15,000	Up to approximately 25,000	Up to approximately 45,000 for two-lane roundabout

*Operational analysis needed to verify upper limit for specific applications or for roundabouts with more than two lanes or four legs.

Figure 2.7 Excerpt of the Roundabout Design Guide

In addition, operational rules at roundabout require that vehicles on a main road must yield the right of way even for one vehicle in circular lane. Due to small-sized roundabout, vehicle coming from/to secondary road disturbs main traffic. The situation shown in Figure 2.8 was confirmed in the peak hours at all roundabouts.

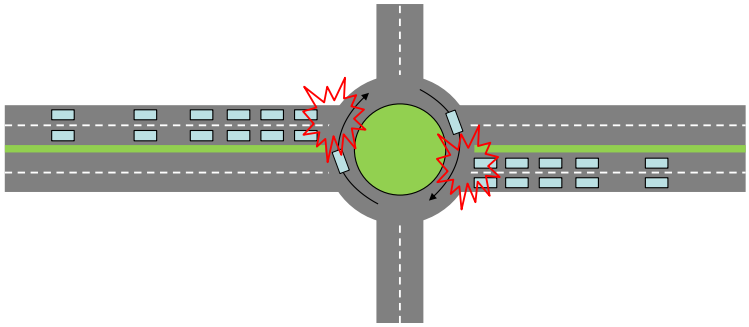


Figure 2.8 Disturbance to Main Traffic by Vehicle from/to Secondary Road

(2) Cause 2: Excessive Median Openings

4-lane section of the project objective stretch have a median opening at about every 300m interval, and the total number of such openings is nine (9). Median openings have both positive and negative effects on traffic operation. Median openings facilitate/enhance accessibility to and from abutting properties but reduces safe and smooth mobility.

Traffic maneuver resulting in traffic disturbance that can be actually observed due to existence of median openings is illustrated in Figure 2.9.

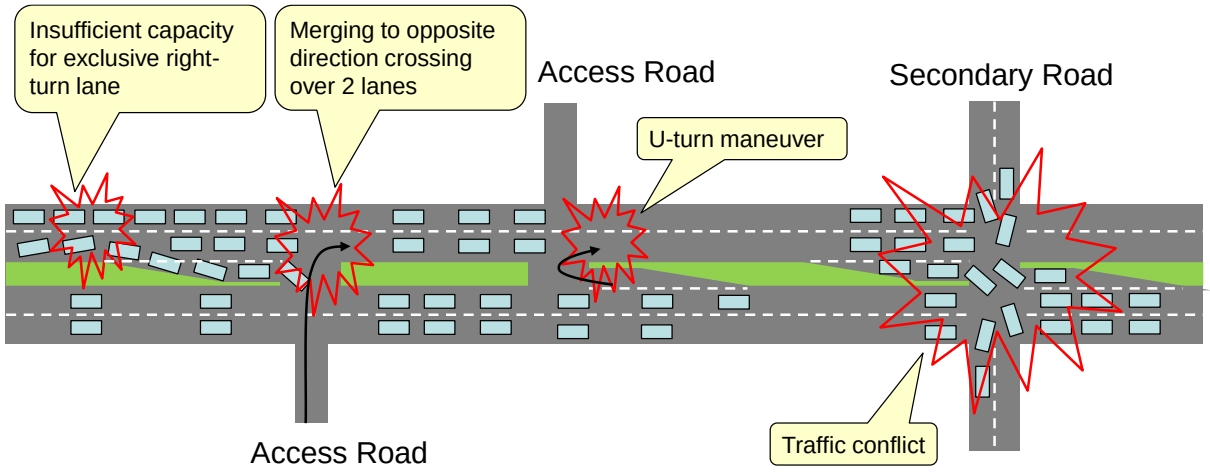


Figure 2.9 Traffic Maneuver Resulting in Traffic Disturbance

(3) Cause 3: Deterioration of Pavement Structure

Pavement surface distress is prominent along the existing road, especially the worst is along the section after the Lungga Bridge drainage system does not exist, if not dysfunctional. Travel speed in this section is forced to reduction to 10km/h due to flooding on the road surface after a rainfall

Figure 2.10 Current Condition after Rainfall

On the other hand, site investigation conducted under this Survey confirmed some pot holes and numerous continuous alligator cracks as shown in Figure 2.11. Some deteriorated sections were seen repaired by sealing or patching.

However, these simple repairs are not durable measures since one of the factors for such distress is the deterioration of the subbase course and/or subgrade caused due to lack of drainage capacity.

Figure 2.11 Alligator Cracks

2.2.2.1.2 Inundation on Carriageway

Locations where the carriageway of the highway experiences inundation during and for some time after rainfall are highlighted in Figure 2.12 and Figure 2.13.

Figure 2.12 Inundation on Carriageway (Western Section from Lungga River)

Figure 2.13 Inundation on Carriageway (Eastern Section from Lungga River)

2.2.2.1.3 Existing Bus Terminal near the Lungga Bridge

The existing bus terminal near the Lungga Bridge will be affected by future widening of the Kukum Highway of this section from 2 lanes to 4 lanes. However, according to the MID, there seem to exist no specific plan (target year) yet and it is unlikely that the widening will not take place in the immediate future. A lot of passengers are currently using this terminal. The Team observed the terminal and found the followings;

- A good portion of the terminal is occupied by street vendors. Should these be shifted, the terminal could retain its initial capacity,
- It is preferable to upgrade this terminal in the future widening project because doing so will result in to more appropriate planning that considers currently unforeseeable issues. It can also correspond to the future demand and necessities.

Therefore, to avoid negative impacts on users and to save time and cost, the Team proposes utilization of the existing terminal by applying small scale improvement measures.

2.2.2.1.4 Current Situation under Heavy Traffic Condition

The Team carried out an axle load survey by using a portable truck scale at Solomon Port to understand the actual loading condition of heavy traffic. The survey result is summarized in Table 2.2.

According to the hearing results from the MID and Solomon Port, allowable maximum total weight is 40 tons. The survey result as compiled in Figure 2.14 shows that heavy trucks weighing over 40 tons accounts for 15% of the total trucks surveyed. The overload condition was appropriately reflected in the pavement design.

Table 2.2 Outline of Axle Load Survey

Survey Point	Point① Honiara Port Entrance	Point② Honiara Port Exit	Point③ In front of King George High school
Survey Date	2019/10/15～10/18	2019/10/21～10/25	2019/10/31, 11/4～11/8
Surbey Time	9:00～16:30		9:00～16:00
Target	Tuck (Without Bus and Passenger Car)		
Method	Using a portable axis scale		
Smple Number	174	177	192
Total Sample Number	543		

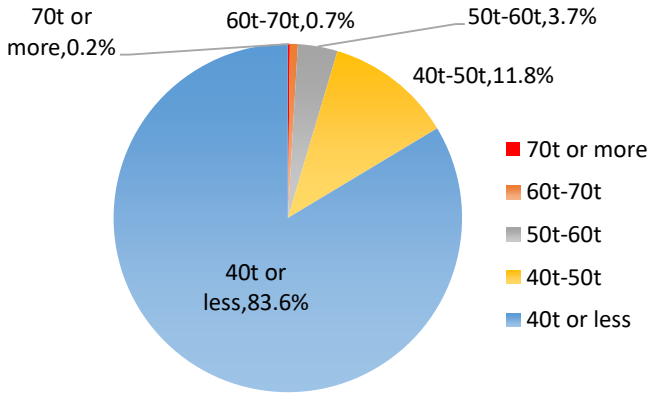


Figure 2.14 Axle Load Survey Result

2.2.2.2 Engineering Surveys and Investigation for Outline Design

Table 2.3 gives the list of engineering surveys and investigations conducted under this Survey for application in the outline design.

Table 2.3 List of Engineering Surveys and Investigations

No.	Type of Survey/Investigation	Target
1	Road Inventory Survey	・ Existing road, facilities, connecting roads, intersection, bus-bay, utilities, etc.
2	Drainage Facility Survey	・ Existing rivers, creeks, drainage facilities, etc. ・ Runoff collection point
3	Axle Load Survey	・ Heavy vehicles

No.	Type of Survey/Investigation	Target
4	Bridge Inspection	· Lungga Bridge
5	Condition Survey for Lungga River	· River banks erosion and existing revetments well as morphology of Lungga River
6	Underground Water Measurement	· Near Honiara International Airport
7	Statistical Data Collection	· Following data and records related to the project: · Metrological data in the Project area · Water level, flow rate and flow speed of Lungga River at Lungga Bridge · Change in River - bed elevation of Lungga River · Hydraulics structures in Lungga River · Past flood hydrographs and inundation records · Disaster record (type, date, degree of damage) · Tide level, wave · Earthquake · Traffic accident record
8	Topographic Survey	· Kukum Highway Phase 2 section (L=approx. 7km) · Installation of Benchmarks · Lungga River · Burns Creek
9	CBR Test	· In-situ CBR test and soaked CBR test (field and lab)
10	Construction Material Test	· Bulk Soil Tests for Embankment · Tests on Rock/Aggregate Samples for Base Course and Subbase Course · Tests on Rock/Aggregate Samples for Asphalt Concrete Pavement · Tests on Rock/Aggregate Samples for Base for Concrete · Data collection on material plants, cost and transportation conditions
11	Utilities (underground) layout Confirmation Work	· Kukum Highway Phase 2 section (L=approx. 7 km)
12	Environmental and Social Survey	· Kukum Highway Phase 2 section (L=approx. 7 km)
13	Supplemental Traffic Volume Survey	· See Section 2.2.3.3.5

2.2.2.3 Policy on Road Planning

Following policies were applied for planning of the road;

- Access road to roadside facilities, runoff collection points for road surface drainage, existing underground utilities, trees and elevation of connecting roads shall be considered as control points in deciding the road alignment.
- Maximum utilization of the existing Right of Way (ROW).
- Environmental and social impact shall be minimum.
- Traffic safety for road users shall be enhanced by provision of proper road ancillaries.
- Drainage facilities shall be provided based on the engineering survey results.
- Pavement design shall be made reflecting actual loading and traffic condition on the Kukum Highway

- Road alignment for 2-lane section shall take the future 4-lane widening plan into consideration.

2.2.2.4 Policy on Future Traffic Volume

Ttraffic demand forecast was carried out in the Honiara Traffic Master Plan project which is currently undergoing. Application of the forecast result from this project is considered to be appropriate as future development scenarios are reflected in the forecast.

Therefore, the traffic volume projected in the master plan shall be used in the design of this Project.

2.2.3 Basic Plan

2.2.3.1 Contents of the Project

Table 2.4 shows contents of the Project.

Table 2.4 Contents of the Project

Item			Overlay Section (Beginning point–2.3 km)	Upgrading Section (2.3 km–End point)
Design Element	Objective Length		2.3 km	4.0 km
	Design Speed		50 km/h	50 km/h
	Road Width	4-lane	22.0-25.0 m	23.0 m
		2-lane	—	16.0 m
	Carriageway Width	4-lane	3.0-3.5 m	3.5 m
		2-lane	—	
	Median Width (0.5 m inner shoulder included)	4-lane	2.4-4.0 m	4.0 m
		2-lane	—	2.0 m
	Shoulder Width	4-lane	0.5-1.5 m	0.5 m
		2-lane	—	
	Footpath Width	4-lane	2.0m	2.0 m
		2-lane	—	
Work Item	Asphalt Pavement		t=5 cm	t=10 cm
	Roundabout		2 locations	
	Drainage		7.5 km	
	Cross Drainage		19 locations	
	Gravity Wall		120 m	
	Retaining Wall		54 m	
	Street lights		4 km	
	U-Turn exclusive Lane		1 location	
	Handrail		860 m	
	Bus Bay		19 locations	
	Road Ancillary		Entire section	
	Lungga Bridge Repair		1 location	

2.2.3.2 Standards for Road Design

In the Solomon Islands, there is no authorized road design standard. It was agreed in the discussions with the MID to apply the Japanese Standard. The list of standards applied to design the improvement of the road design for the upgrading section including the contents is as given in Table 2.5.

Table 2.5 List of Standards Applied

Items	Applied Standards	Contents
Road and Ancillary Facilities	• Japanese Road Structure Ordinance (Japan Road Association, June 2015)	• Design Speed : 50 km/h
Pavement	• Guide for Design of Pavement Structures 1993 (AASHTO, 1993) • Pavement Design Manual (Japan Road Association, February 2006)	• Performance Period : 10 years • Use of modified asphalt under study
Intersections and Traffic Safety Facilities	• Japanese Road Structure Ordinance Japan Road Association, June 2015 • An Informational Guide Second Edition (NCHRP Report 672, FHWA, 2000)	• Roundabout applied without traffic signal
Structures	• Culvert Structure Guideline (Japan Road Association, April 2010)	• Design load T-25
Drainage	• Drainage Guideline(Japan Road Association, July 2009)	• Rational method for discharge volume calculation • Box culverts at Burns Creek: 1/10 year return period • Other drainage facilities: 1/5 year probability
Street Light	• Street Light Installation Standard, MLIT, Japan • LED Installation Guideline, Japan • Australian Standard	• LED lighting adopted

2.2.3.3 Road and Intersection

2.2.3.3.1 Geometric Condition

Conforming standards and basic design conditions are shown in Table 2.6.

Table 2.6 Geometric Design Conditions

Conforming Standards	Basic Design Condition
• Japanese Road Structure Ordinance • Japanese Specification for Road Earth Work	• Design Speed : 50km/h • Japanese design standards applied in Phase1 shall apply for this project also. AASHTO is used in pavement design

2.2.3.3.2 Design Vehicle

WB-19 defined in the AASHTO is applied as the design vehicle (Figure 2.15). Size of this vehicle type covers the largest vehicle (L=18 m) in the Solomon Islands. Design vehicle for U-turn lane and roundabout is shown in Figure 2.19.

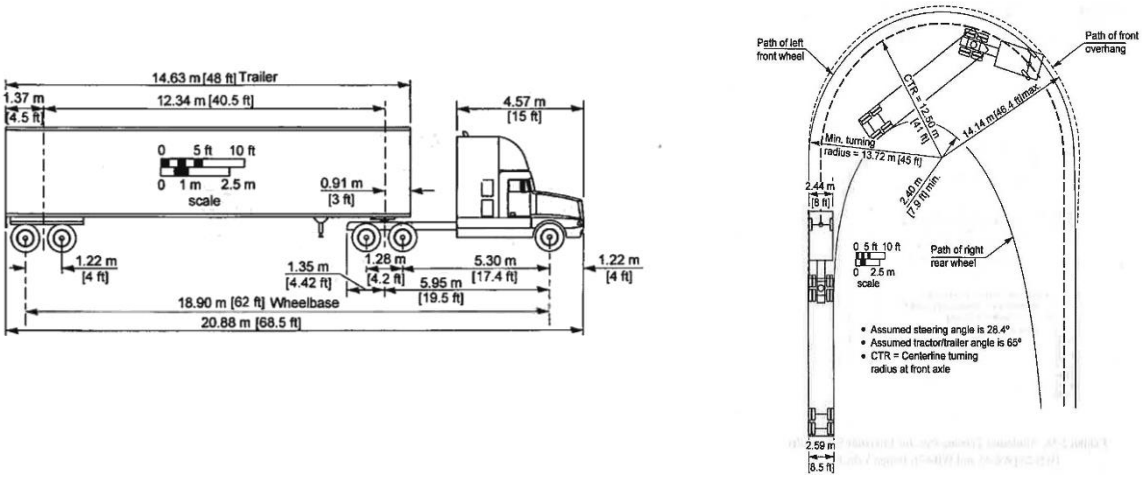


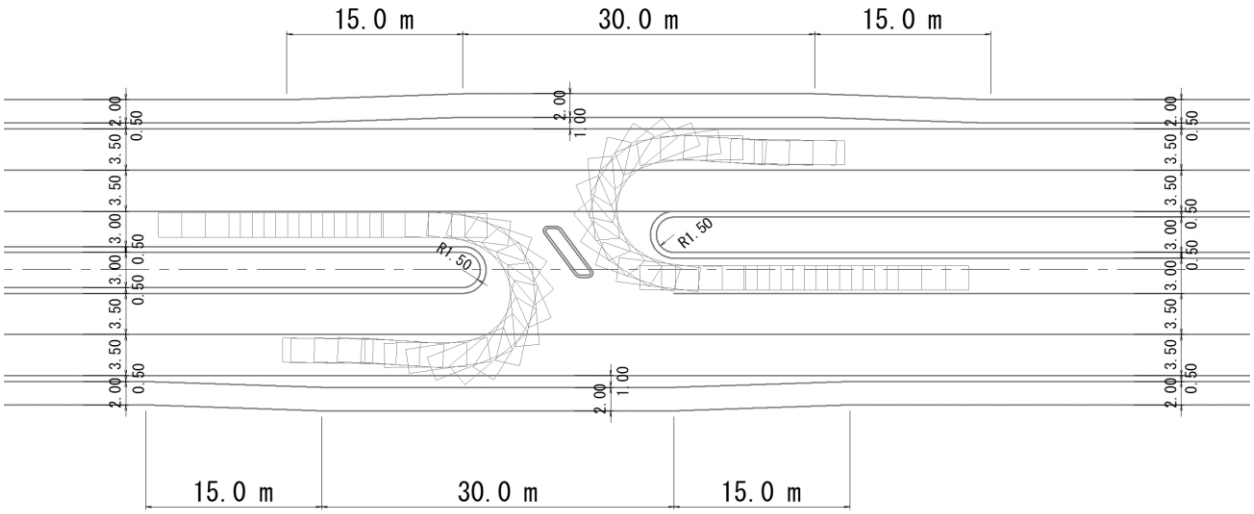
Figure 2.15 Design Vehicle

2.2.3.3.3 Four (4) Lanes Section

(1) Design Policy

The design policies of the 4-Lanes section are as follows:

- Designate roadside facilities, under-ground utilities and ROW as control points in studying the alignments.
- Minimize impact on the surrounding by maintaining existing road alignment.
- Raise the finished surface level at Burns Creek to avoid inundation during the run-off of 10- year return period flood (described in 2.2.3.3.3 (3))
- Existing ROW is utilized at a maximum.
- Minimize median openings and provide exclusive U-turn Lane for improving traffic conditions (Figure 2.16).
- Application of similar but larger roundabout currently installed on Kukum Highway (Figure 2.17).
- Dimensions recommended by US standards will be applied (central island outer diameter is minimum 27 m (existing is about 18 m), 2-lane circulatory road).



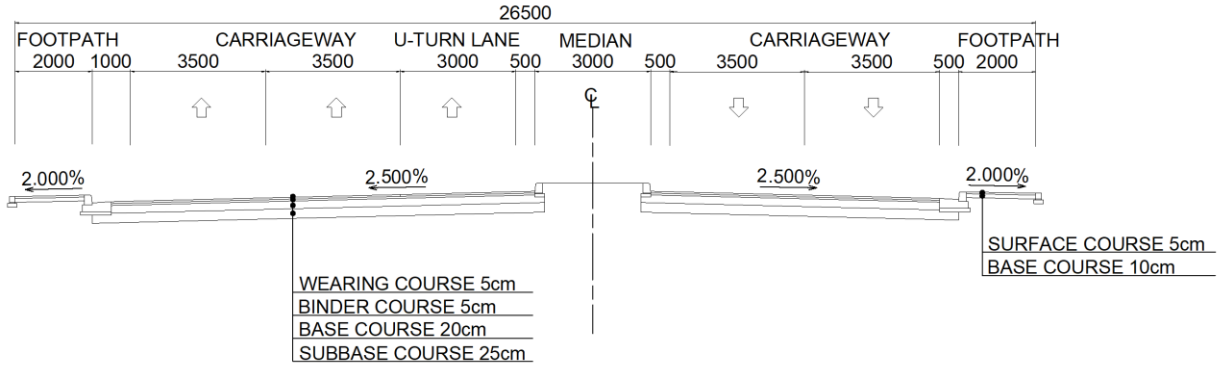


Figure 2.16 Proposed U-turn Lane

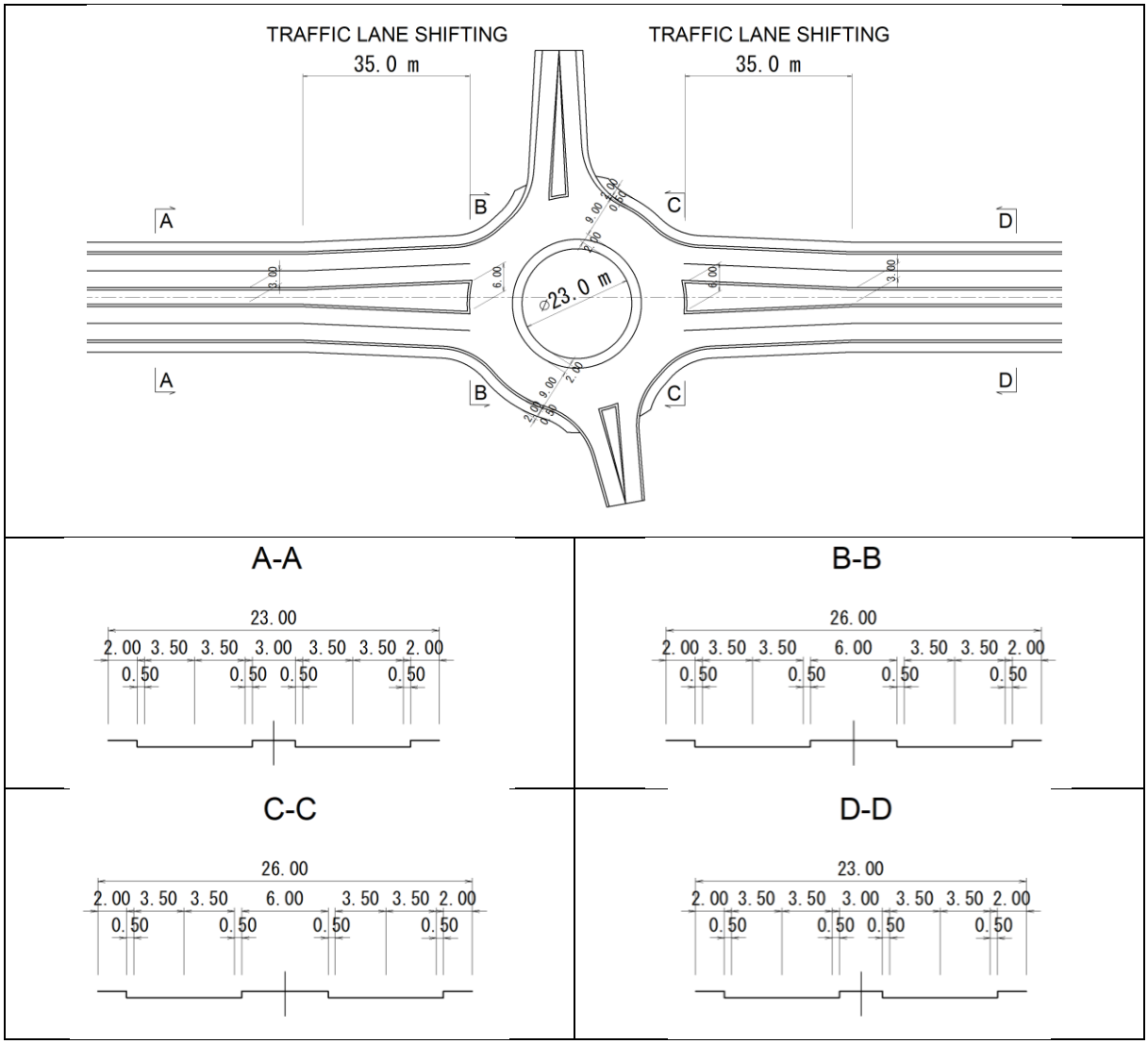


Figure 2.17 Dimension and Cross Sections of Proposed Roundabout

(2) U-turn Lane and Roundabout Layout Plan

To facilitate safe and smooth about-turn (U-turn) of vehicles, exclusive lane is provided approx. every 1 km interval on the entire section (Figure 2-20). However, the construction of U-turn lane in the overlay section at the beginning point side is not included in the Project.

Since the U- turn lane should be installed in ROW, the design vehicle at the U-turn lane roundabout are classified as shown in Figure 2-21.

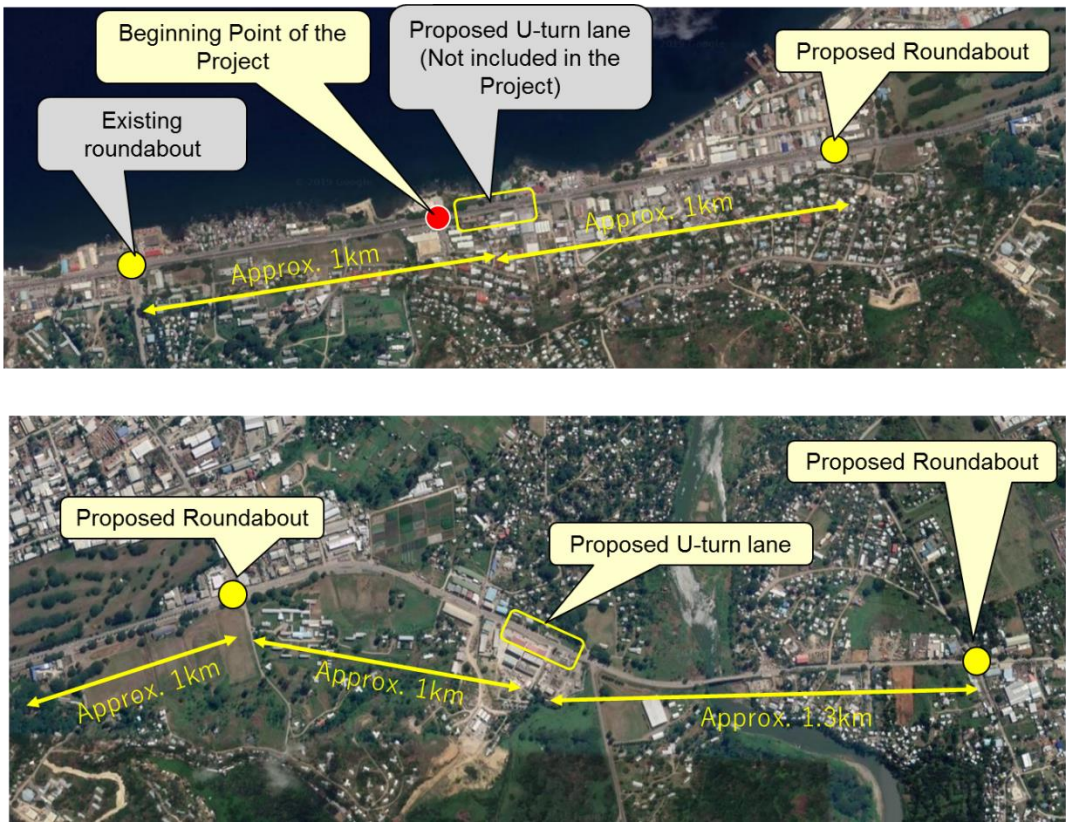


Figure 2.18 U-turn Lane and Roundabout Placement

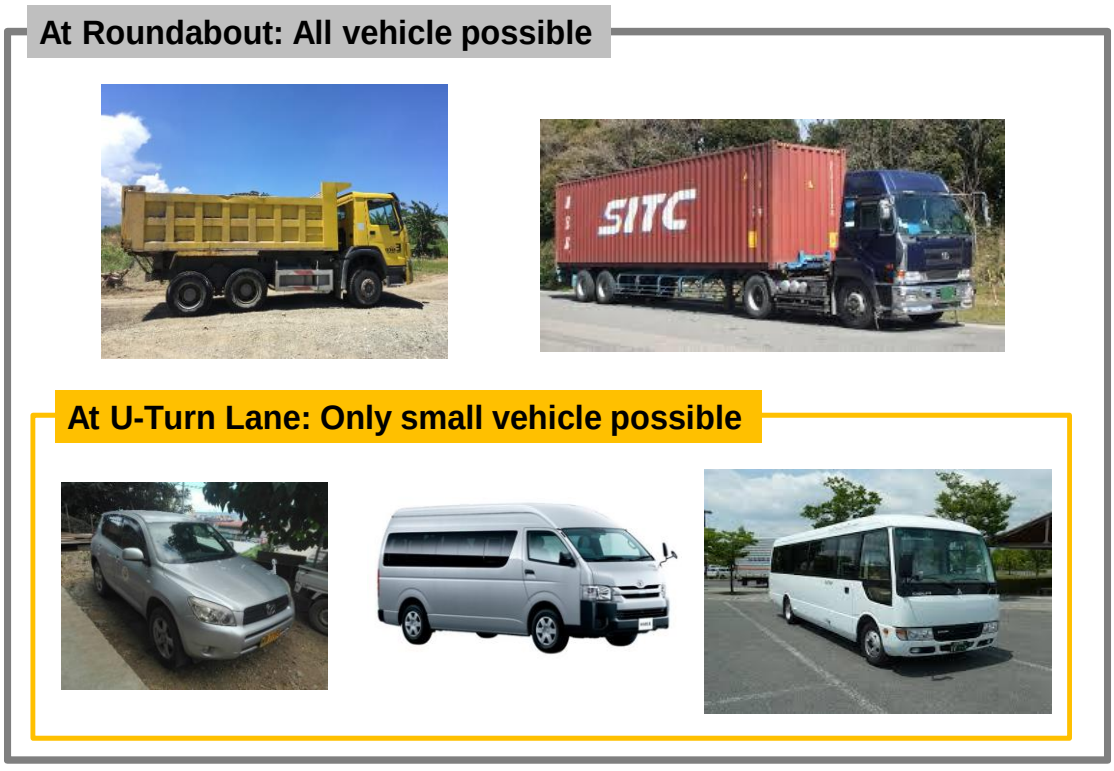


Figure 2.19 Design Vehicle at U-turn Lane and Roundabout

(3) Vertical Alignment Design at Burns Creek

Based on the hydrological/hydraulic analysis result as described in 2.2.3.5 , the vertical alignment at the Burns Creek was designed 45-55 cm higher than the existing surface level to prevent from inundation by a once in a ten (10) year flood (10-year return period).

Transitional Section

As shown in Figure 2.20, the transition runoff from 4 lanes to 2 lanes will be provided before the Lungga Bridge so as not to affect the existing Lungga Bridge.

Figure 2.20 Rubbed section

2.2.3.3.4 Two-Lane Section

(1) Design Policy

Design policies of the 2-Lanes section are as follows:

- The 2-lane section shall be designed considering the existing Lungga Bridge, roadside facilities, underground utilities and ROW control points.
- Horizontal alignment of the 4-lane road shall be determined in consideration of the future 4-Lane road. The cross sectional elements of the 2-lane section shall be planned so that the negative impact on the roads constructed in this Project will be minimized when in the future 4-lane widening project. This means that the project road in 2-lane section is considered as a provisional 2-lane.
- Widening direction of the future 4-lane will be set on the downstream side of the Lungga River（Figure 2.21）

Figure 2.21 Future 4-lane Widening Plan

(2) Horizontal Alignment Plan

As shown in Figure 2.22 to Figure 2.24, the typical cross section was set for each section, such as (1)Existing Lungga Bridge, (2) Lungga Bridge-Bus Terminal-Earth cut section, (3) Earth cut section-End point. The horizontal alignment was determined based on the control points.

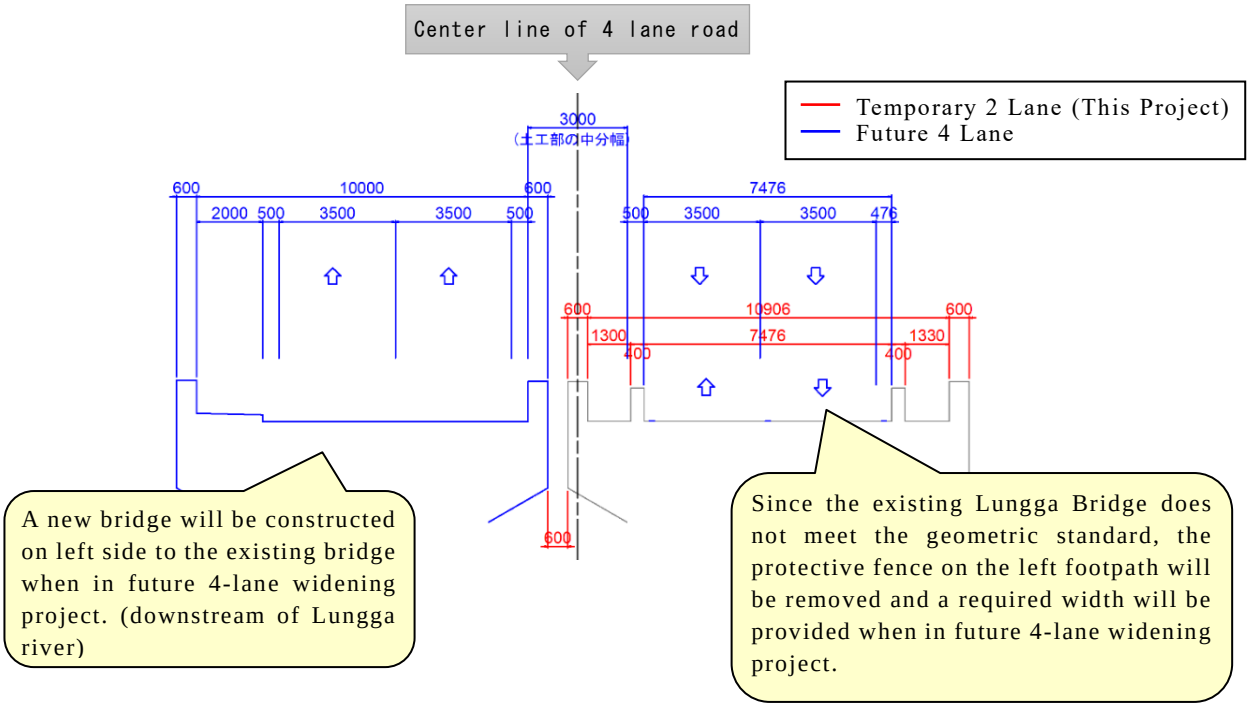


Figure 2.22 (1) Lungga Bridge

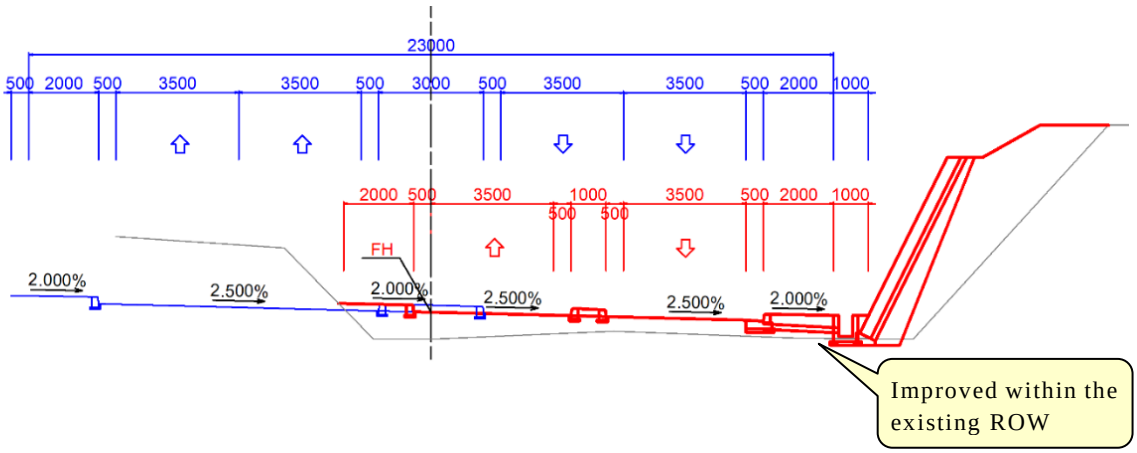


Figure 2.23 (2) Lungga Bridge-Bus Terminal-Earth Cut Section

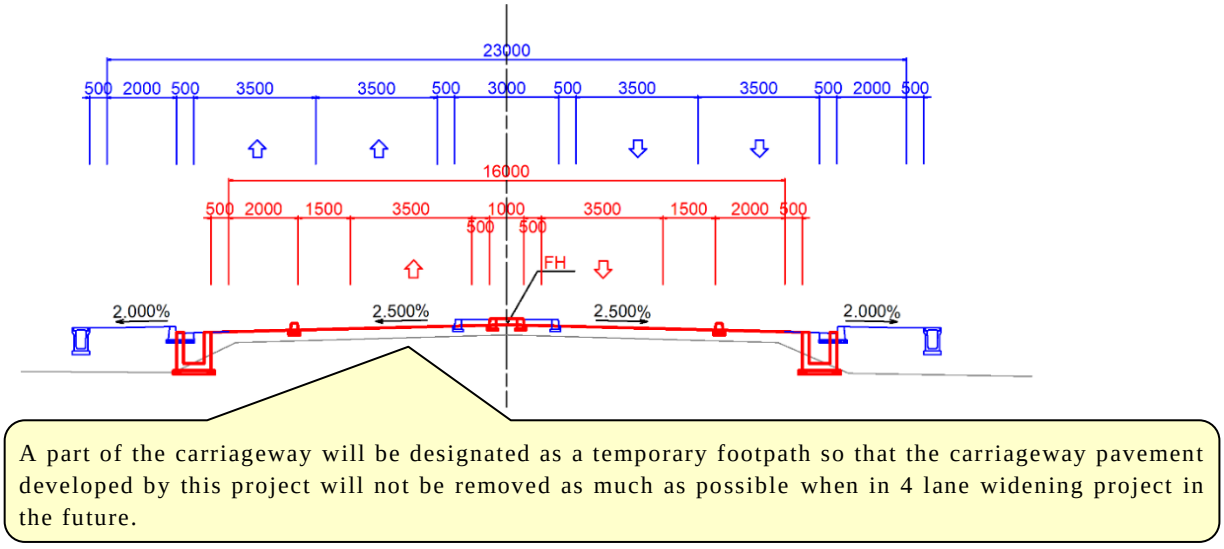


Figure 2.24 (3) Earth Cut Section-End Point

(3) Vertical Alignment Plan

Considering the superelevation and drainage treatment in the future road widening to 4-lanes, the vertical alignment is raised 30cm -50cm from the existing road surface level.

(4) Access to Honiara Airport

An exclusive right-turn lane for access to Honiara Airport will be provided as shown in Figure 2.25.

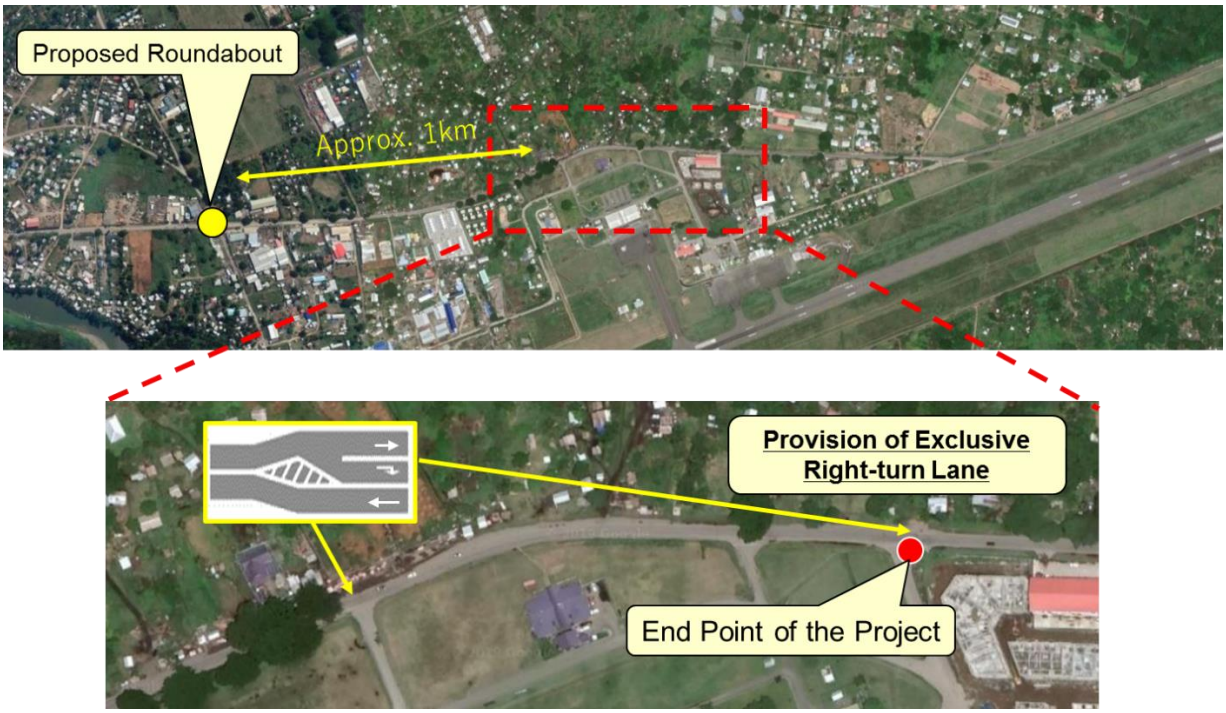


Figure 2.25 Exclusive Right-Turn Lane

2.2.3.3.5 Number of Lanes

(1) General

The number of lanes requested by the Solomon Islands side was verified by future traffic volume and using LOS (Level of Service) based on the Highway Capacity Manual 2016 (HCM). The verification was conducted for the 2-lane section under level D of the LOS, which is generally used for road planning.

(2) Traffic Volume Survey of the Greater Honiara Transport Master Plan

In the Master Plan, traffic volume survey was conducted at two points along the objective section of the Project.

The traffic volume counted at point SL3, which is near the beginning point of the Project, is about 29,000 vehicles/12h, and that at point SL5, which is the west side of the Lungga Bridge, is about 12,000 vehicles/12h.

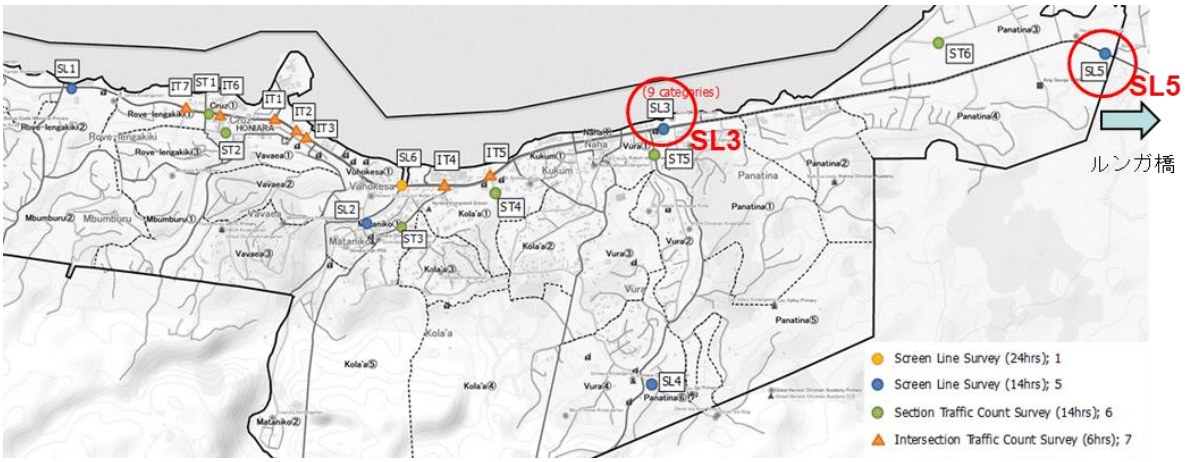
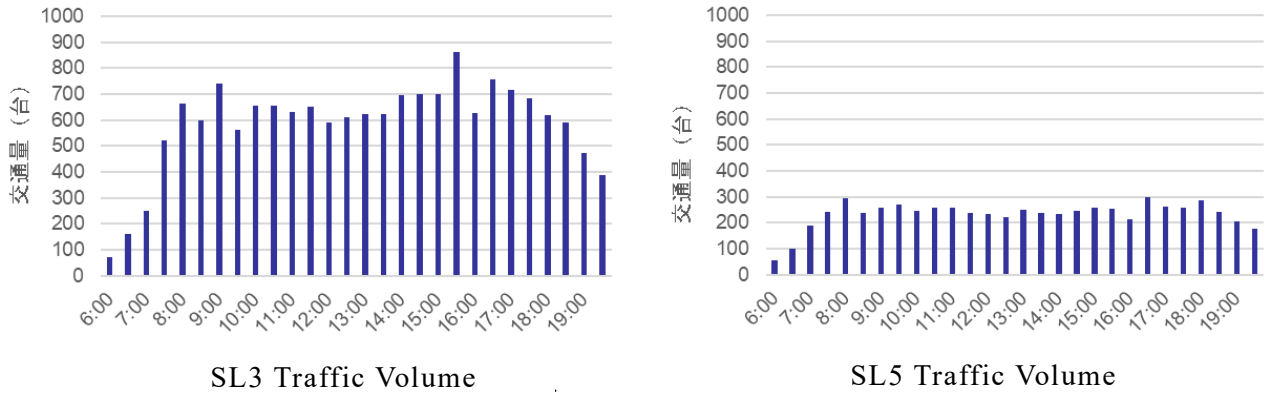


Figure 2.26 Traffic Volume Survey Points of the Master Plan



SL3 Traffic Volume　　SL5 Traffic Volume

Figure 2.27 Traffic Volume Survey Result of the Master Plan

(3) Supplemental Traffic Volume Survey

Supplemental traffic volume survey was conducted on the east side of the Lungga Bridge to clarify the traffic volume and composition by vehicle type in the 2-lane section. The outline of the survey is given in Table 2.7 and Figure 2.28, The result is shown in Figure 2.29 and Figure 2.30.

Table 2.7 Outline of Supplemental Traffic Volume Survey

Survey Point	①Lungga Bridge East side Earth cut section（Sta. 4+550）	②In front of Henderson Market （Sta. 6+550）
Date	2019/11/20（Wed）	2019/11/26日（Tue）
Time	7:00-19:00（12 hours）	
Target	Vehicles（Bicycle、Motorcycle、Passenger Car、Bus、Truck）※Without Pedestrian	
Method	Manual	

Figure 2.28 Supplemental Traffic Volume Survey Sites

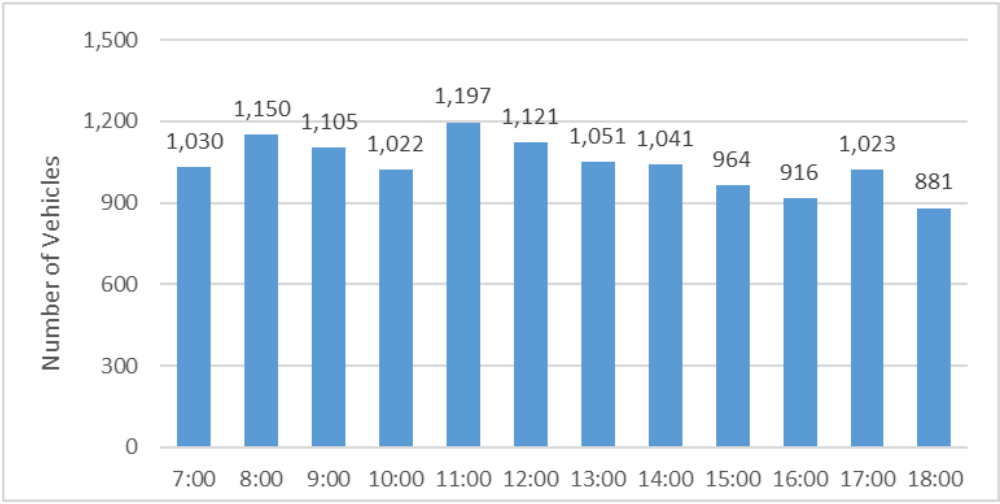


Figure 2.29 Traffic Volume by Time ((1)Lungga Bridge East side(Sta. 4+550))

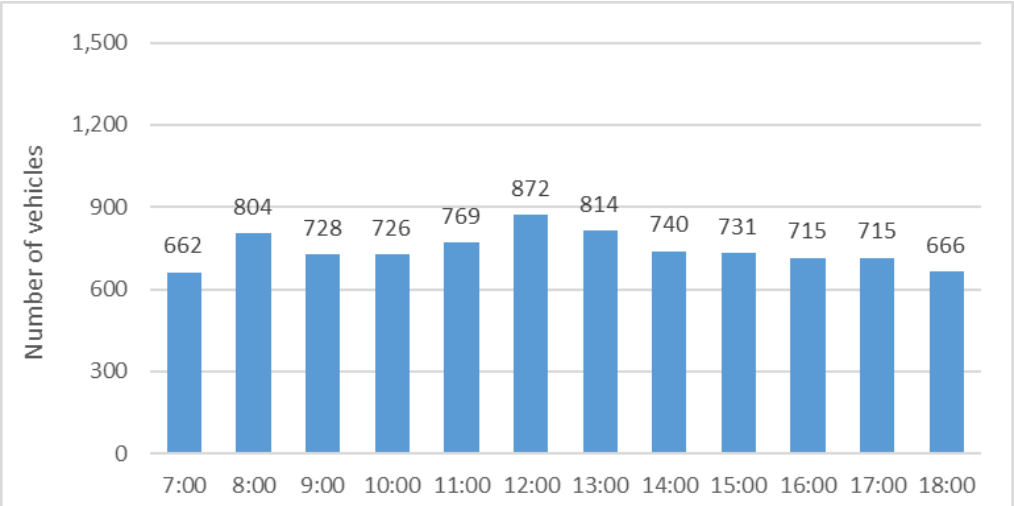


Figure 2.30 Traffic Volume by Time ((2)In front of Henderson Market (Sta. 6+050))

The traffic volume at point (1) is 12,501 vehicles/12h, and the traffic volume at point (2) is 8,942 vehicles/12h. The heavy vehicle ratio is about 2% at the survey point (1) and about 1% at the survey point (2). The peak ratio is about 8% at both survey points.

(4) Future Traffic Volume

In order to ensure consistency with the Master Plan, the future traffic volume estimated in the Master Plan was applied for verification of the number of Lanes in the Project.

The daily traffic volume in the 2-lane section on the east side of the Lungga Bridge in the target year is 28,932 vehicles/day. (Note that the estimated traffic volumes in the Master Plan are only those for Year 2025, 2030 and 2036, so the estimated values of others are calculated by linear interpolation.)

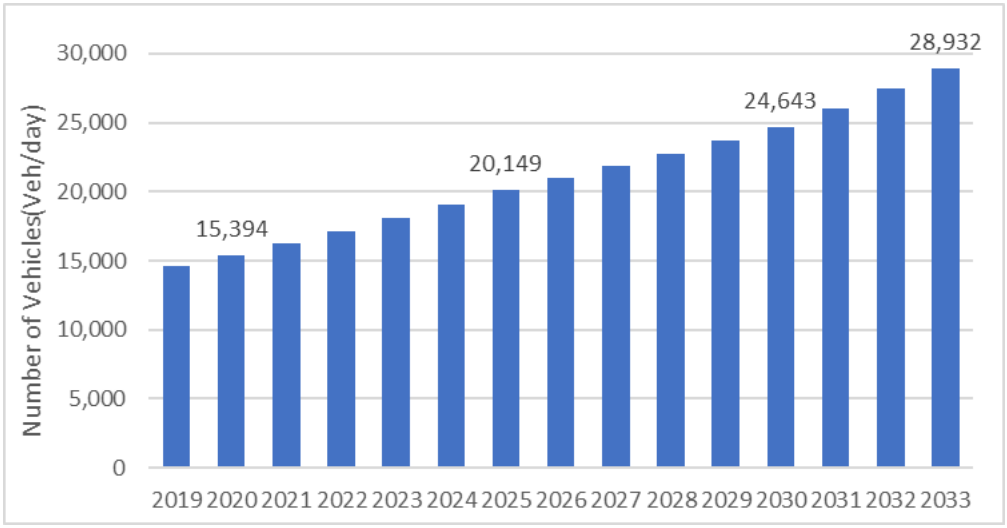


Figure 2.31 Future Traffic Volume in the 2-Lane Section at East Side of Lungga Bridge

(5) Verification of Traffic Capacity in the-2 Lane Section

Evaluation result by the HCM indicates that LOS in the 2-lane section is [D] until 2029, and LOS will be [E] after 2030 (Table 2-7). The breakdown of freight vehicle types was calculated by using the ratio of vehicle types based on the supplemental traffic volume survey result.

(6) Recommendation

Apparently, the traffic volume will exceed the capacity of the 2-lane section in 2029. Therefore, 4-lane widening is required by 2029.

Table 2.8 Prediction of LOS

Year	Daily Traffic Volume (veh/day) (a)	Peak Hour Traffic Volume(veh/hour) (b=a*0.075)	LOS
2019	14,587	1,092	D
2020	15,394	1,152	
2021	16,245	1,216	
2022	17,144	1,283	
2023	18,092	1,354	
2024	19,093	1,429	
2025	20,149	1,508	
2026	20,977	1,570	
2027	21,839	1,635	
2028	22,736	1,702	
2029	23,670	1,772	
2030	24,643	1,844	E
2031	25,997	1,946	
2032	27,425	2,053	
2033	28,932	2,165	

2.2.3.4 Road Surface Drainage

2.2.3.4.1 Policy on Road Surface Drainage Planning

Policies for road surface drainage planning are as follows:

- The existing drainage facilities shall be utilized to the extent possible.
- Size of drainage facilities shall be determined based on the hydrological/hydraulic analysis result.

2.2.3.4.2 Drainage/Discharge Outlet

The MID agreed to set the Drainage/Discharge Outlet as shown in Figure 2.32.

Figure 2.32 Location of Drainage/Discharge Outlet

2.2.3.4.3 Drainage System

Drainage system which aims to accelerate the road surface discharge to minimize provision of catch basins will be applied to the extent possible.

2.2.3.4.4 Recommendation

Existing river or channel are the planned drainage/discharge outlets. But, downstream of these outlets are not functional and capacity is significantly poor due to accumulated soil or garbage. Periodic cleaning and clearing of debris trapped needs to be undertaken by MID after completion the project to keep the drainage facilities functional.

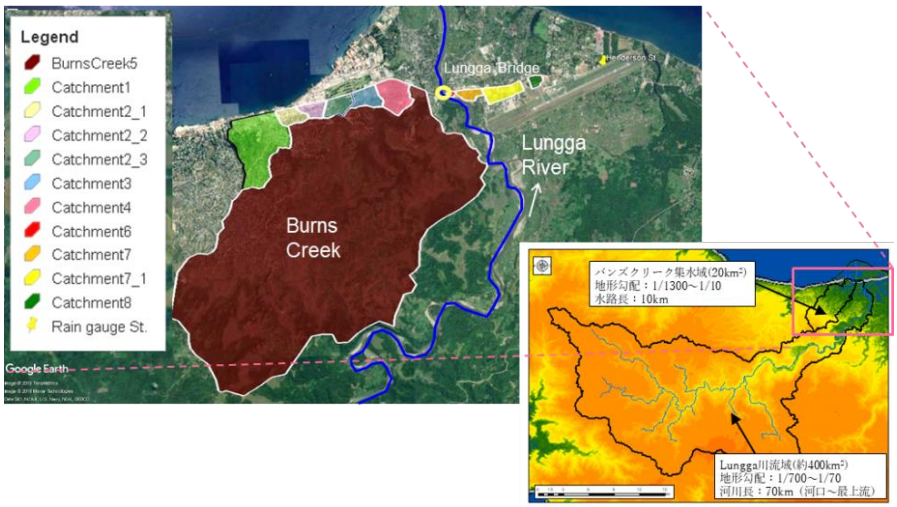
2.2.3.5 River and Drainage Plan

2.2.3.5.1 Drainage Plan Concept and Consistency with Previous Studies

Following Phase 1 design policy, the runoff in each catchment area was calculated based on the Papua New Guinea Flood Estimation Manual (SMEC, 1990), which is generally used for hydraulic analysis in Oceania. The conditions applied are given in Table 2.9 and the discharge of each catchment is provided in Figure 2.33.

Table 2.9 Calculation Conditions

Items	Calculation Conditions	
Target Basin	11 basins of rivers and channels in this study area	
Rainfall Intensity	hourly rainfall (10-year return period) based on the collected rainfall data	
Runoff Calculation	Basin area: less than 4 km2	Rational Runoff Formula (all rivers except the Burns Creek)
	Basin area: 4 to 100 km2	Regional Flood Frequency Method (the Burns Creek)



Catchment	Area (km^2)	Peak Discharge (m^3/s)
Catchment1	1.26	9.01
Catchment2_1	0.17	1.95
Catchment2_2	0.15	1.89
Catchment2_3	0.21	1.63
Catchment3	0.22	1.38
Catchment4	0.39	2.76
BurnsCreek5	**22.40**	**47.10**
Catchment6	0.02	0.30
Catchment7	0.10	0.75
Catchment7_1	0.22	2.85
Catchment8	0.06	0.52

Figure 2.33 Discharge in Each Catchment

2.2.3.5.2 Impact Assessment on Flooding around the Burns Creek by the Project Implementation

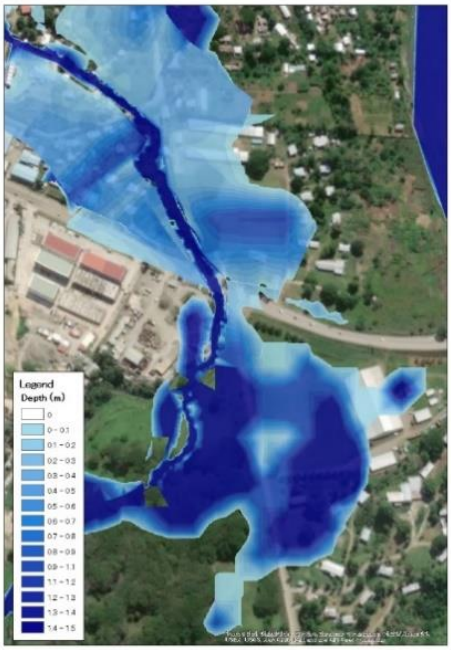
Road section at Burns Creek frequently experience inundation during and after rain. Here, the basic policy of the Project is to "keep the improved road section from inundation while ensuring the severity of the current inundation against a 10-year probability flood is not induced due to (after) implementation of this project". To accomplish the policy the existing culvert will be replaced by a bigger sized culvert (B2.6m x H2.0m x 3) while the finished surface of the road is raised (45 to 55 cm).

In this section, the flood inundation analysis model was developed, and the influence of the abovementioned measures on the surrounding inundation condition was quantitatively evaluated. In addition, to promptly resolve the inundation on the north side of the road, the installation of a drainage channel connecting the Burns Creek and the Lungga River was examined, which is discussed in the section below.

(1) Calibration of Inundation Analysis Model

The flood inundation analysis model around the Burns Creek was developed using the collected hydrological data and survey results. The reproducibility of the constructed model was confirmed by using the inundation area of the flood occurred in March 2018 as a verification material.

Figure 2.34 shows the results of the calculation and the actual inundation area of the March 2018 flood (estimated from the interviews and the UAV images). The actual flood inundation is well reproduced in both the inundation area and inundation depth obtained by the constructed analytical model.



Inundation Area by Reproduction Calculation Result

Actual Inundation Area during Food in March 2018

Figure 2.34 Diagram of Inundation Analysis Model

(2) Confirmation of the Effect of Planned Roads Around the Burns Creek on Inundation

The effectiveness of the road finished height and culvert specifications set in the road plan was verified by using the flood inundation analysis model. The calculation cases are (1) the March 2018 flood (equivalent to 7-year return period), (2) 10-year return period, and (3) 50-year return period. The 10-year probability is the design scale used in the road planning, and the 50-year probability is the scale adopted as the river planning design scale in the Solomon Islands. The analysis results are shown in Figure 2.35 to Figure 2.37. The analysis results are discussed below.

1) The March 2018 Flood (Equivalent to 7-year return period)

It was found that the road inundation would be resolved after the project implementation. It was also confirmed that the inundation area around the road remained almost unchanged before and after the Project. This is mainly because the flood water that overflow the road before the project implementation began to flow downstream through the culvert.

2) 10-year Return Period

(Extension of Hyetograph in March 2018 by Daily Rainfall)

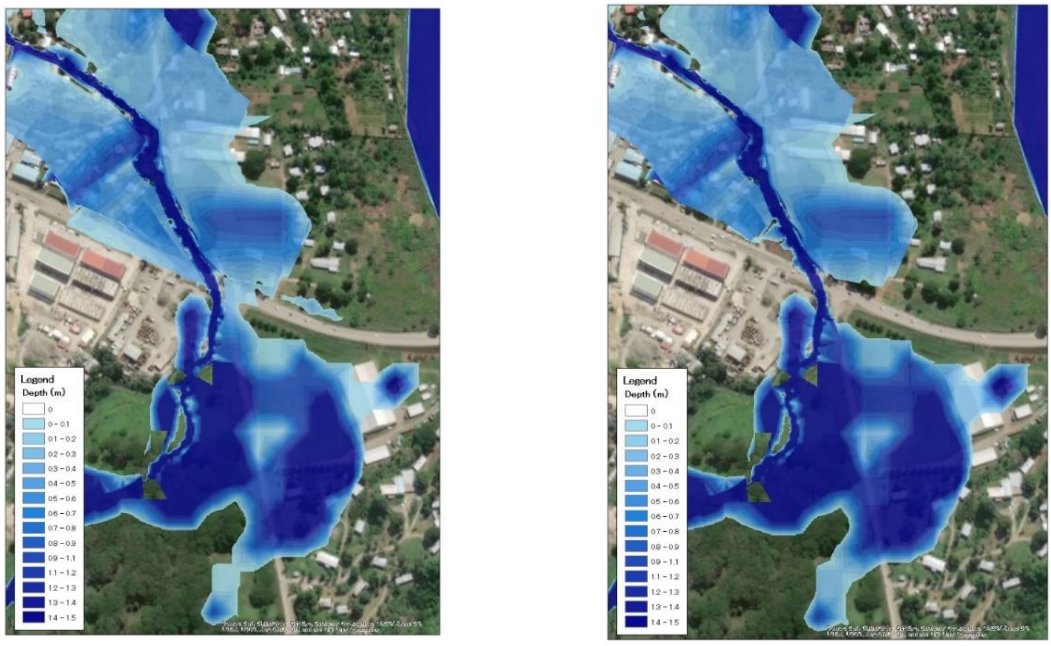
Although a slight expansion of the inundation area was confirmed on the north side of the road, the inundation area was almost the same as after the implementation of the Project. Therefore, it was confirmed that even in the case of the 10-year probability flood, which is applied in the road plan, the road flooding will be resolved by the implementation of the Project, and the inundation damage around the road will be limited.

3) 50-year Return Period (For Reference)

(extension of hyetograph in March 2018 by daily rainfall)

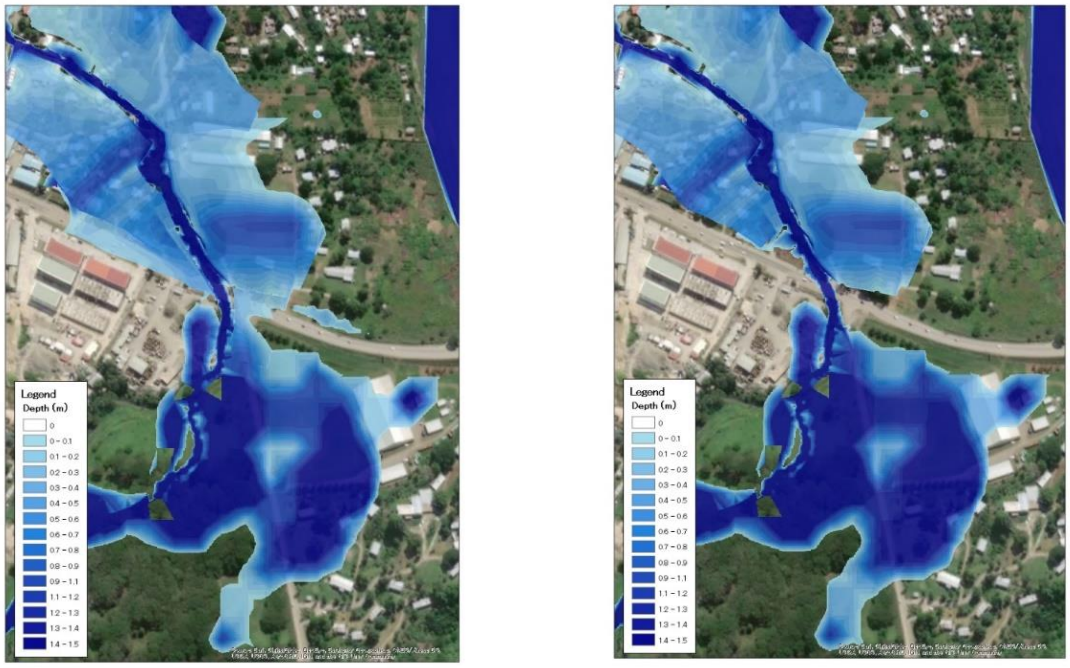
After the implementation of the Project, the road inundation and the expansion of the inundation area around the road were confirmed. However, even with the 50-year return period the inundation depth on the south side of the road did not reach the crown of the raised road. It was confirmed that no road would be submerged.

In addition, it was also confirmed that the inundation area on the mountain side after raising the road would be almost the same as the current situation.



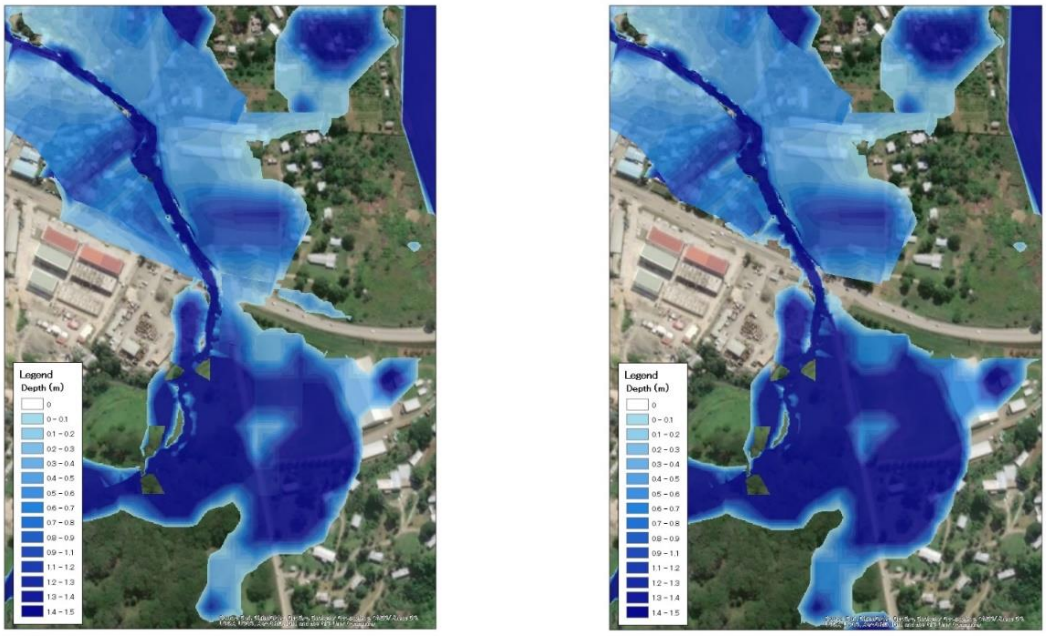
Before Project Implementation　　After Project Implementation

Figure 2.35 (1) Inundation Map of Flood in March 2018



Before Project Implementation　　After Project Implementation

Figure 2.36 (2) Inundation Map at 10-year Return period



Before Project Implementation　　After Project Implementation

Figure 2.37 (3) Inundation Map at 50-year Return period (For Reference)

(3) Study on Possibility of Draining Food water Around the Burns Creek to the Lungga River

1) Comparison of Water Level of the Lungga River and Inundation Elevation Around the Burns Creek

One of the measures to drain the food water around the Burns Creek is to drain into the Lungga River. The drainage method is basically to use gravity. Therefore, it was examined whether flood water could be drained or not by comparing the elevation of inundation surface around the Burns Creek and the water level of the Lungga River at the time of flood occurrence. Considering the current topography and land use, the normal of the channel was divided from the direct downstream of the box culvert at the Burns Creek and installed along the embankment of the Lungga Bridge (Figure 2.38).

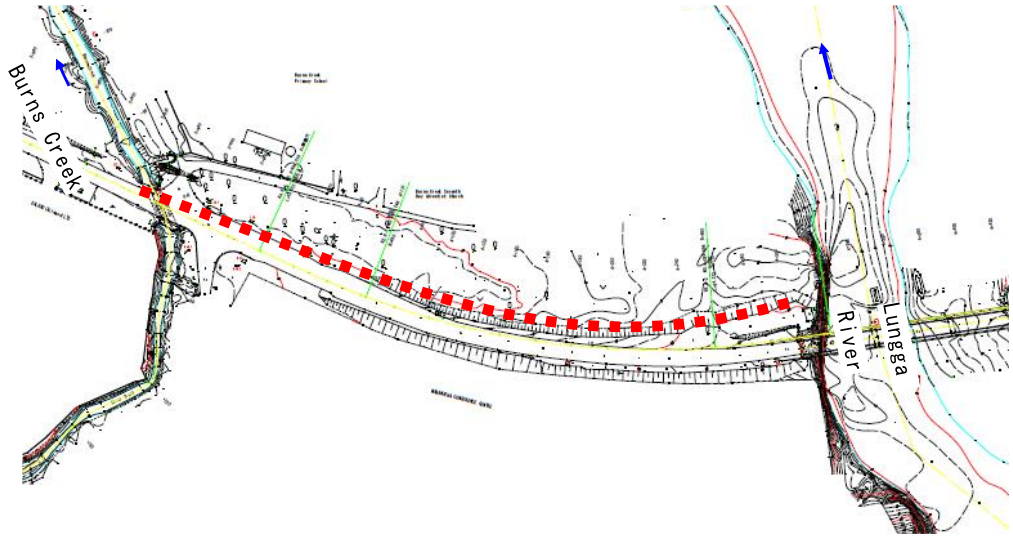
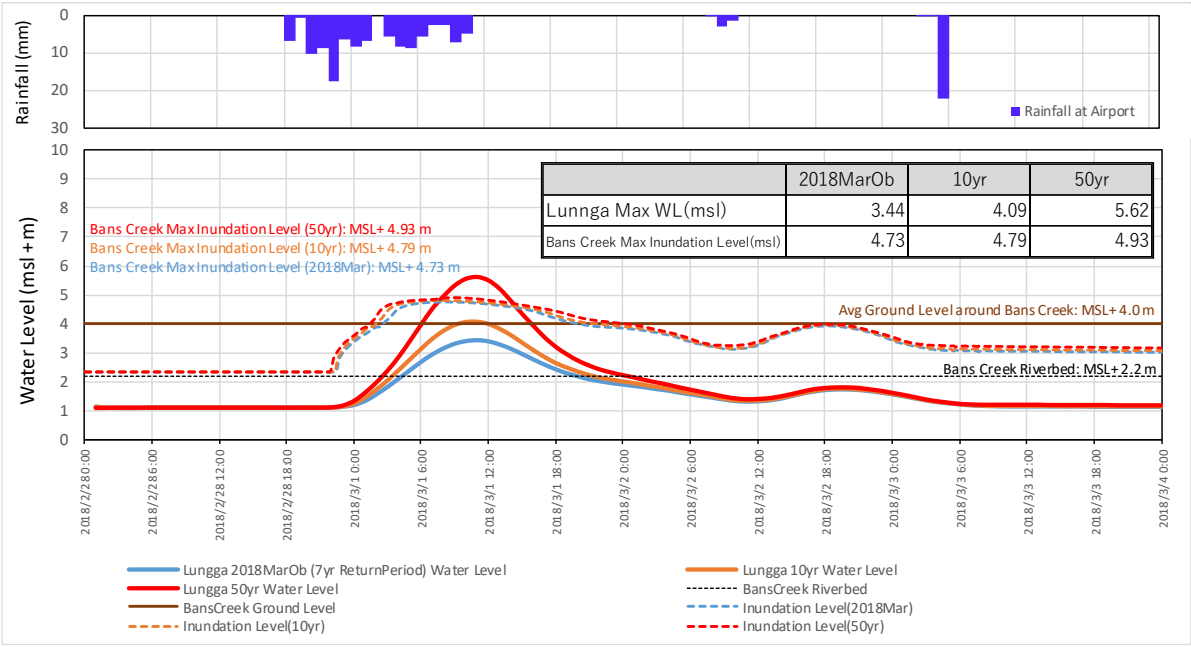


Figure 2.38 Layout Plan of Drainage Channel

Three cases are considered (1) flood in March 2018 (equivalent to the 7-year return period), (2) the 10-year return period, and (3) the 50-year return period.

The analysis results are shown in Figure 2.39 and Table 1.1. In the figure, the deepest height of the river bed (MSL+2.2 m) of the Burns Creek and the elevation of inundation surface around the Burns Creek in 2018 are also shown. Therefore, in the 2018 flood and the 10-year probability flood, the drainage by gravity is possible as the elevation of inundation surface around the Burns Creek is higher than the water level of the Lungga River. On the other hand, in the case of the 50-year return period, there is a possibility of backflow because the water level of the Lungga River is higher than the water level around the Burns Creek. Therefore, when the drainage channel is installed, it is necessary to consider a backflow prevention facility such as a sluice gate or sliding timber weir.



	2018MarOb	10yr	50yr
Lunnga Max WL(msl)	3.44	4.09	5.62
Bans Creek Max Inundation Level(msl)	4.73	4.79	4.93

Figure 2.39 Elevation of Inundation Surface around Burns Creek and Water Level of Lungga River

Table 2-1 Summary of Maximum Water Level at Burns Creek and Lungga River

Study Case	Maximum Water Level		Evaluation
	Lungga River	Inundation Depth around Burns Creek	
(1) Flood in March 2018 (Equivalent to 7-year return period)	3.44 m	4.73 m	Possible to drain to the Lungga River
(2) 10-year return period	4.09 m	4.79 m	Possible to drain to the Lungga River
(3) 50-year return period (For reference)	5.62 m	4.92 m	Backwater effect from the Lungga River (backflow)

2) Installation of drainage channel connecting the Burns Creek and the Lungga River

From the examination of 2.3.5.2 (2),

- The road will not be submerged at flood scale with 10-year return period which is the target scale of the road design in the project implementation;
- The inundation area around the road is almost the same before and after the project implementation, and the implementation of the Project will not worsen the inundation situation from the current situation; and
- The road will not be submerged even at flood scale with 50-year return period.

Connecting the Burns Creek and the Lungga River with a channel may reduce flood damage around the Burns Creek. However, if a large flood occurs, for example the 50-year return period which is the design scale of the Lungga Bridge, there is a risk of inundation damage due to backflow.

From the above, it was confirmed that the road submergence could be avoided and the inundation area would not be expanded by the project implementation.

Although it is effective to install drainage channels to reduce the inundation damages, it is necessary to operate the backflow prevention facilities (gates, sliding timber weir, etc.) that take into account the water levels of the Lungga River and the Burns Creek. In addition, it is necessary to operate the facilities under dangerous conditions during floods. Since it is supposed to be challenging for the Solomon side to perform these operations smoothly at this time, it was concluded not to study the drainage channel including the examination of the backflow prevention facilities in the Project.

(4) Issues and Recommendations Related to the Hydraulic analysis

1) Runoff Analysis

The culvert specifications, the discharge of the downstream at the end of the Burns Creek, the water level around the road which is for determination of the height of the road, and the discharge and water level of the Lungga River are calculated based on the current basin conditions with the 10-year return period. Since there is no large-scale land development plan for the upstream of the Burns Creek, the runoff calculation is conducted based on the current land use, and the storage capacity of the basin is taken into consideration. Therefore, if a large-scale development is implemented in the future and the storage capacity decreases, the runoff volume may increase. It is necessary to monitor the development status in the upstream area and consider revising the designed values when the runoff volume is expected to increase.

2) Accuracy of Inundation Analysis

This study is based on the very limited hydrological data and topographical data. It is desirable to conduct the rainfall and water level observations (especially, the observations at the Lungga Bridge site which are not currently being conducted), because the lack of rainfall observation data directly affects the evaluation of the planned scale. Also, in order to improve the accuracy of inundation analysis, precise topographic survey is essential. Therefore, it is desirable to conduct a LiDAR survey (Light Detection and Ranging).

2.2.3.5.3 Study on Flood Control Measures for the Burns Creek and the Lungga River

In the previous section, the effects of the Project were verified hydraulically, and it was confirmed that road inundation would be resolved, and the current inundation situation would not be worsened. This section includes the outline study such as the flood control measures around the Burns Creek and the safety against bank erosion and scouring at the Lungga River.

(1) Flood Control Measures at the Burns Creek

1) Current Flow Capacity

The peak discharge of the 10-year return period at the culvert site is 47.10 m^3/s (see Figure 2.40). Figure 2.40 shows the flow capacity of the Burns Creek (evaluated by the river bank heights on the left and right, respectively). According to this, it is confirmed that almost all areas of the river lack the flow capacity considering the design peak discharge. From this reason, it is necessary to implement measures such as improvement of the cross-section and construction of channel dike.

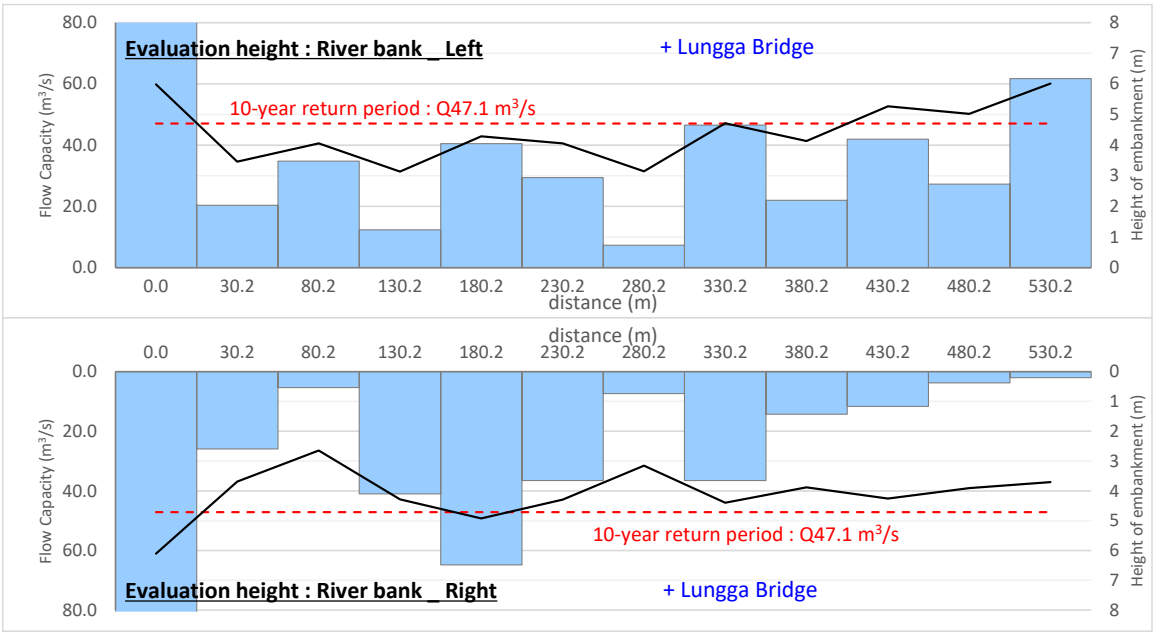


Figure 2.40 Flow Capacity Diagram of Burns Creek

Source: JICA Study Team

Figure 2.41 Location Map of Cross-section Survey at Burns Creek

2) Outline Study of Channel Improvement

In order to prevent the inundation situation around the Burns Creek, it is necessary to improve the river channel and install flood control facilities. Figure 2.42 and Figure 2.43 show the cross-section of the river improvement (+230.2 m and +80.2 m) for the 10-year return period.

Since houses are located very close to the river channel, the improvement work will be carried out without expanding the river channel as much as possible, and the concrete revetment with a slope (1:0.5) will be installed. In addition, riverbed height of the current channel will be secured in order to maintain the current channel environment. Although the energy gradient varies depending on the channel cross-section, it is possible to secure the flow capacity corresponding to the 10-year return period discharge by maintaining the channel width of 13 to 14 m and the water depth of 2 to 3 m.

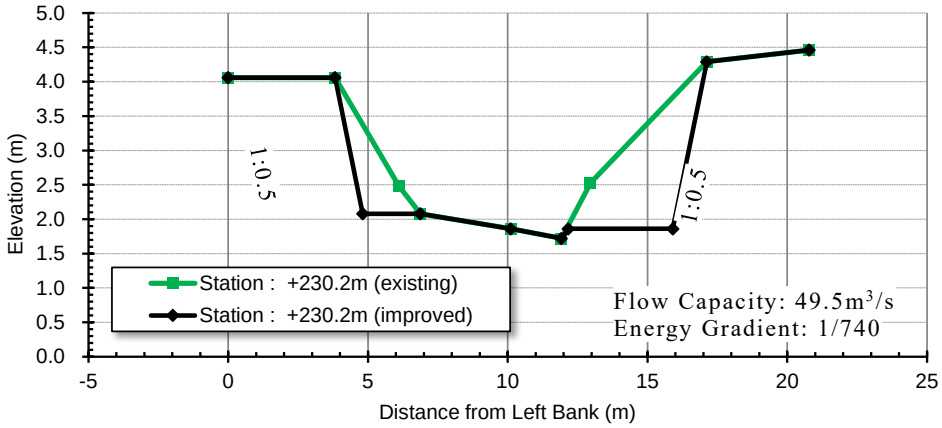


Figure 2.42 Cross-section of River Improvement at +230.2m (10-year Return period)

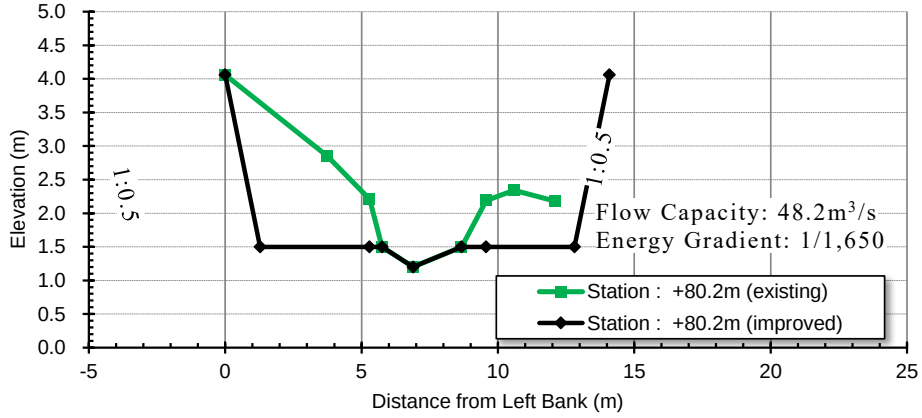


Figure 2.43 Cross-section of River Improvement at +80.2m (10-year Return period)

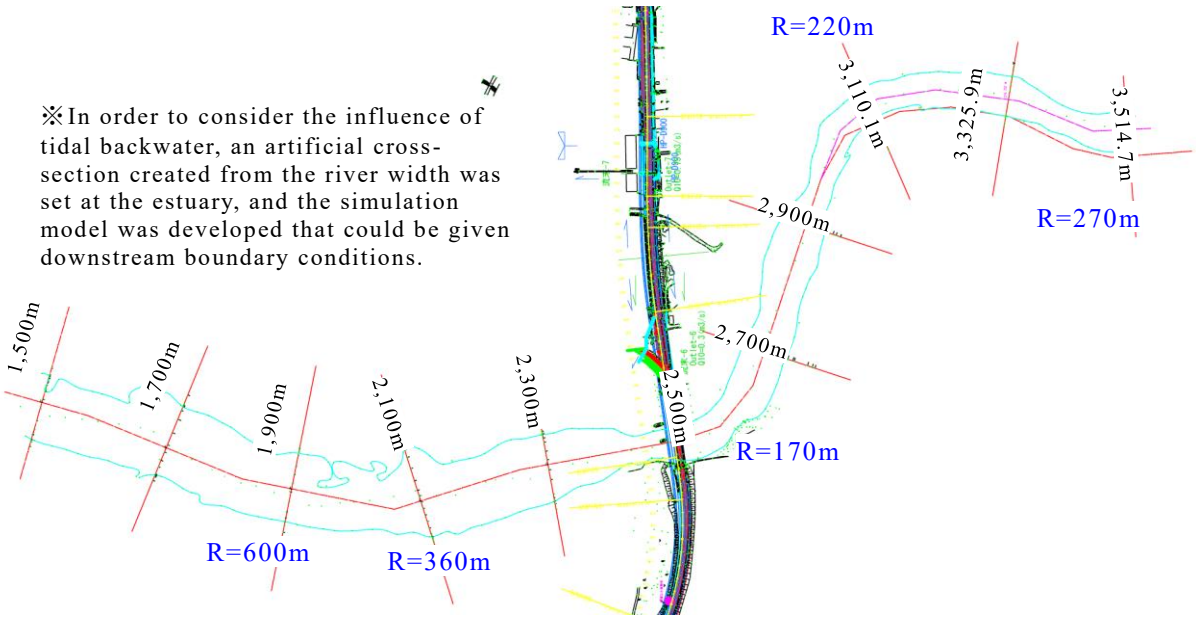
Table 2.10 shows the outline of the hydraulic analysis model of the Burns Creek and the Lungga River. This model was utilized to evaluate the flow capacity and to set the improved cross-section.

Table 2.10 Overview of Burns Creek and Lungga River Hydraulic Analysis Model

No.	Item	Description
1	Method	One-dimensional varied flow calculation Using HEC-RAS Ver.5.07, US Army Corps of Engineers
2	River Cross Section	Survey results in 2019 (implemented in this project)
3	Roughness Coefficient	Set to a general value of 0.030
4	Upper Boundary Condition	Peak discharge by return period
5	Lower Boundary Condition	[The Burns Creek] Set the water level at downstream end in a uniform flow calculation. Topographic gradient is used as the energy gradient in the calculation. [The Lungga River] Set an artificial cross-section at the estuary and give the tide level (average tide level) in order to evaluate the tide effects.
6	Flow Capacity	Calculate water level according to discharge scale and create the H-Q curve for each cross-section by the least square method.

(2) Preliminary Study on Riverbank Erosion and Scouring Measures for the Lungga River

Many rivers in the Solomon Islands are planned for target scale of the 50-year return period. Although the flood control plan for the Lungga River has not been formulated, it was confirmed that there is a risk of bank erosion according to local hearing surveys. Figure 2.44 shows the plan view of the upstream and downstream of the Lungga Bridge and the curve radius, R, of the curved waterway. The curve radius is small at immediately upstream of the Lungga Bridge, and there is a possibility of scouring on the outside of the curved waterway.



Source: JICA Study Team

Figure 2.44 Plan View of Lungga River

Table 2.11 shows the results of the hydraulic analysis with the 50-year return period. From this, the average velocity, *Vm*, is around 3 m/s. Table 2.12 shows the relationship between bank protection method and design velocity. Generally, the bank protection method is selected according to the design flow velocity V_D in the table, and the construction method is adopted which is suited to the on-site conditions such as the material procurement. The value of V_D is set considering the maximum scouring depth and the characteristics of the river normal (curvature).

Table 2.11 Lungga River Hydraulic Analysis Results (50-year Return period)

Sta.	Discharge *Q* (m^3/s)	Deepest Riverbed Height (m)	Max Water Level (m)	Energy Gradient *I*	Ave. Velocity V_m (m/s)	Cross-Sectional Area *A* (m^2)	Water Surface Width (m)	Froude Number
3514.7	2,430	-0.31	8.00	0.001077	3.86	639.35	93.17	0.47
3325.9	2,430	-0.37	7.66	0.001214	4.21	603.84	91.87	0.51
3110.1	2,430	-0.49	7.63	0.000854	3.44	727.61	115.02	0.42
2900	2,430	-0.71	7.40	0.000903	3.55	697.27	104.38	0.43
2700	2,430	-0.99	7.32	0.000760	3.36	784.22	129.46	0.4
2500	2,430	-2.65	6.94	0.001288	3.65	664.94	116.02	0.49
2300	2,430	-0.54	6.91	0.000663	3.07	821.37	128.76	0.37
2100	2,430	-2.07	7.03	0.000239	1.97	1269.04	173.36	0.23
1900	2,430	-1.84	6.77	0.000506	2.74	919.22	139.61	0.33
1700	2,430	-1.35	6.69	0.000469	2.67	950.32	139.21	0.32
1500	2,430	-1.41	6.35	0.000840	3.33	760.78	122.10	0.42
0	2,430	-1.41	2.35	0.006057	5.85	415.10	120.00	1.01

In this study, the revetment will be examined at＋2,500 m (the Lungga Bridge) where the curve radius is the smallest and scouring on the outside of the curved waterway is confirmed based on the cross-sectional survey. According to Figure 2.45 showing the cross-section of the Lungga Bridge, it is confirmed that scouring has occurred at the curved portion (left bank side).

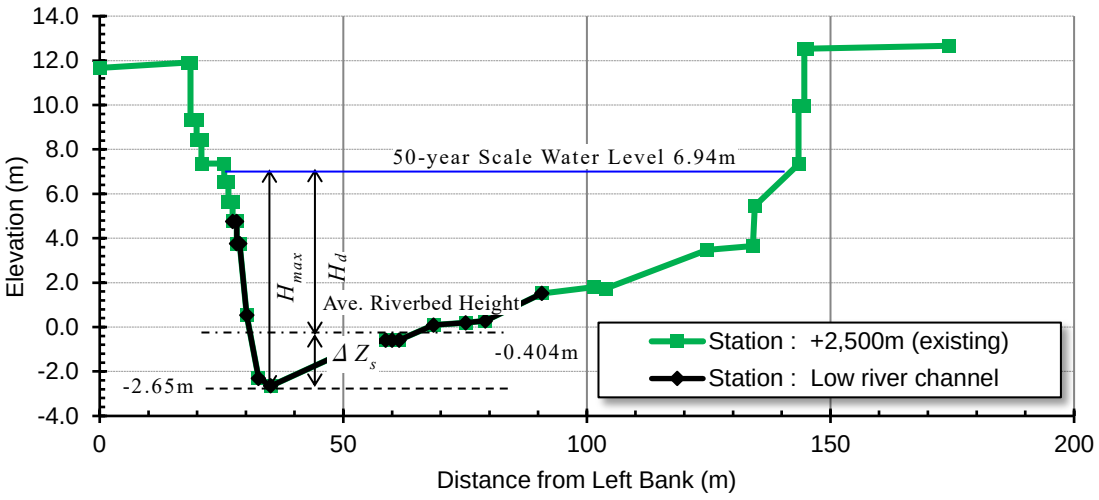


Figure 2.45 Cross-Section at Lungga Bridge (+2,500m)

As mentioned above, since there is no flood control plan for the Lungga River, there are no specifications such as the design high water level (HWL), etc. Therefore, in this study, the maximum water level with the 50-year return period was set as the design water depth, H_d.

Table 2.12 Adaptable Velocity of River Revetment (Table C)

(Slope of Revetment is steeper than 1.5 :1)
(This will be revised based on the construction results.)

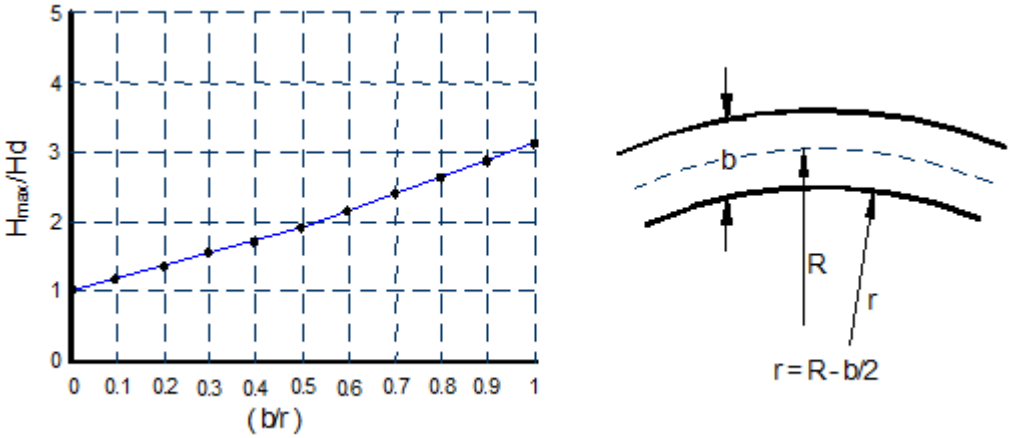
Type of River Revetment		Adaptable Design Velocity (m/s) 2	3	4	5	6	7	8	Condition and Note
Wooden Type	Log Grid Type	═	═	═					・Suitable under the conditions wher there are no rolling stones and elevation is lower than the inland areas ・Existing lumber may be re-used for this type
	Wooden Block Type	═	═	═					・Suitable under the conditions wher there are no rolling stones and elevation is lower than the inland areas ・Existing lumber may be re-used for this type (Wide Lange of Pile Diameter is Recommended) ・Commonly Used for the Places with slope steeper than 1.0 : 1
	Picket Fence Type	═	═	═					・Suitable under the conditions wher there are no rolling stones and elevation is lower than the inland areas ・Filling stones designed against the Representative Velocity should not move ・Above the Ordinary Water Level, some plants such as willow are commonly planted along the slope.
Stone Type	Fieldstone (Mortar Masonry)	┅	┅	┅	═	═	═	═	・Suitable when materials can be easily obtained ・Backfill Concrete will be not appear so the joint should be deeper ・If Design Velocity is less than 5m/s, other methods should be considered
Gabion	Gabion (Multi-Stage Masonry)	═	═	═	═	═	═		・Suitable under the conditions wher there are no rolling stones and elevation is lower than the inland areas ・Higher corrosion resistance material should be used under acidic or salty conditions
Concrete Block Type	Concrete Block (Dry Masonry)	═	═	═	═				・Because there are many types of concrete blocks, the most adequate type should be selected during the design
	Concrete Block (Mortar Masonry)	┅	┅	┅	═	═	═	═	・Because there are many types of concrete blocks, the most adequate type should be selected during the design ・If Design Velocity is less than 5m/s, other methods should be considered

＊Legend ═ Range of Adaptable Velocity
┅ Range of Basically Unused Velocity (But Sometimes Used under Some Conditions of hinterland and River)
Slope of Revetment is steeper than 1.5 :1. This will be revised based on the construction results.

Source: "Guidelines for Disaster Restoration Works for Conservation of Precious natural surroundings", Revised on March 31, 2014

1) Calculation of Estimated Maximum Scouring Depth (ΔZs)

In order to calculate the estimated maximum scouring depth (ΔZs) of the curved waterway, the width of low-water channel, b and the curve radius, r are required. The value of r is calculated by $r = R - b/2$. The estimated maximum scouring depth ($Hmax$) is calculated using the design depth Hd obtained from Figure 2.46.



Reference: Guidelines for Disaster Restoration Works for Conservation of Precious natural surroundings, Japan Oct. 1998.

Figure 2.46 Relationship Diagram of Hmax/Hd and b/r

Table 2.13 shows the calculation results of ΔZs. Based on the results, the maximum scouring depth near the left bank of the Lungga Bridge is estimated to be -5.545 m, and there is a possibility of scouring about 3 m deeper than the current deepest riverbed height of -2.65m.

Table 2.13 Calculation of Estimated Maximum Scouring Depth ΔZs

Item	Value
①HWL	6.94 Elm
②Low-Water Channel Average Riverbed Height	-0.404 Elm
③Design Water Depth H_d ①-②	7.344 m
④Curve Radius R	170 m
⑤Low-Water Channel Width b	63.5 m
⑥r	138.25 m
⑦b/r ⑤/⑥	0.46
⑧H_{max}/H_d from Figure 2.46	1.7
⑨H_{max} ③×⑧	12.48 m
⑩ΔZ_s ⑨－③	5.141 m
Estimated Maximum Scouring Depth (Elevation)②－⑩	-5.545 Elm

2) Calculation of representative velocity V_o

The representative velocity *Vo* is calculated using the average flow velocity *Vm* summarized in Table 2.11. V_o is calculated by multiplying v_m by the correction α_1. The value of α_1 on the curved waterway is calculated by the following equations.

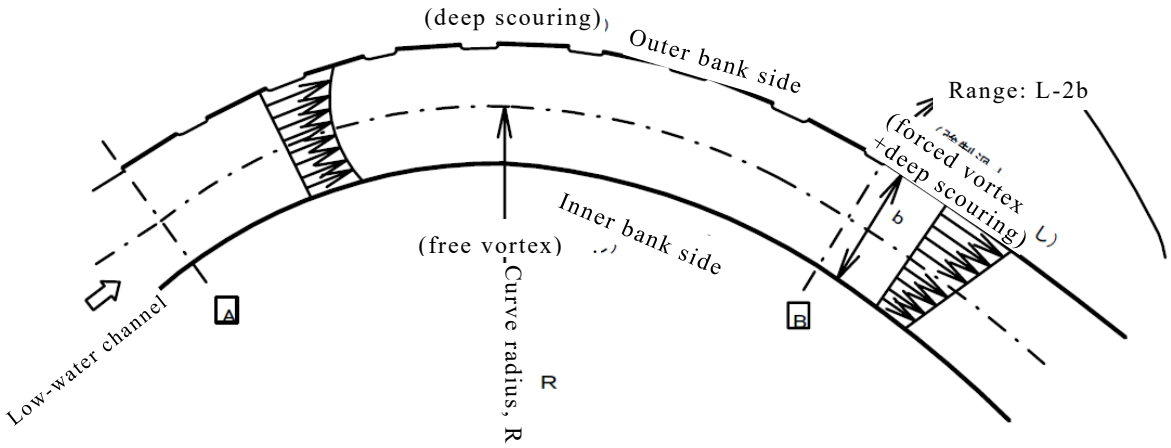
[For Moving Bed]

Outer bank side : $\alpha_1=1+b/2R+\Delta Z/2H_d$

Inner bank side : $\alpha_1=1+b/2R$

Downstream 2b section : $\alpha_1=1+b/2R+\Delta Z/2H_d$

※The upper limit of α_1 is 2.



Source: "Guidelines for Disaster Restoration Works for Conservation of Precious natural surroundings", Appendix

Figure 2.47 Velocity Distribution and Surcharge Range (for Moving Bed)

The calculation results of the representative velocity are shown in Table 2.14.

Table 2.14 Calculation Results of Representative Velocity Vo

Range	Correction α_1	Ave. Velocity V_m (m/s)	Representative Velocity V_o (m/s)
Outer Bank Side	1.54	3.65	5.62
Inner Bank Side	1.19		4.34
Downstream 2*b* Section	1.54		5.62

The design velocity, V_D, is the average value of multiple V_o on the curved waterway. In this study, there was no multiple cross-section, therefore it was treated as $V_D \fallingdotseq V_o$.

3) Selection of Revetment Method

According to Table 2.12 and Table 2.14, it is determined that the concrete revetment is appropriate near the Lungga Bridge. In addition, it is necessary to consider the installation of floor (riverbed) protection work since the estimated maximum scouring depth is as deep as about 3 m.

2.2.3.6 Pavement

2.2.3.6.1 Design Policy

Policy for pavement design is as follows:

- Applying flexible pavement which is common in the Solomon Islands
- Calculating design based on the CBR test result
- Application of pavement structure that is durable against possible damage from deceleration of heavy traffic at U-Turn lanes and at roundabouts
- Determine input parameters reflecting existing conditions
- Calculating by AASHTO method

2.2.3.6.2 Performance Period

Performance period of pavement shall be 10 years as mentioned in 2.2.1.8 .

2.2.3.6.3 Calculation by AASHTO Method

(1) Design Parameters

Design parameters are summarized in Table 2.15. The Structural Number (SN) required for the asphalt pavement will be calculated from the following formula.

$$\begin{aligned} \mathrm{Log}_{10}(W_{18}) &= Z_R \times S_0 + 9.36 \times \mathrm{Log}_{10}(SN+1) - 0.20 + \frac{\mathrm{Log10}\{\Delta PSI/(4.2-1.5)\}}{0.40 + \{1094/(SN+1)^{5.19}\}} \\ &\quad + 2.32 \times \mathrm{Log}_{10}(M_R) - 8.07 \end{aligned}$$

Table 2.15 Design Parameters (Inputs) of Pavement Design

Item	Definition	Condition
Design Period	The period that an initial pavement structure will last before it needs rehabilitation.	10 years (2023 to 2033)
Traffic Load	The traffic load is expressed by cumulative number of 18-kip equivalent single axle load (ESAL) applications (w_{18}) during the performance period and is calculated based on the future traffic volume which is converted to 18-kip ESALs applying the axle load equivalency factors given in the AASHTO Guide.	Calculated by traffic demand forecast
Reliability	Means of incorporating some degree of certainty into the design process.	• The level of reliability (R)=80% • Standard normal deviate corresponding to level of reliability (Z_R) = -0.841 • Combined standard error of the traffic prediction and performance prediction (S_o) = 0.45

Item	Definition	Condition
Performance Criteria	The Present Serviceability Index (PSI) is used to represent pavement performance. The total change in PSI (△PSI) is defined as the difference between initial serviceability index (p_0: value immediately after construction) and terminal serviceability index (p_t: lowest index that will tolerate before rehabilitation, resurfacing or reconstruction)	p_0 = 4.2 pt = 2.5
Roadbed Soil Property	The resilient modulus (M_R) is used. The AASHTO Guide introduces the equation estimating M_R from CBR as M_R = 1,500 x CBR (CBR is regarded as 20 in case of CBR more than 20)	CBR=10 (calculated based on CBR investigation)
Pavement Layer Material Properties	The pavement strength is expressed by the structural number (SN) which is calculated as : $SN = a_1D_1 + a_2D_2m_2 + a_3D_3m_3$ where a_i=i^{th} layer coefficient D_i=i^{th} layer thickness (inches) m_i=i^{th} layer drainage coefficient	• Asphalt concrete wearing course : a1=0.40 • Asphalt concrete binder course : a2=0.38 • Base Course : :a4=0.14 • Subbase Course : a5=0.11
Drainage Condition	The factor to modify the SN considering the effects of drainage.	m_4 = m_5 =1.0

(2) Estimation of ESAL (Equivalent Single Axle Load)

The Team calculated Load Equivalency Factor (LEF) on the basis of the axle load survey result by the number of axle as listed in Table 2.16. Future traffic volume is converted into ESAL by applying LEF

Table 2.16 LEF by Number of Axle

Number of Axle	Applied
2 (SS)	0.631
2 (ST)	2.211
3 (SST)	2.321
4 (STSS)	5.510
4 (STTS)	4.104

S: Single, T: Tandem

As a result, ESAL is calculated at 8.7 million.

(3) Calculation Result

The result is shown in Table 2.17.

Table 2.17 Pavement Calculation Result

Pavement Layer Material	Layer Coefficient (a)	Thickness (inch) (D)	Drainage Coefficient (m)	SN = a*D*m	Thickness(cm) (D)
Wearing course (Asphalt)	0.400	1.969	—	0.787	5
Binder course (Asphalt)	0.380	1.969	—	0.748	5
Base course (CBR 80%)	0.140	7.874	1.00	1.102	20
Sub-base course (CBR 30%)	0.110	9.843	1.00	1.083	25
Total			Required SN 3.582	<	Calculated SN 3.720
				OK	

2.2.3.6.4 Road Surface Temperature

Road surface temperature was measured. The result is shown in Table 2.18. The surface temperature at most of the locations are over 50 degrees Celsius., at which bituminous material can undergo plastic deformation. As a measure to prevent plastic deformation from loads exerted by heavy vehicles, application of modified asphalt is considered.

Table 2.18 Measurement Result of Road Surface Temperature

No	Survey Location	Date	Time	Temperature (℃)
1	CAPITAL PARK	24-Oct-20	13:00	51.2
2	SOUTH PACIFIC CONSTRUCTION	26-Nov-20	9:20	47.8
3	King George High School	26-Nov-20	9:30	44.7
4	Central Market	02-Dec-20	14:00	55.6
5	Roundabout in front of MID	02-Dec-20	14:00	57.0
6	CAPITAL PARK	02-Dec-20	15:00	52.6
7	SOUTH PACIFIC CONSTRUCTION	02-Dec-20	15:00	54.0
8	King George High School	02-Dec-20	15:00	56.2
9	Roundabout in front of MID	03-Dec-20	9:30	50.4
10	Roundabout in front of MID	03-Dec-20	13:00	59.1
11	Roundabout in front of MID	03-Dec-20	13:00	56.0
12	St. Barnabas Anglican Cathedral	03-Dec-20	13:00	64.6

2.2.3.6.5 Application of Modified Asphalt Concrete

In the Project, modified asphalt concrete is provided on the wearing course at the U-turn lane sections and the roundabout where vehicles are anticipated to have low speed, subject to sudden and repeated acceleration and repeated intensive load.

2.2.3.6.6 Groundwater Level

In order to evaluate how the ground water affects pavement structure, monitoring of ground water level was conducted in the monitoring well installed at four locations shown in Figure 2.48.

The monitoring record in Figure 2.49 shows that groundwater level is more than 1 m lower from the bottom of the planned subgrade. Therefore, the Team confirmed that the groundwater will not adversely affect pavement structure.

Figure 2.48 Location of Monitoring Well

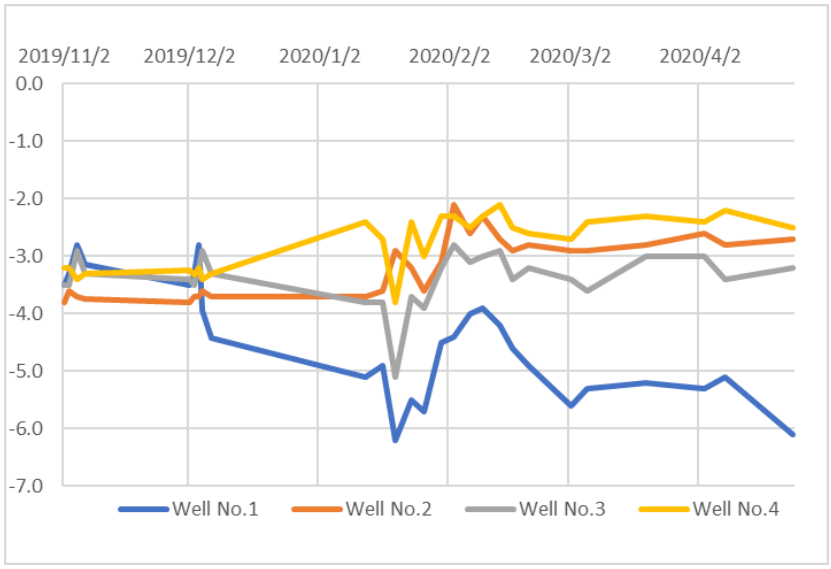


Figure 2.49 Monitoring Record of Groundwater Level

2.2.3.6.7 Asphalt Overlay

(1) Policy on Overlay

Policy on overlay is as follows.

- The target area shall be on the existing pavement. Only curbs and drainage facilities that require strengthening its function to mitigate flooding shall be covered in the Project subject to it does not affect subsequent projects.
- Performance period shall be 3 years and thickness of overlay will be based on calculation using AASHTO method.

(2) Pretreatment of Overlay Work

Pretreatment of overlay work is divided into four types depending on current pavement condition. Table 2.19 shows pretreatment of overlay depending on the pavement condition.

Table 2.19 Breakdown of Overlay Work

No	Condition	Pretreatment	Remarks
1	Good or fair	Cleaning	―
2	Small-scaled crack observed	Sealing	By bituminous material
3	Large-scaled crack observed	Removal of an existing asphalt layer and compaction of base course	―
4	Potholes and other serious damage confirmed	Removal of a pert of base course or reconstruction from subbase course depending on the situation	Assumed that objective section accounts for approx. 20 % of whole overlay section (L=2.3 km)

(3) Thickness of Overlay

The overlay will have a thickness of 5 cm, as derived from the calculation recommended in AASHTO under 3-year performance period.

2.2.3.7 Concrete Structure

2.2.3.7.1 Cross Drainage Structure

The existing cross drainage structures shall be replaced with new box culverts.

2.2.3.7.2 Box Culvert at the Burns Creek

(1) Design Policy

Existing box culverts will be replaced with appropriate size and installed height, that was determined based on the hydrologic analysis result.

(2) Design Condition

Design conditions provided in the Japanese standards mentioned above shall be applied.

(3) Ground Condition

Figure 2.50 presents the stiffness of the ground in terms of N-value (Standard Penetration Test (STP)) obtained from a simplified geo-technical investigation carried out in this preparatory survey. The bearing ground layer consists of clay with an approx. N-value of 20. The layer is thus judged to be strong enough for a spread foundation.

At D/D stage, detailed STP will be carried out to verify the below (O/D) result.

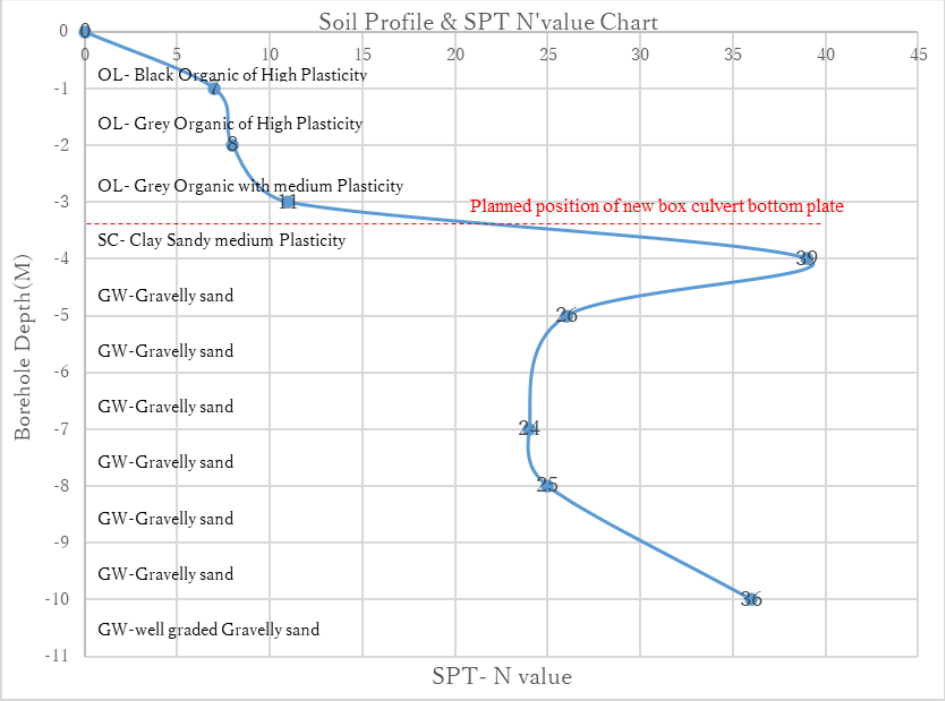


Figure 2.50 Boring Survey Result

(4) Box Culvert General Drawings

Figure 2.51 shows general drawings of the box culvert.

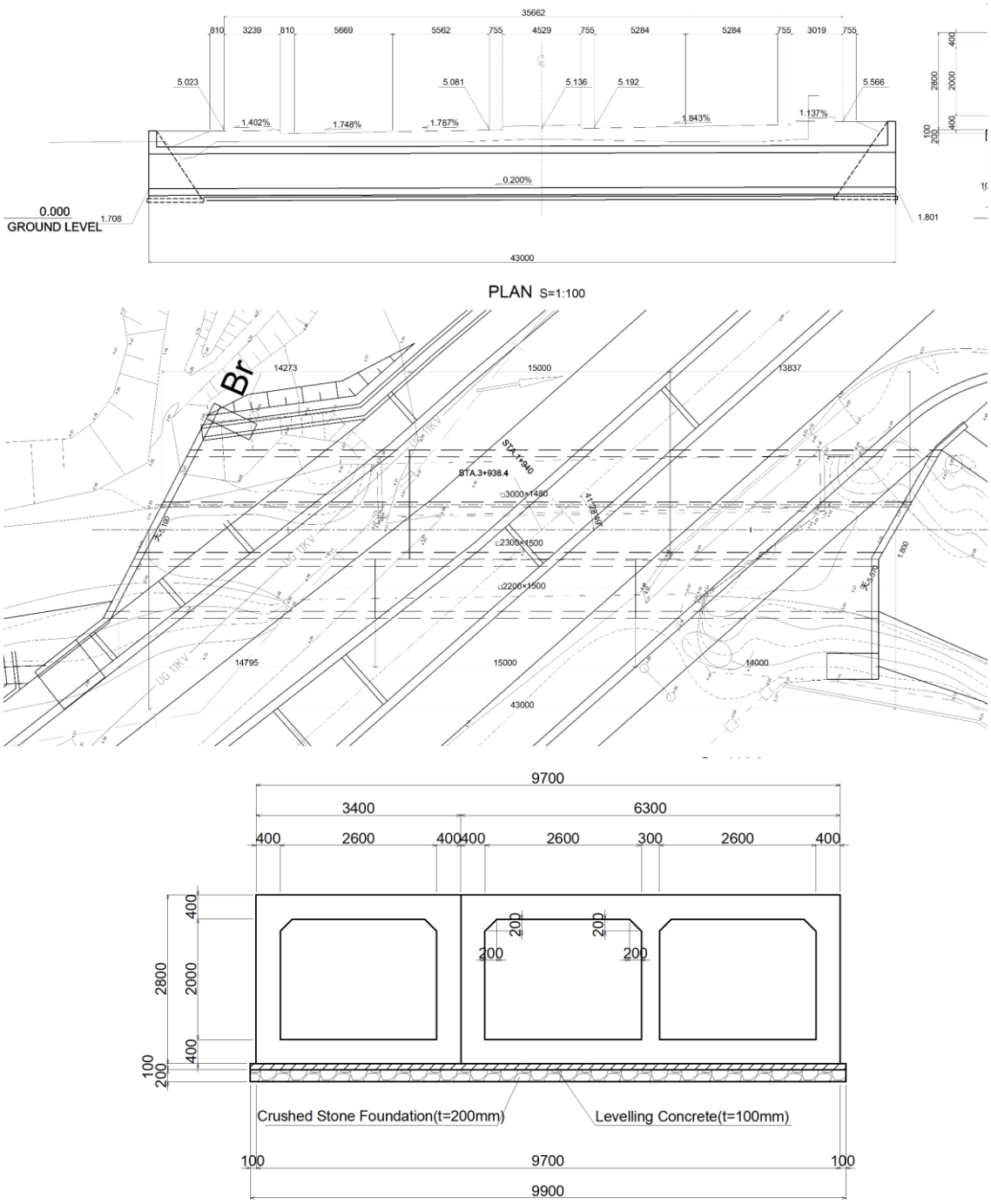


Figure 2.51 Box Culvert General Drawings

2.2.3.7.3 Retaining Wall

The right-hand side of the road beyond the Lungga Bridge from STA.4+540 to 4+680 is a cut slope apparently reinforced using vegetation. However, there are several locations where the slope has undergone small failures. The slope is composed of loose and dry soil and is about 8m high (refer to Figure 2.52). There are houses on the top of the slope.

Figure 2.52 Cut Section from STA.4+540 to 4+680

The Team judged that application of L-typed or T-typed retaining walls are not suitable here as these structures require excavation of the slope during construction which is deemed to adversely affect the natural slope and buildings. Therefore, masonry for a height up to 5m (Figure 2.53), retaining walls that does not require structural excavation during construction is provided for heights exceeding 5 m.

Where slope heights are less than 5m, gravity walls are provided.

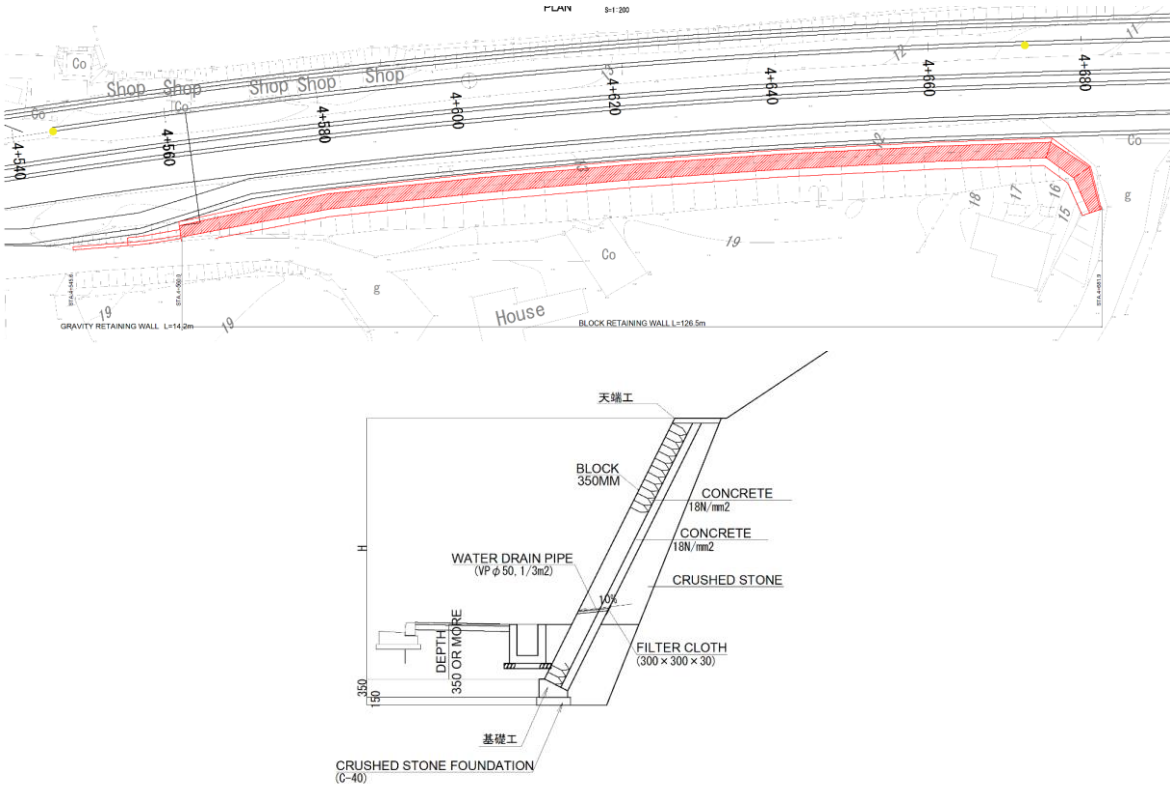


Figure 2.53 Masonry Retaining Wall General Drawing

2.2.3.7.4 Revetment

The cross-sectional area of the box culvert is planned to be larger by 40% than that of the existing one in order to accommodate discharge volume of a 10-year probability flood, as mentioned in 2.2.3.5 . Revetment structures such as retaining walls and gabions as illustrated in Figure 2.54, will be provided to protect riverbank and river bed.

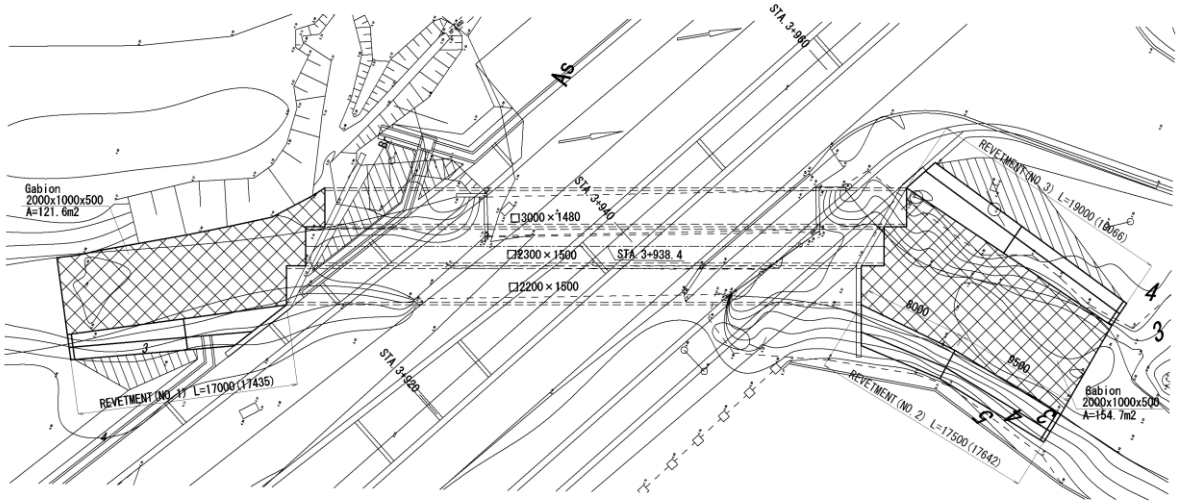


Figure 2.54 Revetment Structure Layout Plan

2.2.3.8 Traffic Safety Measures

2.2.3.8.1 Technical Approach

Traffic safety measures were planned by analyzing the data prepared or collected. The data were prepared and collected by;

- Conducting pedestrian count survey,
- Collecting traffic accident data,
- Conducting meetings with road users, and
- Preparing an accident black spot map (accident prone areas).

In addition, Virtual Reality (VR) technology was applied to verify the safety of the designed road.

2.2.3.8.2 Pedestrian Count Survey

A pedestrian count survey was carried out at seven locations shown in Figure 2.55 and its result is in Table 2.20.

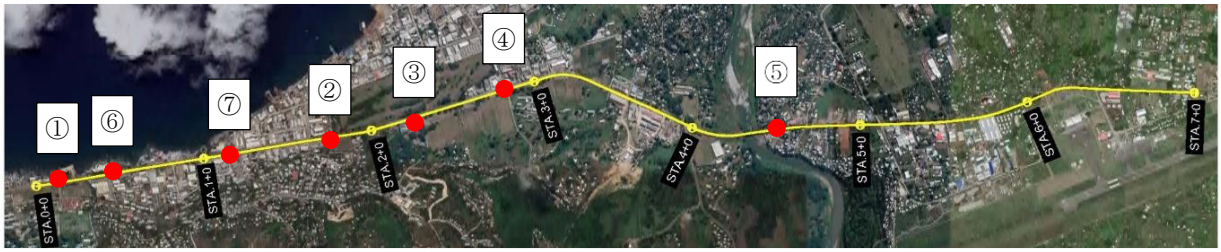


Figure 2.55 Location of Pedestrian Count Survey

Table 2.20 Pedestrian Count Survey Result

No	①	②	③	④	⑤	⑥	⑦
Location	SINU Kukum Campus	Ranadi Roundabout	SINU Panatina Campus	KGVI	Lungga Bus Terminal	Panatina Plaza	SINU Marine Campus
Peak Hour	AM 8:00	PM 5:00	AM 9:00	PM 5:00	AM 7:00	PM 3:00	PM 5:00
No of Pedestrian (person/hr.)	137.	462	170	633	263	67	194

2.2.3.8.3 Black Spot Map

The Team prepared a black spot map that indicates accident prone by hearing opinions and gathering comments from participants at the public consultation and the stakeholder meeting (Figure 2.56). It also conducted the pedestrian count survey.

Figure 2.56 Preparation of Black Spot Map

Furthermore, the Team obtained traffic accident records from the Solomon traffic police. Based on the data accumulated from these sources, the locations that need to be provided with safety measures were identified and the measures were studied and determined. Figure 2.57 to Figure 2.59 show the spots where traffic accidents frequently occur and the pedestrian count survey result, and Figure 2.60 to Figure 2.62 show the black spot map.

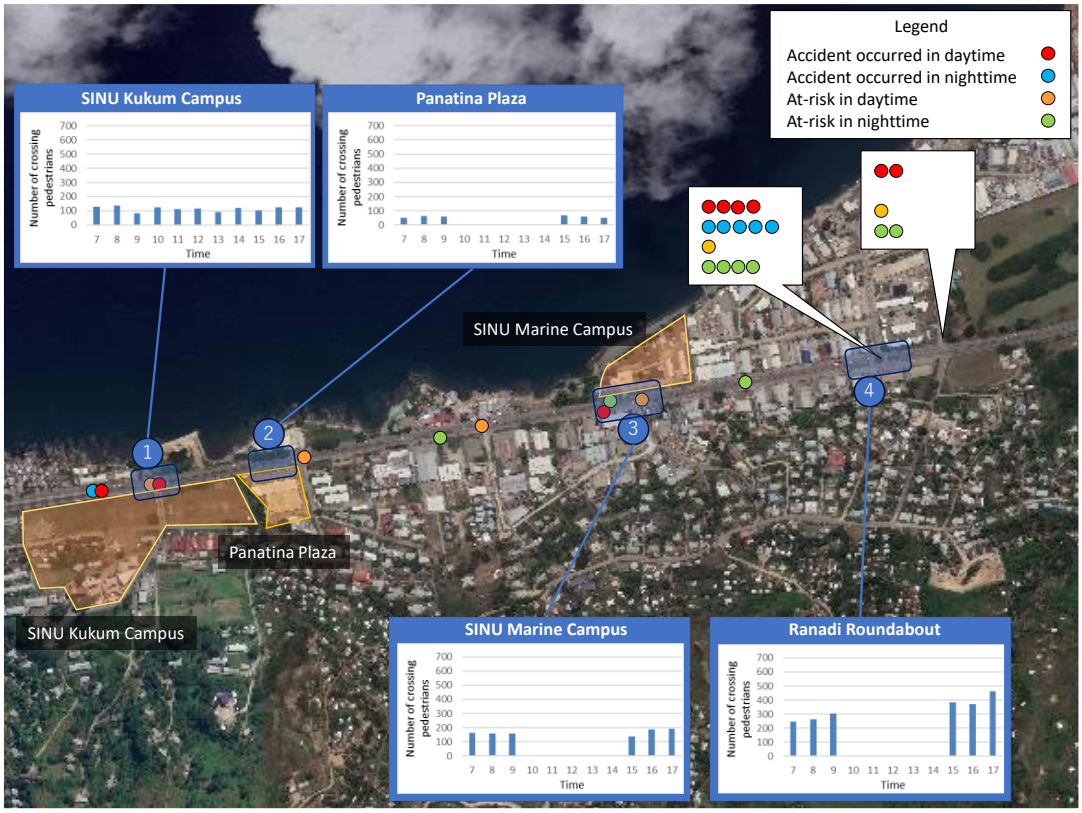


Figure 2.57 Traffic Accident Spot and Pedestrian Count Survey Result (1/3)

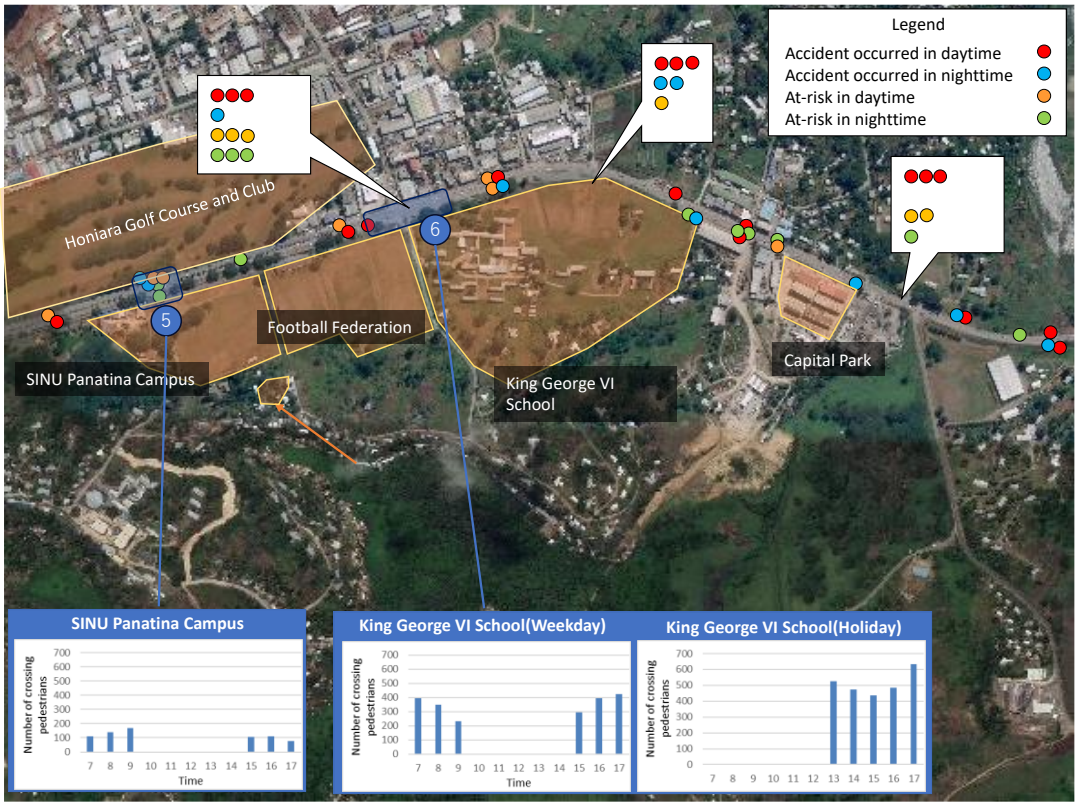


Figure 2.58 Traffic Accident Spot and Pedestrian Count Survey Result (2/3)

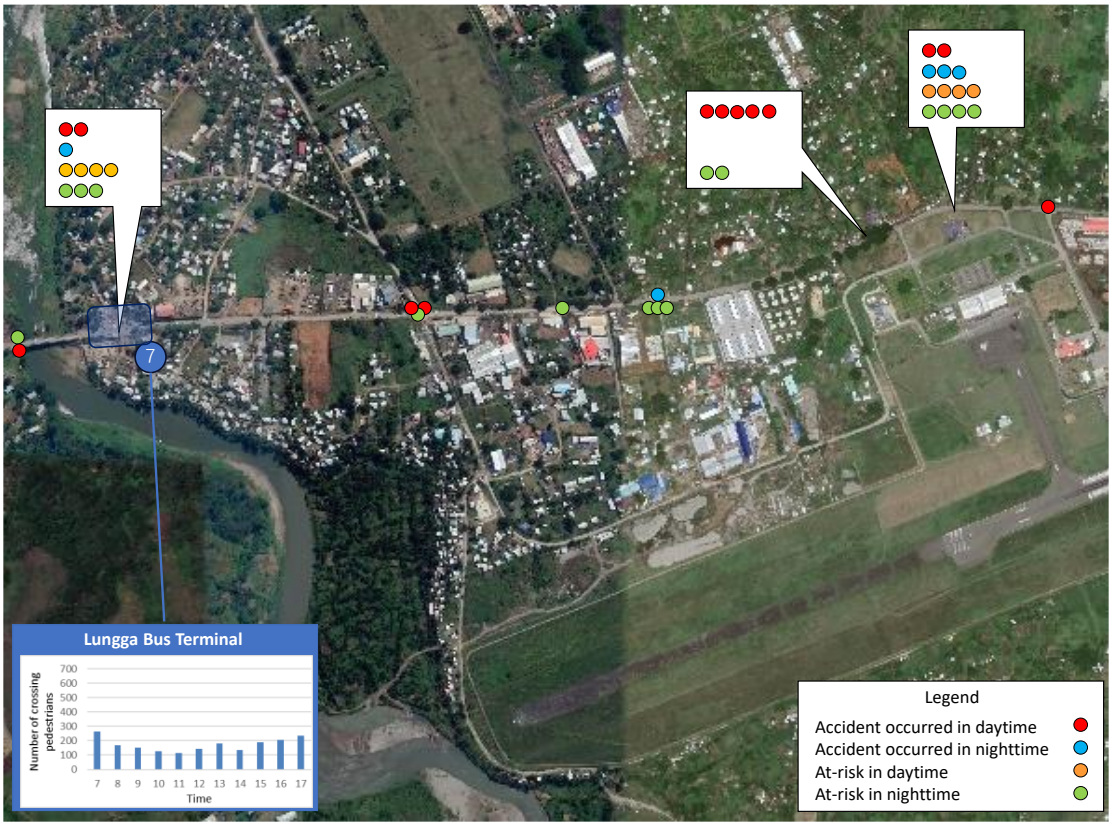


Figure 2.59 Traffic Accident Spot and Pedestrian Count Survey Result (3/3)

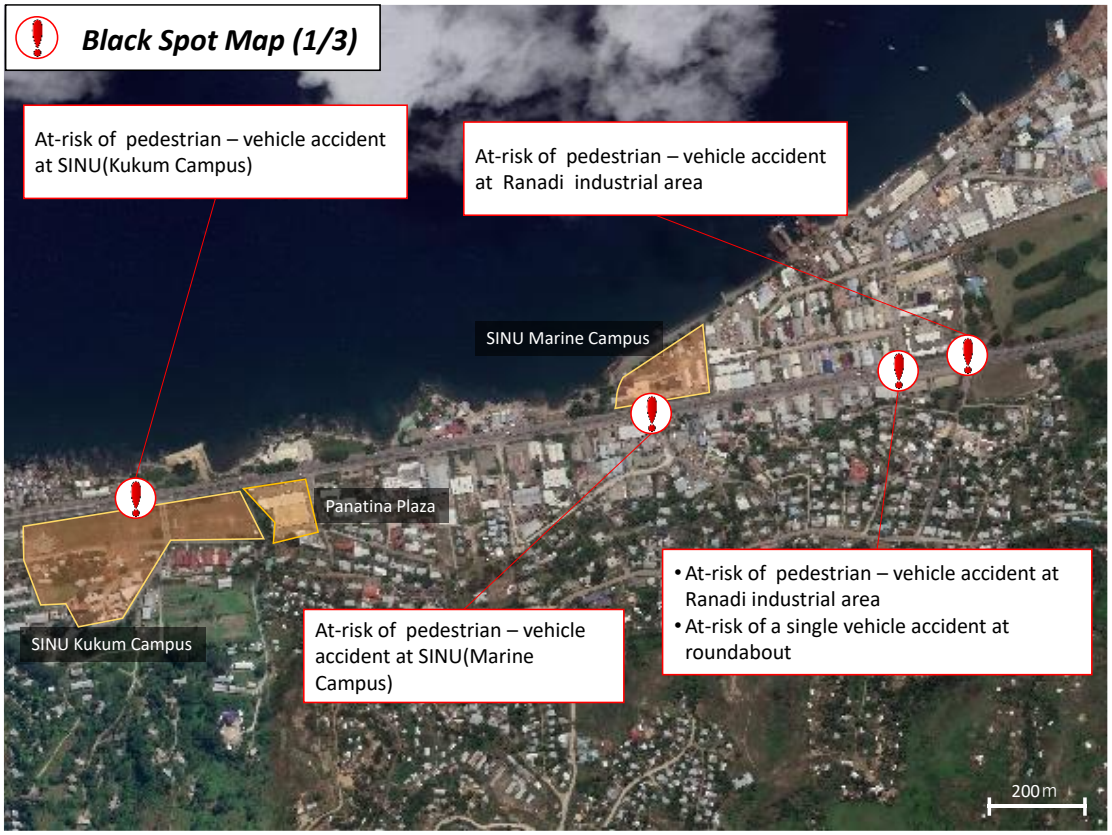


Figure 2.60 Black Spot Map (1/3)

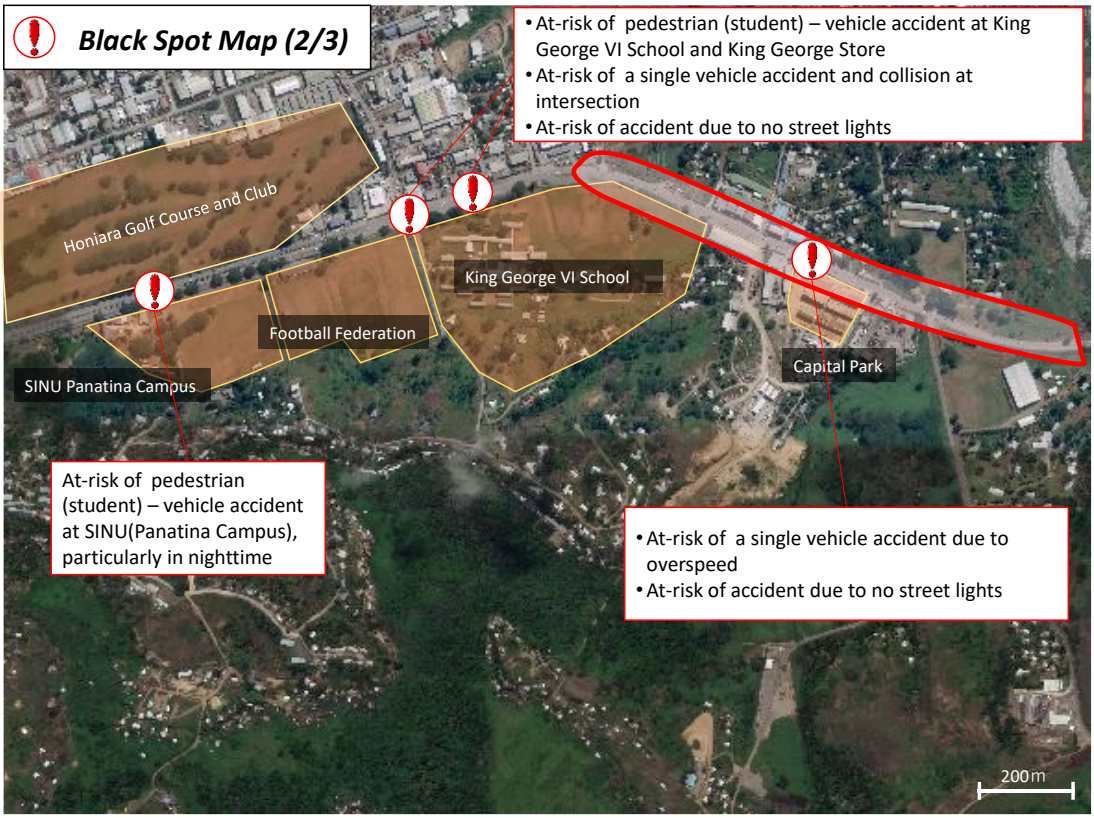


Figure 2.61 Black Spot Map (2/3)

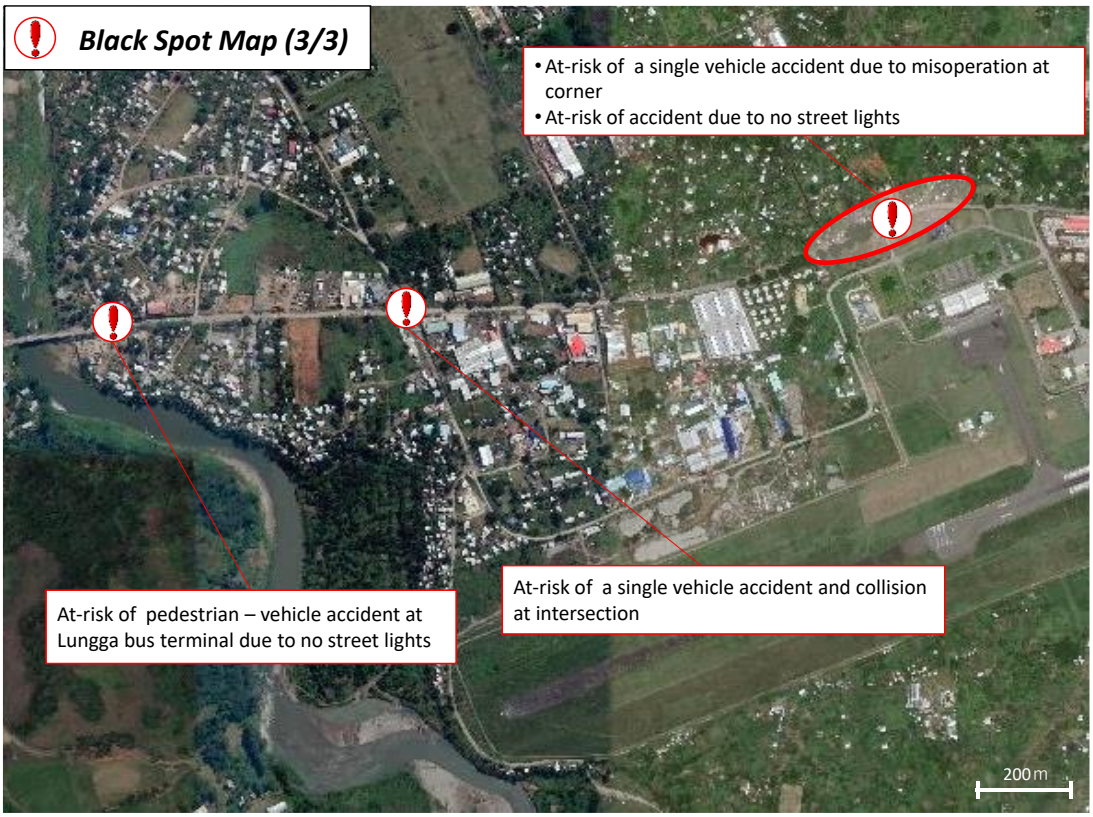


Figure 2.62 Black Spot Map (3/3)

2.2.3.8.4 Street light

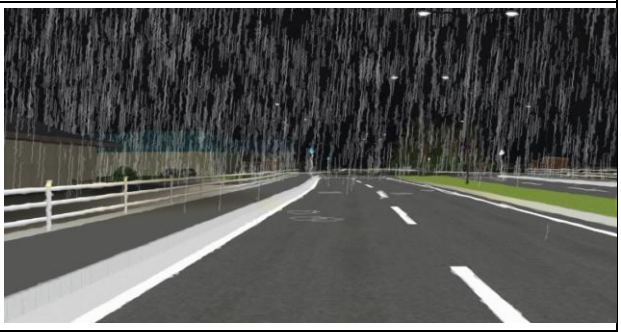
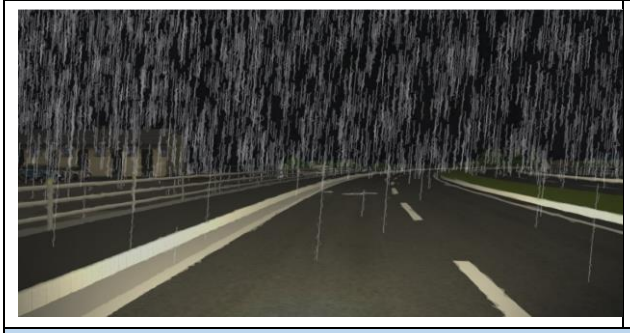
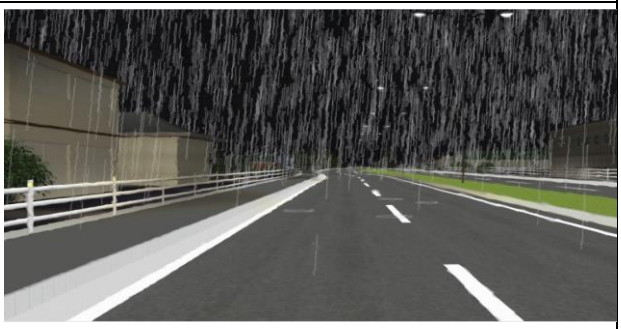
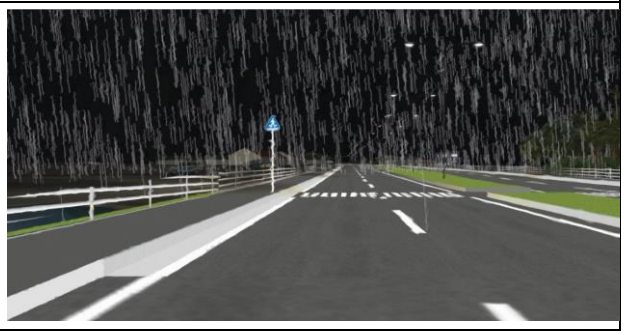
The street lights will be provided for entire stretch except the overlay section. The entire stretch of the project road will ultimately be widened to a 4-lane road in the future. Therefore, from safety perspective, it is desirable to provide street lights along the entire section including the 2-lane stretch. The street lights will use commercial power source.

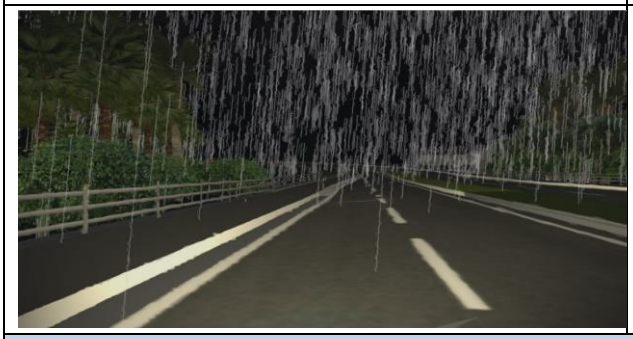
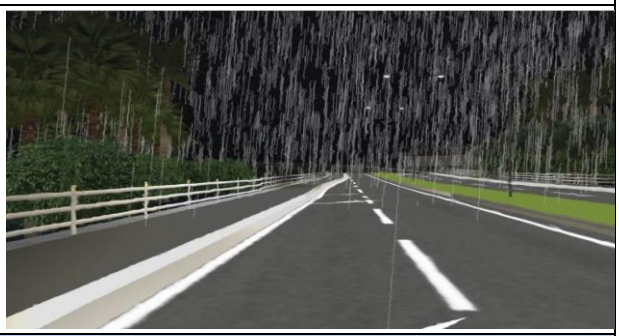
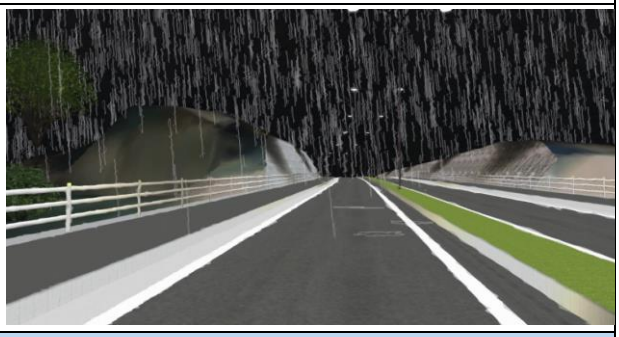
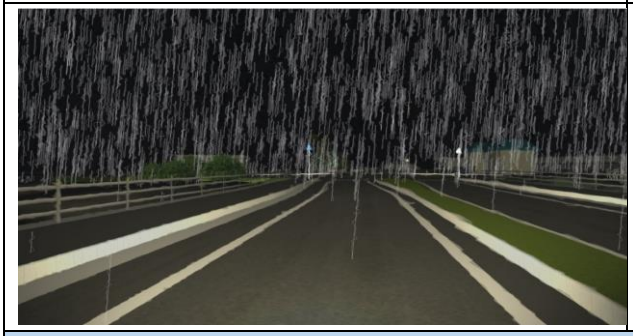
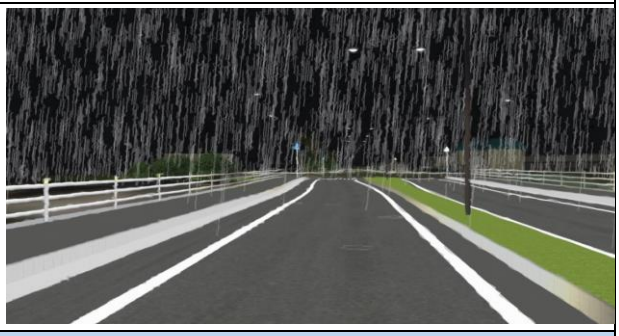
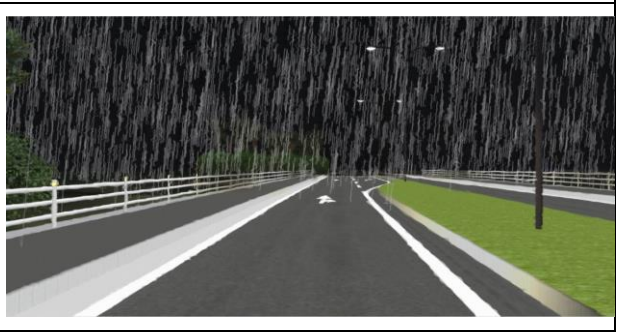
2.2.3.8.5 Introduction of Virtual Reality (VR) Technology

Virtual Reality (VR) technology is an emerging technology to simulate the real world on a computer and is being applied to many fields of industries like Civil and Architectural Engineering. In order to check the traffic safety of the project road after completion of the Project from all aspects by simulating a virtual driving for the worst road condition which apparently is during rainfall at nighttime, was checked by using the VR.

As a result, effectiveness of street lights was confirmed.

Table 2.21 Check Result by VR

(1) 2+740	
Without Street Light	**With** Street Light
	
(2) 3+100	
Without Street Light	**With** Street Light
	
(3) 3+520	
Without Street Light	**With** Street Light
	
(4) 3+960	
Without Street Light	**With** Street Light
	

(5) 3+960	
Without Street Light	**With** Street Light
	
(6) 4+720	
Without Street Light	**With** Street Light
	
(7) 5+40	
Without Street Light	**With** Street Light
	
(8) 6+340	
Without Street Light	**With** Street Light
	

2.2.3.8.6 Traffic Safety Measures to be Applied

Pedestrian crossings are provided at locations shown in Table 2.22. Plus, street lights except along the overlay section are provided for securing traffic safety for road users.

Table 2.22 Planned Location of Pedestrian Crossing

No.	Station No.
1	0+80
2	1+160
3	1+600, 1+680
4	2+300
5	2+800, 2+860
7	3+840
8	4＋520
9	5+80, 5+160

2.2.3.9 Road Ancillaries

2.2.3.9.1 Improvement of the Lungga Bus Terminal

As mentioned in 2.2.2.1.3 , the Lungga bus terminal is one of the traffic bottlenecks of the project road. Considering that this terminal will be required to be relocated when the 4-lane widening will be conducted in the future, for the time being, improvement shall be made as a tentative measure by providing a lane divider between in/out bound carriageways under one-way operation. This measure will contribute to mitigation of traffic congestion as this will prevent the road users from making U-turns at the bus terminal.

On the other hand, since there are 5 m margin in front of the shopping mall currently under construction located in the opposite side to the bus terminal, a tentative bus terminal at this side is be provided.

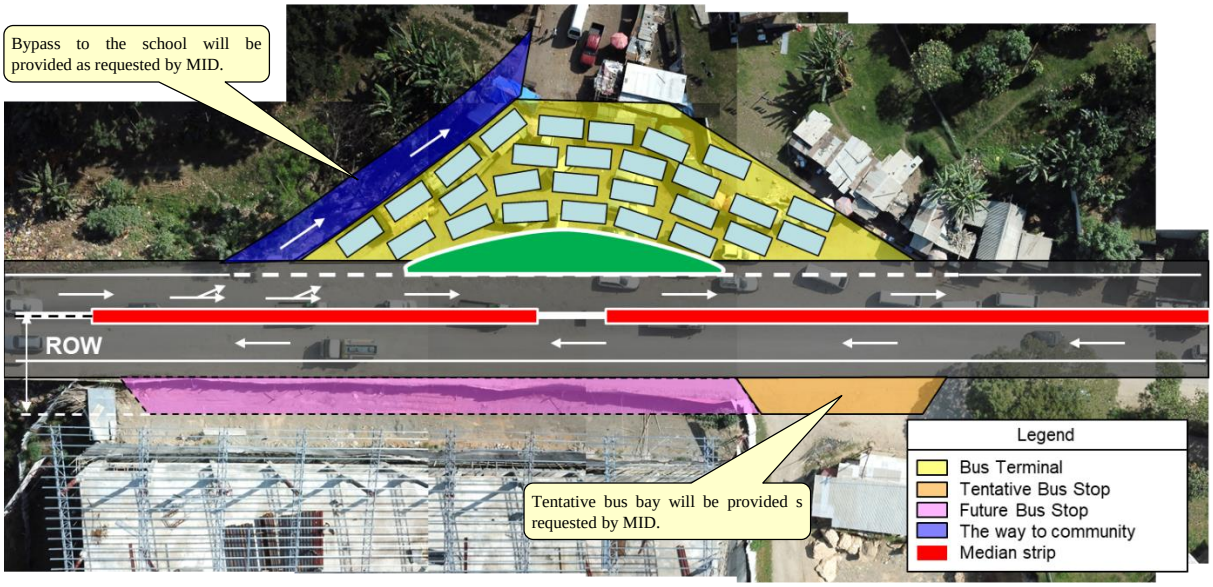


Figure 2.63 Design Policy on Improvement of the Bus Terminal

2.2.3.9.2 Handrails

Handrails will be provided in the section where embankment height is more than 3 m in order to prevent pedestrians from falling down from footpath.

2.2.3.9.3 Fences for Prevention of Pedestrian Crossing

Fences similar to those provided in Phase 1 are provided to control pedestrians and integrate road-crossing points. Pedestrians crossings are provided at;

- Approach sections of a roundabout, and
- STA.4+500 the Lungga Bus Terminal.

2.2.3.9.4 Traffic Signs

There are no authorized traffic signs in the Solomon Islands and British or Australian standards are currently being used.

Through the discussion with the MID, it was agreed to apply the Japanese standards for this Project.

Through the site survey, the Team observed that drivers in the Solomon Islands are well-mannered and strictly follow traffic rules, and judged that it is preferable to minimize application of types of traffic signs so that the road users are not confused by introduction of new types of traffic signs.

Figure 2.64 Waring Sign of Existence of Pedestrian Crossing

Therefore, provision of traffic signs is limited to simple warning signs generally used in Japan and shown in Figure 2.64, will be provided.

2.2.3.9.5 Bus Bay

A portion of road shoulder as illustrated in Figure 2.65 is utilized at the planned bus bays. .

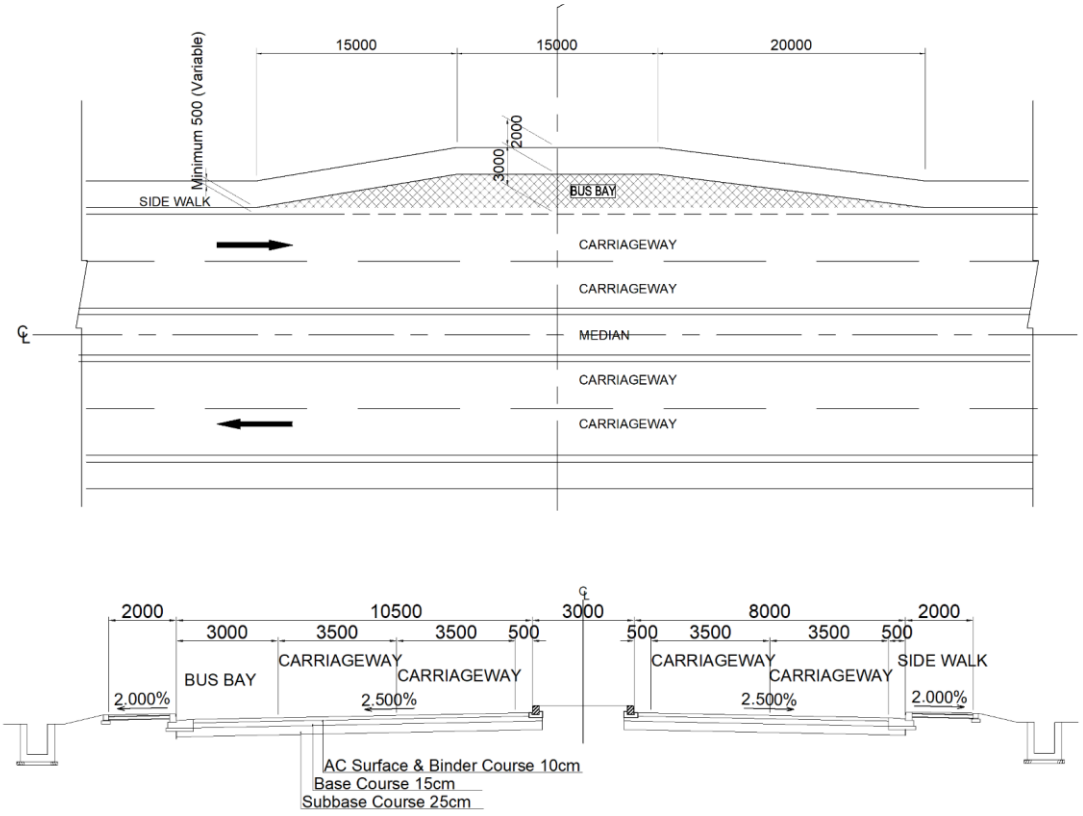


Figure 2.65 Bus Bay General Drawings

2.2.3.10 Inspection of the Lungga Bridge

2.2.3.10.1 Bridge Inspection Methodology

The Team inspected the existing condition of the Lungga Bridge in reference to the Japanese technical guidelines using a specific pole equipped with a camera, which is used for inspection of high unreachable places.

2.2.3.10.2 Inspection Result

Corrosion damages as shown in Figure 2.66 were observed on web plate and fringe. In addition, deformation by fire caused by burning of accumulated garbage around the abutment was observed. However, fatal damages immediately leading to collapse were not confirmed.

Figure 2.66 Corrosion Damages Observed

2.2.3.10.3 Policy on Bridge Repair

Rehabilitation or drastic improvement of the Lungga Bridge is not included in the Project as mentioned in 2.1.2 .

Although fatal damages were not confirmed, tentative repair by applying a steel sheet repair methodology that places a steel sheet on a defective surface portion of a structure with high strength bolts as illustrated in Figure 2.67 will be carried out.

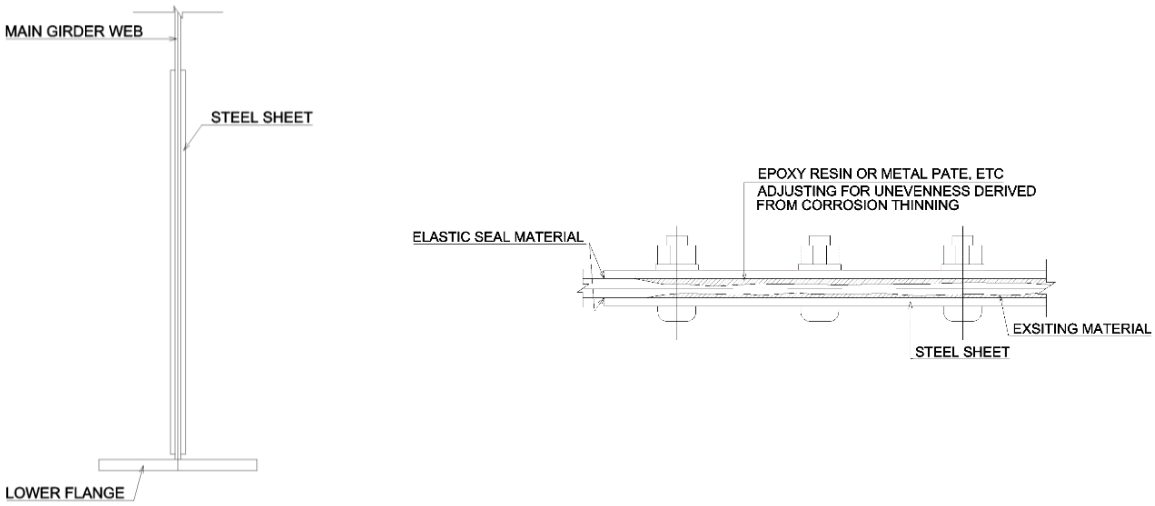


Figure 2.67 General Drawings of Steel Sheet Repair

2.2.3.10.4 Recommendation

The check on the strength of the existing Lungga Bridge indicates allowable weight a heavy vehicle is less than 33 tons. However, heavy vehicles over 40 tons are being observed at Honiara Port. Until permanent measures such as rehabilitation or reconstruction in the subsequent projects are made, applying traffic regulation for the heavy vehicles is required to avoid further deterioration of the bridge.

2.2.4 Outline Design Drawing

2.2.4.1 Table of Contents of Outline Design Drawings

The table of contents of outline design drawings shown in Table 2.23. The drawings are attached in Appendix 7.

Table 2.23 Table of Contents of Outline Design Drawings

No.	DRAWING TITLE
1	PROJECT LOCATION MAP
2	PLAN
3	PROFILE
4	TYPICAL CROSS SECTION
5	INTERSECTION PLAN
6	PAVEMENT
7	CROSS DRAINAGE BOX CULVERT
8	REVETMENT
9	RETAINING WALL
10	ROAD ANCILLARIES
10-1	DRAINAGE STRUCTURE GENERAL DRAWINGS
10-2	U-TURN LANE GENERAL DRAWINGS
10-3	BUS BAY AND ACCESS ROAD GENERAL DRAWINGS
10-4	LAYOUT PLAN OF TYPICAL TRAFFIC SIGNS
10-5	TYPICAL TRAFFIC SIGNS GENERAL DRAWINGS
10-6	LAYOUT PLAN OF ROAD MARKINGS
10-7	ROAD MARKINGS GENERAL DRAWINGS
10-8	HANDRAILS GENERAL DRAWINGS
11	STREET LIGHT
11-1	LAYOUT PLAN OF STREET LIGHTS
11-2	STREET LIGHT GENERAL DRAWINGS
12	LUNGGA BRIDGE REPAIR GENERAL DRAWING

2.2.4.2 Items to be Considered in the D/D Stage or later

(1) Street Light in the Overlay Section

At the Discussion on Outline Design (DOD), the MID requested the Team to repair or replace the street lights which is broken or not functional in the overlay section. This request will be discussed with MID in the D/D stage or later whether it will be included in the project.

(2) Traffic Signs

Just the warning sign which gives the drivers attention of the pedestrian crossing is planned in the current design. However, the MID requested the Team at the discussion on DOD to install the other type of the traffic signs, such as regulatory signs and guide signs. This request will be discussed with the MID in the D/D stage or later whether it will be included in the Project.

(3) Protection of the Street Lights in the Two-Lane Section

The MID requested to add a preventive measure for traffic collisions with the street light poles in the two-lane section. This request will be reflected in the D/D.

2.2.5 Implementation/Procurement Plan

2.2.5.1 Implementation/Procurement Policy

2.2.5.1.1 Procurement of Laborer

Highly skilled workers are hard to find in the Solomon Islands, although general workers can be readily hired.

According to interviews with Japanese companies, the local workers were either persistently trained by its engineers or are hired from third countries for use in their projects. Currently, several construction projects requiring skilled workers, such as the Pacific Games related projects, airport construction and road/dam projects are being carried out by other donors. Therefore, it is necessary to consider measures to secure enough skilled workers for the smooth implementation of the project.

2.2.5.1.2 Labor Law (Confirm Requirements, Labor codes, General labor and Employment acts 1996 edition)

Working conditions are stipulated in the Laborer Act of the Solomon Islands. The working conditions related to the Project are as follows.

- Working hours per day: 9 hours
- Working hours per week: 45 hours
- Overtime work on weekdays: extra payment of 50% of basic wage
- Work on holiday: extra payment of 100% of basic wage
- Work on public holidays: extra payment of 200% of basic wage
- Paid holidays: A worker who has been employed for one year or more shall be given 15 days of paid holidays per year.
- Termination notice: one month before
- Severance pay:
    - A worker who has been employed for one year or more shall receive severance pay equal to wages of two (2) weeks.
    - A worker who has been employed for five (5) years or more shall receive severance pay equal to wages of ten (10) weeks.
    - A worker who has been employed for ten (10) years or more shall receive severance pay equal to wages for twenty (20) weeks.

2.2.5.1.3 Traffic Plan During Construction

General traffic on the existing roads is in service with 2 lanes or 4 lanes. This Project shall be conducted in consideration of maintaining this current traffic volume.

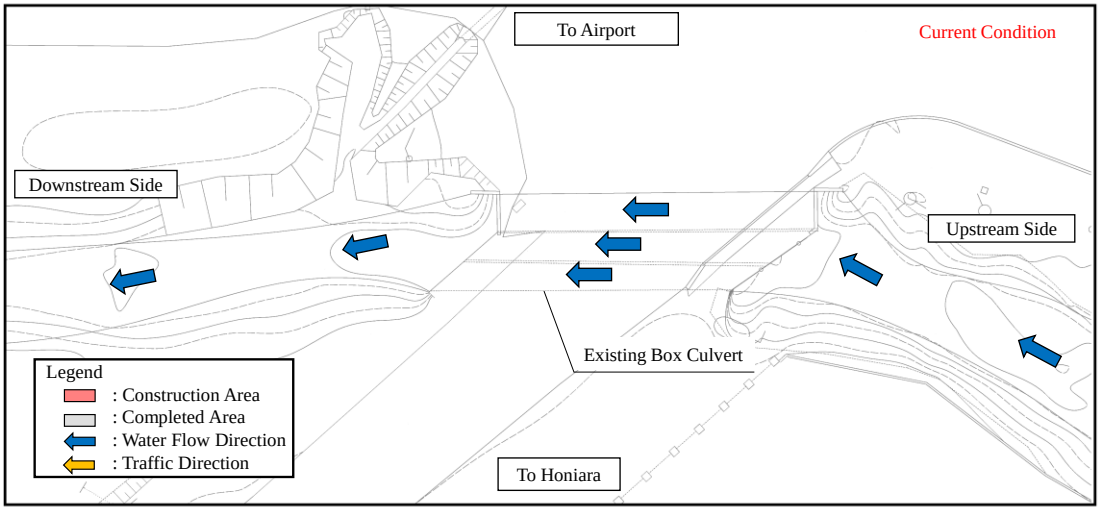
2.2.5.1.4 Construction of Box Culverts

Basically, the box culvert at the Burns Creek shall be constructed by cast-in-place and other box culverts shall be constructed by using precast concrete.

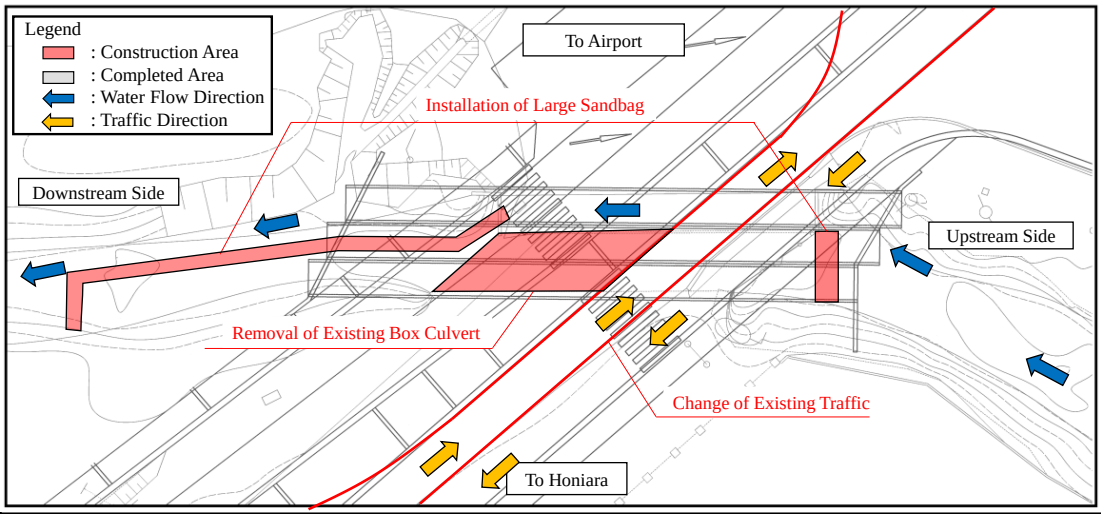
The existing box culvert at the Burns Creek will be utilized fully while the new culvert is under construction. Other cross drainage works shall be implemented appropriately considering the overall construction schedule of the project.

The construction procedure for the box culvert at the Burns Creek is shown in Figure 2.68.

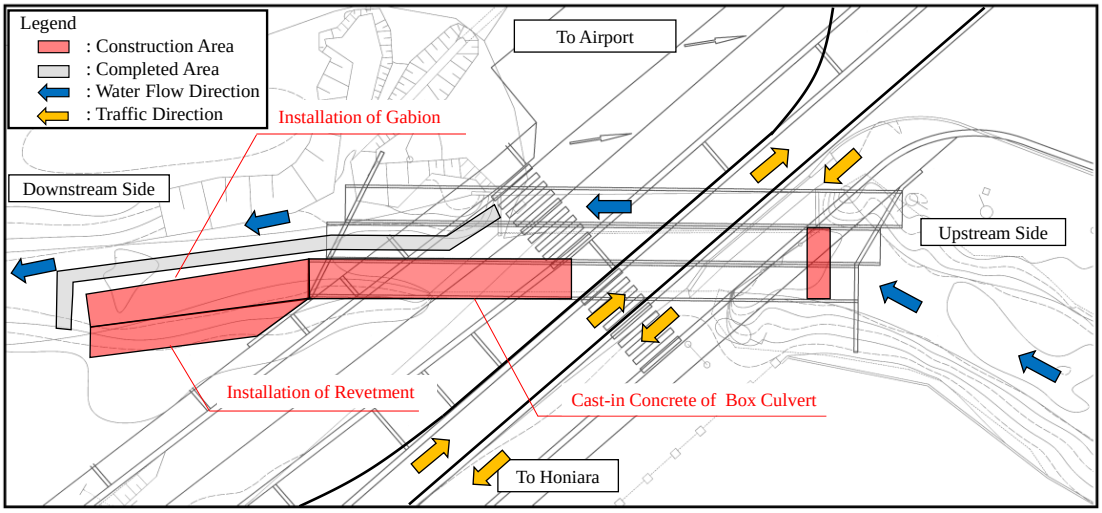
Step 0



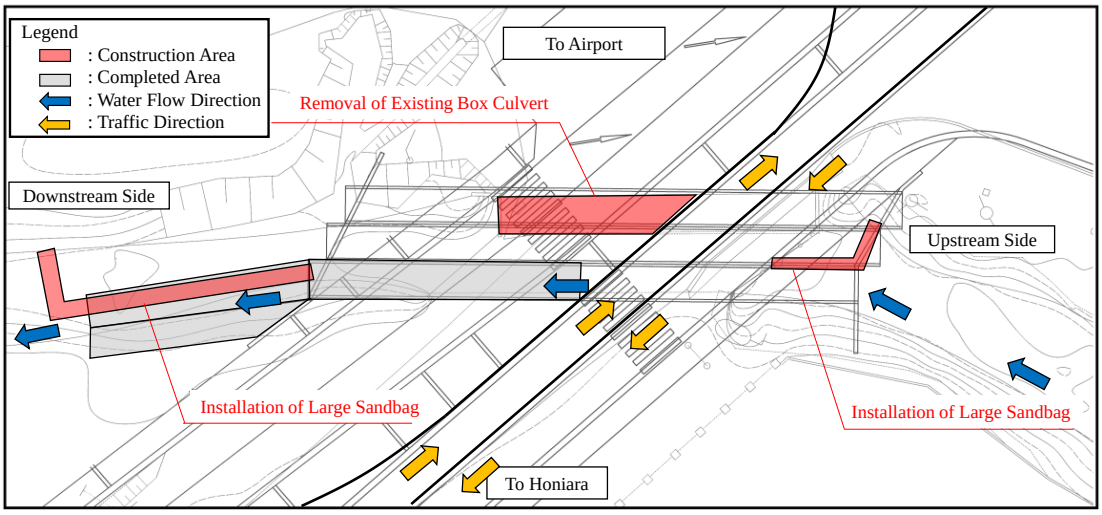
Step 1



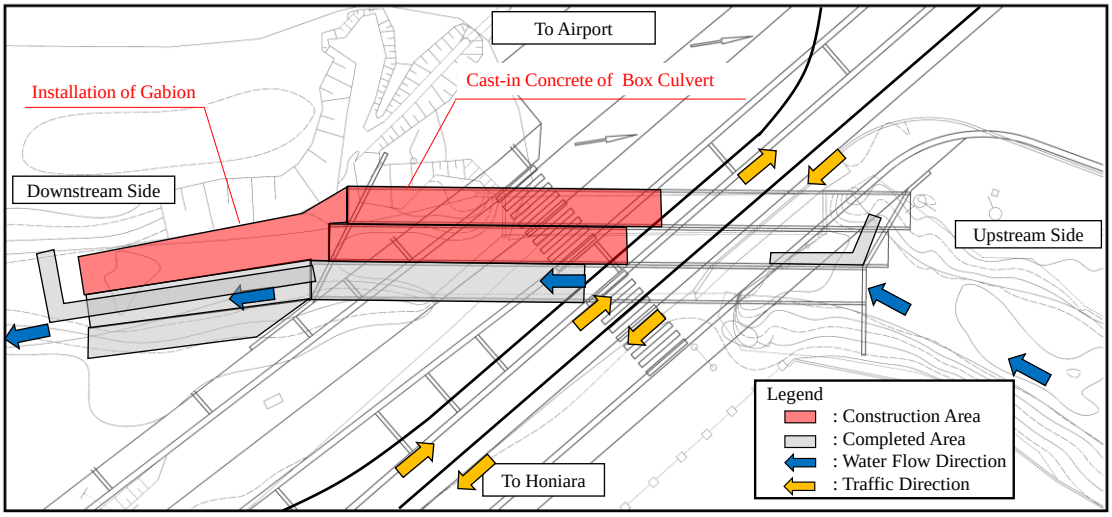
Step 2



Step 3



Step 4



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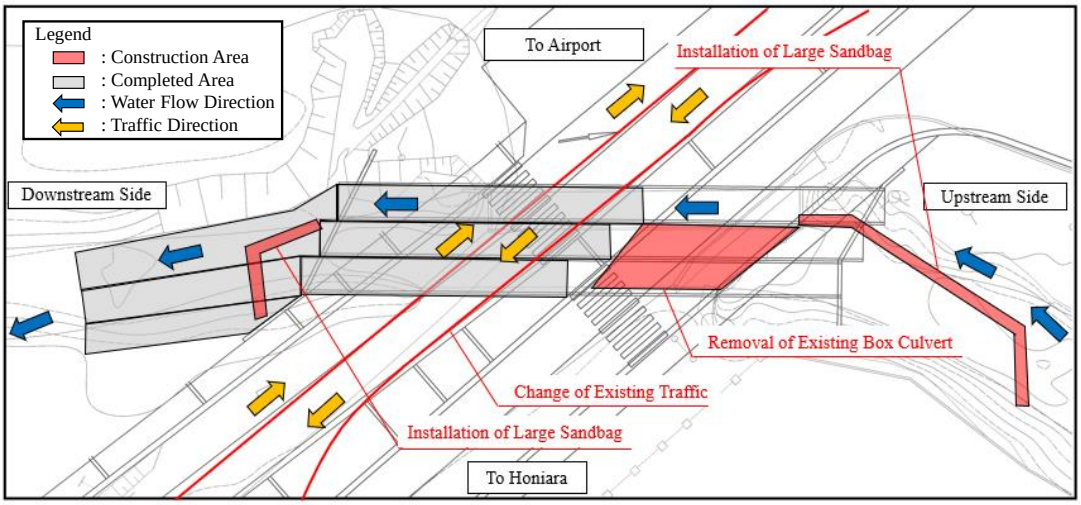

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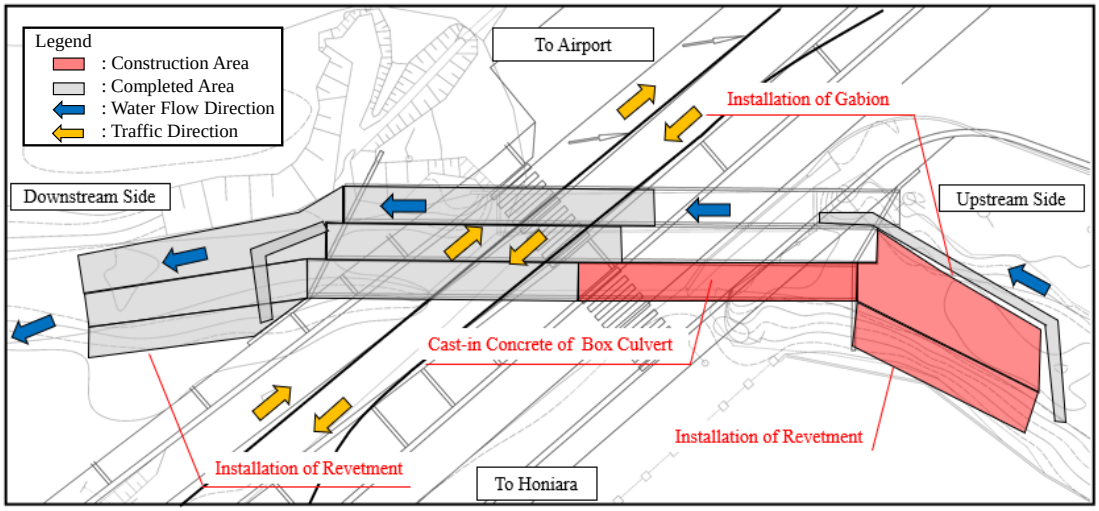

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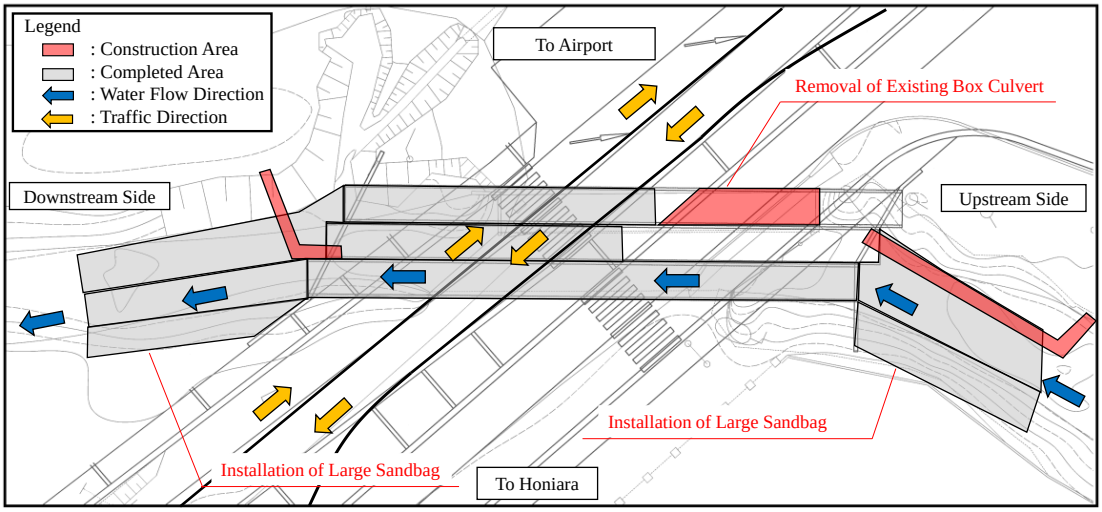

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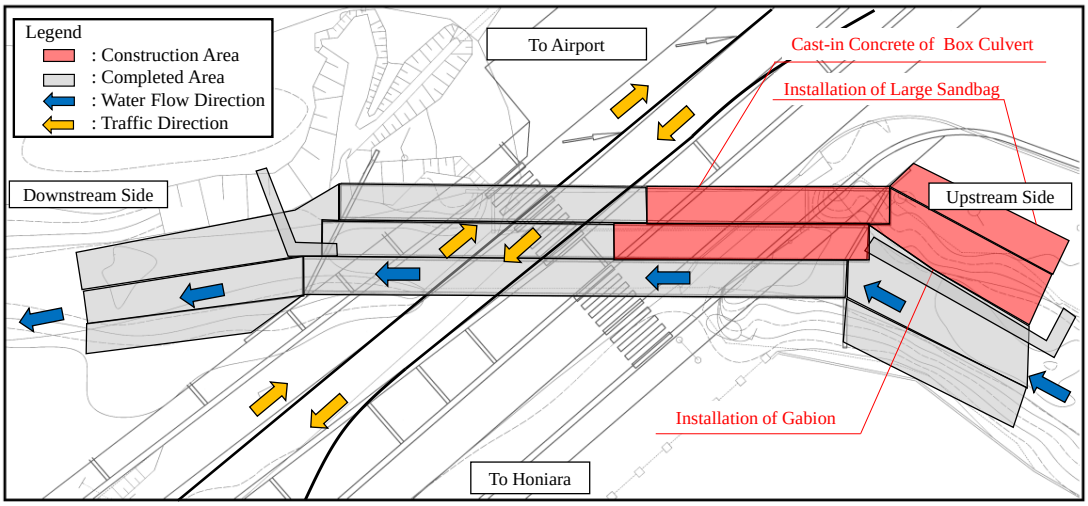

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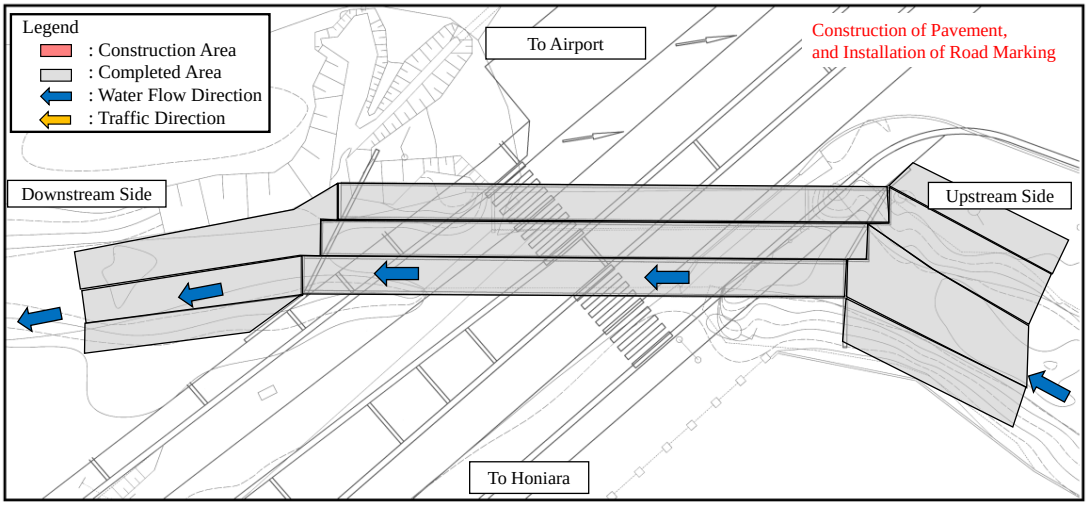


Figure 2.68 Construction Procedure for Box culvert at Burns Creek

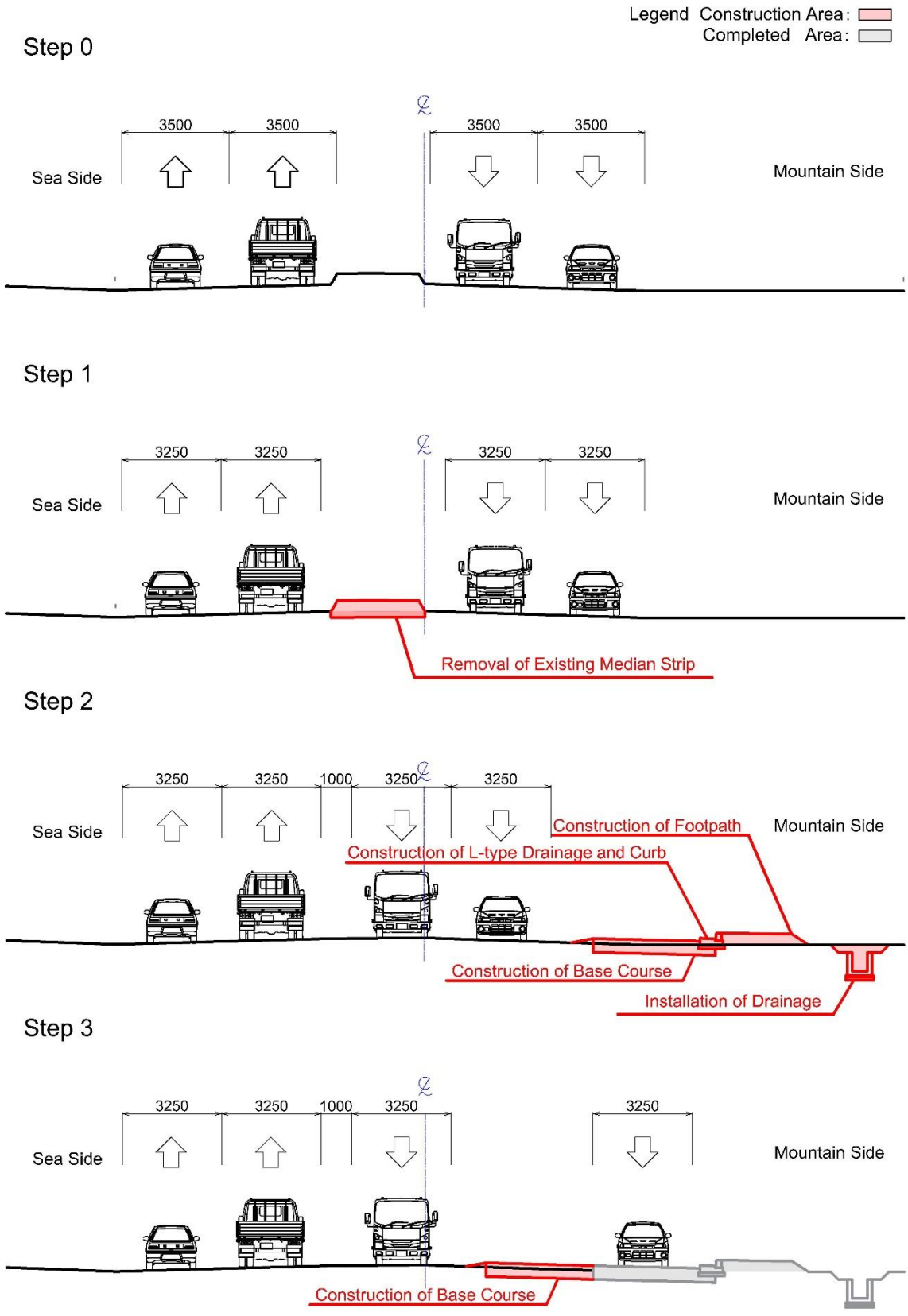
2.2.5.2 Considerations on Construction/Procurement

2.2.5.2.1 Completion before the Pacific Games

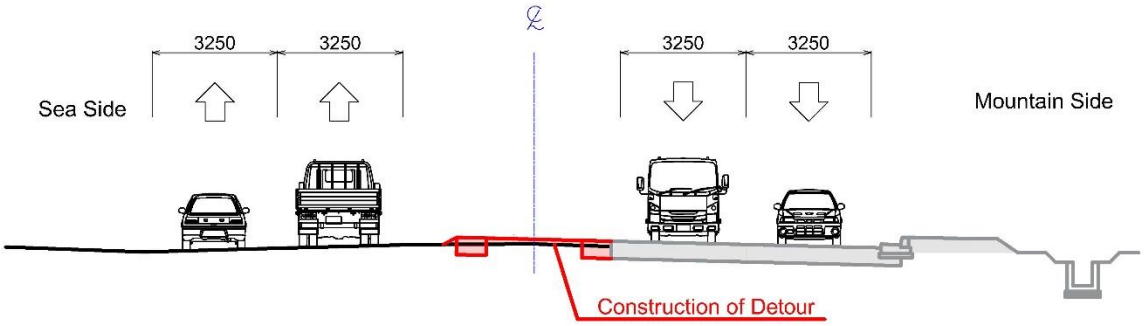
The construction plan has been formulated aiming to complete the entire construction by June 2023, before the Pacific Games. The construction period will be about 24 months.

2.2.5.2.2 Effects of Rainy Season

The construction plan is determined in consideration of rainy season and dry season because draining work and pavement work are affected by rainfall. The procedure of traffic detour is shown in Figure 2.69


Legend Construction Area:
Completed Area:
Step 0
3500
3500
3500
3500
Sea Side
Mountain Side
Step 1
3250
3250
3250
3250
Sea Side
Mountain Side
Removal of Existing Median Strip
Step 2
3250
3250
1000
3250
3250
Sea Side
Construction of Footpath
Mountain Side
Construction of L-type Drainage and Curb
Construction of Base Course
Installation of Drainage
Step 3
3250
3250
1000
3250
3250
Sea Side
Mountain Side
Construction of Base Course

Step 4



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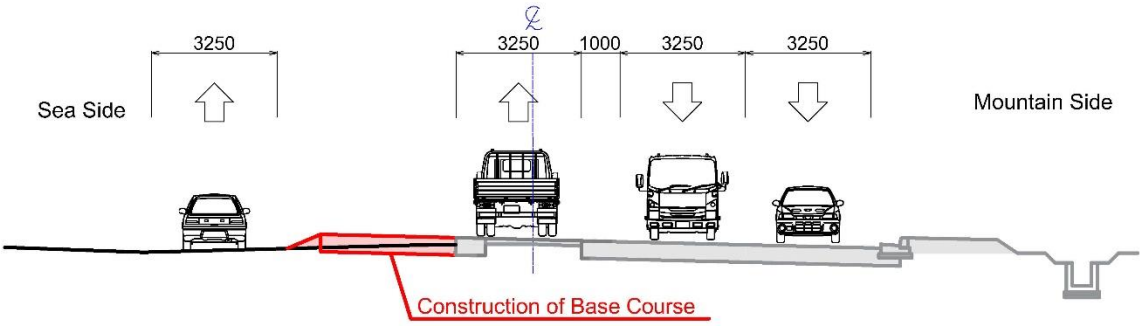

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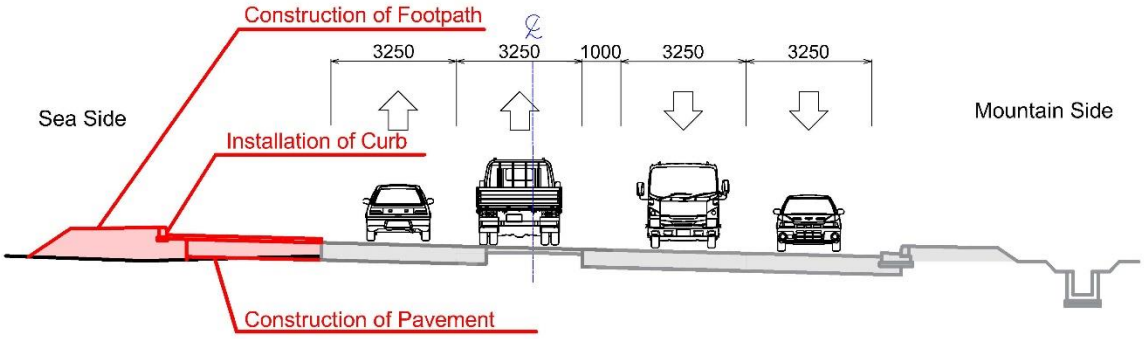

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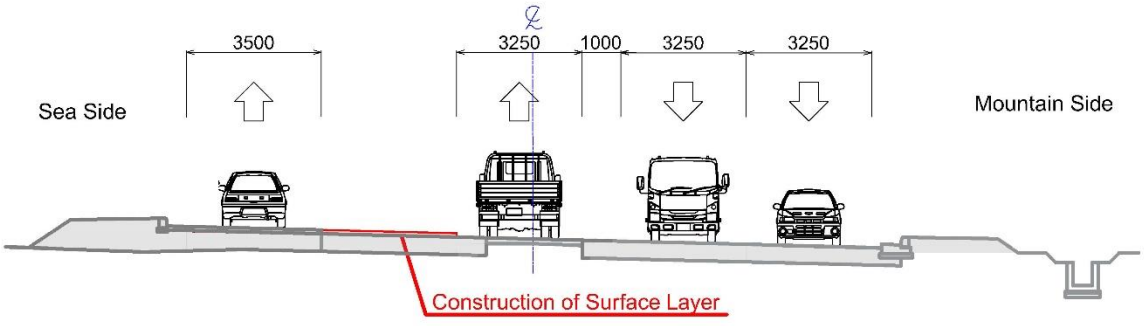


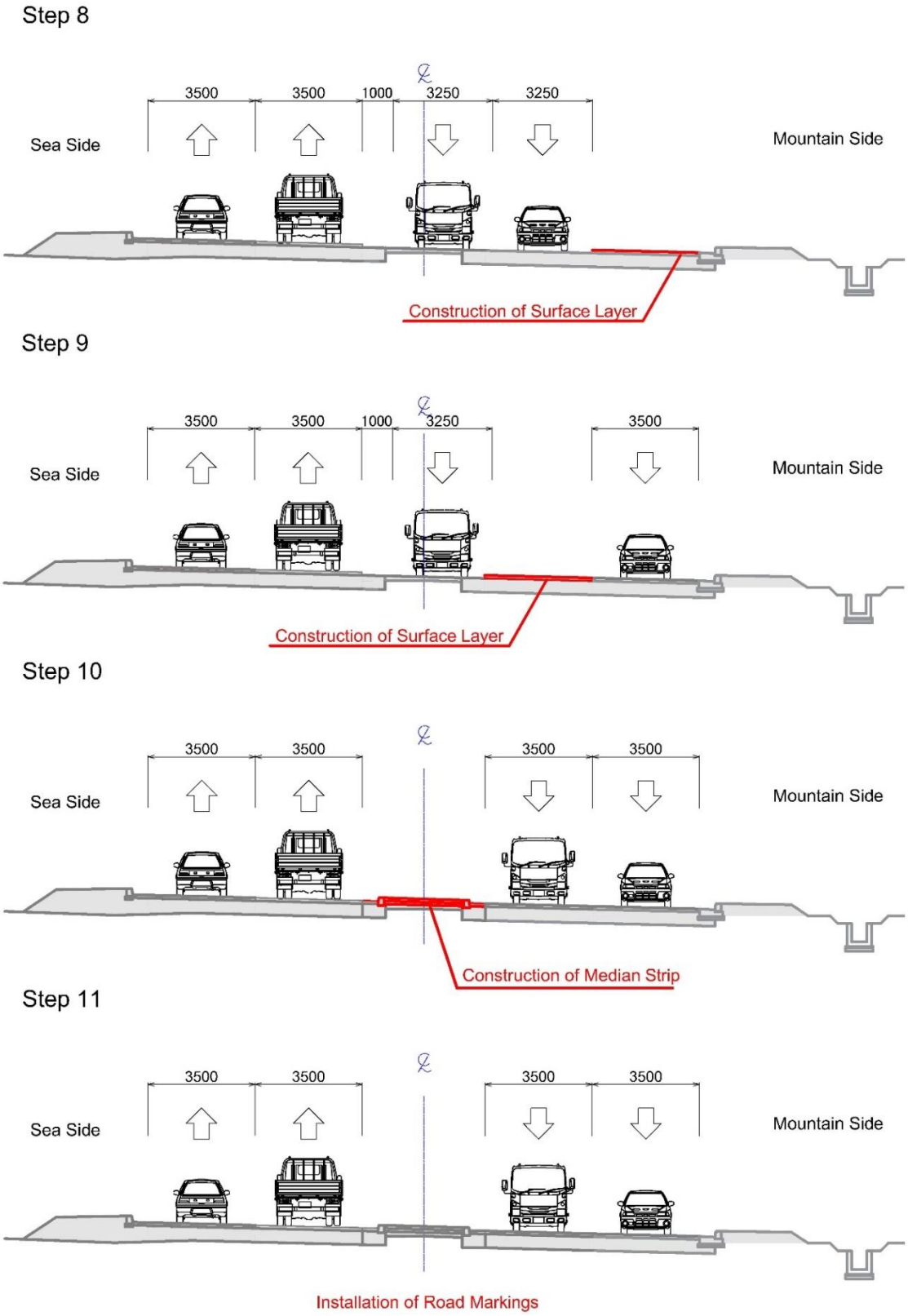


Figure 2.69 Procedure of Traffic Detour

2.2.5.3 Scope of Works

The responsibilities to be borne by Japan and the Solomon Islands are summarized in Table 2.24.

Table 2.24 Responsibility of Each Government

Items	Contents/Requirements	Responsible Country		Remarks
		Japan	Solomon Islands	
Land acquisition	Procurement before construction		○	―
Electric power for street lighting	Power supply		○	―
Procurement	Materials and equipment	○		Materials shall be procured from Japan other than aggregate, cement, and fuel. Machines shall be procured in Japan.
	Customs clearance	○	○	Mainly performed by Japan side
Land provision	Land acquisition necessary for construction		○	Project office, Accommodation, Construction yard
	Other than above	○		―
Removal/Relocation of utilities	Relocation of obstruction		○	Water pipe, electric cable, and sign board
Main construction	Road, box culvert, retaining wall, subsidiary facility works	○		Pavement, draining, road light, safety fence, pedestrian bridge

2.2.5.4 Consultant Supervision/Procurement

Basically, the Japanese Consultant will enter into an agreement with SIG to request their support for the bidding activities and the construction supervision.

2.2.5.4.1 Detailed Design

The major works to be carried out by the detailed design consultant are as follows:

- Undertake consultations with concerned authorities of the Solomon Islands and conduct field surveys.
- Detail design and drawing preparation
- Additional boring survey at the planned box culvert in the Burns Creek
- Project cost estimate

The duration to carry out the detailed design work is approximately one (1) month.

2.2.5.4.2 Bidding Activities

The major tasks to be undertaken between the time to inviting contractors to bid and the time for signing of contract for construction includes:

- Preparation of bid documents (in parallel with the detailed design).

- Bid announcement
- Pre-qualification of bidders
- Bidding
- Evaluation of bid document
- Preparation of Contract Agreement

The duration of the bid-related activities is approximately 4 months.

2.2.5.4.3 Construction Supervision

The consultant will supervise the Contractor's planning and implementation of the construction contract. The major tasks under this stage include:

- Verification/Approval of related surveys and quantities
- Review/Approval construction plans
- Quality Control
- Process Control
- Work output Control
- Safety Management
- Turnover Inspection and Acceptance

The duration of construction supervision is approximately 24 months.

The construction supervision team shall consist of six members: one resident/chief engineer (Japanese), two site engineers (Japanese in charge of pavement and repair of bridge), two site engineers (Local) and one utility personnel (Local). The construction supervision engineer is responsible for support of commencement construction, completion inspection and quality control meetings of and shall dispatch an engineer to the defect inspection.

Since traffic zones for general vehicles and for pedestrians will be switched frequently during the construction, the consultant shall assign a safety manager of the contractor to prevent accidents from occurring.

2.2.5.5 Quality Control Plan

The tasks to be carried out for the quality control in the construction period are as follows:

- Concrete works
- Reinforcing Bars and Formworks
- Earthwork
- Pavement Works

Based on above, main items of the quality control for concrete and earthwork/pavement is listed in Table 2.25 and Table 2.26.

Table 2.25 Quality Control Plan of Concrete Works

Item	Test item	Test method	Test frequency
Cement	Cement property/Physical test	AASHTO M85	Once before trial mix and once every 500 m3 batch of concrete; or once during production of cement (Mill sheet)
		JIS R 5201	Once before commencement works, and once every month during construction
Aggregate	Property/Physical test	AASHTO M6	Once before trial mix and once every 500 m3 batch of concrete; and every change of source/ quarry location (check supplier data)
		AASHTO M80	Once before trial mix and once every 500 m3 batch of concrete; and every change of source/ quarry location (check supplier data)
		JIS A 1109 JIS A 1110	Once before commencement of works, once every month during construction and change of source/ quarry location
	Sieve Analysis	AASHTO T27	Once a month and every change of source/ quarry location (check supplier data)
		JIS A 1102	Once before commencement of works, once every month during construction and change of source/ quarry location
	Alkali-silica Reactive Test (Mortar Method)	ASTM C1260	Once before trial mix and every change of source/quarry (check supplier data)
		Countermeasure of ASR(Minister's of Secretary Engineering Affairs Division No.112)	Once before commencement of works, once six month during construction and change of source/ quarry location
	Mineral Composition Test	ASTM C295	Once before trial mix and every change of source/quarry
	Abrasion test of aggregate	AASHTO T96	Once before trial mic and when necessary
		JIS A 1121	Once before commencement of works, once every year during construction and change of source/ quarry location
	Impunity test of fine aggregate	AASHTO T21	Once before trial mic and when necessary
		JIS A 1105	Once before commencement of works, once every year during construction and change of source/ quarry location
Water	Water Quality Test	AASHTO T26	Once before trial mic and when necessary
		JIS A 5308 attachment C	Once before commencement of works, once every year during construction and change of source/ quarry location
Admixture	Quality Test	ASTM C494	Once before trial mic and when necessary (Mill sheet)
		JIS A 6204	Once before commencement of works, once six month during construction
Concrete	Slump Test	AASHTO T119	Once every 75 m3 or per batch
		JIS A 1101	Once unloading and once every 50m3
	Air Content Test	AASHTO T121	Once every 75 m3 or per batch
		JIS A 1116 JIS A 1118 JIS A 1128	Once unloading and once every 50m3
	Compressive strength test	AASHTO T22	6 samples per batch or 6 samples for every 75 m3 of concrete (3 samples each for 7-days strength and 28-day strength)

Item	Test item	Test method	Test frequency
Concrete		JIS A 1108	Once unloading and once every 5 0m3 of concrete, 9 sample per once(3 samples each for 1-week strength, 4-week and 13-week strength)
	Regulation chloride	Improved durability of concrete	Once unloading and once if cast concrete PM
	Temperature	ASTM C1064	Once every 7 5m3 or per batch
		JIS A 1156	Once unloading and once every 50 m3

Table 2.26 Quality Control for Earthwork and Pavement Work

Item	Test item	Test Method	Test frequency
Embarkment	Density Test (Compaction)	AASHTO T191	Every 500 m2
		JIS A 1210	Once before commencement of works and change of soil
Basecourse	Material Test (Sieve Analysis)	AASHTO T27	Once before placing and once every 1,500 m3 of change in source/ quarry location.
		JIS A 1102	Once before commencement of works and change of materials
	Material Test (Modify CBR Test)	AASHTO T193	Once before placing and once every 1,500 m3 of change in source/ quarry location.
		Survey of pavement and method handbook	Once before commencement of works and change of materials
	Dry Density Test (Compaction)	AASHTO T180	Once before placing and twice every 1,500 m3 of change in source/ quarry location.
		JIS A 1210	Once before commencement of works and change of materials
	Field Density Test (Compaction)	AASHTO T191	Every 500 m2
		Survey of pavement and method handbook	1 lot per 10,000 m2, 1 lot per 10 pieces (more 3000m2)
Asphalt paving	Stability test of mix asphalt	ASTM D6926	3 places of each site
		JIS K 2207	Once before commencement of works and change of materials
	Asphalt Density Test	JHS 217	3 places of each site
		Survey of pavement and method handbook	1 lot per 10,000 m2, 1 lot per 10 pieces (more 300 0m2)
	Surface Smoothness Test	JHS 223	All road
Modified asphalt paving	Marshall stability test	ASTM D 1559-89	Design stage: Five samples a mix, three pieces =15 times Trial mix stage: Three samples a mix, three pieces = 9 times Paving stage: Once before placing
	Dynamic Stability Test	Measurement of Plastic Deformation by Wheel Tracking Machine	At trial Mix: Once per 1 mix At Construction: Once per paving asphalt of 1,000 ton
	Other Test	JIS	As may be necessary

2.2.5.6 Procurement Plan

2.2.5.6.1 Procurement of Major Construction Materials

Materials shall be procured from Japan other than crushed stone, cement, wood excluding form panel and fuel locally available. Reinforcing bars are available in the Solomon Islands but their quality and delivery condition are less reliable. Therefore, reinforcing bars shall be procured form Japan in the same way as the previous grant aid project.

(1) Procurement of Ready-mixed Concrete and Aggregate

All asphalt materials shall be procured from Japan other than aggregate.

(2) Procurement of Other Materials

Procurement suppliers of major materials is shown Table 2.27

Table 2.27 Procurement Area of Major Materials

Item		Procurement area			Procurement Reason	Procurement Routes
Item	Type	Local	Japan	Third country		
Reinforcing bars	D12-D32		○		Secure of quality and delivery date	
Cement	Portland	○				Honiara
Aggregate for concrete	0 to 30mm	○				Riverbed
Sub-basecourse	Crushed stone	○				Riverbed
Embarkment	Good soil	○				Riverbed
Admixture	Concrete		○		Difficult to procure locally	
Straight asphalt			○		Difficult to procure locally	
Admixture for modified asphalt concrete	Polymeric material Type-II		○		Difficult to procure locally	
Fuels	Gasoline/Light oil	○				Honiara
Equipment of highway light	Lighting and light pole	○				Honiara
Timber Formwork		○				Honiara
Panel form			○		Difficult to procure locally	

2.2.5.6.2 Procurement of Major Construction Equipment

In the Solomon Islands, there is no leasing machinery industry and local companies have construction equipment individually. In addition, the construction works of this project will commence after the construction works of other projects mentioned in 2.2.5.1.1 . Therefore, it is judged that procurement of machinery locally will be difficult and impractical. All machines shall therefore be procured from Japan, where there are official estimation standards for rental fee of machinery.

2.2.5.6.3 Other Procurement

(1) Temporary yard

The temporary yard is planned near Honiara International Airport. The average transport distance to the site is 2.9 km. The temporary yard/sites (government site and private site) have been agreed in the technical note.

(2) Quarry Site and Borrow Pit

Quarry site and borrow pit is planned at a site which is located farther upstream of the sampling site by the Lungga River used for the airport project and the average transport distance is 5.14 km. (Figure 2.70). The material cost for mining from the planned site will be borne by the MID. This have been agreed in the technical note.

Figure 2.70 Location of Temporary Yard, Quarry and Borrow Pit

(3) Construction Waste

Construction waste is carried to the Ranade waste disposing site (average transport distance L=2.71 km).

Figure 2.71 Location of Waste Disposal Site

2.2.5.7 Implementation Schedule

Figure 2.72 shows the sections of the project area, which is divided into nine sections. Figure 2.73 on the other hand shows the implementation period of the project, which is about 24 months.

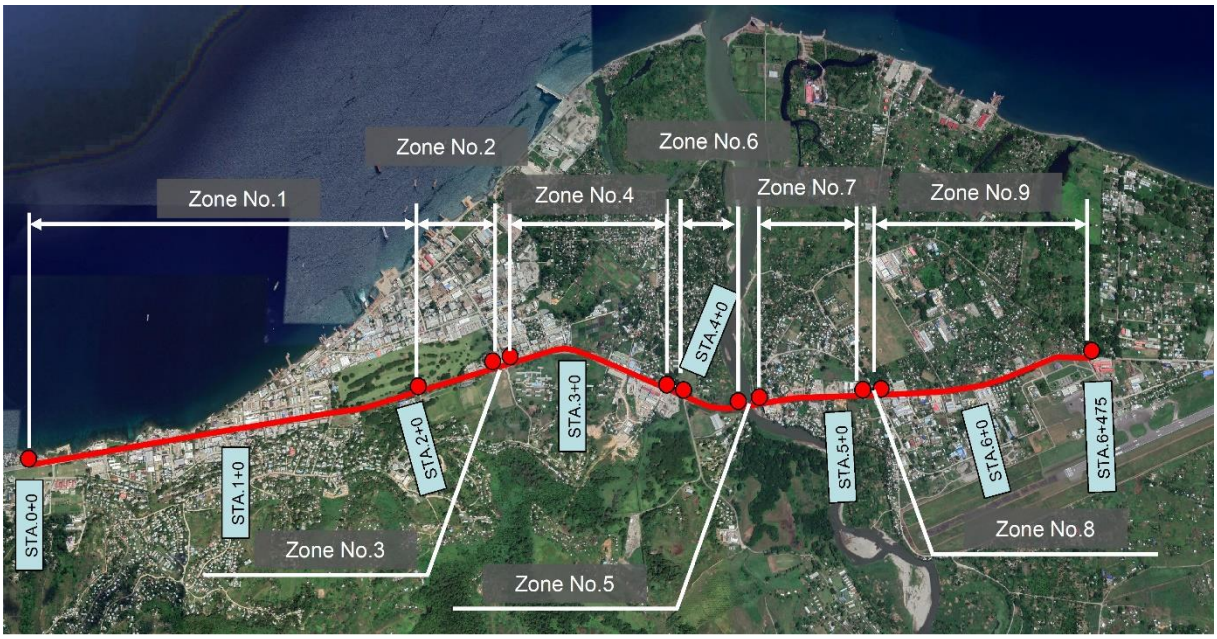


Figure 2.72 Constriction Sections

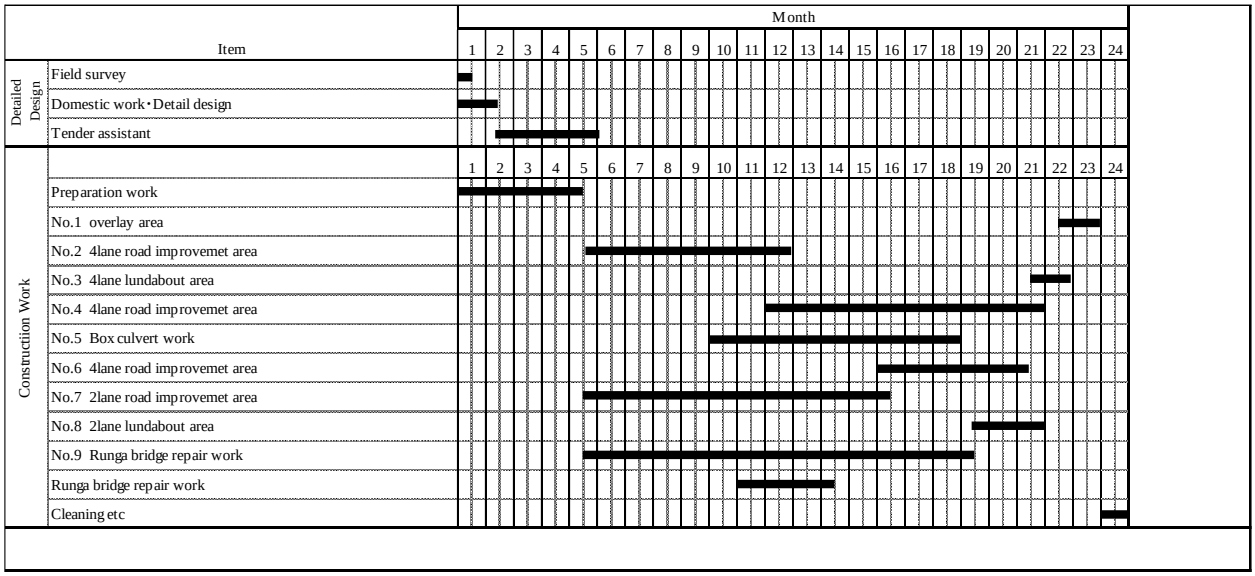


Figure 2.73 Implementation Schedule

2.3 Safety Measure Plan

The objective of this Project is improvement of one of the main roads, and it is required to conduct the construction with controlling movement of many vehicles and pedestrians. Therefore, prevention of traffic accidents is a top priority and shall be ensured by preparing a Safety plan. In particular, traffic controllers/guides will be assigned for both pedestrians and for vehicles.

The safety measure plan shall be in accordance with the Safety at Work Act (enacted 1996) as well as the Management of Safety for Construction Works in Japanese ODA Projects (JICA, September 2014).

2.4 Obligations of Recipient Country

2.4.1 General

Main obligations of the recipient country in the Project are shown in Table 2.28.

Table 2.28 Obligations of Recipient Country

No.	Item	Details
1	Land Acquisition, Resettlement	Compensation for land acquisition, resettlement (The survey is undergoing by subcontractor) and trees.
2	Borrow pit, Quarry site	Obtaining of permissions for borrow pits and quarry site.
3	Temporary yard	Rental of temporary yard and drawing of power and water.
4	Installation of power supply for street light	Installation of primary power source for street light. (The distribution board is by Recipient Country)
5	Permission for construction	Permission to construction of the project road and the start of the construction of the crossing channel.
6	Relocation of Utilities	Relocation of overhead power lines, utility poles, and underground utilities (water and communication cable). Avoidance of interference with future optical fiber cables.
7	Relocation of Existing obstacle	Removal of commercial signs. Tree transplantation, felling, branch removal.
8	Traffic regulation	Permission and support of traffic handling during the construction.
9	Environmental Permission	Obtaining of IEE (PER) approval and implementation of environmental monitoring（excluding environmental monitoring during the construction）
10	Drainage	Permission of road drain connection
11	Tax exemption	Import tax, value added tax, corporate tax on Japanese corporations, income tax on Japanese and third countries, residence permit and visa issuance for project members.
12	Removal of sediment and dust on the downstream of the drainage	At the end of drainage, some channels are divided due to illegal landfill on the downstream.

2.4.2 Special Note

2.4.2.1 Relocation of Ground Obstacles

The items shown in Table 2.29 should be relocated.

Table 2.29 Ground Obstacles

No.	Item	Owner/Responsibility
1	Lungga River and Burns Creek	Land owner
3	Cropland along the project road	Land owner
4	Roads/bridges connecting to the project road	Honiara city, Guadalcanal Province
5	Drainage Facilities (Box Culvert, drain)	Traffic Police
6	Street Light	MID
7	billboards	Private companies
8	Roadside plantings	MID
9	Utility pole/ground transformer	Solomon Power
10	Street Stall in the ROW	Owner

2.4.2.2 Relocation of Underground obstacle

The items shown in Table 2.30 should be relocated.

Table 2.30 Underground obstacles

No.	Item	Owner/Responsibility
1	Water supply	Solomon Water
2	Telephone/Internet	Telekom
3	Electricity	Solomon Power

2.4.2.3 Acquisition of PER (Public Environmental Report)

Approval of the Public Environmental Report (PER) is one of the requirements of G/A execution. The MID shall do the required for obtaining approval of the PER.

2.4.2.4 Acquisition of Permission of Quarry Sites and Borrow Pits

The Honiara International Airport Development Plan Project plans to collect aggregates from the riverbed on the left bank of the Lungga River. In this Project, the MID shall obtain permission to collect aggregate and soil from the landowner before the start of construction.

2.4.2.5 Acquisition of Permission of the Ranadi Disposal Site

In this survey, MOL and MID replied that the existing Ranadi disposal site could be used for a fee. Before the start of construction, the MID shall obtain a permission for the disposal site before the start of construction so as not to affect the construction.

2.4.2.6 Coordination with the Pacific Games Executive Committee

The MID shall appropriately discuss and coordinate with the National Hosting Authority (NHA), which is the executive committee of the Pacific Games, to ensure consistency with this project and to avoid adverse effect on this project.

2.4.2.7 Implementation of Unexploded Ordnance Exploration

Exploration and disposal of unexploded ordnance in the construction area of this project shall be conducted and completed before the commencement of construction.

2.4.2.8 Preparation of the Next Project for Improvement of the Temporary Section and Widening to 4 lanes at the east side of the Lungga Bridge

As mentioned above, the Project will develop the entire section (L=6.3 km) including the overlay section (2.3 km). The east side of the Lungga Bridge will be developed as a 2-lane road. Therefore, it is necessary to prepare for improvement of the temporary section and widening to four lanes in the future

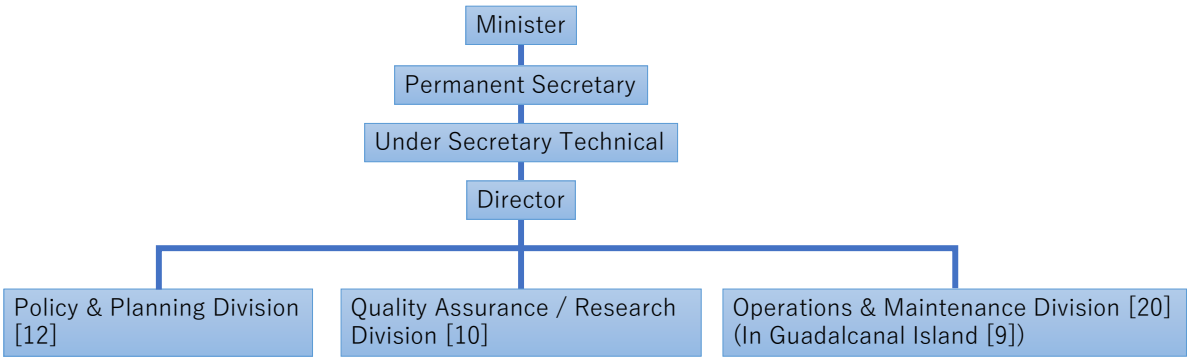
2.5 Project Operation Plan

2.5.1 Project Operation

2.5.1.1 Operation and Maintenance Flamework

2.5.1.1.1 Organizational Framework

Roads under MID's jurisdiction in the Solomon Islands are operated and maintained by the Operation & Maintenance Division of MID by outsourcing to the private company. The division consists of 20 staff members, of which 9 members oversee Guadalcanal Island. The organization chart of MID is shown in Figure 2.74.



[ ] shows No. of staff

Figure 2.74 Organization Chart of MID

2.5.1.1.2 Budgetary Allocation

Table 2.31 shows the MID budget for 2015- 2019. In 2018, expenditure of the MID exceeded its budget due to the construction works of the Phase 1, so SIG provided the MID with supplemental budget.

In the Project, expenses needed to fulfill responsibility of the MID would be additionally allocated by the SIG in the same way as during the Phase 1.

Table 2.31 Budgetary Allocation

(Unit: Million SBD)

	Item	2015	2016	2017	2018	2019	2020 (Plan)
Government of Solomon	Revenue	3721.4	3733.2	3533.8	3692.7	3643.2	3941.2
	Expenditure	2375.2	2524.9	2828.8	2899.4	3148.5	–
MID (for O&M)	Budget	242.7	288.9	350.1	78.2	85.5	87.9
	Expenditure	167.4	10.6	296.9	166.1	75.7	–

2.5.1.2 Implementation of Operation and Maintenance

An outsourced private company operates and maintains the road under the supervision of the MID. In Honiara city, there are four private companies which can maintain and repair roads and related facilities.

2.5.1.3 Contents of Maintenance

Maintenance services outsourced are:

- Repair of pavement;
- Repair of ancillary structures;
- Cleaning of road surface and gutters/ditches;
- Vegetation;
- Traffic signals and lighting; and
- Bridges.

2.5.2 Asset Management and Maintenance Plan

2.5.2.1 Asset Management

The project road plays an important role as a social infrastructure supporting socio-economic activities and community life in the Solomon Islands. They have critical functions such as storage space of water supply and sewerage systems, telecommunication lines and electricity supply and a disaster prevention space in the event of an earthquake or a tsunami, in addition to as a transportation system for vehicles and pedestrians.

Introducing of an asset management is recommended for such important route. An asset management will contribute to life cycle cost reduction of infrastructure when it is implemented appropriately. A detailed maintenance plan at a practical level is necessary to this end.

A specific asset management will be discussed with the MID during the D/D stage and then developed with the assistance of the Team.

2.5.2.2 Maintenance Plan

2.5.2.2.1 Policy

To ensure and sustain effectiveness of the Project, road and related facilities should be kept in good condition for smooth driving through maintenance works, and road durability should also be improved.

The maintenance policy will be required, particularly, to reduce flooding risk in the Burns Creek and to prevent sediment deposition on the road covering the road markings, which prominently occurred in the Phase 1.

To continuously secure safe and smooth traffic by implementing this Project, it is necessary to consider the following points for appropriate operation and maintenance:

- Grasping the road and facility conditions precisely by regular inspection and managing a system to deal with damages or abnormalities upon noticing them.
- Cleaning of roads and facilities, especially drainage facilities and their vicinity.
- Sufficiently implementing regular inspections, cleaning and repair work of facilities associated with safe traffic management.
- Securing budget needed to maintenance and management.

2.5.2.2.2 Necessity of Maintenance and Repair

The Solomon Islands has a high rainfall so it is predicted that cracks and puddles will occur caused by flooding or increase of groundwater level with age. Damages of roadbed are also presumed due to increase of traffic volume and vehicle size with respect to the economic growth of the country. Therefore, repair works should be implemented effectively in a timely manner to identify cause of damages and predict damage processes.

2.5.2.2.3 Policy of Maintenance and Repair

In maintenance and repair, it is verified in Japan that preventive maintenance on a regular basis can reduce life cycle cost more than corrective maintenance. In Solomon, preventive maintenance activities for road surfaces will be mainly conducted for the time being. The proposed policy is shown below.

1) Implementing inspections of the road regularly and timely.
2) Strengthening inspection in the event of a typhoon, an earthquake, and other natural disasters.
3) Conducting following items during inspection.
    - Identification of actual damages or triggers of damages on road surfaces, roadside, structures, and accessories.
    - Supervision of road maintenance works
    - Monitoring of unauthorized use or occupation of roads and the adjacent sites, and identification of the effects to the roads.
    - Grasping of traffic conditions.
    - Implementation of emergency response measures (i.e. warning sign setting and traffic guidance) when it is determined that the defects can be dangerous for traffic and residents.
4) Dealing with abnormalities noticed during an inspection tour appropriately. In case of abnormalities on road surfaces should be carried out with simple repair by outsourcing.
5) In 4), taking measures to conduct prompt repair using a unit price contract etc.

2.5.2.2.4 Recommendations for Future Maintenance Scheme

Considering the current budgetary issues, equipment and personnel in the Solomon Islands, a basic and simple maintenance policy is acceptable. However, regular maintenance is needed to sustain effectiveness of the project.

The project road plays an important role as a social infrastructure supporting socio-economic activities and community life in the Solomon Islands. Roads can function as storage space of utilities (water supply and sewerage systems, telecommunication lines and electricity supply) and a disaster prevention space in the event of an earthquake or a tsunami, in addition to as a transportation system for vehicles and pedestrians. If maintenance and repair of the roads are not conducted due to failure to notice defects and/or delay of repair works, the road traffic will not be safe and smooth and repair cost will increase with post measures. In addition, this might adversely affect the lives and properties of the people as well as economic growth of Solomon. Therefore, the MID should record and analyze data precisely such as actual damages of roads, traffic conditions and damages caused by natural disasters, and try to obtain budget for maintenance and repair. In the future, the MID should introduce and implement comprehensive asset management including utilization of roads.

Furthermore, the existing the Lungga Bridge was built about 30 years ago and should be inspected regularly its soundness.

2.6 Project Cost Estimate

2.6.1 Initial Cost Estimation

2.6.1.1 Japan's Contribution

The cost borne by the Japanese's Grant Aid is not shown in this report due to the confidentiality.

2.6.1.2 Solomon's contribution

The approximate amount estimated for contribution from the Solomon Islands is as shown Table 2.32.

Table 2.32 Solomon Islands Contribution

Item		Amount (SBD)	Amount (USD)
(1) Banking fee		483,000	59,630
(2) Land acquisition, relocation of electric, telecom and facilities	Temporary yard rent fee	500,000	61,728
	Relocation of underground utilities	13,868,000	1,712,099
	Relocation of sign board and ground utilities	270,000	33,333
	Relocation building, compensation	6,579,000	812,222
	UXO investigation	800,000	98,765
	Removal of trees	72,000	8,889
	Primary power for road lights and traffic lights	1,297,000	160,123
	Routine Maintenance (annual)	124,000	15,309
Amount		23,993,000	2,962,099

2.6.1.3 Cost Estimation Condition

Currency in circulation is Solomon Islands dollar (SBD) of the Solomon Islands.

Base currency is USD and the currency exchange rate is the market average (TTS rate) for the past 3 months starting from the end of November 2019 by Bank of Tokyo-Mitsubishi UFJ announced. Currency exchange rate of SBD to USD is the market average (TTB rate) for the past 3 months starting from the end of November 2019 by Bank of South Pacific announced.

Cost Estimation Condition

(1) Cost Estimation Date : December 2019

(2) Foreign Exchange Rate : USD1.00=JPY109.17
(US Dollar to Japanese Yen Exchange Rate)
SBD1.00=JPY13.44
(Solomon Dollar to Japanese Yen Exchange Rate)

(3) Construction Period : Schedule of construction supervision is shown in the implementation schedule.

(4) Others : The project shall be conducted based on the Japanese Government's Grant Aid Scheme.

2.6.2 Operation and Maintenance Cost

Operation and maintenance cost for the major works is shown in Table 2.33 The MID is responsible for securing the budget for operation and maintenance cost. The required cost is about 0.2% of the MID's road maintenance budget, and the operation and maintenance of the Project is sufficiently possible.

The Project introduces L-type gutters and box culverts for low-maintenance and modified asphalt concrete for more enhancing fluidity resistance of pavement. It is therefore expected that there would only be minimal operation and maintenance costs at the early commissioning stage. As durability of the overlay section is expected to be 3 years as mentioned in 2.2.3.6.7 , a full-scale improvement plan should be considered immediately. In addition, a production facility of asphalt concrete is required at an early stage to conduct appropriate maintenance of pavement for the future.

Table 2.33 Maintenance Cost

Items	Action	Frequency	Equipment/ Materials	Amount (SDB)
Regular Maintenance	Patrol, cleaning, and removal of debris	Twice/month	Broom and pickup truck	44,000 SBD
Regular Inspection	Regular inspection on road conditions, damage, and deformation	Once/month	Shovels/hammer/ sickle/barriers/ related materials/ pickup truck	17,000 SBD
	Inspection on cracks on structures	Once/year		4,000 SBD
	Inspection on road lighting	Once/month	Pickup truck	11,000 SBD
Repair	Repair on shoulders and embankment	Twice/year	Plate Compactor/ base course material/ asphaltic concrete/ ordinary Portland cement/ flat bodied truck	21,000 SBD
	Repair on pavement	Once/year		12,000 SBD
	Repair on concrete structure	Once/year	Ordinary Portland cement/ flat bodied truck	3,000 SBD
	Replacement of lighting	Once/year	Lamps for Lighting	12,000 SBD
			Total	**124,000 SBD** (1,667,000 JPY)

CHAPTER 3. PROJECT EVALUATION

3.1 Precondition

The Project preconditions related to the required undertaking from the Solomon Islands are as follows:

- Banking Arrangement (B/A) with a Bank in Japan shall be concluded within one (1) month after the signing date of Grant Agreement (G/A).
- The payments will be made when payment requests are presented by the Bank under an Authorization to Pay (A/P). This A/P shall be issued to the Bank that concluded B/A within one (1) month after Consulting Service Agreement is made.
- Before the date of formal invitation to Pre-Qualification, such public utilities, like power poles, electric lines/cables, and communication network lines/pipes as will interrupt the Project works shall be all relocated to the locations where no hindrance and inconvenience shall occur.
- It is essential that land, stock yard, borrow pits, spoil banks and industrial waste disposal for the Project construction shall be acquired prior to public announcement of Pre-Qualification and no pending issues in relation to this shall be left behind.
- Prior to commencement of the works, adequate and proper compensation and resettlement in accordance with RAP shall be undertaken for the sake of the PAPs.
- Any necessary actions for tax exemption shall be taken keeping to the regulations of E/N and G/A.
- Quick and smooth customs declaration and import tax formalities shall be completed when the imported materials or goods arrive from Japan and any other third countries.
- Solomon's obligation shall be completed within three (3) months after signing of E/N.
- Agreement on the project implementation with the related organizations (Guadalcanal Province, Honiara City and Utility Owner) shall be made before commencement of construction work.
- Necessary permits for cutting trees that disturb the facilities shall be obtained before the commencement of construction
- Conduct it unexploded ordnance exploration in undeveloped areas. If it is confirmed that it exists, it should be removed before the start of the construction of the main unit.

- Necessary permits for using industrial waste disposal site for Project construction shall be obtained before the commencement of construction.
- During and after the construction, a monitoring report on the natural environment that may be affected, such as air and water pollution, will be submitted to JICA quarterly during the construction period.
- During the construction period, eminent assistance shall be given to traffic handling and management plus safety control management.
- Construction Water must be drawn into the construction yard for the construction work.
- As a means of dispute resolution while the works proceed, discussion and assistance in good earnest shall be made to reach agreement on disputes with people in the vicinity or any other third party around.

3.2 Necessary Inputs by Recipient Country

After the completion of the Project, bridges and roads maintenance is necessary not only to provide smooth flow of traffic but also to prolong the life of the structures and the roads. Maintenance work includes daily or routine maintenance, removal of obstacles, cleaning, etc. Periodic inspection shall be carried out and if damage is observed to structures and pavements, essential repairs will be undertaken appropriately. Therefore, it is an important assumption that the SIG secures an annual maintenance budget (approximately 124,000 SBD) to maintain and repair the facilities. As noted in the earlier sections, the allocation of operation and maintenance budget in the Solomon Islands is considered possible.

3.3 Important Assumptions

Important assumptions of the Project outcome are as described below:

- Maintenance of drainage facilities, roads, structure, and roadside lights shall be properly and periodically made.
- Activities on traffic safety education to road users, particularly neighborhood residents along the Project road, shall be carried out by the MID in cooperation with traffic police.
- Immigration restrictions due to COVID-19 pandemic shall be relaxed.

3.4 Project Evaluation

3.4.1 Relevance

- Approximately 240,000 residents of the project area (Honiara City and Guadalcanal Province) are direct beneficiaries of the Project.
- This Project will contribute to decreasing traffic congestion and the improvement of travel environment as well. It is expected that movement of people and logistics will be smooth and that it will contribute to decrease in traffic congestion and facilitation of domestic logistics.
- This Project will be immediately and strongly needed to eliminate the disruption of the highway network due to flooding and to improve the lives of the residents.
- There is little negative impact upon environmental and social conditions.
- There is a need and an advantage in using construction technology including Japan's process control, safety control, and quality control, and the grant aid system of Japan enables the Project to be implemented without difficulties.

3.4.2 Effectiveness

3.4.2.1 Quantitative Effect

The Quantitative effects are shown in Table 3.1.

Table 3.1 Quantitative Effect

Index	Current Value (as of 2019)	Design Value (as of 2023)	3 years after Project Completion (as of 2026)
Average Travel Speed* (km/h)	33	50	50
Volume of Passengers (person / year)	2.2 million	2.7 million	3.1 million
Volume of Cargo (t / year)	658,760	870,000	900,000
Traffic Disruption (hours/year)	24	0	0

*Of the project section (approximately 6.3 km)

Basis of estimation of the above quantitative effects are explained as follows.

Average Travel Speed:

Average Travel Speed for 3 days measured by drive recorder in November 2019.

Volume of Passengers:

An average number of passengers is set by vehicle type.

- Motorcycle, Bicycle: 1 person/veh, Passenger car: 3 person/veh,

- Mini bus:10 person/veh. Bus:15 person/veh, Truck:2 person/veh.

Volume of Cargo:

An average cargo volume on the truck is set as 0.5t/veh.

Traffic Disruption:

This is based on the hearing results from local residents as of December 2019. Traffic disruption for 24 hours have caused by flooding occurs once a year on average.

3.4.2.2 Qualitative Effect

The prospective effects are;

(1) Improvement of disaster prevention functions by increasing drainage capacity
(2) Economy enhancement brought from traffic congestion mitigation and reducing transportation costs by improvement of road condition
(3) Improvement of traffic safety and accessibility for road users by providing street lights sidewalks and pedestrian crossings