The Independent State of Papua New Guinea
East New Britain Provincial Administration (ENBPA)

NEGID-Plan

[Northeast Gazelle Peninsula Infrastructure Development Plan]

The Project for Kokopo-Rabaul Infrastructure Development Plan

Final Report
Main Text
July 2024

Japan International Cooperation Agency (JICA)

Oriental Consultants Global Co., Ltd.
Kokusai Kogyo Co., Ltd.

IM
JR
24-076

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Currency Exchange Rates

USD 1.00 = JPY 143.97

PGK 1.00 = JPY 41.08

USD 1.00 = PGK 3.50

As of August 2023

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Appendix E

List of Abbreviations

Abbreviation	
ADB	Asian Development Bank
AFD	French Development Agency
AMTDP	Agriculture Medium Term Development Plan
AROB	Autonomous Region of Bougainville
AusAID	Australian Agency for International Development
BESS	Battery Energy Storage System
BIA	Business Improvement Area
BID	Business Improvement District
CADIP	Civil Aviation Development Investment Programme
CADIP II	Civil Aviation Development Investment Programme II
CBA	Census of Business
CEPA	Conservation and Environment Protection Authority
CID	Community Improvement District
CIESIN	Center for International Earth Science Information Network
CNO	Coconut Natural Oil
COVID-19	Coronavirus Disease of 2019
CPB	Cocoa Pod Borer
CPL	Coconuts Products Ltd
CPO	Crude Palm Oil
DBST	Double Bituminous Surface Treatment
DCDR	Department of Community Development & Religion
DDA	District Development Authority
DEC	Department of Environmental Conservation
DEM	Digital Elevation Model
DHS	Demographic and Health Survey
DLPP	Department of Lands and Physical Planning
DNPM	Department of National Planning and Monitoring
DoT	Department of Transport
DoWH	Department of Works and Highways
DPA	Deputy Provincial Administrator
DPLGA	Department of Provincial and Local-Level Government Affairs
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
ENBP	East New Britain Province
ENBPA	East New Britain Principal Administration
ENBP-EDP	East New Britain Province Economic Development Plan
ENBP-ISDP	East New Britain Provincial Infrastructure Sector Development Plan
ENBP-SDP	East New Britain Provincial Strategic Development Plan
EU	European Union
FCA	Forest Clearance Authority

Abbreviation	
FDI	Foreign Direct Investment
FMA	Forest Management Agreement
FS	Feasibility Study
FTZ	Free Trade Zone
GDP	Gross Domestic Product
GPDP	Gross Provincial Domestic Product
GRA	Gazelle Restoration Authority
GRDP	Gross Regional Domestic Product
HDI	Human Development Index
HIES	Household Income and Expenditure Survey
ICAO	International Civil Aviation Organisation
ICDC	Industrial Centres Development Corporation
ICT	Information and Communication Technology
IEE	Initial Environmental Evaluation
ITC	International Trade Centre
JICA	Japan International Cooperation Agency
KDDA	Kerevat District Development Authority
KIK	Coconuts Industry Cooperation
KRA	Key Result Area
KTCSDP	Kokopo-Tokua Corridor Subject Development Plan
LLG	Local Level Government
LNG	Liquefied Natural Gas
MRA	Mineral Resources Authority
MTDP	Medium Term Development Plan
MTDS	Medium Term Development Strategy
MTRF	Medium Term Resources Framework
MTTP	Medium Term Transport Plan
NAC	National Airports Corporation
NADP	National Agriculture Development Plan
NEC	National Executive Council
NEGID-Plan	Project for Northeast Gazelle Peninsula Infrastructure Development Plan or Project for Kokopo-Rabaul Infrastructure Development Plan
NEP	National Energy Policy
NEROP	National Electrification Rollout Plan
NFA	National Fisheries Authority
NGDP	National Goals and Directive Principle
NGO	Non-Governmental Organizations
NMSA	National Maritime and Safety Authority
NPV	Net Present Value
NRW	Non-Revenue Water
NSO	National Statistical Office
NSRSD	National Strategy for Responsible Sustainable Development
NTS	National Transport Strategy
PA	Provincial Administrator

Abbreviation	
PACD	PNG Agriculture Commercialization and Diversification Project
PGK	Papua New Guinea Kina
PIU	Project Implementation Unit
PMV	Passenger Motor Vehicle
PNG	Papua New Guinea
PNG-DSP	Papua New Guinea Development Strategic Plan
PPAP	Productive Partnerships in Agriculture Project
PPP	Public-Private Partnership
Pre-FS	Pre-Feasibility Study
RDDA	Rabaul District Development Authority
RVCO	Rabaul Virgin Coconut Oil
RVO	Rabaul Volcanological Observatory
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SBA	Survey of Business Activities
SC	Steering Committee
SCADA	Supervisory Control and Data Acquisition
SDP	Strategic Development Plan
SEA	Strategic Environmental Assessment
SEZ	Special Economic Zone
SHM	Stakeholder Meeting
SME	Small and Medium Enterprise
S/S	Substation
SWOT	Strengths, Weaknesses, Opportunities and Threats
TEU	Twenty-Foot Equivalent Unit
TOR	Terms of Reference
TRP	Timber Rights Purchase
TWG	Technical Working Group
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USA	United States of America
USAID	United States Agency for International Development
USDA	U.S. Department of Agriculture
VCT	Voluntary Counselling and Testing
WASH	Water, Sanitation and Hygiene
WB	World Bank
WNBP	West New Britain Province
WTP	Water Treatment Plant

Executive Summary

The Project for Kokopo-Rabaul Infrastructure Development Plan (Project for NEGID-Plan)

Final Report

Objectives of the Project

Objectives of the Project

The objectives of the Project are as follows:

- To promote development of infrastructure in harmony with economic sectors and environment in the Northeast Gazelle Peninsula
- To contribute to budget planning necessary for infrastructure development in the Northeast Gazelle Peninsula

Outputs of the Project

The outputs of the Project are as follows:

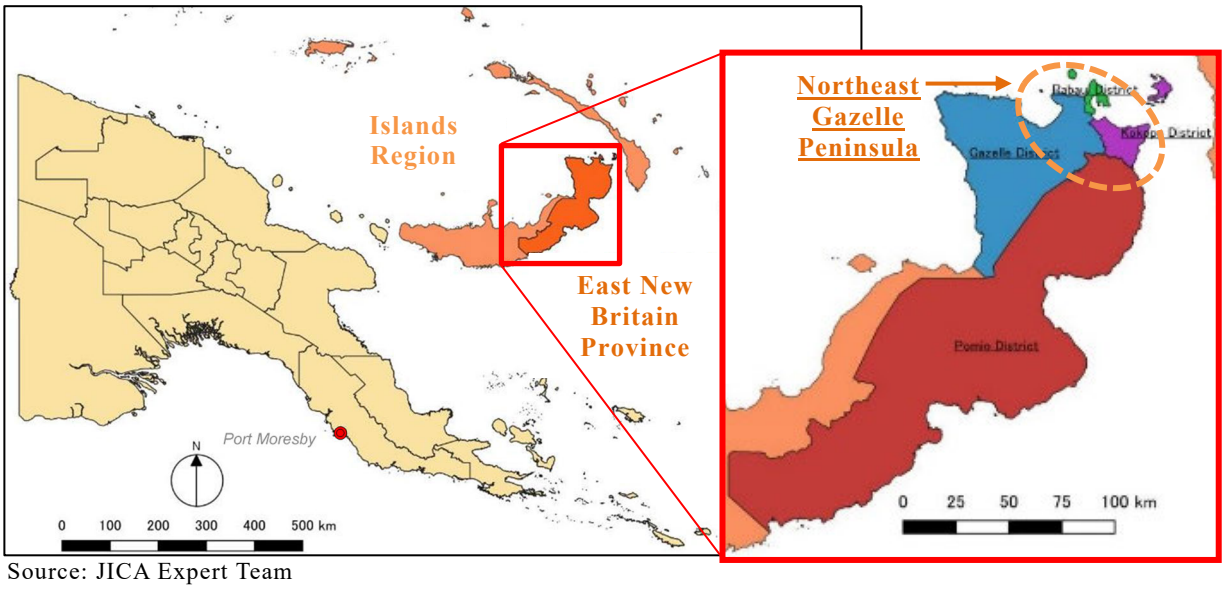
- Formulation of an infrastructure development plan for the Northeast Gazelle Peninsula with target year 2032
- Conduct of capacity development for the formulation of infrastructure development plan
- To conduct a pre-feasibility study for one of the highest-priority projects proposed by the infrastructure development plan to be formulated for the Northeast Gazelle Peninsula

The infrastructure development plan is to deal with two types of infrastructure: regional infrastructure, such as trunk roads, ports and airports; and urban infrastructure including urban roads, water supply infrastructure and power supply infrastructure.

Study Area and Planning Areas of the Project

Northeast Gazelle Peninsula

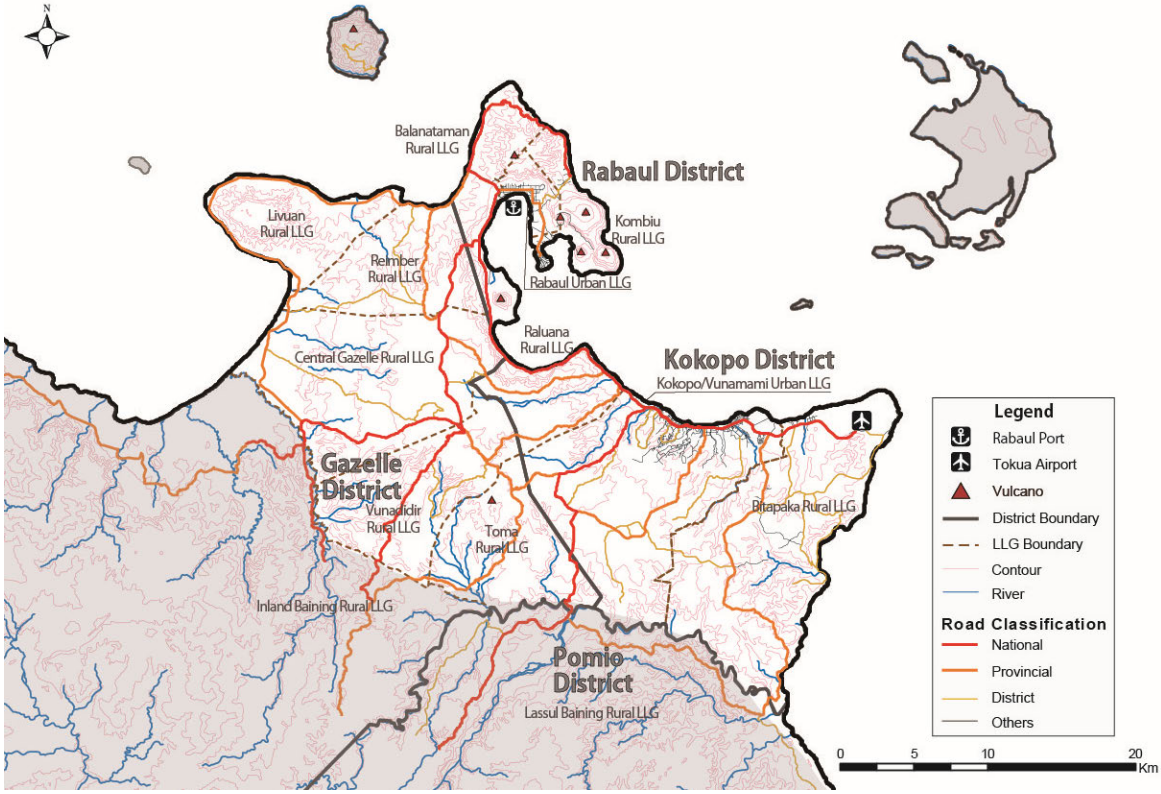
The Study Area of the Project is the Northeast Gazelle Peninsula in ENBP as shown in Figure 1.



Source: JICA Expert Team

Figure 1 Northeast Gazelle Peninsula's location in East New Britain Province, and in Papua New Guinea

The Northeast Gazelle Peninsula covers Kokopo District (excluding the islands), Rabaul District (excluding the islands) and the north-eastern Gazelle District. Administratively, the Northeast Gazelle Peninsula comprised three LLGs in Kokopo District (Bitapaka Rural LLG, Kokopo/ Urban LLG, and Raluana Rural LLG), three LLGs in Rabaul District (Rabaul Urban LLG, Balanataman Rural LLG, and Kombiu Rural LLG), and five LLGs in Gazelle District (Central Gazelle Rural LLG, Vunadidir Rural LLG, Toma Rural LLG, Livuan Rural LLG and Reimber Rural LLG). See Figure 2.



Source: JICA Expert Team

Figure 2 Northeast Gazelle Peninsula: Planning Area for Regional Infrastructure Development

Northeast Gazelle Peninsula is a disaster prone and vulnerable area with earthquakes and active volcanic activities. In 1994, Northeast Gazelle Peninsula experienced the volcanic eruption of Mt. Tavurvur and Mt. Vulcan, which is considered as one of the largest natural disasters in PNG.

The government has been struggling to restore damaged infrastructure and economic sectors in the past 30 years. During this period, the provincial government prepared a long-term ENBP Economic Development Plan (2003-2030) and ENBP Strategic Development Plan (2011-2021) for promoting development of the province.

ENBP has the potential to become the "Showcase of Sustainable Economy" in PNG by formulating suitable plans to promote regional and local economic development and attract tourists.

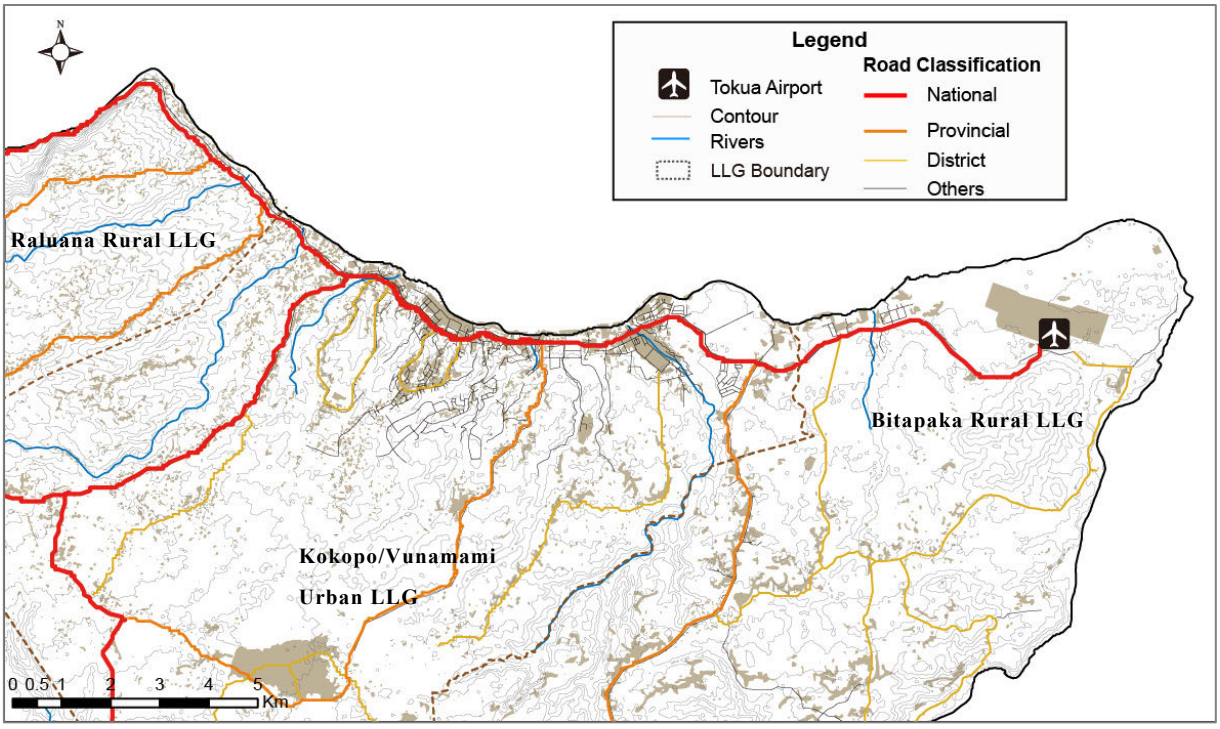
For further development, it has become necessary to have an infrastructure development plan for the purpose of seeking sustainable development by going beyond the stage of restoration and reconstruction in Northeast Gazelle Peninsula.

Regional Infrastructure and Urban Infrastructure

The development plans for the regional infrastructure (trunk roads, ports and airports) were formulated for the Northeast Gazelle Peninsula.

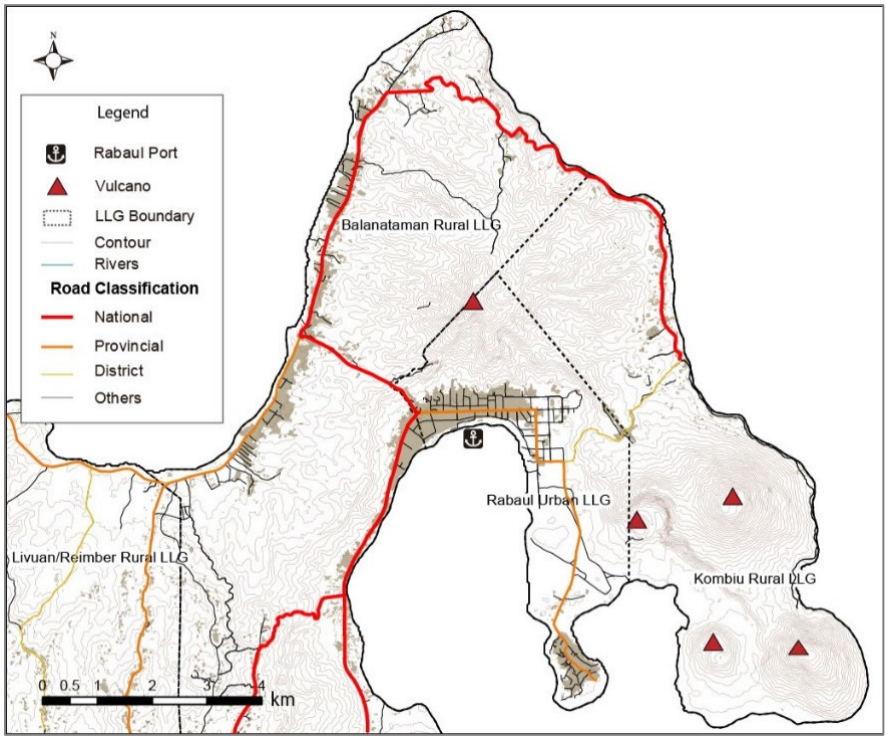
On the otherhand, the development plans for urban infrastructure (urban roads, water supply and power suppy) were formulated for areas to be urbanised in Kokopo District and Rabaul District by 2032.

Development plans for urban infrastructure cover the urban areas in three Local Level Governments (LLG) of Kokopo District (Bitapaka Rural LLG, Kokopo/ Urban LLG, and Raluana Rural LLG) and three LLGs in Rabaul District (Rabaul Urban LLG, Balanataman Rural LLG, and Kombiu Rural LLG). See Figure 3 and Figure 4.



Source: JICA Expert Team

Figure 3 Study Area for Development Planning on Urban Infrastructure in Kokopo District



Source: JICA Expert Team

Figure 4 Study Area for Development Planning on Urban Infrastructure in Rabaul District

Organisation of the Final Report

The Final Report is organised into the following 11 parts:

- Part I: Introduction
- Part II: Review of National-Level Development Plans and Development Trends
- Part III: Present Situational Analysis of Location, Nature and Social Services of Northeast Gazelle Peninsula
- Part IV: Visions, Socioeconomic Framework, and Basic Development Strategies for Northeast Gazelle Peninsula
- Part V: Present Situation of Economic Sectors and Development Strategies for Economic Sectors of Northeast Gazelle Peninsula
- Part VI: Present Regional Spatial Characteristics and Future Regional Spatial Structure of Northeast Gazelle Peninsula
- Part VII: Infrastructure Development Plan for Northeast Gazelle Peninsula
- Part VIII: Environmental and Social Considerations
- Part IX: Pre-Feasibility Study on the Project for Strengthening of Kokopo-Rabaul Coastal Road
- Part X: Pilot Projects
- Part XI Conclusions and Recommendations

There are five appendices which cover the analysis of present situations and review of existing development policies and plans at the national level and in Northeast Gazelle Peninsula.

Regional Development Strategies for Northeast Gazelle Peninsula

Future Vision

The future vision for Northeast Gazelle Peninsula is as follows:

> "Nation's most **liveable**, **resilient** and **enterprising** region with **sustainable** infrastructure for economic growthl."

The development directions of NEGID-Plan are as follows:

- Focus on expanding agriculture, forestry and fisheries, while at the same time focusing on processing industries using products from these sectors.
- Rehabilitation of ageing and deteriorating infrastructure
- Upgrading of infrastructure to support processing industries
- Re-organisation of the spatial structure of the region to improve disaster resilience
- Upgrade infrastructure in line with re-organisation of spatial structure

Overall Issues on Regional Development

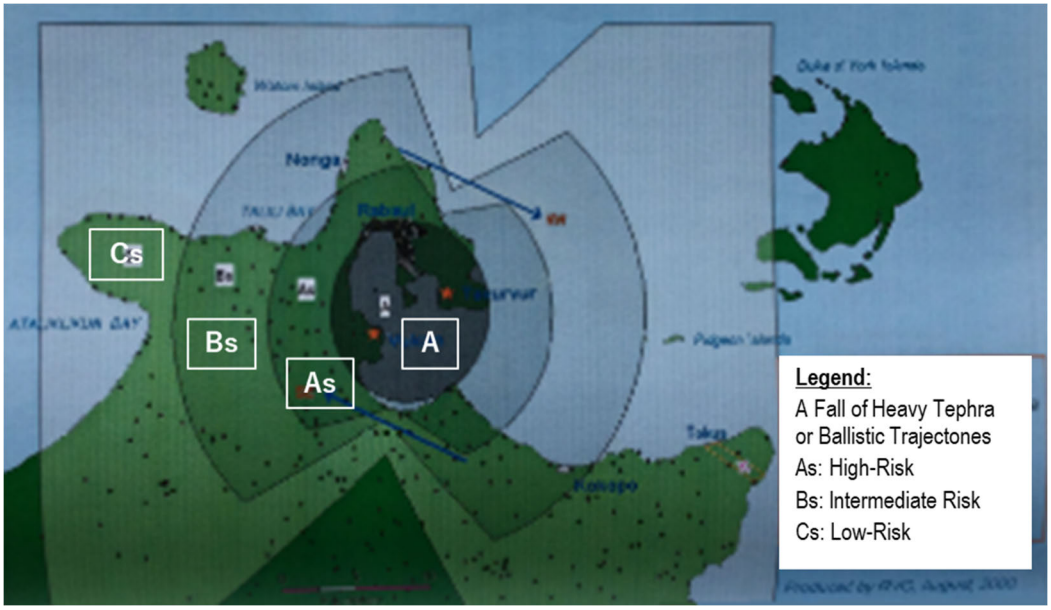
Based on the present situation, the following overall issues have been identified for the region of Northeast Gazelle Peninsula:

- The land and other resources in Northeast Gazelle Peninsula region have not been fully and efficiently utilised for developing economic sectors due to ageing, deteriorated condition, or underdeveloped infrastructure.
- Since low-density population is spread over a wide area in the Northeast Gazelle Peninsula region, it is not possible to provide a dense and extensive road network to fully cover and efficiently utilise the region as a whole.
- The small population and economic agglomeration make it costly and inefficient to expand and upgrade the existing infrastructure.
- Growth potential of individual economic sectors is constrained by the relatively small population and economic agglomerations in the region, as well as by insufficient infrastructure.
- The areas near Rabaul in the Northeast Gazelle Peninsula are at risk of volcanic eruptions and there is a landslide hazard due to weathering of volcanic rocks and ash fallout from volcanic eruptions.
- Following the 1994 volcanic eruption, Rabaul Airport, the ENBP capital and other functions were relocated away from Rabaul and towards Kokopo, but the province's main port, the Port of Rabaul, remained. Therefore, the Rabaul Port and access roads to Rabaul Port from the surrounding areas remain at risk of volcanic eruption damage. (During the 1994 volcanic eruption, thick layers of volcanic ash on the slopes caused landslides due to rainfall, which cut off the access road to the port of Rabaul from the surrounding areas).
- Therefore, resilient spatial structure and infrastructure of the region have not been well prepared yet.
- As a result, it is not easy to attract public investment to infrastructure to support economic sectors in the region, despite having relatively good development potential endowment. Moreover, it is not easy to attract private investment for the economic sectors in the region.

Volcanic Ash Hazard (Tephra[1] Fall Hazard)

After the 1994 eruption of twin volcanos in Rabaul, the following four hazard zones of tephra fall are considered in the Northeast Gazelle Peninsula as shown in Figure 5.

- A: Fall of Heavy Tephra or Ballistic Trajectones
- As: High-Risk
- Bs: Intermediate Risk
- Cs: Low-Risk



Source: Rabaul Volcanic Observatory, August 2000

Figure 5 Rabaul Volcanic Ash Fall Hazard (Tephra Fall Hazard)

There are several kinds of hazards due to volcanic eruption, like lava flow, pyroclastic flow, ash fall and secondary hazard of ash-mud flow. Lava and pyroclastic flows are devastating and limited to the close vicinity of the caldera. Similarly, volcanic ash hazard is devastating and needs to be considered for the infrastructure plan.

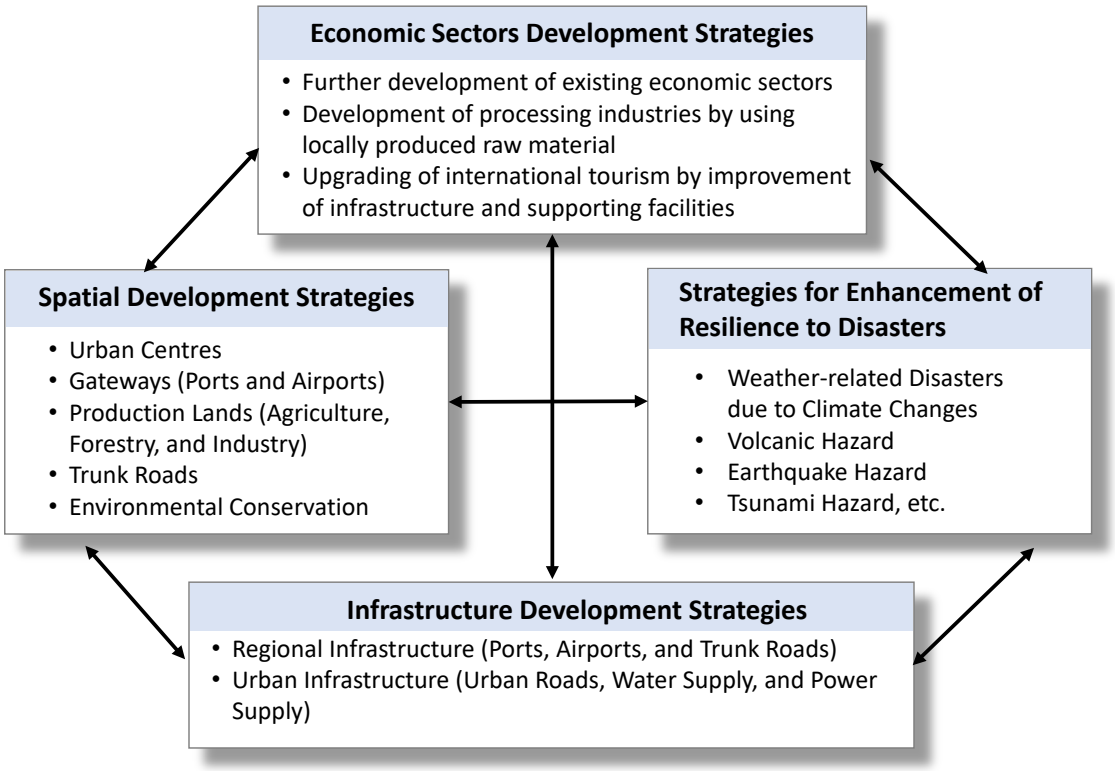
Regional Development Strategies for Northeast Gazelle Peninsula

The following aspects are considered in the process of composing/formulating components of regional development strategies:

- Basic Directions and Strategies for Development of Economic Sectors in the Region
- Basic Directions and Strategies for Spatial Development including spatial utilisation from the perspective of environmental conservation in the Region
- Basic Directions and Strategies for Enhancement of Resilience to Disaster Hazards/Risks (including consideration of weather-related disasters that are becoming more severe and frequent due to climate change) in the Region
- Basic Directions and Strategies for Phased Development in Timeframe
- Basic Directions and Strategies for Infrastructure Development in the Region

The first four aspects, namely: (1) economic sectors, (2) spatial development (including environmental conservation considerations), (3) disaster resilience (including climate change response considerations), and (4) phased development, will guide the formulation of infrastructure development strategies.

[1] The term "Tephra" is used to describe all erupted clasts regardless of size, while the term "ash" describes particles of less than 2 mm in size.



Source: JICA Expert Team

Figure 6 Major Aspects and Relations Considered in Formulating Regional Development Strategies in Northeast Gazelle Peninsula

Socioeconomic Framework for Northeast Gazelle Peninsula

Table 1 shows the future population framework for East New Britain Province and Northeast Gazelle Peninsula over the short, medium and long terms. Table 2 shows the change of share of economic sector and growth rates by economic sector.

Table 1 Future Population Framework for Northeast Gazelle Peninsula

		2011*	2022**	2032**	2042**	2052**
Gazelle District	Population	129,317	167,700	205,000	241,700	276,000
	Annual Growth Rate	-	2.39%	2.03%	1.66%	1.34%
Kokopo District	Population	87,829	114,300	141,200	662,000	998,000
	Annual Growth Rate	-	2.42%	2.14%	1.77%	1.45%
Pomio District	Population	71,836	94,600	113,800	131,300	146,900
	Annual Growth Rate	-	2.53%	1.87%	1.44%	1.13%
Rabaul District	Population	39,387	51,700	64,500	77,300	89,700
	Annual Growth Rate	-	2.50%	2.24%	1.83%	1.50%
East New Britain Province	Population	328,369	428,300	524,500	618,600	706,800
	Annual Growth Rate	-	2.44%	2.04%	1.66%	1.34%
Northeast Gazelle Peninsula	Population	198,745	263,100	330,600	400,200	467,900
	Annual Growth Rate	-	5.37%	2.31%	1.93%	1.58%
Outside Northeast Gazelle Peninsula	Population	129,624	165,200	193,900	218,300	239,000
	Annual Growth Rate	-	2.23%	1.61%	1.19%	0.91%

Sources: *National Statistical Office
**JICA Expert Team

Table 2 Future Economic Framework for Northeast Gazelle Peninsula

	GRDP (Kina Million, at 2013 constant prices)	Primary Sector (%)	Secondary Sector (%)	Tertiary Sector (%)
2011 (Estimated)	1,128	175	306	646
2022 (Projected)	1,508	243	397	868
2032 (Projected)	2,253	342	595	1,316
2042 (Projected)	2,144	507	1,020	2,144
2052 (Projected)	6,015	750	1,771	3,493

Source: JICA Expert Team

Future Spatial Structure of Northeast Gazelle Peninsula

The regional spatial structure for Northeast Gazelle Peninsula for the target year 2032 has been prepared, by first formulating a regional spatial structure targeting 2052 as a super long-term spatial structure. This is because a 10-year period is not long enough to consider changes in the spatial structure.

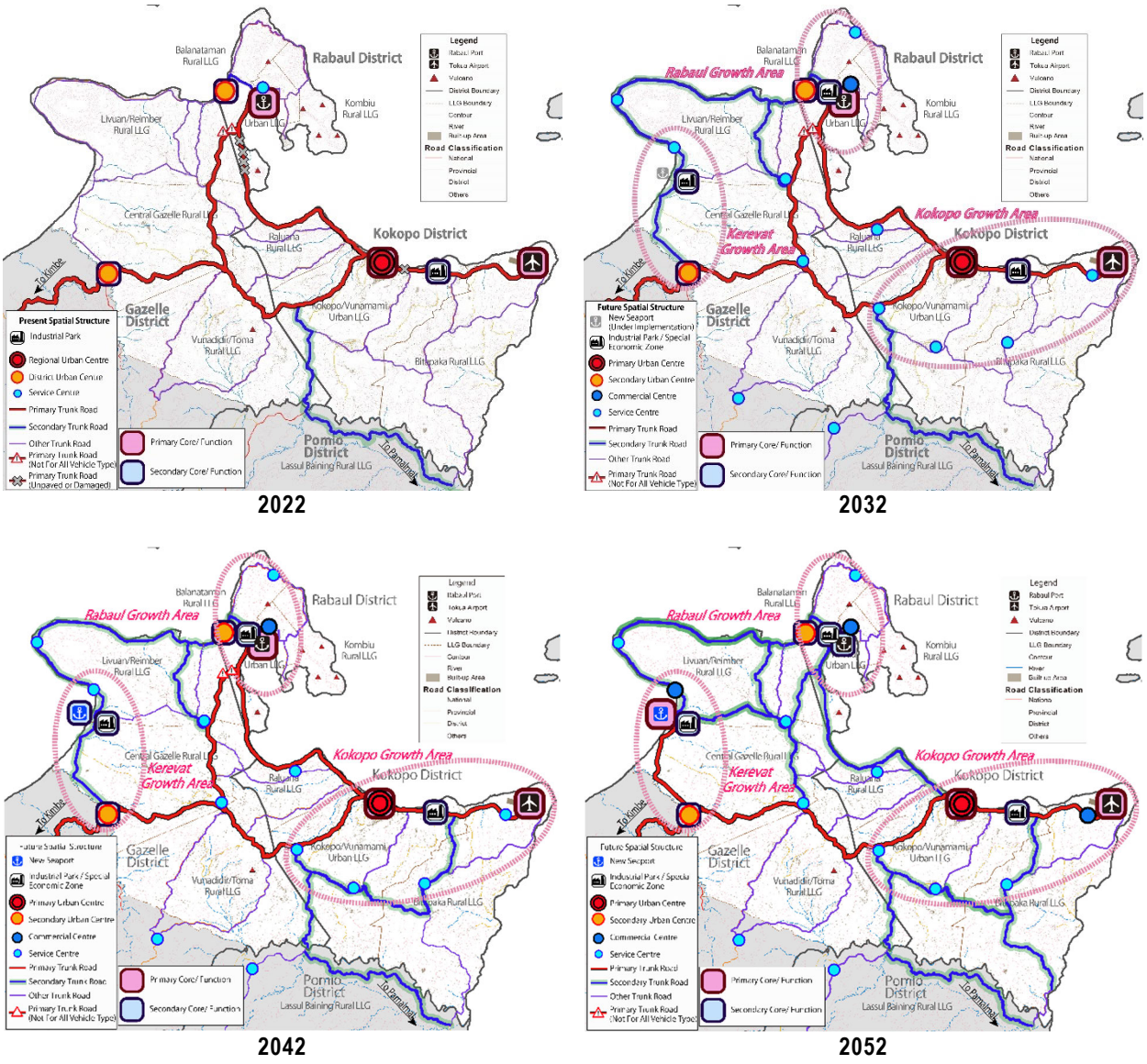
The objectives for transforming the regional spatial structure of Northeast Gazelle Peninsula region are as follows:

- To enhance disaster resilience of wide areas of the region by strategically selecting a location of a central port for Northeast Gazelle Peninsula and implementing the port relocation in a phased manner over the super-long term (about 25~30 years) for reducing disaster risks, and by upgrading trunk roads in accordance with the transformed regional spatial structure
- To fully utilise wide areas of the territory and marine resources for strategically promoting the development of economic sectors in the region by establishing an extensive and upgraded network of trunk roads
- To establish growth areas consisting of government administrative functions, commercial and service functions, and manufacturing functions by providing urban infrastructures (urban roads, power supply and water supply facilities)
- To develop service centres to provide public services in a balanced way covering wide areas of the region

The future spatial structure is also formulated by considering the development of new planned SEZs, Gazelle Agro-Industry SEZ and Rabaul Tuna Export Processing Zone (or SEZ). The development of these SEZs will enable three regional growth areas to develop in Northeast Gazelle Peninsula: Kokopo Growth Area, Rabaul Growth Area and Kerevat Growth Area.

The regional spatial structures for 2032 and 2042 are important milestones for achieving the regional future vision.

The phased development plan of the future Regional Structure is shown in Figure 7.



Source: JICA Expert Team

Figure 7 Phased Development Plan of Regional Spatial Structures for Northeast Gazelle Peninsula

Development Scenario from Short Term, Medium Term, Long Term and Super-Long Term

Given that the population and regional economy in the Northeast Gazelle Peninsula are not very large, the demand for infrastructure is not high enough. For this reason, it is not financially or economically feasible to make the regional spatial structure disaster resilient in the short or medium term. Therefore, the following two-stage development scenario is planned for economic sector development, strengthening disaster resilience, and infrastructure development.

First, in the short and medium terms, measures will be taken to expand the production of existing export-oriented agricultural, forestry, and fishery products. Regarding infrastructure, measures will be taken to rehabilitate and upgrade port and road functions. To improve disaster resilience, measures will be taken to make each infrastructure more disaster resistant.

In the medium term, while continuing the above measures, some industries will also work on diversifying into high-value-added manufacturing and international tourism. For realising such high-value-added economic activities, it is necessary to focus on developing urban infrastructure while establishing the SEZs.

In the long and super-long term, as the population and regional economy grow, it will be possible to reorganise the regional spatial structure and transfer port and production functions, and then develop infrastructure to make the region more disaster resilient.

Infrastructure Development Plan

Integrated Strategies for Regional Development with Emphasis on Infrastructure Development

The following integrated regional development strategies have been formulated by paying attention to different areas of Northeast Gazelle Peninsula for achieving the vision, goals, and development objectives:

- Basic Strategy 1: Extension and Upgrading of Trunk Road Network for Expanding the Production of Export-Oriented Agriculture and Forestry Sectors and Improving Accessibility of Urban Centres, and for Enhancing Resilience Against Disaster Risks in the Region
- Basic Strategy 2: Renovation of Rabaul Port and Revitalisation of Rabaul Town
- Basic Strategy 3: Industrialisation and Port Gateway Development in Ataliklikun Bay
- Basic Strategy 4: Upgrading of Kokopo-Tokua Urban Corridor as the Primary Centre not only of ENBP, but also of the Islands Region
- Basic Strategy 5: Upgrading of Research and Higher Education Functions, with Focus on Volcanos and Marine Environment, and Hospitality Fields
- Basic Strategy 6: Strengthening of ICT Infrastructure and Services in Kokopo, Rabaul and Kerevat Growth Areas
- Basic Strategy 7: Strengthening of Disaster Risk Reduction in Emergency Response, Enhancement of Preparedness and Implementation of Mitigation Structural Measures

These basic strategies for regional development are supported by development efforts at various infrastructures in different locations.

Trunk Roads

The objectives for development of trunk roads are identified as follows:

- To support sustainability of socioeconomic activities of people and economic sectors of the region by maintaining and rehabilitating the trunk roads
- To enhance the disaster resilience of wide areas of the region by improving the resilience of trunk roads against disasters including the improvement of redundancy of the trunk road network in the region
- To promote the development of economic sectors in the region by upgrading the primary routes and secondary routes of the trunk road network in the region
- To widely and efficiently utilise lands in the region for promoting the development of economic sectors by expanding the trunk road network in the region

Important projects for trunk roads are as follows:

- [TR-01] Project for Strengthening of Kokopo-Rabaul Coastal Road
- [TR-02] Project for Upgrading of Rabaul-Kurakakaul-Rakunai Road (Alternative Road to the Kokopo-Rabaul Coastalr Road and to Kokopo-Rabaul Top Road)
- [TR-03] Project for Upgrading of North Coast Road between Kabaira (Ataliklikun Bay) and Kerevat Town
- [TR-04] Project for Upgrading of Kurakakaul-Kabaira (Ataliklikun Bay) Section of North Coast Road
- [TR-05] Project for Upgrading of Malakuna-Putput Road
- [TR-06] Project for Upgrading of Kabakaul-Toma Road

Ports

The objectives for development of ports are identified as follows:

- To manintain the existing Rabaul Port with regular inspection
- To improve the port handling efficiency at Rabaul Port
- To expand the port in accordance with the increase in port demand

- To provide uninterrupted services even upon occurrence of disaster due to volcaninc eruption or tsunami
- To plan a new port taking into account risk of volcanic disaster and future economic sector development of the region
- To maintain and strengthen the regilience of the port infrastructure
- To develop a new primary port in a lower disaster risk area while remaining some functions in Rabaul Port

Important port projects are as follows:

- [SP-01] Project for Rehabilitation of the Rabaul Port Infrastructure
- [SP-02] Project for Upgrading of Rabaul Port Berth 2
- [SP-03] Project for Basic Study on New Port Development in Ataliklikun Bay
- [SP-04] Project for Development of Berth especially for Fishing Vessels (for providing water, fuel and others)
- [SP-05] Project for New Port Development in Ataliklikun Bay

Airports

The objectives for development of airports are as follows:

- To strengthen the international air transport connectivity with major air transport hubs, such as those in Southeast Asia and Australia
- To make a regional hub airport at Tokua Airport, the central airport not only in ENBP, but also of the Islands Region
- To ensure resilience of Tokua Airport, as the central airport not only of ENBP, but also of the Islands Region
- To fulfil the function of alternative airport for Port Moresby and Lae International Airports
- To strengthen the air transportation function from the perspective of disaster resilience

Important airport projects are as follows:

- [AP-01] Project for Redevelopmen of Tokua Airport Phase 1 (Upgrading of the Capacity and the Status of Tokua Airport to International Airport Phase 1)
- [AP-02] Project for Rehabilitation of Tokua Airport Phase 2 (Upgrading of the Capacity and the Status of Tokua Airport to International Airport Phase 2)
- [AP-03] Project for Formulation of Airport City Development Plan and Promotion of Investment in Airport City Precincts Adjacent to the Prospective Upgraded Tokua Airport
- [AP-04] Project for Feasibility Study for Development of Tavilo Emergency Airport

Urban Roads

The objectives for development of urban roads are identified as follows:

- To provide accessibility and mobility with primary centres / primary functions in urban areas not only by extending and upgrading urban roads, but also by connecting urban roads with trunk roads
- To provide accessibility and mobility with secondary centres / functions in urban areas not only by extending and upgrading urban roads, but also by connecting urban roads with trunk roads
- To support the expansion of urban areas in primary centres and secondary centres by extending and upgrading urban roads
- To improve the resilience of urban roads against disasters by providing disaster risk reduction measures

Important urban road projects are as follows:

- [UR-01] Project for Rehabilitation of Rabaul Port Access Road in Rabaul Town (1.8 km) including Improvement of Drainage Network in Rabaul Town
- [UR-02] Project for Rehabilitation of Mango Avenue (1.1 km) and Blanche Street (0.9 km) in Rabaul Town
- [UR-03] Project for Development of Southern Section of Kokopo Town Ring Road (3.7 km)
- [UR-04] Project for Development of Kokopo Town Bypass Road (6.5 km)

Water Supply

The objectives for development of water supply are identified as follows:

- To cover urbanised areas by water supply systems
- To improve and rehabilitate existing water supply systems
- To manage the systems properly with satisfaction of users
- To save the cost

Important water supply projects are as follows:

- [WS-01] Project for Rehabilitation and Improvement of Kokopo Borehole Field
- [WS-02] Project for Rehabilitation and Improvement of Water Supply System for Rabaul Town Area
- [WS-03] Project for Rehabilitation and Improvement of Water Supply System for Nonga Area
- [WS-04] Project for Development of Water Supply System for Kerevat Area
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- [WS-07] Project for Expansion of Water Supply System for Rabaul Town Surrounding Area
- [WS-08] Project for Expansion of Water Supply System for Southern Nonga Coastal Areas
- [WS-09] Project for Development of Water Supply System for Kerevat Agro-Industry SEZ, Ataliklikun New Port and Surrounding Areas

Power Supply

The objectives for development of power supply are identified as follows:

- To rehabilitate existing power facilities including reinforcement of high-priority transmission lines, substations, and distribution lines
- To satisfy short-term needs to provide supplemental power supply by strengthening diesel power generators at Kokopo S/S, Rabaul S/S, and Kerevat S/S in Kokopo Town, Rabaul Town, and Kerevat Town, in which economic sector development is promoted by establishing Special Economic Zones and industrial parks
- To satisfy medium and long-term needs, reduce dependence on diesel power generators, and develop alternative energy resources, such as geothermal and solar energy resources, to diversify power sources in response not only to the demand growth in urban areas but also to the need for rural electrification
- To reinforce the maintenance capability of power facilities of PNG Power

Important power supply projects are as follows:

- [PW-01] Ulagunan Diesel Generators Rehabilitation Project
- [PW-02] 66kV Transmission Lines 552 and 553 Rehabilitation Project
- [PW-03] 66kV Transmission Lines 554 Rehabilitation Project
- [PW-04] Kokopo Substation Rehabilitation Project
- [PW-05] Rabaul Substation Rehabilitation Project
- [PW-06] Kokopo Feeder 2 Rehabilitation Project
- [PW-07] 22kV Kerevat 1 Feeder and 22kV Rabaul 1 Feeder Rehabilitation Project
- [PW-08] Project to Promote the Development of Alternative Sources of Power Through Both Private and Public Investments

High-Priority Projects

The projects which are highly critical in line with the formulated regional development strategies have been selected as high-priority projects. Eleven high-priority projects have been selected based on the following points:

- To initiate significant efforts at development of economic sectors, enhancement of disaster resilience, or transformation of regional spatial structure
- To break through difficult problems on development of economic sectors, enhancement of disaster resilience, or transformation of regional spatial structure
- To create synergies for development of economic sectors, enhancement of disaster resilience, or transformation of regional spatial structure by implementing in conjunction with different infrastructure development

The eleven high-priority projects for infrastructure development at Northeast Gazelle Peninsula are listed in Table 3.

Table 3 List of High-Priority Projects

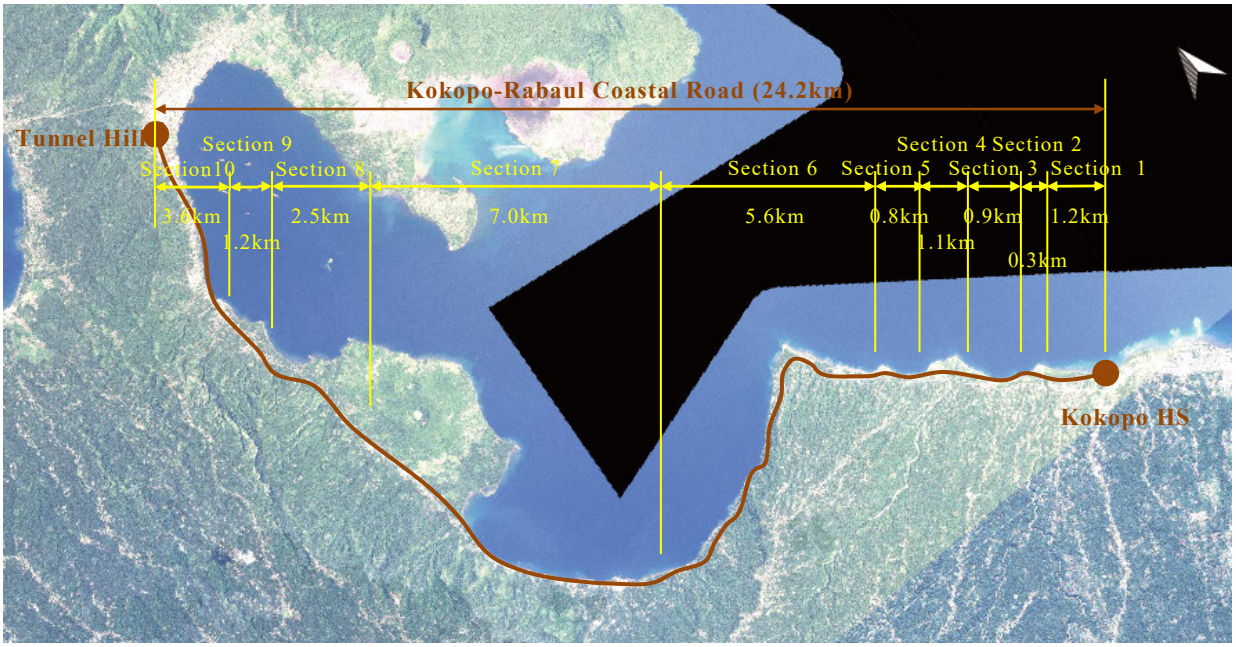
No.	Project Code	Project Name	Executing Agency	Project Costs (PGK)
1	TR-01	Project for Strengthening of Kokopo-Rabaul Coastal Road	Department of Works and Highways	PGK 57 million
2	TR-02	Project for Upgrading of Rabaul-Kurakakaul-Rakunai Road (Alternative Road to the Kokopo-Rabaul Coastal Road and to Kokopo-Rabaul Top Road)	Division of Infrastructure Development, ENBPA	PGK 90 million
3	SP-01	Project for Rehabilitation of Rabaul Port Infrastructure	PNG Ports Corporation Ltd.	PGK 85 million
4	SP-02	Project for Upgrading of Rabaul Port Berth 2	PNG Ports Corporation Ltd.	PGK 80 million
5	SP-03	Project for Basic Study on New Port Development in Ataliklikun Bay	Department of Transport PNG Ports Corporation Ltd.	PGK 6 million
6	AP-01	Project for Redevelopment of Tokua Airport Phase 1	National Airport Corporation (NAC)	PGK 880 million
7	UR-01	Project for Rehabilitation of Rabaul Port Access Road in Rabaul Town (1.8 km) including Improvement of Drainage Network in Rabaul Town	Division of Infrastructure Development, ENBPA Rabaul District	PGK 42-55 million
8	UR-03	Project for Development of Southern Section of Kokopo Town Ring Road (3.7 km)	Division of Infrastructure Development, ENBPA Kokopo City	PGK 26 million
9	WS-01	Project for Rehabilitation and Improvement of Kokopo Borehole Field	Water PNG Corporation Ltd.	PGK 5 million
10	WS-02	Project for Rehabilitation and Improvement of Water Supply System for Rabaul Town Area	Water PNG Corporation Ltd.	PGK 8 million
11	PW-02A	66kV Transmission Lines 552 and 553 Rehabilitation Project including the Rehabilitation of Kokopo and Rabaul Substations	PNG Power Corporation Ltd.	PGK 62 million
				Total: PGK 1,341-1,354 million

Source: JICA Expert Team

Pre-Feasibility Study

Target Project for Pre-Feasibility Study

The selected target project for the pre-feasibility study is the Project for Strengthening Kokopo-Rabaul Coastal Road.The location map of the project is shown in Figure 8.



Source: JICA Expert Team

Figure 8 Location Map and Road Sections for Strengthening Kokopo-Rabaul Coastal Road

Importance of the Kokopo-Rabaul Coastal Road

The Kokopo-Rabaul Coastal Road is an important regional arterial road linking Rabaul Port with Kokopo Town and Tokua Airport, as well as the Gazelle District (Kerevat Town) and Pomio District (Warangoi).

The Gazelle and Pomio Districts also produce export-oriented agricultural and forest products, which need to be transported by trucks to Rabaul Port. The Kokopo-Rabaul Coastal Road is used for this purpose, as it is the shortest route and allows the passage of large heavy vehicles.

Vulnerability of the Kokopo-Rabaul Coastal Road

The Kokopo Rabaul Coastal Road is a coastal road formed by a submerged caldera created by major eruptions of volcanos in the region in the past. On the land side of the road are the outer slopes of the caldera, which are covered with ash from past volcanic eruptions. Several floodways have formed, and the slopes are prone to collapse. As a result, several times a year, during heavy rainfall events, the slopes collapse and a large supply of sediment flows into the area, causing the coastal road to be closed to traffic.

Road Improvement Plan by Section

The improvement measures shown in Table 4 are proposed to be conducted for each road section. These were determined in consideration of the road condition of each road section.

Table 4 Improvement Measures for Road Sections

Section	Road Improvement	Drainage Improvement	Slope Improvement
1	- DBST is provided. - Proper crossfall to discharge rainwater is provided.	- Side ditch is provided for both sides of the road. - Cross drainage culverts are installed at some points.	- Slope protection is provided.
2	- DBST is provided. - Proper crossfall to discharge rainwater is provided. - Road height is raised to secure the waterway under the road. - Bridge is constructed to secure the waterway under the road.	- Side ditch is provided for both sides of the road. - Cross drainage culverts are installed at some points. - Sedimentation basin is constructed to catch sand / soil from the mountain during heavy rain.	- Slope protection is provided.
3	- DBST is provided. - Proper crossfall to discharge rainwater is provided.	- Side ditch is provided for both sides of the road. - Cross drainage culverts are installed at some points.	- Slope protection is provided.
4	- DBST is provided. - Proper crossfall to discharge rainwater is provided. - Road height is raised to secure the waterway under the road. - Bridge is constructed to secure the waterway under the road.	- Side ditch is provided for both sides of the road. - Cross drainage culverts are installed at some points. - Sedimentation basin is constructed to catch sand/soil from the mountain during heavy rain.	-
5	- DBST is provided. - Proper crossfall to discharge rainwater is provided.	- Side ditch is provided for both sides of the road. - Cross drainage culverts are installed at some points.	- Slope protection is provided.
6	- DBST is provided. - Proper crossfall to discharge rainwater is provided.	- Side ditch is provided for both sides of the road. - Cross drainage culverts are installed at some points.	- Slope protection is provided.
7	- DBST is provided. - Proper crossfall to discharge rainwater is provided.	- Side ditch is provided for both sides of the road. - Cross drainage culverts are installed at some points.	-
8	- DBST is provided. - Proper crossfall to discharge rainwater is provided. - Road height is raised to secure the waterway under the road.	- Side ditch is provided for both sides of the road. - Cross drainage culverts are installed at some points. - Waterway is constructed along the mountain side of road to preventt inflow of the water from the mountain into the road.	-
9	- DBST is provided. - Proper crossfall to discharge rainwater is provided. - Road height is raised to secure the waterway under the road. - Bridge is constructed to secure the waterway under the road.	- Side ditch is provided for both sides of the road. - Cross drainage culverts are installed at some points. - Sedimentation basin is constructed to catch sand/soil from the mountain during heavy rain.	-
10	-	-	-

Source: JICA Expert Team

Economic Analysis

Development cost for the strengthening of Kokopo-Rabaul Coastal Road in economic price amounts to 193 million PGK.The operation and maintenance (O&M) work is assumed to be 0.1% of construction cost every year and 2.0% of construction cost every 10 years.

Economic benefit of the Project consists of the savings of vehicle operating cost (VOC), savings of travel time cost (TTC), savings of truck-cargo-hour cost, and the reduction of restoration and rehabilitation costs associated with sediment disasters.

Based on the costs and benefits calculated, the economic internal rate of return (EIRR) and the net present value (NPV) at a discount rate of 12% are calculated for four cases as shown in Table 5.

The results of all cases of the Project are judged economically inviable as the calculated EIRRs do not exceed 12%, which is considered a threshold to judge project viability in developing countries.

Table 5 EIRR and NPV by Case

Case	Future Traffic Demand for Kokopo-Rabaul Coastal Road and Top Road	EIRR (%)	NPV (PGK million): at discounted rate of 12%
1	Passeger Volume: The same as annual average population increase rates Cargo Vehicles: The same as annual average population increase rates	8.1	-39
2	Passenger Volume: The same as annual average population increase rates Cargo Vehicles: The same as annual average GRDP increase rates	8.5	-36
3	Passenger Volume: 1.5 times larger than annual average population Cargo Vehicles: 2.0 times larger than annual average GRDP increase rates	10.5	-15
4	Passenger Volume: 2.0 times larger than annual average population increase rates Cargo Vehicles: 2.5 times larger than annual average GRDP increase rates	11.6	-3

Source: JICA Expert Team

Pilot Project

Approach and Overall Goal

Pilot projects were implemented as initatives that contribute to improving the attractiveness of the region by involving local private sectors (residents, business owners, etc.). The pilot projects were designed to make immediate and short-term impacts to the improvement of local physical and business environments. The target areas were within the Urban LLGs of Kokopo and Rabaul.

The overall goal for the implementation of the pilot projects is "To provide a lively space and vibrant atmosphere which can be enjoyed by both residents and tourists."

Based on discussions among stakeholders of issues of each town and ideas to solve them, holding a night market for Kokopo and improving public amenities for Rabaul were selected as the pilot projects.

Pilot Project in Kokopo

ENBP Governer's Office, Kokopo/Vunamami Urban LLG and local business owners coordinated to implement a Night Market which aims to improve night life for residents and tourists in Kokopo. Benches, pedestrian bridges, portable toilets and lightings were installed at public open space to hold the Night Market and improve urban environment of the town.

Pilot Project in Rabaul

Rabaul Urban LLG and Rabaul Community and Business Council coordinated to improve public amenities and urban environment of Rabaul as a tourist destination. Benches, public kiosks and signboards were installed at public open spaces and sidewalks

Conslusions and Recommendations

Conclusions

(1) Formulation of Infrastructure Development Plan Taking into Consideration Regional Development Perspectives that are based on Characteristics of the Region

In the Northeast Gazelle Peninsula, infrastructure development planning revealed the need to reorganise the regional spatial structure over the very long term by clarifying the direction of development of the region's economic sectors and measures to improve its disaster resilience. Various infrastructure development strategies were identified to support the reorganisation of the regional spatial structure, and a phased development plan was formulated.

In the Northeast Gazelle Peninsula, to work on improving disaster resilience from volcanic eruptions, it was necessary to consider a super-long-term perspective (beyond 25 to 30 years) for the formulation of a 10-year infrastructure development plan.

(2) Formulation of a 10-Year Infrastructure Development Plan

Important projects for each infrastructure sector that correspond to the short and medium-term scenarios were prepared, and among them high-priority and priority projects were selected. Eleven high-priority infrastructure projects are to be implemented over the next eight years (by 2032 in line with the target year of the PNG's medium-term plan.)

(3) Relocation of the Functions of Rabaul Port with Comprehensive Considerations, Not Only of Economic Sector Development and Disaster Hazard Mitigation but also of Environmental Perspectives

Considering the location of the new port, which will have an impact on the future spatial structure, a preliminary survey of the marine environment was carried out to investigate the natural environment like the flora and fauna that inhabit Kokopo and Ataliklikun Bay. Also the possibility of changes to the marine environment and the possible impact on the tourism industry due to the proposed location of the port in Kokopo was also taken into consideration, since several resort hotels are currently located in Kokopo.

(4) Budget Planning

ENBPA had formulated long-term plans in the past witha large number of projects, but prioritisation and the steps for implementation were not indicated.

In the NEGID-Plan, 11 high-priority projects were selected to secure budgets for important infrastructure development. The importance of these 11 high-priority projects was explained through the development scenario for the entire region. Coordination was also carried out at an early stage with each central government departments and infrastructure state companies, including the Department of National Planning and Monitoring, to secure funds for feasibility studies and project implementation. These 11 high-priority projects are to be included in the national plans and each sector plan, making it possible to secure certain funding.

(5) Capacity Development

Through TWG meetings, Joint TWG meetings, and SC meetings that were held at each stage of the plan formulation process, the coordination capacity was strengthened by utilising the forum of the meetings not only for coordination among stakeholders within the province, but also between ENBPA and each sector agency at the central government.

In addition, a PIU was established within the ENBPA, and core members were selected among the PIU members. Through continuing meetings, understanding of each stage of the plan formulation was deepened.

(6) Pre-Feasibility Study

The pre-feasibility study was carried out on the "Kokopo-Rabaul Coastal Road Strengthening Project," which aims to reduce the risk of landslides and improve transportation functions in line with the short- and medium-term scenarios mentioned above.

Recommendations

(1) Importance of Formulation of Regional Plans Targeting Part of a Province

The Government of PNG should pay attention on formulating regional development plans and infrastructure development plans targeting "parts of the province" with high development potential, such as the Northeast Gazelle Peninsula, in addition to provincial development plans that cover the entire province. Provincial development plans, tend to be generic as they follow the national government template as medium-term development plans for the need to treat all sectors equally. In contrast, regional development plans targeting specific regions are more likely to be plans that address specific challenges and specific potentials without being bound by given templates.

(2) Characteristics, Logics and Strategies of Provinces and Districts

To achieve sustainable regional development, it is important for national-level planning agencies to listen and understand the regional logic and strategies of the provincial and district-level governments. Alongside that, provincial and district-level governments should seek ways to align with national-level policies and priorities while respecting the local characteristics and logics in the province.

(3) Continuous Dialogue Between the National and Local Governments

To promote sustainable development through the implementation of high-priority projects selected through the formulation of this plan, dialogue between the East New Britain Provincial Administration (ENBPA) and the Department of National Planning and Monitoring (DNPM) should continue. Through this dialogue, it is necessary to aim achieve the following points:

- To proceed with the process of official approval of the 11 high-priority projects by the National Executive Council (NEC)
- To ensure that the 11 high-priority projects are incorporated in the sector medium-term development plans formulated by the relevant organisations at the national level
- To obtain the necessary national budget or international development partners' support to conduct full-scale feasibility study or pre-feasibility studies for all high-priority projects
- To continue efforts to obtain national budget and international development partners' support for implementing the 11 high-priority projects

PART I
INTRODUCTION

Chapter 1 Introduction

1.1 Background

The Independent State of Papua New Guinea (PNG) is a country with a population of approximately 9.5 million in 2022.[1] It consists of over 600 islands, spreading over the eastern half of New Guinea Island and Bismarck Archipelago. Located in the northeast of the country, the New Britain Island has the second largest surface area following the New Guinea Island in PNG. It is comprised of East New Britain Province (ENBP) and West New Britain Province (WNBP).

Northeast Gazelle Peninsula includes the towns of Kokopo, Rabaul and Kerevat functions as the primary centre of government administration, trade, industry and logistics not only for the ENBP, but also for its surrounding islands connected by marine and air transport. Rabaul Port handles the fourth largest amount of cargoes in PNG, and Tokua Airport has the fourth largest volume of passengers throughput in PNG.

The major economic sectors of the Northeast Gazelle Peninsula are composed of the primary sector that includes agriculture (cacao, palm oil and coconut) and fisheries (tuna), as well as the tertiary sector that includes tourism, government and other service industries. To support such economic sectors, regional infrastructure like seaports, airport and trunk roads, as well as urban infrastructure, such as urban roads, power supply, and water supply, are essential.

The population of ENBP, according to 2011 population census, was 328 thousand. It grew at a rate higher than 3% in recent years. As a result, the population of ENBP, especially that of Northeast Gazelle Peninsula, is expected to increase rapidly.

Despite the fact that the Northeast Gazelle Peninsula, centred on the provincial capital Kokopo and the port of Rabaul, is thus a relatively populous and export-oriented industrial area within ENBP, Rabaul Town and its surrounding areas have been repeatedly hit by volcanic eruptions, with two volcanic eruptions in the 20th century in 1934 and 1994 The city was severely damaged (both eruptions were caused by the Tavurvur and Vulcan volcanoes). In particular, the 1994 eruption brought down volcanic ash several metres thick, crushing many buildings under the weight of the ash and rendering major infrastructure, such as airports, ports and roads inoperable, forcing many residents to relocate in and around Rabaul Town. Within 1994, after the eruption, it was decided that the provincial capital in Rabaul Town would be relocated to Kokopo and the district government building to Kurakakaul. Rabaul Airport was relocated to Tokua, east of Kokopo Town. After 30 years of restoration and reconstruction efforts following the 1994 eruption disaster, the local economy is gradually recovering.

Under these circumstances, aiming for prosperous and sustainable development, the Government of ENBP formulated the "East New Britain Economic Development Plan (2003-2030)" (ENBP-EDP) and "East New Britain Provincial Strategic Development Plan (2011-2021)" (ENBP-SDP 2011-2021). The strategies addressed in these development plans are oriented to development of modern industries, such as agro-processing and tourism industries, based on the development of the agricultural, forestry and fisheries sectors.

However, the main roads from Tokua Airport to Kokopo Town and further to Rabaul Port, which are part of the main road network, have many potholes due to drainage problems. Furthermore,

[1] See Table 7.3.1 Population Projection for PNG for NEGID-Plan (2000-2052).

some of their road sections are prone to landslide during the rainy season that hinders stable connectivity within the Northeast Gazelle Peninsula. At the same time, the increasing transport demands are considered to catch up with the facilities' capacity of Tokua Airport and Rabaul Port. In addition, well-planned provision of economic infrastructure, including electricity and water supply, is a challenge for attracting investments in economic sectors.

Consequently, the Government of PNG requested the Government of Japan for this project of infrastructure development planning for seeking sustainable and resilient socio-economic development in Northeast Gazelle Peninsula in ENBP.

In response to this request, Japan International Cooperation Agency (JICA) dispatched a detailed plan formulation study team to PNG in February and August 2019 to discuss the contents of the project request and the framework of this project based on a study by visiting the Northeast Gazelle Peninsula. In July 2020, the ENBPA and JICA agreed to implement this project and signed a Record of Discussion (R/D). In line with the agreed R/D, this project will formulate an infrastructure development plan for the Northeast Gazelle Peninsula with a target year 2032.

1.2 Objectives of the Project

The objectives of the Project are as follows:

- To promote development of infrastructure in harmony with economic sectors and environment in the Northeast Gazelle Peninsula
- To contribute to budget planning necessary for infrastructure development in the Northeast Gazelle Peninsula

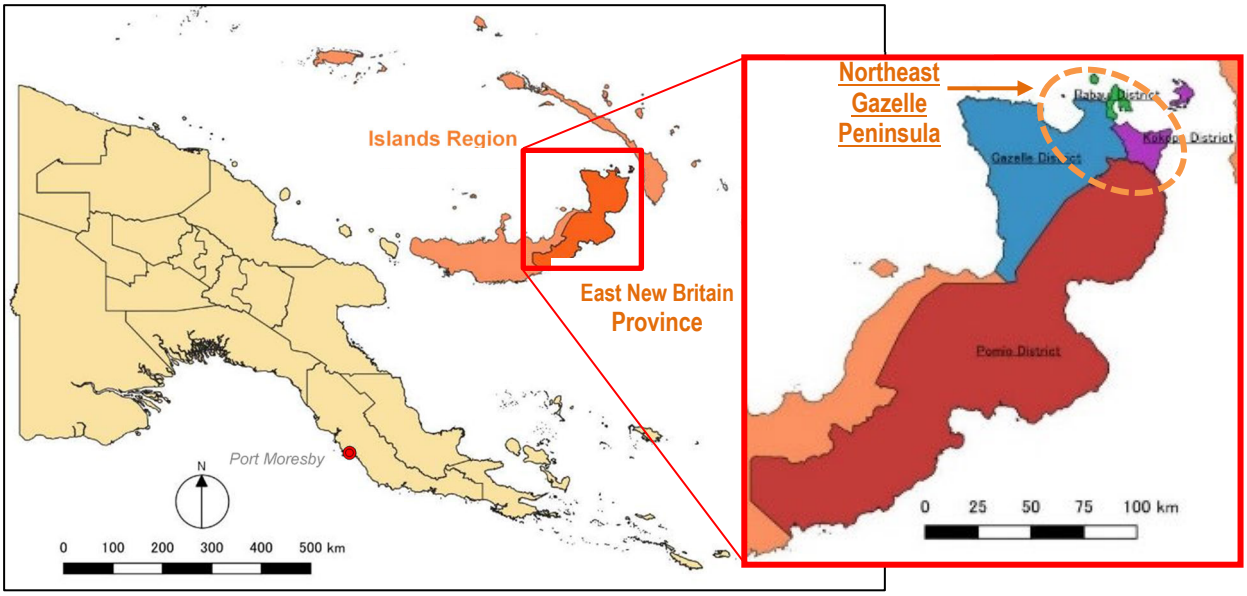
The expected outputs of the Project are as follows:

- Formulation of an infrastructure development plan for the Northeast Gazelle Peninsula with a target year of 2032
- Conduct of capacity development for the formulation of infrastructure development plan
- The infrastructure development plan to be formulated are to cover the following contents:
  - Development Vision
  - Socioeconomic Framework
  - Future Regional Spatial Structure
  - General Land Use Plans in Urban Areas
  - Policies, Strategies and Priority Projects for Target Infrastructure Sectors
  - Result of Strategic Environmental Assessment
- Pre-Feasibility Study for a selected one of the high-priority infrastructure projects proposed by the infrastructure development plan to be formulated

The infrastructure development plan is to deal with two types of infrastructure. The one is regional infrastructure, such as trunk roads, ports and airports. The other is urban infrastructure including urban roads, water supply infrastructure and power supply infrastructure.

1.3 Study Areas and Planning Areas of the Project: Northeast Gazelle Peninsula

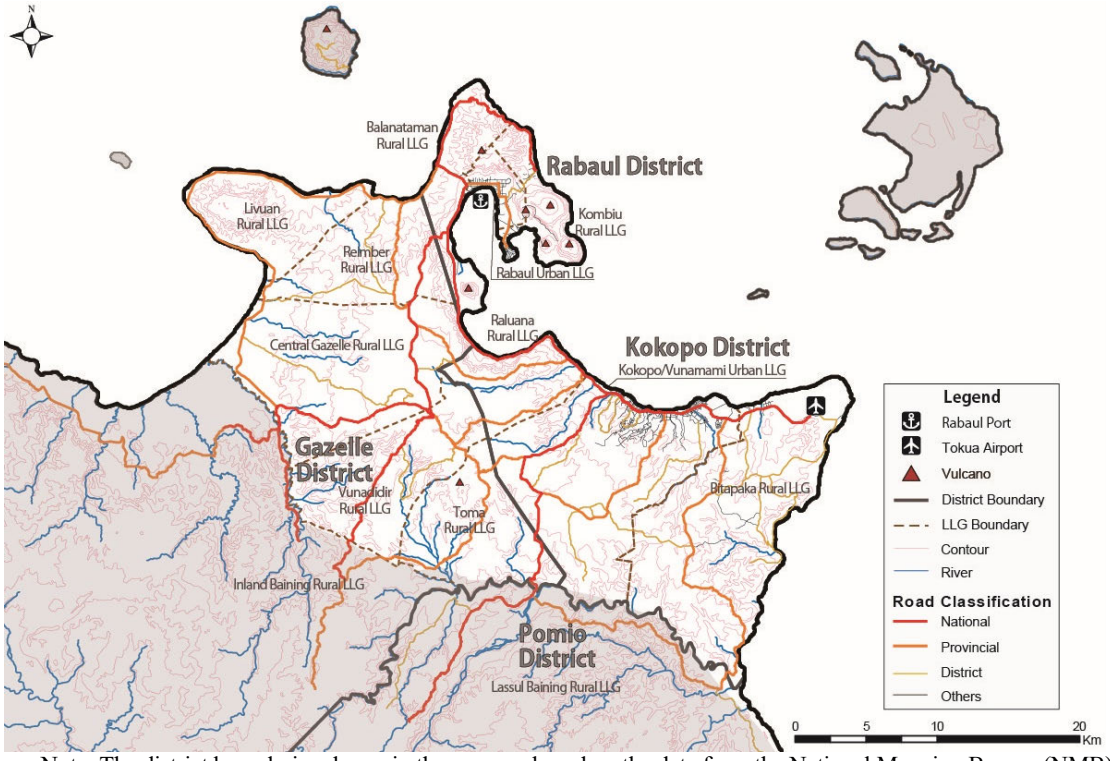
The Study Area of the Project is the Northeast Gazelle Peninsula in ENBP as shown in Figure 1.3.1.



Source: JICA Expert Team

Figure 1.3.1 Northeast Gazelle Peninsula in the East New Britain Province and Papua New Guinea

The Northeast Gazelle Peninsula covers Kokopo District (excluding the islands), Rabaul District (excluding the islands) and the north-eastern Gazelle District. Administratively the Northeast Gazelle Peninsula is comprised of three Local Level Governments (LLGs) in Kokopo District (Bitapaka Rural LLG, Kokopo/ Urban LLG, and Raluana Rural LLG), three LLGs in Rabaul District (Rabaul Urban LLG, Balanataman Rural LLG, and Kombiu Rural LLG), and five LLGs in Gazelle District (Central Gazelle Rural LLG, Vunadidir Rural LLG, Toma Rural LLG, Livuan Rural LLG and Reimber Rural LLG). (See Figure 1.3.2.)



Note: The district boundaries shown in the map are based on the data from the National Mapping Bureau (NMB), Papua New Gunia. However, there are some disparities between NMB's district boundaries and actual village boundaries within each district in Northeast Gaelle Peninsula. In the base map, the LLG boundaries prepared by ENBPA are adjusted to match the district boundaries.
Source: JICA Expert Team

Figure 1.3.2 Northeast Gazelle Peninsula: Planning Study Area for Regional Infrastructure Development

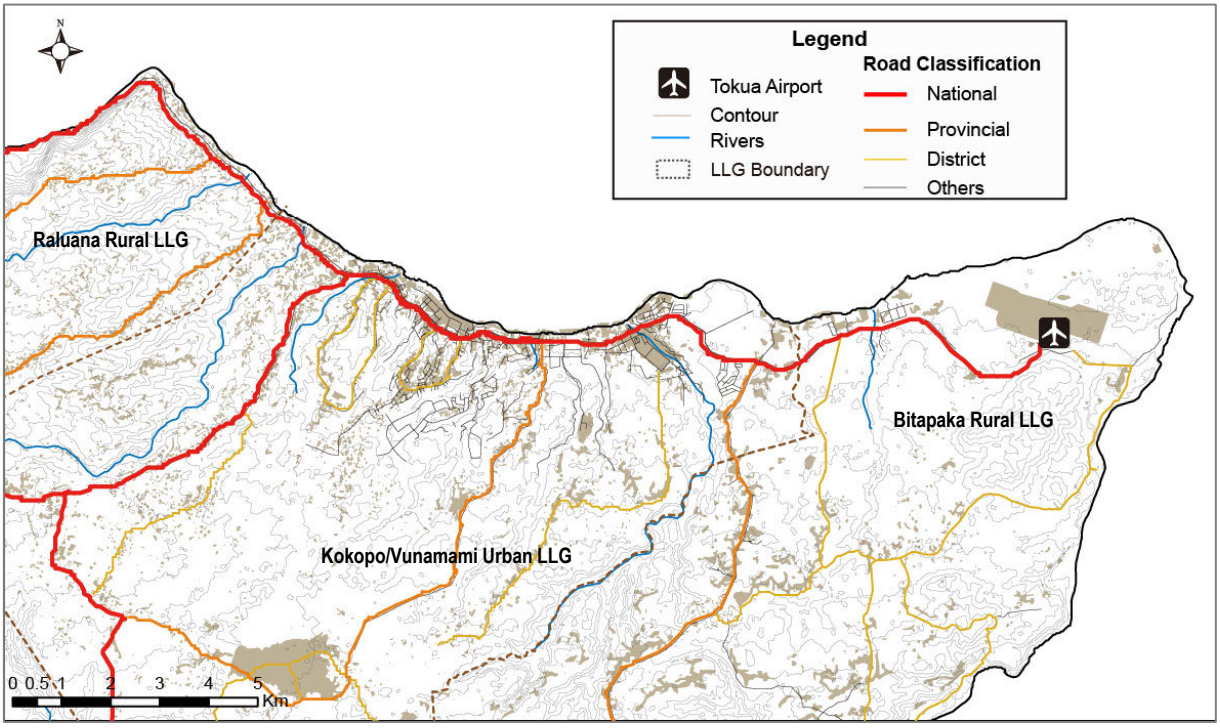
1) Regional Infrastructure Planning Study Area

Development plans for regional infrastructure (trunk roads, ports and airports) were formulated for the Northeast Gazelle Peninsula. (See Figure 1.3.2.)

2) Urban Infrastructure Planning Study Area

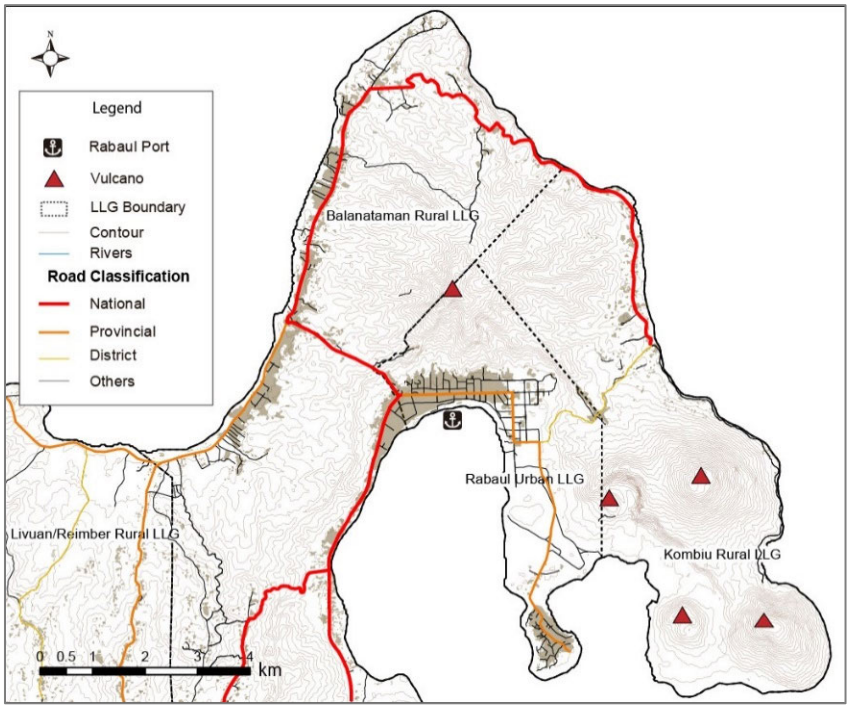
Development plans for urban infrastructure (urban roads, water supply and power supply) were formulated in the areas to be urbanised in Kokopo District and Rabaul District by 2032.

Development plans for urban infrastructure cover the urban areas in three Local Level Governments (LLG) of Kokopo District (Bitapaka Rural LLG, Kokopo/ Urban LLG, and Raluana Rural LLG) and three LLGs in Rabaul District (Rabaul Urban LLG, Balanataman Rural LLG, and Kombiu Rural LLG). （See Figure 1.3.3 and Figure 1.3.4.）



Source: JICA Expert Team

Figure 1.3.3 Planning Study Area for Urban Infrastructure in Kokopo District



Source: JICA Expert Team

Figure 1.3.4 Planning Study Area for Urban Infrastructure in Rabaul District

1.4 Phases of the Project

The development planning study was conducted from January 2022 to March 2024 in PNG. The JICA Expert Team completed and submitted the Final Report in July 2024.

The Project was conducted in the following three phases:

Phase1: Analysis of present situation, preparation of base map, formulation of development vision, preparation of future socioeconomic framework, consideration of concepts of pilot projects

Phase2: Formulation of infrastructure development plans, conducting of Strategic Environmental Assessment (SEA), consideration of project ideas for pre-feasibility study, and selection of pilot projects

Phase3: Finalisation of infrastructure development plans, conducting of a pre-feasibility study, and implementation and evaluation of pilot projects

1.5 Organisation of the Final Report

The Final Report is composed of the following volumes:

- Summary
- Main Text

The main texts are organized by 11 parts and 23 chapters:

- Part I: Introduction
- Part II: Review of National Development Plans and Development Trends
- Part III: Present Situational Analysis of Location, Nature, Societies and Disasters of Northeast Gazelle Peninsula
- Part IV: Visions, Socio-Economic Framework, and Basic Development Strategies for

Northeast Gazelle Peninsula

- Part V: Present Situation of Economic Sectors and Development Strategies for Economic Sectors of Northeast Gazelle Peninsula
- Part VI: Present and Future Regional Spatial Structures and Urban Areas of Northeast Gazelle Peninsula
- Part VII: Infrastructure Development Plan for Northeast Gazelle Peninsula
- Part VIII: Strategic Environmental Assessment
- Part IX: Pre-Feasibility Study on the Project for Strengthening of Kokopo-Rabaul Coastal Road
- Part X: Pilot Projects
- Part XI: Conclusion and Recommendation

There are five appendices which cover the analysis of present situations and review of existing development policies and plans at the national level and in Northeast Gazelle Peninsula.

1.6 Study Approaches

In order to address the development issues and key concerns on planning for the Project in the previous section, the following ten basic approaches were used:

1.6.1 Basic Approach 1: Formulation of Regional Infrastructure Development Plan for Seeking Sustainable Development beyond Rehabilitation and Reconstruction

For 15 years (1994 until 2010) after two volcanic eruptions in Rabaul, a variety of projects for rehabilitation and reconstruction had been implemented with donors' economic and technical assistance. By 2010, rehabilitation and reconstruction had been substantially achieved. And since 2010, further sustainable development has been sought to go beyond rehabilitation and reconstruction by targeting future goals set by ENBP-EDP and EDBP-SDP.

In this Project, an infrastructure development plan was formulated for the purpose of seeking sustainable development by going beyond the stage of rehabilitation and reconstruction in Northeast Gazelle Peninsula.

In contrast with rehabilitation and reconstruction, the stage of seeking sustainable development is characterised by the following features:

- A wider range of viewpoints than rehabilitation and reconstruction should be considered.
- The formulation of development plans should be led by regional, district and local-level governments, rather than by the national government.
- An infrastructure development plan to be formulated by regional, district and local-level governments should be explained and obtain support from the national government.

Table 1.6.1 Characteristics of the Stages of Rehabilitation and Reconstruction, and Sustainable Development

Characteristics of Rehabilitation and Reconstruction Stage	Characteristics of Sustainable Development Stage
For the purpose of satisfying immediate needs after volcanic eruption, the following actions were conducted: • Initial emergency response • Rehabilitation of major public economic infrastructure • Construction of relocation sites for affected people • Development of a new regional capital of New East Britain in Kokopo • Rehabilitation of Rabaul Port for functioning as a regional major port • Development of a new district centre of Rabaul	• Infrastructure for the region is to be developed considering a wide range of perspectives as follows: ➢ Promotion of economic sector development and generation of employment opportunities ➢ Enhancement of disaster resilience ➢ Conservation of the environment
Short-term 5-year programs were designed and implemented by donor initiatives. Such short-term programs were implemented by individual projects, not considering the situation as a whole.	• Programs/projects for regional infrastructure development are to be designed and implemented under the initiative of local governments (province / district / LLG). • Medium- to long-term (10 to 15 years) regional infrastructure development plans are to be formulated. • Regional infrastructure development plans are to be composed of projects with scenarios and priorities. • Implementation of priority projects identified in regional infrastructure development plans is to be promoted.
Programs and projects were carried out mostly with donor funding.	• Regional infrastructure development plans and infrastructure projects formulated by local governments (province, districts, LLGs) are to be explained, discussed, and promoted to the national government ministries and agencies. • Regional infrastructure development plans and infrastructure projects are to be incorporated into medium-term development plans of the national government to secure the allocation of national budget. • Donor funds are to be raised and secured for implementation of regional infrastructure development plans and infrastructure projects.

Source: JICA Expert Team based on various data

1.6.2 Basic Approach 2: Formulation of Regional Infrastructure Development Plan by Integrated Spatial Analysis from Different Perspectives

(1) Three Different Perspectives for Integrated Spatial Analysis

The Northeast Gazelle Peninsula is composed of three districts and nine LLGs, extending over an area of 844 km^2. Various economic sectors are spatially distributed over this region.

In order to seek sustainable development beyond the stage of rehabilitation and reconstruction, it is necessary to formulate a regional infrastructure development plan by conducting integrated spatial analysis of the region from the following three viewpoints. How to respond to each viewpoint is described below:

1) Promotion of Economic Sector Development and Generation of Employment Opportunities

The vision set by the Economic Development Plan 2003-2033 for East New Britain Province (ENBP-EDP 2003-2033) is “creation of diversified economic activities including manufacturing and service sectors (including tourism), on the basis of primary industries, such as agriculture and fisheries.”

A variety of attractive and high-potentiality economic sectors such as logistics, agriculture, fishery, tourism and manufacturing (agro-processing, etc.) spatially spreads over the Northeast Gazelle Peninsula, while their scales of production are relatively small. Since those economic sectors are small in scale and growth potential, it is difficult to adopt strategies to provide large-scale

infrastructure for promoting economic sector development. Therefore, the JICA Expert Team considered phased implementation strategies by combining different kinds of appropriate scale of infrastructure development projects for the purpose of supporting the development of diversified economic sectors.

Furthermore, due to the recent COVID-19 pandemic, the international tourism sector had been largely impacted so that the number of international tourists, including cruise tourists, became almost zero.

Since it is difficult to know what kind of negative impacts will occur in specific economic sectors in the future, regional development scenarios and strategies aiming for growth based on small and medium-sized but diversified economic sectors might be suitable for the post-COVID-19 contexts, rather than regional economies that depend on a small number of large-sized economic sectors. The JICA Expert Team considered and formulated such an infrastructure development plan while adding this kind of perspective.

2) Enhancement of Disaster Resilience

In the restoration and reconstruction projects carried out by the Gazelle Restoration Authority (GRA) in Northeast Gazelle Peninsula, a decentralised policy has been adopted for the purpose of spatially avoiding large disaster risks in specific areas and economic sectors.

In terms of regional spatial structure, the policy for formulating the infrastructure development plan is to develop growth centres spatially in a decentralised manner rather than establishing a single growth centre (as recommended in the Urban and Regional Development Plan formulated in 2004). For economic sectors, the promotion of economic sector development and generation of employment opportunities are necessary to create diverse economic activities and jobs in agriculture, fisheries, manufacturing, and tourism. In this project, while starting from the decentralised spatial policy adopted at the restoration / reconstruction stage, the JICA Expert Team started with a planning study by concretely confirming the spatial structure once again among a wide range of stakeholders.

Aside from volcanic eruptions, there are various disasters (such as earthquakes, tsunamis, floods and landslides) which could hit Northeast Gazelle Peninsula. The spatial distribution of disaster hazards varies depending on disaster types. Considering the necessity and requirements for land use regulations in response to these various disaster hazards, the JICA Expert Team considered spatial structures of the region and measures for economic sector development.

3) Conservation of the Environment

The various industries in Northeast Gazelle Peninsula are all supported by the natural environment – land, sea, and atmosphere. In particular, tourism is based on the natural landscape of volcanoes and the coastal and marine environment, including coral reefs. Therefore, conservation of the environment is an important criterion when considering the placement of a regional port.

In addition, throughout the process of formulating infrastructure development plan, strategic environmental assessment (SEA) was conducted. Environmental and social consideration by involving stakeholders in the SEA process was implemented.

(2) Consideration of Regional Spatial Structure by Paying Attention to Location of the Regional Port and Access Road to the Regional Port

PNG Ports Corporation Ltd. that manages Rabaul Port has been focused on the renovation of the port after the 1994 volcanic eruption disaster. In 2014, PNG Ports conducted a Rabaul Port master planning study that includes examination of the relocation from the existing Rabaul Port, identifying alternative locations for the construction of a new port. However, PNG Ports has not yet reached a conclusion on the relocation of the port.

In order to complete the 15-year restoration / reconstruction stage from 1995 and proceed to the next stage of sustainable development, first, the JICA Expert Team evaluated improvement and development potential of the disaster resilience of Rabaul Port, which historically made the Rabaul District not only a regional administrative centre, but also a regional commercial and logistics centre. The alternative development policies for regional spatial structure were formulated, including port location in the future by considering roles of growth centres and network, and functions of roads, as well as disaster resilience of a regional port. The process of considering port location and development, as well as alternative regional spatial structure was done with priority at the early stage of plan formulation.

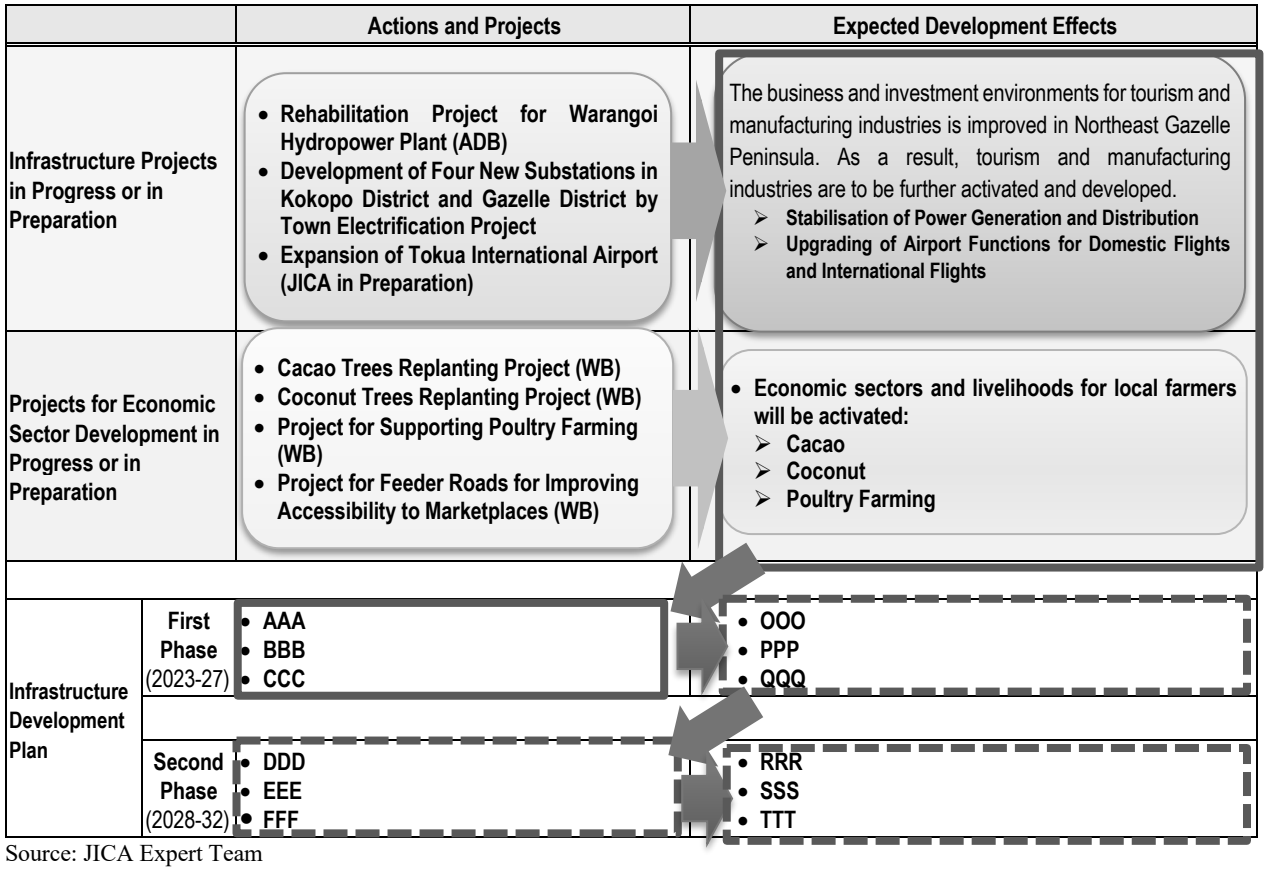
1.6.3 Basic Approach 3: Formulation of Regional Infrastructure Development Plan by Considering Alternative Scenarios and Implementation Priorities

ENBP-EDP and ENBP-SDP do not have scenarios integrating infrastructure development and economic sector development. In other words, there are no scenarios or explanations by which to connect identified projects and to set priorities for implementation of development plans.

Scenarios are stories by which to describe a series of actions of "what to do for what purposes." It is not always possible for scenarios to deal with all elements of development, and it is not always possible to describe them qualitatively. By scenarios, the following things are explained: What actions are to be taken for various elements of regional development (for example, urban infrastructure and regional infrastructure), then what situations of certain economic sectors and what investment environments will occur.

What should be noted in the region is the fact that, as shown in Table 1.6.2, important actions have been implemented or have been prepared, according to the past and existing development plans and project plans. As a result, development effects are expected to emerge in two to a few years from now.

Table 1.6.2 Chains of Actions for Infrastructure and Economic Sector Development and Effects of These Actions (Image)



Source: JICA Expert Team

The target year for the infrastructure development plan in this project is 10 years from now (that is, year 2032). Since the emergence of development effects takes time after implementation of infrastructure projects, the period of ten years is divided into two phases.

1.6.4 Basic Approach 4: Preparation of General Land Use Plan and Development of Urban Infrastructure (Urban Roads, Water Supply and Power Supply) for Future Urbanised Area

Within the study area, only the areas of Kokopo City within Kokopo/Vunamami Urban LLG and Rabaul Urban LLG are officially recognised as urban areas. Urban development plans have been formulated for these areas, and land use regulations are implemented. The 2020 population in Kokopo City is estimated to be 46,000, and 6,000 in Rabaul City. The average annual population growth rate (2000-2011) is 3.70% in Kokopo/Vunamami Urban LLG, and 3.48% in Rabaul Urban LLG. However, looking at how the residential area is spreading, the urbanised area not only expanded in the coastal and inland areas of Kokopo/Vunamami Urban LLG, but it has scattered in the areas of Rural LLG on the west and east sides of Kokopo. In Rabaul, population is also sprawling along the western coast to avoid the damage caused by the 1994 volcanic eruption. In other words, in Northeast Gazelle Peninsula, in addition to the urbanised area which the urban development plan has been formulated for, peri-urban (which is between urban and rural areas) area spreads and it is assumed that people here are living an urban life.

In the past, urban infrastructure (urban roads, power supply and water supply) was developed mainly in urban LLGs of Kokopo and Rabaul districts, but people needing water and power supply have been rapidly increasing and so are their service areas. In fact, past data reflect that the number of households being supplied with electricity by the Gazelle Power System had increased at an average annual rate of 5.7% between 2000 and 2013. On the other hand, for water supply, according to the national government's Medium-Term Development Plan, the goal is to increase the water supply coverage rate in urban areas to 100% by 2022.

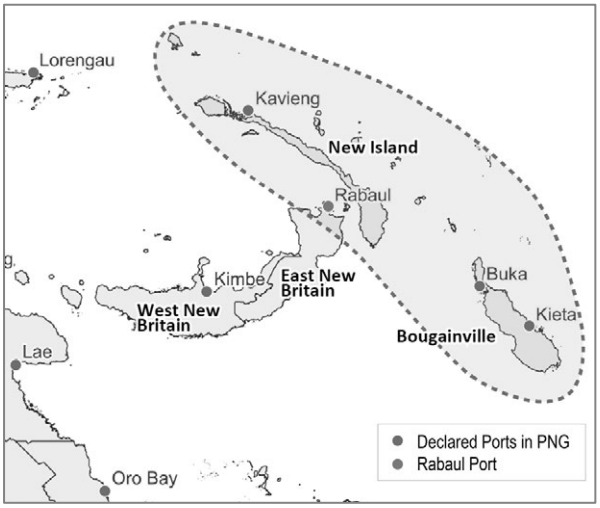
In this project, it is necessary to identify places in the peri-urban areas that are part of the future urban areas to be covered by the urban development plan with land use regulations. Regarding water and power supply, it is necessary not only to increase the connection rate in the urban area, but also to expand the service area for both in the future urban area outside the urban LLGs of Kokopo and Rabaul.

1.6.5 Basic Approach 5: Demand Forecast for Regional Infrastructure, Seaport and Trunk Roads

It is important to pay attention to the following points in future demand forecasting for regional infrastructure, especially ports and trunk roads.

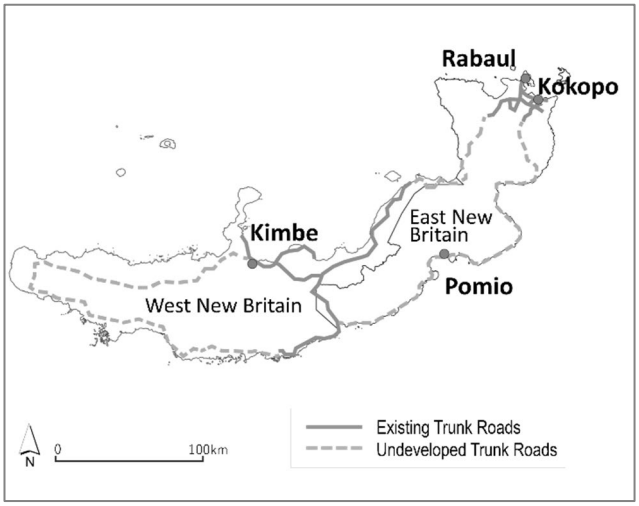
The estimated 2020 population of the study area of this project is 260,000, which is small. However, the area is connected with the islands, as shown in Figure 1.6.1, with regional logistic network by sea route starting at Rabaul Port. For example, agricultural products (cacao and coconut) from Bougainville and New Ireland are transported to Rabaul Port, which are transshipped to large ships and exported.

In the future, the production of agricultural products (coconut, cacao, etc.) is expected to increase, so the increase in production in the surrounding islands was also reflected in the increase in cargo exports from Rabaul Port. This is also the case for road infrastructure. Although ENBP currently has not fully extended the trunk roads throughout the province, the national government intends to lengthen the trunk roads, connecting WNBP and ENBP with a northern corridor (New Britain Highway). At the same time, there is also a plan to connect the two provinces by a corridor along the southern coast (see Figure 1.6.2). By extending trunk roads of ENBP, it is expected that the agricultural production areas connected to the port will expand and the cargo export volume from Rabaul Port will increase.



Source: JICA Expert Team

Figure 1.6.1 Connection by Regional Infrastructure: Sea Route Network



Source: JICA Expert Team

Figure 1.6.2 Connection by Regional Infrastructure: Road Network

1.6.6 Basic Approach 6: Consultation and Coordination with National Government Departments, Incorporation of Infrastructure Development Plan into Existing Planning System, and Securing Budget

(1) Consultation and Coordination with National Government Departments

The main infrastructure that contributes to the development of the study area are urban infrastructure (urban roads, water supply and power power) and regional infrastructure (trunk roads, seaport and airport). However, the process of planning, development, fund procurement and implementation management of all these infrastructures, excluding urban roads, are under the jurisdiction of the national government departments.

In this project, the plans and strategies related to infrastructure development at the provincial level were integrated into an infrastructure development plan. From the early stage of plan formulation to planning, financing and implementation management of individual infrastructure projects, in order to strongly convey and encourage support to the intentions of local governments (provinces, districts and LLGs) from the national government, the result at each stage of the infrastructure development plan formulation should be prepared as "a tool for consultation and coordination with the national-level government" by the local government.

(2) Incorporation of Infrastructure Development Plan to Existing Planning System and Securing Budget

The Infrastructure Development Plan formulated in this project should be included in the appendix of ENBP-EDP while being consistent with the contents of ENBP-EDP, and should be situated as part of priority projects in the provincial medium-term development plan. In addition, to locate the budget at the national government and implement the project in PNG, the competent authority applies for project approval to the Department of National Planning and Monitoring (DNPM) for approval. At the same time, since the priority projects need to be consistent with the policy of the Medium-Term Development Plan (MTDP) at the national level, whether the priority projects proposed by ENBP are consistent with the National MTDP shall be confirmed. Priority projects in the infrastructure development plan were selected considering they are consistent with the National MTDP.

(3) Utilisation of District Governments and LLGs' Development Budgets: Contribution to Development of Urban Roads

Decentralisation has progressed in PNG, and the development budget allocated from the national government to the provincial government has been reduced (1.6 million USD/year budget for provincial government), while the allocation of development budget to district government (3.3 million USD/year), and to LLG (0.3 million USD/year) have increased significantly. Among the infrastructure to be considered in Kokopo-Rabaul Infrastructure Development Plan, urban roads (which are part of urban infrastructure) are the infrastructure wherein local governments (province, districts, LLGs) can contribute. Therefore, counterparts of province, districts and LLGs were be invited to discussion during the stage of identifying future urban areas and considering general land use plans.

1.6.7 Basic Approach 7: Well-Balanced Project Implementation Structure Consisting of Both Local Government and National Government

As written in the R/D of this project, the steering committee (SC) is to be consisted of the Provincial Administrator of ENBP as chairperson, with representatives from the four national government departments as members, and representatives from six central-level government agencies as observers. However, considering that this project is a local initiative, while an infrastructure development plan should be formulated with the coordination of the national government, only one participant from the local level at SC may not be sufficient. Therefore, the JICA Expert Team proposed to increase the number of representatives from the local level as observers of SC as the main counterpart from PNG. Since most of the official members and observers (12 organisations) of the SC were from the central-level government, the SC meetings were held in the capital Port Moresby.

It is still difficult to convey the contents of the discussion and coordination at the SC Meeting to the local level, and it is also difficult to grasp what is being discussed for the overall project at the local level. To address these issues, the study team also proposes to hold meetings with seven technical working groups (TWGs) together (Joint TWG meetings). For explanation and discussion of the Progress Report, Interim Report and Draft Final Report to PNG, first Joint TWG Meeting should be held at ENBP, and once the discussions at the local level are completed, then the conduct of SC Meeting with the SC members from the national government were held.

1.6.8 Basic Approach 8: Cooperation and Coordination with Other Projects Assisted by Development Partners and NGOs

ENBP has donors such as Australia, China, WB and UNDP, as well as JICA, that support various sectors. In addition, ENBP has Australian and Japanese NGO offices and training centres, and it is implementing projects funded by them targeting the agricultural and health sectors. In this project, there were active sharing of information with those projects and fostering cooperation to promote efficient operations.

1.6.9 Basic Approach 9: Meeting Management According to the Situation of Local Government (Combining Face-to-Face Meeting and Online Meeting)

Members of the SC and TWG of this project include both national government departments and agencies, and organisations of ENBP. The government of PNG is responsible for the budget required to travel for attending the meetings. The timing of the meetings were set so that each meeting can be held efficiently. But it can be assumed that the participants may not be able to travel and participate in all the meetings due to budget limitations of each institution and conflict in schedules. Therefore, the SC meetings and the Joint TWG meetings were connected online so that all members from Kokopo, Rabaul and Port Moresby can participate from the respective venues in both cities.

1.7 Project Management Structure

In order to carry out the project effectively and efficiently, the SC and seven TWGs are organised on the PNG counterpart side. As discussed in Basic Approach 7 above, a Joint TWG is also proposed for conveying the contents of the discussion and coordination at the SC meeting to the local level, and grasp what is being discussed for the overall project at the local level.

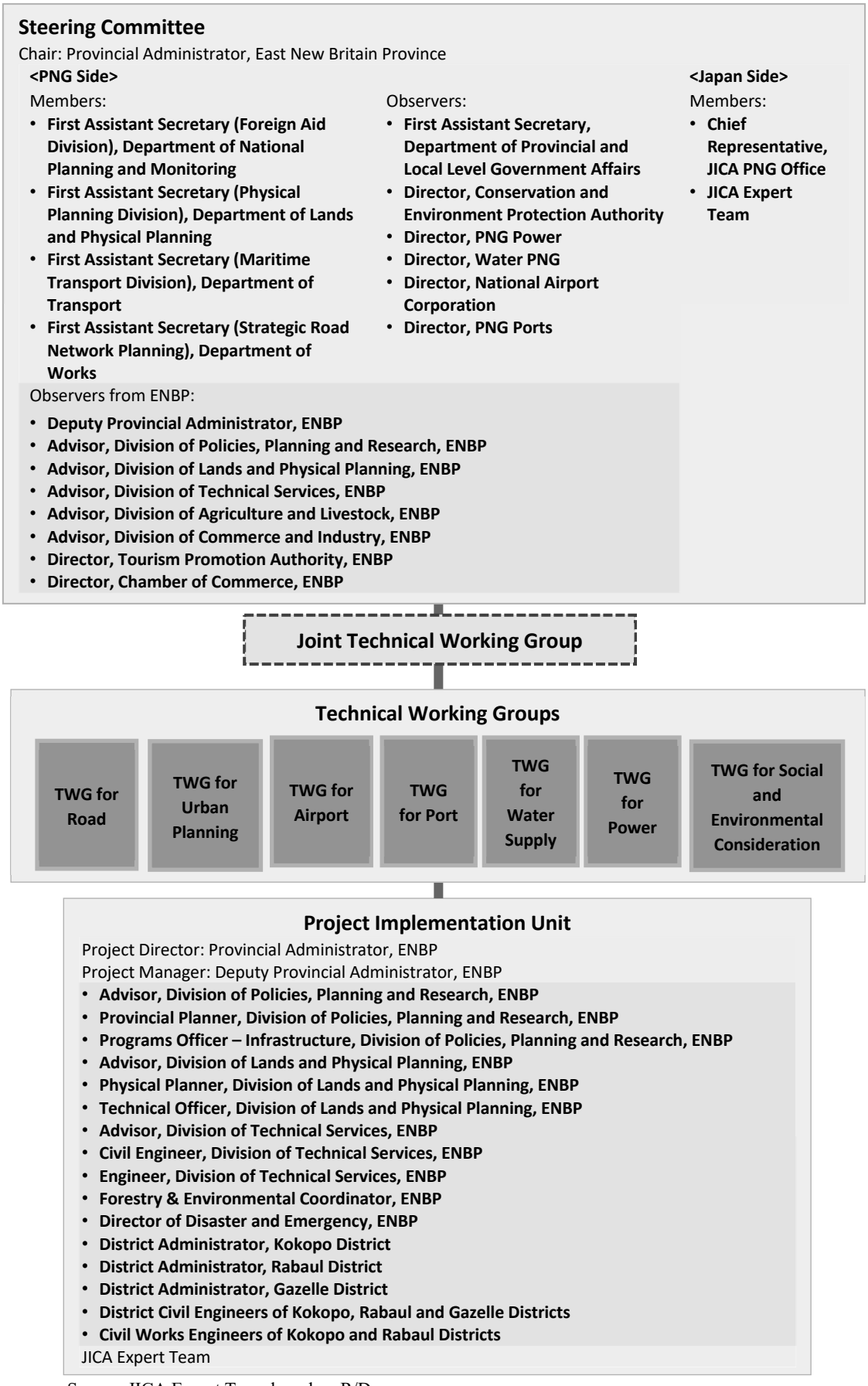
The JICA Expert Team also proposed to establish a Project Implementation Unit headed by the Provincial Administrator of ENBP as the Project Director and Deputy Provincial Administrator as the Project Manager with core counterparts.

The roles of the SC, Joint TWG, the seven TWGs and Project Implementation Unit are shown in Table 1.7.1. Members of each organisation are shown in Figure 1.7.1.

Table 1.7.1 Project Management Structure (Steering Committee and TWG)

Project Management Structure	Roles and Timing of Meetings
Steering Committee (SC)	• To discuss and define main items of the Project to facilitate inter-organisational coordination, and take necessary actions required for smooth implementation of the project. • To hold a meeting whenever a main report of the Project becomes ready for discussion, and/or whenever it is deemed necessary
Joint Technical Working Group (Joint TWG)	• To discuss and define main items of the Project at the provincial level • To hold a meeting whenever a main report of the Project becomes ready for discussion and/or whenever it is deemed necessary
Technical Working Group (TWG)	• To promote the coordination among ENBPA, JICA Expert Team and other related organisations • To monitor the progress of the project • To hold a meeting at least once a quarter
Project Implementation Unit (PIU)	• To discuss daily issues and take direct actions for smooth implementation of the project • To hold a regular meeting.

Source: JICA Expert Team



Source: JICA Expert Team based on R/D

Figure 1.7.1 Members of Project Management Structure

Table 1.7.2 Members of Joint TWG for NEGID-Plan

No.	Oranization	Division/Office	Position
1	East New Britain Province Administration (ENBPA)	-	Deputy Provincial Administrator
2		Division of Policy Planning and Research	Advisor
3			Provincial Planner
4			Programs Officer-Infrastructure
5		Division of Lands and Physical Planning	Advisor
6			Physical Planner
7			Development Assessment Planner
8			GIS Officer
9		Division of Agriculture and Livestock	Advisor
10			Program Officer-Agriculture
11			Program Officer-Livestock
12		Division of Fisheries & Marine Resources	Advisor
13		Division of Commerce and Industry	Advisor
14			Industrial Development Officer
15			Culture & Tourism Development Officer
16		Division of Infrastructure Development	Advisor
17			Civil Engineer
18		Natural Resource Management and Development Unit	Coordinator
19		Division of Community Development	Acting Advisor
20		Division of Response & Management	Director of Disaster and Emergency
21	Tourism Promotion Authority	ENBP Office	CEO
22	Kokopo District Administration	-	District Administrator
23		-	Civil Engineer
24		Kokopo/Vunamami Urban LLG	Town Manager
25		Kokopo/Vunamami Urban LLG	Town Development Planner
26		Bitapaka Rural LLG	Manager
27		Raluana Rural LLG	Manager
28	Rabaul District Administration	-	District Administrator
29		-	Civil Engineer
30		Rabaul Urban LLG	Town Manager
31		Rabaul Urban LLG	Town Development Planner
32		Balanataman Rural LLG	Manager
33		Kombiu Rural LLG	Manager
34	Gazelle District Administration	-	District Administrator
35		-	Civil Engineer
36		Central Gazelle Rural LLG	Manager
37		Vunadidir/Toma Rural LLG	Manager
38		Livuan/Reimber Rural LLG	Manager
39	Department of Works	ENBP Office	Provincial Works Manager
40		ENBP Office	Regional Works Manager
41		Central Office	Islands Regional Manager
42	Department of Lands and Physical Planning	Islands Regional Office	Principal Planner
43		Central Office	Chief Physical Planner
44	Department of Agriculture and Livestock	Islands Regional Office	Director
45	Department of Transport	Central Office	
46	National Airport Corporation	ENBP Office	Airports Operations Manager - Tokua
47		Port Moresby Head Office	Project Manager for Tokua Airport Redevelopment Project
48	PNG Power	ENBP Office	Business Manager - Kokopo
49		Port Moresby Head Office Government Relations and Regulations	Acting Executive General manager
50	Water PNG	ENBP Office	Business Centre Manager - Kokopo
51		Port Moresby Head Office	Acting Project Director

52	PNG Ports	ENBP Office	Business Manager – Rabaul
53		Port Moresby Head Office	Chief Infrastructure Office
54		Port Moresby Head Office	Manager Island Region
55	National Maritime Safety Authority	Port Moresby Head Office	Manager, Projects
56	JICA PNG Office	-	-
57	JICA Expert Team	-	-

Source: JICA Expert Team

PART II

REVIEW OF NATIONAL DEVELOPMENT PLANS AND DEVELOPMENT TRENDS

Chapter 2 National Visions and National Development Plans for Papua New Guinea

2.1 PNG Vision 2050

2.1.1 Background

In December 2007, the National Executive Council (NEC) of Papua New Guinea decided to formulate a framework for a long-term development strategy — "The Papua New Guinea Vision 2050" — that identifies future directions for PNG, reflecting the aspirations of its people.

2.1.2 Vision Statement

The vision to be realised for PNG by 2050 is as follows:

"Papua New Guinea will become a smart, fair, wise, healthy and happy nation."

2.1.3 Strategic Direction

By 2007-2010, PNG economy was characterised by the dominance of the mining and energy sectors, which contributed about 80 percent to PNG's total export revenue.

The strategic direction for Vision 2050 is as follows:

Papua New Guinea will develop and grow the manufacturing, services, agriculture, forestry, fisheries and ecotourism sectors from 2010 to 2050.

This direction will enable PNG's economy to grow and transform by 2050 to be more diversified (broad based), ensuring that disposable household incomes will be much higher than in 2010. These initiatives will increase GDP per capita and enhance its overall HDI ranking by 2050.

2.1.4 Strategic Focus Areas (Pillars)

To achieve the vision by 2050, seven areas (pillars) are considered Strategic Focus Areas as shown in Figure 2.1.1.

Source: Papua New Guinea Vision 2050

Figure 2.1.1 Seven Strategic Focus Areas of Vision 2050

2.1.5 Goals by 2050 and Intermediate Targets by 2020

Vision 2050 sets a national development goal of raising PNG's Human Development Index (HDI) to the top 50 or higher in the world by 2050. A wide range of economic activities is considered essential to improve household income.

As an intermediate target for economic development, the real GDP was set to grow from 15 billion to 24 billion PGK by 2020, and the per capita GDP from 1,820 to 2,820 PGK. In order to achieve these economic targets, as well as the national goal, the need for infrastructure development was argued to be essential.

2.2 PNG Development Strategic Plan (PNG-DSP) 2010-2030

2.2.1 Background of PNG-DSP 2010-2030

By translating the focus areas of Vision 2050 into clear directions for economic policies and sector interventions, Development Strategy Plan 2010-2030 (PNG-DSP 2010-2030) was prepared by the guidance of the National Goals and Directive Principles (NGDPs) in the preamble to the Constitution, Eight Point Plan and Vision 2050.

PNG-DSP 2010-2030 is the third edition of its kind (Development Strategic Plan). In the past for DSP 1997-2002 and DSP 2005-2010, integrated economic development plans were intended from medium-term perspectives to promote the integration of different sectors. Not preoccupied with or too much bounded by annual government budgets, PNG-DSP 2010-2030 was formulated by considering national development directions from long-term perspectives.

2.2.2 Vision and Goal

(1) Vision by 2030

The vision for PNG-SDP 2010-2030 is to achieve the status of a middle-income country by 2030.

(2) Goal by 2030

Seeking to achievement of a higher goal “High Quality of Life for all Papua New Guineans,” SDP 2010-2030 was formulated.

(3) Targets: Human Development Index (HDI) and Economic Growth Rates

The target of the World Ranking of Human Development Index (HDI) is set as follows:

- Improvement of HDI from the world ranking of 149th out of 179 countries in 2006 to the status within 50th by 2030

As for GDP, the following three targets of average annual growth rates of GDP in the period of 2010-2030 are set:

- Achievement of the Higher Goal: Average Annual Growth Rate: 8.4%
- Growth Rate for Achieving Vision 2050: 4.6% per year
- Without Development Strategic Plan: 2.6% per year

2.2.3 20-Year Development Strategy

The 20-year Development Strategy Plan (DSP) sets long-term goals and targets that are to guide development planning and are to set development priorities for development expenditure. In using this long-term development strategy and plan, the government tries to get away from the dominance and preoccupation of short-term and annual budgets for resource allocation.

The DSP 2010-2030 is to be implemented by four five-year Medium Term Development Plans.

The priorities and directions set in the PNG-DSP are to guide the development of sector policies, plans and strategies.

2.2.4 Development Targets of Economic Sectors

PNG's main economic sectors are agriculture, fisheries, forestry, petroleum, mineral, informal sectors, manufacturing and tourism. An overall direction of the PNG-DSP is to diversify the national and regional economies other than mining and petroleum sectors by strengthening the foundations for development of these sectors.

The three major sectors, namely, natural gas, land development and legal institutions, are expected to drive the national economy. The contributions of these three sectors in increases of sector GDP are forecast to be 60% in natural gas, 57% in land development and 48% in legal institutions respectively.

Following the first three sectors are agriculture, manufacturing and tourism sectors. Their contributions in increase of sector GDP are estimated to be 25% in agriculture, 23% in manufacturing and 21% in tourism.

Tourism and agriculture are expected to generate 360,500 jobs and 267,400 jobs, respectively. The target parameters related to tourism and agriculture sectors are as shown in Table 2.2.1.

Table 2.2.1 Target Parameters of Development of Tourism and Agriculture Sectors under the Development Strategy Plan (DSP)

	Baseline Numbers / Production	Target Numbers / Production in 2030
Tourist Arrivals	121,000 tourists （2008）	1.5 million tourists （2030）
Coffee Production (tons)	63,000 tons （2008）	500,000 tons （2030）
Palm Oil Production (tons)	556,000 tons （2007）	1.5 million tons （2030）
Cocoa Production (tons)	56,00 tons （2008）	310,000 tons （2030）
Copra Production (tons)	110,000 tons （2007）	440,000 tons （2030）

Source: PNG Development Strategy Plan 2010-2030

2.2.5 Economic Corridors

(1) The Economic Corridor Concept for PNG

In the PNG-DSP 2010-2030, the development of economic corridors is proposed for aiming at alleviating poverty. Target corridors are those in which poverty is prevalent. Such corridors of poverty are to be selected and transformed into economic corridors.

An economic corridor is a region in which the government is to provide a well-developed and effective network of transport and utilities, and quality education and health services, so that less costly business operations would be possible, and international and domestic investments could be attracted, under such environment and other well-designed incentives.

Economic corridors will be located in poorer regions within PNG, aiming at extending the development benefits to disadvantaged regions.

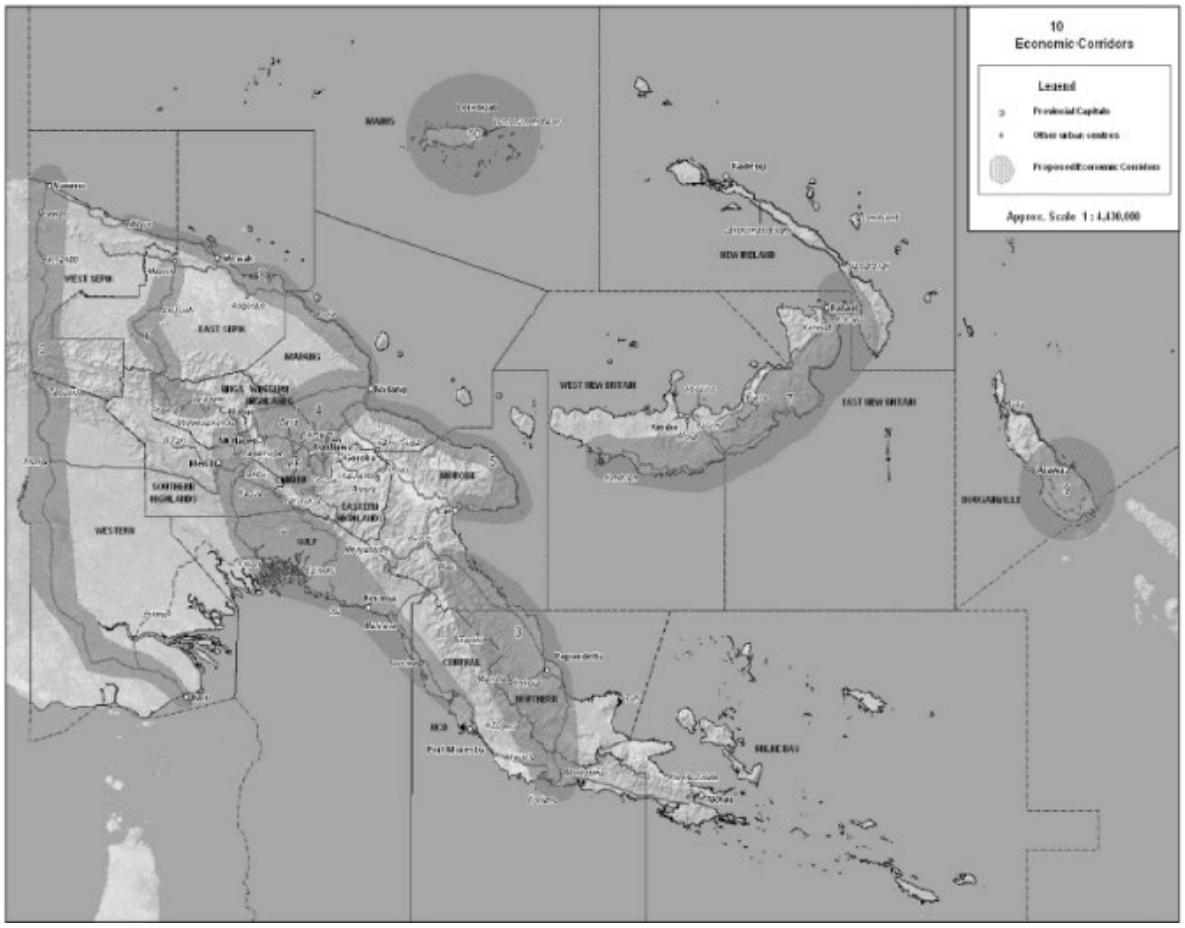
(2) 10 Economic Corridors Identified by the PNG-DSP 2010-2030

The PNG-DSP 2010-2030 identified 10 economic corridors, as shown in Table 2.2.2 and Figure 2.2.1. One of these 10 economic corridors are located in the New Britain Island, for connecting East New Britain Province (ENBP) and West New Britain Province (WNBP) through construction of a road in southern coastal areas.

Table 2.2.2 Ten Economic Corridors Identified by the PNG-DSP 2010-2030

No.	Name of Economic Corridor	Location (Provinces) of Economic Corridor
1	Petroleum Resource Area Economic Corridor (PRAEC)	Southern Highlands, parts of Enga, Gulf, and Central Provinces. The PRAEC was approved by Cabinet in May 2009
2	Border Corridor	Western, Southern Highlands and Sandaun Provinces
3	Central Corridor	Central, Milne Bay, Oro and Morobe
4	Madang-Baiyer-Karamui-Gulf Corridor	Madang, Simbu, Gulf and Western Highlands
5	Morobe-Madang Corridor	Morobe, Madan
6	Enga-Sepiks Corridor	Enga and East & West Sepik Provinces
7	South Coast Corridor	Connecting East New Britain and West New Britain Provinces by constructing a road through the southern coast of the New Britain Island
8	Momase Corridor	Madang, East Sepik, and West Sepik Provinces
9	Solomons Corridor	Autonomous Region of Bougainville
10	Free Zone Corridor	Manus, New Ireland, East and West Sepik Provinces

Source: PNG Development Strategy Plan 2010-2030



Source: PNG Development Strategy Plan 2010~2030

Figure 2.2.1 10 Economic Corridors in PNG

2.2.6 Development Targets of Infrastructure Sectors set in PNG-DSP 2010-2030

Development of a variety of infrastructure is required for promoting urban development, as well as development of national economies.

Priorities and directions for infrastructure development are provided in the PNG Development Strategic Plan 2010-2030 (PNG DSP 2010-2030) for guiding the formulation of sector policies, development plans and development strategies, and sector initiatives in infrastructure development.

Strategic targets and objectives for infrastructure development by 2030 are set by PNG-DSP 2010-2030 including the following:

- Tripling national roads coverage
- An increase in the proportion of national roads in good condition from 29% to 100%
- Expenditure on upgrading and rehabilitation to be directed to the 16 priority roads
- New road developments to be focused on economic corridor roads
- A three-fold increase in the provision of marine infrastructure
- All 22 regional airports to meet international certification standards
- 10 airports to be upgraded to high-seat jet capacity
- 50 airstrips to be rehabilitated

2.2.7 Transport Sector

The transport sector is comprised of road transport, maritime transport air transport sub-sectors in PNG.

(1) Road Transport Sub-Sector

1) Key Strategic Areas and Targets of the Transport Sector

PNG has one of the countries with lowest road densities in the world. PNG's road transport infrastructure is insufficient both in terms of maintenance and nationwide connectivity.

Key strategic areas and targets of the road transport sub-sector are as following table.

Table 2.2.3 Key Strategic Areas and Targets of Road Transport Sub-Sector in PNG-DSP 2010-2030

Key Strategic Areas	Current Situation	Targets (by 2030)
Road network	8,460km of national roads (total network 30,000km)	Triple national roads to 25,000km
Percentage of national roads in good condition	28.7% (2512km)	100%

Source: PNG Development Strategy Plan 2010-2030

2) Strategies for Road Transport

Upgrading and maintenance is essential for road infrastructure. National Government expenditure on upgrading (including re-routing) and on rehabilitation is to be devoted to the following 16 priority roads in the table below.

Table 2.2.4 Priority Roads in the National Transport Development Plan 2006-10

Very High Priority	High Priority	Medium Priority
Highlands Highway	Sepik Highway	Kokoda Road
Buluminsky Highway	West Coast Road	Wau Road
Koroba-Mendi Road	Baiyer Road	Buka Road
Pogera-Togoba Road	Hiritano Highway	Magi Highway
New Britain Highway	Coastal Highway	Ramu Highway
-	-	Northern Road

Source: PNG Development Strategy Plan 2010-2030

In addition to these priority roads, the following two types of nation building roads are proposed to be constructed over the next 20 years:

- **16 missing links**, which are to connect the national territory by a complete road network, facilitating the movement of people and goods/services
- **Corridor roads**, which are to open up productive regions, for supporting the national development.

Table 2.2.5 National Building Roads in PNG-DSP 2010-2030

No.	Region	Location	Road Category
1	Momase	Coastal Highway (Aitape-Vanimo)	Missing link
2	Momase	Bogia-Angoram Road (Madang to East Sepik)	Missing link
3	Momase/ Highlands	Baiyer River–Aiome –Amele Road (Western Higlands to Madang)	Missing link
4	Momase	Saidor–Wasu–Sialum Road	Missing link
5	Momase	Bewani-Imonda-Amanab-Green River- Telefomin Road (West Sepik to Western Province)	Missing link
6	Momase/ Highlands	Pagwi-Ambunti-Kuvenmas-Laiagam Road (East Sepik to Enga)	Missing link
7	Momase	Lae-Finchaffen-Kabwum Road	Missing link
8	Momase	Wau-Garaina-Morobe Patrol Post	Missing link
9	Highlands/ Southern	Kagua-Kikori Road	Corridor
10	Momase	Bogia-Angoram-Wewak	Corridor
11	Highlands	Kopiago-Oksapmin-Telefomin-Tabubil Road (Southern Highlands to Western Province)	Missing link
12	Highlands	Kiunga-Mendi Road	Corridor
13	Southern	Kupiano-Gadaisu Road (Central to Milne Bay)	Missing link
14	Southern	Bubuletta-Motau-Lavora-Raba Raba-Agaun Road	Missing link
15	Southern	Bariji-Safia-Moreguina Road (Oro to Central)	Missing link
16	Southern	Moreguina-Popondetta-Wau Road	Corridor
17	Southern	Kerema-Kopi Road (Gulf to Southern Highlands)	Missing link
18	Islands	Siara Junction-Soreken-Kunua Road (linking Torokina)	Missing link
19	Islands	New Britain Highway	Missing link
20	Islands	Ralubang-Tol-Pomio-Gasmata-Kandrian-Gloucester Road (linking East and West New Britain)	Missing link

Source: PNG Development Strategy Plan 2010-2030

The New Britain Highway connecting ENBP and WNBP is one of the missing links included in the Nation Building Roads in the PNG Development Strategy Plan.

Ralubang-Tol-Pomio-Gasmata-Kandrian-Gloucester Road is also one of the missing links included in the above list of national building roads. And also this road is part of the Southern Coastal Corridor linking East and West New Britain.

(2) Maritime Transport Sub-Sector

1) Key Strategic Areas and Targets of Maritime Transport Sub-Sector

Key strategic areas and targets in the period of 2010-2030 of the maritime transport sub-sector are as below.

Table 2.2.6 Key Strategic Areas and Targets of Maritime Transport Sub-Sector in PNG-DSP

Key Strategic Areas	Current Situation	Targets (by 2030)
Domestic water Transport capacity	N.A.	Triple number of routes serviced and number of vessels, and upgrade ports
International port turnaround times	3 days	1 day

Source: PNG Development Strategy Plan 2010-2030

2) Strategies for Maritime Transport Infrastructure

For achieving the accelerated development envisioned by the PNG Development Strategic Plan (PNG-DSP), five-times larger cargo throughputs (international and domestic coastal cargos) than the level of 2010 should be handled at all of the ports in PNG.

When the efficiency of cargo handling at ports can be improved at an average annual growth rate of 2%, the port infrastructure can be expanded by 2030 at least three times larger than the 2010 level. Inability to comply with this expansion of port infrastructure capacity might limit the potential volume of export and import of PNG, leading to the erosion of PNG's foundation of economic development. Therefore, investment for rehabilitation, expansion and upgrading of ports in PNG is needed.

(3) Air Transport Sub-Sector

1) Key Strategic Areas and Targets of the Air Transport Sub-Sector

Key strategic areas and targets of the air transport sub-sector are as below.

Table 2.2.7 Key Strategic Areas and Targets of Air Transport Sub-Sector in PNG-DSP 2010-2030

Key Strategic Areas	Current Situation	Targets (by 2030)
Share of regional airports meeting international certification	7 out of 22 in 2008 (32%)	22 out of 22 by 20030 (100%)
Airports upgraded for higher seating capacity	Only Port Moresby handles large jets	10 airports upgraded for larger jets
Number of unused airstrips rehabilitated	Most airstrips located in remote areas are not in use	Up to 50

Source: PNG Development Strategy Plan 2010-2030

2) Strategies for Increasing International Airports in PNG

In addition to the above key strategic areas of the air transport sub-sector, the development of international tourism will require upgrading of airport infrastructure at key tourist destinations including Alotau, Rabaul, Madang and Manus, for the purpose of creating new international routes. In relation to this development direction, Tokua Airport of New East Britain is required for upgrading to an international airport.

2.2.8 Water Supply Sector

(1) Key Strategic Areas and Targets of the Water Supply Sector

Key strategic areas and targets of the water supply sector are as below.

Table 2.2.8 Key Strategic Areas and Targets of Water Supply Sector in PNG-DSP 2010-2030

Key Strategic Areas	Current Situation	Targets (by 2030)
Access to Improved water source	39% of total population (30% of rural population in 2008)	70% of population
Access to improved sanitation	44% of population	70% of population
Proportion of education institutions having access to safe water	30% in 2008	100%

Source: PNG Development Strategy Plan 2010-2030

(2) Strategies for Water Supply Sector Development

Public and Private Investment

The targets for utilities are ambitious. To achieve the targets, the private sector is expected to play a role through public private partnerships. Investments of the private sector together with the public

sector should be attracted to the expansion of the water and sewerage network and services in response to PNG's growing urban population.

2.2.9 Power Sector

(1) Key Strategic Areas and Targets of the Power Sector

Key strategic areas and targets of the power supply sector are as below.

Table 2.2.9 Key Strategic Areas and Targets of Power Supply Sector in PNG-DSP 2010-2030

Key Strategic Areas	Current Situation	Targets (by 2030)
Access to electricity	12.4% of households	At least 70% of households
Gas, hydro and other renewable generation capacity	Gas: 72 MW Hydro: 217 MW Other: 56 MW	Gas: 390 MW Hydro: 1020 MW Other renewables: 500 MW
Diesel and coal generation capacity	158 MW grid connected diesel generation	Less than 40 MW capacity diesel generation and 30 MW coal generation
National grid	Does not exist	All major towns and cities to be in the national grid which will feed off an electricity super-corridor
Easipay domestic customers (prepaid power)	4% of households (51,000 households)	Most households have access to Easipay

Source: PNG Development Strategy Plan 2010-2030

(2) Strategies to Develop Energy Sources

For supporting PNG's development strategy, development of energy, especially electricity generation and transmission is essential. It is necessary to promote investments in electricity infrastructure in respond to the expected 5-time increase in demand for electricity by 2030.

Establishment of Electricity Super-Corridor

An electricity super-corridor with transmission lines and electricity generation capacities will be developed that goes through the areas where electricity can be generated at lower costs. This will enable towns, cities and rural communities to access electricity where it can be generated at lower costs.

2.3 Medium Term Development Plan (MTDP) III 2018-2022

2.3.1 Medium Term Development Plans (MTDPs)

Under the guidance of the following vision and strategic plan, medium term development plans (MTDPs) are to be formulated every five years:

- The PNG Vision 2050
- The PNG Development Strategic Plan (DSP) 2010-2030
- MTDP I, MTDP II and MTDP III translated the Vision 2050 and DSP 2030 into more specific programmes for implementation over the relevant five-year period.

The first Medium Term Development Plan (MTDP I) was formulated for the period of 2011-2015. The second Medium Term Development Plan (MTDP II) was done for the period of 2016-2017. MTDP II covered only one year period so that the period of MTDP II ended at the end of the term for the parliament. The current MTDP III was prepared for the period of 2018-2022 in response to the term of the parliament.

2.3.2 The Overall Goal of Medium Term Development Plan (MTDP) III 2018-2022

The overall goal of the MTDP III 2018-2022 is as follows:

"Securing our future through inclusive sustainable economic growth."

2.3.3 Key Result Areas (KRAs) of Medium Term Development Plan (MTDP) III 2018-2022

To achieve the overall goal of MTDP III, the following 8 Key Result Areas (KRAs) are set:

- KRA 1: Increased revenue and wealth creation
- KRA 2: Quality infrastructure and utilities
- KRA 3: Sustainable social development
- KRA 4: Improved law and justice and national security
- KRA 5: Improved service delivery
- KRA 6: Improved governance
- KRA 7: Responsible sustainable development
- KRA 8: Sustainable population

While the all Key Result Areas are important aspects for NEDID-Plan, Northeast Gazelle Peninsula's infrastructure development is more strongly related to Key Result Areas No.1, No,2, No, No.5. as follows:

(1) KRA 1: Increased Revenue and Wealth Creation

- To increase Exports of Major Agricultural Commodities, Fisheries Products, Processed Timber, Manufacturing, and Minerals.
- To create **more Employment and Economic Opportunities** for youth and build the capacity of productive workforce.
- To create wealth by promoting SME growth and **Attracting Direct Investments**.

(2) KRA 2: Quality Infrastructure and Utilities

- To improve **Infrastructure with Sustainable and Disaster Resilient Quality** to provide more enabling environment for growth of economy and for the improvement of service delivery

(3) KRA 4: Improved Law and Justice and National Security

- To improve law and order for reducing impediment of **Private Sectors Investments**.

(4) KRA 5: Improved Service Delivery

- To improve **Government Capacity in Districts and Provinces** by improving poor infrastructure and service centres

(5) KRA 7: Responsible Sustainable Development

- To promote Environmental Sustainability;
- To manage and reduce **the Risks of Natural Disasters and to** increase the Resilience of Communities to Disasters;
- To promote Sustainable Use of Water

2.3.4 Approach of MTDP III

MTDP III recommends that local governments and citizens should stop relying on the national government and focus on their own initiatives for raising revenues and incomes.

The expenditure required to implement MTDP III is estimated at 27.2 billion PGK. The government is aware of the importance of the economic sector and transport sector, whose government budgets are relatively large as much as 12% and 19% respectively.

The transport sector includes the development of economic corridors and construction of missing links. About 60% of the revenue comes from the government of PNG, and other sources of funding are foreign concession loans and grant aids.

2.4 Medium Term Development Plan (MTDP) IV 2023-2027

2.4.1 Medium Term Development Plans (MTDPs)

Launched in July 2023, the Fourth Medium Term Development Plan (MTDP IV) was formulated for the period of 2023-2027.

2.4.2 The Theme and Objectives of Medium Term Development Plan (MTDP) IV 2023-2027

The theme of the MTDP IV 2023-2027 is as follows:

"National Prosperity through Growing the Economy"

The objectives of the MTDP IV 2023-2027 are as follows:

- To achieve a K200 billion PNG economy by 2030;
- To create one million additional jobs; and
- To improve the quality of life for all PNG citizens.

2.4.3 Strategic Priority Areas (SPAs) of Medium Term Development Plan (MTDP) IV 2023-2027

To achieve the objectives of MTDP IV, twelve Strategic Priority Areas (SPAs) are set as pillars for MTDP IV as shown in Table 2.4.1.

Deliberate Intervention Programs (DIPs) which guide the government's investment plans, budget, programming and implementation by sectors are also set for each of these SPAs, as shown in Table 2.4.1..

Table 2.4.1 SPAs and DIPs of Medium Term Development Plan IV 2023-2027

Strategic Priority Areas (SPAs)	Deliberate Intervention Programs (DIPs)
SPA 1: Strategic Economic Investment To expand the PNG's economic base, the government of PNG focuses on strategic investment in critical economic sectors for the country such as agriculture, forestry, fisheries, mining and petroleum, clean energy, and the Micro, Small and Medium Enterprises (MSME).	**DIP 1.1: Commercial Agriculture and Livestock Development** DIP 1.2: Mining and Petroleum Development **DIP 1.3: Fisheries and Marine Resources** **DIP 1.4: Forestry** DIP 1.5: Banking and Finance DIP 1.6: Micro, Small and Medium Enterprises (MSME) **DIP 1.7: National Tourism, Arts and Culture Development** DIP 1.8: Trade and Investment **DIP 1.9: Manufacturing** DIP 1.10: Land Development **DIP 1.11: Downstream Processing**

SPA 2: Connect PNG Infrastructure Connect PNG, a long-term infrastructure program, aims to improve connectivity around the country through the development of critical infrastructure including transport infrastructure, energy grids and ICT networks, water and sanitation systems, and affordable housing.	**DIP 2.1: Connect PNG - Road Transport** **DIP 2.2: Connect PNG - Sea / Water Transport** **DIP 2.3: Connect PNG - Air Transport** **DIP 2.4: Connect PNG - Telecommunication and ICT Connectivity** **DIP 2.5: Connect PNG - Electrification Roll-out** **DIP 2.6: Connect PNG - Water, Sanitation and Hygiene (WaSH)** **DIP 2.7: Connect PNG - Housing** **DIP 2.8: Connect PNG - Urban Townships and District Growth Centres** **DIP 2.9: Connect PNG - Special Economic Zones (SEZs)**
SPA 3: Quality and Affordable Health Care The Government of PNG intends to secure quality and affordable health care services for every citizen in collaboration with private health care providers.	DIP 3.1: Primary Health Care DIP 3.2: Specialised Health Care DIP 3.3: Health Infrastructure DIP 3.4: Specialised Training and Accreditation DIP 3.5: HIV-AIDS
SPA 4: Quality Education and Skilled Human Capital In addition to existing initiatives such Tuition Fee Free (TFF) education policy and investment in Technical Vocational Education and Training (TVET), the PNG Government intends to invest to provide "accessible, affordable and quality education" for early childhood, primary and secondary education.	DIP 4.1: Early Childhood Education DIP 4.2: Quality Basic Primary and Secondary Education DIP 4.3: Tertiary and College Education DIP 4.4: Technical Vocational Education and Training (TVET) DIP 4.5: Quality Training and Accreditation
SPA 5: Rule of Law and Restorative Justice The Government aims towards restoring the "respect for the rule of law" by improving effective policing, public safety, crime prevention, restorative justice, access to justice systems, community peace and capacity building for effective delivery of justice services.	DIP 5.1: National Policing and Crime Prevention Program DIP 5.2: Judiciary Systems Administration DIP 5.3: Correctional Services Rehabilitation and Reintegration (CSRR) Program DIP 5.4: Community Peace and Restorative Justice
SPA 6: National Security The Government of PNG has concerns about increase of external threats and emphasis securing National Security by improve the capabilities of the National Defence systems.	DIP 6.1: National Security and Defence Cooperation DIP 6.2: Immigration DIP 6.3: Cyber Security DIP 6.4: Biosecurity DIP 6.5: National Business Protection DIP 6.6: National Intelligence
SPA 7: National Revenue and Public Finance Management National revenue and public finance management are intended to be improved by supporting tax and non-tax revenue mechanisms through strengthen of compliance and collection, capacity enhancement, reporting, and new revenue sources.	DIP 7.1: Tax Compliance and Administration DIP 7.2: Customs Compliance and Administration DIP 7.3: Non-Tax Revenue Compliance and Administration DIP 7.4: Public Expenditure Governance DIP 7.5: Payroll Administration
SPA 8: Digital Government, National Statistics and Public Service Governance Digitisation and integration of public service are encouraged to improve governance and service delivery at the National, Provincial and District levels.	DIP 8.1: Integrated Digital Government System DIP 8.2: National Statistical System DIP 8.3: National Identification Registration DIP 8.4: Electronic Electoral System DIP 8.5: Censorship DIP 8.6: Public Service Administration] DIP 8.7: Public Service Governance DIP 8.8: Central Agencies Coordination

SPA 9: Research, Science and Technology The Government intends to invest in Research, Science and Technology (RST) strategically to make a smart country.	DIP 9.1: Medical Research DIP 9.2: Environment and Bio-Science Research DIP 9.3: Agricultural Research DIP 9.4: Engineering and Technology Research DIP 9.5: Socio-Economic Policy Research DIP 9.6: Food Security
SPA 10: Climate Change and Natural Environment Protection The Government aims to build a resilient economy to climate change which threatens public assets, export commodities, private investments and the well-being.	DIP 10.1: Climate Change Mitigation and Adaptation DIP 10.2: Environmental Protection **DIP 10.3: Natural Disaster Management**
SPA 11: Population, Youth and Women Empowerment To support sustainable population growth, the government empowers youths through skills training and addresses issues affecting women and requirements of people living with disability and vulnerable.	DIP 11.1: Sustainable Population DIP 11.2: Youth Development and Labour Mobility DIP 11.3: National Sports Development DIP 11.4: Women Empowerment DIP 11.5: Family and Social Inclusion
SPA 12: Strategic Partnerships The government is concerned with strengthen of bilateral and multilateral partnerships for strategic development cooperation arrangements to advance economic, development, security and other strategic interests of PNG.	DIP 12.1: Foreign Relations DIP 12.2: Development and Economic Cooperation DIP 12.3: Private Sector DIP 12.4: Civil Society and Faith-based Organisations DIP 12.5: National Volunteerism

Source: PNG Medium Term Development Plan IV 2023-2027

While all these Strategic Priority Areas are important aspects for NEDID-Plan, Northeast Gazelle Peninsula's infrastructure development is more strongly related to Strategic Priority Areas No.1, No,2, and No.10. as shown above.

2.4.4 ENBP Development Directions Aligned with MTDP IV

The strategic investments towards the twelve SPAs in MTDP IV are estimated at 51 billion PGK. Out of the twelve SPAs, share of investments for the Strategic Economic Investment (SPA 1) and Connect PNG Infrastructure (SPA 2) are relatively large as much as 35.1% and 19.0% respectively.

While SPA 1 "Strategic Economic Investment" identifies 11 target groups as shown in Table 2.4.1, the following six areas are relevant to ENBP's development directions:

- DIP 1.1: Commercial Agriculture and Livestock Development
- DIP 1.3: Fisheries and Marine Resources
- DIP 1.4: Forestry
- DIP 1.7: National Tourism, Arts and Culture Development
- DIP 1.8: Trade and Investment
- DIP 1.9: Manufacturing
- DIP 1.11: Downstream Processing

Connect PNG is a program to improve country-wide connectivity in terms of transport infrastructure, energy and water supply, telecommunication networks, etc. Strategies for land transport in the Connect PNG include rehabilitation and maintenance of the National Road Network. The development of economic corridors and construction of missing links are intended to be implemented, continuing from MTDP III, New Britain Corridor is identified as a priority in this MTDP IV. For Sea Transport, upgrading of port facilities including Rabaul Port is expected. Air transport sector has a program for development of five regional airports including Tokua Airport, to cater for international and commodity airfreight flights.

Strategies for electric power sector include improving power generation and increasing transmission infrastructure. It aims to provide reliable and affordable energy to 70% of householders and industries by 2030.

Water supply sector has strategies which include upgrading and rehabilitation of existing national and provincial WaSH infrastructure. It intends to provide WaSH to schools, health centres, communities and rural towns and peri-urban centres. The government recognises that accessibility to reliable water and power is one of challenges of manufacturing industries in PNG. In this MTDP IV, provision of enabling infrastructure and social environment is focused to encourage such manufacturing and processing industries.

The funding for these infrastructures mainly comes from the government of PNG, foreign concession loans and grant aids and Infrastructure Tax Credit Scheme.

In implementing MTDP IV, natural disaster is concerned as one of main potential risks. The government recognises managing and reducing the risk of natural disasters as a priority and intends to develop a Disaster Resilient Infrastructure Program whose cost is estimated at 170 million PGK.

2.5 Special Economic Zones: Policy, Law, and Organization

2.5.1 Law for Special Economic Zones (SEZs)

The Special Economic Zone Authority Act was enacted in November 2019.

This Act removed the effectiveness of the Free Trade Zone Act 2000 and the Industrial Centres Development Corporation Act (ICDC Act) 1990.

According to the Act, the Act is intended to do the following things:

- To enable the establishment, development, operation and regulation of SEZs in PNG.
- To encourage the development of new and additional business activities in SEZ
- To create a Special Economic Zone Authority to develop and regulate SEZs including the selection of sites for development and operation for related purposes

2.5.2 The Special Economic Zone Authority

Under the SEZ Authority Act, a Special Economic Zones Authority was established to regulate the establishment and development of Special Economic Zones in PNG. It was organized in 2019 by taking over the Industrial Centers Development Corporation (ICDC), but it has not yet carried out any substantive activities. ICDC has managed industrial parks in Lae (Malahang) of Morobe Province and Kokopo (Ulaveo) of East New Britain Province.

The SEZ Authority was provided with the power and responsibilities to be able to acquire land, evaluate submissions from enterprises that have the intention to develop and operate SEZs, and make final determinations on the provision of licences to operate within a zone.

2.5.3 Special Economic Zones

Special economic zones are any delimited geographic areas that are designated under the SEZ Authority Act. They will have on-site single services including administrative regulation, and management, infrastructure.

Special Economic Zone Development Programme (SEZDP) is PNG's national programme to institutionalise the development and operation of SEZs including planning, implementation, monitoring and evaluation. The SEZDP is to adopt a flexible policy in which various types of Special Economic Zones listed in Table 2.5.1 are to be operated in PNG:

Table 2.5.1 Various Types of SEZs Allowed to be Operated in PNG

1	Free Trade Zone	13	Logistics Park
2	Export Processing Zone	14	Airport Free Zone
3	Free Port Zone	15	Airport City
4	Enterprise Zone	16	Forestry Park
5	Tourism Zone	17	Industrial Park
6	Bonded Area	18	Agriculture Park
7	Single Factory Zone	19	Arts and Crafts Park
8	Marine Industrial Zone	20	Border Free Trade Zone
9	Science Technology Park	21	Residential Estate Zone
10	Petroleum Park	22	Eco-Industrial Zones
11	Metals Refinery Park	23	Finance SEZ
12	Energy Park	24	Comprehensive SEZ

Source: SEZ Authority's presentation material of SEZ Summit 2024 in PNG

2.5.4 Taxation of Special Economic Zone Enterprises

In the designated SEZ, operating enterprises will get benefits of free of taxes and duties for 10 years, to promote Foreign Direct Investment (FDI) to build critical capital Infrastructures, industries, facilities, establishes and to increase export.

Free Trade Zones (FTZs) can be the main functions of any SEZs, in which only certain classified goods and services may be exempted from taxes and duties after 10 years' concession to maintain maximum export.

2.5.5 Potential Areas for Setting SEZs in PNG

The SEZ Authority Act has an attachment of a list of 20 potential SEZ areas as shown in Table 2.5.2.

Table 2.5.2 Types and Activities Potential SEZs in Provinces and Districts

No.	Province.	Districts	Type / Activity.
1	East New Britain	All Districts	Tourism
2	West New Britain	All Districts	General
3	Autonomous Regional of Bougainville	All Districts	Agriculture
4	National Capital District	All Districts	General
5	Central	All Districts	General
6	Oro	All Districts	Tourism
7	Milne Bay	All Districts	Tourism
8	Western	All Districts	Agriculture
9	Gulf	All Districts	Industrial
10	Morobe	Finschhafen	Technology
11		Markham District	Agriculture Park
12		Huon Gulf	Industry
13	Madang	All Districts	Marine and Tourism
14	East Sepik	All Districts	Agriculture
15	West Sepik	All Districts	Agriculture
16	Western Highlands	All Districts	Agriculture and General
17	Jiwaka	All Districts	Agriculture and General
18	Hela	All Districts	Petroleum and General
19	Southern Highlands	All Districts	Petroleum and General
20	Eastern Highlands	All Districts	Agriculture

Source: Attachment of the SEZ Authority Act, 2019 (PNG)

Under the new Act, the government allocated a certain amount of budget for newly establishing the SEZ Authority and for preparation of Ihu Special Economic Zone in Gulf Province. A new SEZ in Manus Province is also at the stage of preparation.

2.5.6 PNG SEZ Summit 2023

In order to activate and accelerate the establishment of SEZs in PNG, Ministry of International Trade & Investment and SEZ Authority organised a summit (a conference) for promoting and diffusing a new SEZ policy from 7th until 9th of May 2023 in Port Moresby. About 500 participants from government and private sectors, including international speakers and investors gathered this summit for the following objectives:

- To understand the definition, types, functions and benefits of Special Economic Zones,
- To understand why the last 30 years effort at Free Trade Zones (FTZ), Export Processing Zones (EPZ) and other types of promoting FDIs have failed in PNG, and
- To discuss the directions of implementing the SEZ policy by overcoming difficulties related to a variety of government sectors including lands, transport, power, telecommunication, and security.

The SEZ Authority has been engaged in the formulation of a SEZ Master Plan for PNG, including evaluations about 20 candidate SEZs all over the provinces in PNG in respect of potential investment targets, location and land suitability and preparedness for establishing SEZs. According to the SEZ Master Plan presentation at the SEZ Summit 2023, the top several SEZ candidates have been identified as high potential to work toward the establishment and operation of SEZs in PNG.

Moreover, the amendment of the SEZ Authority Act and capacity development of government officers in charge of SEZ administration under the SEZ Authority have been considered for substantiating the efforts at establishment and operation of SEZs in PNG.

2.6 Papua New Guinea National Disaster Risk Reduction Framework 2017-2030

2.6.1 Expected Outcome and Goal by 2030

The Papua New Guinea Government's National Disaster Centre formulated and established a National Disaster Risk Reduction Framework in 2017.

The Expected Outcome by 2030 is as follows:

- "The substantial reduction of disaster risk and increased resilience of communities in PNG."

To achieve this expected outcome, the following goal should be achieved:

- "Reduce existing and prevent new disaster risk through the implementation of integrated structural and non-structural risk reduction measures that prevent and reduce hazard exposure and vulnerability to disasters, increase preparedness for response and recover capacity, and thus strengthen resilience."

2.6.2 National Targets

To assess the progress in achieving the outcome and goal of the present framework, seven national targets are set. Also, target indicators are set to measure the achievement of each target.

The national targets and their target indicators are as shown in Table 2.6.1.

Table 2.6.1 National Targets and their Target Indicators

National Targets	Target Indicators
Target 1 Reduce Disaster Mortality in PNG by 2030	• Number of deaths and missing persons attributed to disasters, per 100,000 population • Number of deaths attributed to disasters, per 100,000 population • Number of missing persons attributed to disasters, per 100,000 population

Target 2 Reduce the Number of People Affected by Disasters in PNG by 2030	• Number of directly affected people attributed to disaster, per 100,000 population • Number of injured or ill people attributed to disaster, per 100,000 population • Number of people whose damaged dwellings were attributed to disaster • Number of people whose destroyed dwellings were attributed to disaster • Number of people whose livelihoods were disrupted or destroyed, attributed to disaster • Number of people below nutrition standards attributed to disaster
Target 3 Reduce Direct Disaster Economic Loss in Relation to National Gross Domestic Product (GDP) by 2030	• Direct economic loss attributed to disasters in relation to national gross domestic product • Direct agriculture loss attributed to disasters • Direct economic loss to all other damaged or destroyed productive assets attributed to disasters • Direct economic loss in the housing sector attributed to disasters • Direct economic loss resulting from damaged or destroyed critical infrastructure attributed to disasters • Direct economic loss to cultural heritage damaged or destroyed attributed to disasters • Number of gardens destroyed attributed to disasters • Number of livestock killed attributed to disasters
Target 4 Reduce Disaster Damage to Critical Infrastructure and Disruption of Basic Services	• Damage to critical infrastructure attributed to disasters • Number of destroyed or damaged health facilities attributed to disasters • Number of destroyed or damaged educational facilities attributed to disasters • Number of destroyed or damaged communication system & networks (radio/telephone towers) attributed to disasters • Number of destroyed or damaged church-run facilities • Number of other destroyed or damaged critical infrastructure units and facilities attributed to disasters • Number of disruptions to basic services attributed to disasters • Number of disruptions to educational services attributed to disasters • Number of disruptions to health services attributed to disasters
Target 5 Increase the Number of Provinces with Provincial and Local Disaster Risk Reduction Strategies by 2030	• Number of provinces that adopt and implement disaster risk reduction strategies in line with the National Disaster Risk Reduction Framework • Percent of local governments that adopt and implement local disaster risk reduction strategies in line with the National Disaster Risk Reduction Framework
Target 6 Enhance International Cooperation through Adequate and Sustainable Support to Complement National Actions for Implementation on this Framework by 2030	• Enhance International Cooperation through Adequate and Sustainable Support to Complement National Actions for Implementation on this Framework by 2030 • Total official international support (official development assistance (ODA) plus other official flows), for national disaster risk reduction actions • Total official international support (ODA plus other official flows), for transfer and exchange of disaster risk reduction related technology • Total official international support (ODA plus other official flows), for disaster risk reduction capacity building • Number of international, regional and bilateral programmes and initiatives for the transfer and exchange of science, technology and innovation in disaster risk reduction for PNG • Number of international, regional and bilateral programmes and initiatives for disaster risk reduction related capacity building in PNG • Number of initiatives to strengthen disaster risk reduction related statistical capacity
Target 7 Increase the Availability of and Access to Multi Hazard Early Warning Systems and Disaster Risk Information and Assessments to People in PNG by 2030	• Number of provinces that have multi-hazard early warning systems • Number of provinces that have multi-hazard monitoring and forecasting systems • Number of people per 100,000 that are covered by early warning information through regional, national or sub-national dissemination mechanisms • Percentage of local governments having a plan to act on early warnings

	• Number of people that have accessible, understandable, usable and relevant disaster risk information and assessment available at the national and sub-national levels • Percentage of population exposed to or at risk from disaster protected through pre-emptive evacuation following early warning

Source: National Disaster Risk Reduction Framework 2017-2030, PNG

2.6.3 Guiding Principles

The National Disaster Risk Reduction Framework 2017-2030 is guided by the following principles adapted from the Sendai Framework.

Government Responsibilities

The Government has the primary responsibility to prevent and reduce disaster risk through international, regional. transboundary and bilateral cooperation. Responsibilities for disaster risk reduction are shared by provincial and local level governments as well.

Protection of Human Rights

Management of the disaster risk aimed to protect persons and their property, health livelihoods, products and cultural and environmental assets, and to promote and protect all human rights.

Inclusive Engagement and Partnership

The adoption of a gender, age, disability and cultural perspective in all policies and practices, and the promotion of women and youth leadership are critical.

Coordination

Effective vertical and lateral coordination which accounts for relevant sectors, stakeholders and executive and legislative institution is essential for disaster risk reduction and management.

Community Empowerment

Empowering local authorities and communities to reduce disaster risk is necessary.

Information Management

Free access to multi-sectoral disaggregated data is critical to effective information management.

Sustainable Development

The development, strengthening and implementation of relevant policies, plans, practices and mechanisms need to aim at coherence across sustainable development and growth, food security, health and safety, climate change and variability, environmental management and disaster risk reduction agendas.

Understanding Local Risk

It is needed to understand the drivers of disaster risk in the local context to determine appropriate risk reduction measure.

Risk-Informed Development

To address fundamental factors of disaster risk through risk-informed investments across public and private sectors is more cost-effective than post-disaster response and recovery.

Building Back Better

In the post-recovery, rehabilitation and reconstruction, it is critical to reduce disaster risk based on "Building back better".

Education and Awareness

To promote public education and awareness in disaster risk reduction and safety is essential.

2.6.4 Priorities for Action

Based on the experience gained through the previous Framework, focused actions within and across sectors at all levels in the following four priority areas are formulated:

Priority 1: Understanding Disaster Risk

Policies and practices for disaster risk management based on an understanding of disaster risk in all its dimensions are fundamental to prevention and mitigation activities and implementation of appropriate disaster preparedness and effective response.

Priority 2: Strengthening Disaster Risk Governance to Manage Disaster Risk

Collaboration and partnership across mechanisms and partnerships for successful disaster risk reduction and sustainable development are promoted by an inclusive governance for effective and efficient disaster risk management.

Priority 3: Investing in Disaster Risk Reduction for Resilience

Public and private investment in disaster risk prevention and reduction are essential to enhance the economic, social, health and cultural resilience of persons, communities and countries.

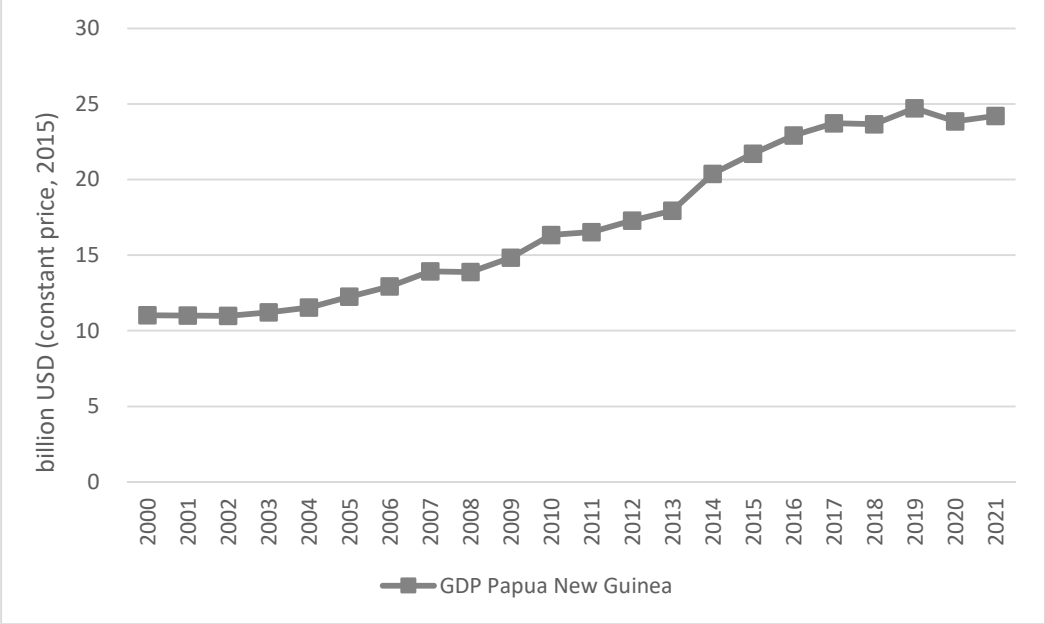
Priority 4: Enhancing Disaster Preparedness for Effective Response and to "Build Back Better" in Recovery, Rehabilitation, and Reconstruction

Rehabilitation and reconstruction are important phases to bolster communities' resilience to future disasters. It is critical to integrate disaster risk reduction measures into post-disaster development program for enhancing disaster preparedness.

Chapter 3 National and Regional Development Trends

3.1 Review of Past Development Situation of Papua New Guinea

Papua New Guinea (PNG) is a lower-middle-income country with gross domestic product (GDP) per capita of USD 2,916 in 2021. The GDP of PNG was steadily increasing in late 2000 to early 2010. However, since 2016, the economy has been stagnating.



Source: World Developmentn Indicators (data as of 20th July 2022)

Figure 3.1.1 GDP Trend of Papua New Guinea (2000 – 2021)

The coronavirus disease (COVID-19) pandemic has significantly affected PNG's economy (GDP), which had contracted by 3.5% in 2020, followed by a weak recovery to 1.3% growth in 2021 according to the IMF's World Economic Outlook (July 2022 data).

GDP per capita (current US$) had increased from US$ 1,949 in 2010 to US$ 2,757 in 2020. Inflation and unemployment rates were in the 4-6% range and in the 2% range, respectively.

Investment levels were likely lower in 2021. Investment in the mining and liquefied natural gas (LNG) sectors had been rising until 2019. However, investment dropped sharply in 2020. Investment in the non-extractive sector also appears to have declined. It is said that this decline in investment is likely to have the greatest long-term impact on future growth.

PNG consistently runs merchandise trade surpluses. PNG exports mainly minerals (gold, oil, LNG, copper, coffee, cocoa, and vegetable oils). It is dependent on the regular import of food for daily consumption, manufactured goods including building materials and fuel, and chemicals. The main trading partners of PNG are Australia, USA, Singapore, China and Malaysia.

3.2 Economy

(1) Review of Gross Domestic Product (GDP) in the Whole Country

The gross domestic product of PNG was PGK 65,714 million (2013 constant prices) in 2019. Table 3.2.1 shows the recent trend of GDP at constant prices (2013 prices) by sector/activity. The annual average growth rate between 2011 and 2019 was approximately 5.2%.

The growth rate of the mining and quarrying sector is highest at approximately 15% mainly by the contribution of the extraction of crude petroleum and natural gas, followed by information and communication sector at 7.8%, education at 5.8%, and electricity, gas and steam at 5.7%, respectively. The agriculture sector has been increasing steadily at 2.9%. On the other hand, the growth rates of manufacturing and construction are negative; and those of wholesale and retail trade, and transport and storage are low at around 1%.

Table 3.2.1 Gross Domestic Product (GDP) by Sector in PNG

Unit: Kina millions (2013 constant prices)

Industrial Sector/ Activity		GDP (Year)									Annual Growth Rate
		2011	2012	2013	2014	2015	2016	2017	2018	2019	2011-2019
A	Agriculture, forestry and fishing	8,287	8,781	9,191	9,503	9,252	9,497	9,720	10,165	10,394	2.87%
B	Mining and quarrying - total	6,888	6,166	6,478	11,264	16,586	19,124	20,667	18,775	20,889	14.88%
	Extraction of crude petroleum and natural gas	1,489	1,463	1,515	6,055	11,249	12,860	13,390	11,340	13,057	31.18%
	Other mining	5,399	4,703	4,963	5,209	5,337	6,264	7,277	7,436	7,832	4.76%
C	Manufacturing	1,151	1,145	1,165	1,155	1,006	1,043	1,082	1,009	1,003	-1.71%
D	Electricity, gas, steam and air-conditioning supply	374	404	453	473	487	512	536	559	581	5.66%
E	Water supply, sewage, waste management	83	86	96	86	87	91	95	105	109	3.47%
F	Construction	4,206	4,621	4,473	4,644	4,103	4,182	3,739	3,704	3,387	-2.67%
G	Wholesale and retail trade	5,223	5,380	5,543	5,612	5,274	5,363	5,427	5,532	5,616	0.91%
H	Transport and storage	1,327	1,331	1,423	1,233	1,312	1,344	1,360	1,407	1,458	1.18%
I	Accommodation and food service activity	882	922	949	949	969	972	1,014	1,119	1,104	2.85%
J	Information and communication	767	764	774	1,049	1,104	1,152	1,180	1,209	1,402	7.83%
K	Financial and insurance activities	1,773	2,092	2,340	1,980	1,664	1,581	1,556	1,583	1,510	-1.99%
L	Real estate activities	2,812	2,889	3,057	3,136	3,234	3,392	3,512	3,582	3,680	3.42%
M	Professional, scientific and technical activities	849	892	863	798	653	640	608	551	615	-3.95%
N	Administrative and support service activities	3,657	4,069	3,949	4,023	3,926	3,949	3,969	4,485	4,671	3.11%
O	Public administration and defence, compulsory social security	2,181	2,152	2,334	2,604	2,703	2,749	2,800	3,079	3,095	4.47%
P	Education	1,109	1,206	1,392	1,500	1,552	1,640	1,675	1,726	1,738	5.78%
Q	Human health and social work activities	851	924	974	972	965	1,117	1,150	1,215	1,223	4.64%
	Other service activities	381	489	501	462	408	400	387	391	404	0.74%
	GVA at basic prices	42,800	44,315	45,955	51,443	55,284	58,747	60,477	60,199	62,882	4.93%
	Taxes less subsidies on product	1,118	1,648	1,766	2,741	2,465	2,172	2,595	2,698	2,832	12.32%
	Total GDP	**43,918**	**45,963**	**47,721**	**54,185**	**57,749**	**60,919**	**63,072**	**62,896**	**65,714**	**5.17%**

Source: National Statistical Office, National Accounts 2011-2018 and National Accounts 2013-2019

Table 3.2.2 illustrates the share of gross value added (GVA) by sector at constant prices (2013 prices). The share of the mining and quarrying sector has rapidly increased since 2015 in particular. As for major economic sectors, the shares of agriculture, manufacturing, construction, wholesale and retail trade, and transport and storage have decreased since 2011. On the other hand, the share of information and communication sector increased from 1.8% in 2011 to 2.2% in 2019.

Table 3.2.2 Share of Gross Value Added (GVA) by Sector in PNG

Industrial Sector/ Activity		Share of GVA (Year)								
		2011	2012	2013	2014	2015	2016	2017	2018	2019
A	Agriculture, forestry and fishing	19.4	19.8	20.0	18.5	16.7	16.2	16.1	16.9	16.5
B	Mining and quarrying - total	16.1	13.9	14.1	21.9	30.0	32.6	34.2	31.2	33.2
	Extraction of crude petroleum and natural gas	3.5	3.3	3.3	11.8	20.3	21.9	22.1	18.8	20.8
	Other mining	12.6	10.6	10.8	10.1	9.7	10.7	12.0	12.4	12.5
C	Manufacturing	2.7	2.6	2.5	2.2	1.8	1.8	1.8	1.7	1.6
D	Electricity, gas, steam and air-conditioning supply	0.9	0.9	1.0	0.9	0.9	0.9	0.9	0.9	0.9
E	Water supply, sewage, waste management	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
F	Construction	9.8	10.4	9.7	9.0	7.4	7.1	6.2	6.2	5.4
G	Wholesale and retail trade	12.2	12.1	12.1	10.9	9.5	9.1	9.0	9.2	8.9
H	Transport and storage	3.1	3.0	3.1	2.4	2.4	2.3	2.2	2.3	2.3
I	Accommodation and food service activity	2.1	2.1	2.1	1.8	1.8	1.7	1.7	1.9	1.8
J	Information and communication	1.8	1.7	1.7	2.0	2.0	2.0	2.0	2.0	2.2
K	Financial and insurance activities	4.1	4.7	5.1	3.8	3.0	2.7	2.6	2.6	2.4
L	Real estate activities	6.6	6.5	6.7	6.1	5.8	5.8	5.8	6.0	5.9
M	Professional, scientific and technical activities	2.0	2.0	1.9	1.6	1.2	1.1	1.0	0.9	1.0
N	Administrative and support service activities	8.5	9.2	8.6	7.8	7.1	6.7	6.6	7.5	7.4
O	Public administration and defence, compulsory social security	5.1	4.9	5.1	5.1	4.9	4.7	4.6	5.1	4.9
P	Education	2.6	2.7	3.0	2.9	2.8	2.8	2.8	2.9	2.8
Q	Human health and social work activities	2.0	2.1	2.1	1.9	1.7	1.9	1.9	2.0	1.9
	Other service activities	0.9	1.1	1.1	0.9	0.7	0.7	0.6	0.6	0.6
	GVA at Basic Prices	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: JICA Expert Team, based on data from the National Statistical Office, National Accounts 2011-2018 and National Accounts 2013-2019

(2) Economically Active Population and Number of Employed Persons by Sector

Economically active population of PNG was 3.34 million in 2011, which was 46% of the total population.

As shown in Table 3.2.3, the total number of employees above 10 years old of the whole country in 2011 was approximately 3.27 million. The agriculture sector had the largest number with 2.48 million, followed by wholesale and retail trade with 0.36 million, construction with 64 thousand, and education with 59 thousand.

The shares of the major industrial sectors in East New Britain Province (ENBP) were almost the same as those of the whole country. On the other hand, the share of the agriculture sector at 68.8% in Northeast Gazelle Peninsula was smaller than the national average at 75.9%; and the shares of manufacturing at 1.6%, construction at 3.5%, and transport and storage at 2.3% in the Northeast Gazelle Peninsula were larger than those of the whole country.

Table 3.2.3 Number of Employed Persons by Sector in PNG (2011)

Industrial Sector/Activity	PNG		ENBP		Northeast Gazelle Peninsula	
	Persons	Share	Persons	Share	Persons	Share
Total	3,272,026	*100.0%*	129,138	*100.0%*	74,596	*100.0%*
Agriculture Hunting and Forestry	2,482,609	*75.9%*	97,645	*75.6%*	51,335	*68.8%*
Fishing	17,679	*0.5%*	374	*0.3%*	228	*0.3%*
Mining and Quarrying	24,743	*0.8%*	317	*0.2%*	182	*0.2%*
Manufacturing	25,243	*0.8%*	1,484	*1.1%*	1,188	*1.6%*
Electricity Gas Steam and Hot Water	3,734	*0.1%*	195	*0.2%*	172	*0.2%*
Construction	64,147	*2.0%*	3,324	*2.6%*	2,612	*3.5%*
Wholesale and Retail Trade Sale, and Motor Vehicle Repair	359,223	*11.0%*	12,169	*9.4%*	8,269	*11.1%*
Hotel and Restaurant	6,511	*0.2%*	168	*0.1%*	149	*0.2%*
Transport Storage and Communications	38,952	*1.2%*	2,021	*1.6%*	1,687	*2.3%*
Financial Intermediation	4,931	*0.2%*	206	*0.2%*	187	*0.3%*
Real Estates Renting and Business Service Activities	54,830	*1.7%*	2,399	*1.9%*	2,065	*2.8%*
Public Administration	33,267	*1.0%*	1,399	*1.1%*	1,116	*1.5%*
Education	59,333	*1.8%*	2,921	*2.3%*	2,031	*2.7%*
Health	17,557	*0.5%*	742	*0.6%*	518	*0.7%*
Other Community Social and Personal Service Activities	21,574	*0.7%*	962	*0.7%*	744	*1.0%*
Private Households with Employed Persons	11,764	*0.4%*	664	*0.5%*	515	*0.7%*
Extra-Territorial Organisations	45,929	*1.4%*	2,148	*1.7%*	1,598	*2.1%*

Source: JICA Expert Team, based on data from the National Statistical Office, 2011 Census Database System

(3) Export of Products

As shown in Table 3.2.4, PNG exports are mainly raw materials such as petroleum gas, gold, vegetable fats and oils, copper ores, etc. The share of the exports in the top five code accounts for slightly less than 90% of the total exports in the recent five years. Value-added processing of existing mining products and the export value of manufactured products are still very limited. PNG's main export partners are Australia, China, Singapore, Japan and USA.

Table 3.2.4 Exports of Products from PNG

Unit: US$ thousand

Code	Products	2017	2018	2019	2020	2021
Total	All products	10,603,343	11,242,099	11,800,427	9,967,328	11,608,165
'27	Mineral fuels, mineral oils and products of their distillation (Mainly petroleum gas)	4,781,586	5,005,626	5,522,000	4,167,182	5,756,749
'71	Natural or cultured pearls, precious stones, precious metals (Mainly gold)	2,148,771	2,244,686	2,623,291	2,405,442	1,775,561
'26	Ores, slag and ash (Mainly copper ores)	913,959	937,794	1,017,079	916,840	1,091,129
'15	Animal or vegetable fats and oils and their cleavage products (Mainly palm oil and its fractions, coconut, copra, and palm kernel)	658,887	582,989	496,457	571,296	932,815
'75	Nickel and articles thereof	363,400	522,463	535,364	458,729	606,020
Subtotal in the Top 5 based on the order in 2021		8,866,603	9,293,558	10,194,191	8,519,489	10,162,274
Share (%) in the Top 5		83.6	82.7	86.4	85.5	87.5

Source: JICA Expert Team, based on data from the International Trade Centre (ITC)

(4) Import of Products

As shown in Table 3.2.5, PNG imports mineral fuels, machinery and equipment, vehicles, electric machinery and equipment, cereals, meat, plastic, iron and steel, etc. PNG's main import partners are Australia, China, Japan, and Singapore.

Table 3.2.5 Imports of Products to PNG

Unit: Thousand US$

Code	Products	2017	2018	2019	2020	2021
Total	All products	4,445,645	4,487,519	4,290,048	3,867,963	4,185,085
'84	Machinery, mechanical appliances, boilers; parts thereof	720,049	795,036	842,511	681,837	684,905
'27	Mineral fuels, mineral oils and products of their distillation	549,718	751,930	602,661	412,723	462,096
'87	Vehicles other than railway or tramway rolling stock, and parts and accessories thereof	305,273	287,661	296,956	275,633	332,203
'85	Electrical machinery and equipment and parts thereof;	377,278	355,855	261,148	317,097	229,195
'73	Articles of iron or steel	174,483	202,452	217,372	196,939	204,090
'10	Cereals	173,041	124,212	145,001	162,331	191,762
'02	Meat and edible meat offal	128,620	114,603	121,944	122,793	151,475
'39	Plastics and articles thereof	118,771	127,883	122,620	117,541	136,546
'72	Iron and steel	82,852	73,519	86,067	81,843	115,752
	Others	1,815,560	1,654,368	1,593,768	1,499,226	1,677,061

Source: JICA Expert Team, based on data from the International Trade Centre (ITC)

(5) Major Trading Partners

PNG's biggest importer and exporter, Australia, accounts for 23% of its exports, and 37% of its imports, as shown in Table 3.2.6. Apart from Australia, Asian countries such as China, Japan, Singapore and Malaysia are PNG's important trading partners.

Table 3.2.6 Main Importers and Exporters in PNG (2020)

Importers (from PNG)		
	Kina thousand	%
Australia	8,070,845	23.0
Japan	7,822,201	22.3
China	6,441,011	18.3
Singapore	1,299,729	3.7
Malaysia	666,783	1.9
Others	10,832,913	30.8
Total	35,133,482	100.0

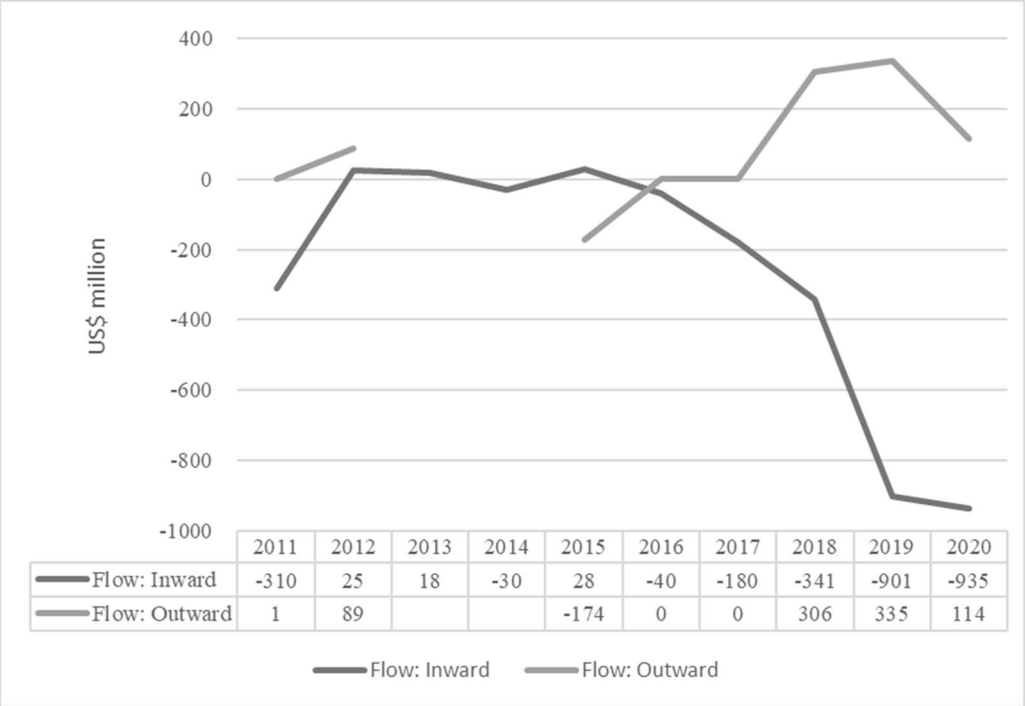
Exporters (to PNG)		
	Kina thousand	%
Australia	5,885,868	36.5
China	2,631,983	16.3
Singapore	2,126,769	13.2
Malaysia	1,087,931	6.7
Japan	633,466	3.9
Others	3,753,423	23.3
Total	16,119,440	100.0

Source: JICA Expert Team, based on data from the National Statistical Office

3.3 Investments

(1) Foreign Direct Investment (FDI) in PNG

The total foreign direct investment (inflows) has sharply dropped since 2019 due to the decline of both the extractive sector and non-extractive sector's investments as shown in Figure 3.3.1. This decline in investment is likely to have a long-term impact on future growth.



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Flow: Inward	-310	25	18	-30	28	-40	-180	-341	-901	-935
Flow: Outward	1	89			-174	0	0	306	335	114

Source: JICA Expert Team, based on data from ITC Investment Map by the International Trade Centre (ITC)

Figure 3.3.1 Foreign Direct Investment in PNG

According to Investment Promotion Authority, a total of 249 FDI approvals was given with a total investment value of 1.3 billion Kina between 2020 and 2021. The top five investing countries/territories as of September 2021 were Australia with 375.9 million Kina, Malaysia with 374.4 million Kina, USA with 205.1 million Kina, Hong Kong with 121.5 million Kina, and China with 120.6 million Kina.

(2) Foreign Direct Investment (FDI) in ENBP

The total proposed foreign direct investment in ENBP amounted to 430 million Kina for five years (2017-2021) as shown in Table 3.3.1, while the proposed jobs amounted to 2,244. Table 3.3.2 shows the total amounts of FDI by sector in the same period. Wholesale and retail trade and real estate have large shares at 37.8% and 34.1%, respectively, followed by forestry at 10.5%, construction at 10.5%, and manufacturing at 3.6%.

Table 3.3.1 FDI Proposed in ENBP between 2017 and 2021

Year	Proposed FDI Values (Kina)	Proposed Jobs
2017	38,229,548	245
2018	201,238,754	504
2019	62,695,887	865
2020	79,732,242	358
2021	47,646,835	272
Total	429,543,266	2,244

Source: Investment Promotion Authority

Table 3.3.2 FDI Proposed in ENBP between 2017 and 2021 by Sector

Industrial Sector/ Activity	Proposed FDI Value by Sector		No. of Approvals	
	Kina	Share (%)	Number	Share (%)
Agriculture	911,750	*0.2*	3	*2.5*
Architectural Engineering	425,400	*0.1*	3	*2.5*
Business Management and Consultancy	-	-	2	-
Catering and Hospitality	8,300,650	*1.9*	3	*2.5*
Construction	45,246,609	*10.5*	11	*9.2*
Financial Intermediation	500,130	*0.1*	1	*0.8*
Forestry	45,269,396	*10.5*	25	*21.0*
Health	82,120	*0.0*	2	*1.7*
Insurance	0	*0.0*	1	*0.8*
Legal Services	415,448	*0.1*	1	*0.8*
Maintenance and Repair	2,406,270	*0.6*	3	*2.5*
Manufacturing	15,589,420	*3.6*	10	*8.4*
Mining and Petroleum	0	*0.0*	1	*0.8*
Real Estate	146,567,400	*34.1*	6	*5.0*
Telecommunication	293,300	*0.1*	1	*0.8*
Wholesale and Retail	162,234,589	*37.8*	43	*36.1*
Others	1,300,784	*0.3*	3	*2.5*
Total	429,543,266	*100.0*	119	*100.0*

Source: Investment Promotion Authority

On the other hand, the total proposed amounts of FDI by country between 2017 and 2021 are shown in Table 3.3.3. China keeps the top position with 48.7%, followed by Malaysia with 17.8%.

Table 3.3.3 FDI Values Proposed in ENBP between 2017 and 2021 by Country of Origin

Country of Origin	Proposed FDI Values		No. of Approvals	
	Kina	Share (%)	Number	Share (%)
Australia	3,980,098	*0.9*	14	*11.8*
China	209,233,188	*48.7*	53	*44.5*
Philippines	4,252,420	*1.0*	10	*8.4*
Hong Kong	0	*0.0*	1	*0.8*
Japan	109,750	*0.0*	3	*2.5*
Malaysia	76,336,256	*17.8*	32	*26.9*
New Zealand	368,284	*0.1*	1	*0.8*
Sri Lanka	353,300	*0.1*	1	*0.8*
UK	1,059,840	*0.2*	3	*2.5*
Not specified	133,850,130	*31.2*	1	*0.8*
Total	429,543,266	*100.0*	119	*100.0*

Source: Investment Promotion Authority

3.4 Population

The present projected population of PNG is approximately 9.5 million (2022). [1]

The populations by region and province in the whole country between 1980 and 2011, as enumerated in the censuses[2], are shown in Table 3.4.1. In 2011, the total population of Papua New Guinea was about 7.3 million, and the annual growth rate between 2000 and 2011 was 3.1%. On

[1] See Table 7.3.1 Population Projection (2000-2052) for PNG for NGID-Plan.
[2] In Papua New Guinea, a population census is due to be conducted in July 2024. However, at the time of writing this report, the results of the census have not yet been published.

the other hand, the population of the ENBP was 328,369 in 2011 with an annual growth rate of 3.7% in the same period, which was much higher than the national average.

In Northeast Gazelle Peninsula, the population totalled 198,745 in 2011 with an annual growth rate of 3.5% in the same period, which was also higher than the national average. The population of Northeast Gazelle Peninsula accounted for 2.7% of the population of the whole country and 60.5% of that of ENBP.

The growth rates of the populations vary across the different regions and provinces. Between 2000 and 2011, the Island Region showed the highest growth at 3.5%, followed by the Highlands Region at 3.3%, the Southern Region at 3.0%, and the Momase Region at 2.4%.

Table 3.4.1 Populations of the Whole Country, Regions and Provinces

Region/Province	Population				Annual Growth Rate (%)			
	1980	1990	2000	2011	1980 – 1990	1990 – 2000	2000 - 2011	1980- 2011
Papua New Guinea	3,010,727	3,761,954	5,190,786	7,275,324	2.2	3.3	3.1	2.9
Southern Region	588,700	771,193	1,041,820	1,456,250	2.7	3.1	3.0	2.9
Highlands Region	1,121,258	1,373,673	1,973,996	2,854,874	2.0	3.7	3.3	3.0
Momase Region	857,773	1,027,600	1,433,432	1,867,657	1.8	3.4	2.4	2.5
Islands Region	442,996	589,488	741,538	1,096,543	2.9	2.3	3.5	2.9
Manus Province	26,036	32,840	43,387	60,485	2.3	2.8	3.0	2.7
New Ireland Province	66,028	86,999	118,350	194,067	2.8	3.1	4.5	3.5
ENBP	**133,197**	**185,459**	**220,133**	**328,369**	**3.3**	**1.7**	**3.7**	**2.9**
Northeast Gazelle Peninsula (11 LLGs)	**86,128**	**121,155**	**135,826**	**198,745**	**3.5**	**1.1**	**3.5**	**2.7**
West New Britain Province	88,941	130,190	184,508	264,264	3.8	3.5	3.3	3.5
AR Bougainville	128,794	154,000	175,160	249,358	1.8	1.3	3.2	2.1

Source: National Statistical Office

PART III

PRESENT SITUATIONAL ANALYSIS OF LOCATION, NATURE, SOCIETIES AND DISASTERS OF NORTHEAST GAZELLE PENINSULA

Chapter 4 Present Locational, Natural and Social Characteristics of Northeast Gazelle Peninsula

4.1 Locational Characteristics of Northeast Gazelle Peninsula within Papua New Guinea

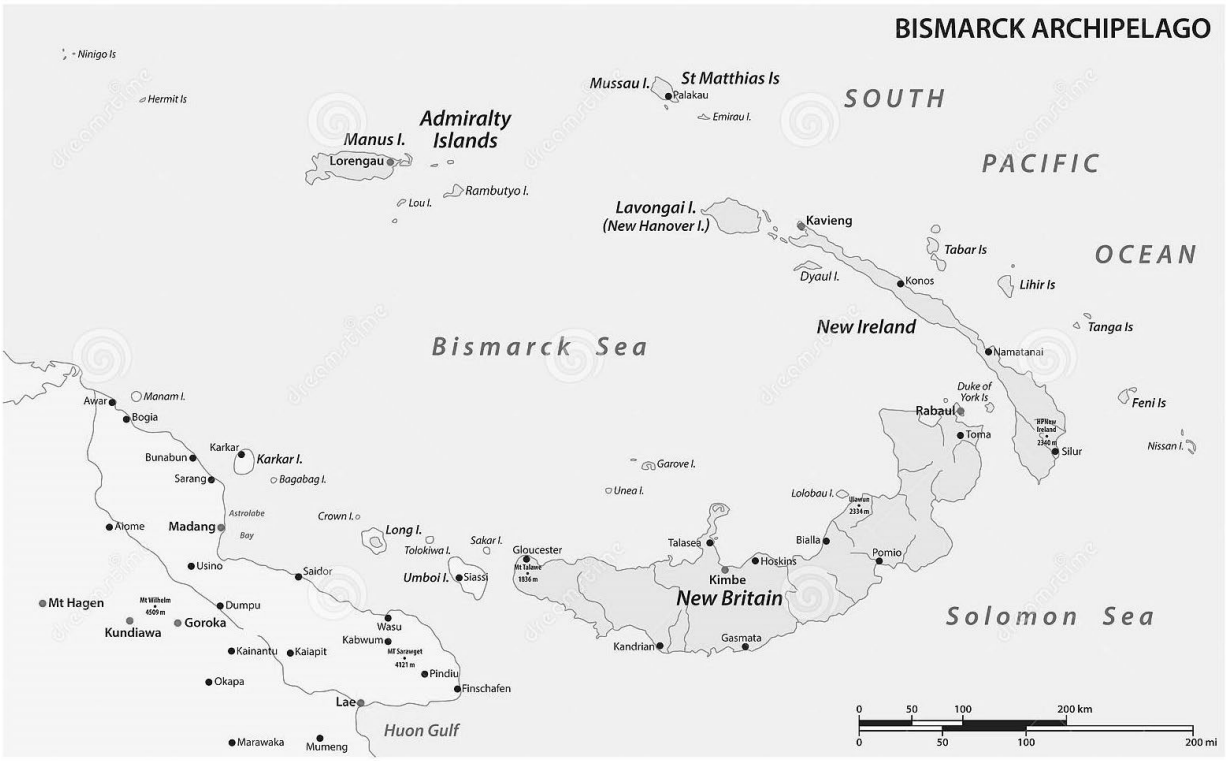
4.1.1 Geography of Northeast Gazelle Peninsula, Gazelle Peninsula and East New Britain

(1) East New Britain Province (ENBP) in the New Britain Island

New Britain Island is part of the Bismarck Archipelago. It is the largest island (Area: 36,520 km²) in the archipelago. Administratively, it is part of the Islands Region of Papua New Guinea. There are two provinces in New Britain: East New Britain, whose provincial capital is Kokopo, and West New Britain, whose capital is Kimbe.

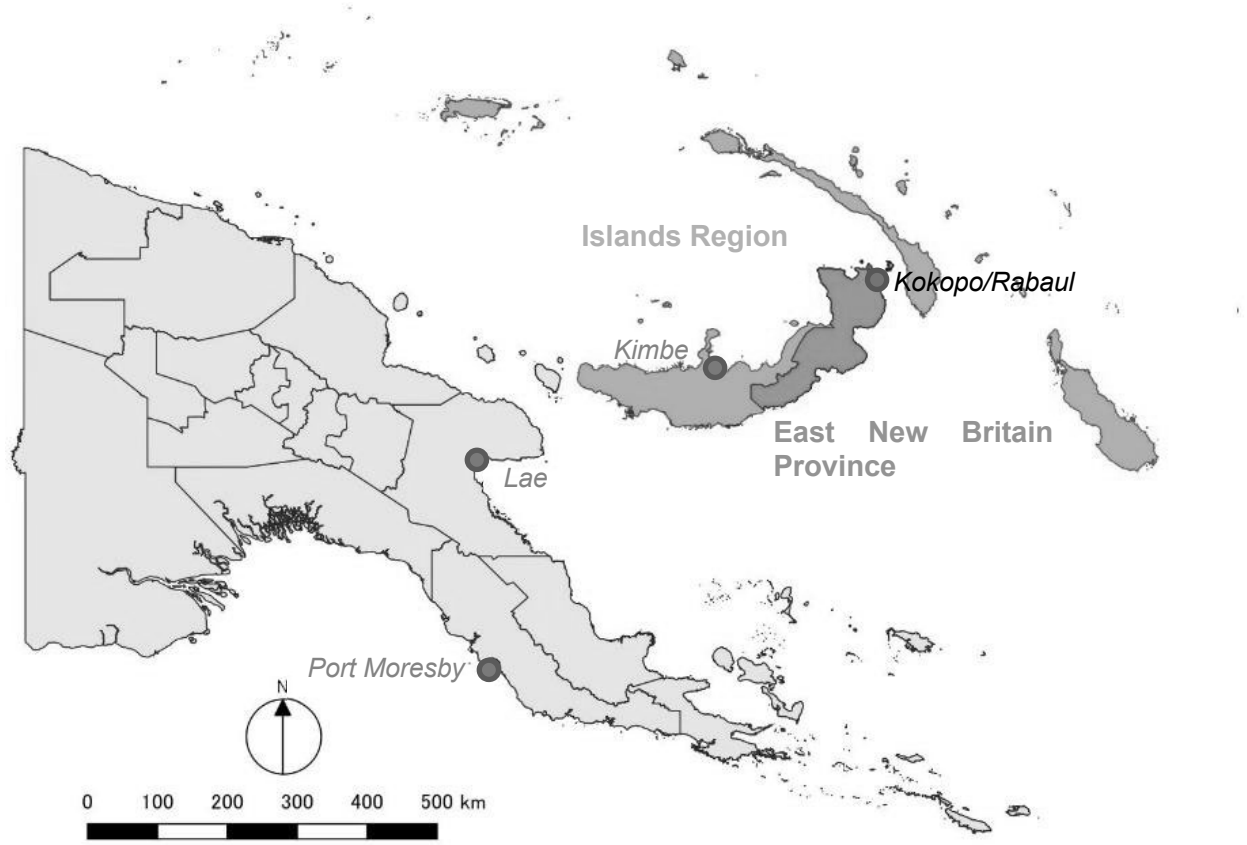
The population size of the island was small, only 513,926 based on 2011 population census, in comparison to the large landmass of the island. The average population density was about 14 persons/km^2 in 2011.

The two provinces are not well physically connected by roads in the New Britain Island. In fact, the two provincial capital towns (Rabaul and Kimbe) are planned to be connected by the New Britain Highway. At present, the road sections connecting the two provinces are not so well maintained.



Source: dreamstime.com, https://www.dreamstime.com/vector-map-bismarck-archipelago-belonging-to-papua-new- guinea-image184993105

Figure 4.1.1 Bismark Archipelago and New Britain Island



Source: JICA Expert Team, based on GIS data from the National Statistical Office

Figure 4.1.2 Location of ENBP in the New Britain Island and in Papua New Guinea

Kokopo, the provincial capital city of ENBP, is approximately 800km northeast from Port Moresby, the national capital city. The two cities are connected by commercial flights which has multiple flights a day taking 1 hour and 20 minutes to 2 hours, depending on the aircraft.

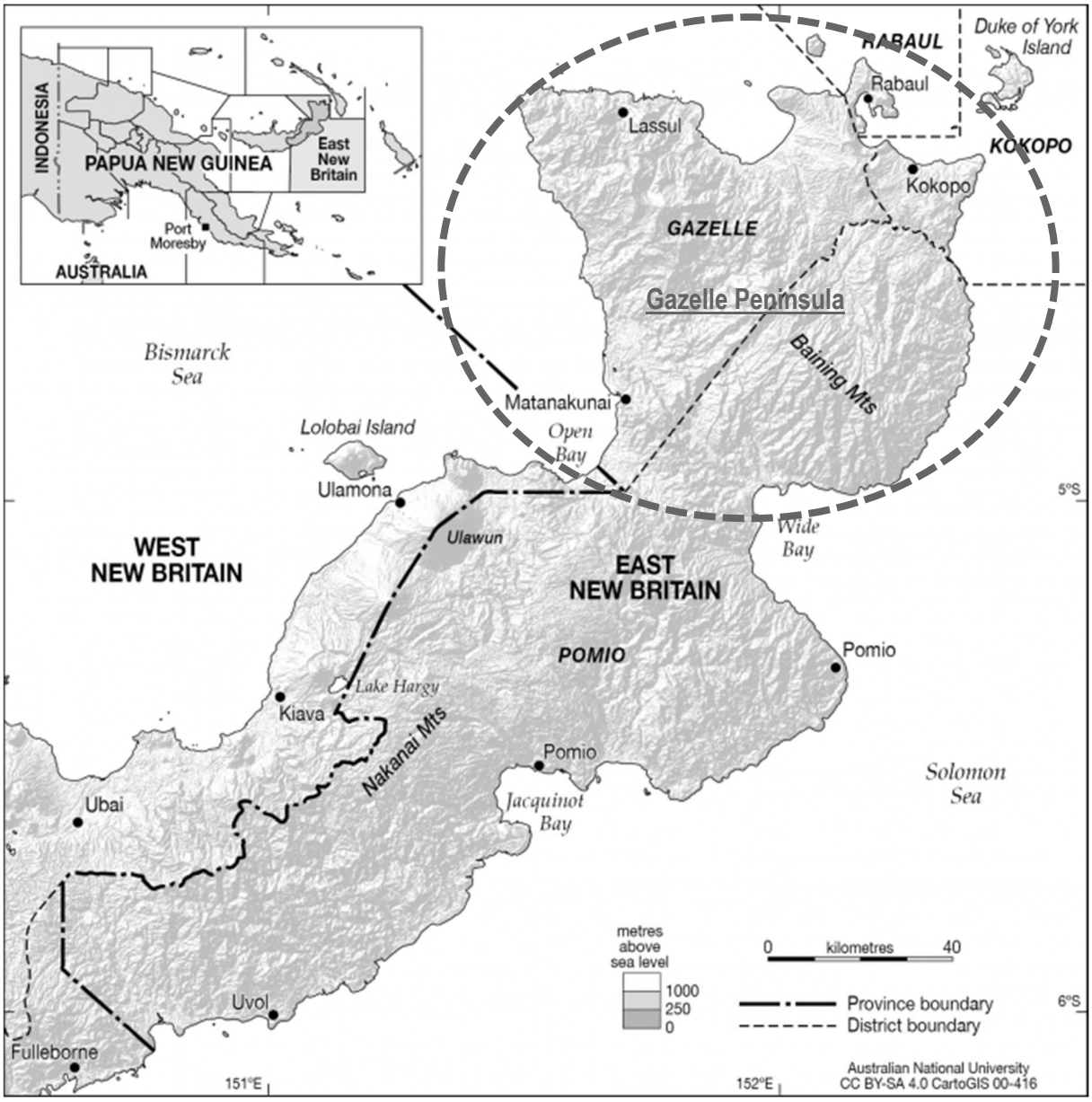
Kokopo is approximately 650km from Lae, the second largest city in Papua New Guinea. There is a regular round-trip flight connecting Port Moresby, Lae and Kokopo. It is approximately 1 hour flight between Lae and Kokopo. There is also a passenger ship connecting Rabaul, Kimbe and Lae once a week, and the trip between Rabaul and Lae takes 2 days.

(2) Gazelle Peninsula in ENBP

Gazelle Peninsula is located at the east end of New Britain Island and ENBP.

The shape of Gazelle Peninsula is roughly rectangular, and its area size is about 6,000 km^2.

Gazelle Peninsula is connected with the main part of New Britain Island through a 35 km width of isthmus. The isthmus is located between Open Bay on the west and Wide Bay on the east.



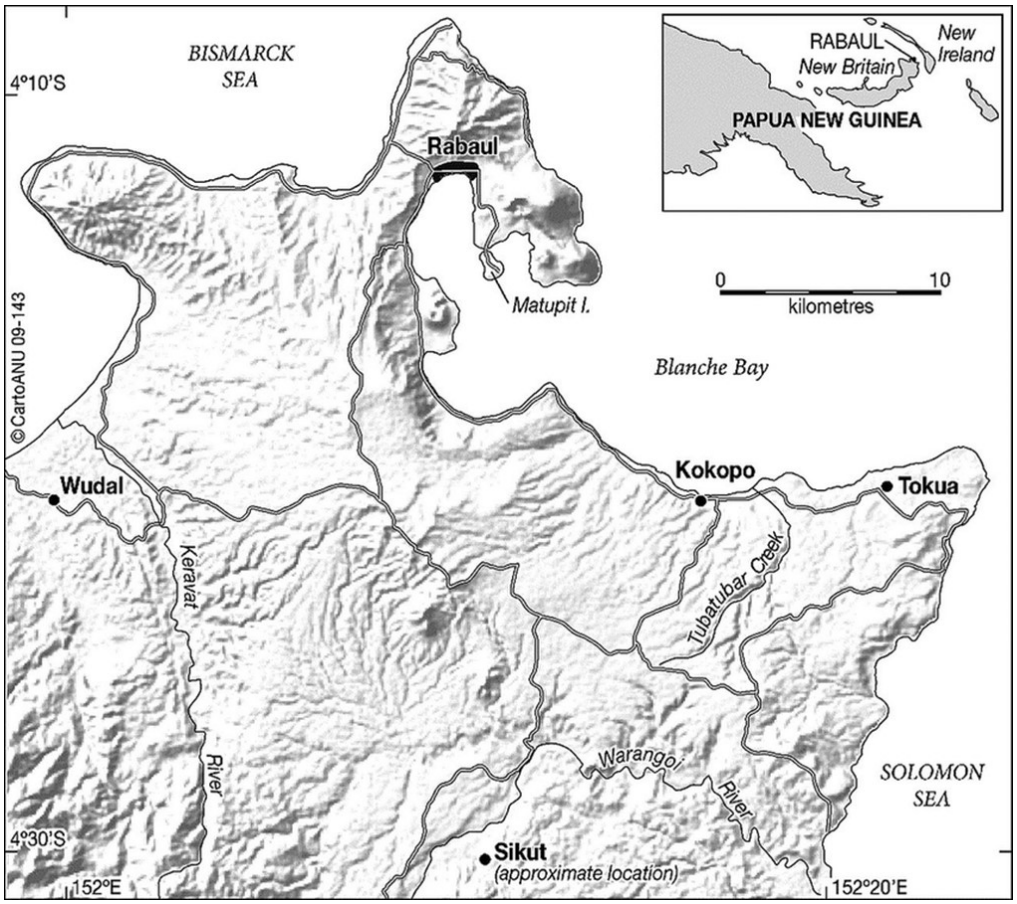
Source: CartoGIS Services, College of Asia and the Pacific, The Australian National University

Figure 4.1.3 Gazelle Peninsula in ENBP

(3) Northeast Gazelle Peninsula in Gazelle Peninsula

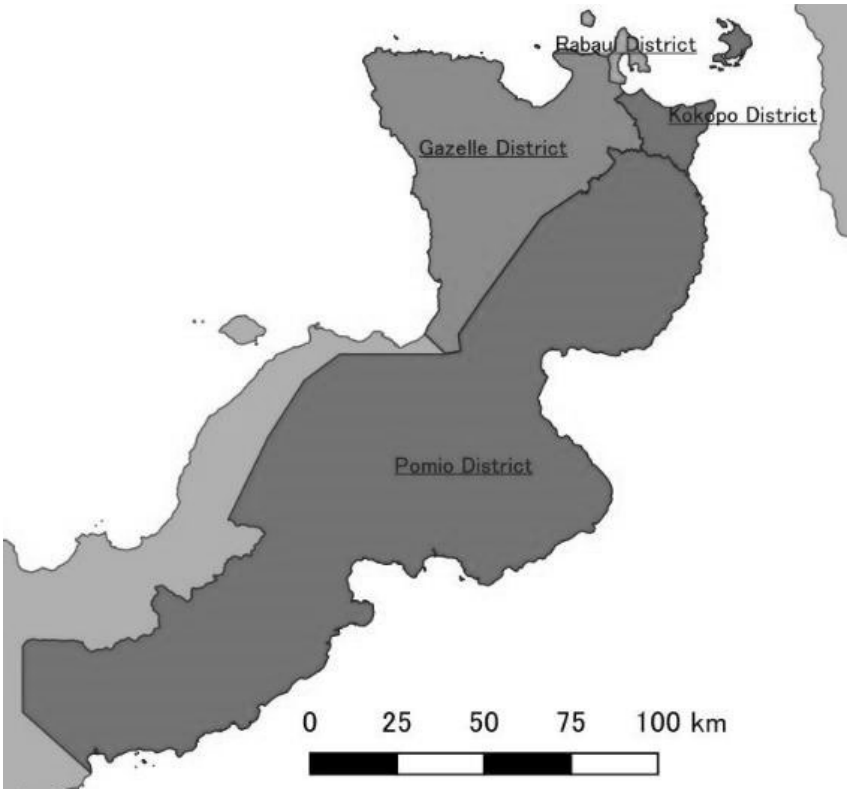
Gazelle Peninsula is divided into four physiographic areas, namely: 1) North Baining Mountains, 2) Central Mountains, 3) South Baining Mountains, and 4) Northeast lowlands (encompassing Rabaul Town and Kokopo Town). Northeast Gazelle Peninsula corresponds to the Northeast lowlands. The Northeast Gazelle Peninsula is a low altitude area of less than 700m. The lowlands are surrounded by the Kerevat River and the Warangoi River.

The ENBP is administratively divided into four districts, namely: Rabaul District, Kokopo District, Gazelle District, and Pomio District. The boundaries of these four districts are shown in Figure 4.1.5. The Northeast Gazelle Peninsula is composed of Rabaul District, Kokopo District and eastern part of Gazelle District.



Source: The Australian National University Cartography Department

Figure 4.1.4 Geomorphology of Northeast Gazelle Peninsular in Gazelle Peninsula



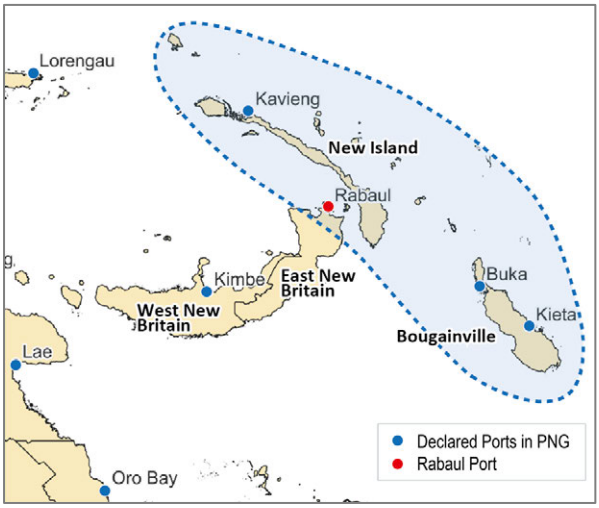
Source: JICA Expert Team, based on GIS data from National Statistical Office

Figure 4.1.5 District Boundaries of ENBP

4.1.2 Rabaul Port and Its Influential Areas over Surrounding Islands

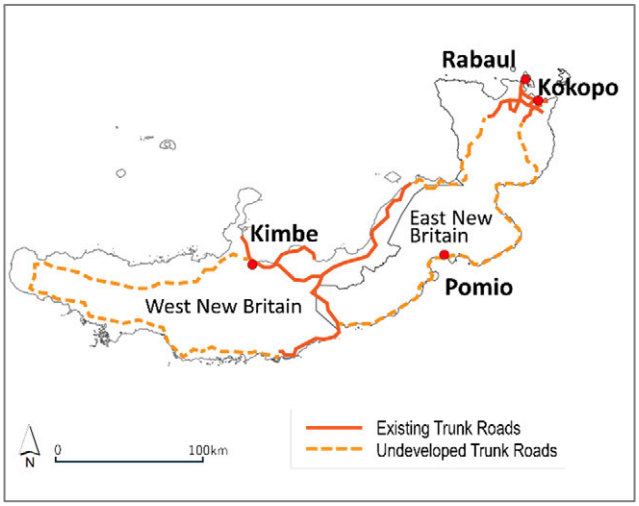
The estimated 2020 population of the project's study area is 260,000, which is small. However, the area is connected with the islands, as shown in Figure 4.1.6, with regional logistic network by sea route starting at Rabaul Port. For example, agricultural products (cacao and coconut) from Bougainville and New Ireland are transported to Rabaul Port, where these products are transhipped to large ships and exported.

In the future, the production of agricultural products (coconut, cacao, etc.) is expected to increase, so the increase in production in the surrounding islands will be also reflected in the increase in cargo exports from Rabaul Port. This is also the case for road infrastructure. Although ENBP currently has not fully extended the trunk roads throughout the province, the national government intends to lengthen the trunk roads, connecting WNBP and ENBP with a northern corridor (New Britain Highway). At the same time, there is also a plan to connect the two provinces by a corridor along the southern coast (see Figure 4.1.7). By extending the trunk road of ENBP, it is expected that the agricultural production areas connected to the port will expand and the cargo export volume from Rabaul Port will increase.



Source: JICA Expert Team

Figure 4.1.6 Influential Areas or Service Coverage Areas of Rabaul Port



Source: Alamgir, et al., 2019, Infrastructure Expansion Challenges Sustainable Development in Papua New Guinea

Figure 4.1.7 Existing Trunk Roads and Undeveloped Trunk Roads in New Britain Island

4.2 Natural Condition in Northeast Gazelle Peninsula

4.2.1 Geological Condition

(1) Geological Overview of the Project Area

In Northeast Gazelle Peninsula, most of the units, if not all, are part of the original volcanic activities in the build-up of New Britain Island. Generally, the Quaternary and recent age deposits of alluvium and undifferentiated volcanic ashes are observed at present.

The locality of interest can be viewed generally as coastal shallow marine environment formed by receded water, and filled by beach sand and fluvial deposition of humic carbonaceous and silt overlaid by undifferentiated volcanic sediments (0.5 m to 2.0 m thick). Composition of the volcanic sediments is common undifferentiated material ranging from fine pyroclastic, pumice and weathered tuffaceous material. The lower section of the volcanic material is weathered or showed some extent of weathering due to presence of sea water and fresh water altering to a low grade clay type material. At 30 m beachfront is shoreline sand deposit.

(2) Overview of Distributed Soil

According to the U.S. Department of Agriculture (USDA) Soil Taxonomy, Vitrandepts, Eutrandepts and Dystrandepts are found on the Northeast Gazelle Peninsula. Among these three types of volcanic ash origin soils, Dystrandepts is the most widely distributed in the Project Area (Figure 4.2.1). "Dystrochrept" is a coined term to describe immature soils (Inceptisols Order) that are nutrient poor (Dystric Subgroup) due to little accumulation of humic substances with light-colored surface layer (Ochric surface horizon). Primitive soil developed on an accumulated parent material with weak weathering and infiltration of humic substance from soil surface. This soil is widely used as aggregate at construction sites, but the weathered unconsolidated matrix is floating through the air as wind dust.

Source: JICA Expert Team

Figure 4.2.1 Condition of Widely Distributed Soil (Dystrandepts) in the Project Area

In contrast to Dystrandepts, Eutrandepts is relatively rich in nutrients (eutrophic) and is used for various types of agriculture. This soil is well developed with aggregates and superior water retention and aeration (see Figure 4.2.2).

Source: JICA Expert Team

Figure 4.2.2 Condition of Eutrandepts in the Project Area

In addition, Vitrandepts is a volcanic ash soil with a consolidated clayey subhorizon that is strongly affected by soil moisture movement due to the alternation of wet and dry seasons (see Figure 4.2.3).

Source: JICA Expert Team

Figure 4.2.3 Condition of Vitrandepts in the Project Area

All soils are weakly weathered, but clay minerals, such as allophone and imogolite, are developed. Hence, fertilizer efficacy is estimated to be low because phosphorus is strongly adsorbed to amorphous clay minerals mentioned above, unless the soil pH is amended.

4.2.2 Vegetation and Land Cover

Lowland tropical rainforest is distributed in the Project Area, with many species of *Dipterocarpaceae*, *Cercidiphyllaceae*, *Mucuroideae*, *Asteraceae* and *Urticaceae*. The vegetation generally consists of three layers, with an upper canopy group of about 30-40 m, under which grows different plant species, such as palms, vines, and larches (see Figure 4.2.4). In addition, wild sugarcane, reed-type plants, nipa palms and sago palms grow in the wetlands and estuaries.

Source: JICA Expert Team

Figure 4.2.4 Vegetation Overview in the Project Area (in Gazelle District)

The surface area of each category in Northeast Gazelle Peninsula is shown in Table 4.2.1. According to this classification, most of the study area is covered by forest and shrubs (approximately 87%). Grassland is mainly distributed along the roads. Urban areas are concentrated around the towns of Kokopo and Rabaul. Bare lands are scattered around the volcanos and along the rivers.

Table 4.2.1 Land Cover by Category in Northeast Gazelle Peninsula (2019)

Category	Area (km^2)	Ratio (%)
Forest	272.75	32.4
Shrub / Bush	457.15	54.4
Grassland	83.87	10.0
Urban / Bare land	27.03	3.2
Water body	0.20	0.0
Total	841.00	100.0

Source: JICA Expert Team, based on SPOT data.

4.2.3 Hydrological Condition

The hydrological processes in the Project Area are geo-morphologically controlled and they are affecting the area from the sea and the hinterland. According to a recent report[1], the relatively quiet marine environment is indicated at 86 m from shoreline by a smaller underlying layer of less than 30 cm thick marine detrital materials including sand. From the shore moving 86 m inland, the zone is considered of high-density saline water intrusion through a homogeneous, confined aquifer and sediments. Lateral homogenous sediments here concur with shoreline sand deposit and volcanic material. The extent of this zone is about 270 m end of the ditch, where the environment controls the processes such as the water flow and hydraulic charge. The hydraulic charge decreases due to geomorphic control by the slope. It may not have a saturated confined aquifer of fresh water but there is a seasonal influx from inland due to periods of rain. In this case, a seasonal or periodical flush of fresh water is applicable to the inland boundary, while the seaward boundary is exposed to a stationary body of higher density sea water converging at approximately 200 m mark from shoreline, both environmentally controlled. In the absence of full extent of hydraulic charge in line with low tidal heave, slope environment is open to the fresh water flow inland sources, but more prominent during rainy period. At such timing, there is no impeding force to fresh water flow at 200 m exerted by the hydraulic charge from the seafront.

As conclusion, the Project Area is located locally in a flow path subjected to fresh water flow from inland and hydraulic charge from the sea, both activities are environmentally controlled. Fresh water flows and flush from inland sources may be periodical and coincide with rainfall. Presence and persistence of water and high-moist content at site most of the time are possibly due to hydraulic charge from the sea.

4.2.4 Climate

There is a meteorological observation point at Tokua Airport located 28 km southeast of Rabaul and 12 km from Kokopo.

In the Köppen climate classification, New Britain Island belongs to the equatorial climate (Af), but the temperature difference is small and the maximum temperature rises to around 30°C throughout the year.

The average rainfall amount recorded at the Tokua Airport Observatory based on the rainfall data for 10 years between 2009 and 2018 is 2,498 mm/year. The climate in Papua New Guinea is mainly divided into two seasons: dry season from May to November, and rainy season from December to April. But the distinction between rainy season and dry season in the Project Area is smaller than in other regions because of its relativity on the equator.

Table 4.2.2 Monthly Average Rainfall and Temperature at Tokua Airport (2009-2018)

Item	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Yearly
Rainfall (mm)	222.1	188.2	246.1	238.5	164.0	205.2	245.2	248.8	250.6	176.8	131.2	191.0	2,498
Temp. (°C)	29.2	29.0	29.2	29.5	29.5	29.0	28.3	28.4	28.7	29.3	29.6	29.4	(29.1)
Max. Temp.	31.2	31.1	31.2	31.3	31.0	30.5	29.9	29.8	30.2	30.8	31.2	31.5	(30.8)
Min. Temp.	23.9	23/7	23.6	23.6	24.0	23.8	24.0	23.8	23.8	23.7	23.9	23.9	(23.8)

Source: OCG (2020), Application for Environmental Permit to Abstract Water and Discharge Waste, p.14. This application was prepared for JICA's Preparatory Survey for Tokua Airport Redevelopment Project (2019-2021).

4.2.5 Flora and Fauna

(1) Flora

Vast land in the Northeast Gazelle Peninsula is currently utilised for cocoa, balsa, and coconut plantations. The original natural vegetation has been mostly cleared for plantation development, but remnants of the original forest and secondary growth are present. The original forest, prior to

[1] China Jiangsu International Economic Technical Co. (2018), EIS Report for Design and Construction of Kokopo Town Sewerage Project.

agricultural conversion, likely consisted of large to medium-sized trees with canopy heights of 30-35 metres and had a high degree of flora diversity, including species such as *Pometia pinnata* and *Octomeles sumatrana*.

The plantations have a mix of young to mature balsa and cacao trees, shaded by taller coconut trees and other species. Ground cover in less shaded areas includes common weeds and grasses, and the area is home to a variety of plants including cassava, pawpaw, bananas, and orchids. This area is adjacent to a range of habitats, from mangrove and beach forests to plantations. The mangroves are vital for coastal protection but are threatened by dredging, pollution and urban development.

For example, the fringe mangrove forests and swamplands near Tokua Airport support a variety of species, highlighting the importance of mangroves as ecological indicators. The surrounding land, once used for large-scale coconut and cocoa production, now has secondary regrowth dominated by grasses and legumes, indicating early successional stages. There is no record of endemic, rare, or threatened plant species in the plantation surveys conducted for the upgrade project for Tokua Airport. However, the proposed activities at Tokua Airport will have an impact on the marine ecosystem, particularly the discharge of wastewater. The marine environment around Kabakaul Bay is still pristine, with no signs of mangrove dieback or coral bleaching.

Overall, the area has a mix of cultivated land, secondary regrowth, and diverse marine and terrestrial ecosystems, with significant environmental considerations for future development and conservation efforts.

(2) Fauna

Mammal diversity in the Northeast Gazelle Peninsula is relatively low compared to that in the Baining Mountains. This observation may be due to limited sampling, as only a few species were recorded. However, bird diversity in the area is more significant, with over 50 species recorded, including 15 that are rare, threatened, and endemic or protected under CITES II or PNG legislation. These birds are distributed throughout the peripheral forests and plantations.

Amphibian diversity includes five species, including the cane toad (*Bafo marinus*) and *Platymantis papuensis*, the latter being endemic to the area. Most amphibians, except the cane toad, are sensitive to disturbance and are usually found near streams and rivers. The monitor lizard is of traditional importance to the local people, particularly for its skin, which is used to make cultural instruments such as the kundu drum. Other reptiles such as skinks, geckos and snakes are recognised but traditionally considered of little or no importance. Insect diversity under old coconut plantations is unclear, but economically important groups include several families of butterflies, weevils, beetles and moths.

Fauna endemism is more restricted towards the Baining Mountains, away from the plantations. Endemic species are rare due to the depleted vegetation, but smaller animals may persist in the riparian forests.

(3) Marine Environment

The biodiversity and ecological processes of the Bismarck Sea are influenced by seasonal maritime wind patterns and geography. Also, the major surface current system of the Pacific Ocean influenced by southeast monsoon season (May to October) is driven by wind, and produces current flows. In the Bismarck Sea, the tides are reasonably small as they only have a range of 1m at spring tides. Tidal currents are much slower and less vigorous; however, the region can have flood and ebbs over 12 hours, which means the tidal excursion can still be quite large. Sea level anomalies (tides, seasonal cycles and trend removed) for the region are highly correlated with the Southern Oscillation Index (SOI) as the Bismarck Sea is in the Western Pacific warm pool. Local trade wind changes associated with El Nino Southern Oscillation (ENSO), therefore, directly affect the local sea levels.

The marine habitats of Kabaira Bay and Ragaga Bay in Ataliklikun Bay Area are diverse and ecologically abundant with healthy coral reefs and systems. Ragaga Bay is a deep coastal basin

and characterised by a nearshore fringing coral reef system, seagrass and macroalgae habitats, beaches, and mangrove communities. The most conspicuous coral presence has been associated with water depths between approximately 5 to 10 m. The International Union of Conservation (IUCN) Red List has identified one coral species categorised as Endangered (*Cantharellus noumeae*), and 134 species classified as Vulnerable with distributions that overlap Blanche Bay and Ragaga Bay. *Cantharellus noumeae,* is endemic to New Caledonia, has a restricted range size and is naturally rare.

On the other hand, crown thorns of starfish which feeds on corals were also observed at Kabaira Bay and Ragaga Bay in Ataliklikun Bay Area, indicating the reason for the coral mortality. There is also high abundance of corallivorous snails which cause coral mortality. Potential of pollution coming from neighbouring oil palm plantation and logging operations cannot be discounted.

Ragaga Bay nearshore habitats support a range of biota, some of which are of conservation and resource significance on local and international scales. There is presence of mangroves along the coast at Ragaga, Kabaira, Kerevat River/Tavilo (Ataliklikun Bay) and Kabakaul (Tokua).

Large dense seagrass meadows were observed within the shallow waters of Rarongo at Kabaira study area, in front of Kabakaul village and at Ragaga mainly in the inner tidal areas and sandy seafloor, between the mangroves and fringing reefs. Seagrass communities are important nursery habitats for prawns, lobsters, crabs, turtles, and fish, aid in stabilising the substrate, and can also be important feeding sites for dugong.

4.2.6 Protected Areas

There were no observable native flora or fauna species, nor landmarks and culturally significant sites which must be protected, nor there are flagship terrestrial flora and fauna species of conservation concern in ENBP. However, in the surrounding waters of Northeast Gazelle Peninsula, there are two protected areas acknowledged by Conservation and Environmental Protection Agency (CEPA) and ENBPA, which are Talele Island Reserve Area and Nanuk Provincial Park/Recreational Area. (See Figure 4.2.5 and Table 4.2.3.)

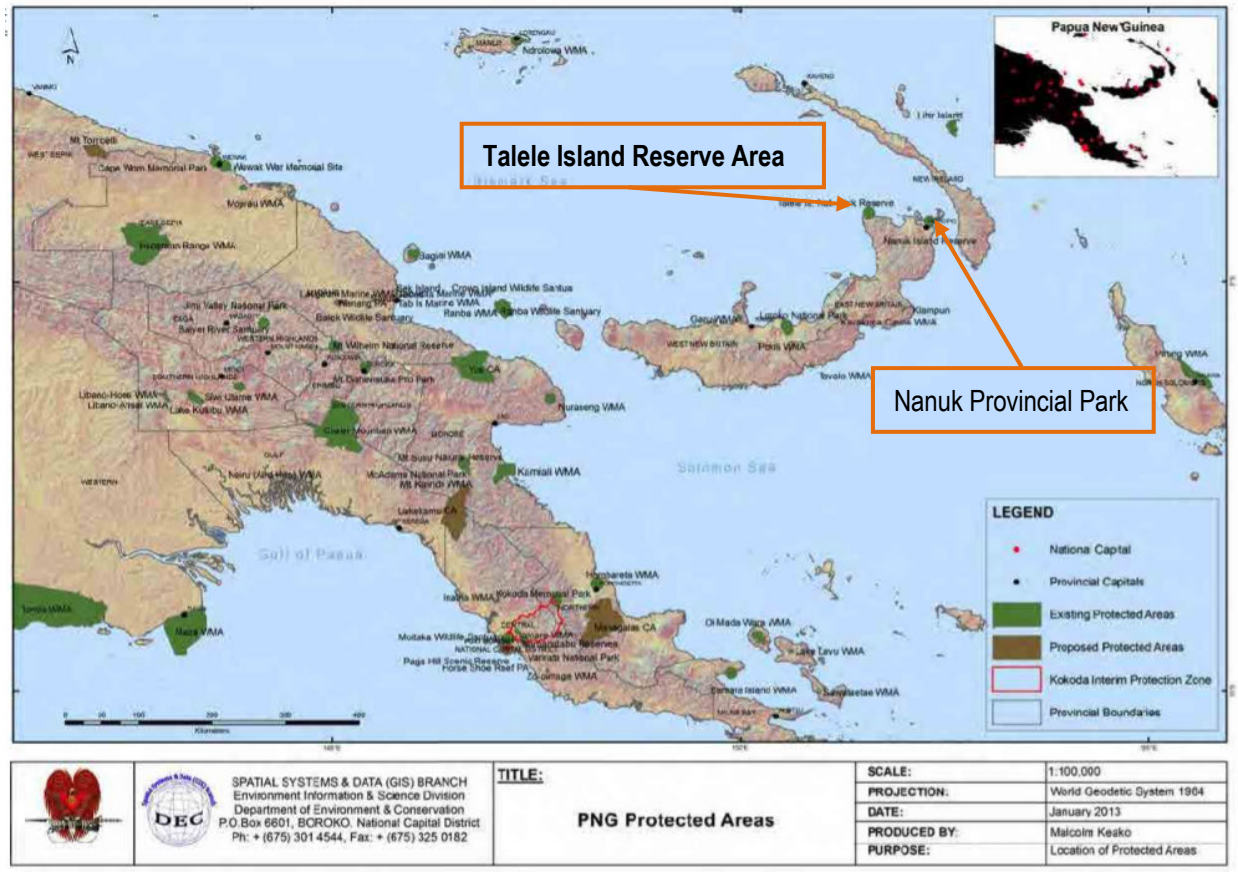
Table 4.2.3 Protected Areas in ENBP

Protected Area	Location	Surface Area
Tavolo Wildlife Management Area	Melkoi LLG, Pomio District	23.08 km^2
Kavakuna Cave	Central/Inland Pomio LLG, Pomio District	45.91 km^2
Talele Island Reserve Area	Reimber/Livuan LLG, GazelleDistrict	0.12 km^2
Klampun Wildlife Management Area	East Pomio LLG, Pomio District	45.91 km^2
Nanuk Provincial Park/Recreational Area	Duke of York Island LLG, Kokopo District	0.12 km^2

Source: JICA Expert Team based on inverview with ENBPA in 2019

Besides these protected areas, there is evidence of dolphin breeding in the surrounding water of Kokopo District. Moreover, residents also reported that dugongs are found near Duke of York Island and in Ataliklikun Bay.

There are no areas of archaeological and historical significance in the Project Area. However, Northeast Gazelle Peninsula is known as the tourist site with war legacy from World War II.



Source: CEPA

Figure 4.2.5 Protected Areas in PNG

4.3 Social Condition in ENBP

4.3.1 Ethnicity

(1) Ethnic Groups and Languages in ENBP

There are sixteen Austronesian languages spoken by various ethnic groups in ENBP. The Kuanua language is the most widely spoken by the Tolai people in the Gazelle Peninsula. Other Papuan languages, such as Baining, Taulil, Ata, Kol, Makolkol, and Sulka languages, are also spoken in ENBP.

(2) Ethnic Groups and Languages in Gazelle Peninsula[2]

The Tolai people live mostly in the northern and eastern parts of Gazelle Peninsula in the east, while the Pomio people live in the southwest, as shown in Figure 4.3.2.

The Baining people are the original inhabitants of the Gazelle Peninsula in ENBP. Linguistically, the Baining language is different from those spoken by the Tolai and Pomio people.

The Baining language group consists of six languages within the Gazelle Peninsula: Kairak, Makolkol (extinct), Mali, Qaqet, Simbali, and Ura.[3] The geographical distribution of these five languages, except for the extinct one, is shown in Figure 4.3.3.

[2] Faik-Simet, 2017, "The Politics of the Baining Fire Dance" was referred to in writing this section.
[3] Lewis, Simons, and Fennig, 2013, Ethnologue

These languages are not used by people located in only one part of the Baining area. The people who use them are distributed throughout the north to the south Baining areas through intermarriage and movement of their residence in search for land for gardening and other social activities.

While the Baining are the original people in the region, they have smaller population than the Tolai and Pomio.

Due to differences among the Baining and Tolai people, the Baining moved farther into the hinterland. Occupying primarily the remote parts of East New Britain, the Baining mostly continue their life and daily activities in isolation. It was not until the early 1960s that the Baining became visible in Rabaul and Kokopo towns for selling their cash crops.

(3) Ethnic Groups and Languages in Rabaul District

The Rabaul District population is broadly composed of two major ethnic groups, namely, the Tolais and the non-Tolais. The non-Tolai population consists of expatriates and those from other parts of the country who have come to work and settle in Rabaul Town, including historically the plantation workers. These people have migrated to Rabaul as part of the urbanisation.

(4) Ethnic Groups and Languages in Kokopo District

The Kokopo District population consists of three major ethnic groups, namely the Tolais, Sulkas and Duke islanders.

These groups live in respective areas. The Duke of York islanders live in the island and in the northeast of the mainland, while the Tolais people are in the main part of the district. The Sulkas people occupy the southeast end of the Kokopo District.

The Tolais occupy the majority of the district land areas and the population of the Kokopo District.

There four linguistic groups in Kokopo District:Kuanua, Sulka, Minigir and Ramoaina.

Kuanua is the most common and is widely spoken in the district mainly by the Tolais but can also be spoken and understood by others.

The Sulkas speak Sulka, the Birars speak Karus, and the Marmars speak Minigir, while the Duke of York islanders speak Ramoaina.

(5) Ethnic Group Distribution in the Gazelle District

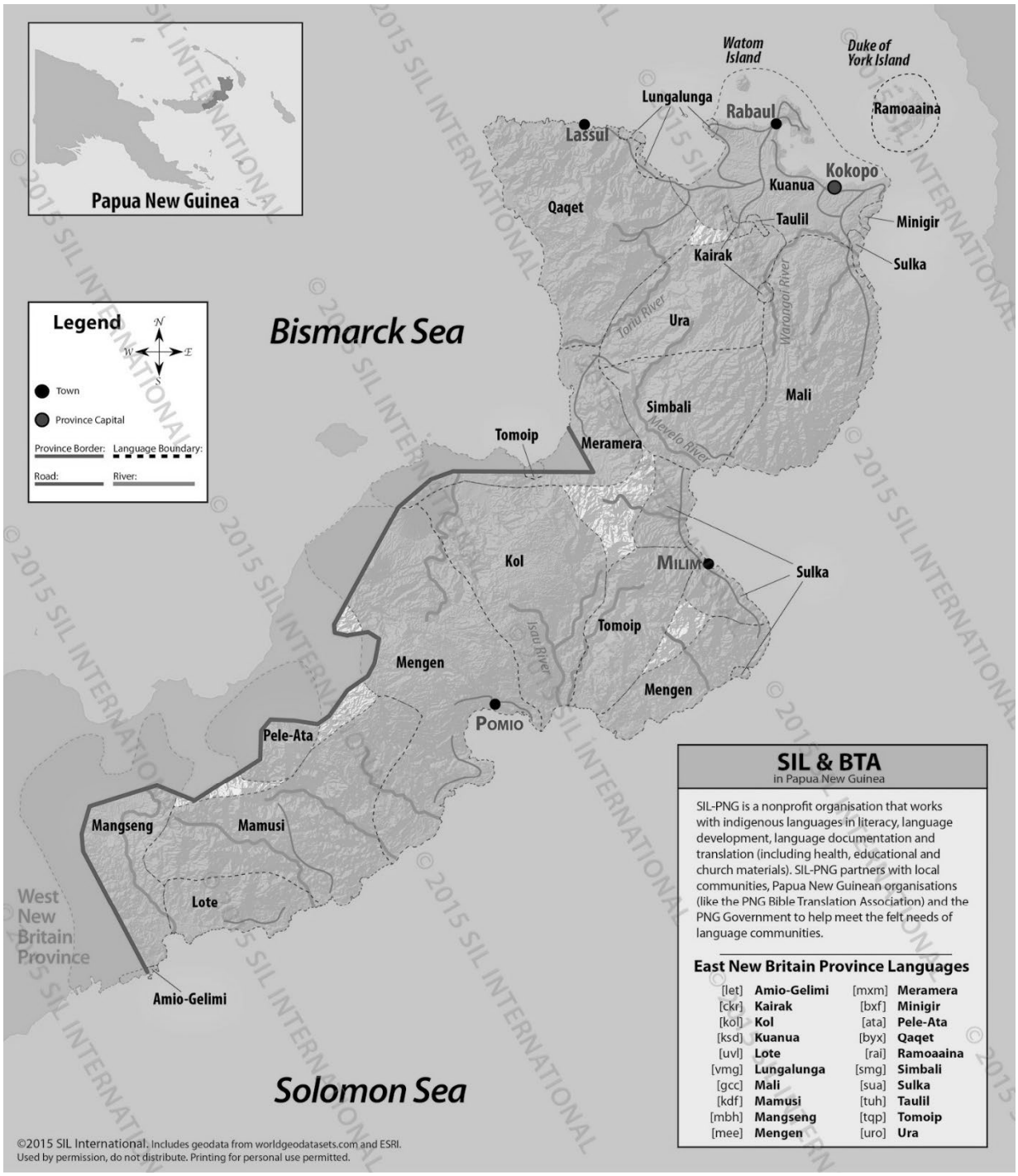
The main ethnic groups in the Gazelle District are the Bainings, Tolais, Makolkols, Nakanais and the Tomoips. Morobeans, Sepiks, Highlanders and other New Guinea islanders are those who were brought in to work in plantations while others migrated into the province for other reasons.

In 1912, the Germans administratively set the boundaries between the Tolais and the Bainings: the coastal areas are for the Tolais, and the areas west of the Kerevat River extending to Open Bay are for the Bainings.

(6) Ethnic Groups in Ataliklikun Bay Area

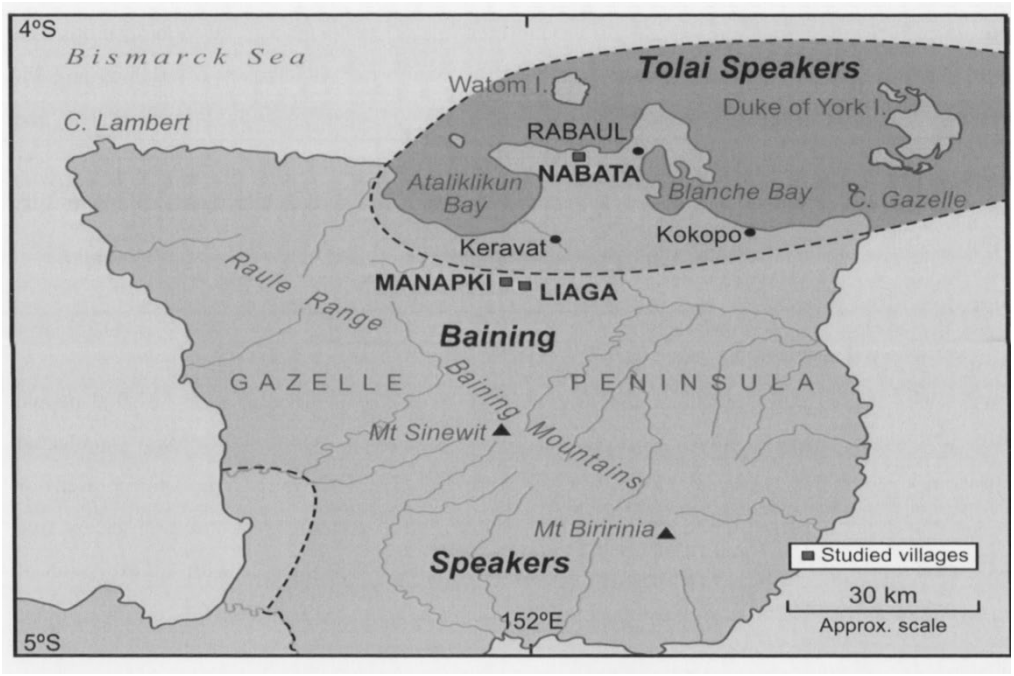
Ataliklikun Bay area, as well as Kerevat Town, in Gazelle District has attracted special attention to development potential for agro-industries. In fact, the Gazelle District Development Authority has a plan to establish a special economic zone for agro-industries in Ataliklikun Bay area.

While it is known that Ataliklikun Bay area has a mixture of ethnic groups, there is an ethnic group, called the Lungalunga, who has a strong solidarity near Ataliklikun Bay as shown in Figure 4.3.4. It is said that they originally migrated from New Ireland Province in the 1700s.



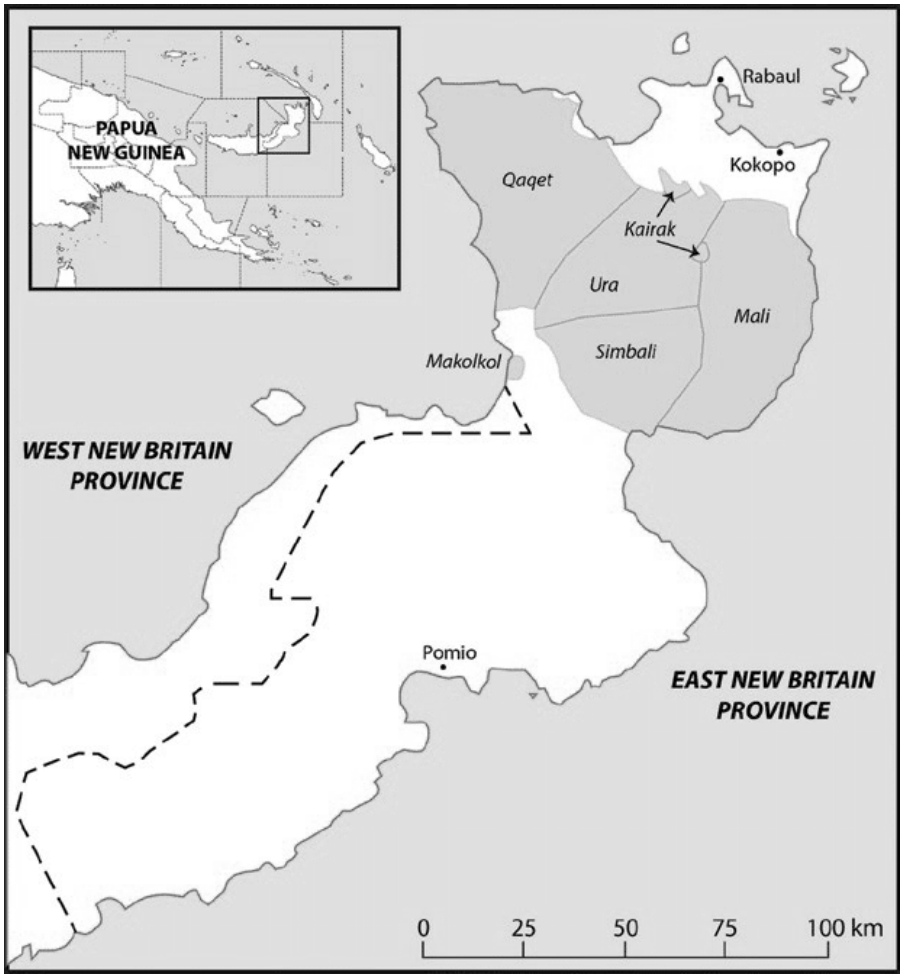
Source: Website of Languages of Papua New Guinea, https://pnglanguages.sil.org/resources

Figure 4.3.1 Distribution of Languages in EMBP



Source: F. Essacu, 2015, Community-Level Leadership and Development Outcomes in Rural Papua New Guinea: Evidence from Three Case Study Regions

Figure 4.3.2 Geographical Distribution of Tolai Speakers



Source: Naomi Sime, 2017, "The Politics of the Baining Fire Dance" (Map adapted from Ethnologue (Lewis, Simons, and Fenning 2013) by Don Niles)

Figure 4.3.3 Usage of Five Baining Languages in the Gazelle Peninsula: Kairak, Mali, Qaqet, Simbali, and Ura

Source: Joshua Project, a Ministry of Frontier Ventures, https://joshuaproject.net/people_groups/13729/PP

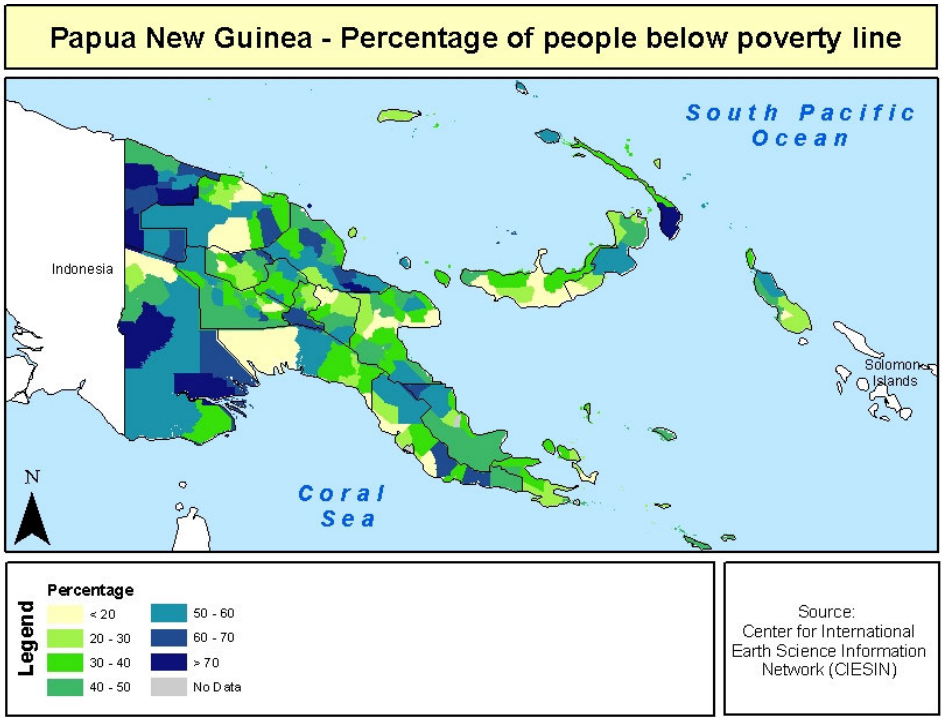
Figure 4.3.4 Location of Lungalunga People near Ataliklikun Bay

4.3.2 Poverty

(1) Poverty Situation in 2005

The data of geographical distribution of poverty rates (percentages of people below poverty line) for 2005 are available and presented in Figure 4.3.5. The figure showing the poverty rate distribution is prepared by the Center for International Earth Science Information Network of Colombia University.

The Northeast Gazelle Peninsula has 20% to 30% poverty rate, according to this map.



Source: Center for International Earth Science Information Network (CIESIN), Colombia University

Figure 4.3.5 Poverty Rate by Area in PNG, 2005

(2) Household Income and Expenditure Survey 2009-2010

In the past 10 years, only one Household Income and Expenditure Survey (HIES) was conducted in PNG. This survey was in 2009-2010, while the previous one was conducted in 1996.

Four different poverty rates are estimated and described below and shown in Table 4.3.1.

- Applying the national poverty line based on basic needs, 39.9 percent of the population lived below the poverty line.
- Using the international poverty line of $1.90 per person per day, the poverty rate was estimated at 38.0 percent. By using the two different poverty lines for urban and rural areas (the international poverty lines), the poverty rate turned out to be 40 percent in rural areas and 27 percent in urban areas. In PNG, the percentage of urban population is 13%.
- The poverty rate was 65.6% and very high, being measured against the Lower Middle Income Class Poverty Line of $3.20.
- According to the multi-dimensional poverty measure considering not only monetary aspects, but also other education and other public services, the poverty rate was 85.7 percent.

Table 4.3.1 Five Different Types of Poverty Rates of PNG, 2009

	Population under the Poverty Line (million)	Poverty Rate (%)	Period (year)
National Poverty Line	2.8	39.9%	2009
International Poverty Line 3.8 in Papua New Guinea kina (2009) or US$1.90 a day (2011 PPP) per capita	2.7	38.0%	2009
Lower Middle Income Class Poverty Line 6.4 in Papua New Guinea kina (2009) or US$3.20 a day (2011 PPP) per capita	4.7	65.6%	2009
Multi-dimensional Poverty Measure	6.1	85.7%	2009

Source: The Household Income and Expenditure Survey 2009-2010

(3) Conduct of Next Household Income and Expenditure Survey

PNG was planned to conduct the next Household Income and Expenditure Survey in 2021. However, due to COVID-19, it has not yet been conducted.

4.3.3 Social Services Conditions in ENBP

In 2016 - 2018, a demographic and health survey (DHS) was conducted and compiled for PNG by the National Statistical Office of PNG and the Demographic and Health Surveys (DHS) Program of ICF, USA.

This DHS was a sampling survey covering various basic indicators of fertility, fertility preferences, family planning practices, childhood mortality, maternal and child health, knowledge and awareness of HIV/AIDS, domestic violence, and other related health issues.

Based on the survey results, some features of ENBP's social services are summarised in Table 4.3.2.

Table 4.3.2 Features of Social Services in ENBP, 2016-2018

1. Accessibility to Drinking Water
Access to relatively good quality drinking water (tap, managed wells, water trucks, etc.) was relatively high (62.2%) compared to other provinces.
Access to sanitary toilets was higher in ENBP than in other provinces (the best level, except in the National Capital District).
2. Accessibility to Health Facilities
In ENBP, a very high percentage of women (58.4%, the highest among all provinces) had problems obtaining permission to receive treatment in medical facilities (from family members).
The percentage of women who visited a health facility in the past year in ENBP was higher than the national and region averages. Reasons for visiting medical facilities were about average compared to other states. There were few visits due to accidents or family planning consultations.
The percentage of men visiting medical facilities in ENBP was about average compared to other provinces. The percentage of men's visits for health check-up reasons was lower than those in many other provinces.
The percentage of women who were aware of facilities where they could receive HIV testing in their areas was much higher than the national average and regional average. However, the percentage was low for men.
3. Accessibility to School Education
While the proportion of women and men (aged 15-49) with a primary school diploma or above was higher than men on the average across the country, the opposite was true in East New Britain. (In ENBP, the percentage of men who graduated from secondary school or above was slightly higher). Women's median of years of school completion (6.7 years) was above the national average, while that for men (6.3 years) was below it, and the percentage of men dropping out of primary school was high.
4. Literacy Rates
The literacy rates of both men and women combined and women alone were well above the national average. Also, the Islands Region has a higher literacy rate than other Regions. Moreover, there is no significant difference between male and female literacy rates in ENBP.
5. Accessibility to Internet Services
The percentage of people who used the internet in the past years was average for both men and women. However, the percentage who used the internet at least once a week was below the national average.

Source: JICA Expert Team summarising the results of "Papua New Guinea Demographic and Health Survey 2016-18"

4.3.4 Socioeconomic Condition in ENBP

The Demographic and Health Survey (DHS) 2016-2018 contained some information on socioeconomic aspects, especially about fertility rates, cash incomes, employment and safety. Based on the survey results, some features of the socioeconomic condition in ENBP are summarised in Table 4.3.3.

Table 4.3.3 Features of Socioeconomic Condition in ENBP, 2016-2018

1. Fertility Rates
The Islands Region's total fertility rate (4.5 in 2016-2018) was relatively higher than those of the other regions in PNG. In the Demographic and Health Survey 2016-2018, there were no data on total fertility rates by province, but data by Region are available.
2. Household Cash Earnings
In the Islands Region, the proportion of households who grew cash crops to those who grew food crops was relatively low, and the proportion of livestock holdings was relatively high.
The percentage of households where the wife earned more cash than the husband was lower than the national average. In the ENBP, the share of households in which husbands and wives jointly decide how to use women's cash earnings was higher than the national average, and this was easily influenced by male family members. The percentage of households where men control their own cash earnings was higher than the national average.
3. Employment
The employment rates of women in the past 12 months were higher than the national average and the regional average. Comparing within the Islands Region, the proportion of women engaged in agriculture was high, while the respective proportions of sales and service personnel, professional engineers and managers were low.

The employment rates for men in the past 12 months were lower than the national average, and 60% were unemployed. Compared to the national average and the regional average, the percentage of skilled manual workers was high.
4. Security Related to Women
The percentage of women who had been physically assaulted in the past 12 months was below the national average. It was about the same as the Islands Region average. ENBP had lower rate than the national and region averages for sexual assault.

Table 4.3.4 Total Fertility Rates in PNG in 2006 and 2016-2018

	2006	2016-18
Highlands Region	3.87	3.8
Southern Region	4.48	4.5
Momase Region	4.97	4.4
Islands Region	4.59	4.5

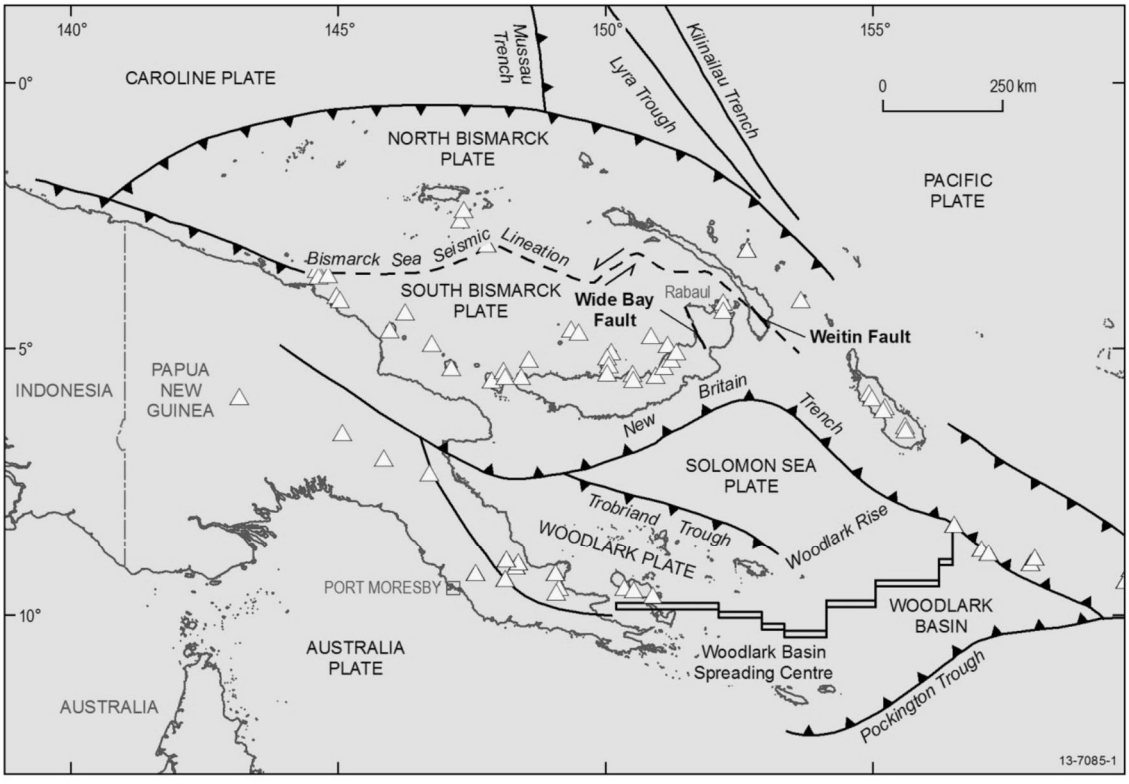
Source 1: 2006 - Papua New Guinea Demographic and Health Survey 2006 National Report
Source 2: 2016-18 - Papua New Guinea Demographic and Health Survey 2016-18

Chapter 5 Disaster Risk Profile of Northeast Gazelle Peninsula

5.1 Background

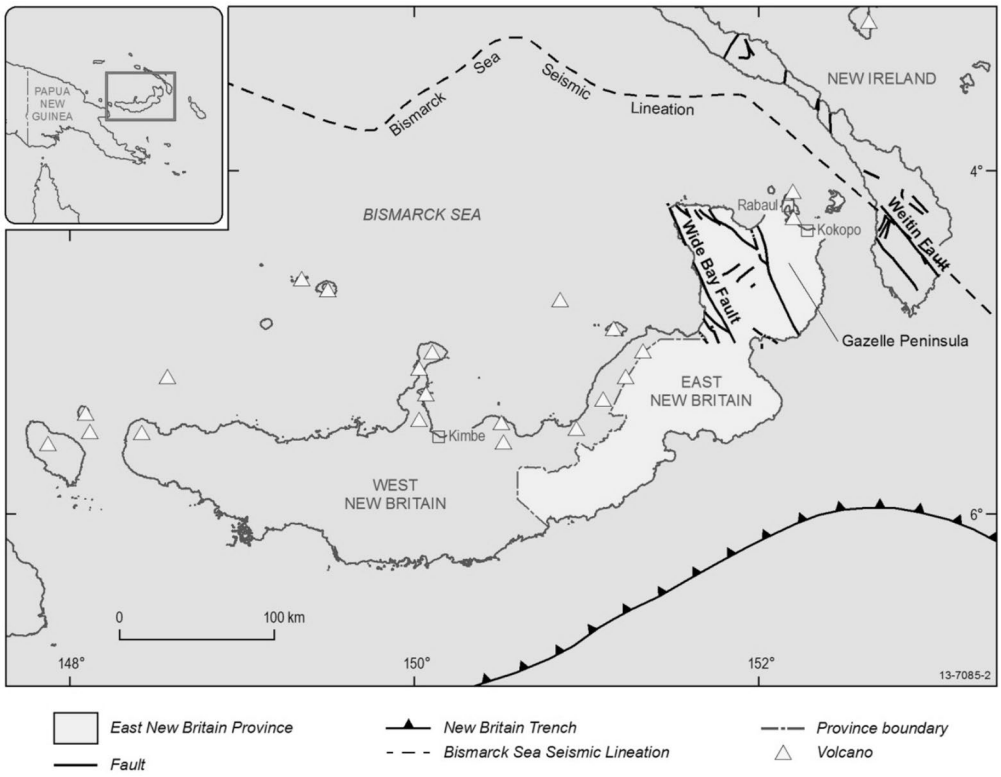
ENBP is prone to a variety of serious disasters caused by geological setting in and around the province, including characteristics of techno plates, trenches, fault lines, and volcanoes, as shown in Figure 5.1.1. Especially, Northeast Gazelle Peninsula's disaster hazards are due to the geological setting of New Britain Island and presence of active volcanoes, as shown in Figure 5.1.2.

Existing documents concerning disaster hazards have been reviewed, and the results are summarised in this chapter.



Source: Moihoi, et al., July 2013, "Integrating Hazard and Exposure for East New Britain," Geoscience Australia, Australian Government

Figure 5.1.1 Geological Setting of Papua New Guinea

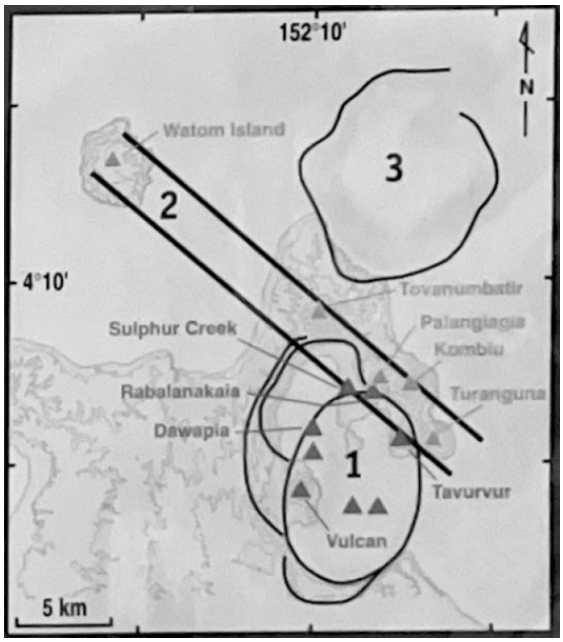


Source: Moihoi et al., July 2013, "Integrating Hazard and Exposure for East New Britain," Geoscience Australia, Australian Government

Figure 5.1.2 Geological Features of ENBP

5.2 Rabaul Volcanic Complex

Rabaul has many volcanoes which overlap with each other. Volcanologists refer to them as a "volcanic complex." It is composed of several calderas (large craters) that have been formed over thousands of years. These calderas in the south have been flooded by sea, forming the Rabaul Harbour (Simpson Harbour).



Source: Rabaul Volcanic Complex Poster

Figure 5.2.1 Rabaul Volcanic Complex

Magma generation and eruption have happened in the Rabaul area at least in the past 500,000 years. The Rabaul volcanic system is much larger than the present Rabaul Caldera. It is about 35 km from Watom Island to Kokopo.

In the past, the large Rabaul volcanic system had at least 9 major caldera-forming eruptions. It is considered that its latest major eruption was about 1,400 years ago, which devastated the area within 50 km diameter and made the Rabaul Caldera deeper and wider.

5.3 Review of Disaster Risk Assessment Report for ENBP, 2002

(1) Background

The Disaster Risk Assessment Study was conducted for 10 months by a group of officers from Gazelle Restoration Authority (GRA) and ENBP Administration (ENBPA) with the support of AusAid. Experts of Rabaul Volcanological Observatory (RVO) also played a major role in providing expert investigations.

Major strength of this disaster risk assessment report is a comprehensive coverage of varieties of disaster hazards. The following hazard assessments were done, and these are described below.

- Geological Hazard
- Volcanic Hazard
- Earthquake Hazard
- Landslide Hazard
- Tsunami Hazard
- Coastal Erosion Hazard
- Floods Hazard
- Drought Hazard

However, the analyses and assessments in the Disaster Risk Assessment Report for ENBP (2001) were mostly qualitative based on geological information and maps, and historical disaster information.

(2) Geological Hazard [1]

East New Britain is one of the most seismically active regions in PNG. The whole Island of New Britain is prone to volcanic activities, high density and intensity earthquakes, landslides, tsunamis and rapid tectonic plate movements (subduction, sinking or slips).

It is considered that most parts of the province are geologically made of soft structure, and are highly prone to landslides, ground subsidence and rapid erosion through contact with water and high seismic movements.

(3) Volcanic Hazard

All volcanoes pose danger. In particular, a sea-filled caldera like Rabaul pose more danger because during eruption, the seawater can make contact with the magma and react intensely to cause massive explosions.

Within the present caldera of Rabaul, small volcanoes might erupt again within 40-60 years with the same magnitude as the eruption in 1994. While simultaneous eruptions of Tavurvur and Vulcan volcanoes are highly likely, and there is a possibility of eruptions from other vents. Tavui (a submerged volcano), Kombiu and Turanguna volcanoes also have potential volcanic risks.

[1] Many of the geological analyses of hazards in Gazelle Peninsula were based on scientific contributions found in Lindley, I.D., 1988, Early Cainozoic Stratigraphy and Structure of the Gazelle Peninsula, East New Britain. An Example of Extensional Tectonics in the New Britain Arc-Trench Complex. Australian Journal of Earth Sciences 35, 231-244.

The possibility of medium-scale eruptions in Rabaul, whose accumulated volcanic ash could damage areas within 8-10 km radius, should not also be disregarded or underestimated.

With massive volcanic ash emitted by volcanic eruptions in 1994, buildings, infrastructure, vegetation, properties and villages were heavily damaged in Rabaul Town. About 80% of the houses were damaged by the weight of volcanic ash in Rabaul Town. Direct and indirect costs of damages to homes, properties, plantations and businesses were estimated to exceed PGK 300 million.[2] The government conducted relocation programmes to assist affected communities.

There are different types of events in volcanic eruptions. Among them, there are ten types of hazards relevant to the eruption of Rabaul volcano.

1) Tephra Falls

Tephra comprised of fragments of lava and other rocks thrown into the air during volcanic eruption. They range from fine ash particles to large rocks. Tephra materials are most widely spread during eruptions. The distribution of tephra depends on various factors including the height of eruption column, the strength and the direction of wind, and the size and density of the fragments.

The weight of the accumulated tephra (volcanic ash) caused failure and collapse of roofs of buildings around Rabaul Town and surrounding areas.

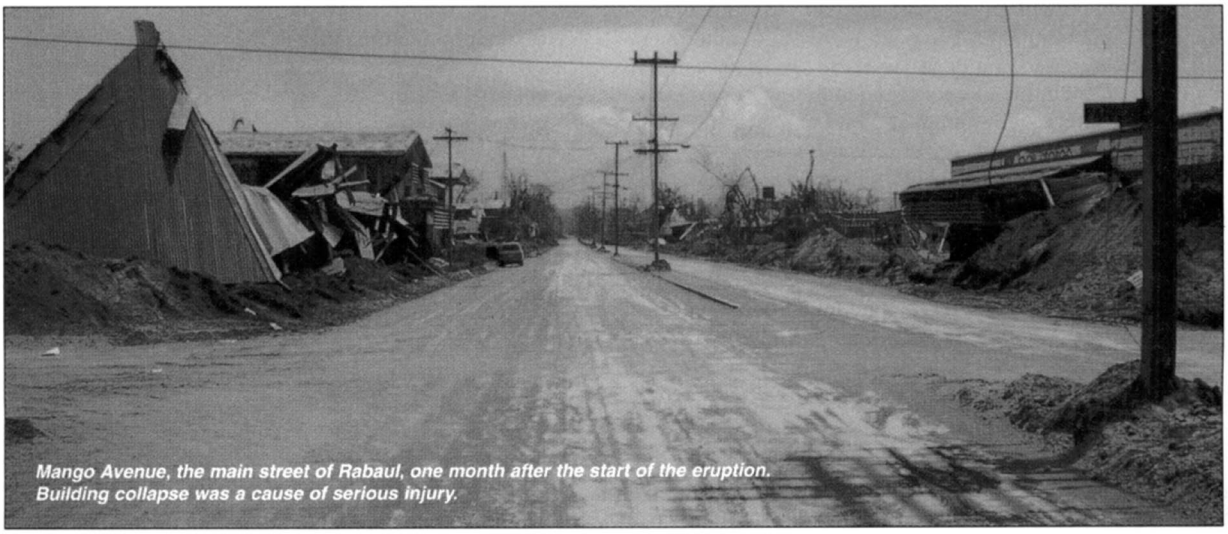
In the Final Report of Kokopo Urban Development Plan (December 1995), tephra (including ash) accumulation and its impacts are described as follows:

- "The eastern part of Rabaul town, along and around Mango Avenue, was the hardest hit in terms of ash load and damage. The depth of ash and pumice cover ranged from approximately 2 metres in Malay Town to 0.5 metre at the harbour, reducing further west along Malaguna to approximately 0.3 metre near the main wharf. The surrounding hillsides were also heavily covered in ash which presented a landslide hazard which could persist for many months."
- "Building damage was extensive and appears to have been primarily caused by the weight of ash shifting on roofs. The failure of the roof structures has subsequently resulted in the failure of the supporting walls and, as a consequence, many buildings in the town are beyond repair."
- "Buildings with high-pitched roofs including some houses, the Travelodge and Hamamas Hotels, and some buildings at the western end of Malaguna Road have largely escaped serious damage as the ash build up on their roofs was not as great. However, investigations confirmed that even these buildings sustained an ash build-up of between 100 mm and 150 mm on their roofs, a load equivalent to approximately 8 times the design live load or approximately three times the design wind load."
- "The ash itself ranges from coarse grain to very fine talcum powder consistency and irritates the throat and eyes. Analysis of the fine tephra indicated that it has a dry weight of approximately 1,620 kg/m^3 and a saturated weight approaching 2,000km/m^3. When wet the material forms a thick abrasive slurry. Observations on the ground showed that the ash is able to maintain a high angle of repose, meaning that it has tended to bulk up instead of falling over, even on inclined surfaces. This tendency is enhanced by the slightly plastic behaviour of the material when moist."
- "The high sulphur content of the ash presents a significant corrosion problem to all metals, including aluminum and even some stainless steels. Concrete in foundations and walls is also vulnerable to sulphur contamination which causes the surface of the concrete to turn brittle and crack. Long-term contact (over a period of years) between the concrete and the ash can cause permanent damage due to this corrosive effect."

[2] PGK 300 million is equivalent to USD 300 million in 1994 exchange rate.

- "Damage to town services appears to be minimal. Despite the earthquakes that preceded the first eruption, there is no visible evidence of significant ground movement, meaning that the water, sewerage and stormwater infrastructure are intact. Obviously, a great deal of ash has found its way into the sewer and storm water systems and these will take some time to clear."
- "Overhead electrical power distribution lines remained mostly intact, although most individual connections to buildings were lost."

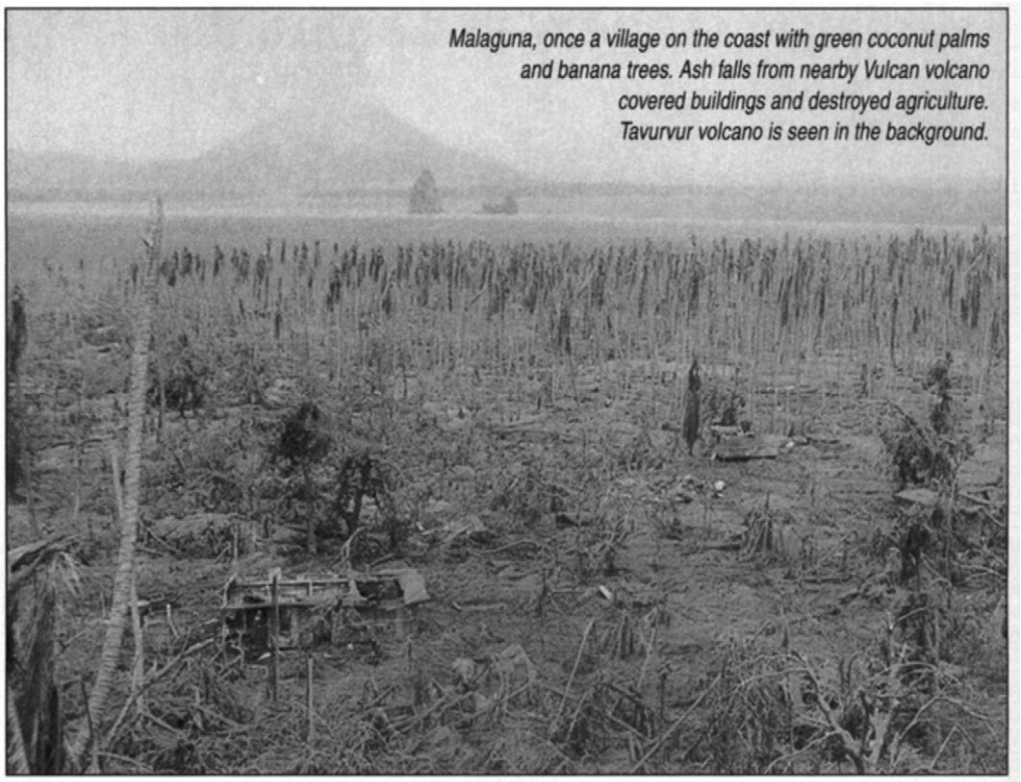
During 1994 eruptions, Rabaul Port and oil depots escaped destruction caused by the weight of thick volcanic ash. This was because personnel continued to remove ash from the facilities after the volcanic eruption.



Source: Dent, Andrew W., December 1995, The 1994 Eruption of the Rabaul Volcano, Papua New Guinea: Injuries Sustained and Medical Response, The Medical Journal of Australia, Vol.163 4/18.

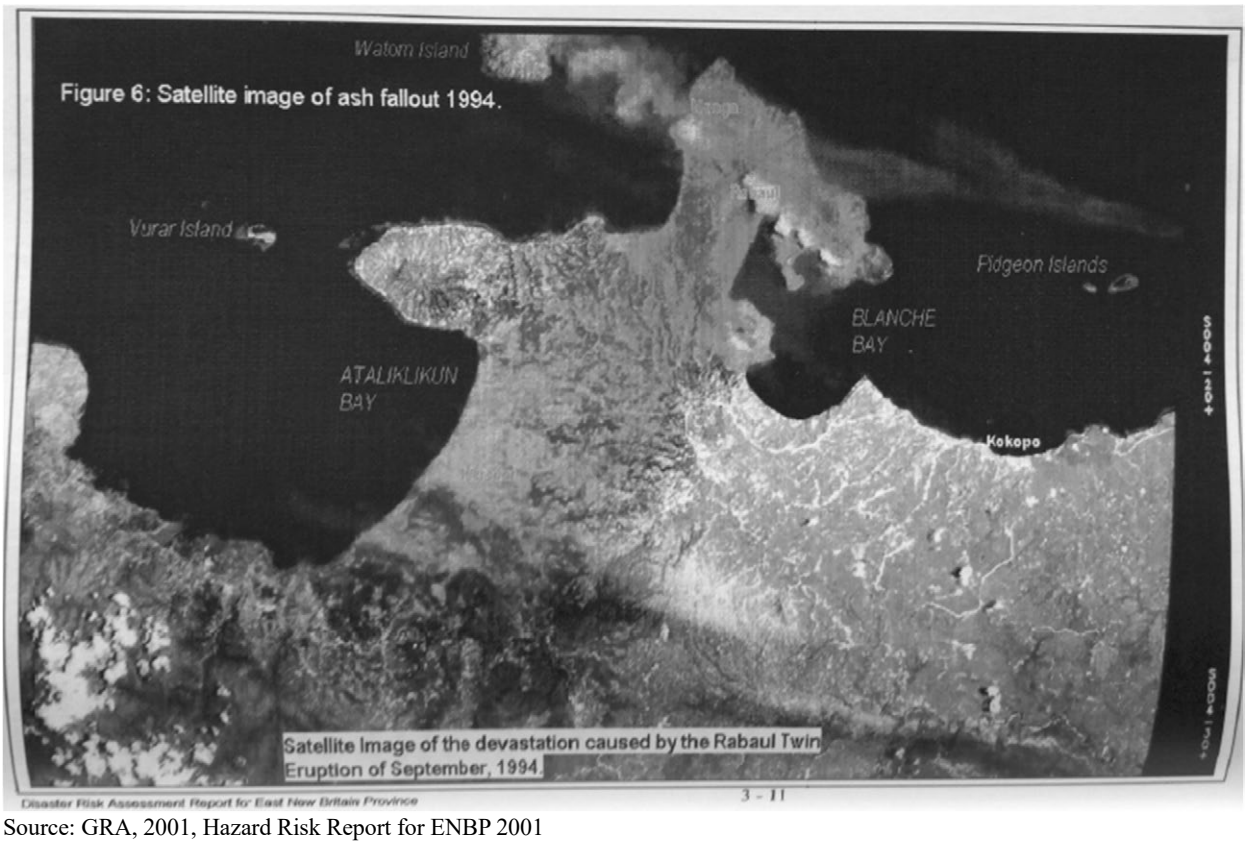
Figure 5.3.1 Situation of Tephra Fall on Mango Avenue, the Main Street of Rabaul Town, One Month After the 1994 Volcanic Eruptions

Ash also seriously damaged agriculture land and other vegetation. Ash in the atmosphere reduced visibility and hindered air traffic and road traffic. Ash also affected motor vehicles by clogging air filters and causing the rapid wearing out of moving spare parts. It also contaminated sources of water supply, especially the unprotected ones like uncovered water tanks and other water reservoirs.



Source: Dent, Andrew W., December 1995, The 1994 Eruption of Rabaul volcano, Papua New Guinea: Injuries Sustained and Medical Response, The Medical Journal of Australia Vol.163 4/18

Figure 5.3.2 Situation of Agricultural Land Damaged by Ash Fall Due to 1994 Rabaul Volcanic Eruptions



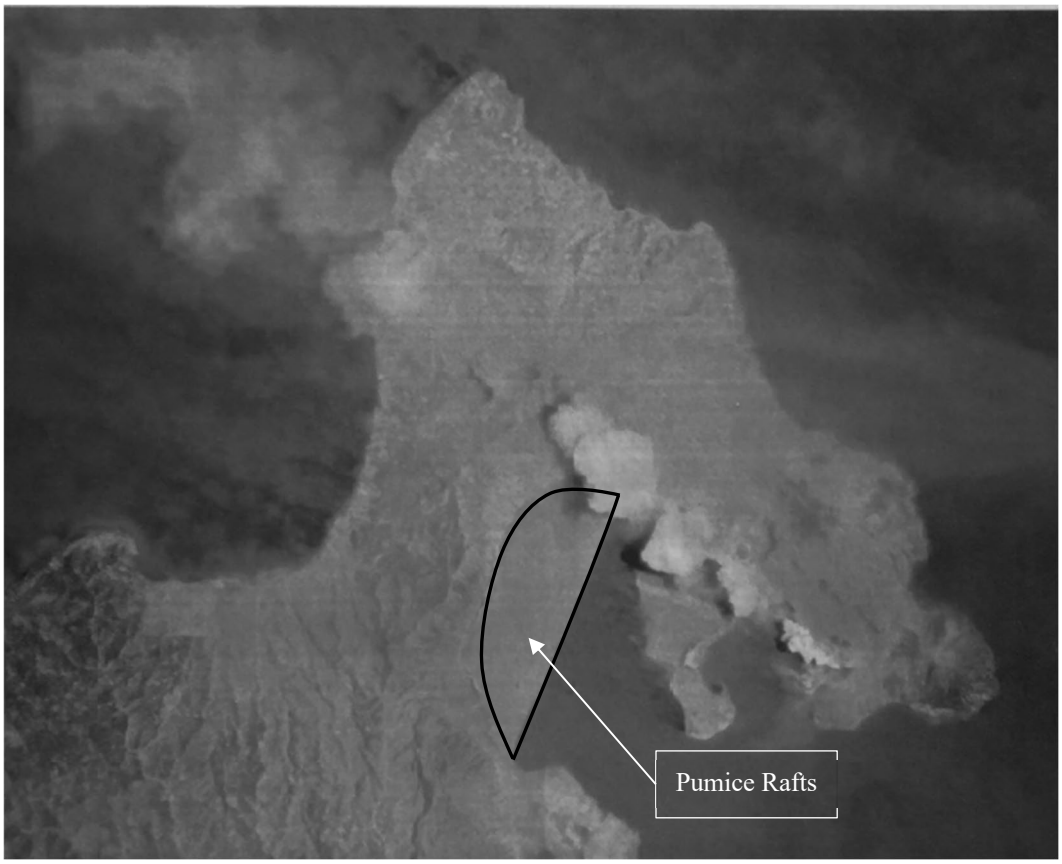
Source: GRA, 2001, Hazard Risk Report for ENBP 2001

Figure 5.3.3 Distribution of Volcanic Ash (Tephra) in 1994 Volcanic Eruptions over Part of Northeast Gazelle Peninsula

2) Pumice Rafts

Pumice are light-coloured vesicular glassy rocks which often float on water. If they are deposited in water, they form "pumice rafts" which can be several metres thick, and/or can cover the entire bay or harbour. See the case of Simpson Harbour in 1994 eruptions in Figure 5.3.4. Pumice rafts can block waterways and harbours for months resulting in disturbance of water.

According to the description of Rabaul situation after the volcanic eruptions in the Final Report of the Kokopo Urban Development Plan (December 1995), "a pumice raft up to 1.5 m thick formed in the harbour which was eventually reopened for shipping on 25 October 1995 after the pumice raft began breaking up."



Source: GRA, 2001, Hazard Risk Report for ENBP 2001

Figure 5.3.4 Distribution of Pumice Rafts on Simpson Harbour After 1994 Volcanic Eruptions

3) Electrical Storms Due to Large Quantities of Tephra and Gas Ejected into the Air

Electrical storm killed a local person at Ralalar Village during 1994 eruption.

4) Pyroclastic Flow

Pyroclastic flows are the flowing down of hot volcanic fragments and gases over the flank of a volcano during volcanic eruption.

5) Pyroclastic Mud Flow

6) Torrential Run-Offs (Mud Flow)

Mudflow is a slurry of volcanic debris and water that flow down in valleys of a volcano after heavy rain. Rainfall triggers mudflows even many months after the end of volcano eruptions.

It is different from the normal flood by the amount of rock debris included in the flow. During 1994 Rabaul eruptions, mudflows cut most roads around Rabaul, as shown in Figure 5.3.5.

Similar description of the danger of mud flow in 1994 volcanic eruptions was seen in the Final Report of the Kokopo Urban Development Plan (December 1995) as follows: "The large quantity of fresh unconsolidated ash fallout posed a real threat of mud slides in Rabaul and the surrounding hills… In East Britain, the experience light rains on the peninsula have highlighted the destructive force of the mud flows. The Burma Road has been cut in at least three locations as does the Kokopo Road. The abrasive mud has caused deep souring (up to 5 m deep) which has washed away parts of the Burma and Kokopo Roads and nearby property."

Source: GRA, 2001, Hazard Risk Report for ENBP, 2001

Figure 5.3.5 Effect of Mudflow Along Namanula Road in Rabaul During 1994 Eruption

7) Lava Flows

Lava flows are streams of hot, molten liquid rocks (with temperature of 1,000 degrees centigrade). Lava flows are slow-moving. However, their high temperature and great mass render them a threat to buildings and forest land in their paths. Then they can also block or cover road system and productive agriculture land.

The 1996 and 1997 lava flows from Tavurvur Volcano which cover a large land between Sulphur Point and Talvat Village, making a barren land for a long time.

8) Earthquake Due to Magma Injection

Volcanic earthquakes caused damages in Rabaul Town.

9) Tsunami Due to Earthquake and Volcanic Activity

Approximately, 1937 tsunami killed 500 people in Vulcan.

10) Toxic Volcanic Gas

(4) Earthquake Hazard

Seismic activities are very high in East New Britain. There are four types of sources of these seismic activities: subduction seismicity, transform seismicity, triple junction seismicity and active fault (intraplate) seismicity.

While high-density earthquakes of magnitude 6.0-8.0 are highest in Central Pomio and West Pomio/Mamusi, the probability of occurrence of high-intensity earthquakes within a 100-year period in Rabaul, Kokopo and Pomio Districts is high.

1) Landslides

Friction supports rocks, soil and debris to maintain a stable slope. When earthquakes and volcanic eruptions occur, friction is reduced. Then the slope becomes unstable, and a landslide may occur.

Earthquakes have caused large landslides in East New Britain. In 1971 and 2000, strong earthquakes hit Rabaul and Kokopo, causing landslides which triggered small-scale tsunamis and heavily damaged housing properties and rainwater tanks. The landslides were mainly seen around the steep caldera slopes and deep road cuts.

2) Subsidence of Ground

Subsidence is the sinking of a part of the ground surface. Weak geological structures, including faults, caldera, and water-soluble rocks (like limestone), are at risk of subsidence.

The Caldera of Rabaul is in the collapsing process. Rabaul Town and portions within the caldera are at risk of subsidence.

In fault lines and plate margin, there are dangers of massive "landmass" subsiding. Subsidence can take place rapidly in case of a major earthquake. Subsidence can also happen very slowly over many years.

(5) Tsunami Hazard

ENBP's coastal areas have high tsunami risks due to their high seismicity and volcanism.

Earthquakes cause coastal landslides, submarine slumps, and possible undersea explosions (submerged volcanoes, such as Tavui Caldera) that can significantly disturb sea levels.

No major tsunamis similar to the size of the event in Aitape have occurred yet in East New Britain. However, danger is imminent if the population of coastal communities continues to grow.

- At least 12 damage-causing tsunamis hit Rabaul Harbour, Kokopo and Pomio since 1900 due to magnitude 7.0-8.0 earthquakes.
- Mortality was recorded during the 1937 eruption of Vulcan.
- During other events, damages to properties, shorelines, the harbour and houses along the coasts were caused by tsunamis.
- The magnitude 8.1 earthquake in New Ireland in November 2000 caused a tsunami that hit Duke of York Islands, Kokopo, Vunapope and Takubar, and inundation of over 100 metres inland.

This report of hazard assessment recommended that the province should maintain 500 metres in flat land as a coastal buffer zone against tsunami, and 300 metres for areas higher than 3 metres.

(6) Coastal Erosion Hazard

Shoreline loss or coastal erosion is alarmingly high in Kokopo, Rabaul and Pomio Districts. In Kokopo District, shorelines have been observed to have moved 10-15 metres inland in just 5-8 years. Factors for this coastal erosion include loss of mangrove forests and faster surface run-off due to loss of ground cover.

It is highly recommended that coastal development be controlled by establishing safe inundation zones of 300-500 metres in all coastal areas for mangrove afforestation and public parks.

(7) Floods Hazard

Flooding is critical in Kerevat and Warangoi areas mainly because of the loss of upland forests, which have reduced water retention capacities in upland areas, and increased soil deposits in natural drainage lines.

Kokopo has experienced isolated flooding due to the loss of natural drainage areas caused by land use change brought about by development. Rabaul Town's natural drainage paths are also vulnerable to seasonal flooding.

(8) Drought Hazard

There has been no disaster incidence of drought in Northeast Gazelle Peninsula. On the other hand, the problem of drought has been found in inland Melkoi, Pomio District. It is caused by lower rainfall and the inability to hold surface water of the localities partly due to the prevalence of limestone in Pomio District.

5.4 Review of "Integrating Hazard and Exposure for East New Britain, 2013"

(1) Strengthening Natural Hazard Risk Assessment Capacity in Papua New Guinea

In 2010, the Government of PNG and Geoscience Australia started a project for "Strengthening Natural Hazard Risk Assessment Capacity in PNG." This project was supported by AusAID and developed in collaboration with Government of PNG's technical agencies.

The project was designed to strengthen the technical capacity of PNG agencies to develop natural hazard and exposure information.

As a selected pilot programme in the above project, natural hazard and exposure information for ENBP was developed jointly by staff from the Port Moresby Geophysical Observatory (PMGO), Rabaul Volcanological Observatory (RVO), the East New Britain Provincial Administration (ENBPA) and Geoscience Australia through a series of capacity building activities undertaken over a three-year period (2010–2013).

(2) Research Report "Integrating Hazard and Exposure for East New Britain, 2013"

A research report entitled "Integrating Hazard and Exposure for ENBP" was prepared and published in 2013 as a professional opinion. The report was prepared by experts and officers of PNG's Department of Mineral Policy and Geohazards Management, ENBPA, and Geoscience Australia, based on the findings of the ENBP study.

The report elaborates the information on integration of hazard and exposure for ENBP so that town planners and scientists make use of them in decision-making process related to disaster risk reduction.

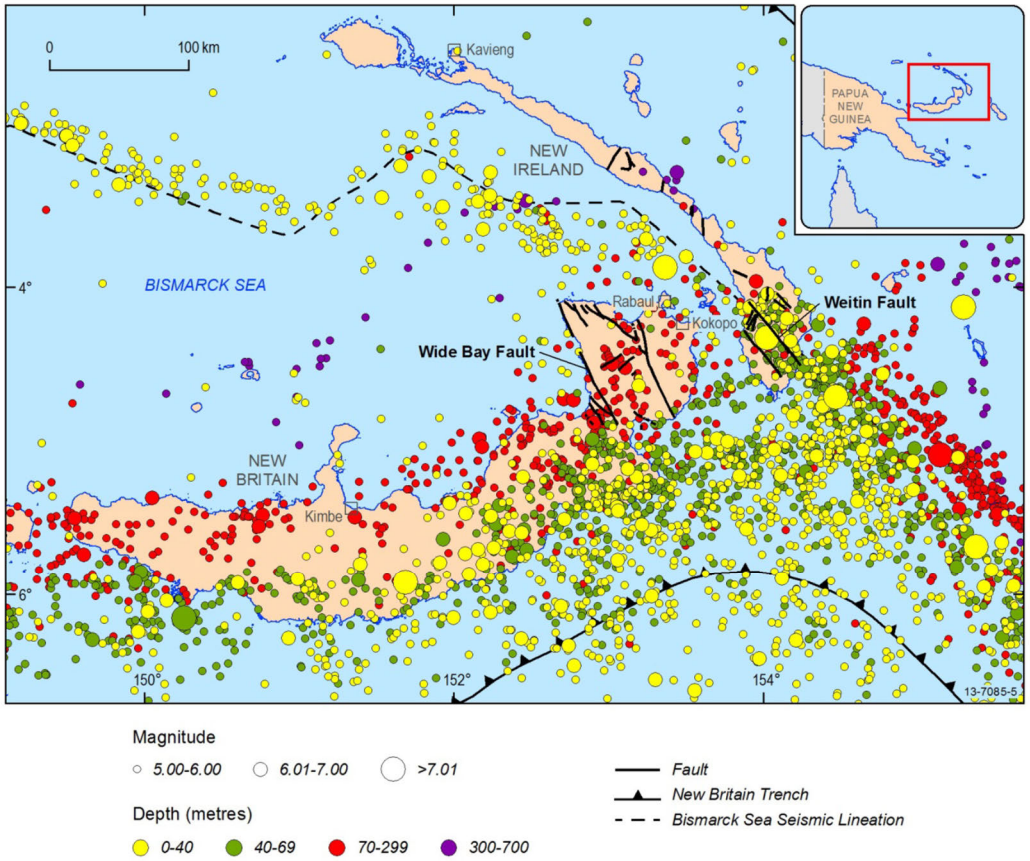
(3) Earthquake Hazard

1) Background

PNG is located in one of the most seismically active regions in the world, as shown in Figure 5.4.1. A historical database of seismicity includes 63 earthquakes of magnitude 7.0-8.0 and 4 earthquakes of magnitude 8.0 along the Bismarck arc (Mori, et al., 1987).

2) Seismic Hazard

For analysing seismic hazards, a method for Probabilistic Seismic Hazard Assessment (PSHA) is used. But no method for Deterministic Seismic Hazard Analysis (DSHA) is applied. Three earthquake scenarios with return periods of 100, 500, and 1,000 years are used for estimating ground motion. Northeast Gazelle Peninsula is less prone to seismic hazards than the other areas in the New Britain Island.



Source: Moihoi, et al., July 2013, "Integrating Hazard and Exposure for East New Britain," Geoscience Australia, Australian Government

Figure 5.4.1 Seismic Activities in PNG

(4) Tsunami Hazard

1) Review of Past Tsunami Hazard Assessment

The hazard assessment included in the Disaster Risk Assessment Report, 2001, for ENBP was based on consultations with communities affected by tsunami, literature reviews, and correlation studies of occurrence of earthquakes and volcanic eruptions.

East New Britain is considerably vulnerable to major tsunamis. Major factors making tsunamis include 1) high seismicity in the region, 2) the presence of active volcanoes in the region and 3) other factors such as coastal and submarine landslides and submarine volcanoes.

This assessment report suggested that the absence of necessary scientific data, such as detailed bathymetry maps covering the coast areas of ENBP, and such data insufficiency limited the satisfactoriness of the Hazard Assessment Report 2001 for ENBP.

2) Province-Scale Tsunami Hazard Assessment: Methodology and Results

For this research report, a province-scale assessment was conducted by using the Probabilistic Tsunami Hazard Assessment (PTHA) methodology. The PTHA for ENBP used the data from the Tsunami Hazard Assessment for the South West Pacific by Thomas and Burbidge (2009).

This assessment includes tsunamis caused by earthquakes, and does not include tsunamis made by other factors, such as volcanic eruptions, volcanic flank collapse, or submarine landslides. This is because over 90% of reported tsunamis in the Pacific Islands occurred due to earthquakes.

Tsunami amplitudes for different return periods (100-year return period, 500-year return period, and 1000-year return period) are analysed and mapped as shown in Figure 5.4.2, Figure 5.4.3, and Figure 5.4.4.

Source: Moihoi et al., July 2013, "Integrating Hazard and Exposure for East New Britain," Geoscience Australia, Australian Government

Figure 5.4.2 Inundation-Based Tsunami Hazard Map of East New Britain for the 100-year Return Period

Source: Moihoi et al., July 2013, "Integrating Hazard and Exposure for East New Britain," Geoscience Australia, Australian Government

Figure 5.4.3 Inundation-Based Tsunami Hazard Map of East New Britain for the 500-year Return Period

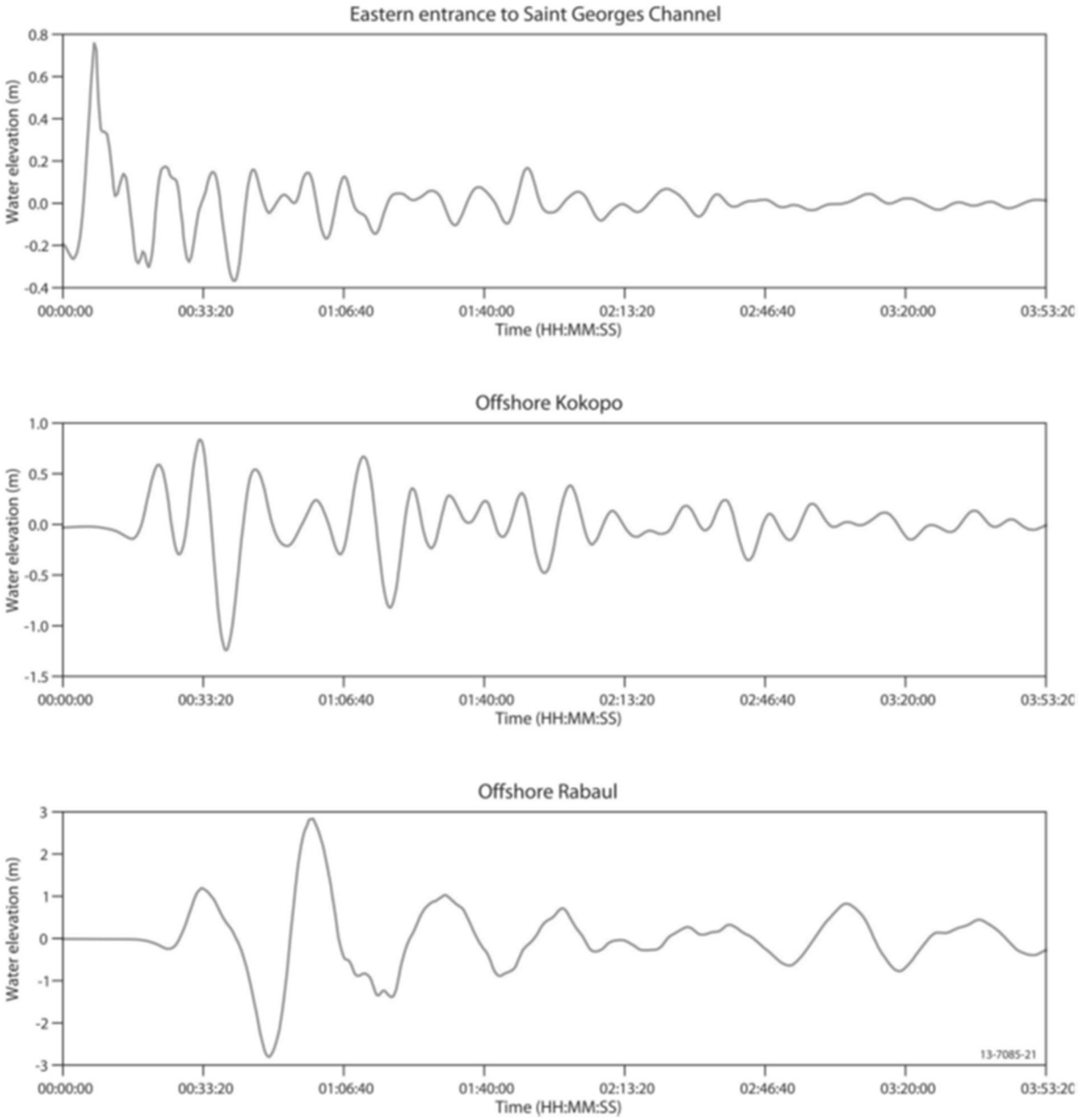
Source: Moihoi et al., July 2013, "Integrating Hazard and Exposure for East New Britain," Geoscience Australia, Australian Government

Figure 5.4.4 Inundation-Based Tsunami Hazard Map of East New Britain for the 1000-year Return Period

3) Detailed Northeast Gazelle Peninsula Hazard Assessment: Methodology and Results

In addition to the province-based tsunami hazard assessment which is described in the previous section, a more detailed tsunami hazard assessment was conducted for the Northeast Gazelle Peninsula, paying attention to the coastal zone for Tokua Area in the eastern part of the Northeast Gazelle Peninsula, and for Rabaul Area in the northern part of the Northeast Gazelle Peninsula.

For this tsunami hazard assessment, a detailed tsunami inundation modelling was made using a hydrodynamic model, ANUGA7, which is a joint development between Geoscience Australia and the Australian National University (Nielsen et al., 2005). [3]



Note Different scales are used for tsunami height.
Source: Moihoi et al., July 2013, "Integrating Hazard and Exposure for East New Britain," Geoscience Australia, Australian Government

Figure 5.4.5 Estimated Tsunami Height with respect to Mean Sea Level over time for the Magnitude 8.0 Scenario Earthquake at Three Locations around Northeast Gazelle Peninsula

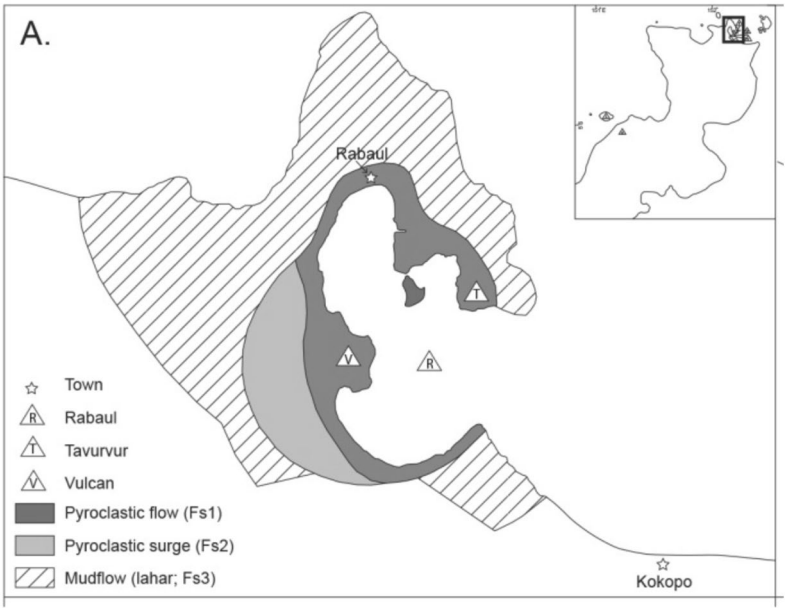
(5) Volcanic Flow (Pyroclastic Mudflow) Hazard Assessment

A local scale "volcanic flow" hazard (pyroclastic, mudflow) assessment was based on a GIS approach and previous eruptions focusing on the Gazelle Peninsula area.

[3] ANUGA is a free and open source software package, which is capable of modelling a variety of hydrodynamic hazards including tsunami, storm surge, floods and dam breaks.

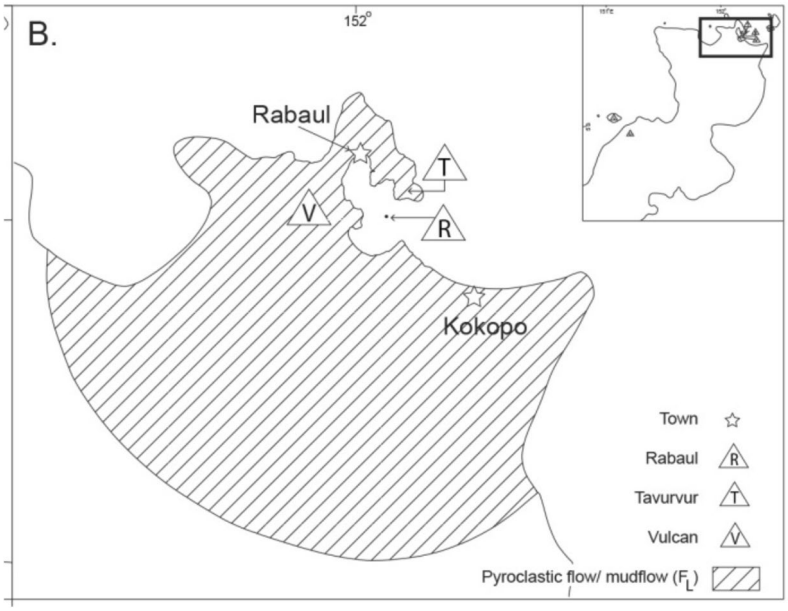
Pyroclastic flow, pyroclastic surge and lahar inundation zones were digitised for the Gazelle Peninsula region of ENBP from McKee et al (1985).[4]

Rabaul volcanoes' hazard maps on Pyroclastic Flow, Pyroclastic Surge and Mudflow are prepared for the two magnitudes of eruptions: small-moderate scale eruptions (See Figure 5.4.6) and moderate-large scale eruptions (See Figure 5.4.7).



Source: Moihoi et al., July 2013, "Integrating Hazard and Exposure for East New Britain," Geoscience Australia, Australian Government

Figure 5.4.6 Pyroclastic Flow, Pyroclastic Surge and Mudflow Hazard Zones for the Major Volcanic Centres of ENBP: A. Flow Hazard Zones for Small-Moderate Scale Eruptions from Source Vents associated with Rabaul Caldera



Source: Moihoi et al., July 2013, "Integrating Hazard and Exposure for East New Britain," Geoscience Australia, Australian Government

Figure 5.4.7 Pyroclastic Flow, Pyroclastic Surge and Mudflow Hazard Zones for the Major Volcanic Centres of ENBP: B. Flow Hazard Zone for Moderate-Large Scale Eruptions from Rabaul Caldera

[4] Mackee, et al. (1985) "Rabaul Caldera, Papua New Guinea: Volcanic hazards, surveillance, and eruption contingency planning, Journal of Volcanology and Geothermal Volume 23, Issues 3–4, February 1985, Pages 195-237

(6) Volcanic Ash Hazard

1) Computational Model for Volcanic Ash Hazard Assessment

A regional-scale probabilistic "volcanic ash hazard" assessment is based on computational modelling using a volcanic ash dispersal model. Computational models together with field studies and monitoring efforts were used for conducting volcanic ash hazard assessments. The computational model used for this assessment was the open-source volcanic ash dispersal model FALL3D (Folch et al, 2009) for the five source vents identified in this study.

2) Volcanic Ash Hazard Zone Classification

Volcanic ash hazard maps are prepared by contouring percentage probability of exceeding a particular threshold of volcanic ash load (kg/m^2). Increasing threshold values of volcanic ash load suggest increased severity of impact on exposed elements (e.g. buildings, roads, people, and crops).

Volcanic ash load thresholds were extracted from modelled data at 1kg/m^2, 10kg/m^2 and 300kg/m^2 in order to capture a range of impact factors. These three ash load thresholds of 1kg/m^2, 10kg/m^2 and 300kg/m^2 represent lower limit estimates of the different damages as shown in Table 5.4.1.

Table 5.4.1 Volcanic Ash Load and Different Damage

	Volcanic Ash Load (kg/m^2)	Damages due to Volcanic Ash Load
1	1kg/m^2	Crop damage
2	10kg/m^2	Surficial damage to buildings
3	300kg/m^2	Partial or total collapse of roof material

Source: Moihoi et al., July 2013, "Integrating Hazard and Exposure for East New Britain," Geoscience Australia, Australian Government

(7) Volcanic Ash Hazard Map in Case of Intermediate Magnitude (VEI4) Eruption

Intermediate magnitude (VEI4) eruptions were simulated at the five volcano source vents of Tavurvur, Vulcan, Rabaul, Ulawun and Lolobau.

These volcanic ash load maps were contoured from 1-100% in increments of 10% for both of the following seasonal different meteorological conditions:

Table 5.4.2 Wind Directions in Northeast Gazelle Peninsula

	Months	Wind Direction
1	October-March	The monsoon winds from the northwest direct the distribution of the volcanic ash towards the southeast.
2	April-September	Trade winds from the southeast direct the distribution of volcanic ash towards the northwest.

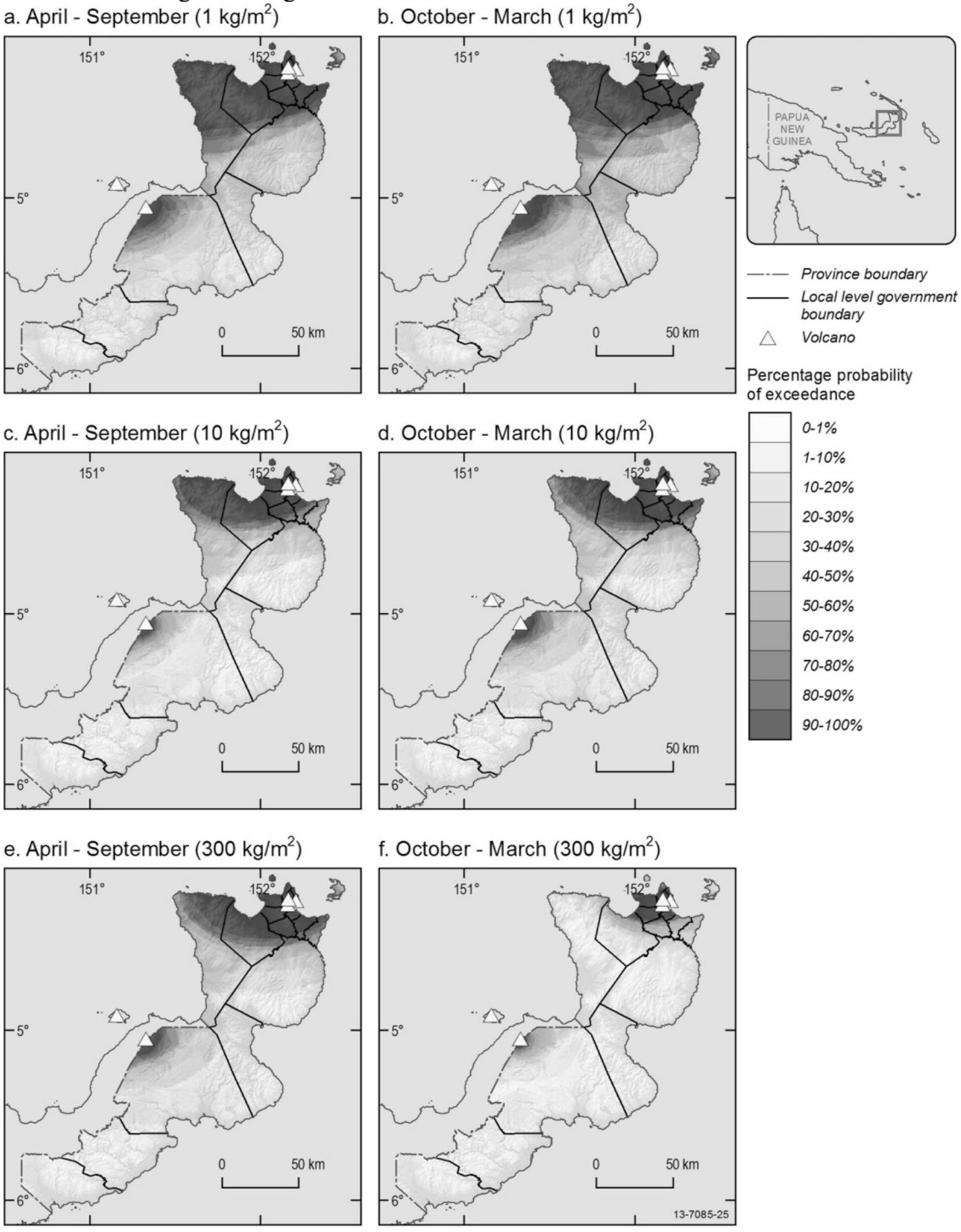
Source: Moihoi et al., July 2013, "Integrating Hazard and Exposure for East New Britain," Geoscience Australia, Australian Government

The maps were then re-classified for risk analysis by grouping ranges of percentages as follows:

- Low (<30%) volcanic ash hazard zones,
- Moderate (31 – 60%) volcanic ash hazard zones,
- High (61 – 80%) volcanic ash hazard zones, and
- Very high (> 81%) volcanic ash hazard zones

In the case of intermediate magnitude eruption, the volcanic ash hazard maps depending on the following season (wind directions) and three ash load thresholds are shown in six maps in Figure 5.4.8:

- A Ground load probability maps showing probability in % that the deposit load exceeds 1 kg/m^2 during April-September wind conditions
- B Ground load probability maps showing probability in % that the deposit load exceeds 1 kg/m^2 during October - March wind conditions
- C > 10 kg/m^2 during April - September wind conditions
- D > 10 kg/m^2 during October - March wind conditions
- E > 300 kg/m^2 during April - September wind conditions
- F > 300 kg/m^2 during October - March wind conditions.



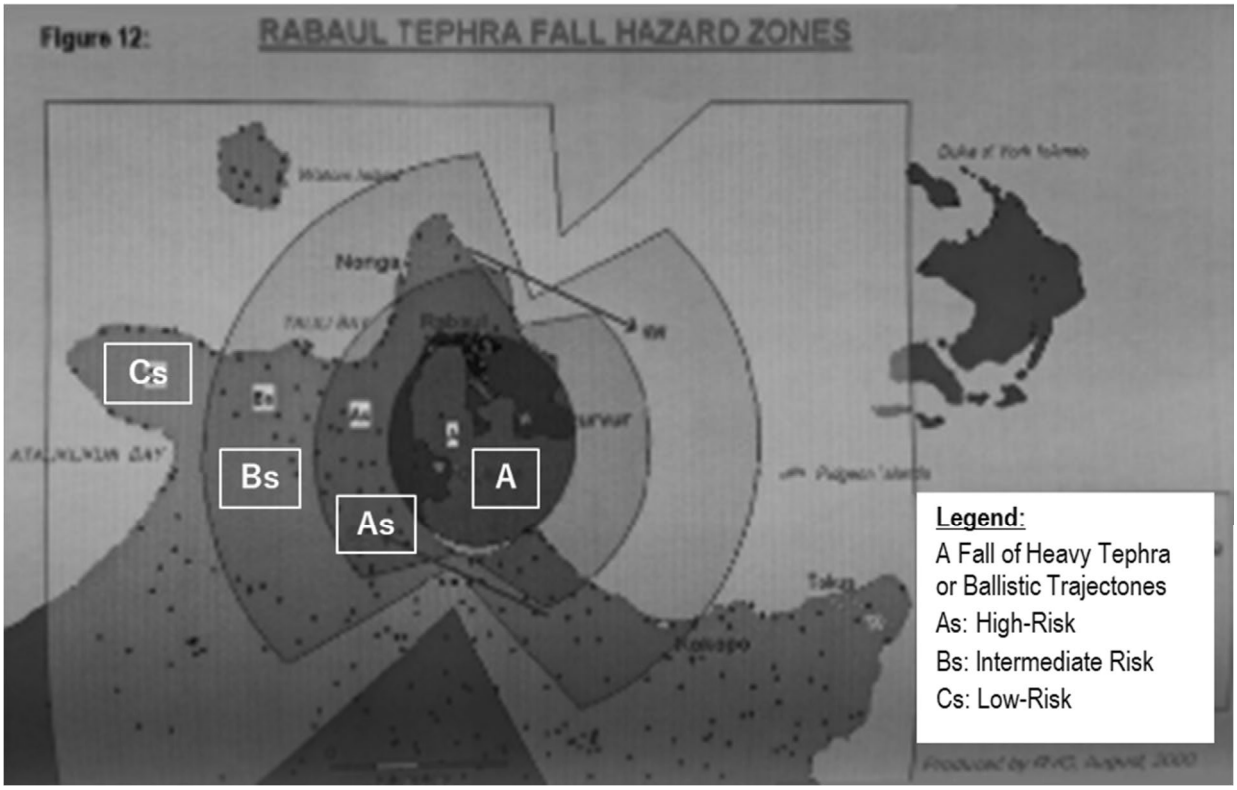
Source: Moihoi et al., 2013, "Integrating Hazard and Exposure for East New Britain," Geoscience Australia, Australian Government

Figure 5.4.8 Intermediate Magnitude (VEI4) Eruption, Volcanic Ash Hazard Maps for ENBP

5.5 Volcanic Ash Hazard (Tephra[5] Fall Hazard)

After the 1994 eruption of twin volcanos in Rabaul, the following four hazard zones of Tephra Fall are considered in the Northeast Gazelle Peninsula as shown in Figure 5.5.1:

- A: Fall of Heavy Tephra or Ballistic Trajectones
- As: High-Risk
- Bs: Intermediate Risk
- Cs: Low-Risk



Source: Prepared by Rabaul Volcanic Observatory, August 2000

Figure 5.5.1 Rabaul Volcanic Ash Fall Hazard (Tephra Fall Hazard)

There are several kinds of hazard due to volcanic eruption, like lava flow, pyroclastic flow, ash fall and secondary hazard of ash-mad flow. Since lava and pyroclastic flows are devastating and limited to the close vicinity of caldera as shown in Figure 5.4.6 and Figure 5.4.7, volcanic ash hazard is considered for infrastructure plan.

From the simulated volcanic ash hazard results by a three-dimensional time-dependent model analysis, it is found out (as shown in Table 5.5.1) that Rabaul has a higher hazard than Kokopo and the other areas are lower than Rabaul and Kokopo in all wind conditions.

[5] The term 'Tephra' is used to describe all erupted clasts regardless of size, while the term 'ash' describes particles of less than 2 mm in size.

Table 5.5.1 Percentage Probability of Exceeding the Ash Load Thresholds

Ash Load	Wind	Rabaul (North)%	Kokopo (North)%	Western & Central Regions (%)
1kg/m^2	Apr-Sep	90-100	30-50	1-30
	Oct-Mar	90-100	60-90	10-80
10kg/m^2	Apr-Sep	90-100	20-40	1-20
	Oct-Mar	80-100	30-60	0-50
300kg/m^2	Apr-Sep	10-40	0-1	1-10
	Oct-Mar	0-30	0-10	0-10

Source: JICA Expert Team based on Moihoi et al., 2013, "Integrating Hazard and Exposure for East New Britain," Geoscience Australia, Australian Governmen

5.6 East New Britain Provincial Disaster Management Plan 2022-2032

(1) Background

East New Britain Provincial Disaster Management Plan 2022-2032 is prepared by the Division of Disaster and Emergency Services of ENBPA, in collaboration with the Division of Policy Planning, Monitoring and Research, ENBPA, and other stakeholders related to disaster management.

1) Stakeholders

In addition to ENBPA, the following institutions and actors have contributed to the preparation of the ENBP Provincial Disaster Management Plan:

- National Disaster Centre
- Rabaul Volcanological Observatory (RVO)
- Red Cross (Kokopo)
- PNG Royal Constabulary
- Correctional Services (Kokopo)
- National Maritime & Shipping Agency (NMSA)
- East New Britain Council of Churches

2) Disaster Risk Reduction Approach and Multi-Hazard Approach

The ENBP-DMP 2022-2032 is a general document based on a disaster risk reduction approach, as well as a multi-hazard risk approach.

As described in the National Disaster Act, 1984, the ensuring of disaster risk reduction is part of provincial sustainable development plans. That means, disaster preparedness should be mainstreamed in all development plans of all sectors.

As defined by the UNISDR, disaster risk reduction is the concept and practice, by which to reduce disaster risks through systematic efforts to analyse and reduce causal factors of disasters. Disaster risk reduction measures include those for reducing exposure to hazards, lessening vulnerability of people and property, managing land and the environment effectively, improving preparedness and early warning for adverse events.

3) Multi-Hazard Risk Approach

For the case of incidence of exceptionally high risk with possible catastrophic consequences, a contingency plan should be developed in addition to the Provincial Disaster Management Plan (PDMP).

(2) Vision

The vision for this plan is "A safe and disaster-resilient society."

(3) Mission

The mission of this plan is to "empower the people to be disaster resilient through partnership by fostering integrating disaster risks into sustainable development plans disaster programmes, generating long-term benefits and empowering them to be resilient communities."

(4) Aim

The aim of this plan is to "enable ENBP to mitigate the effects of disaster events, prepare for these, respond to, recover from and build resilience to the disaster events."

(5) Objectives

The objectives of this plan are as follows:

- To develop and strengthen institutions, mechanisms and capacities at all levels, in particular at the community level, which can systematically contribute to building resilience to hazards.
- To foster effective integration of disaster and environmental risk considerations into sustainable development policies, planning and programming at all levels, with a special emphasis at the wards on disaster prevention, mitigation, and preparedness and vulnerability reduction; through mechanisms for coordinating DRR actions and budgetary assignation.
- To enhance systematic incorporation of risk reduction approaches into the design and implementation of emergency preparedness, response and recovery programs in the reconstruction of affected communities.
- To describe the roles and responsibilities of disaster stakeholders to support disaster management as legislated in the Disaster Management Act 1984.

(6) Natural Hazards

East New Britain is prone to the following various hazards:

- Earthquakes,
- Volcanic eruptions,
- Tsunamis,
- Cyclones,
- River flooding
- Landslides, and
- Drought.

(7) Summary of Disaster Risks by Region in ENBP

Disaster risks are summarised for each region of ENBP in Table 5.6.1.

Table 5.6.1 Summary of Disaster Risk Assessment in Six Regions in ENBP Based on Geology

REGIONS	GEOLOGICAL PARAMETERS	DEGREE OF STABILITY	RISK HIGH – 1 LOW – 4
1. Central Gazelle	Stanstone Hrd 3 Landslide Close vicinity of Baining Fault	WEAKLY STABLE TO MODERATELY UNSTABLE	3 – 2
2. Northwest Gazelle	Rx Hrd =>6 Close vicinity of Baining Fault	MODERATELY STABLE	4
3. Northeast Gazelle	Very soft rock Hrd => 1 Vicinity of active R volcano Amplification of shockwaves Landslide, Subsidence Soil Erosion, 50km from active Weitin Fault	UNSTABLE	1
4. Southeast Gazelle	Intense faulting, Landslide Deeper earthquakes Coast is high risk of tsunami 50km from active Weitin	UNSTABLE	1
5. Wide Bay	Complex block faulting, Landslide Subsidence, High risk of tsunami	UNSTABLE	1
6. Pomio	High earthquake density Subsidence and landslide due to weathering of limestone	CHEMICALLY UNSTABLE	1

Source: GRA, 2002, Disaster Risk Assessment Report 2002

(8) Institutional Structures for Disaster Management

1) Roles and Members of Provincial Disaster Committee

ENB Provincial Disaster Committee is established in accordance with the Section 9 of the Disaster Management Act of 1987.

The ENB Provincial Disaster Committees are responsible for the following matters:

- To provide and render advice to the Provincial Executive Council (PEC) through the Governor in ensuring development plans for the province to take into account hazards prone to the province;
- To conduct assessments on particular hazards prone or common in the province
- To prepare contingency plans for respective hazards and supervise the state of preparedness for emergencies in the province
- To foster public awareness on natural phenomena and mitigation measures; and organize training of relief workers in the province

The ENB Provincial Disaster Committee is composed of the following members:

- Head of Provincial Administration (PA) - as the chairman of Disaster Committee
- The Provincial Police Commander – as the wise chairman of Disaster Committee
- The Provincial Works Manager
- The Provincial Health Authority Advisor
- The Advisor – Division of Education
- The Advisor – Technical Services Division
- The Advisor – Community Development
- The Advisor – Division of Agriculture & Livestock
- The Advisor – Division of Finance & Revenue
- The Advisor – LLG Division
- The Advisor – Lands Division

2) Roles of District Disaster Committee

The District Disaster Committee is responsible for ensuring lives, property, livelihoods and the environment should be protected disasters. In the district, under the District Disaster Committee, all sectors and partners have to fulfil the following roles in relation to disaster risk management in their districts:

- To premote a culture of safety and risk reduction within the working environment, office premises and other workplaces
- To ensure that all development policies incorporate and implement disaster risk management measures
- To ensure that adequate prevention, mitigation, preparedness and response measures are put in place to protect assets which are under the responsibility of the provincial disaster centre.
- To designate Disaster Risk Management Focal Persons to actively participate in DRR AND Emergency Management activities.
- To train, educate and sensitize both staff and the general public on Disaster Risk Reduction and Emergency Management related issues.
- To take part in disaster risk management activities as requested by PDC.

3) Local Disaster Committee

Local governments are primarily responsible for disaster management in mitigating/ preventing, preparing for, responding to and recovering from a disaster in their local government areas.

5.7 Rabaul Volcanological Observatory (RVO)

(1) Background

Rabaul Volcanological Observatory (RVO) was established as a national institution in 1940 following the eruption of Tavurvur Volcano in Rabaul in 1937. RVO started its function with monitoring of volcanoes in Rabaul. It expanded its responsibilities under the Department of Mineral Policy and Geohazards Management to the monitoring of other volcanoes in PNG after the disastrous eruption of Lamington in 1951.

While there are 15 active and 22 potentially active volcanoes in Papua New Guinea, RVO is monitoring seven active volcanoes due to shortage of resources including funding, manpower and monitoring equipment.

(2) Mission Statement of RVO

"To study and monitor volcanoes in Papua New Guinea effectively so that early warnings of volcanic eruptions can be provided to authorities, and to work in partnership with these authorities and with communities to promote awareness of volcanic hazards and risks so that communities become self-reliant".

(3) Key Result Areas of RVO's Activities

- Volcano monitoring and eruption forecasting
- Risk and hazard mapping and assessment on volcanoes
- Community awareness and preparedness on volcanic hazards
- Provision of assistance for volcanic disaster plans

(4) RVO's Engagement with Provincial Authorities

RVO started its engagement with ENBP in Rabaul, in 1983 following the start of Rabaul volcanic crisis in March 1983. An Act of Parliament on establishment of Provincial Disaster Committees in

Papua New Guinea. East New Britain Provincial Disaster Committee was established following the act in the first time.

The collaborative and coordinative work between RVO and the ENB Provincial Disaster Committee lead to the preparation of the first volcanic disaster-evacuation plan in Papua New Guinea.

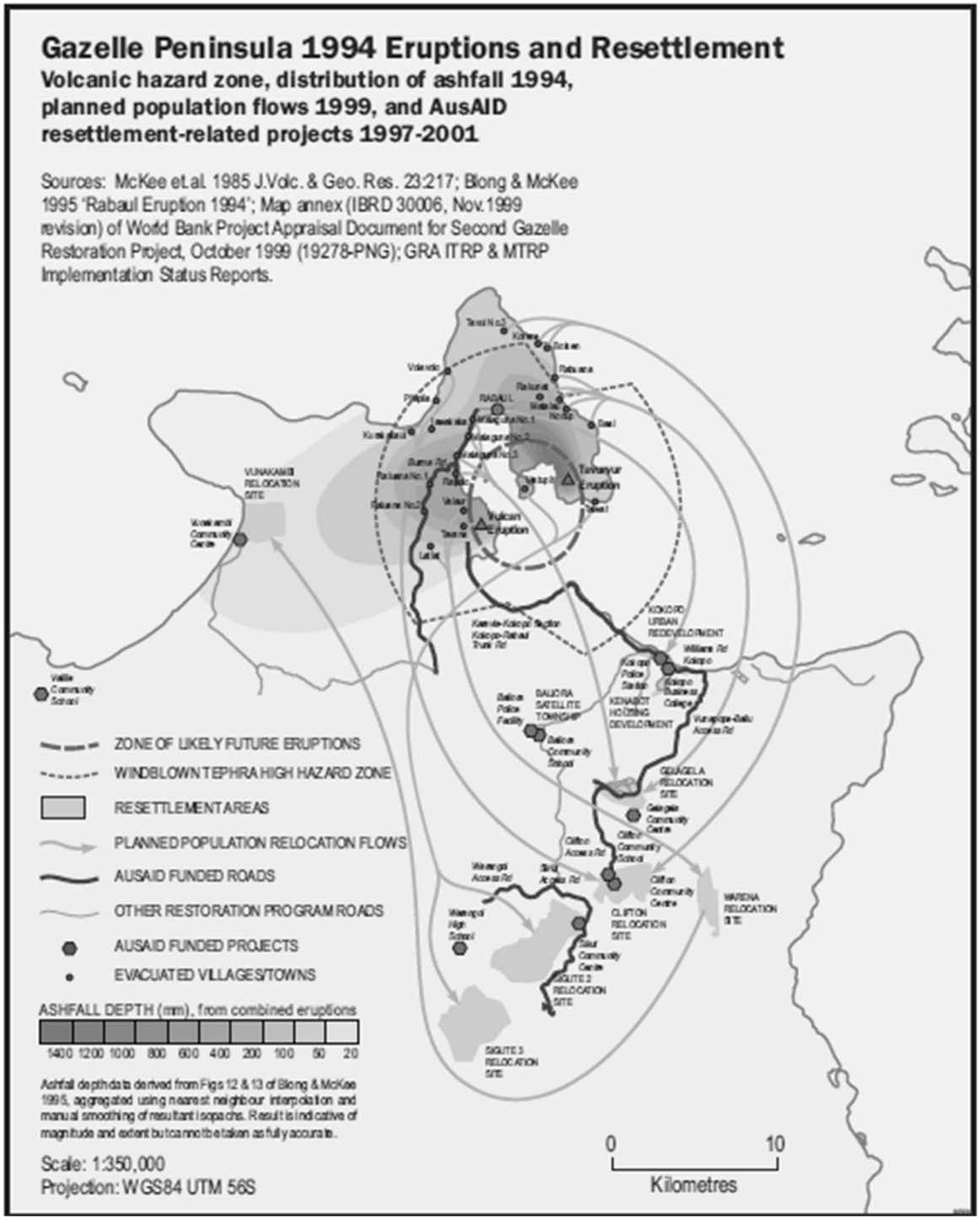
The completion and launching of the disaster/evacuation plan was followed by preparedness activities including evacuation exercises in coordination with the newly established Provincial Disaster Committee in anticipation for an eruption in Rabaul.

This kind of engagement and collaborative relationship between provincial authorities and RVO was later expanded to other provinces that have volcanoes.

5.8 Resettlement Areas for Affected Communities of 1994 Volcanic Eruptions in Northeast Gazelle Peninsula

With the external assistance of AusAID, ADB and WB, the Government of PNG had developed resettlement sites for affected communities, as shown in Figure 5.8.1.

Resettled people and households have kept lands in their original home villages, as well as provided lands in resettlement areas.



Source: Scales, Ian, April 2010, Roads in Gazelle Peninsula Development: Impact of Roads in the Post-Eruption Economic Landscape of East New Britain, AusAID, Canberra

Figure 5.8.1 Resettlement Areas for Resettlement-Related Projects, 1997-2001, After the 1994 Volcanic Eruptions in Northeast Gazelle Peninsula

PART IV

VISIONS, SOCIO-ECONOMIC FRAMEWORK, AND BASIC DEVELOPMENT STRATEGIES FOR NORTHEAST GAZELLE PENINSULA

Chapter 6 Visions and Strategies for Regional Development of Northeast Gazelle Peninsula

6.1 Overall Issues

6.1.1 Constraints and Opportunities for Regional Development of Northeast Gazelle Peninsula

The strengths, weaknesses, opportunities, and threats (SWOT) in Northeast Gazelle Peninsula have been analysed with respect to economic sectors, infrastructure, private investments, and disaster risks as shown in Table 6.1.1.

Table 6.1.1 SWOT Analysis for Northeast Gazelle Peninsula

Strengths	Weaknesses
• Northeast Gazelle Peninsula has relatively fertile land which is the basic foundation for regional economies, agriculture and forestry. Therefore, various export-oriented agricultural and forestry products (cacao, coconut, palm oil, balsa, etc.), as well as food crops, are produced in the region. • Bismarck Sea located to the west of Gazelle Peninsula has rich resources of skipjack and tuna fish. There are also many fishing boats based in Rabaul Port. The total tuna catch exported from Rabaul Port in 2021 was 262,020 tons, which was the largest in Papua New Guinea, followed by total catch exported from Lae Port (91,986 tons) and that from Madang Port (5,010 tons). • ENBP, as well as Rabaul and Kokopo, is well recognised as one of the major international tourism destinations in PNG including for cruise ship tourism and marine nature tourism. Northeast Gazelle Peninsula has a variety of tourist attractions with resources such as volcanoes, war heritage, culture (traditional dances, traditional folk tools and folk art, etc.) and marine nature. Furthermore, ENBP is also known as one of the safest areas in the country. • Literacy rate of ENBP is higher than the national average.[1] One of the five government universities in Gazelle District has courses in the field of natural resources, environment and climate change, and sustainable resource management. • Handling the fourth largest throughputs of overseas and coastal cargo in PNG, the Rabaul Port is one of the major ports in PNG. Rabaul Port has connection with international container shipping routes. It is the central port of the Islands Region, which handles coastal cargo of surrounding island provinces. • Rabaul has a fuel terminal, which supplies fuel by shipping bulk fuel to surrounding island provinces. • Kokopo is the administrative capital of ENBP and the Islands Region.	• The population size of Northeast Gazelle Peninsula is small with approximately 300 thousand inhabitants, while the population of the whole province is approximately 500 thousand which lives in an area of 15,724km^2. • The economic agglomerations of the region are limited because there are no large-scale economic sectors, such as large mines, in the region. It is not easy to promote public investment to infrastructure in the region. • In the Northeast Gazelle Peninsula, due to the limited road extension and density, lands effectively used for agriculture and forestry are limited. • Some sections of the coastal road connecting Rabaul Port with Kokopo Town (which is the important backbone access road to Rabaul Port) is vulnerable to landslides due to heavy rain, resulting in increased transport costs in the region. • In Northeast Gazelle Peninsula, power and water supply infrastructure, as well as trunk roads, are insufficient to support existing local industries. • To support the processing industry, improvement of power supply and water supply infrastructure are necessary. However, since the population and economic activities are not large, and the population density and economic activity density are not high, it is not financially feasible to implement large-scale infrastructures all at once. • Rabaul Port is an export port for agricultural and forestry products of ENBP, and the distance from agricultural and forestry production areas to Rabaul Port constrains the extent of lands usable for agricultural and forestry production. Furthermore, there is already a shortage of unused land for agriculture and forestry development. • Rabaul is a port city which used to be the regional administration centre. Therefore, the urban infrastructures in the town area were well developed before the volcanic eruption in 1994. However, after the eruption, the infrastructures have not been adequately upgraded or maintained, so old insufficient facilities are still being used.

[1] PNG's male average literacy rate is 79.9%. ENBP's male average literacy rate is 87.4%. PNG's female average literacy rate is 66.4%. ENBP's female average literacy rate is 86.1%. Source: PNG Population and Health Survey 2016-2018

	• The facilities at Rabaul Port which survived the volcanic eruption with minimum damage have not been rehabilitated or upgraded for over 30 years. As a result, they are heavily deteriorated now. Although the import and export cargos are increasing, Rabaul Port's cargo handling capacities are not sufficient to accommodate them. • Many of the urban infrastructures in Kokopo were developed to accommodate the relocated provincial capital and regional capital after the 1994 volcanic eruptions. However, the infrastructure constructed 27 years ago in Kokopo have aged and deteriorated. • The facilities at Tokua Airport which were relocated from Rabaul after volcanic ash buried Rabaul Airport have also aged and already deteriorated. Furthermore, although Kokopo and Rabaul are promoted as major international tourist destinations, currently large aircraft cannot land at Tokua Airport. • Not having taken sufficient measures (including provision of necessary infrastructure) to reduce risks due to earthquake, tsunami and volcanic hazards, a resilient and sustainable regional spatial structure has not yet been established. Because of this situation, Northeast Gazelle Peninsula has not been able to attract a sufficient amount of private investment in economic sectors.
Opportunities	**Threats**
• Northeast Gazelle Peninsula has relatively fertile soil, enabling it to produce a variety of export-oriented agricultural and forestry products. Depending on world's increased consumption, it is possible to achieve a large potential expansion of such export-oriented production by extending the trunk road network for securing efficient accessibility to the central port and urban commercial centres in the region. • Taking advantage of the regional production of the export-oriented agricultural, forestry and fishery products, it is possible to attract foreign investments in processing industries for these products. • Because of rich tuna resources in Bismarck Sea to the west of the Gazelle Peninsula, Rabaul Port will be able to attract an increasing number of fishing boats and reefer vessels. • Taking advantage of the regional catch of export-oriented tuna fish, it is possible to attract foreign investment in processing industries, especially for processing fishery products. • Because of cruise ship tourism targeting Rabaul volcanoes, Rabaul and ENBP have been internationally famous for volcanoes, marine nature reserves, and cultural and war relic tourism sites. Rabaul, Kokopo and other sites in ENBP will be able to attract more tourists not only from Australia but also more widely from other long-haul travellers (from Southeast Asia, Far East, Europe and US). • Based on the status of Kokopo as the regional administrative capital city of the Islands Region covering the surrounding four island provinces, as well as international container shipping connections and international/domestic flight connections, Kokopo and Rabaul will attract the establishment of regional branch offices of international and domestic corporations. • The national government has a strategy for expanding and upgrading a national road network, including the New Britain Highway connecting Kimbe and Kokopo through Open Bay and Kerevat, and the Southern Coastal Corridor connecting ENBP and West New Britain Province through the southern coastal areas. • Currently, the National Executive Council (NEC) has approved the plans to develop two Special Economic Zones (SEZs) in the	• Currently the PNG government has an excessive external debt to GDP ratio (52.3% as of the end of 2021). If this external public debt situation is not improved for various reasons for many years in the future, the government will not be able to maintain external borrowing for public investment in necessary infrastructure for promoting socioeconomic development. • If for some reasons, the price of natural gas continues to be low in the future, it will not be possible to obtain sufficient foreign currency income, and government income will decrease. As a result, necessary public infrastructure cannot be developed for supporting socioeconomic development. • Both Lae and Madang have export-oriented tuna processing factories. Since there are already two port cities which have tuna processing industries, no more foreign investors are willing to come to Rabaul Special Economic Zone. • Due to COVID-19 pandemic, the tourism sector in the region has been heavily affected. It is unknown how much international tourists will come back when travel restrictions are lifted. • When another pandemic of infectious disease like COVID-19 hits globally, international tourism will be seriously affected again. • Due to effects of the COVID-19 pandemic, Russian invasion to Ukraine, and global inflation, a global recession might worsen and prolong, resulting in the world's largely reduced consumption of various agricultural and forestry commodities which ENBP has been producing and exporting. • If another volcanic eruption hits the region in the future and devastates the town and infrastructures near the volcanoes including Rabaul Port and Town, the burden for recovery and reconstruction from the volcanic disaster will seriously disrupt the path of sustainable development of the Northeast Gazelle Peninsula.

Northeast Gazelle Peninsula. One of them is Gazelle Agro-Industrial Special Economic Zone to be located at Ataliklikun Bay of Gazelle District. The other is Rabaul Tuna Export Processing Zone to be located adjacent to Rabaul Port. Feasibility studies and basic plans will be prepared towards the construction and operation of the SEZs. The SEZs can improve the situation for attracting international investments in economic sectors.	

Source: JICA Expert Team

6.1.2 Overall Issues Identified on Regional Development for Northeast Gazelle Peninsula

Based on the present situation, the following overall issues are identified for the region of Northeast Gazelle Peninsula:

- The land and other resources in Northeast Gazelle Peninsula region have not been fully and efficiently utilised for developing economic sectors due to ageing, deteriorated condition, or underdeveloped infrastructure.
- Since low-density population is spread over a wide area in the Northeast Gazelle Peninsula region, it is not possible to provide a dense and extensive road network to fully cover and efficiently utilise the region as a whole.
- The small population and economic agglomeration make it costly and inefficient to expand and upgrade the existing infrastructure.
- Growth potential of individual economic sectors is constrained by the relatively small population and economic agglomerations in the region, as well as by insufficient infrastructure.
- The areas near Rabaul in the Northeast Gazelle Peninsula are at risk of volcanic eruptions and there is a landslide hazard due to weathering of volcanic rocks and ash fallout from volcanic eruptions.
- Following the 1994 volcanic eruption, Rabaul Airport, the ENBP' capital and other functions were relocated away from Rabaul and towards Kokopo, but the province's main port, the Port of Rabaul, was not. Therefore, the Rabaul Port and access roads to Rabaul Port from the surrounding areas remain at risk of volcanic eruption damage. (During the 1994 volcanic eruption, thick layers of volcanic ash on the slopes caused landslides due to rainfall, which cut off the access road to the port of Rabaul from the surrounding areas).
- Resilient spatial structure and infrastructure of the region have not been well prepared yet.
- As a result, it is not easy to attract public investment to infrastructure to support economic sectors in the region, despite having relatively good development potential endowment. Moreover, it is not easy to attract private investment to economic sectors in the region.

6.2 Visions, Objectives and Strategies for Regional Development of Northeast Gazelle Peninsula

6.2.1 Future Visions for Regional Development of Northeast Gazelle Peninsula

(1) Visions of Existing Provincial Development Plans for ENBP

The 20-year vision from 2003 for ENBP set by the East New Britain Province Economic Development Plan 2003-2030 is as follows:

> "To create diversified economies including manufacturing and service industries (including tourism) based on strong agriculture and other primary industries."

The 10-year vision from 2021 for ENBP set by the ENBP Strategic Development Plan 2011-2021 is as follows:

"ENB to have an educated, healthy and wealthy people living in a socially peaceful and wise community."

(2) Vision of NEGID-Plan for Northeast Gazelle Peninsula

By considering the above two existing visions, the following vision statement is adopted for Northeast Gazelle Peninsula: [2]

Northeast Gazelle Peninsula will become "Nation's most liveable, resilient and enterprising region with sustainable infrastructure for economic growth."

6.2.2 Development Goals and Objectives for Regional Development of Northeast Gazelle Peninsula

For achieving the vision proposed above, a set of goals and overall development objectives are considered. These are the following:

(1) Goals for Development in the Region

To achieve the visions proposed above, the following set of goals is required:

- [Formal Economy] Development of prosperous economies for creating employments. Especially for the economic growth, it is necessary to develop diversified productive and export-oriented economies (agriculture, forestry, fishery, manufacturing, and tourism) based on land and marine resources, as well as rich cultures.
- [Subsistence and Informal Economy] Inclusive development should be promoted by paying attention to both subsistent agriculture and informal economies in addition to export-oriented economies in the region.
- [Resilience] Enhancement of resilience against various disasters in economic sectors, spatial structure and infrastructure.
- [Social Well-being] Maintaining social well-being based on family and community ties.
- [Environment] Sustainable management of natural environment and natural resources including lands and sea.

Based on these resources, the region's economic sectors have good potentialities to seek high-value addition by developing manufacturing and services industries. These development vision and goals will be supported by the Northeast Gazelle Peninsula's strong hub function of maritime and air transport (international and domestic).

(2) Overall Objectives of Development in the Region

The following overall development objectives are proposed for achieving the visions described above:

- To create a socioeconomic policy environment enabling the sustainability and prosperity of both export-oriented economies and family-based subsistence or informal economies
- To seek economic sectors development by widely and efficiently utilising regional products of land, marine and other natural resources, as well as cultural resources
- To make a challenging effort in developing new economic sectors, such as processing industries and upgrading tourism products, by using regionally available products and resources (including unprocessed materials of agricultural, forestry, and fisheries sectors) and by producing tourism products targeting diversified segments of international tourist market, including the high-end segment)

[2] In the course of the Project, Vision of NEGID-Plan has been discussed by PIU Core Members, the Joint Working Group and the Steering Committee.

- To transform spatial structure for enhancing resilience against various disaster hazards and for promoting wide and efficient utilisation of land and other natural resources in the region
- To promote sustainable management of natural resources and natural environment of land and sea

6.2.3 Development Directions and Strategies for Northeast Gazelle Peninsula

(1) Formulation of Regional Development Strategies: How to Compose Regional Development Strategies for Northeast Gazelle Peninsula

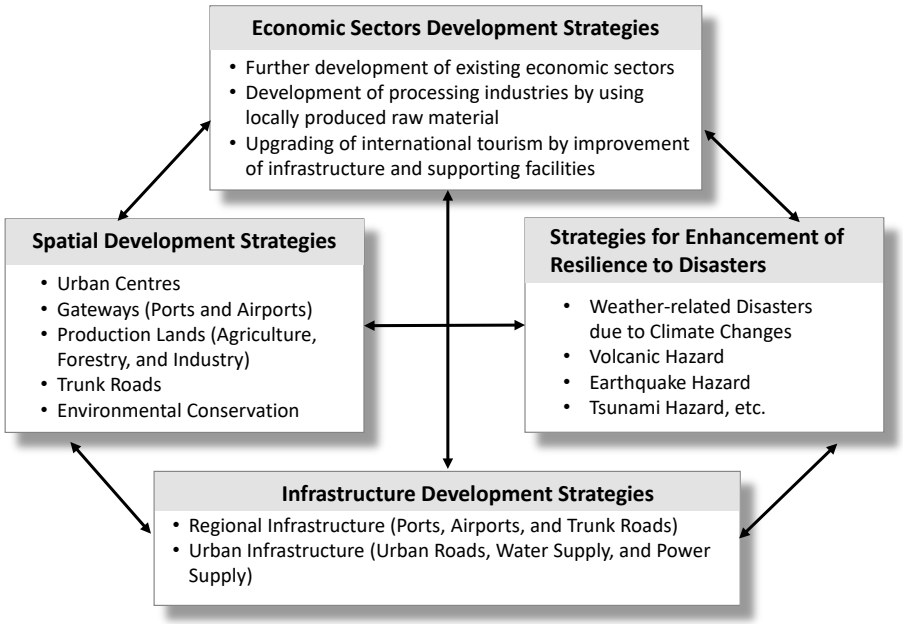
1) Aspects to Be Considered in the Formulation of Regional Development Strategies

Based on the understanding and recognition of the SWOT of the region, the following aspects will be considered in the process of composing/formulating components of regional development strategies:

- Basic Directions and Strategies for Development of **Economic Sectors** in the Region
- Basic Directions and Strategies for **Spatial Development** (including spatial utilization from viewpoints of natural environmental conservation) in the Region
- Basic Directions and Strategies for Enhancement of **Resilience to Disaster Hazards/Risks** (including considerations of intensification and increased frequency of weather-related disasters due to climate changes) in the Region
- Basic Directions and Strategies for **Phased Development** in Timeframe
- Basic Directions and Strategies for **Infrastructure Development** in the Region

The first 5 aspects, namely: (1) economic sectors, (2) space (including viewpoints of natural environmental conservation), (3) resilience against disasters (including viewpoints of climate change strategies), and (4) phased development, will guide the formulation of infrastructure development strategies.

The relationship among the major aspects to be considered in formulating regional development strategies is shown in Figure 6.2.1.



Source: JICA Expert Team

Figure 6.2.1 Major Aspects and Relations Considered in Formulating Regional Development Strategies in Northeast Gazelle Peninsula

(2) Basic Directions and Strategies for Development of the Economic Sectors in the Region

There are two basic development directions and strategies in economic sector development in the region:

- Development directions and strategies for promoting **<u>further development (expansion) of existing economic sectors</u>**, including the following production activities (by rehabilitating and upgrading existing infrastructures):
  - Production of export-oriented agricultural and forest products (copra, cacao, palm oil, balsa, etc.)
  - Fishing of tuna in Bismarck Sea
  - Cruise ship tourism targeting Rabaul volcanoes, cultural tourism, and war relic tourism
  - Marine nature tourism including dolphin watching, snorkeling, scuba diving and sport fishing
- Development directions and strategies for promoting **<u>processing industries</u>** by using locally produced raw materials and upgrading **<u>international tourism</u>** by improvement of urban infrastructure and supporting facilities
  - Agro-processing and forest processing industries by using locally produced copra, cacao, palm oil, balsa, tropical timber, etc. including the raw materials produced in surrounding island provinces
  - Fishery processing industries using tuna caught in Bismarck Sea
  - Upgrading of international tourism attractions and destinations by improving tourist infrastructure (hotels and conference centres) and supporting facilities (rest facilities, toilets and streets for walking)

It is easier to select and promote the basic directions and strategies of development in existing economic sectors, including production of export-oriented agricultural and forest products (copra, cacao, palm oil, balsa, etc.), than selecting and promoting other basic directions and strategies (e.g., promotion of attracting investments in processing industries of agricultural and forest products, as well as fisheries products). The impact of this development direction/strategy based on the existing economic sectors will gradually become lesser in the course of development.

On the other hand, it is more difficult or challenging to implement measures or strategies towards investment promotion to new economic sectors, especially to processing industries, than the efforts at further development of existing economic sectors. Once it is successful to attract investments to the processing industries, its impact on economic development is large and extensive in the region.

However, without any substantial intervention related to economic sector development, the gradual decline or stagnation in growth is expected to happen in the region. When either one direction of the above two directions/strategies is selected and implemented, it is uncertain if development results would be better.

<u>Under such uncertain situations in the Northeast Gazelle Peninsula, it is wise and better to take actions in the both directions mentioned above. Fortunately, both of these directions and strategies are related to each other.</u>

(3) Basic Strategies for Spatial Development in the Region

The spatial structure (spatial pattern) of the region is composed of the following things/functions:

- Urban Centres of Different Functions and Hierarchies (Primary Urban Centres, Secondary Urban Centres and Tertiary Urban Centres)
- Gateways for Inter-Regional Transportation (Ports and Airports)
- Agricultural Production Lands, Forestry Production Lands, and Industrial Parks

- Trunk Roads Connecting Important Functions, such as Urban Centres, Primary Gateways, and Productive Lands

Some of these functions are variable. It is possible to change the status of urban functions or gateways by changing hierarchical functions of different urban centres or location of ports or airports.

For example, the provincial capital of ENBP was relocated from Rabaul Town to Kokopo Town after the 1994 volcanic eruptions because Rabaul Town was heavily damaged and the provincial capital function needs to be reconstructed somewhere in a safe place.

Another example is the gateways (ports and airports) for inter-regional transportation which can be relocated for some reasons. Damaged by the 1994 volcanic eruptions, Rabaul Airport was relocated to Tokua Area. Now, the future location of Rabaul Port functions is under discussion/consideration among concerned agencies considering volcanic disaster hazards.

Depending on the spatial structure (spatial patterns) in the region, it is possible to put different service levels or development levels of trunk roads. With that, when urban centres and gateways are relocated, it will be necessary to change the function level of trunk roads. When some areas receive SEZs for processing industries, the function levels of some trunk roads connecting the SEZs and a regional gateway port or a regional gateway airport can be re-classified as different function levels of trunk roads.

Overall vision and goal of the region is to seek economic sector development, as well as social development, sustainably, inclusively and resiliently.

For seeking this vision and goal, given the limited lands and natural resources in the region, and considering the limited government budgets for infrastructure for the region, it is necessary to wisely and efficiently utilise not only available lands and natural resources, but also available/existing infrastructures of transportation and urban centres, including the existing spatial structure (spatial pattern) of the region.

The actual consideration of future spatial structure of the region will be discussed in Section 9.3.

(4) Basic Strategies for Enhancing Resilience Against Disasters in the Region

The Northeast Gazelle Peninsula is prone to various disaster hazards including the following:

- Geological Hazard (Subsidence and Landslides)
- Earthquake Hazard
- Volcanic Hazard (Pyroclastic Flow and Volcanic Ash)
- Sediment Disaster Hazard
- Flooding Hazard

To reduce disaster risks, it is essential to take the following three types of mitigation measures:

- Enhancing people's awareness of potential disaster hazards and risks, and preparing for responding to avoid disaster hazards and risks by emergency response (evacuation to safer places) and by selecting to reside in safer areas
- To strengthen the physical structure of infrastructure and residential buildings against disaster hazards (especially earthquake, volcanic ash, and sediment disaster)
- To transform the spatial structure (spatial pattern) of the region by relocating important functions to safer areas and for improving redundancy of infrastructure networks

The third aspect above is considered in spatial development strategies and future spatial structure of the region. The transformation of regional spatial structure for enhancing resilience against different disaster hazards is to be considered not only by relocation of important functions, such as urban centres and transport gateways (ports and airports), but also by restructuring the trunk road

network in the region. Information and knowledge on disaster hazards and risks have been accumulated and ideas on mitigation measures to be taken have been regionally available. However, since port relocation and road network restructuring for regional spatial structure transformation require a lot of funds to be invested in infrastructure, it takes time for their realisation. Such spatial structural transformation should be incorporated in the spatial development strategies in the region.

(5) Time Framework: Phased Development

Under limited regional resources, including government budgets and private sectors' investment capacities, it is impossible to implement necessary projects (to do everything necessary) from public sector investment in infrastructure provision to private sector investment in economic sectors for driving development in the region. It is inevitable to select certain actions and a limited number of interventions under constraints of government budgets and private investments.

Taking advantage of any good opportunities for economic sector development in timely manner, it is essential for the region to be strategically prepared for selected infrastructure, by which to take a chance for economic sector development by receiving private investments in economic sectors.

Then, which infrastructure development or rehabilitation is more important or more strategic for promoting subsequent development of economic sectors should be considered and determined for infrastructure development planning.

Chapter 7 Future Socio-economic Framework for Northeast Gazelle Peninsula

7.1 Population of Northeast Gazelle Peninsula

(1) Population Data of Northeast Gazelle Peninsula and East New Britain Province (ENBP)s

The population data of Northeast Gazelle Peninsula and East New Britain Province (ENBP) in 2000 and 2011 are shown in Table 7.1.1. The population of Northeast Gazelle Peninsula was 198,745 with an annual growth rate of 3.5% between 2000 and 2011. This growth rate was slightly lower than the growth rate of ENBP (3.7%), which had a population of 328,369 in 2011[1].

The growth rate of the population varied across the different districts. Between 2000 and 2011, Kokopo District showed a growth rate of 3.8%, Rabaul District had 3.5%, while Gazelle District had 3.4%.

As for the annual population growth rates among the LLGs, Bitapaka Rural LLG (Kokopo District), Kokopo/Vunamami Urban LLG, and Vuadidir/Toma Rural LLG (Gazelle District) showed more than 4%. On the other hand, the growth rates were rather low in Rabaul Urban LLG (1.86%) and Central Gazelle Rural LLG (2.61%).

Table 7.1.1 Population in Northeast Gazelle Peninsula and ENBP (2000 and 2011)

District/LLG	2000	2011	Annual Growth Rate (%) (2000-2011)	Share (%) in ENBP Population (2011)
ENBP	220,133	328,369	3.70	100.0
Kokopo District	58,345	87,829	3.79	26.7
Bitapaka Rural LLG	14,766	23,116	4.16	7.0
Duke of York Rural LLG	10,292	14,009	2.84	4.3
Kokopo/Vunamami Urban LLG	19,933	31,965	4.39	9.7
Raluana Rural LLG	13,354	18,739	3.13	5.7
Rabaul District	27,048	39,387	3.48	12.0
Balanataman Rural LLG	12,869	19,621	3.91	6.0
Kombiu Rura LLG	8,044	11,583	3.37	3.5
Rabaul Urban LLG	3,907	4,785	1.86	1.5
Watom Island Rural LLG	2,228	3,398	3.91	1.0
Gazelle District	89,776	129,317	3.37	39.4
Central Gazelle Rural LLG	21,140	28,075	2.61	8.5
Inland Baining Rural LLG	18,628	26,826	3.37	8.2
Lasul Baining Rural LLG	8,195	13,555	4.68	4.1
Livuan Rural LLG	21,659	13,485	2.68	4.1
Reimber Rural LLG		15,488		4.7
Toma Rural LLG	20,154	17,080	4.26	5.2
Vunadidir Rural LLG		14,808		4.5
Pomio District	44,964	71,836	4.35	21.9
Northeast Gazelle Peninsula	135,826	198,745	3.52	60.5
Outside Northeast Gazelle Peninsula	84,307	129,624	3.99	39.5

Note: 11 LLGs with underline are included in the Study Area (Northeast Gazelle Peninsula). In 2022, Livuan/ Reimber Rural LLG and Vunadidir/Toma Rural LLG have been divided into Livuan Rural LLG, Reimber Rural LLG, Toma Rural LLG and Vunadidir Rural LLG. The population at 2000 could not be divided for these LLGs so the population by LLG prior to 2022 is used.
Source: National Statistical Office, 2013, National Population & Housing Census 2011

[1] The most recent population census in Papua New Guina is planned to take place in 2024. The result is not yet available when preparing this report.

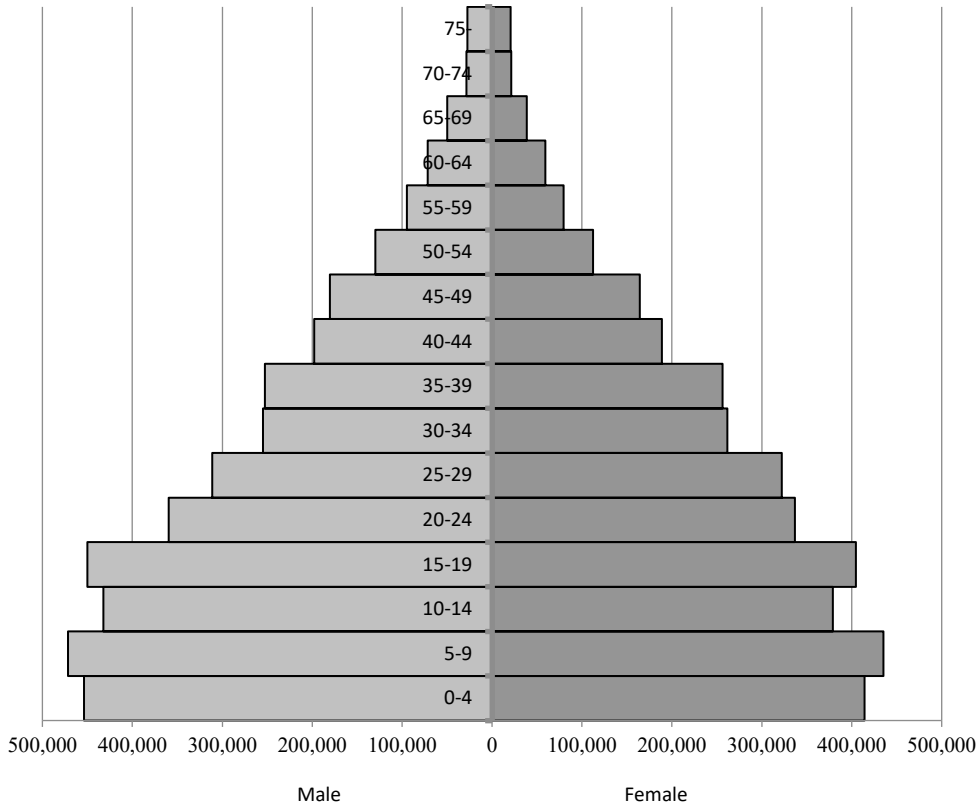
(2) Population Distribution in Northeast Gazelle Peninsula

In 2011, among the 11 LLGs in Northeast Gazelle Peninsula, Kokopo/Vunamami Urban LLG had the largest population (31,965 or 16.1% of the total Northeast Gazelle Peninsula population); followed by Central Gazelle Rural LLG, Gazelle District (28,075 or 14.1%); and Bitapaka Rural LLG, Kokopo District (23,116 or 11.6%). The 2011 population data of Vunadidir/Toma Rural LLG and Luvuan/Reimber Rural LLG, which have been divided into four LLGs, were as follows: 17,080 for Toma Rural LLG; 15,488 for Reimber Rural LLG; 14,808 for Vunadidir Rural LLG; and 13,485 for Livuan Rural LLG.

(3) Age Structure and Sex Composition of the Population of Northeast Gazelle Peninsula

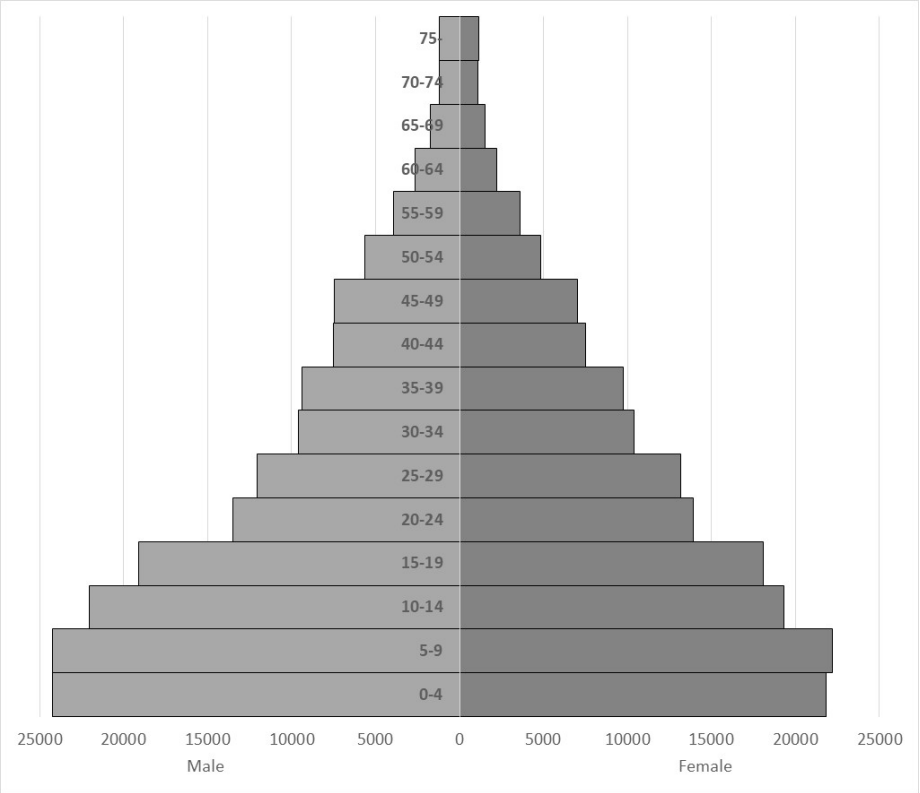
The age structure and sex composition of a population are represented by a population pyramid. In a developing country, the shape of the population pyramid is usually broad-based, depicting a higher proportion of the population in the younger age groups.

The 2011 population pyramid of Papua New Guinea, as shown in Figure 7.1.1, indicated that 57% of the population had ages below 24 years. The narrowing of the base may be indicative of slight declining births in recent years or inaccurate counting of children before school age at population census. On the other hand, the population pyramids for ENBP and Northeast Gazelle Peninsula, as shown in Figure 7.1.2 and Figure 7.1.3, indicated that large proportion of the population comprised of individuals with ages below 24 years (61% of the total population). The decline in births was starting to be seen between the age group 0-4 and 5-9. Also, the population in both ENBP and Northeast Gazelle Peninsula showed a drop in the age group 20-24, which may be due to migration of youth to other cities for education and work. Furthermore, the proportion of males compared to females was higher throughout the country and the study area.



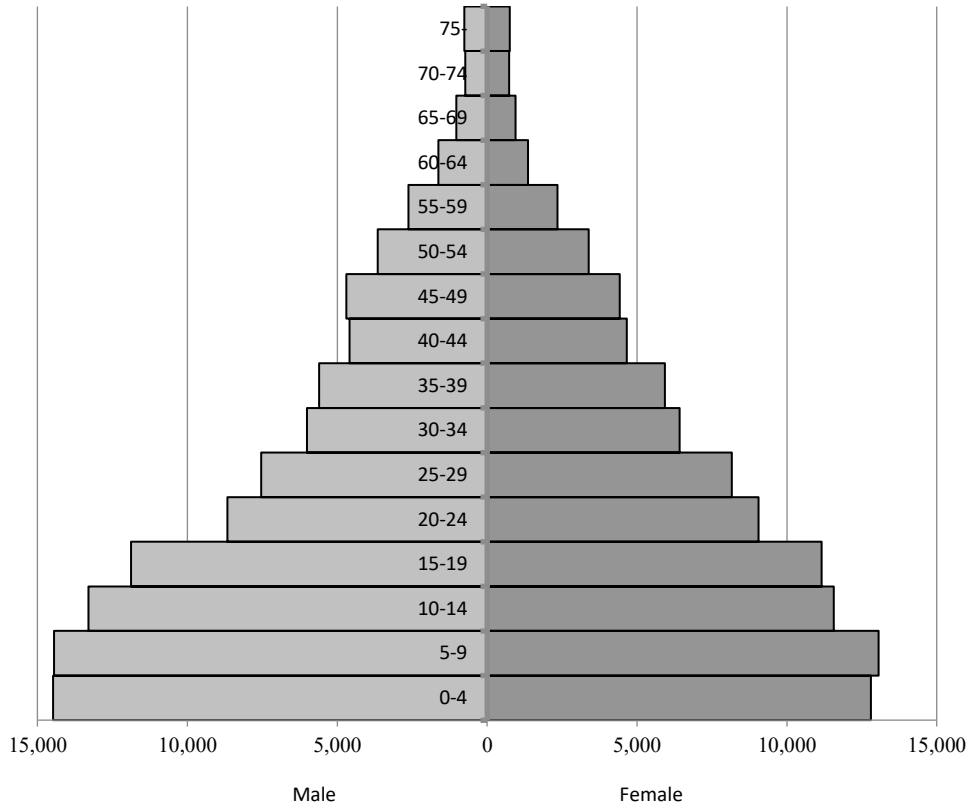
Source: JICA Expert Team, based on the National Population & Housing Census 2011 by NSO

Figure 7.1.1 Population Pyramid of Papua New Guinea (2011)



Source: JICA Expert Team, based on the National Population & Housing Census 2011 by NSO

Figure 7.1.2 Population Pyramid of ENBP (2011)



Source: JICA Expert Team, based on the National Population & Housing Census 2011 by NSO

Figure 7.1.3 Population Pyramid of Northeast Gazelle Peninsula (2011)

7.2 Economy of Northeast Gazelle Peninsula

(1) Gross Regional Domestic Product

According to the National Accounts Branch, Economics Statistical Division of NSO, the Gross Regional Domestic Product (GRDP) or the Gross Provincial Domestic Product (GPDP) is not estimated in PNG.

The Survey of Business Activities (SBA) by NSO is an annual survey to collect economic information from selected legal companies operating in the country. This collection is done to compile national accounts, in particular those measuring the Gross Domestic Product (GDP), along with other statistics. For example, in 2019, SBA covered four industries, namely: manufacturing, construction, transport and storage, and administrative and support services. Locations covered were Port Moresby, Lae, and Madang. A sample comprising of 300 companies was surveyed to which 187 companies responded.

While SBA has been run annually since 2015, in the future, NSO plans to run a Census of Business Activities (CBA) to take account of the business population in operation in PNG. A CBA may also provide an opportunity to capture accurate economic benchmarks, help measure across all industries in the country, and contribute to the estimation of the GRDP or the GPDP.

(2) Economically Active Population

In 2011, the economically active population between the age group 15 to 64 in ENBP and Northeast Gazelle Peninsula were 121,712 and 71,498, respectively. That means, the share of economically active population in this age group were 66.0% in ENBP and 69.3% in Northeast Gazelle Peninsula as shown in Table 7.2.1. The difference may be due to longer period of education in Northeast Gazelle Peninsula region compared to other LLGs in the region. The respective shares of not economically active females were lower in the three LLGs of Rabaul, Balanataman and Kombiu (below 60%).

Table 7.2.1 Employed Population by Industrial Sector in ENBP (2011)

	Economically Active Population (15-64)			Not Economically Active Population (15-64)			Share (%) of Economically Active Population (15-64)			Share (%) of Not Economically Active Population (15-64)		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Central Gazelle	5,102	4,775	9,877	2,453	2,941	5,394	67.5	61.9	64.7	32.5	38.1	35.3
Inland Baining	5,249	4,972	10,221	1,943	1,865	3,808	73.0	72.7	72.9	27.0	27.3	27.1
Lassul Baining	2,970	2,486	5,456	825	910	1,735	78.3	73.2	75.9	21.7	26.8	24.1
Livuan/Reimber	5,216	5,196	10,412	2,454	2,879	5,333	68.0	64.3	66.1	32.0	35.7	33.9
Toma/Vunadidir	6,139	5,994	12,133	2,568	2,929	5,497	70.5	67.2	68.8	29.5	32.8	31.2
Bitapaka	4,563	3,863	8,426	1,673	1,885	3,558	73.2	67.2	70.3	26.8	32.8	29.7
Duke of York	2,716	2,665	5,381	1,116	1,356	2,472	70.9	66.3	68.5	29.1	33.7	31.5
Kokopo/Vunamami	5,649	5,081	10,730	2,750	3,322	6,072	67.3	60.5	63.9	32.7	39.5	36.1
Raluana	3,597	3,538	7,135	1,508	1,937	3,445	70.5	64.6	67.4	29.5	35.4	32.6
Central/Inland Pomio	3,796	4,373	8,169	902	943	1,845	80.8	82.3	81.6	19.2	17.7	18.4
East Pomio	1,206	1,257	2,463	505	559	1,064	70.5	69.2	69.8	29.5	30.8	30.2
Melkoi	2,190	2,163	4,353	526	758	1,284	80.6	74.0	77.2	19.4	26.0	22.8
Sinvit	4,390	3,445	7,835	1,190	1,473	2,663	78.7	70.0	74.6	21.3	30.0	25.4
West Pomio/Mamusi	2,447	2,695	5,142	800	825	1,625	75.4	76.6	76.0	24.6	23.4	24.0
Balanataman	3,969	3,139	7,108	1,539	2,401	3,940	72.1	***56.7***	64.3	27.9	43.3	35.7
Kombiu	2,291	1,950	4,241	993	1,418	2,411	69.8	***57.9***	63.8	30.2	42.1	36.2
Rabaul	920	516	1,436	413	701	1,114	69.0	***42.4***	56.3	31.0	57.6	43.7
Watom Island	624	570	1,194	321	348	669	66.0	62.1	64.1	34.0	37.9	35.9
Northeast Gazelle Peninsula	37,446	34,052	71,498	16,351	20,413	36,764	69.6	62.5	66.0	30.4	37.5	34.0
ENBP	63,034	58,678	121,712	24,479	29,450	53,929	72.0	66.6	69.3	28.0	33.4	30.7

Source: National Statistical Office, 2013, National Population & Housing Census 2011

In 2011, 75.7% of the employed population in the industrial sector of ENBP worked in the primary sector. Since in Northeast Gazelle Peninsula, 68.8% worked for the primary sector, the shares of secondary sector and tertiary sector were larger than those outside Northeast Gazelle Peninsula. Notably, the primary sector had the largest share of employed population in the industrial sector.

Table 7.2.2 Employed Population by Industrial Sector in ENBP (2011)

		Primary Sector	Secondary Sector	Tertiary Sector	Total
ENBP	Economically Active Population	93,527	4,965	25,085	123,577
	Share	75.7%	4.0%	20.3%	100.0%
Northeast Gazelle Peninsula	Economically Active Population	49,455	3,946	18,458	71,859
	Share	68.8%	5.5%	25.7%	100.0%
Outside Northeast Gazelle Peninsula	Economically Active Population	44,072	1,019	6,627	51,718
	Share	85.2%	2.0%	12.8%	100.0%

Source: National Statistical Office, 2013, National Population & Housing Census 2011

7.3 Future Socio-economic Framework for Northeast Gazelle Peninsula

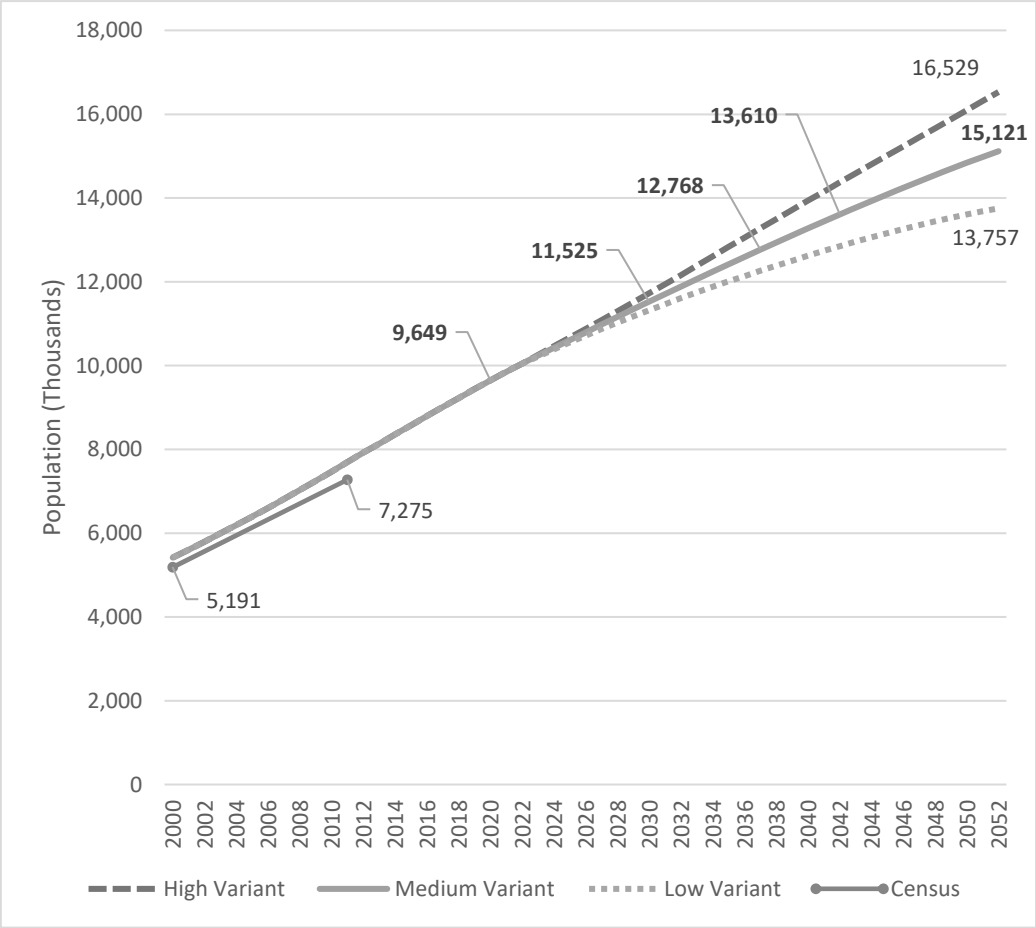
(1) National Population Projection

PNG's population reached 5,190 thousand in 2000 and 7,275 thousand in 2011 based on census data. The annual population growth rate was 3.1% between 2000 and 2011. According to the Papua New Guinea Development Strategic Plan (PNG DSP) 2020-2030 by the Ministry of National Planning and Monitoring, the population is projected to increase to 9.8 million in 2030. The PNG DSP states that the key to reducing population growth is to achieve reductions in the high fertility rate. Across the globe, developing countries that have educated their people and become prosperous middle-income countries have seen sharp reductions in fertility rates. This too will happen in PNG with fertility expected to fall in 2030 in line with the prosperity and education planned for under the PNG DSP, and with family planning.

On the other hand, the World Population Prospects 2022 of the United Nations shows three patterns of projections, namely: high-variant, medium-variant and low-variant between 2020-2100. The population in 2022 is estimated to be 10,048 thousand with the annual growth rate of 2.45% between 2011 and 2022, using the population data in World Population Prospects.

According to the medium-variant projection, as shown in Figure 7.3.1, PNG's population will reach 11,525 thousand in 2030; 12,768 thousand in 2037; 13,610 thousand in 2042; and 15,121 thousand in 2052.

The population in 2052 reaches 16,529 thousand in high-variant projection and 13,757 thousand in low-variant projection.



Source: JICA Expert Team, based on World Population Prospects 2022 of the United Nations

Figure 7.3.1 Population Projections for PNG by UN between 2000-2052

By adopting the annual population growth rate used in World Population Prospects 2022, the population of PNG in 2022 is estimated to be 9,516,000, using the population of the 2011 population census result as the base population.

The population in 2052 is projected to reach 15,971 thousand in high-variant projection; 14,635 thousand in medium-variant projection; and 13,315 thousand in low-variant projection, as shown in Table 7.3.1.

Table 7.3.1 Population Projection for PNG for NEGID-Plan (2000-2052)

	Population						Annual Growth Rate (%)				
	2000	2011	2022	2032	2042	2052	2000-2011	2011-2022	2022-2032	2032-2042	2042-2052
High Variant	5,190,786	7,275,324	9,516,000	11,634,000	13,827,000	15,971,000	3.12	2.47	2.03	1.74	1.45
Medium Variant	5,190,786	7,275,324	9,516,000	11,368,000	13,096,000	14,635,000	3.12	2.47	1.79	1.43	1.12
Low Variant	5,190,786	7,275,324	9,516,000	11,239,000	12,438,000	13,315,000	3.12	2.47	1.68	1.02	0.68

Note: Population data for the years 2000 and 2011, across three variants, are derived from the Census Data.
Source: JICA Expert Team

For the preparation of future population framework in NEGID-Plan, the medium-variant projection is adopted.

(2) Population Projection for Northeast Gazelle Peninsula

1) Current Population Projection

The ENBP Strategic Development Plan 2018-2022 states that the projected population in 2018 is 410,000. Thus, the annual growth rate between 2011 and 2018 is about 3.2%.

According to the NSO, the population of ENBP between 2011 and 2021 is projected to have an annual growth rate of 3.1% as shown in Table 7.3.2. The projected population will reach about 446,000 in 2021.

Table 7.3.2 NSO's Projected Current Population of ENBP

	2011	2016	2017	2018	2019	2020	2021	Annual Growth Rate 2011-2021
	Actual	Projection	Projection	Projection	Projection	Projection	Projection	
Population of ENBP	328,369	382,831	394,763	407,066	419,753	432,836	446,326	*3.1%*

Source: JICA Expert Team, based on NSO data

The population of ENBP is estimated to be 428,300 in 2022, while the population of Northeast Gazelle Peninsula is estimated to be 263,100 which is approximately 61.4% of the population in the province. The share of population in Northeast Gazelle Peninsula was 60.5% in 2011. It is expected that Northeast Gazelle Peninsula has increased its share of population.

The 2022 population in each of the 11 LLGs is estimated in Table 7.3.3.

Table 7.3.3 Population by LLG in Northeast Gazelle Peninsula (2011 and 2022)

District	LLG	2011 (Census)	2022 (Projection)	Annual Growth Rate (2011-2022)	Share (%) of the Population in the Study Area (2011)	Share (%) of the Population in the Study Area (2022)
Kokopo	Bitapaka	23,116	30,400	2.52%	11.6	11.6
	Duke of York	14,009	15,800	1.10%	-	-
	Kokopo/Vunamami	31,965	43,300	2.80%	16.1	16.5
	Raluana	18,739	24,800	2.58%	9.4	9.4
Rabaul	Balanataman	19,621	25,900	2.56%	9.9	9.8
	Kombiu	11,583	15,100	2.44%	5.8	5.7
	Rabaul	4,785	6,400	2.68%	2.4	2.4
	Watom Island	3,398	4,300	2.16%	-	-
Gazelle	Central Gazelle	28,075	37,400	2.64%	14.1	14.2
	Inland Baining	26,826	31,900	1.59%	-	-
	Lasul Baining	13,555	18,500	2.87%	-	-
	Livuan	13,485	17,800	2.56%	6.8	6.8
	Reimber	15,488	20,400	2.54%	7.8	7.8
	Toma	17,080	22,300	2.45%	8.6	8.5
	Vunadidir	14,808	19,400	2.49%	7.5	7.4
Pomio	-	71,836	94,600	2.53%	-	-
ENBP		328,369	428,300	2.44%	-	-
Northeast Gazelle Peninsula		198,745	263,100	2.58%	100.0	100.0

Sources 1 (Population 2011): National Statistical Office, 2013, National Population & Housing Census 2011; and JICA Expert Team, based on information from ENBPA and 2011 National Population & Housing Census Ward Population Profile
Sources 2 (Populaton 2022): JICA Expert Team, based on UN Population Prospects; and The National Research Institute Papua New Guinea, 2020, Provincial Estimates of Key Population Groups 2018-2022

2) Future Population Projection

The population by province is projected up to 2052 based on the population framework for PNG set above and considering the population trend in a long term.

The total projected population of ENBP is projected to become 524,500 in 2032; 618,600 in 2042; and 706,800 in 2052.

Table 7.3.4 Population Projection by Region and Province in Islands Region (2000-2052)

NATION/ REGION/ PROVINCE	Population						Annual Growth Rate				
	2000	2011	2022	2032	2042	2052	2000-2011	2011-2022	2022-2032	2032-2042	2042-2052
PAPUA NEW GUINEA	5,190,786	7,275,324	9,516,000	11,367,600	13,095,500	14,634,700	3.12%	2.47%	1.79%	1.43%	1.12%
SOUTHERN REGION	1,041,820	1,456,250	1,955,500	2,356,000	2,734,400	3,074,500	3.09%	2.72%	1.88%	1.50%	1.18%
HIGHLANDS REGION	1,973,996	2,854,874	3,531,500	4,176,000	4,762,000	5,270,900	3.41%	1.95%	1.69%	1.33%	1.02%
MOMASE REGION	1,433,432	1,867,657	2,574,600	3,041,300	3,461,500	3,817,100	2.43%	2.96%	1.68%	1.30%	0.98%
ISLANDS REGION	741,538	1,096,543	1,454,400	1,794,300	2,137,200	2,472,200	3.62%	2.60%	2.12%	1.76%	1.47%
Manus Province	43,387	60,485	77,800	91,800	104,300	114,900	3.07%	2.34%	1.66%	1.33%	1.00%
New Ireland Province	118,350	194,067	280,800	376,300	485,700	607,300	4.60%	3.42%	2.97%	2.57%	2.26%
ENBP	**220,133**	**328,369**	428,300	524,500	618,600	706,800	**3.70%**	2.44%	2.04%	1.66%	1.34%
West New Britain Province	184,508	264,264	368,800	457,200	545,900	631,400	3.32%	3.08%	2.17%	1.80%	1.47%
AR Bougainville	175,160	249,358	298,700	344,500	382,700	411,800	3.26%	1.66%	1.44%	1.05%	0.74%

Source: JICA Expert Team

Based on the population census data in 2011, the future population of ENBP set above, considering the following aspects, the population of Northeast Gazelle Peninsula is projected by LLG between 2022 and 2052, as shown in Table 7.3.5. It is assumed that the total fertility rate will be gradually declining from 2022:

- Influences of demographic factors, such as the first-year single-age population
- Age-specific fertility rate, total fertility rate, and life expectancy
- Economic development planned in Northeast Gazelle Peninsula such as SEZ development

Table 7.3.5 Projected Population by LLG in Northeast Gazelle Peninsula (2032, 2037, 2042 and 2052)

District	LLG	Population						Annual Growth Rate		
		2011	2022	2027	2032	2042	2052	2022 -2032	2023-2042	2042-2052
Kokopo	Bitapaka	23,116	30,400	34,000	37,800	45,200	52,300	2.20%	1.80%	1.47%
Kokopo	Kokopo/Vunamami	31,965	43,300	49,000	55,300	67,900	80,700	2.48%	2.07%	1.74%
Kokopo	Raluana	18,739	24,800	27,800	31,000	37,300	43,400	2.26%	1.87%	1.53%
Rabaul	Balanataman	19,621	25,900	29,000	32,300	38,700	44,900	2.23%	1.82%	1.50%
Rabaul	Kombiu	11,583	15,100	16,800	18,600	22,000	25,200	2.11%	1.69%	1.37%
Rabaul	Rabaul	4,785	6,400	7,200	8,400	10,600	12,900	2.76%	2.35%	1.98%
Gazelle	Central Gazelle	28,075	37,400	42,000	47,100	57,000	66,800	2.33%	1.93%	1.60%
Gazelle	Livuan	13,485	17,800	19,900	22,700	28,300	33,600	2.46%	2.23%	1.73%
Gazelle	Reimber	15,488	20,400	22,800	25,900	32,100	37,900	2.42%	2.17%	1.67%
Gazelle	Toma	17,080	22,300	24,800	27,500	32,600	37,400	2.12%	1.72%	1.38%
Gazelle	Vunadidir	14,808	19,400	21,600	24,000	28,500	32,800	2.15%	1.73%	1.42%
Northeast Gazelle Peninsula		**198,745**	**263,100**	**294,900**	**330,600**	**400,200**	**467,900**	**2.31%**	**1.93%**	**1.58%**
Outside Northeast Gazelle Peninsula		198,745	165,200	181,900	193,900	218,300	239,000	1.61%	1.19%	0.91%
ENBP		328,369	428,300	476,800	524,500	618,500	706,900	2.05%	1.66%	1.34%

Source: JICA Expert Team

The total projected population of Northeast Gazelle Peninsula is 330,600 in 2032; 400,200 in 2042 and 467,900 in 2052. This means that in 30 years, the population will have an increase of approximately 200 thousand.

In terms of LLG, by 2052, Kokopo / Vunamami is forecasted to have the largest population with 80,700; followed by Central Gazelle (Gazelle District) with 66,800; and Bitapala (Kokopo District) with 52,300.

(3) GDP Projections

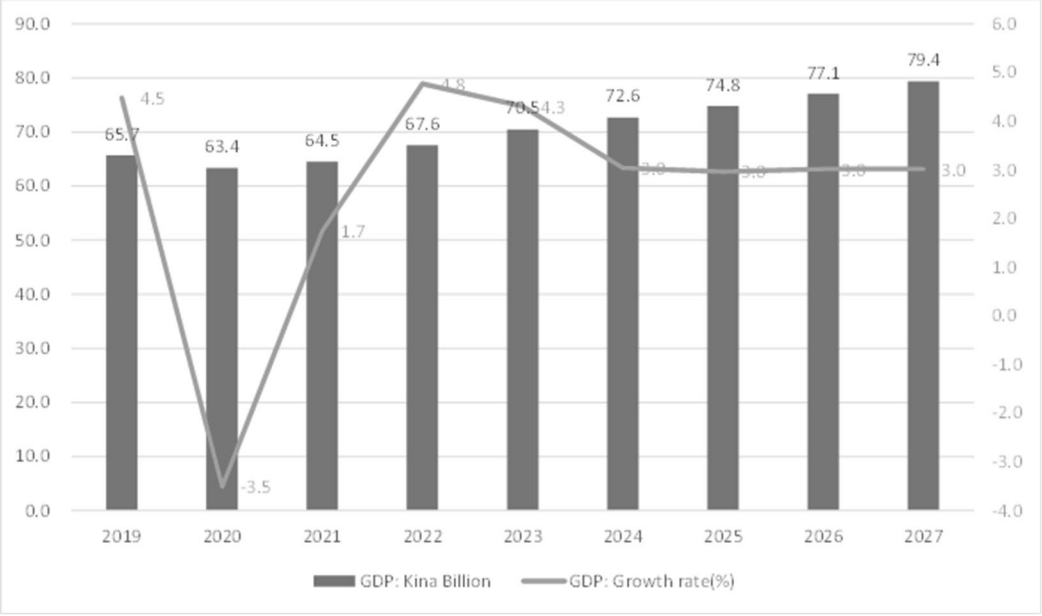
Several GDP projections are seen in the existing plans as shown in Table 7.3.6. The projected figures may differ due to a variety of factors and conditions in the plans. According to the 2022 Budget Strategy Paper by the Department of Treasury, the annual growth rates from 2022 onwards are estimated at 3 or 4%.

Table 7.3.6 GDP Projections in the Existing Plans and Strategies

Plans/Strategies	Projected GDP growth rate	Remarks
PNG Vision 2050	Base-case: **4.5%** between 2010 and 2050, Base-case plus LNG development: **7.1%**	-
PNG National Strategic Plan (NSP) 2010-2030	**2.6%** between 2010 and 2020 without the implementation of NSP **8.4%** between 2010 and 2020 with the implementation of NSP	-
PNG Medium-term Development Plan III 2018 -2022	GDP growth rate should be responded to the reduction of the population growth rate from 3.1% to 2.3%.	Sustained growth in the non-mining and petroleum sectors will be expected to grow GDP.
PNG 2022 Budget Strategy Paper, Department of Treasury	Estimated GDP growth rates are **-3.5%** in 2020, **1.7%** in 2021, **4.8%** in 2022, **2.7%** in 2025 and **3.7%** in 2027.	The growth rates between 2019 and 2023 are the same as those by IMF's World Economic Outlook, April 2022.

Source: JICA Expert Team based on various development plans

Figure 7.3.2 illustrates the GDP projections by IMF's World Economic Outlook. The annual growth rate of GDP from 2024 onwards is estimated at around 3%.



Source: JICA Expert Team based on IMF World Economic Outlook data

Figure 7.3.2 Projected GDP of PNG by IMF's World Economic Outlook

(4) Projection of Gross Regional Domestic Product (GRDP)

The data on the GRDP or gross domestic provincial product of ENBP or Northeast Gazelle Peninsula are not available. Consequently, the following steps of calculation are taken to estimate the current GRDP of the study area.

First, the share of the employed workers by the economic sector of the study area in the whole country is calculated based on the result of the 2011 National Population & Housing Census.

Second, the GDP in 2011 by the economic sector in the whole country is allocated to the study area by using these shares of the employed workers of the Study Area in the country, assuming the value-added amount or the labour productivity per worker in the same sector is the same all over the country.

The result of the estimation is summarized in Table 7.3.7. According to this table, the GRDP of the study area amounted to about 1,130 million Kina (2013 constant prices) in 2011. This amount is 2.6% of the GDP of the whole country. This share is slightly lower than that of the population of the study area in PNG at 2.7% in 2011.

As for the broad economic sector, the share of the services sector is the highest at 57.3%, followed by the industry sector at 22.6%, the primary sector at 15.6%, and the mining & quarrying sector at 4.6%.

Table 7.3.7 Estimated GRDP of Northeast Gazelle Peninsula in 2011

Broad Economic Sector	GDP (2011) in the Whole Country		**Estimated GRDP of the Study Area (2011)**	
	Kina Million at Constant Prices	Share (%)	Kina Million at Constant Prices	Share (%)
Agriculture, Forestry and Fishing	8,503	*19.4*	**175**	***15.6***
Mining and Quarrying	7,068	*16.1*	**52**	***4.6***
Industry	5,966	*13.6*	**254**	***22.6***
Services and others	22,382	*51.0*	**646**	***57.3***
Gross Domestic Product	43,918	*100.0*	**1,128**	***100.0***

Source: JICA Expert Team

(5) Projection of the Future GRDP of Northeast Gazelle Peninsula

The future GRDP of Northeast Gazelle Peninsula is estimated by the economic growth rate of the broad economic sector. The estimation is based on the trend of the GDP in the whole country and the projections by the past plans and donor agencies. Also, the following analysis of Northeast Gazelle Peninsula is taken into account.

The agriculture sector still evolves around cocoa and copra although alternate crops such as vanilla, cardamon, and chillies, and garden food production for the local market is emerging rapidly. Steady progress on a medium or long-term basis will be expected. As for forestry, balsa is a fast-growing tree species, which suits the rich soil of the Northeast Gazelle. Growing and/or harvesting non-wood forest products have also potential. ENBP has extensive potential fisheries resources ranging from inland fisheries, aquaculture, large-scale deep-water tuna fisheries, and so on.

The manufacturing industry in the province is still small, but manufacturing finished products like coconut oil, cosmetic products and timber products are expected to grow. Also, the development of the Rabaul Tuna Export Processing Zone and the Gazelle Agro-Industry Special Economic Zone (SEZ) will become a driving force of the local economy on a mid-term basis. The mining industry in ENBP is mainly quarrying, which involves gathering sand, gravel, and rocks from rivers side and crushing them for road and building aggregation and construction. In recent years there have been some activities in the Wild Dog Gold Mine in the Baining area of the Gazelle Peninsula, but these activities are not counted for the future GRDP since the site is located outside Northeast Gazelle Peninsula.

Northeast Gazelle Peninsula has a unique and diversified tourism product with its natural, socioeconomic, political environment and its history. Thus, the growth of tourism services will be expected in the medium-term basis after the end of the COVID-19 pandemic.

In conclusion, as shown in Table 7.3.8, the total GRDP amounts to 6,015 million Kina (2013 constant prices) in 2052. In other words, the value of GRDP of the Study Area rises from 1,508 million Kina in 2022 to 6,015 million Kina (almost quadruple increase) in 2052 with an annual growth rate of 4.7%.

As for the composition of the broad economic sector in 2052, as shown in Table 7.3.8 and Figure 7.3.3, the services sector shows the highest share at 58.1%, followed by the industry sector at 27.5% and the agriculture, forestry, and fishing sector at 12.5%, respectively.

Table 7.3.8 GRDP Projection of Northeast Gazelle Peninsula by Broad Economic Sectors in 2022-2052

(1) Value of GRDP by Broad Economic Sector in Northeast Gazelle Peninsula

Unit: Kina Million at constant prices (2013 prices)

Sector	2011	2017	2022	2027	2032	2037	2042	2052	Share (%) of GRDP in 2052	Annual Growth Rate (%) 2022-52
Agriculture, Forestry and Fishing	175	209	243	288	342	417	507	750	12.5	3.83
Mining and Quarrying	52	59	65	71	79	87	96	117	1.9	2.00
Industry	254	287	332	404	516	690	924	1,654	27.5	5.50
Services and others	646	749	868	1,056	1,316	1,680	2,144	3,493	58.1	4.75
Gross Regional Domestic Product (GRDP)	1,128	1,303	1,508	1,820	2,253	2,874	3,671	6,015	100.0	4.72

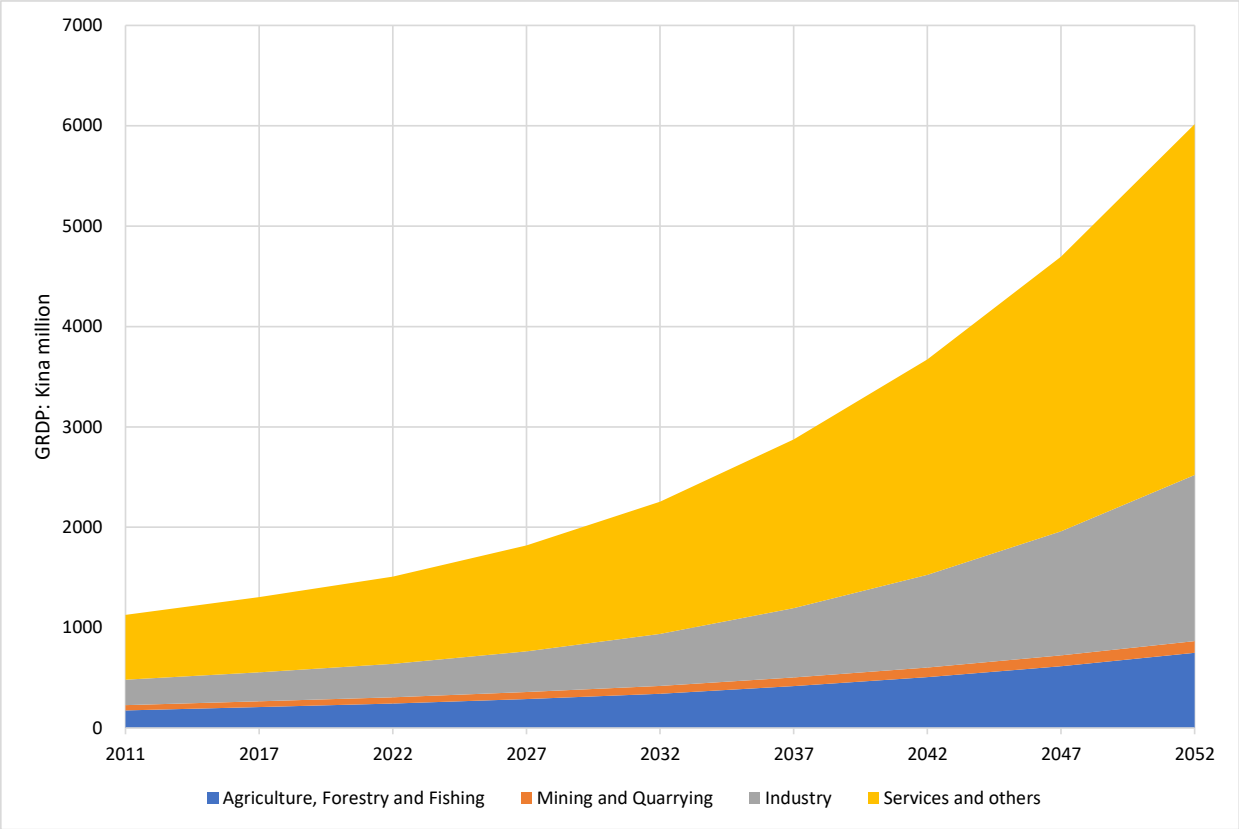
(2) Annual Growth Rate (%) of GRDP by Broad Economic Sector in Northeast Gazelle Peninsula

Sector	PNG (the whole country) 2011-2019	2011-2017	2017-2022	2022-2027	2027-2032	2032-2037	2037-2042	2042-2052
Agriculture, Forestry and Fishing	2.87	3.0	3.0	3.5	3.5	4.0	4.0	4.0
Mining and Quarrying	14.88	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Industry	-1.67	2.0	3.0	4.0	5.0	6.0	6.0	6.0
Services and Others	2.47	2.5	3.0	4.0	4.5	5.0	5.0	5.0
Gross Regional Domestic Product (GRDP)	5.17	2.4	3.0	3.8	4.4	5.0	5.0	5.1

(3) GRDP per Capita in Northeast Gazelle Peninsula

	Unit	2011	2022	2027	2032	2042	2052	Annual Growth Rate 2022-2052
Population	Persons	198,745	263,100	294,900	330,600	400,200	467,900	1.94%
GRDP	Kina Million at Constant Price	1,128	1,508	1,820	2,253	3,671	6,015	4.72%
GRDP per Capita	Kina at Constant Price 2013	5,676	5,732	6,172	6,815	9,173	12,855	2.73%

Source: JICA Expert Team



Source: JICA Expert Team

Figure 7.3.3 Projected GRDP by Broad Economic Sector in Northeast Gazelle Peninsula

PART V

PRESENT SITUATION OF ECONOMIC SECTORS AND DEVELOPMENT STRATEGIES FOR ECONOMIC SECTORS OF NORTHEAST GAZELLE PENINSULA

Chapter 8 Present Situation of Economic Sectors and Development Strategies for Economic Sectors of Northeast Gazelle Peninsula

8.1 Introduction

The economic sectors in this chapter include agriculture, forestry, fisheries, manufacturing, and tourism sectors.

8.2 Agriculture Sector

Cocoa and coconut have long been the main agricultural products of ENBP and the important means of earning foreign currency. Cocoa production has decreased significantly due to an epidemic caused by cocoa pod borer (CPB) since around 2006, but it has gradually recovered in recent years. In addition to cocoa and coconut, the production of agricultural products, such as oil, bean curd, and spices (vanilla, cardamom, etc.) is increasing.

8.2.1 Present Situation of Agriculture Sector

(1) Cocoa

Before the CPB infestation, ENBP was the largest cocoa producing area in PNG, producing over 20,000 tonnes per year and accounting for more than one-third of the national production. However, production decreased seriously due to pest damage. From 2008 to 2012, the devastating effects were realised and production in the ENBP fell by 85% (from around 22,000 tonnes to just 4,000 tonnes). Since 2011, the Autonomous Region of Bougainville (AROB) and the East Sepik Province have accounted for more than 50% of the national cocoa production.

Cocoa production in ENBP has been gradually recovering from a period of decline due to disease through replanting and the introduction of disease-resistant varieties, as shown in Table 8.2.1. However, the production level was still only one-third of the peak level by 2019. However, in 2020, ENBP's cocoa production recovered accounting for about 50% of its annual peak production level. However, it declined again in 2021.

Despite the decline in production, cocoa remains one of the main agricultural products in ENBP and is an important crop, especially for small farmers.

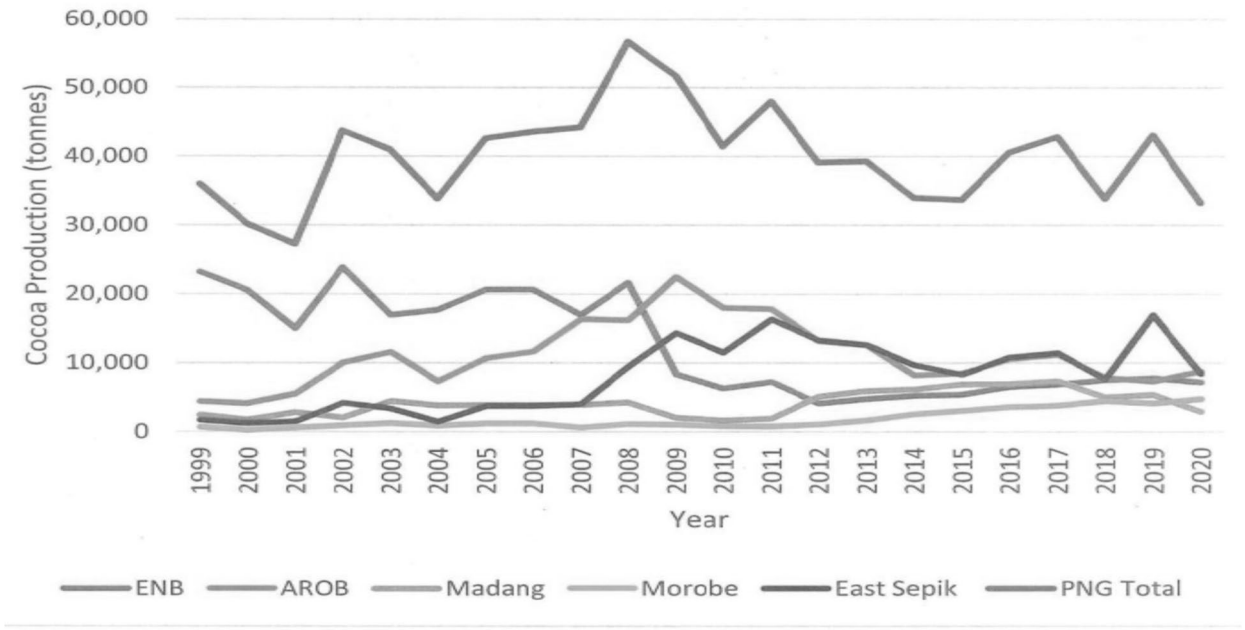
Many efforts have been made to recover from the damage caused by CPB and to promote cocoa production. One of the major efforts is the Productive Partnerships in Agriculture Project (PPAP, 2011-2021) supported by the World Bank. The project positioned ENBP as a priority area for cocoa support and aimed to overcome CPB, restore production, and improve quality through replanting by supplying seedlings, introducing disease-resistant varieties, and improving cultivation management by farmers. ENBP has 11,000 farmers participating in the program, mainly in the Northeast Gazelle Peninsula. The support for cocoa production in ENBP will continue under the PNG Agriculture Commercialisation and Diversification Project (PACD), which is scheduled to launch this year.

Table 8.2.1 Annual Cocoa Production by Province in PNG (2008-2020)

Unit: tonnes

Province	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
East New Britain	21,640	8,279	6,207	7,193	4,061	4,704	5,174	5,357	6,449	6,814	7,449	7,736	11,661	6,438
Autonomous Region of	16,144	22,414	17,945	17,743	13,121	12,543	8,119	8,406	10,554	11,150	7,785	7,241	11,241	9,974
New Ireland	1,628	1,222	979	1,199	484	431	272	282	340	359	183	260	175	175
West New Britain	1,362	1,564	1,252	1,439	898	510	1,020	535	820	867	432	481	701	780
Manus	8	9	7	-	-	-	-	2	2	5	2	6	5	10
Madang	4,257	2,049	1,641	1,918	5,076	5,880	6,108	6,844	6,922	7,310	4,978	5,377	2,775	3,083
Morobe	1,020	931	745	719	1,003	1,568	2,486	3,001	3,555	3,757	4,469	4,075	4,445	5,575
East Sepik	9,411	14,296	11,445	16,304	13,278	12,582	9,640	8,220	10,776	11,385	7,521	16,937	12,060	7,791
West Sepik	1,059	932	746	959	781	627	695	536	644	680	555	504	540	3,078
Northern	172	-	421	480	351	392	420	455	433	457	400	396	400	400
Milne Bay	1	5	4	-	-	-	10	10	10	10	3	6	10	18
Central	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gulf	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chimbu	-	-	-	-	-	-	-	2	3	5	12	25	55	45
Total	56,702	51,701	41,392	47,954	39,053	39,237	33,944	33,650	40,508	42,799	33,789	43,044	44,067	37,367

Source: Cocoa Board 2022



Source: Productive Partnerships in Agriculture Project (PPAP) Completion Report

Figure 8.2.1 Annual Cocoa Production by Province (1999 to 2020)

Although there is insufficient mechanism to directly link quality improvement through improved drying process to higher purchase price, quality improvement is essential to maintain and improve international competitiveness. Currently, cocoa is mainly shipped and exported as cocoa beans, but in the future, downstream processing industry for cocoa butter and powder is expected to be introduced in the province.

(2) Coconut

Export forms of coconut include copra, crude copra oil (coconut natural oil: CNO) and coconut meal. There were more CNO exports compared to copra from 2005 to 2011. However, after 2011 copra exports have been higher compared to CNO. The major reason for this has been attributed to the destruction by fire of the Coconut Products Toboi Mill in Rabaul in 2011. Copra exports from Rabaul Port have volume of about 10,000 to16,000 tonnes per year, accounting for half of PNG's total exports. After the mill ceased production of CNO, only copra is exported from Rabaul Port.

Table 8.2.2 Annual Copra Production of PNG and Major Production Areas

Unit: ha

Year / Province	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
ENB	35,243	42,756	43,873	38,667	50,895	50,529	36,294	27,514	33,089	33,620
AROB	12,427	19,145	23,802	20,448	30,445	40,186	27,714	10,418	21,017	19,193
New Ireland	6,228	11,568	11,514	Table	8,374	8,262	2,327	331	972	2,240
WNB	7,094	7,230	8,388	6,525	10,825	12,063	7,504	4,036	4,545	7,344
Madang	22,160	27,760	37,581	22,308	35,059	26,689	5,780	16,014	22,406	21,709
Milne Bay	1,900	2,433	4,663	2,291	2,717	8,797	8,936	3,223	3,252	2,767
PNG Total	85,569	112,468	132,045	96,676	138,736	146,526	88,555	61,536	85,281	86,873

Source: Coconut Industry Strategic Plan 2016-2025, Kokonas Indastri Koporesen (KIK)

As of 2011, 35% of all households in PNG were involved in coconut cultivation, which, like cocoa, has become an important cash crop as a means of earning foreign currency. The ENBP has been the largest producer of copra in the country, accounting for 33-45% of the country's copra production in the past decade.

Currently, ENBP produces two types of copra: conventional copra (so called black copra) and white copra. The raw materials for both are the same, but the drying process differs. White copra is considered to be of higher quality and has a higher market price. ENBP had been producing only black copra. From 2019, Marico Ltd., in collaboration with the Coconut Industry Cooperation (*Kokonas Indastri Koporesen*, or KIK), has started to promote the production and purchase of white copra. White copra is handled only by Marico Ltd. and is mainly exported to Dubai and Bangladesh. Black copra is purchased entirely by Coconut Products Ltd. (CPL) and exported mainly to the Philippines and Japan. Currently, the ratio of black copra to white copra production at ENBP is said to be about 60:40.

Both white copra and black copra of ENBP are shipped from the Port of Rabaul. The Port of Rabaul receives copra by land from the hinterland and by ship from Pomio District and New Ireland Province. Storage facilities of copra for export are in Rabaul, Kokopo, and Gazelle and currently do not pose any problem; the lack of storage facilities in Pomio and New Ireland is the problem.

Other than copra, seven small and medium enterprises (SMEs) are active in ENBP as coconut-based agro-processing enterprises, and these include makers of virgin coconut oil, soap, and shampoo. Those enterprises are established with support by KIK and the provincial government. In addition, there is a company that produces handicraft using coconut hulls. Virgin coconut oil is currently mainly consumed locally, and some amounts are shipped to other provinces in the country. This is due to the fact that demand is high but production is limited. If production is expanded, the future prospects are not only for the domestic market, but also for export. In order to achieve this, producers need to increase production volume and improve quality through technical guidance. Processing companies need to expand their oil presses, storage facilities, packing containers, and equipment.

Table 8.2.3 Annual Copra Production of PNG and Major Production Areas

Unit: tonnes

Province	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
East New Britain	**35,243**	**42,756**	**43,873**	**38,667**	**50,895**	**50,529**	**36,294**	**27,514**	**33,089**	**33,620**	N.A.	**34,992**	**36,459**	**19,741**	**22,182**
Autonomous Region of Bougainville	12,427	19,145	23,802	20,448	30,445	40,186	27,714	10,418	21,017	19,193	N.A.	31,704	25,225	18,071	18,157
New Ireland	6,228	11,568	11,514	5,622	8,374	8,262	2,327	331	972	2,240	N.A.	17,195	6,495	12,979	3,070
West New Britain	7,094	7,230	8,388	6,525	10,825	12,063	7,504	4,036	4,545	7,344	N.A.	17,355	15,375	6,471	6,514
Manus	101	250	519	207	421	0	0	0	0	0	N.A.	0	0	0	0
Madang	22,160	27,760	37,581	22,308	35,059	26,689	5,780	16,014	22,406	21,709	N.A.	20,517	18,451	20,224	34,845
Morobe	146	255	549	272	0	0	0	0	0	0	N.A.	0	0	0	0
East Sepik	270	41	648	218	0	0	0	0	0	0	N.A.	0	0	0	0
Northern	0	0	12	0	0	0	0	0	0	0	N.A.	0	0	0	0
Milne Bay	1,900	2,433	4,663	2,291	2,717	8,797	8,936	3,223	3,252	2,767	N.A.	2,036	3,257	1,182	837
Central	0	30	496	118	0	0	0	0	0	0	N.A.	0	0	0	0
Total	85,569	112,468	132,045	96,676	138,736	146,526	88,555	61,536	85,281	86,873	N.A.	123,799	105,262	78,668	85,605

Source: KIK, Quarterly Coconut Industry Market Reports 2018-2021

(3) Coffee

Coffee is the leading agricultural export product in PNG, accounting for 20.4% of export revenues of export tree crops, which is second to oil palm at 60.8% in 2017.

Eastern Highlands Province accounts for half of PNG's coffee production, followed by Western Highlands Province, Jiwaka Province, and others. At present, ENBP's coffee production in the country is minimal, with production in 2018 at 288 bags (60-kg green bean bags), or approximately 17 tons, which was only 0.03% of national production.

Farmers in ENBP, even though it is a minor production area, have high expectations for coffee as a cash crop. In Kokopo, the Kabakaul Coffee Factory was established with the support of PPAP and started its operation in 2019. It visibly established a sales destination for farmers, thereby increasing farmers' motivation for production. The Kabakaul Coffee Factory will collect coffee beans from 1,000 farmers in the interior of the Pomio District. In addition, they are planning to collect from 5,000 farmers in other neighbouring states such as New Ireland Province, West New Britain Province, and AROB.

(4) Spices

Spices such as cardamom, vanilla, chili, and turmeric are grown in ENB Province, but production is small and not in large quantities. Some companies also produce essential oils using spices, but the scale of production is small. The main issue for the introduction of processed products is the development of distribution and sales channels.

The product is one of the items to be supported by the PACD Project, and there is a high expectation for improvement of post-harvest processing such as drying and market development.

(5) Palm Oil

PNG was the ninth largest oil palm producer in the world as of 2017, with major production areas in Oro, WNB, Sandaun, Milne Bay, and New Ireland Provinces. ENBP is not a major production area, but in recent years, oil palm plantations owned by Malaysian companies have been increasing in said province. Originally, ENBP hoped to attract oil palm companies to Pomio District, which lacks infrastructure, with the purpose of developing infrastructure in the area. But some companies have acquired cocoa and coconut plantations in Kokopo, Rabaul, and Gazelle Districts to turn them into oil palm plantations.

The total cultivating area of oil palm in PNG is 238,928 ha. In ENBP, there are two plantations, which are Tzen Plantation Limited (17,194 ha) and Memalo Holding Limited (19,463 ha). At the national level, the area ratio of corporate plantations to small farmers is 76%:24%. However, the oil palm cultivation in ENBP is mostly by corporate plantations. Even though oil palm is mainly cultivated by corporate plantations in ENBP, some farmers (landowners) are involved as outgrowers in the management of cultivation, collection and shipment.

There were 20 palm oil mills operating in PNG as of 2019, three of which were located in the ENBP (PNGOPR, *Annual Research Report 2019*). Data of palm oil production volume for ENBP were not available. According to the interview to one palm oil company which has an oil mill in Gazelle District, the company is currently producing 6,000 tonne/month of palm oil. The palm oil produced is stored in the base and shipped once a month. Loading onto carriers is done by a pipe system directly to carriers anchored offshore of the base.,

The Port of Rabaul or other ports are used only for formality of registering export cargo at the customs offices. For export, the palm oil carrier once goes empty to the customs office at Rabaul Port, then travels to the plantation, where it is loaded onto the carrier in pipes and again goes to Rabaul Port to complete customs formalities before being exported.

This is because the pipe system is more advantageous than using overland transport from palm oil mills to Rabaul Port, in terms of total cost, including carrier charter fees, and transport stability.

However, the facilities of Rabaul Port and roads are required for transporting materials, machines and equipment for operating plantations and oil mills of palm oil companies.

(6) Small Livestock

In recent years, ENBP has implemented projects to promote small-scale livestock production and poultry farming and is expected to expand production by private or public/private sector. Currently, activities are mainly aimed at improving community and local nutrition, but they are also expected to contribute to improving farmers' livelihoods. The Gazelle Hatchery Project being implemented is one example of such project, but in the future, a meat processing centre is envisioned to be attached to the project to sell meat to the domestic market. Livestock-related companies currently active in ENBP are listed in the table below.

Table 8.2.4 List of Livestock Enterprises and Projects in ENBP

Name of Enterprise/ Project	Activities	Type of Enterprise	Location
Gazelle Hatchery	Hatchery for day-old chickens & breeding farm	Public/Private	Kerevat. Gazelle District
Rabaul Meat Limited (Ltd)	Slaughterhouse for livestock	Public/Private	Kurakakaul, Rabaul District
Kairak Livestock Project	Breeding pigs and ducks, chickens being supplied for training, distribution to farmers and for marketing	Public/Private	Vudal, Gazelle District
Ulaveo CPL Egg Farming	Breeding and raising layers for egg production	Private	Ulaveo - Tokua, Kokopo District
Ephys Organic Eggs	Raising layers for egg production and growing organic fruits and vegetables to market	Private	Kokopo District
Tobera Slaughterhouse	Slaughterhouse for livestock for marketing	Public/Private	Kokopo District

Source: Division of Agriculture and Livestock, ENBP

8.2.2 Review of Existing Policies, Development Plans and Projects Related to Agriculture Sector

(1) Existing Policies and Development Plan related to Agriculture Sector

The development strategy, such as policy direction and development priorities, for the agricultural sector is set at the national level in the Agriculture Medium Development Plan (AMTDP) 2020-2022, which is aligned to the Medium Term Development Plan (MTDP) III 2018-2022 sector goals and targets. In addition, the National Agriculture Development Plan（NADP) 2023-2032 is being prepared as a 10-year successor of NADP 2007-2016.

The AMTDP 2020-2022 sets "A world-class agriculture and livestock sector that is responsive to international and domestic markets for a diverse range of products." This goal establishes development strategies for the agricultural sector and identifies priority issues for each subsector (crop commodity). The following is a summary of development strategies for the agriculture sector and major subsectors closely related to ENBP.

Table 8.2.5 Development Strategies of Agriculture Sector and Subsectors

Development Strategy of Agriculture Sector	
1. Support MSMEs/SMEs by giving them access to financial capital viable for domestic and international markets (Women) 2. Replanting on smallholder blocks (Export crops) 3. Develop and establish market access infrastructure 4. Rehabilitate run-down plantations which should be prudently operated to boost export volumes 5. Develop and strengthen downstream processing	6. Revive livestock farms and rundown abattoirs 7. Boost local production volume of import commodities (National Rice Policy) 8. Strengthen agriculture research and development (coffee, cocoa, Coconut, spices, fresh produce and livestock, rubber, rice) 9. Strengthen agriculture biosecurity and quarantine inspection 10. Support disaster emergency response
Development Strategies by Major Subsectors (Crops)	
Oil Palm	**Cocoa**
1. Review the OPIC Act, 1992 2. Expand OPIC mandate to a national scope 3. Rehabilitate and maintain existing Smallholder Access Roads (km) 4. Increase area under oil palm 5. Replanting of aged oil palm trees in smallholder blocks and mini estates 6. Increase population engaged in palm oil production 7. Facilitating new investments for outgrower block expansion in oil 8. Promote oil palm research and development	1. Improve regional cocoa nurseries and seed gardens 2. Improve district cocoa nurseries through MOA partnerships 3. Distribute seedlings to cocoa farmers 4. Increase area under cocoa production 5. Facilitate the rehabilitation of cocoa plantations and senile cocoa farms 6. Promote Cocoa MSMEs and group-based production systems 7. Promote cocoa quality improvement, enhancement and downstream processing 8. Facilitate, identify and advise on priority areas for market access infrastructure 9. Support provincial Cocoa Development, Extension and Marketing 10. Support Cocoa Research and Development
Coconut	**Coffee**
1. Establish regional nursery and seedling distribution centres 2. Rehabilitate coconut plantations 3. Support replanting and expansion 4. Promote downstream processing 5. Promote coconut SMEs, diversification, agribusiness, marketing and trade 6. Improve pest and disease control 7. Promote coconut research and development to improve productivity and product quality	1. Revive rundown coffee plantations 2. Support MSME/SME coffee value chain actors 3. Improve coffee market accessibility 4. Establish internationally certified coffee mills to attract premium prices and promote value-adding products 5. Promote green energy and e-marketing in coffee industry 6. Provide research, extension, training, and business support services to coffee smallholder farmers 7. Address pests and diseases affecting coffee production
Spices	**Livestock**
1. Review the Spice Act (1998) 2. Strengthen coordination and management of the industry 3. Improve training and extension services for spice farmers 4. Provide Quality Inspection and Monitoring Systems 5. Create partnerships with provinces and development partners	1. Rehabilitate breeding and distribution centres 2. Reclamation and rehabilitation of old cattle ranches 3. Promote small livestock production 4. Establish and rehabilitate existing abattoirs and poultry processing facilities 5. Support research and development for animal pest and disease control (biosecurity) 6. Promote partnerships

Source: AMTDP 2020-2022

(2) Productive Partnership in Agriculture Project (PPAP) and PNG Agriculture Commercialisation and Diversification Project (PACD)

Productive Partnership in Agriculture Project (PPAP) was a government project started in 2011 and completed in 2022 with loan financing from the World Bank and International Fund for Agriculture Development (IFAD). The project involved rehabilitation of market access (a number of feeder roads) and partnering with the private sector value chain players to provide extension services to its farmers so as to improve quality and increase production and income. PPAP targeted two commodity value chains, one was cocoa industry, and another was coffee industry.

ENBP was identified as a priority area for support to the cocoa industry, and 16 of the total 32 PPAP partners (projects) were implemented in the ENBP, with the participation of 11,150 farmers. PPAP support to the cocoa industry included: support for replanting by providing seedlings and guidance on cultivation techniques, introduction of disease-resistant varieties (CPB tolerant cocoa clones), improvement of drying quality by providing materials for cocoa drying facilities (Kilin pipes), and support for introducing intercropping of Galipnuts on cocoa farmland.

Regarding the coffee industry, ENBP constructed the Kabakaul Coffee Factory in Kokopo. To support the improvement of market access, a feeder road was constructed.

PNG Agriculture Commercialisation and Diversification Project (PACD) is the successor project to the PPAP, which is scheduled to be implemented from 2022 with support from WB and IFAD. In addition to cocoa and coffee, PACD is expanding the range of target value chain to include coconut, spices, and small livestock. In addition, the project will shift from an emphasis on production support focusing on production quantity and quality to the promotion of downstream processing and SME support while supporting production.

8.3 Forestry Sector

8.3.1 Present Situation of Forestry Sector

(1) Forest Resources of ENBP

The forest resources of ENB Province are summarised below. The total area of forest with potential for timber production in the province is estimated at about 787,145 ha (sum of "Potential for Timber Production"), of which 400,750 ha are being logged (sum of "Logged Over"). Out of these, 52,824 ha have been converted to other land use. This means that only 386,395 ha are remaining as potential forest production area for the province. Of the potential forest production area, 44,912 ha are under acquired concession and 47,886 ha remain as forest areas that are identified to be acquired in the near future. About 293,597 ha of forest production area are reserved in the province for small-scale timber harvesting and processing.

Table 8.3.1 Forest Resources of ENBP

Unit: ha

Type of Area	Potential for Timber Production			Other Forest Areas including Protected Areas	Total
	Logged Over		Forest Potential		
	Logged	Converted to Land Use			
Allocated Area to TRPs	72,910	6,676	44,912	113,684	238,174
Expired TRP Areas	61,004	12,610	47,886	9,884	131,384
Reserved and Other Forest Areas	214,012	33,538	293,597	214,850	756,005
TOTAL	347,926	52,824	386,395	338,418	1,125,563
PERCENTAGE (%)	31	5	34	30	100

Source: ENBP Provincial Forest Plan 2021-2025

(2) Logging of Timber

PNG's licence for forest harvesting used to be TRP (Timber Rights Purchase which means landowners let the state contract with timber companies), but no new TRPs are currently being issued. TRPs are replaced by FMA (Forest Management Agreements which cover minimum size of 80,000 ha) for large-scale logging companies and FCA (Forest Clearance Authority which is for logging openings mainly for agricultural land development) for small-scale logging companies TA (Timber Authority) are issued for 12-month short-term contracts. The TRPs that have expired are transformed to FMA or FCA after consultation between the company and the government.

There are eight TRPs that currently exist in ENBP, five of which expires in 2022, and the rest in 2029 or 2030. Therefore, the amount of timber production (permitted cuts) from the current project TRPs is expected to decrease from 1,000,000 m^3 in 2021-2022 to 340,000m^3 after 2023, but the actual production is not expected to decrease due to the transition of contracts to FMA.

(3) Policy on Export Ban of Round Logs

Although the issue on export ban of round logs has been discussed since the 1990s, PNG government has not been able to embark on its implementation. In 2021, PNG government again expressed a policy by which all round logs are to be banned by 2025.

If this export ban of round logs by 2025 is implemented, some of the FCAs which have been issued will be deemed legally invalid.

(4) Balsa Plantations and Balsa Smallholder Farming

Balsa farming in ENBP is a new and promoting industry, which was introduced in the wake of a major cocoa disease outbreak. Once introduced, it has rapidly turned out to be one of the most attractive forest activities with markets readily available and less cost accrued at the initial stages compared to other cash crops.

Balsa is also in line with PNG's policy of shifting from raw materials to exports as processed products in the sector and is expected to continue to grow in this area. Export of balsa is done after processing of raw balsa wood into sawn timber or blocks. The export volume of balsa products has been on the rapid increase as shown in Table 8.3.2.

Table 8.3.2 Export Volume of Balsa in the Form of Sawn Timber or Blocks from Rabaul Port

Year	SAWN TIMBER BALSA (MTQ)	R/S BALSAWOOD BLOCKS STRIPS (NMB)
2016	92,413	353,585
2017	47,787	416,383
2018	88,167	130,568
2019	850,195	938,957
2020	2,213,515	669,403
2021	341,352	88,875

Notes: MTQ: cubic metre; NMB: number (units)
Source: PNG Customs Office 2022

However, caution must be exercised from the standpoint of stable growth of the industry, as the expansion of balsa has led to rapid replanting of traditional cash crops (cocoa and coconut) in some areas.

Currently, there are 15 balsa industry companies in ENBP, of which one produces balsa in its own plantation, three use combination of produce from own plantations and purchase from neighbouring farmers, and the other 11 companies specialise in processing and purchase all raw materials from neighbouring farmers. The majority of balsa plantings are located at the Gazelle Peninsula and owned by local landowners/farmers, plantation companies, church organisations, schools, as well as state agencies.

Since balsa is a relatively new industry, there is no government agency responsible for it, and no industry association has been formed in the private sector. As a result, it is difficult to grasp the overall condition, and the cultivated area and production volume are not yet known. Currently, there is talk of the need to establish a Provincial Balsa Board, but no concrete preparations have yet been made for its establishment.

Unlike timber production, balsa wood is mainly transported overland to ports of shipment, and there is a high demand for the development of road infrastructure.

8.3.2 Review of Existing Policies, Development Plans and Projects Related to Forestry Sector

ENBP is developing the Provincial Forest Plan 2021-2025 document as a set of goals and guidelines for the management, conservation, and development of the provincial forest resources under the National Forest Policy, the Forestry Act 1991 and the National Forest Development Guidelines (NFDG). The Provincial Forest Plan 2021-2025 is currently in draft form and in the process of being finalised. ENBPA has set the following priority goals in the Plan.

Table 8.3.3 Priority Goals of ENBP Provincial Forest Plan 2021-2025

Priority Goals of ENBP Provincial Forest Plan 2021-2025
1. Maximise involvement of locally owned forest management and downstream processing enterprises.
2. Review all current TRPs and ensure compliance with all permit conditions before they cease their operations.
3. Include all potential forest products and services to make sound decisions on sustainable forest management.
4. Achieve full compliance of all forest operations with the revised PNG Logging Code of Practice and all applicable forestry laws and regulations.
5. Promote forest plantations and woodlots by landowner groups with support from PNGFA and Provincial Government.
6. Promote forest restoration of logged over forest areas.
7. Maintenance and conservation of forest cover and biodiversity
8. Creation and promotion of social forestry programmes through village woodlots and agroforestry techniques to meet local forest products and service's needs
9. Encouragement of multiple use forestry through ecotourism and ecoforestry development programmes with a view to perpetuate forest growth.

Source: ENBP Provincial Forest Plan 2021-2025 (Draft)

8.4 Fisheries Sector

8.4.1 Present Situation of Fisheries Sector

Tuna is the largest of Papua New Guinea fisheries and is found throughout the PNG fisheries zone, especially in the north and east. Catch of tuna is usually about 150,000MT to 200,000MT per year, but it is estimated that the resource can sustain much higher annual catches of 250,000MT to 300,000MT. Catch from PNG waters accounts for 20-30% of the total catches of the Parties to the Nauru Agreement (PNA) countries, and it is about 10% of the global catch.

Table 8.4.1 Tuna Catches in 8+ 1 PNA Countries in 2018

	Name of Country	Annual Amount of Tuna Catches MT per Year	% of Each Country out of the Total of PNA Countries
1	Papua New Guinea	316,278	21.3%
2	Kiribati	434,651	29.3%
3	Marshall Islands	93,685	6.3%
4	Micronesia	205,551	13.9%
5	Nauru	131,816	8.9%
6	Palau	6,285	0.4%
7	Solomon Islands	179,200	12.1%
8	Tuvalu	107,143	7.2%
9	Tokelau (+1)	9,374	0.6%
	Total	1,483,983	100.0%

Source: National Fisheries Authority

Tuna product is exported in the form of fresh chilled, canned, fishmeal and frozen tuna. Chilled tuna is air freighted to the sashimi market in Japan. Frozen tuna is exported to Philippines and Taiwan; canned tuna mainly to USA, Germany and Great Britain with small quantities to the

Melanesian Spearhead Group countries; and fishmeal to Australia and Japan. More than 10,000MT of canned tuna is consumed locally per year. Total tuna catch in PNG's Exclusive Economic Zone (EEZ) is summarised in the following table.

Table 8.4.2 Total Tuna Catch in PNG's EEZ

Unit: tonnes

	2012	2013	2014	2015	2016	2017	2018	2019
All Fleets	586,102	592,004	339,172	190,754	316,278	383,267	371,861	353,932
PNG Fleets	78	66	65	65	65	95	78	76

Source: PNG Fisheries Strategic Plan 2021-2030, NFA

In the early 1980s, Rabaul had served as an important centre for the pole-and-line tuna fishery in the Bismarck Sea. There were several fishing companies operating out of Rabaul supported by a 30 metric ton block ice plant, freezer space and office. However, the demise of the pole-and-line tuna fishery during that period saw those Rabaul-based tuna fishing and transhipping arrangements just fell apart. Currently, the functions of the base ports for long-line and purse-seine tuna fishing, mainly longlining, are dispersed among the ports of Wewak, Manus, Kavieng, Rabaul, Lae, and Madang, with the relative decline in the position of the Port of Rabaul. From these ports, tuna is either transhipped to tuna canneries in Thailand and the Philippines or landed at ports outside of PNG. Currently, there are no tuna processing facilities in ENBP.

Currently, the National Fisheries Authority is considering the construction of a tuna fillet processing facility adjacent to the Port of Rabaul, including a freezing facility, and a pre-F/S has been conducted.

In PNG, tuna processing industries have been initiated for exporting canned tuna since 1980s and 1990s. Currently, six factories are operational using tuna catches from the Bismarck Sea. As shown in Table 8.4.3, these factories have not fully utilised the current processing capacities yet. Due to this current situation of not full utilisation of tuna processing capacities in PNG, tuna fillet markets in the US are considered as targets for the Rabaul's tuna processing industry.

Table 8.4.3 Six Tuna Canneries in PNG and Their Tuna Processing Capacities

Name of Processor	Location of Factory	Full Capacity MT / day	Current Capacity MT / day	No. of Processing Days / Year
RD Tuna canners Ltd	Madang Madang Province	150	140	264
Frabelle PNG Ltd.	Lae Morobe Province	120	90	220
International Food Corporation Ltd.	Lae Morobe Province	120	40	140
Majestic Seafood Corporation Ltd.	Lae Morobe Province	250	80	213
Nambawan Seafoods PNG Ltd.	Lae Morobe Province	180	15	215
South Seas Tuna Corporation Ltd.	Wewak Sepik Province	160	110	240
Total		980	475	1,292

Source: Undercurrentnews: Seafood Business Data and News

8.4.2 Review of Existing Policies, Development Plans and Projects Related to Fisheries Sector

(1) Existing Policies and Development Plan

In PNG, the National Fisheries Authority (NFA) has developed the PNG Fisheries Strategic Plan 2021-2030 to promote fisheries and resource management. The Strategic Plan identifies the following missions and 11 Key Result Areas (KRAs).

Table 8.4.4 Mission and KRAs of PNG Fisheries Strategic Plan 2021-2030

Mission of PNG Fisheries Strategic Plan
Papua New Guinea's fisheries sector is developed into a strong, broad-based, diversified and value-adding industry that is globally competitive; domestically inclusive and functioning as a robust and sustainable source of government revenue, food and livelihood for the people.
KRAs of PNG Fisheries Strategic Plan
1. Development of Enabling Infrastructure and Improvement of Industry Operating Environment 2. Optimisation of Government Revenue 3. Increases in Downstream Processing, Value Adding, Employment and Export Earnings 4. Expanding and Enhancing of International Trade and Market Access for Fisheries Products 5. Supporting, Maintaining and Encouraging of Genuine Foreign Direct Investment Inflows 6. Optimisation of Papua New Guinean Participation and Local Content in the Fisheries Sector 7. Improvement in Food Security and Livelihood Opportunities 8. Strengthening of Research, Development, Extension Support Services, Training and Capacity Building 9. Maintain and Strengthen Sustainable Fisheries Management and Healthy Ecosystems 10. Build, Strengthen International Fisheries Cooperation and Engagements 11. Encourage Evidence-Based Policy and Planning Approach

Source: PNG Fisheries Strategic Plan 2021-2030

Related to tuna processing and export which is a highly expected area of economic development for ENBP, KRA3 sets to promote value creation through expanding productive capacities, supply chain opportunities, product development and markets that increase broad economic benefits.

(2) Fisheries Related Projects Undertaken for ENBP by National Fisheries Authority (NFA)

1) Rabaul Tuna Terminal Project

Previously called the Rabaul Regional Fisheries Service Centre Project, it is currently in the planning stage and Pre-F/S has been completed. The project aims to convert tuna fishing in the waters around Rabaul from mere transhipment to landing, storage, and exportation by combining the construction of a wharf and a cold storage facility. This will aim to create industry and employment in the region. This plan does not cover tuna processing facilities.

2) Island Connectivity Programme

Omorong Jetty, Rakand Jetty and Rabaul Fisheries Station Refurbishment were completed and handed over to the state government in March 2022.

(3) Projects for Development of Special Economic Zones

National Executive Council (NEC) has approved to initiate the study of two projects, i) Rabaul Tuna Export Processing Zone, and ii) Gazelle Agro-Industrial Special Economic Zone, in ENBP as a pilot project for the development of a Free Trade Zone Development Policy and Plan in November 2021.

The Rabaul Tuna Export Processing Zone is reported to have land secured near the Rabaul Port by ENBPA, but it needs to be coordinated with other agencies' plans for fishery-related projects around Rabaul Port.

The location of the Gazelle Agro-Industrial Special Economic Zone is considered to be along Ataliklikun Bay in Gazelle District. On the other hand, the entire Gazelle District is also being considered for SEZ designation.

Both projects are at the preparation stage, and the details of the projects will become clearer in the future.

8.5 Manufacturing Sector

8.5.1 Present Situation of Manufacturing Sector

Manufacturing sector in ENBP includes wood production, balsa processing, primary processing of cocoa beans, primary processing of copra (black copra and white copra) and secondary products such as virgin coconut oil, coffee processing, bread making, and so on. In addition, there is a chicken hatcheries and small-scale meat processing plants related to livestock production. All of these are small in scale. There are two industrial concentrations in Kokopo: the Takubar Industrial Center and the Ulaveo Industrial Center. The land of the Takubar Industrial Center is owned by the Catholic Church, which leases approximately 12 ha of land. The Takubar Industrial Center is close to Kokopo, where factories are expanding, and it is becoming increasingly difficult to secure land. On the other hand, the Ulaveo Industrial Park has so far developed 40 ha of infrastructure in Phase 1, with another 40 ha to be developed in Phase 2. Currently, the number of tenant companies is 4-5 small and medium-sized enterprises (SMEs), engaged in bread production, balsa wood manufacturing, etc. Each lot area is approximately 1 ha.

8.5.2 Review of Existing Policies, Development Plans and Projects Related to Manufacturing Sector

(1) Project Undertaken by ENB Provincial Administration (ENBPA) and District Development Authorities (DDAs)

In ENBP, small-scale economic projects are being implemented at the provincial and district levels by the relevant agencies of the ENB Provincial Government (ENBP) and the District Development Authority (DDA) in partnership with the private sector. The following is a list of projects currently being implemented or in preparation.

Table 8.5.1 Economic Projects Undertaken by ENBPA and DDAs

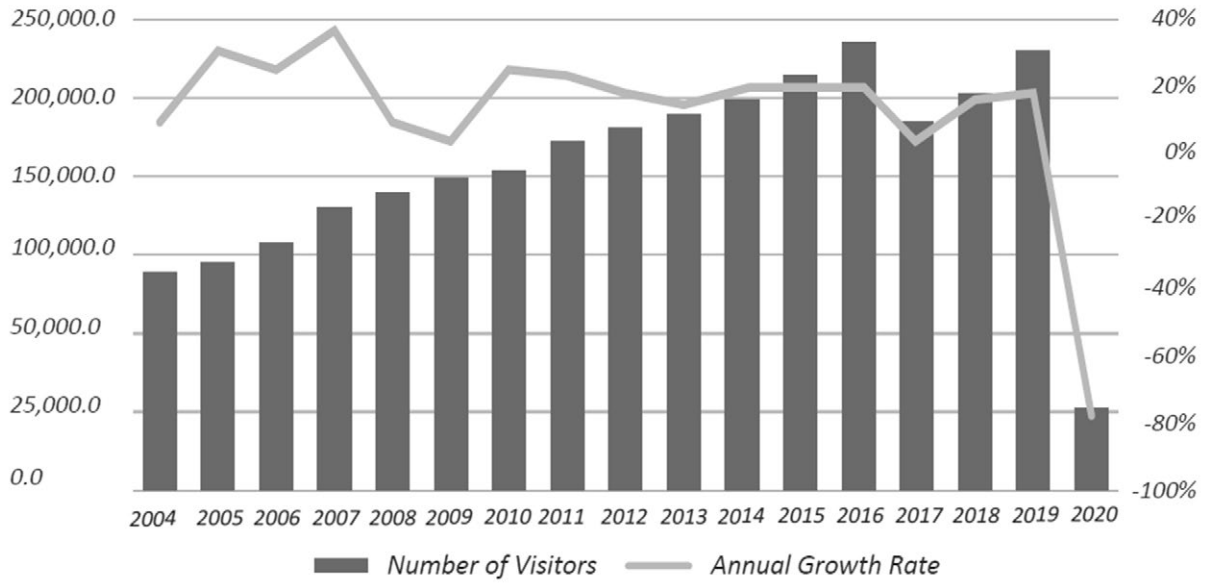
Promoter	Project Title	Activity	Partnership Type	Status
ENB Provincial Administration	Chocolate Factory	Manufacturing of cocoa powder and chocolate	PPP Partnership- ENBPA/OISCA	In construction
	Coffee Factory	Manufacturing of coffee parchment	Partnership- ENBPA/ NB Resources Ltd.	Operational
	National Mask and Warwagira Festival	Promotion and preservation of culture	Partnership-ENBPA, private sponsoring companies and govt. agencies	Suspended due to the COVID-19 pandemic
Rabaul District Development Authority (DDA)	Rabaul Virgin Coconut Oil (RVCO)	Coconut oil production	PPP Partnership- RVCO and Rabaul DDA	Operational
	Rabaul District Merchandising	Retail/Wholesaling	RDDA Business Arm	Proposal
	Rabaul Meat Ltd	Butchery	RDDA Business Arm	Under construction
Kokopo DDA	White Copra Project	White copra export	PPP Partnersip- KDDA and Kokonas Industry Koperesen (KIK)	Operational
Gazelle DDA	Gazelle Business Corporation	Poultry-Hatchery Corn Project	GDDA Business Arm	Operational
	Kololobe Cocoa Dealers	Cocoa Dealer Cocoa Exporter	PPP Partnership	Operational Proposal
	Weelson Trading	Tin Can Dealer Tin Can Exporter	PPP Partnership	Operational Proposal

Source: Division of Commerce and Industry, ENBPA

8.6 Tourism Sector

8.6.1 Present Situation of Tourism Sector

PNG's tourism sector has been growing steadily over the last 15 years. Tourism business provides a myriad of opportunities for SME businesses in various sectors, from tour guides, logistics, transportation, accommodation, etc. in PNG. It accounts for over a billion Kina to the economy through direct and indirect contributions. The total number of visitors had steadily increased during these years. Between 2015 and 2019, of the average annual total visitors of 172,063, 54% came for business and employment purposes, and 29% for holiday purpose, of which 15% was from air mode and 14 % was from cruise. The impact of COVID-19 on the sector was enormous, with the number of visitor arrivals falling by more than 80%, from 210,980 in 2019 to 38,940 in 2020, with a particular drop in visitors for holiday purpose, from 76,616 in 2019 to 3,398 in 2020, or a decrease of 96%.[1]



Source: PNG Tourism Sector Development Plan 2022-2026, PNGTPA

Figure 8.6.1 Historical Numbers of Visitors to PNG

Tourism is an important economic sector for ENBP, and the provincial government places a high priority on it, while the private sector is also active in the sector. The Kokopo Business College in the province has a tourism department, and vocational training schools offer training in tourism.

The ENBP's tourism resources include natural activities such as trekking, bird watching, diving, swimming with dolphins, etc., historical heritage of World War II, traditional culture and events of the Tubuan Society, and so on.

In recent years, cruise ship passengers have become the majority of visitors to ENBP for tourism purposes, and the tourism industry's reliance on cruises is high. In 2015, there were 29,354 visitor arrivals in ENBP, of which 9,684 (33%) came by air mode and 19,670 (67%) by cruise ship[2].

In accordance with the data of Rabaul Port Office of PNG Ports, the numbers of cruise ship calls at Rabaul Port comprised of 74 ships in 2016, 37 ships in 2017, 13 ships in 2018, and 18 ships in 2019. The number of ships reduced from 2017 since the size of the cruise ships became larger.

[1] PNG Tourism Sector Development Plan 2022-2026, PNGTPA
[2] ENB Tourism Master Plan 2017-2020, ENBTA

Although the country has been hit hard by COVID-19, it is hoped that cruise ship calls will resume by the end of 2022. In the mid- to long-term, there is a need to diversify the tourism industry from a strong reliance on cruises to include domestic and international tourism. In addition, it is necessary to develop tourism products in conjunction with tourism promotion.

8.6.2 Review of Existing Policies, Development Plans and Projects Related to Tourism Sector

(1) Existing Policies and Development Plan

ENB Tourism Master Plan 2017-2022 has been prepared by the ENB Tourism Authority. The development strategies outlined in the Master Plan are as follows:

Table 8.6.1 Development Strategies for ENB Tourism Master Plan

Development Strategies for ENB Tourism Master Plan	
Marketing the Destination	Increase tourism demand by raising market awareness of ENB as a viable tourism destination and increasing production formation and distribution.
Product Development and Investment	Encourage investment in new and existing tourism products that meet market needs, increase sector competitiveness and industry standards.
Transport and Infrastructure	Improve the competitiveness and standards of transport and infrastructure to increase market demand and improve visitor satisfaction level
Human Resource Development	Facilitate training and quality education programmes which meet the tourism industry needs, improve skill level and create awareness of the benefits of tourism
Institution and Industry Partnership	Develop institutional structure and capacity within the public and private sector to facilitate tourism development at the provincial level

Source: ENB Tourism Master Plan 2017-2022

The Master Plan proposes "Tourism Cluster Development Programmes" to realise the Tourism Hub Concept in ENBP. Unfortunately, due to the impact of COVID-19, which continued after 2019, these projects have not been implemented.

Table 8.6.2 Tourism Cluster Development Programme for ENB Tourism Master Plan

Components of Proposed Tourism Cluster Development Programmes
1. Ataliklikun-Doy Cluster Development Projects
2. Kambubu–Uvol Cluster Projects
3. Pomio Tracks and Cave Cluster Projects
4. Lasul Baining–Open Bay Cluster Projects
5. Gazelle Peninsular Cluster Projects (include Rabaul, Kokopo and Gazelle Districts) - Development of Japanese Underground Hospital (Gunanur) - Refurbishment and Redevelopment of Kokopo and RabaulMuseums - Refurbishment of Barge Tunnel - Synthetic Track (Sports Tourism) - Development of Lodge at Submarine Base - Development of Craft Markets at Port Road, Rabaul, Kokopo, Mamaluan - Development of Baining Fire Dance Cultural Centre - Development of a Nature Lodge at Notremalin the Lasul Baining - Development of Ecotourism Lodge and Reef Fish Farming-Doy - Development of Comfort Facilities in all Tourism Sites - Development of Marine Park on Pidgin Island - Development of Cultural Villages in Cluster Locations - Development of a Lapita Pottery Cultural Centre at Watom Island - Development of the Rabaul Cruise Ship Terminal - Development of 18 Hole Golf Course and 5-Star Resort Hotel at Raivan Beach-Kokopo

Source: ENB Tourism Master Plan 2017-2022

(2) PNG Tourism Sector Development Project

The PNG Tourism Sector Development Project was initiated in 2017 as a five-year plan in ENB and Milne Bay Provinces with support from the World Bank. The project in ENBP has been withdrawn and is not expected to be implemented soon.

8.7 Issues on Development of Economic Sectors

Based on the present situational analysis, the following issues and directions for individual economic sectors in Northeast Gazelle Peninsula are identified:

Table 8.7.1 Expected Directions of Economic Development by Subsector

Agriculture	
Cocoa	• Further recovery and increase of cocoa production through replanting of cocoa, introduction of disease-resistant varieties, and improved management of cultivation • Improving product quality by improving local drying processes • Increase income of cocoa farmers through promotion of intercropping with other cash crops, such as galip nuts. • Initiate business activities through the formation of cluster groups of cocoa producers (small-scale entry into the cocoa bean processing industry). • Attracting cocoa bean processing industry to Gazelle or Kokopo (cocoa butter, chocolate, etc.). • Collaboration with the Gazelle Agro-Industrial Special Economic Zone for the promotion of agro-processing.
Coconut	• Increase coconut production through improved seedling distribution and cultivation management. • Expansion of quality processing and white copra production through improved local drying processes. • Initiate business activities through the formation of cluster groups of copra producers (small-scale entry into agro-processing industry). • Attract coconut processing industry to Gazelle or Kokopo, support of existing SMEs including marketing support (virgin coconut oil, soap, shampoo, etc.). • Attract coconut oil mills (reconstruction). • Collaboration with the Gazelle Agro-Industrial Special Economic Zone in the promotion of agro-processing.
Coffee	• Expand coffee production through seedling distribution, technical assistance for cultivation, and improved access (construction of a feeder road). • Creation of added value through marketing development and grading by coffee factories in Kokopo. • Increase coffee bean collections for coffee factories by linking coffee farmers outside ENBP
Spices	• Quality improvement and market development through improved product processing such as drying, etc. • Development of agro-processing using spices (essential oils, etc.), support for SEM start-ups and market development. • Collaboration with the Gazelle Agro-Industrial Special Economic Zone concept in the promotion of agro-processing.
Palm Oil	• Facilitate the development of existing oil palm projects and mills in the province. • Expand production by developing oil palm plantations in harmony with local communities.
Small Livestock	• Expansion of small livestock production to improve local nutrition. • Development of the Gazelle hatchery and promotion of poultry meat production. • Development of the meat processing industry at the regional level.
Forestry	
Timber Production	• Ensure forest resource management and local community benefits through appropriate forest use agreements. • Promotion of downstream processing industries, such as sawn wood, other processed wood and furniture manufacturing.
Smallholder Balsa Growers and Balsa Plantations	• Establishment of a management system for smallholder balsa growers and balsa plantations (establishment of a Balsa Board and other administrative structures, establishment of private industry associations). • Coordination of farmland conflicts with traditional commodities, such as cocoa and coconut, as well as with food crops • Improvement of access through the development of road infrastructure.
Fisheries	
Tuna	• Creation of local fishery processing industries and employments ➢ Through the early realisation of the Rabaul Tuna Terminal Project (wharf and cold storage) ➢ By establishing the Rabaul Tuna Export Processing Zone adjacent to Rabaul Port ➢ By upgrading water supply and electricity supply to Rabaul Port • Efficient project implementation through coordination and collaboration of development initiatives and projects of related organisations.

Tourism	
Tourism	• Shift from a tourism destination that mainly focuses on volcanoes and cruise ship calls with supplementary tourism products, such as indigenous culture, military battlefield tourism, and marine nature tourism to a more diversified tourism destinations • Upgrade tourism promotions and enhance the quality of tourism destinations by taking advantage of a variety of regional characteristics, such as volcano, culture, nature and history of the region.

Source: JICA Expert Team

8.8 Vision for Development of Economic Sectors

ENB Economic Development Plan 2003-2030 states that the vision for the economic sectors development is "for the creation of diversified economy, which is characterised by strong manufacturing and service industries including tourism, built upon a strong agricultural (other primary industries) foundation of the province and the New Guinea Islands."

ENBP Strategic Development Plan for 2011-2021 sets development goals for each subsector. The following is a listing of development goals for subsectors related to economic sectors.

- **Goal for Agriculture, Livestock and Forestry Subsectors:** Sustainably transform the Agriculture, Livestock and Forest Industries into vibrant and productive sector in preparation for downstream processing, manufacturing, and service industries. The establishment of which will be a means of growing the local economy.
- **Goal for Fisheries and Marine Resources Subsectors:** To develop the fisheries sector as an emerging industry capable of helping to grow the ENB economy.
- **Goal for Tourism Subsector**: Promote tourism as an alternative socioeconomic activity that has the potential to assist the local economy grow, improve living standards, and reduce poverty without negatively impacting culture and the environment.

Considering these development vision and goals, the following are the development directions for each of several commodity value chains that economic sectors should focus on, with a view to develop over the next 10 years.

8.9 Objectives for Economic Sectors Development

In the economic sector, the following two development objectives are set with a view to creating to a diversified economy, which is characterized by strong manufacturing and service industries including tourism, built upon a strong agricultural (other primary industries) foundation, and with a view to achieving sustainable development of both an export-oriented economy and a family-based subsistence farming or informal economy.

- To seek the expansion of economic sectors' production by widely and efficiently utilizing lands and other natural resources including marine and forestry resources
- To make a challenging effort at developing new economic sectors, such as processing industries and upgrading tourism products, by using regionally available products and resources (including unprocessed materials of agricultural, forestry, and fisheries sectors) and by producing tourism products targeting diversified segments of international tourist market (including the high-end segment).

8.10 Strategies for Economic Sectors Development

The development strategies for the economic sectors are set out below, with two directions: the development and expansion of existing economic activities in the region, and the fostering new economic activities through the promotion of processing industries and the upgrading of international tourism.

(1) Development directions and strategies for promoting further development (expansion) of existing economic sectors, including the following production activities:

- Production of export-oriented agricultural products (copra, cacao, palm oil, balsa, etc.)
- Fishing of tuna in Bismarck Sea
- Cruise ship tourism targeting Rabaul volcanoes, cultural tourism, and war tourism
- Marine nature tourism including dolphin watching

(2) Development directions and strategies for promoting processing industries by using locally produced raw material and upgrading international tourism by improvement of infrastructure and supporting facilities:

- Agro-processing industries by using locally produced copra, cacao, palm oil, balsa, etc. including the raw materials produced in surrounding island provinces
  - By establishing an Agro-Industrial SEZ along Ataliklikun Bay in Gazelle District
  - By strategically providing access roads, water supply infrastructure, and power supply infrastructure to the prospective Agro-Industrial SEZ
  - By relocating part of port functions of Rabaul Port to Ataliklikun Bay
- Fishery processing industries using tuna caught in Bismarck Sea
  - By establishing a Tuna Processing SEZ near Rabaul Port
  - By strategically improving access roads, water supply infrastructure, and power supply infrastructure to the prospective Tuna Processing SEZ
  - By rehabilitating the existing infrastructure of Rabaul Port
- Upgrading of international tourism attractions and destinations by improving tourist infrastructure (hotels and conference centres) and supporting facilities (rest facilities, toilets and streets for walking)
  - By upgrading the current Tokua Airport to an international airport not only serving ENBP but also its surrounding island provinces
  - By promoting the development of airport city surrounding the prospective international airport of Tokua.

(3) Promotiong of foreign investment by designating and developing SEZs for the promotion of processing industries and upgrading international tourism

- To designate and develop strategic economic zones (SEZs) and promote the development of industrial infrastructure and facilities in order to promote the agro-processing, forestry and fish processing industries and international tourism, as noted in (2) above, by promoting investment from both domestic and foreign sources.
- At the same time, to promote infrastructure development in urban areas where processing industries and tourist accommodation facilities are located.

PART VI

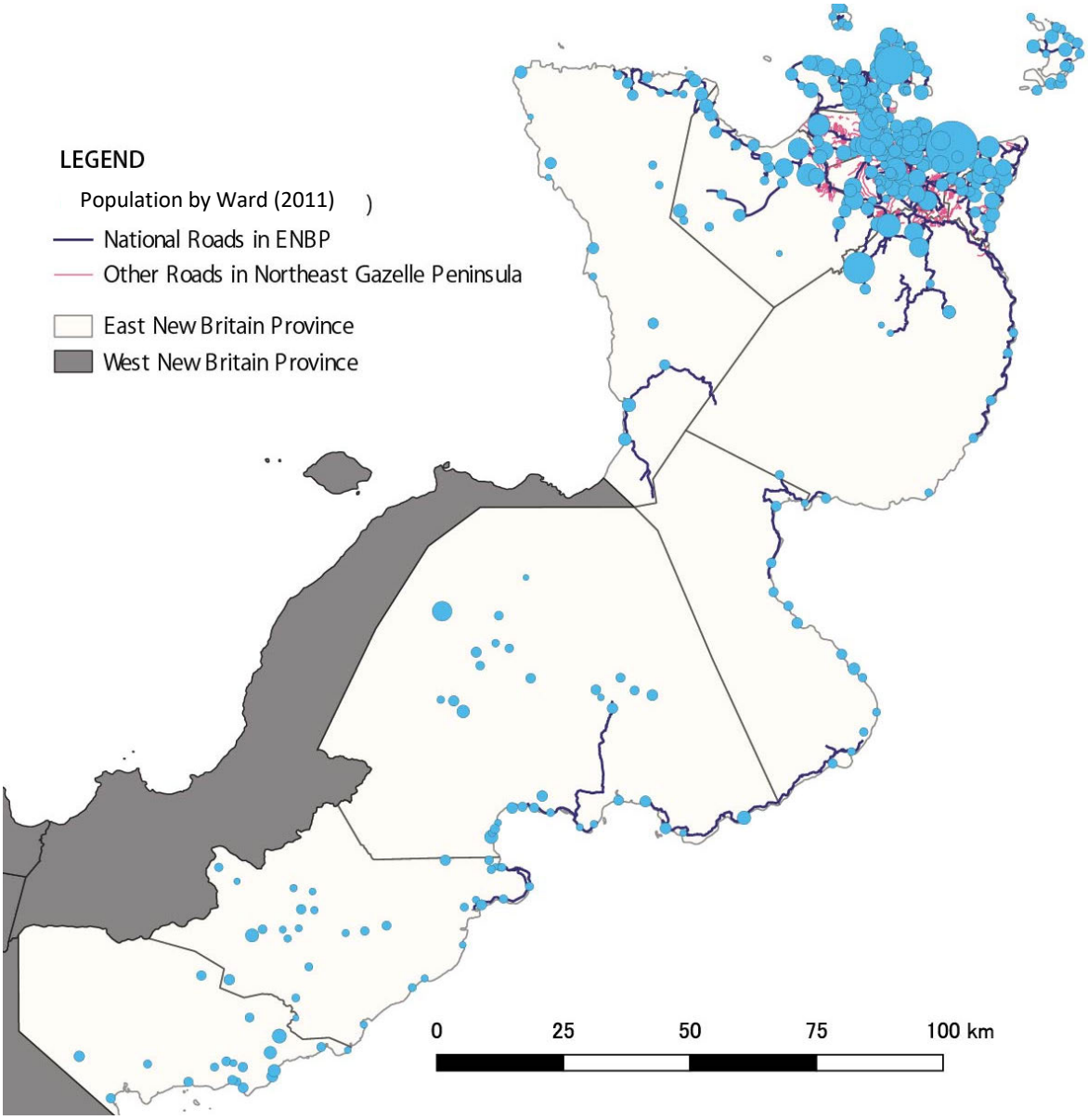
PRESENT AND FUTURE REGIONAL SPATIAL STRUCTURE AND URBAN AREAS OF NORTHEAST GAZELLE PENINSULA

Chapter 9 Present and Future Regional Spatial Structure of Northeast Gazelle Peninsula

9.1 Present Spatial Characteristics of Northeast Gazelle Peninsula

9.1.1 Changes in Population Distribution

The distribution of settlements in ENBP is mostly concentrated in Northeast Gazelle Peninsula. The circles in Figure 9.1.1 show the size of population in each ward. It can be said that the population size in each ward in Northeast Gazelle Peninsula is larger compared with that of the other wards of the local level governments (LLGs) in ENBP.



Source: JICA Expert Team, based on Population and Housing Census 2011 and GIS data from ENBPA

Figure 9.1.1 Population Distribution in ENBP (2011)

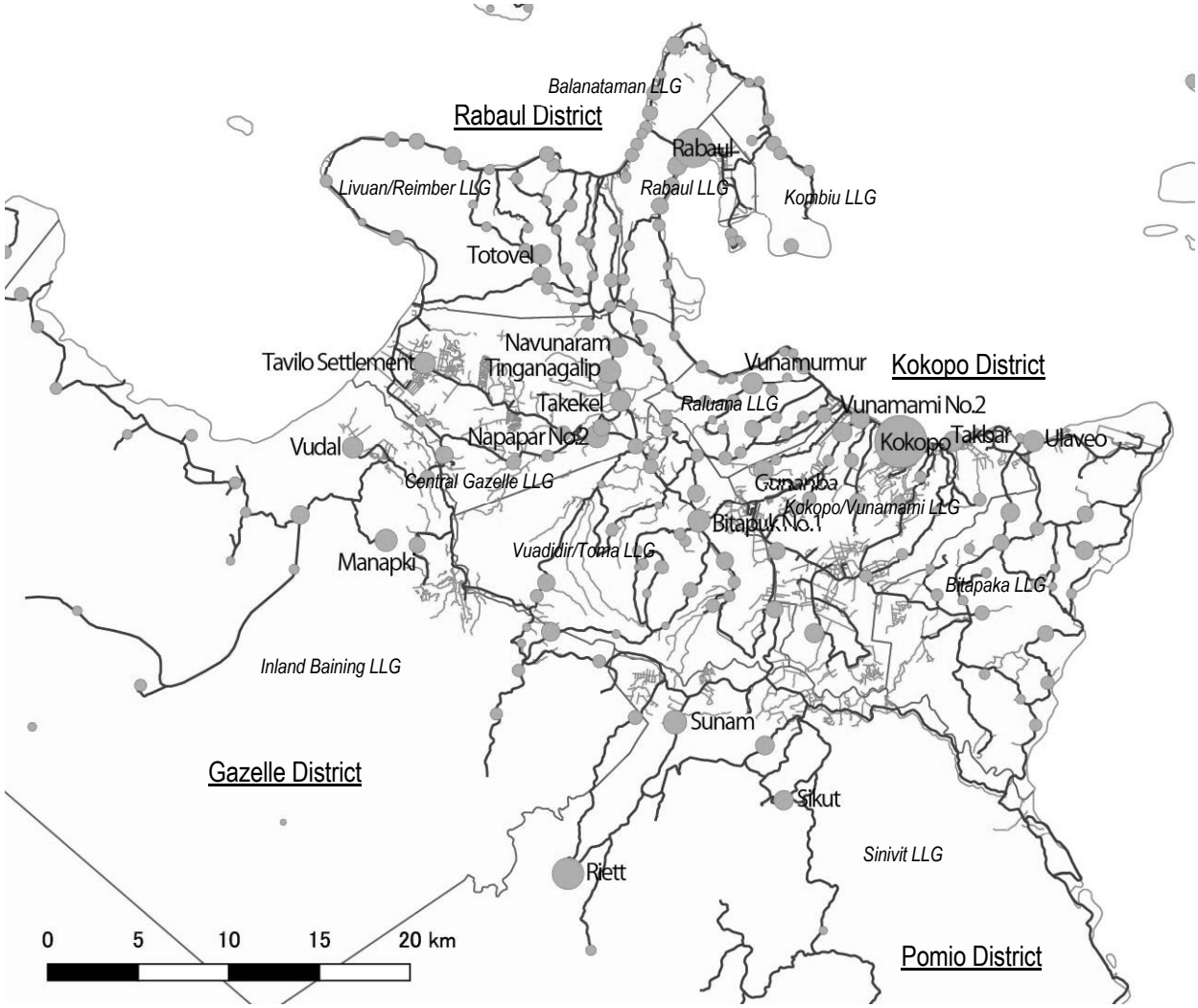
In 2000, the two largest wards were Rabaul Town and Kokopo Town with respective populations between 3,900 and 4,500. There were three other wards with relatively larger populations of more than 2,100, namely: Vunamami Ward and Gelagela Resettlement in Kokopo/Vunamami Urban LLG and Sikut Resettlement in Pomio District. (See Figure 9.1.2.) These wards are major resettlement areas of residents affected by the volcanic eruption in 1994.

Source: Ian Scales, 2010, *Roads in Gazelle Peninsula Development –Impact of Roads in the Post-Eruption Economic Landscape of East New Britain*

Figure 9.1.2 Population Distribution in Northeast Gazelle Peninsula in 2000

Between 2000 and 2011, the population in Northeast Gazelle Peninsula increased by approximately 63,000. The population had increased not only in the urban areas of Kokopo and Rabaul, but in general, across the Northeast Gazelle Peninsula. In 2011, Kokopo Town was the ward with the largest population of 6,677, followed by Rabaul Town with a population of 4,785.

The number of settlements with population of more than 1,500 had increased from 10 settlements in 2000 to 35 settlements in 2011. The settlements with population larger than 2,000, besides Kokopo Town and Rabaul Town, were the following: Tinganagalip Ward, Napapar No.2 Ward, Tavilo Settlement in Central Gazelle Rural LLG, Bitakapuk No.1 Ward in Vunadidir/Toma Rural LLG, Totovel Ward in Livuan/Reimber Rural LLG, Vunamami No.2 Ward, Takbar, and Gunamba Ward in Kokopo/Vunamami Urban LLG, Vunamurmur Ward in Raluana Rural LLG, and Ulaveo Ward in Bitapaka Rural LLG. There were also large settlements just outside the Project Area, namely: Riett Ward, Sunam Ward and Sikut Ward in Pomio District; and Vudal Ward and Manapki Ward in Gazelle District. (See Figure 9.1.3 and Table 9.1.1.)



Note: The red lines were roads wider than 5 metres in 2019.
Source: JICA Expert Team, based on Population and Housing Census 2011 and GIS data from ENBPA

Figure 9.1.3 Population Distribution in Northeast Gazelle Peninsula in 2011

Table 9.1.1 Wards with Population Larger than 2,000 in Northeast Gazelle Peninsula in 2011

Ward	LLG	District	Population
Kokopo Town	Kokopo/Vunamami Urban	Kokopo	6,677
Rabaul Town	Rabaul Urban	Rabaul	4,785
Tinganagalip	Central Gazelle	Gazelle	2,579
Napapar No.2	Central Gazelle	Gazelle	2,527
Bitakapuk No.1	Vunadidir/Toma Rural	Gazelle	2,426
Tavilo Settlement	Central Gazelle	Gazelle	2,368
Vunamumur	Raluana Rural	Kokopo	2,314
Takekel	Central Gazelle	Gazelle	2,275
Ulaveo	Bitapaka Rural	Kokopo	2,256
Takubar	Kokopo/Vunamami Urban	Kokopo	2,118
Vunamami No.2	Kokopo/Vunamami Urban	Kokopo	2,095
Gunanba	Kokopo/Vunamami Urban	Kokopo	2,090
Totovel	Livuan/Reimber Rural	Gazelle	2,081
Navunaram	Central Gazelle	Gazelle	2,010

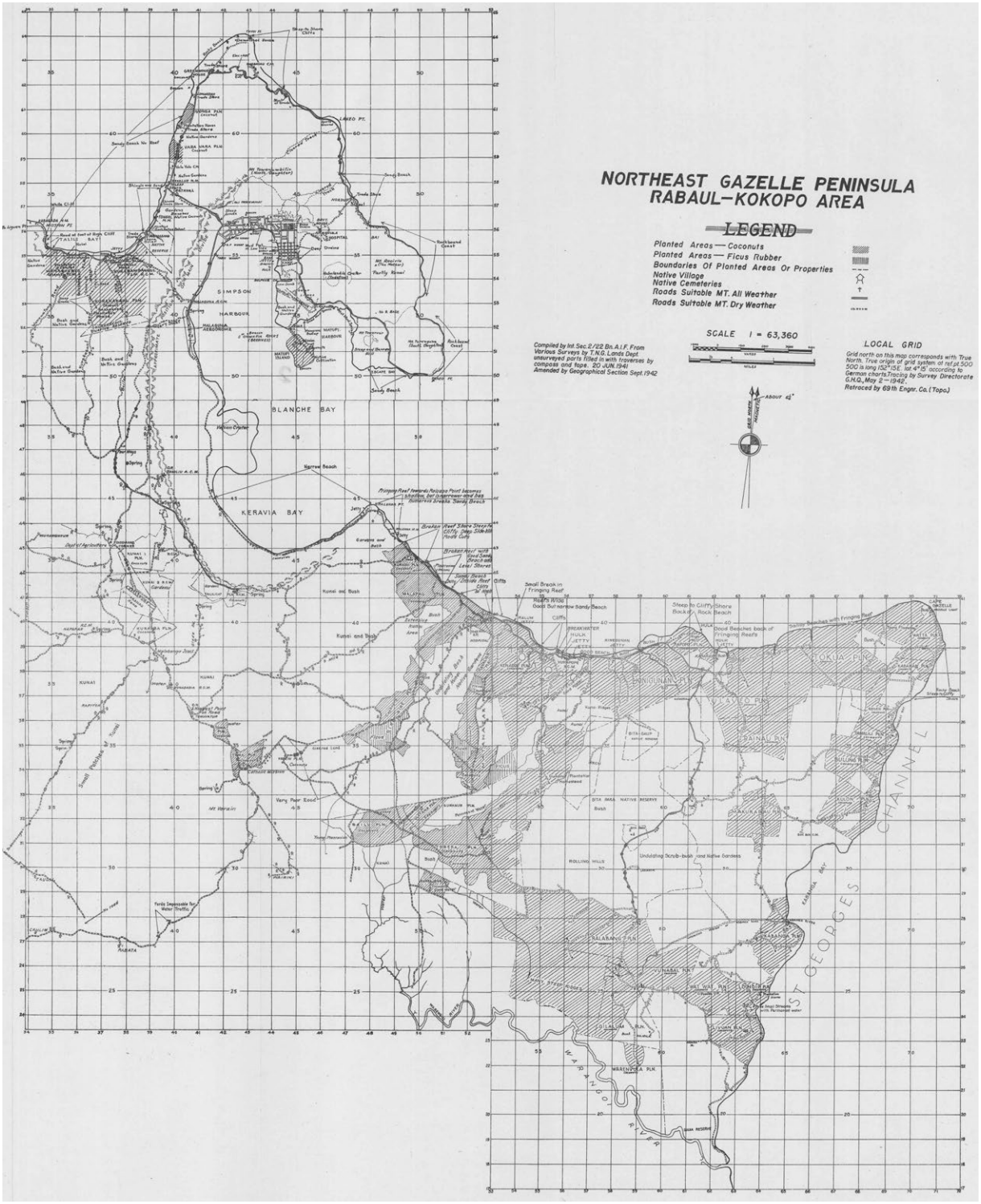
Source: NSO, 2011 National Population and Housing Census Ward Population Profile

9.1.2 Historical Changes in Land Use

In the 19th century, the Germans occupied the northeastern part of New Guinea Island and the other islands such as New Britain Island and New Ireland Island. Until 1899, the German New Guinea Company controlled these territories mainly for plantation development. During this period, coconut plantations were developed in Northeast Gazelle Peninsula. In 1899, the German New Guinea Company relinquished control of its territories to the German Colonial Empire. The administrative headquarters was first established in Kokopo, but was shifted to Rabaul, which became the capital of the German New Guinea. In the late 19th century, the Roman Catholic Church also introduced Christianity to indigenous people, in particular, to the Tolais. The Roman Catholic Church also acquired customary land and started developing plantations in Northeast Gazelle Peninsula.

By the beginning of 20th century, some of the plantation lands were divided and transferred to the Tolai smallholders, and some Tolais also began to invest in cacao plantation.

During the First World War in 1914, Australia occupied Northeast Gazelle Peninsula and, subsequently, occupied the remaining German territories including the New Guinea mainland and New Ireland. The area which was known as German New Guinea became the Territory of New Guinea, administrated by the Australian Government. Rabaul remained as the national capital until 1937. By 1942, when the Japanese military occupied this area, plantations expanded to areas shown in Figure 9.1.4 with all-weather roads covering Rabaul District and Kokopo Town, and also connecting Kokopo with the surrounding plantations.



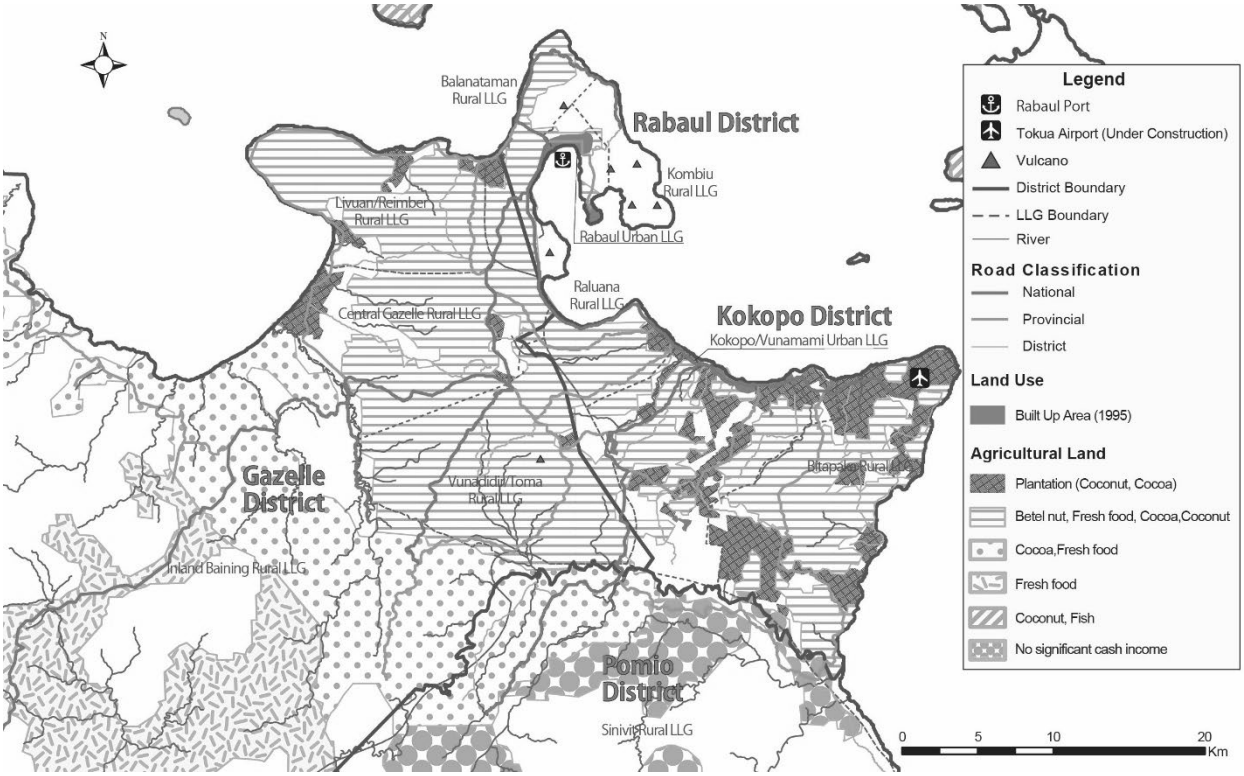
Source: Allied Geographical Service, 1942, "Allied Geographical Section Soutwest Pacific Area Terrain Study No. 22: Area Study of Gazelle Peninsula and Rabaul"

Figure 9.1.4 Coconut and Rubber Plantations in Northeast Gazelle Peninsula in 1941

In the late 20th century, most lands in the Northeast Gazelle Peninsula were arable lands with some lands still remaining as plantations. Most of the arable lands were utilised for mixed cropping cacao, coconut and food crops.

While in Northeast Gazelle Peninsula, most mixed croppings were combination of cacao, coconut, vegetables and betel nut, in Inland Baining Rural LLG and Sinivit Rural LLG, mixed croppings were combination of cacao and vegetables. (See Figure 9.1.5.) Built-up areas were limited to

Rabaul Town, Matupit Settlement south of Rabaul, some parts of Kokopo Town and Kerevat Town, and small areas on the coast.

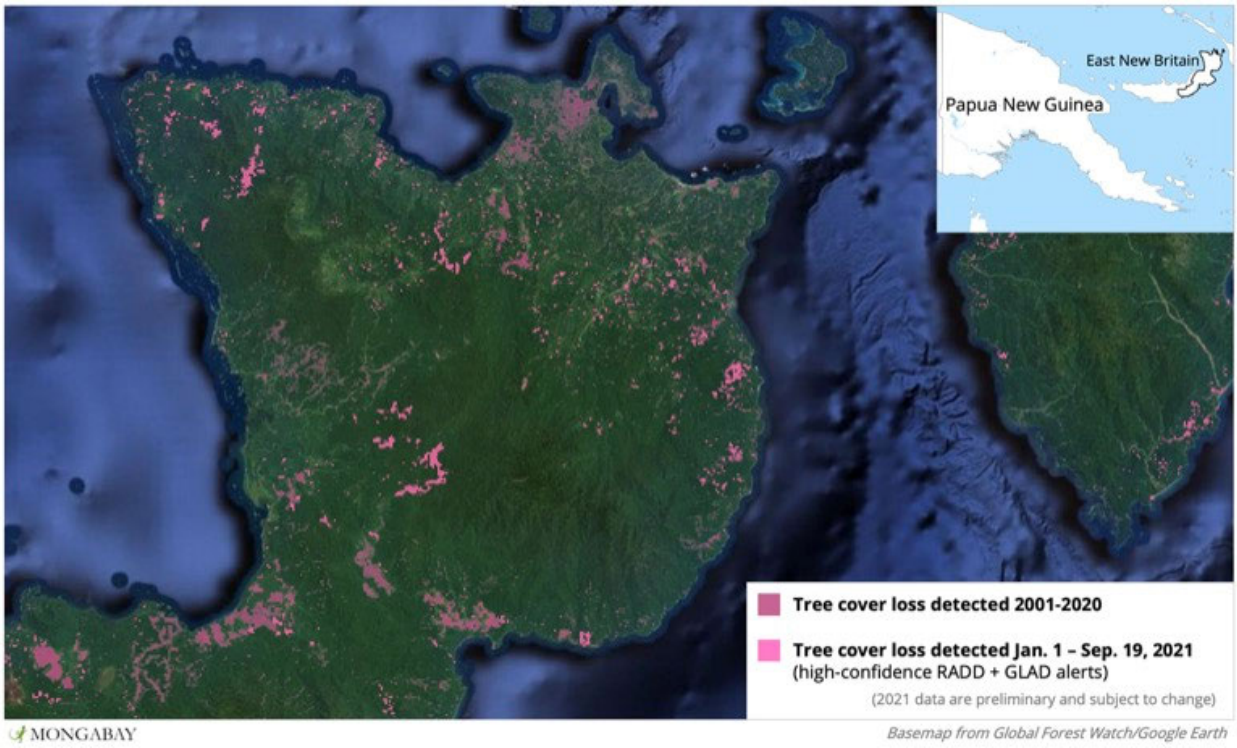


Source: JICA Expert Team, based on the following references: Allied Geographical Service, 1942, "Allied Geographical Section Soutwest Pacific Area Terrain Study No. 22: Area Study of Gazelle Peninsula and Rabaul"; R.M. Bouke, et al., 2002, "Agricultural Systems of Papua New Guinea Working Paper No. 14: East New Britain Province Text Summaries, Maps, Codes, Lists and Village Identification, Australian Agency for International Development; and National Mapping Bureau, 1:50,000 Topographic Survey Map Produced for the Gazelle Restoration Authority (aerial photography taken between December 1995 to May 1996)

Figure 9.1.5 Land Use in Northeast Gazelle Peninsula in 1995

Households in the peri-urban areas have diverse economic activities with farm and nonfarm incomes. In such households, many members work in nearby town or sell their farm products in the market in the town, while growing crops in home areas.

However, the areas which were considered rural in 2010 already had settlements with relatively large populations as described in Figure 9.1.3. Furthermore, areas with tree cover in 2001 had lost the trees, and considered to have been converted to farmlands, built-up areas, etc., as shown in Figure 9.1.6.

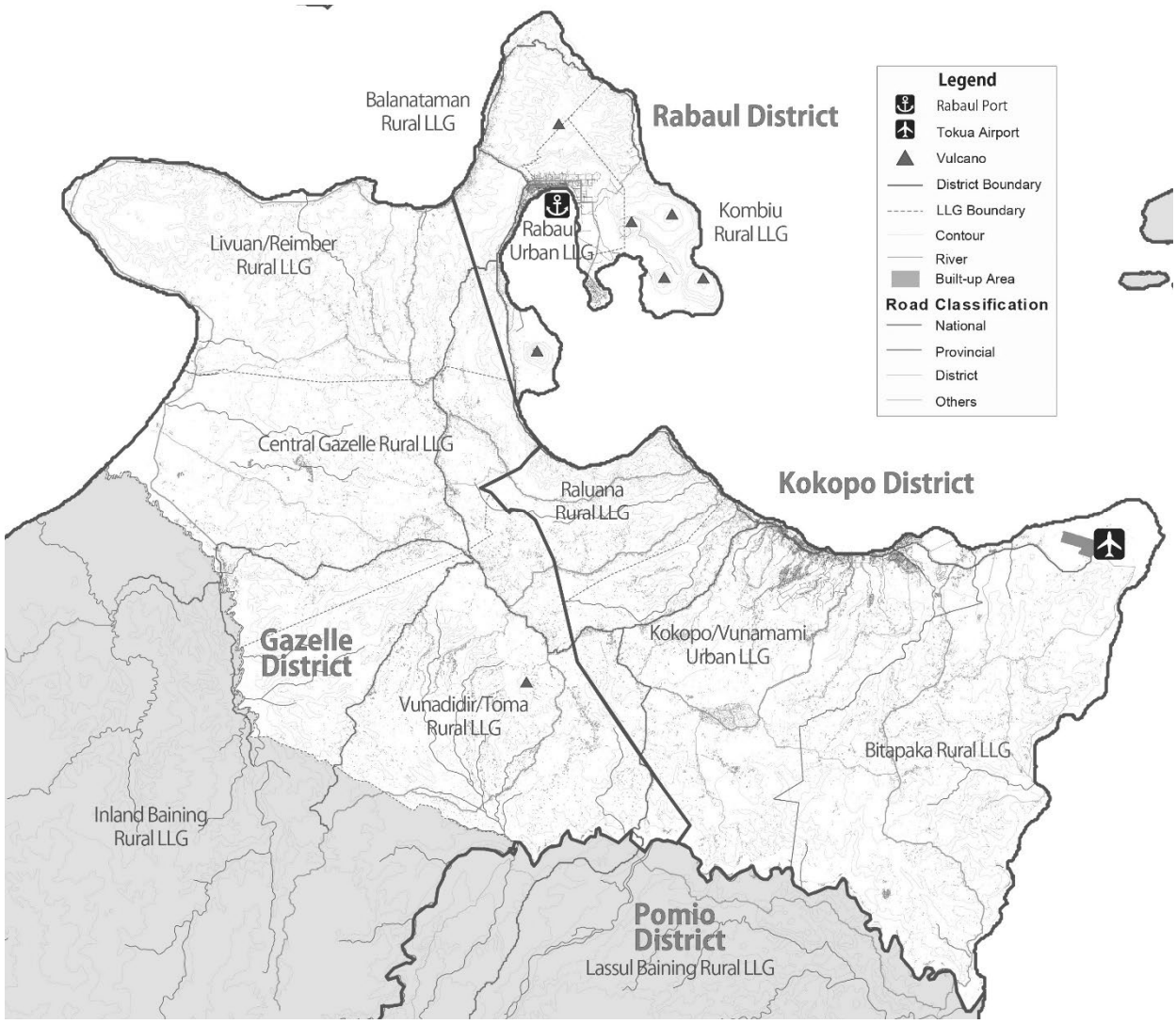


Source: https://news.mongabay.com/2021/10/deforestation-notches-up-along-logging-roads-on-pngs-new-britain-island/

Figure 9.1.6 Tree Cover Loss in Gazelle Peninsula, 2001-2020

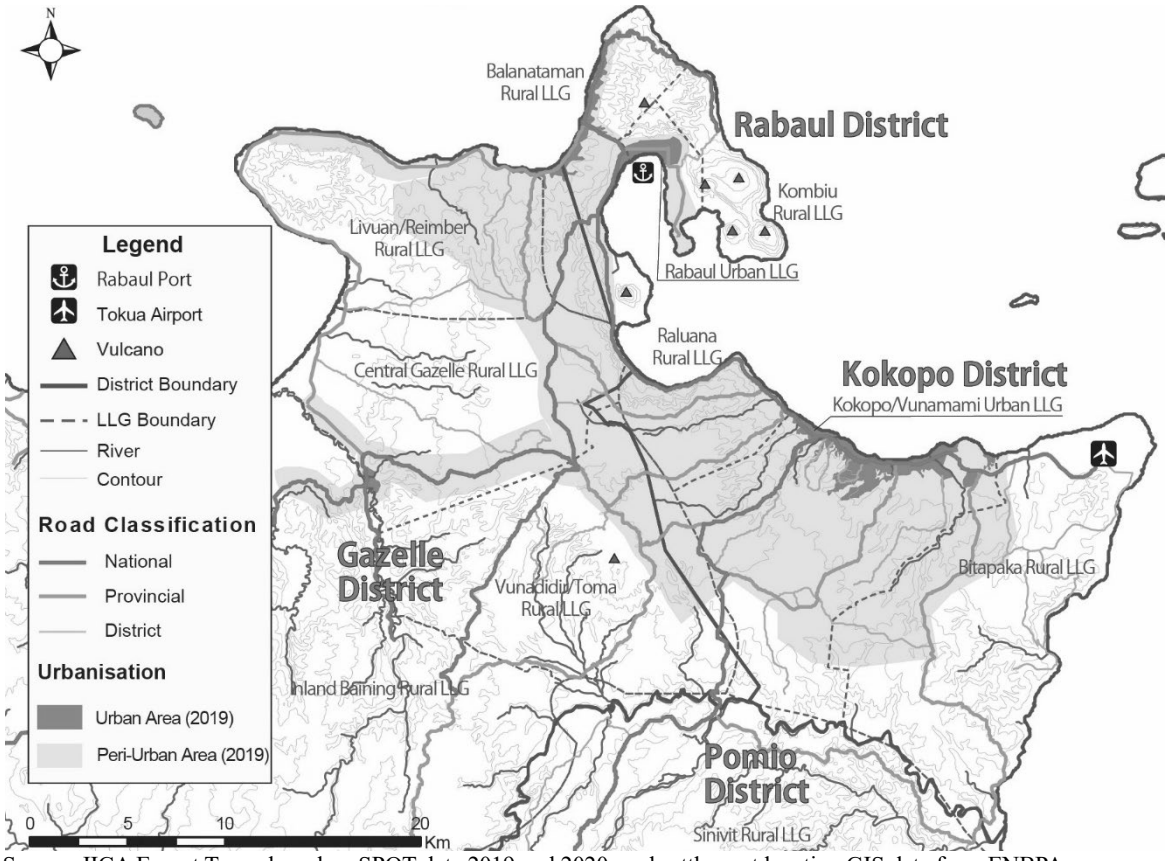
Since 1995, the built-up areas in Northeast Gazelle Peninsula had expanded, especially in Kokopo Town, which became the provincial capital; in the west coastal area between Nonga and Ratung, which accommodated relocated people; and in Kurakakaul, where the Rabaul District administration office was moved after the volcanic eruption in 1994. Besides these areas, most areas along the trunk roads and feeder roads in Northeast Gazelle Peninsula are now built up, including Kerevat, the capital of Gazelle District; and Ulaveo located between Kokopo Town and Tokua Airport. (See Figure 9.1.7.) Ulaveo is the industrial area in Northeast Gazelle Peninsula. The three district capital cities (Kokopo, Rabaul and Kerevat) are located approximately 30 km from each other by road.

While urbanised areas in Northeast Gazelle Peninsula are still limited in size and location as described above, peri-urban areas have spread widely in surrounding areas of urbanised areas and penetrated gradually the rural areas, as shown in Figure 9.1.8.



Source: JICA Expert Team, based on SPOT data 2019 and 2020

Figure 9.1.7 Built-Up Areas in Northeast Gazelle Peninsula in 2019



Source: JICA Expert Team, based on SPOT data 2019 and 2020; and settlement location GIS data from ENBPA

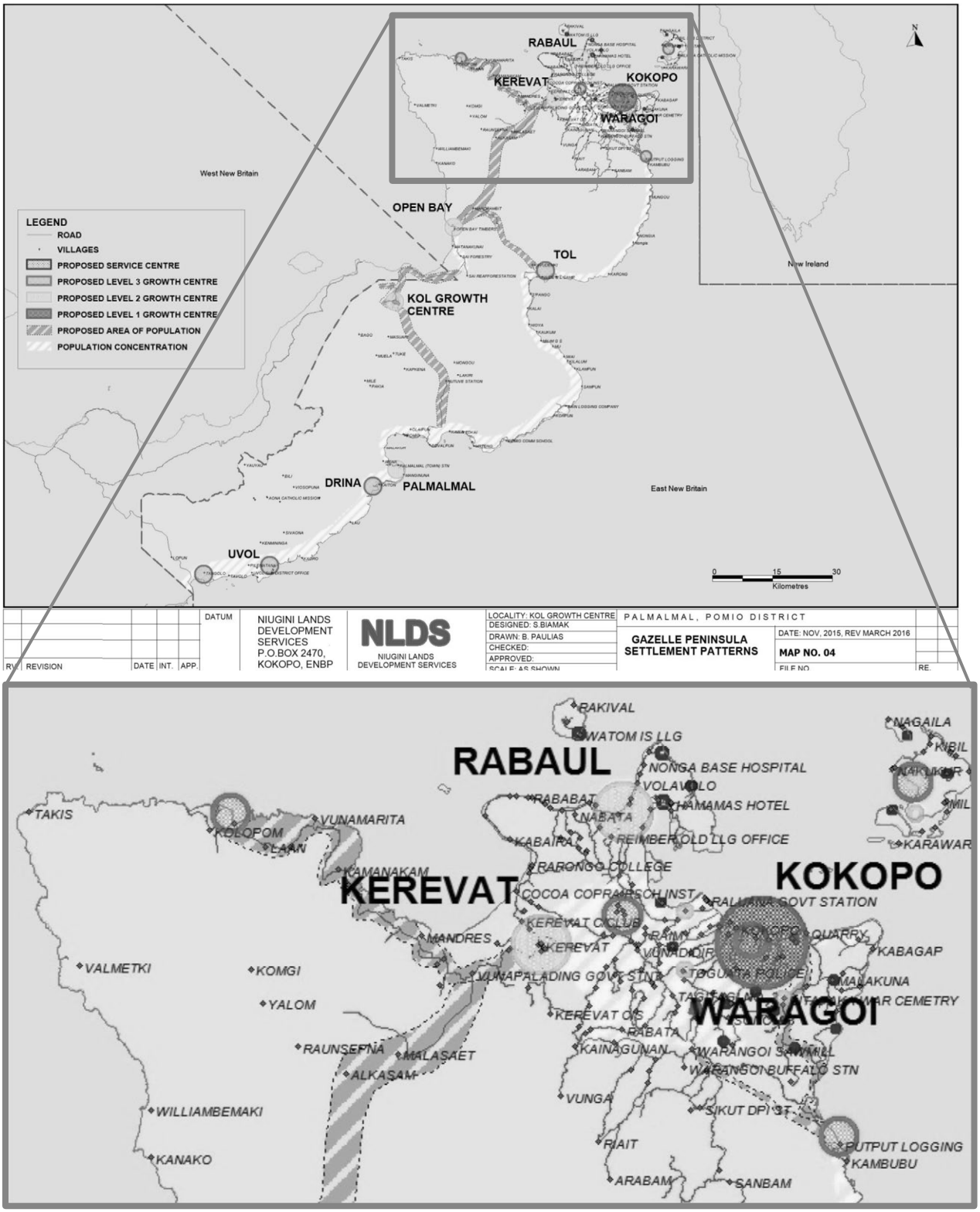
Figure 9.1.8 Urban Areas and Peri-Urban Areas in Northeast Gazelle Peninsula in 2019

9.1.3 Revised Growth Centres 2016

In 2016, the growth centres proposed in the Urban and Regional Plan 2002 were reviewed, and as a result, covered the Pomio District in the plan area. The revision was made when the Urban Development Plan for Palmalmal, the district capital of Pomio District, was formulated. This was done in order to understand the urban characteristics of Palmalmal in the regional context of the province. See Figure 9.1.9.

In Pomio District, Kol and Palmalmal were selected as Level 2 Growth Centres; and Putput, Tol, Drina, Uvol and Tangolo as Level 3 Growth Centres.

For the other three districts, the hierarchy for Level 1 and Level 2 Growth Centres remains the same as in 2004. On the other hand, nineteen (19) Level 3 Growth Centres proposed in 2004 plan have been reviewed, and three centres were selected, namely: Rakunai (Central Gazelle Rural LLG), Lassul Bay (Lassul Baining Rural LLG) and Kumaina (Duke of York Rural LLG). See Table 9.1.2.



Source: Niugini Lands Development Services, 2016, Gazelle Peninsula Settlement Patterns

Figure 9.1.9 Revised Growth Centres in ENBP and Northeast Gazelle Peninsula 2016

Table 9.1.2 Revised Growth Centres in Gazelle Peninsula and ENBP

District	Level 1	Level 2	Level 3	
Kokopo	Kokopo Urban		Kumaina	
Gazelle		Kerevat Open Bay	Rakunai Lassul Bay	
Rabaul		Kurakakaul	Rabaul	
Pomio		Kol Palmalmal	Putput Tol Drina	Uvol Tangolo

Source: JICA Expert Team, based on Niugini Lands Development Services, 2016, Gazelle Peninsula Settlement Patterns

9.2 Objectives for Transforming the Regional Spatial Structure of Northeast Gazelle Peninsula

The objectives for transforming the regional spatial structure of Northeast Gazelle Peninsula region are as follows:

- To enhance disaster resilience of wide areas of the region by strategically selecting a location of a central port for Northeast Gazelle Peninsula and implementing the port relocation in a phased manner for reducing disaster risks, and by upgrading trunk roads in accordance with the transformed regional spatial structure
- To fully utilise wide areas of the territory and marine resources for strategically promoting the development of economic sectors in the region by establishing an extensive and upgraded network of trunk roads
- To establish growth areas consisting of government administrative functions, commercial and service functions, and manufacturing functions by providing urban infrastructures (urban roads, power supply and water supply facilities)
- To develop service centres to provide public services in a balanced way covering wide areas of the region

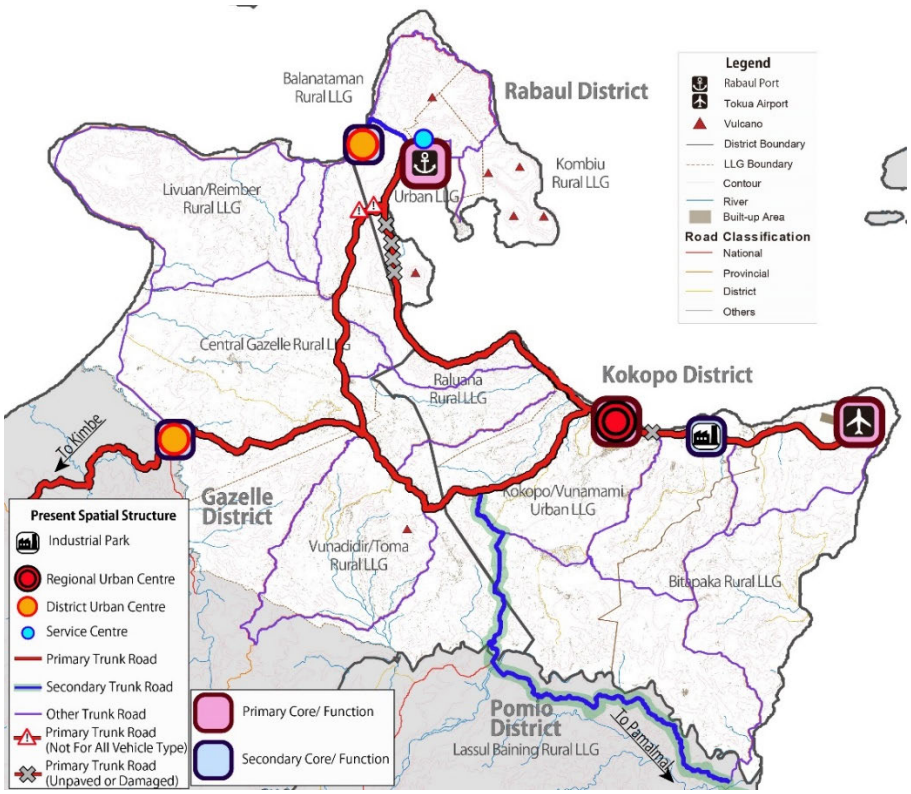
In this chapter, the future regional spatial structure is presented for the super long term. Moreover, the phased transformation plan for regional spatial structure is also discussed and presented. This plan is essential to guide the phased development of regional and urban infrastructures in Northeast Gazelle Peninsula.

9.3 Future Regional Spatial Structure of Northeast Gazelle Peninsula

9.3.1 Factors in Preparing Regional Spatial Structure

The present regional spatial structure (spatial pattern) of Northeast Gazelle Peninsula is drawn in Figure 9.3.1 by using regional gateways (port and airport), urban centres, as well as trunk roads.

Since Kokopo is not only the provincial capital of ENBP, but also the regional capital of Islands Region, it is a primary-level urban centre in Northeast Gazelle Peninsula. Rabaul Port and Tokua Airport are major inter-regional gateways with primary functions for serving the surrounding island provinces in Islands Region. Therefore, they should be considered as of the same grade as primary-level centres. These primary centres should be connected by primary trunk roads. However, the coastal road connecting Rabaul Port and Kokopo Town is partly not paved and damaged. Moreover, although an alternative road to the Kokopo-Rabaul Coastal Road was constructed, with the support of AusAID, inland to connect Rabaul Port and Kokopo Town, the inland road has a narrow and winding portion of steep slope.



Source: JICA Expert Team

Figure 9.3.1 Present Regional Spatial Structure of Northeast Gazelle Peninsula

The locations of inter-regional gateways (port and airport) and primary urban centres are also important factors in formulating the future regional spatial structure of Northeast Gazelle Peninsula. The location and the grade of these primary gateways and primary urban centres are important factors to determine the present and future regional spatial structure.

The grades of urban centres used in the future regional spatial structure are the following:

- Primary Urban Centre: Urban centre functioning as the regional and provincial administration capital with main commercial function
- Secondary Urban Centre: Urban centre with the function of district administration centre and some commercial functions
- Commercial Centre: Urban centre with major commercial function
- Service Centre: Centre with markets, shops, and other public facilities (schools and clinics)

In order to select the locations and grades of gateways (ports and airports) and urban centres, other factors such as redundancy, utilisation of land, and natural environment protection as tourism resources should be considered due to the characteristics of the region described in Section 4.1.

The regional spatial structure for Northeast Gazelle Peninsula for the target year 2032 was done, by first preparing regional spatial structure targeting 2052 as a super long-term spatial structure. This is because, a 10-year period is not long enough to consider changes in the spatial structure.

The super long-term regional spatial structure is prepared by assuming that necessary strategies for achieving the above development vision will be implemented in order. Therefore, the regional spatial structures for 2032 and 2042 are important milestones for achieving the regional future vision.

The future spatial structure is also formulated by considering the development of new planned SEZs, Gazelle Agro-Industry SEZ and Rabaul Tuna Export Processing Zone (or SEZ). The development of these SEZs will enable three regional growth areas to develop in Northeast Gazelle Peninsula: Kokopo Growth Area, Rabaul Growth Area and Kerevat Growth Area.

9.3.2 Future Regional Spatial Structures for Super Long Term

(1) Three Alternative Spatial Structures for Super Long Term

Three alternative spatial structures are prepared for the super long term for Northeast Gazelle Peninsula. How inter-provincial gateways (port and airport), urban centres and growth areas are laid out in each spatial structure are described in Table 9.3.1.

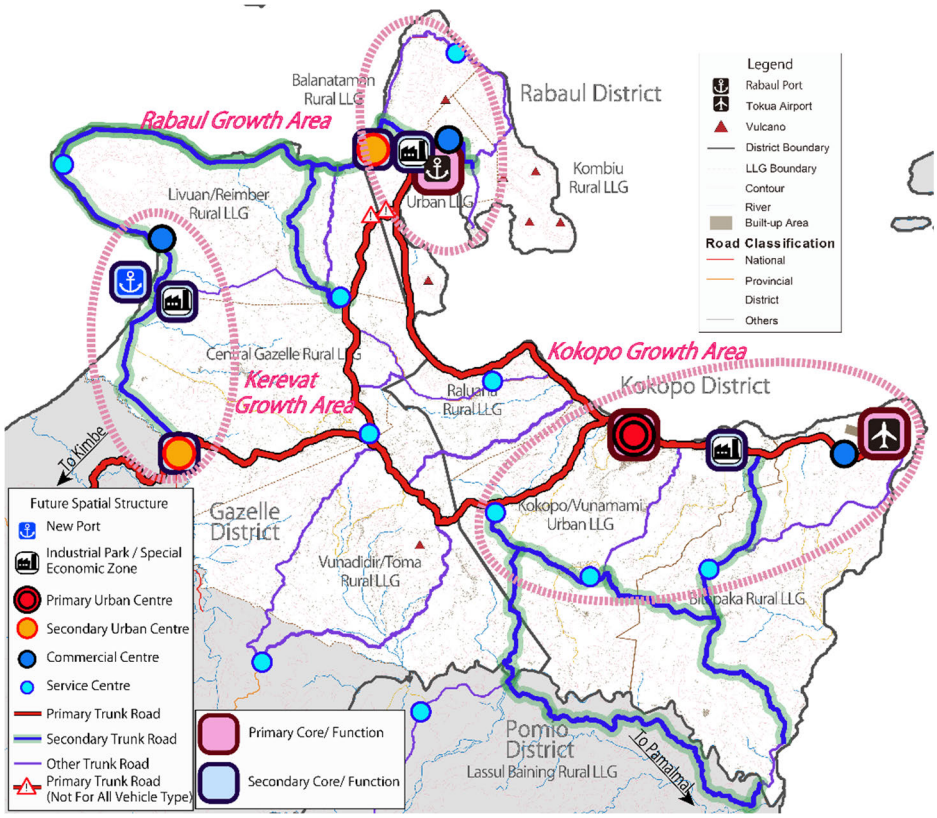
Table 9.3.1 Infrastructure, Gateways and Urban Centres in Alternative Regional Spatial Structures for the Super Long Term (2052)

	Regional Spatial Structure 1	Regional Spatial Structure 2	Regional Spatial Structure 3
Ports	• Rabaul Port will be rehabilitated and upgraded, and continue to function as the main regional port. • A new port is developed at Ataliklikun Bay (in Gazelle District) as an alternative port of Rabaul Port. The new port will function as a port for SEZ and alternative port while Rabaul Port is not functional (due to volcanic eruptions, etc.)	• Rabaul Port will be rehabilitated, and part of the port function (handling bulk fuel, cruise ship calls, and fishing reefer ship calls) will remain in Rabaul. However, the main port function of handling container cargo and bulk cargo will be shifted to a new port. • A new container port will be developed at Kabakaul in Kokopo District.	• Rabaul Port will be rehabilitated, but its main port function will be shifted to a new port, while it will continue to function as the cruise ship terminal and fishing port. • The new port will be developed at Ataliklikun Bay (in Gazelle District) as an alternative port of Rabaul Port by 2042 and will be used as the port for SEZ and alternative port while Rabaul Port is not functional. However, Rabaul Port will continue to have the risk of being affected by volcanic eruptions. Therefore, the new port will be further developed to become the main port, with the main port function of handling container cargo, bulk cargo and bulk fuel will be shifted to Ataliklikun Bay.
Airports	• Tokua Airport will be upgraded and continue to function both as international and domestic airport.	• Tokua Airport will be upgraded and continue to function both as international and domestic airport.	• Tokua Airport will be upgraded and continue to function both as international and domestic airport.
Trunk Roads	• The coastal road between Kokopo and Rabaul will be rehabilitated by putting proper drainage, and necessary structure will be constructed in the road side slopes to reduce risks of landslide. • The road between Kurakakaul and Tokarongon Junction is upgraded to a secondary trunk road so that Rabaul Port is accessible from all areas of the region, even immediately after volcanic eruptions. • The road between Kerevat and a new port at Ataliklikun Bay will be upgraded to a secondary trunk road to access the new port. • The North Coast Road between Kurakakaul and Kabaira (in Ataliklikun Bay) will be upgraded to a secondary trunk road. • The road from Toma Junction to Tokua Airport via Bitapaka will be upgraded to a secondary trunk road.	• The road between Kerevat and new port at Ataliklikun Bay will be upgraded to a secondary trunk road. • The road from Toma Junction to Tokua Airport via Bitapaka is upgraded to a secondary trunk road. • The road between Bitapaka and Ulaveo is upgraded to a secondary trunk road. • The road between Gelagela and Vunapope is upgraded to a secondary trunk road. • The coastal road between Kokopo and Rabaul will become a secondary trunk road. It is because Rabaul Port is classified as the Secondary Gateway. In response, the main port function is shifted to the new port in Kokopo Area.	• The road between Kurakakaul and Tokarongon Junction is upgraded to a secondary trunk road so that Rabaul Town is accessible during volcanic eruptions. • The road between Kerevat and new port at Ataliklikun Bay will be upgraded to a primary trunk road to access the new container port. • The coastal road between Kurakakaul and new port at Ataliklikun Bay will be upgraded to a secondary trunk road. The road between Tokarongon Junction and new port will be upgraded to a secondary trunk road. • The road from Toma Junction to Tokua Airport via Bitapaka is upgraded to a secondary trunk road. • The coastal road between Kokopo and Rabaul will become a secondary trunk road.

Primary Urban Centre, Secondary Urban Centre, Commercial Centre and Growth Area	• Kokopo Town is a Primary Urban Centre since it is the provincial capital town. Kurakakaul and Kerevat Town are Secondary Urban Centres. • Commercial centres will be developed at Rabaul, Tokua and Kabaira, one in each growth area. • In each Growth Area, there will be an airport or seaport.	• Kokopo Town is a Primary Urban Centre since it is the provincial capital town. Kurakakaul and Kerevat Town are Secondary Urban Centres. • Commercial centres will be developed at Rabaul, Tokua and Ulaveo. • Commercialcentres will be developed at Rabaul, Tokua, and Kabaira. • The regional port and airport are concentrated in Kopopo Growth Area.	• Kokopo Town is a Primary Urban Centre. Kurakakaul and Kerevat Town are Secondary Urban Centres. • Commercial centres will be developed at Rabaul, Tokua and Kabaira, one in each growth area. • In each Growth Area, there will be an airport or seaport.

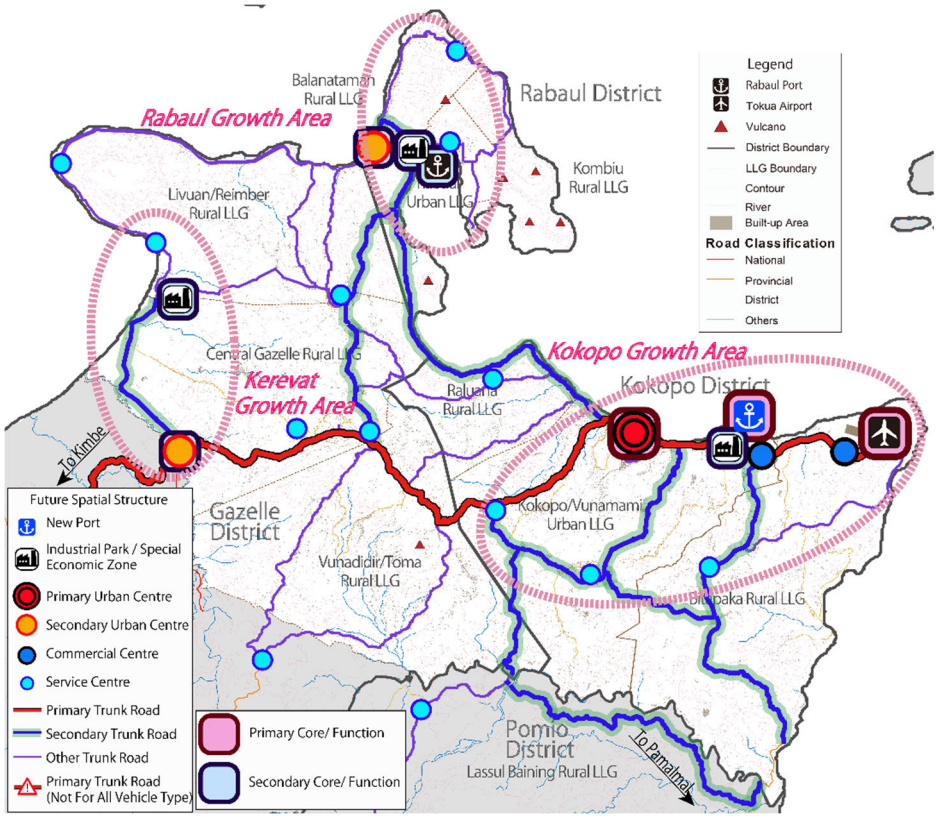
Source: JICA Expert Team

The alternative future regional spatial structures for super long term are shown in Figure 9.3.2, Figure 9.3.3 and Figure 9.3.4.



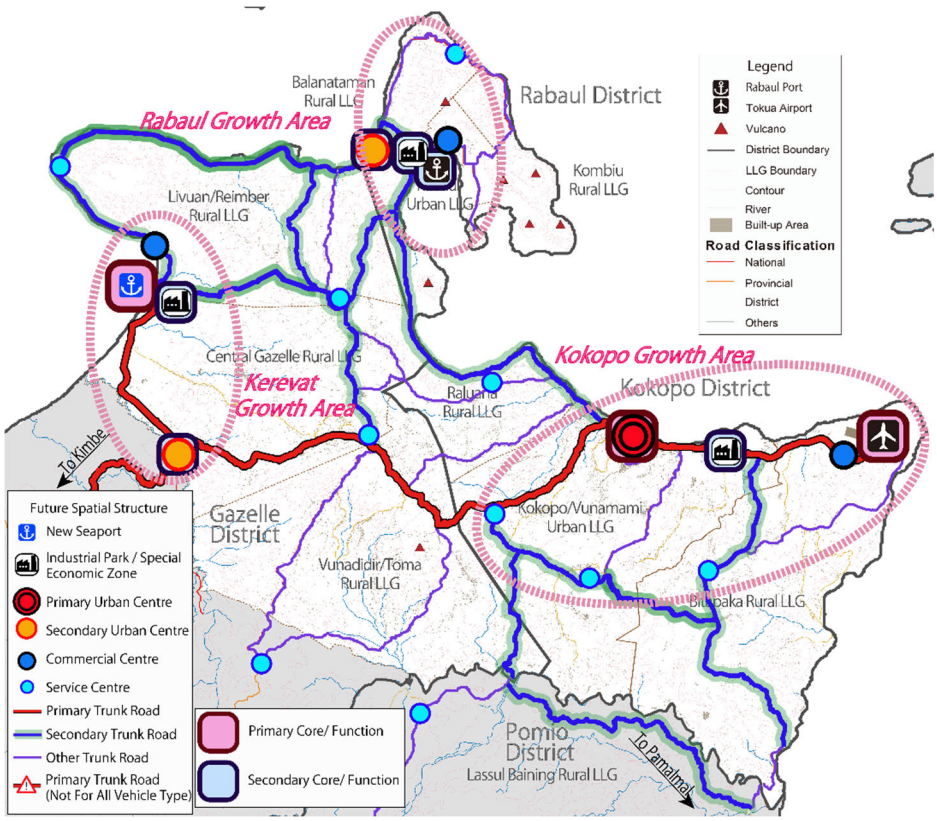
Source: JICA Expert Team

Figure 9.3.2 Future Regional Spatial Structure (2052) of Northeast Gazelle Peninsula for the Super Long Term: Regional Spatial Structure 1



Source: JICA Expert Team

Figure 9.3.3 Future Regional Spatial Structure (2052) of Northeast Gazelle Peninsula for the Super Long Term: Regional Spatial Structure 2



Source: JICA Expert Team

Figure 9.3.4 Future Regional Spatial Structure (2052) of Northeast Gazelle Peninsula for the Super Long Term: Regional Spatial Structure 3

(2) Selected Spatial Structure for the Super Long Term (2052): Spatial Structure 3

Among the three alternatives of regional spatial structures, Regional Spatial Structure 3 is proposed as the best option for Regional Spatial Structure 2052.

The NEGID-Plan formulation project is conducting an SEA study in parallel with the planning process, which is a comparative evaluation of three very long-term regional spatial development scenario alternatives from economic, spatial, social and environmental perspectives. See Table 20.4.1, 'Evaluation of regional spatial development scenario alternatives'.

Regional Spatial Structure 3 was selected for the following reasons:

- The three growth areas will be developed in a well-balanced way compared to the other two structures and will help the region to grow most efficiently with the most secondary roads developed.
- The new port is in a quiet harbour and is safe from waves and wind and has less risk of being affected by volcanic eruptions. The new port for the industry will also be away from Kokopo, where resort hotels are located.

Regional Spatial Structure 1 was eliminated for the following reason:

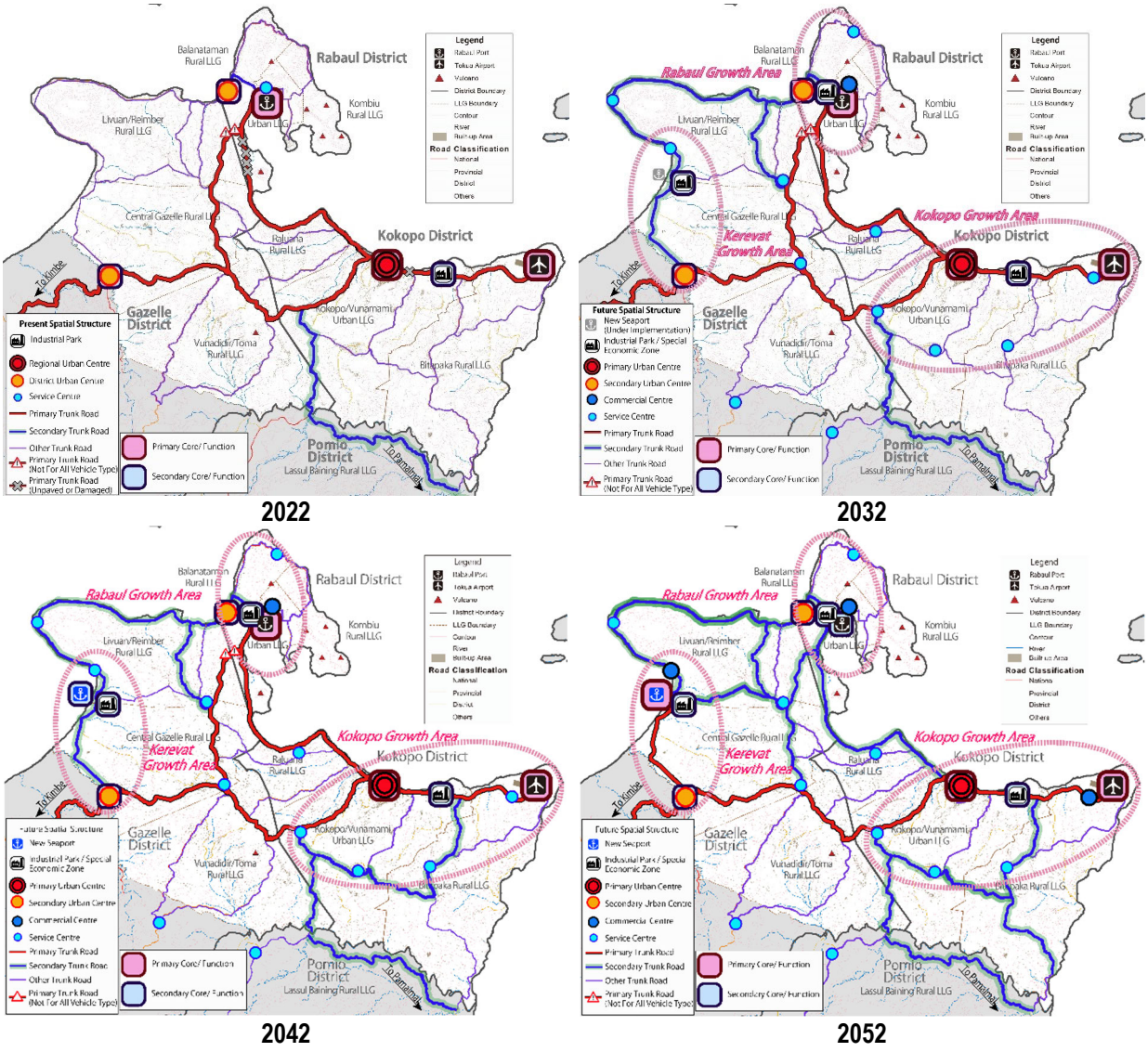
- It will be costly for ENBPA not only to upgrade the coastal road between Kokopo and Rabaul which connects the primary urban centre and Rabaul Port (i.e., by taking mitigation structures to reduce risks of landslide disasters), but also to continue maintaining them.

Regional Spatial Structure 2 was eliminated for the following reasons:

- Kokopo's new harbour could pose a negative impact to the marine environment around Kokopo, which is known as a breeding ground for dolphins.
- The new port at Kokopo may have risk of ships not being able to access the port due to strong wind and waves.
- The construction of the new port at Kokopo may cause a negative impact on the marine environment around the area, which is known as dolphins' breeding place. There are also mangroves and coral reefs in this area, which is part of the resort tourist destination.
- The new container port in Kokopo, as well as Rabaul Port, is far from the Gazelle Agro-Industry SEZ in Ataliklikun Bay, which will be less attractive for investors.

(3) Phased Development Plan for the Selected Regional Spatial Structure 3

The phased development plan of the selected and proposed future Regional Spatial Structure 2052 (Regional Spatial Structure 3) is shown in Figure 9.3.5.



Source: JICA Expert Team

Figure 9.3.5 Phased Development Plan of Regional Spatial Structures for Northeast Gazelle Peninsula (Regional Spatial Development Scenario): Selected Spatial Structure 3

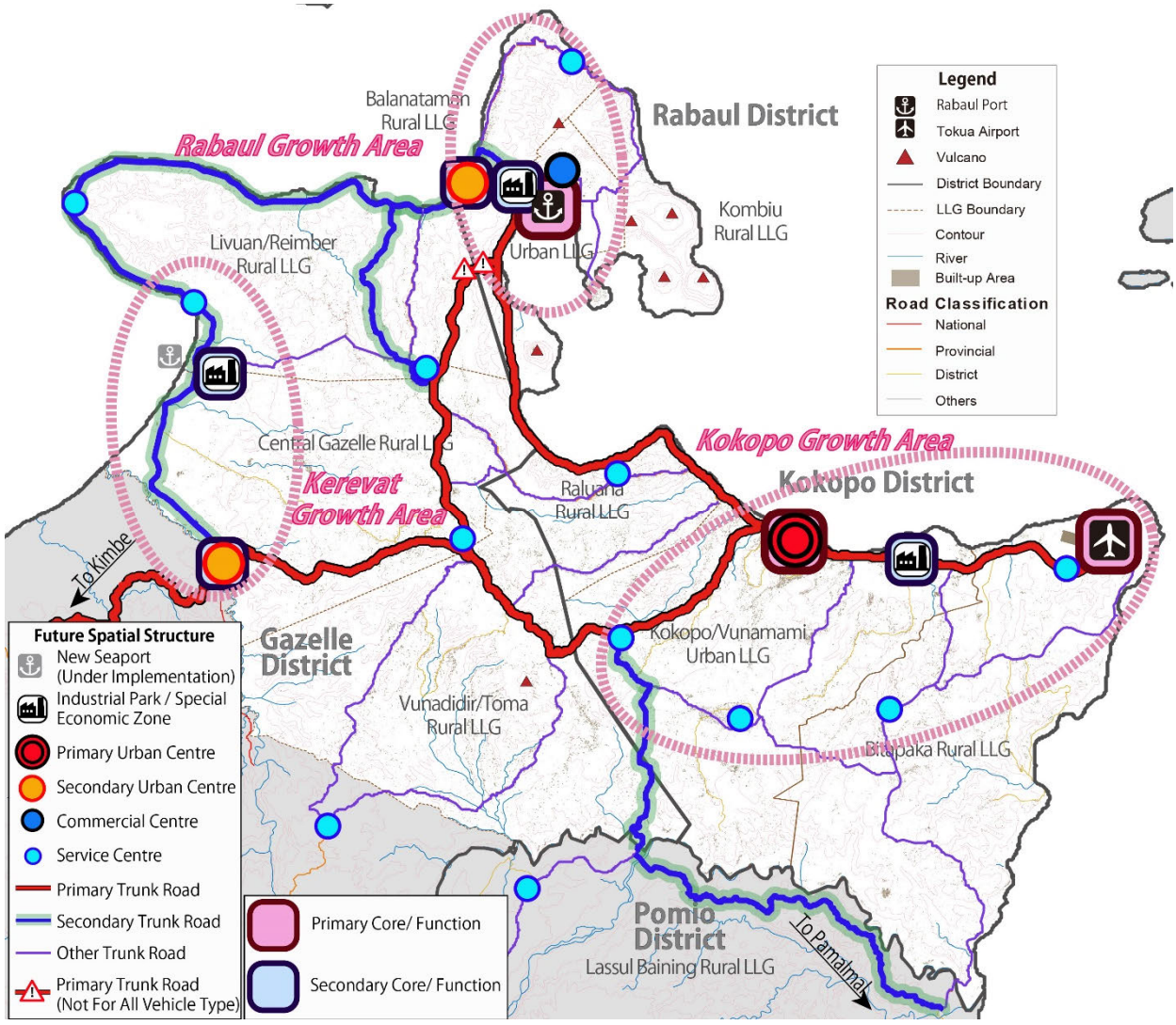
In 2032, Northeast Gazelle Peninsula is proposed to have the following new regional infrastructure:

- Rabaul Port will be upgraded to play the role as main port for the region at least for the next two decades.
- Preparation for the construction of the new port at Ataliklikun Bay will be conducted.
- Tokua Airport will be upgraded to accommodate international flights.
- Road connecting Kurakakaul- Tokarongon Junction will be upgraded as a Secondary Trunk Road.
- Road connecting Kabaira and Kerevat will be upgraded to a Secondary Trunk Road.
- Coastal road connecting Kokopo and Rabaul will be rehabilitated with proper drainage facilities.

Besides the above roads, the following centres and SEZs are proposed to be developed:

- Rabaul Town is developed as Commercial Centre.
- Tokua, Toma, Gelagela, Tokarongon, Kabaira and Rakuna will be developed as Service Centres.
- Rabaul Fish Export Processing Zone and Gazelle Agro-Industry SEZ will be developed.

The regional spatial structure for 2032 is shown in Figure 9.3.6.



Source: JICA Expert Team

Figure 9.3.6 Future Regional Spatial Structures (2032) of Northeast Gazelle Peninsula: Selected Regional Spatial Structure 3

Chapter 10 Present and Future Urban Areas in Northeast Gazelle Peninsula

10.1 Urban Characteristics

10.1.1 Urbanisation

The urban and rural populated areas of Northeast Gazelle Peninsula in year 2001 and year 2015 were comparatively analysed using Landsat data for these two years, which are available covering the region. Table 10.1.1 shows the result of the comparative analysis. Between 2001 and 2015, the developed areas (urban and rural populated areas) in Northeast Gazelle Peninsula increased more than two times from 18.90 km^2 to 43.55 km^2.

Table 10.1.1 Developed Areas in Northeast Gazelle Peninsula

District	LLG	Surface Area	Developed Area (Urban and Rural Populated Areas)			Growth Rate (2001-2015)
				2001	2015	
Kokopo District	Kokopo/Vunamami Urban LLG	148 km^2	Area (km^2)	5.48 km^2	11.82 km^2	5.65%
			Share (%)	3.7%	8.0%	-
	Raluana Rural LLG	41 km^2	Area (km^2)	1.25 km^2	3.23 km^2	7.00%
			Share (%)	3.1%	7.9%	-
	Bitapaka Rural LLG	162 km^2	Area (km^2)	1.52 km^2	6.53 km^2	10.96%
			Share (%)	0.9%	4.0%	-
Rabaul District	Rabaul Urban LLG	12 km^2	Area (km^2)	1.03 km^2	1.80 km^2	4.09%
			Share (%)	8.5%	14.9%	-
	Kombiu Rural LLG	29 km^2	Area (km^2)	0.45 km^2	0.62 km^2	2.41%
			Share (%)	1.6%	2.2%	-
	Balantataman Rural LLG	42 km^2	Area (km^2)	2.61 km^2	3.23 km^2	1.54%
			Share (%)	6.2%	7.7%	-
Gazelle District	Central Gazelle Rural LLG	134 km^2	Area (km^2)	2.09 km^2	6.63 km^2	8.58%
			Share (%)	1.6%	4.9%	-
	Livuan/Reimber Rural LLG	123 km^2	Area (km^2)	2.27 km^2	5.25 km2	6.17%
			Share (%)	1.8%	4.3%	-
	Vunadidir/Toma Rural LLG	150 km^2	Area (km^2)	2.20 km^2	4.44 km^2	5.14%
			Share (%)	1.5%	3.0%	-
Northeast Gazelle Peninsula		841 km^2	Area (km^2)	18.90 km^2	43.55 km^2	6.15%
			Share (%)	2.2%	5.2%	-

Source: JICA Expert Team, based on Landsat data. 2015 data – LANDSAT 8 OLI, USGS (https://earthexplorer.usgs.gov/) acquired on 2015-09-21 and 2001 data – LANDSAT 7 ETM, USGS (https://earthexplorer.usgs.gov/) acquired on 2001-06-01.

Based on the analysis, around one-fourth of the developed areas (urban and rural populated areas) in Northeast Gazelle Peninsula, which is 11.82 km^2, is in Kokopo / Vunamami Urban LLG. This is followed by the developed areas in Central Gazelle Rural LLG and Bitapaka Rural LLG which are 6.63 km^2 and 6.53 km^2, respectively. In Central Gazelle Rural LLG, Kerevat, the district capital of Gazelle District, and the area along the New Britain Highway are the areas mainly developed.

In Bitapaka Rural LLG, Tokua Airport and its surrounding area, and the road between Kokopo Town and the airport, are the areas mainly developed.

The high share of developed areas in Northeast Gazelle Peninsula is seen in Rabaul Urban LLG with 14.9% of its surface area developed, followed by Kokopo / Vunamami Urban LLG and Raluana Rural LLG with 8% and 7.9% of their surface areas developed, respectively.

The LLGs which had increased the area of development the most between 2001 and 2015 were Kokopo / Vunamami Urban LLG (increase of 6.34 km^2), Bitapaka Rural LLG (increase of 5.01 km^2) and Central Gazelle Rural LLG (increase of 4.54 km^2), contributing to 64% of the increase of the developed area in Northeast Gazelle Peninsula. The large increase of the development area in Kokopo / Vunamami Urban LLG was due to the relocation of the provincial capital, and the centre of services shifting from Rabaul Town to Kokopo Town after the volcanic eruption. The increase in Central Gazelle Rural LLG may be due to the development of the new road by AusAID, connecting Rabaul and Kokopo (so-called Top Road).

On the other hand, the LLGs which had the highest annual growth rate of developed area between 2001 and 2015 were Bitapaka Rural LLG (10.96% growth annually), Central Gazelle Rural LLG (8.58% growth annually) and Raluana Rural LLG (7.00% growth annually). Both Bitapaka Rural LLG and Raluana Rural LLG are in Kokopo District, so the shift of provincial capital may have caused this growth.

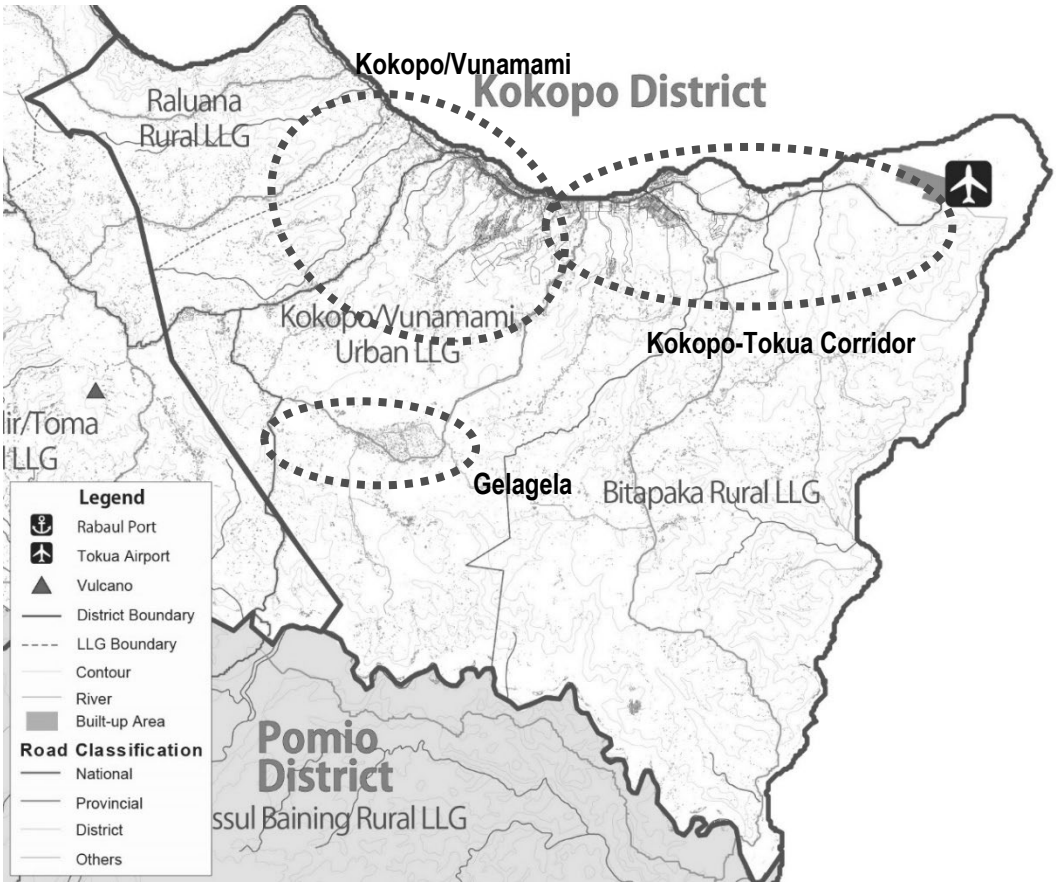
10.1.2 Urban Spatial Structure

The present built-up areas in Northeast Gazelle Peninsula are identified using the SPOT data of 2019 and 2020.

The characteristics of areas which were identified as built-up areas in each district are as summarised below. The built-up areas are shown in Figure 10.1.1, Figure 10.1.2 and Figure 10.1.3.

(1) Kokopo District

In Kokopo District, after the provincial capital moved from Rabaul to Kokopo, the urban area expanded especially in the surrounding area of Kokopo Town and along the Kokopo-Tokua Corridor. In addition, the Gelagela resettlement site, which accommodated people who evacuated from Rabaul District after the volcanic eruption in 1994, has become one of the major built-up areas in Kokopo District.



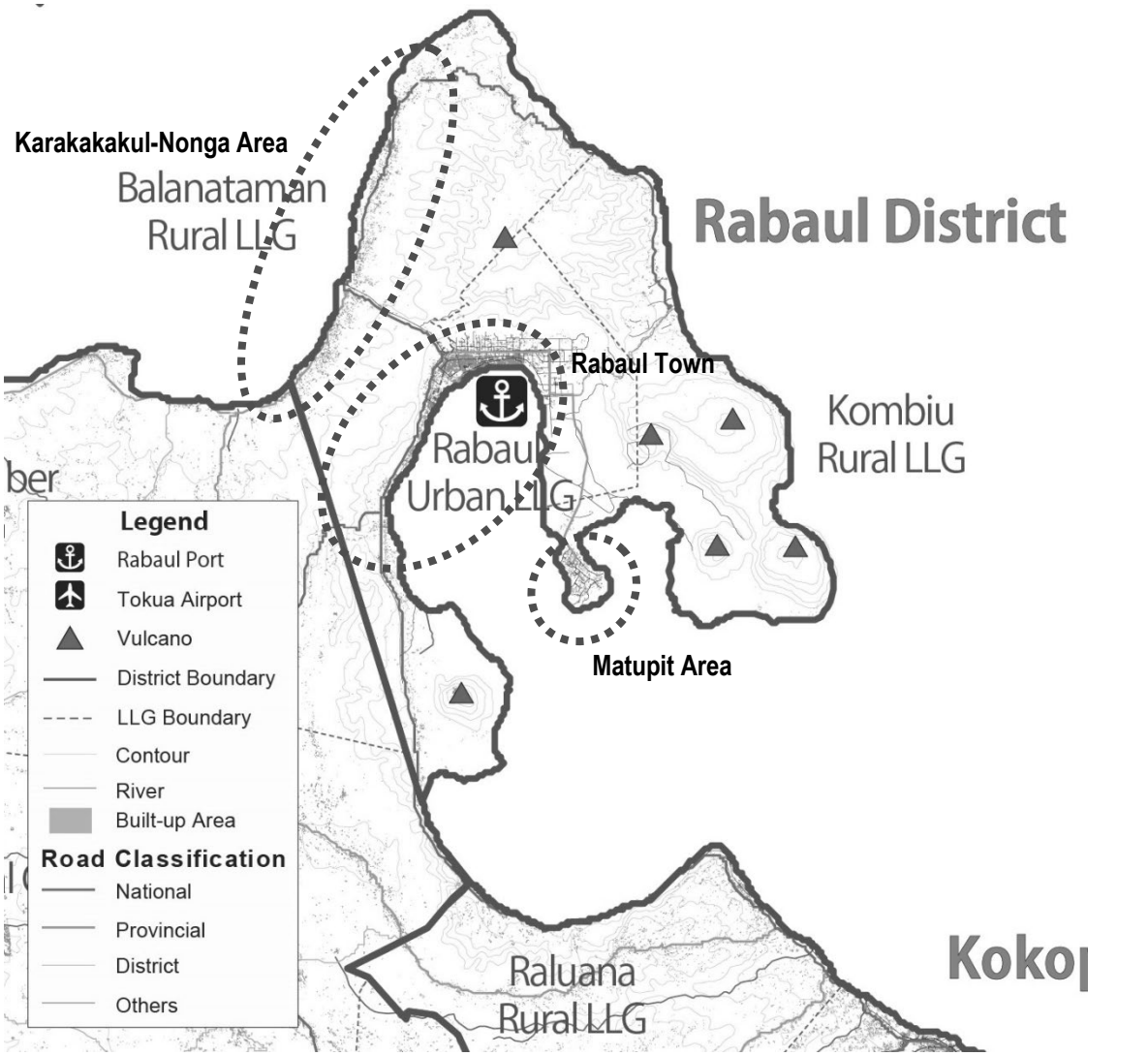
Note: The JICA Expert Team for NEGID-Plan prepared a base map for Northeast Gazelle Peninsula using satellite image, SPOT taken in years 2019 and 2020. The district boundaries shown in the map are based on the data from the National Mapping Bureau (NMB), Papua New Gunia. However, there are some disparities between NMB's district boundaries and actual village boundaries within each district in Northeast Gaelle Peninsula. In the base map, the LLG boundaries prepared by ENBPA are adjusted to match the district boundaries.
Source: JICA Expert Team, based on SPOT data of 2019 and 2020

Figure 10.1.1 Built-Up Areas (Urban and Rural Populated Areas) in the Three LLGs of Kokopo District (2019)

(2) Rabaul District

Out of the three LLGs of Rabaul District in the Northeast Gazelle Peninsula, Rabaul Urban LLG is the only urban LLG. After the provincial capital moved from Rabaul to Kokopo, the urban area shifted from the eastern part of Rabaul Urban LLG, which was affected by the volcanic ashes, to the west and south towards Kokopo along Kokopo-Rabaul Coastal Road. Also, since the district administration office was relocated to Kurakakakul in the west, the urbanisation occurred to the south of Nonga, where the provincial hospital is located.

Matupit area has also developed in the past decades. Although this area is close to the volcano, fortunately, it was not affected by the volcanic ashes in 1994 due to the wind direction. Therefore, most of the residents in this village did not wish to be relocated or are coming back again to settle.



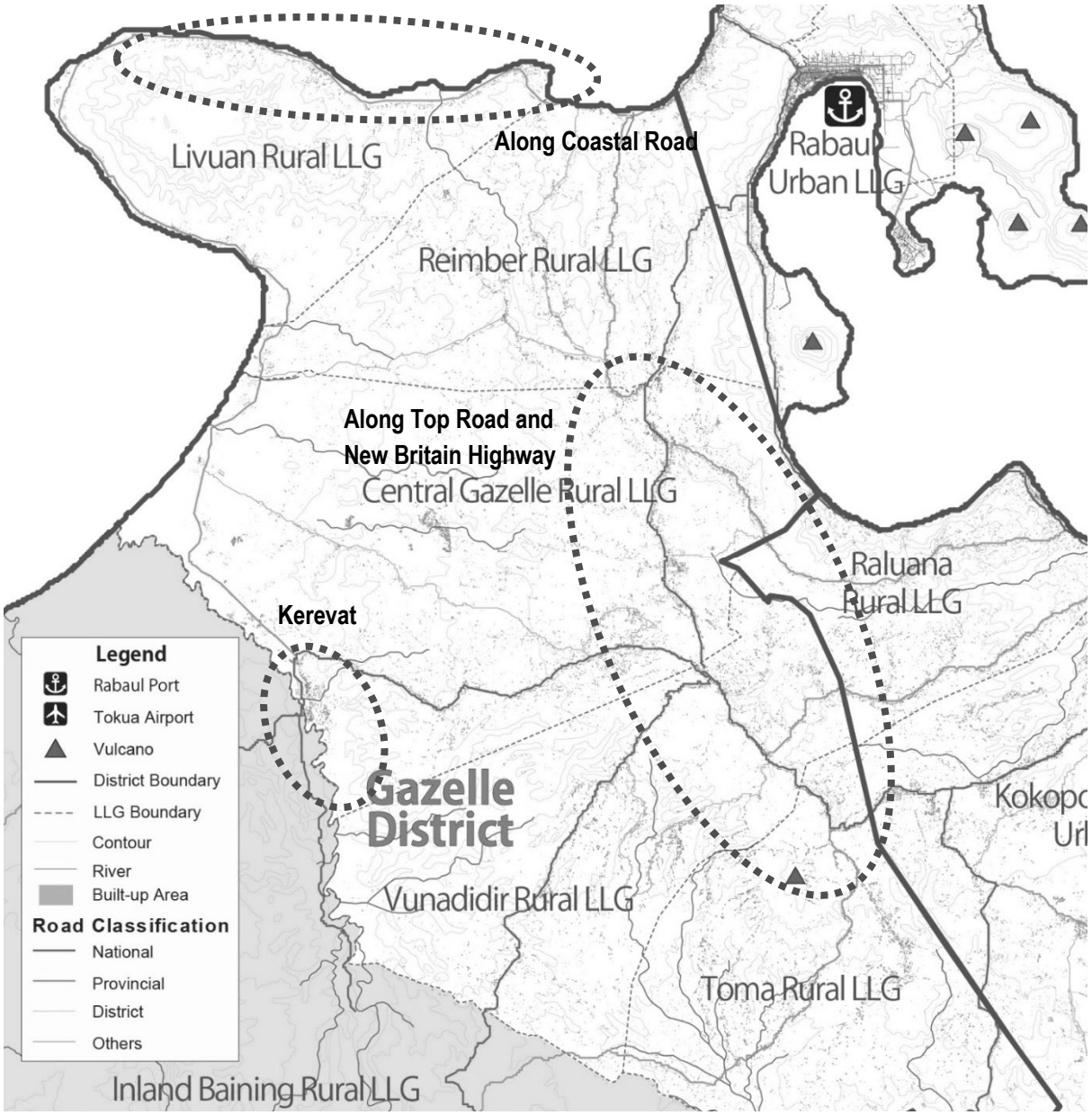
Note: The JICA Expert Team for NEGID-Plan prepared a base map for Northeast Gazelle Peninsula using satellite image, SPOT taken in years 2019 and 2020. The district boundaries shown in the map are based on the data from the National Mapping Bureau (NMB), Papua New Gunia. However, there are some disparities between NMB's district boundaries and actual village boundaries within each district in Northeast Gaelle Peninsula. In the base map, the LLG boundaries prepared by ENBPA are adjusted to match the district boundaries.
Source: JICA Expert Team based on SPOT data 2019 and 2020

Figure 10.1.2 Built-Up Areas (Urban and Rural Populated Areas) in the Three LLGs of Rabaul District (2019)

(3) Gazelle District

The main urbanised area in Gazelle District is within Kerevat Town. In addition, as explained in the previous section, due to the implementation of the new road connecting Rabaul and Kokopo which goes through the three LLGs of Gazelle District in Northeast Gazelle Peninsula (Top Road), the development has been occurring along this road and the road connecting to Kerevat.

In addition, although the extent of development is not as much as the other areas, some developments are emerging along the Northern Coastal Road from Kurakakaul towards Ataliklikun Bay.



Note: The JICA Expert Team for NEGID-Plan prepared a base map for Northeast Gazelle Peninsula using satellite image, SPOT taken in years 2019 and 2020. The district boundaries shown in the map are based on the data from the National Mapping Bureau (NMB), Papua New Gunia. However, there are some disparities between NMB's district boundaries and actual village boundaries within each district in Northeast Gaelle Peninsula. In the base map, the LLG boundaries prepared by ENBPA are adjusted to match the district boundaries.
Source: JICA Expert Team based on SPOT data 2019 and 2020

Figure 10.1.3 Built-Up Areas in the Three LLGs of Gazelle District (2019)

10.2 Review of Existing Urban Development Plans in East New Britain Province (ENBP)

10.2.1 Rabaul Interim Urban Plan

(1) Background

Rabaul Urban Development Plan (RUDP) was one of the important plans that Rabaul needed after the 1994 volcanic eruption. The formulation of this plan provided various strategic options for future urban development. However, since it was announced that the consultant would be engaged to assess the hazards in Rabaul, the Rabaul Urban Development Plan Steering Committee decided

to prepare an interim plan as a short-term plan. The Rabaul Interim Urban Plan was formulated in 1996 to assist the ENBP Physical Planning Board in reaching planning decisions under pressure for the restoration and development in Rabaul.

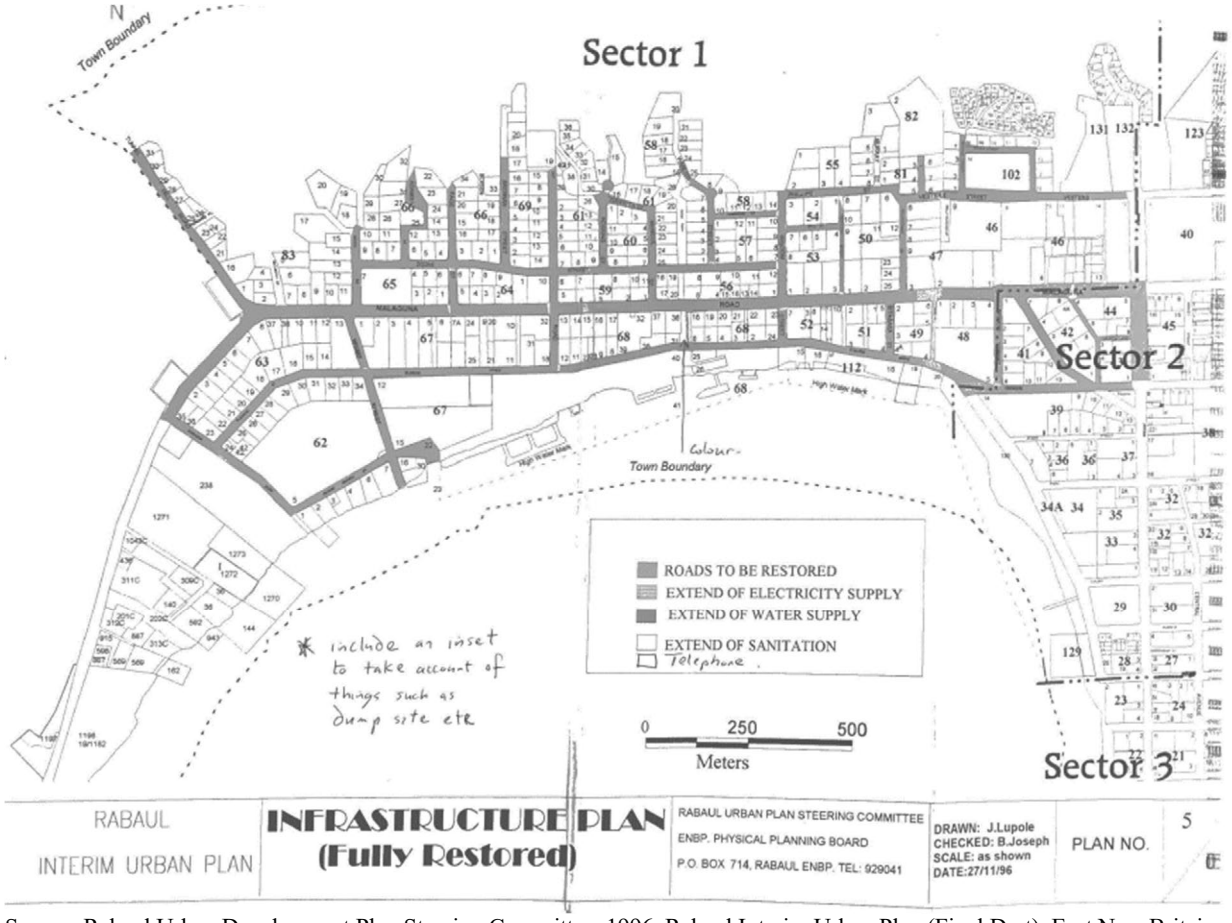
(2) Policies

A long-term role of Rabaul was recommended by the National Physical Planning Board, the East New Britain Provincial Physical Planning Board and Gazelle Restoration Authority (GRA). This role comprised of the following:

- The principal port of New Guinea Islands Regions with port-related activities, especially businesses
- A tourist centre
- A leisure and recreation centre for residents of Northeast Gazelle Peninsula
- A commercial centre for nearby undamaged and restored villages
- A limited residential area, with ancillary facilities, in support of these activities

It was also agreed by the three authorities that it is necessary to limit the population size of the future town of Rabaul, and the amount of investment in building and infrastructure development to minimize the risks to human life and resources when the next disaster occurs.

The Interim Urban Development Plan restricts against any proposals for restoration, development or redevelopment in Sectors 2 and 3 of the town until the overall Rabaul Urban Development Plan would be finalised and approved. However, premises which did not suffer serious damage and which had already been restored in Sectors 2 and 3 prior to the formulation of the Interim Urban Development Plan, were allowed to remain at the owner's risk.



Source: Rabaul Urban Development Plan Steering Committee, 1996, Rabaul Interim Urban Plan (Final Drat), East New Britain Provincial Physical Planning Board

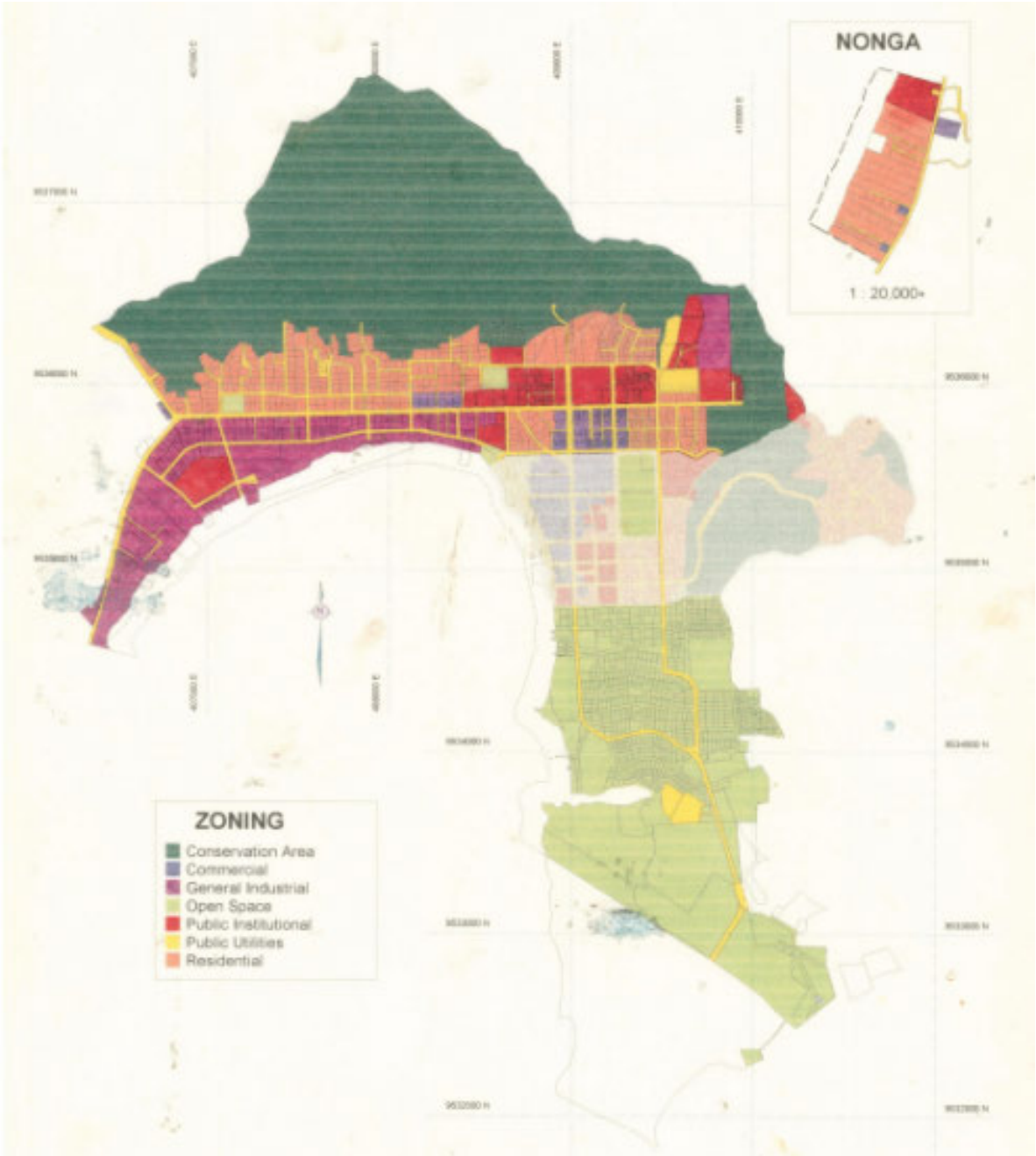
Figure 10.2.1 Sectors 1, 2, and 3 in Rabaul Town, 1996

(3) Zoning Plan

The zoning proposal in the Interim Plan was for the Sector 1 of Rabaul Town. The Sector 3 was determined to become open space. (See Figure 10.2.2.)

There are seven zones in the land use plan as listed below.

- Conservation Area
- Commercial
- General Industrial
- Open Space
- Public Institution
- Public Utilities
- Residential



Source: Rabaul Urban Development Plan Steering Committee, 1996, Rabaul Interim Urban Plan (Final Drat), East New Britain Provincial Physical Planning Board

Figure 10.2.2 Rabaul Zoning Plan (Stage 1), 1996

The southern area of Rabaul Urban LLG, which includes the area where the old Rabaul Airport was located, are designated as open space. With the conservation area and open space, the actual area which can be developed is limited in Rabaul Urban LLG.

10.2.2 Kokopo Urban Development Plan

(1) Background

Kokopo Urban Development Plan was formulated in 1995 by Cardno & Davies PNG Pty. Ltd and was approved by ENBPA.

Ten years before the 1994 volcanic eruption in 1984, a Rabaul Volcanic Eruption Preliminary Urban Planning Study was conducted. In this planning study, Kokopo/Vunapope and Tokua were identified as the preferred alternative urban centres to Rabaul. Therefore, the necessity of preparing an urban development plan for Kokopo was acknowledged before the volcanic eruption in 1994. This was due to the limited availability of developable land within and surrounding Rabual Town and the risk of hazards by future volcanic eruptions in Rabaul District. The tender process for the plan formulation study was already on-going when the volcano erupted. Unfortunately, the Terms of Reference (TOR) for the study was not revised to take into account the new and continuing problems presented by the volcano eruption.

(2) Objectives and Principles

In the Kokopo Urban Development Plan, the following seven objectives were set as the basis for the structure plan:

- To prevent or limit development within most significant areas of high landscape value
- To conserve the considerable natural beauty of the area in formulating future urban proposals
- To protect the primary and agricultural activities of the area
- To protect the recreation and tourist use of the coastal areas
- To conserve water supply resources
- To minimise public and private sector costs particularly those related to servicing and infrastructure
- To minimise all forms of pollution and the impact of development upon the environment.

The principles of formulating the structure plan were set as follows:

- To provide an effective and efficient transportation system appropriate to the density and distribution of uses.
- To ensure the efficient and convenient distribution of all land uses
- To designate land for the widest range of public facilities appropriate to the plan level
- To prohibit development within permanent flood liable areas
- To relate the future urban design and form to the drainage capabilities of the area to ensure acceptable limits of flooding.
- To ensure that the location of use zones does not contribute to pollution.
- To ensure that the form and scale of urban development does not give rise to pollution of existing waterways and water-bodies.
- To ensure a compatible range and intensity of use within areas of landscape value necessarily included in the designation of urban expansion areas.
- To provide a reasonable choice of residential accommodation in any future urban development.
- To achieve a high degree of economic and social self-containment for the area.
- To retain sufficient flexibility in the design of future urban areas to allow for unforseen intensification of any land use or communication link.

Based on the objectives and principles described above, necessary future land to 2015 by land use zones is calculated as shown in Table 10.2.1. The zone that is required to increase the most is the residential zone. It was increased from 10 ha in 1994 to 269.06 ha in 2015. It was followed by public institutional zone for education facilities and health facilities from 21.7 ha in 1994 to 253.4 ha in 2015, and commercial zone from 10 ha in 1994 to 159.19 ha in 2015.

Table 10.2.1 Future Land Requirement in Kokopo Urban Development Plan 1995

LAND USE ZONES	YEAR					
	1994 Exist	1995	2000	2005	2010	2015
COMMERCIAL	10ha	153ha	154.5ha	156.05ha	157.61ha	159.19ha
INDUSTRIAL	11.82ha	11.82ha	43ha	43.43ha	43.86ha	44.29ha
- General	11.82ha	11.82ha	43ha	43.43ha	43.86ha	44.29ha
PUBLIC UTILITIES		0.5ha	0.8ha	1.0ha	3.6ha	3.2ha
Population	3659*	10,000	14,800	18,500	23,100	28,900
OPEN SPACE	15ha	35ha	51.8ha	64.75ha	80.85ha	101.15ha
Town Centre	4ha	1ha	1.48ha	1.85ha	2.31ha	2.89ha
Community Sports Ground	5ha	25ha	34.6ha	37ha	46.20ha	57.80ha
Informal Parkland	6ha	14ha	20.72ha	25.90ha	32.34ha	40.46ha
RESIDENTIAL	10ha	93.10ha	137.79ha	172.24ha	215.06ha	269.06ha
PUBLIC INSTITUTIONAL	21.7ha	117.7ha	145.7ha	202.7ha	223.4ha	253.4ha
- Educational	20ha	116ha	144ha	164ha	184ha	214ha
. Community	4ha	15ha	19ha	23ha	27ha	33ha
. High School	16ha	48ha	64ha	80ha	96ha	120ha
. Tech School	-	30ha	38ha	38ha	38ha	38ha
. International School	-	2ha	2ha	2ha	2ha	2ha
. Secretarial School	-	20ha	20ha	20ha	20ha	20ha
. University Centre	-	1ha	1ha	1ha	1ha	1ha
- Health	1.7ha	1.7ha	1.7ha	38.7ha	39.4ha	39.4ha
. Health Centres	0.7ha	0.7ha	0.7ha	0.7ha	1.4ha	1.4ha
. Aid Post		-	-	-	-	-
. Major Hosp.	1.0ha	1.0ha	1.0ha	38ha	38ha	38ha
- Other Govt Services		13.8ha	19.9ha	19.9ha	19.9ha	19.9ha

Notes:
1. Gross Areas: Within residential areas 20-25% is allowed for public space, roads, community centres, open spaces and corner shops.
2. This area includes 2.4ha required at Kabakaul for the Kokopo Powerhouse.
3. Public Institutional land use requirements are based on population growth over the Plan period.
4. Kokopo Urban Area Population census covers Kokopo, Kenabot Plantation, Vunapope and Takubar Plantation as defined by the National Statistic Office (NSO) (*3659 estimate based on projection of 1990 census figures).
5. Commercial and Industrial land requirements are not necessarily tied to population increases as these and the Health land requirements serve wider population catchment areas including the NGI region.
6. The larger land requirements for Commercial and Public Institutional in the second and third Five (5) Year Plan is to cater for a larger proportion of such activities which were displaced from Rabaul by the volcanic eruptions.

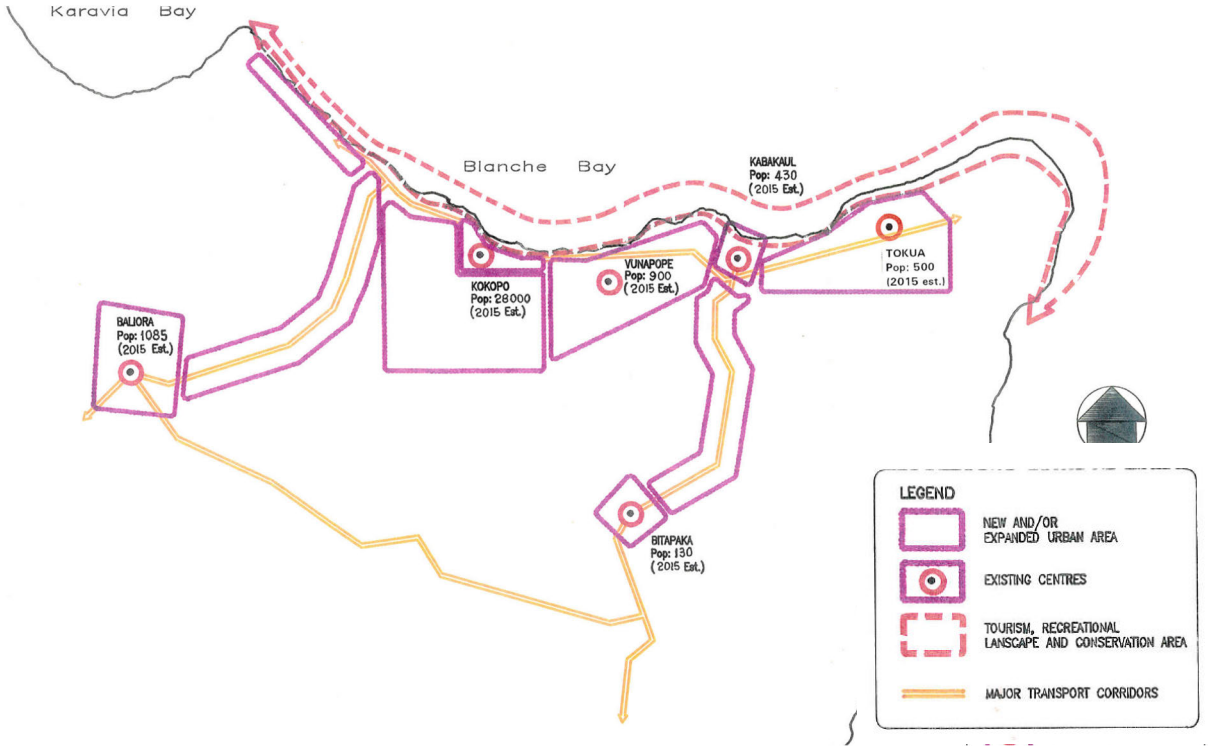
Source: Cardno & Davies PNG Pty Ltd, 1995, Kokopo Urban Developemnt Plan Final Report

(3) Alternative Spatial Structures

Three spatial structures (spatial patterns) were considered in the plan.

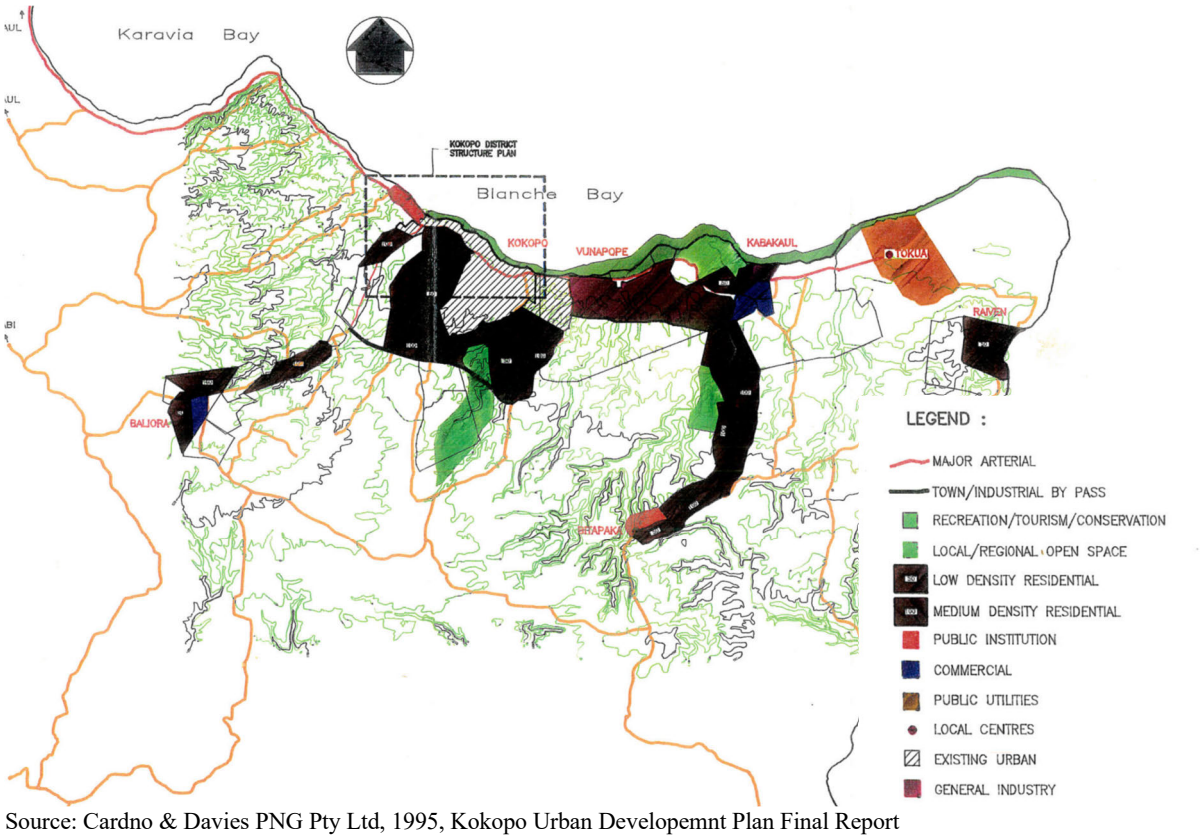
1) Radial Corridor Structure

This option proposes five corridor developments between the town centres. All main facilities are to be located within these five corridors. The existing centres of Bitapaka, Butuwin, Kabakaul and Tokua are expected to be extended and developed into local centres.



Source: Cardno & Davies PNG Pty Ltd, 1995, Kokopo Urban Developemnt Plan Final Report

Figure 10.2.3 Radial Corridor Structure (Option 1) in Kokopo Urban Development Plan 1995

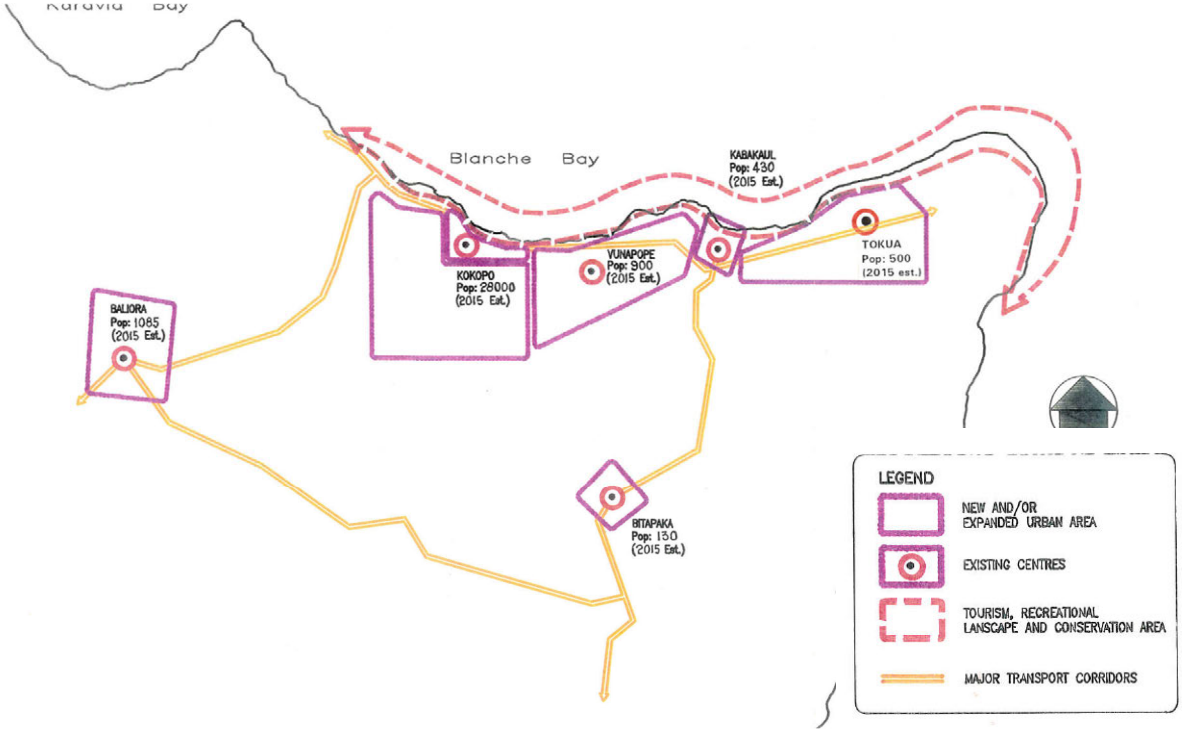


Source: Cardno & Davies PNG Pty Ltd, 1995, Kokopo Urban Developemnt Plan Final Report

Figure 10.2.4 Urban Structure of Radial Corridor (Option 1) in Kokopo Urban Development Plan 1995

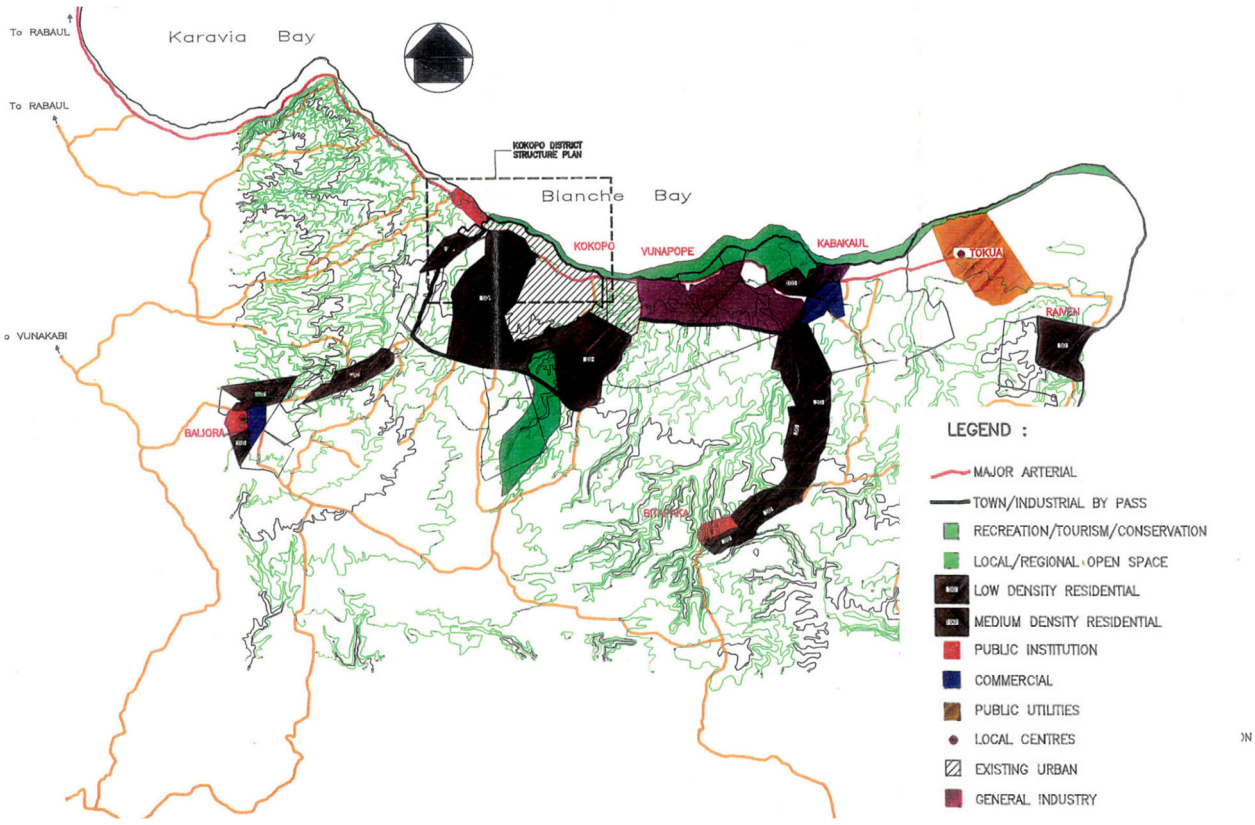
2) Grid Structure

This option proposes low density residential development and industrial activities dispersed. Main activity centres are dispersed on north-south and east-west links.



Source: Cardno & Davies PNG Pty Ltd, 1995, Kokopo Urban Developemnt Plan Final Report

Figure 10.2.5 Grid Structure (Option 2) in Kokopo Urban Development Plan 1995

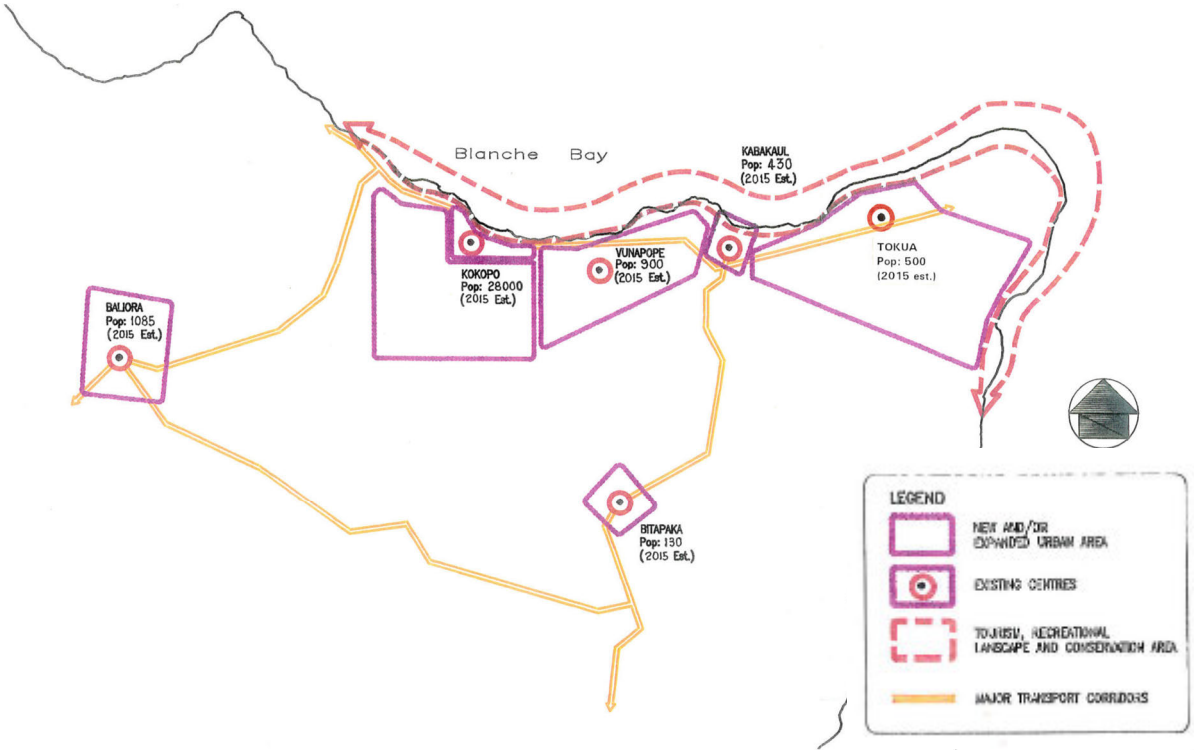


Source: Cardno & Davies PNG Pty Ltd, 1995, Kokopo Urban Developemnt Plan Final Report

Figure 10.2.6 Grid Urban Structure (Option 2) in Kokopo Urban Development Plan 1995

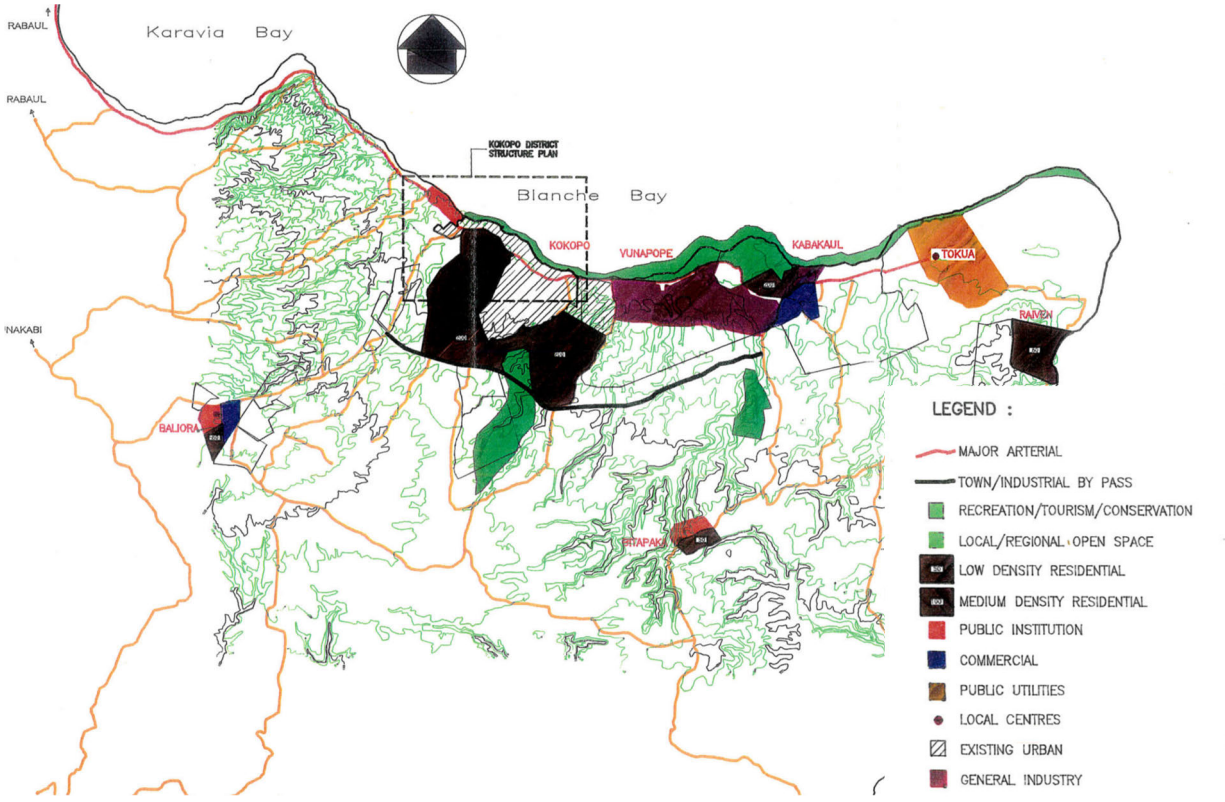
3) Linear Structure

This option is a simple east-west liner spine running from Butuwin to Tokua and with extention to Rabaul. There is also an east-west corridor extending from Bitapaka to Baliora. Residential areas are along the public transport spine at the medium to high densities.



Source: Cardno & Davies PNG Pty Ltd, 1995, Kokopo Urban Developemnt Plan Final Report

Figure 10.2.7 Linear Structure (Option 3) in Kokopo Urban Development Plan 1995



Source: Cardno & Davies PNG Pty Ltd, 1995, Kokopo Urban Developemnt Plan Final Report

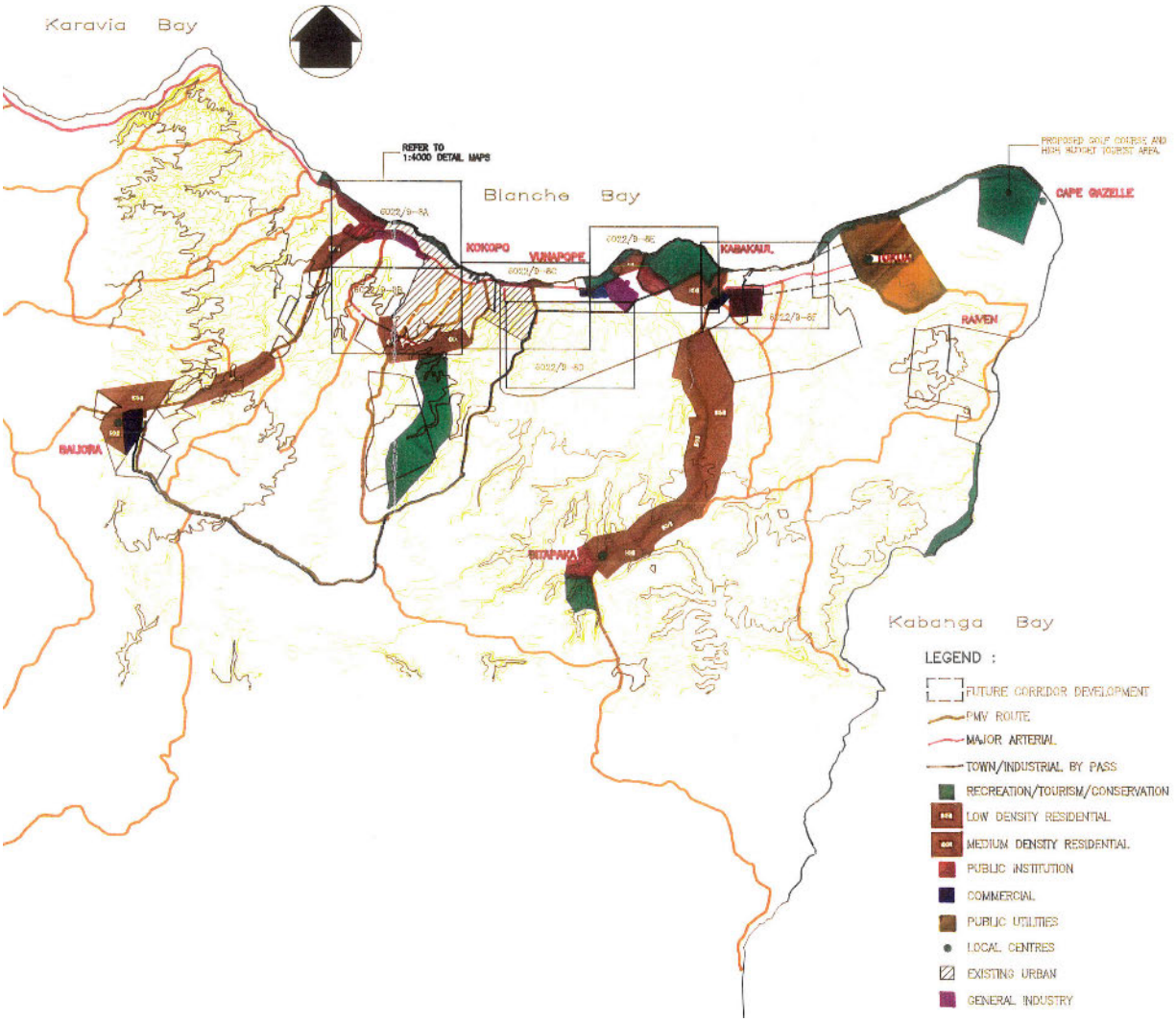
Figure 10.2.8 Linear Urban Structure (Option 3) in Kokopo Urban Development Plan 1995

(4) Preferred Urban Structure Plan

The report recommends the adoption of the Radial Corridor Structure. This structure was selected since it was concluded that a pure linear structure with all development concentrated on one spine is not suitable because it would not enable the integration of the coastal development.

This selected structure is also considered to protect the tourist and recreation function of the coast Therefore, there is no major residential zone along the coastal corridor.

A new commercial centre is proposed at Kabakaul.



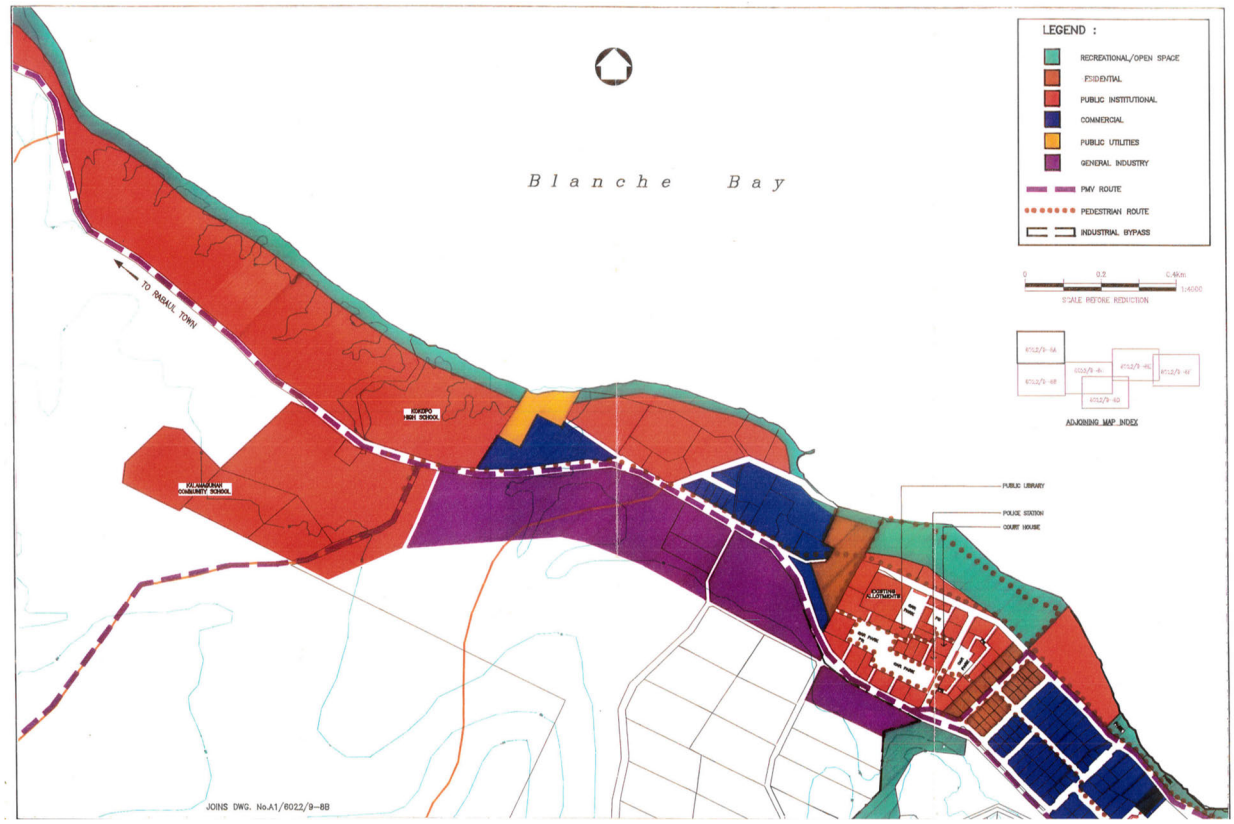
Source: Cardno & Davies PNG Pty Ltd, 1995, Kokopo Urban Developemnt Plan Final Report

Figure 10.2.9 Selected Urban Structure for Kokopo in Kokopo Urban Development Plan 1995

(5) Detailed Plan (Land Use Plan)

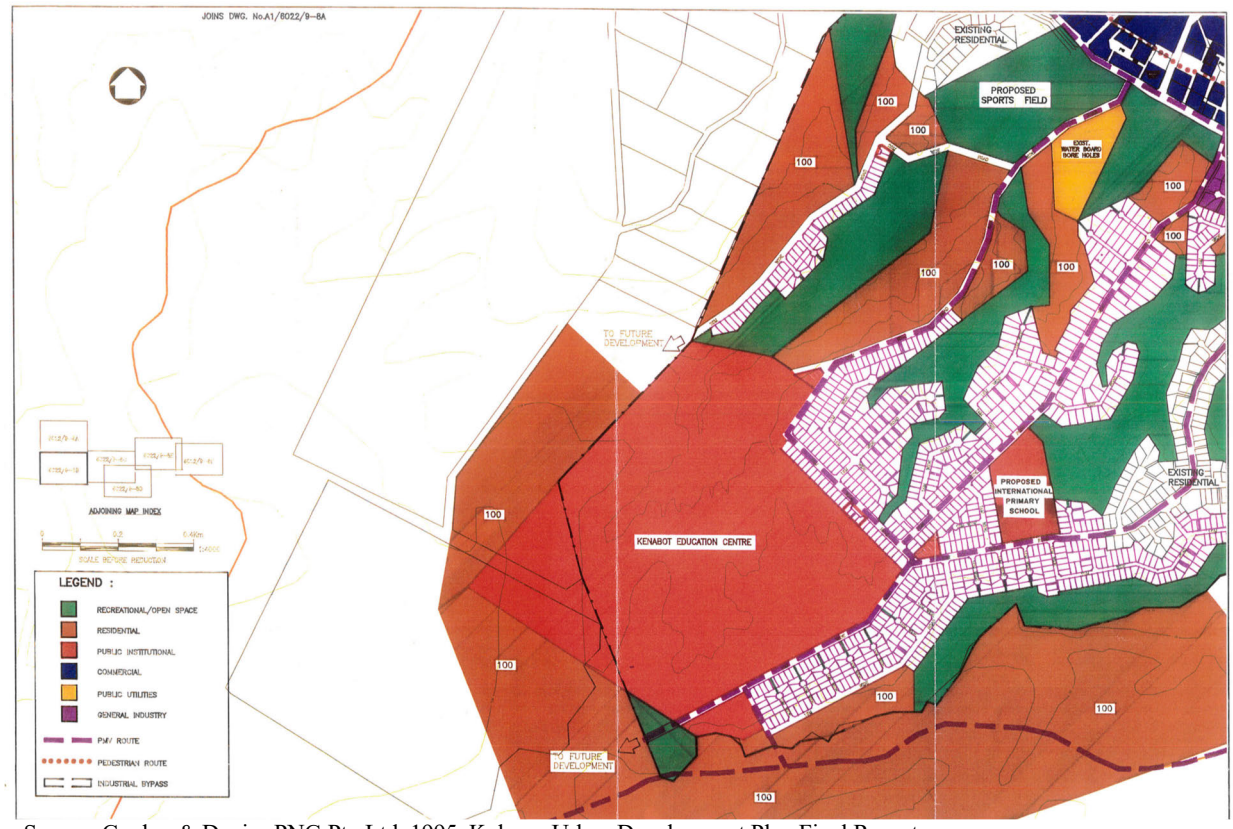
Detailed plan with land use zoning was also prepared for the coastal area at the scale of 1:4,000 as shown in Figure 10.2.10 through Figure 10.2.15. The land use zones included in this plan are as follows:

- Recreational /Open Space
- Residential
- Public Institutional
- Commercial
- Public Utilities
- General Industry



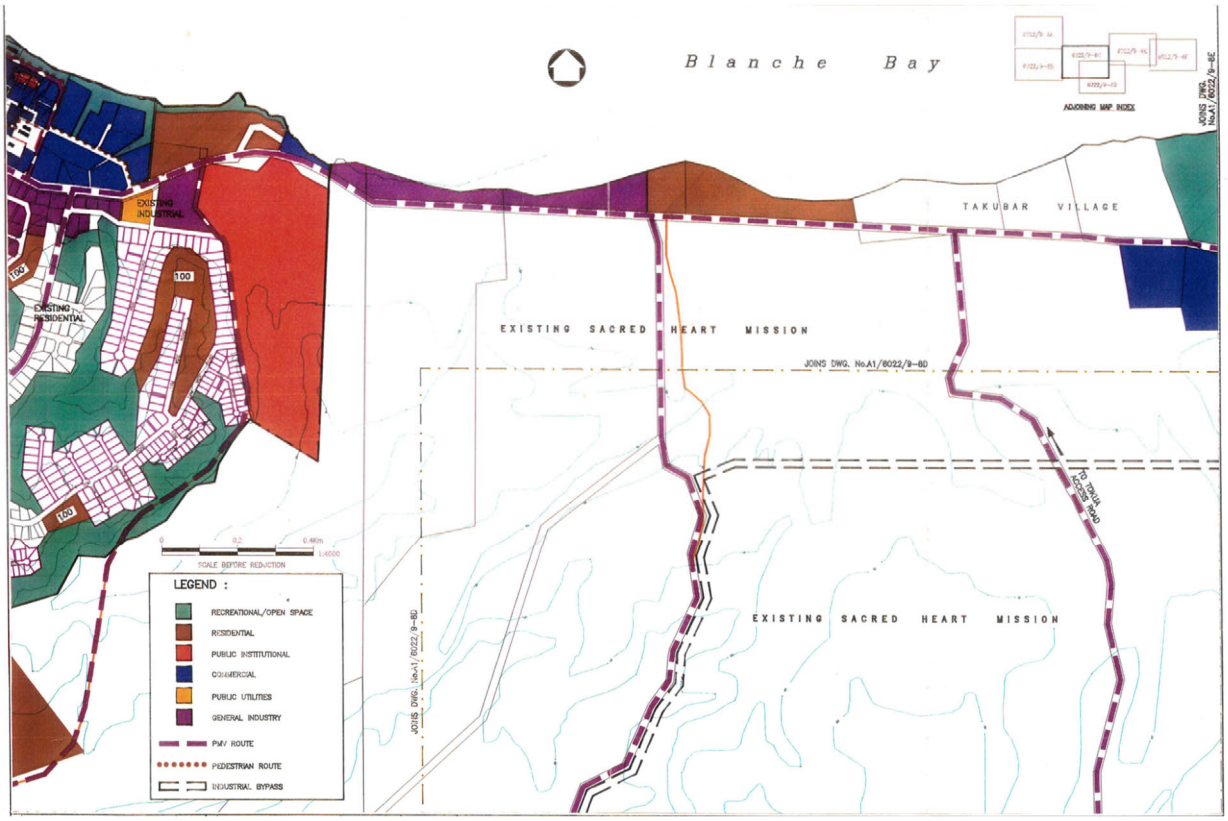
Source: Cardno & Davies PNG Pty Ltd, 1995, Kokopo Urban Developemnt Plan Final Report

Figure 10.2.10 Detailed Plan (Map Area "A") for Coastal Corridor in Kokopo Urban Development Plan 1995



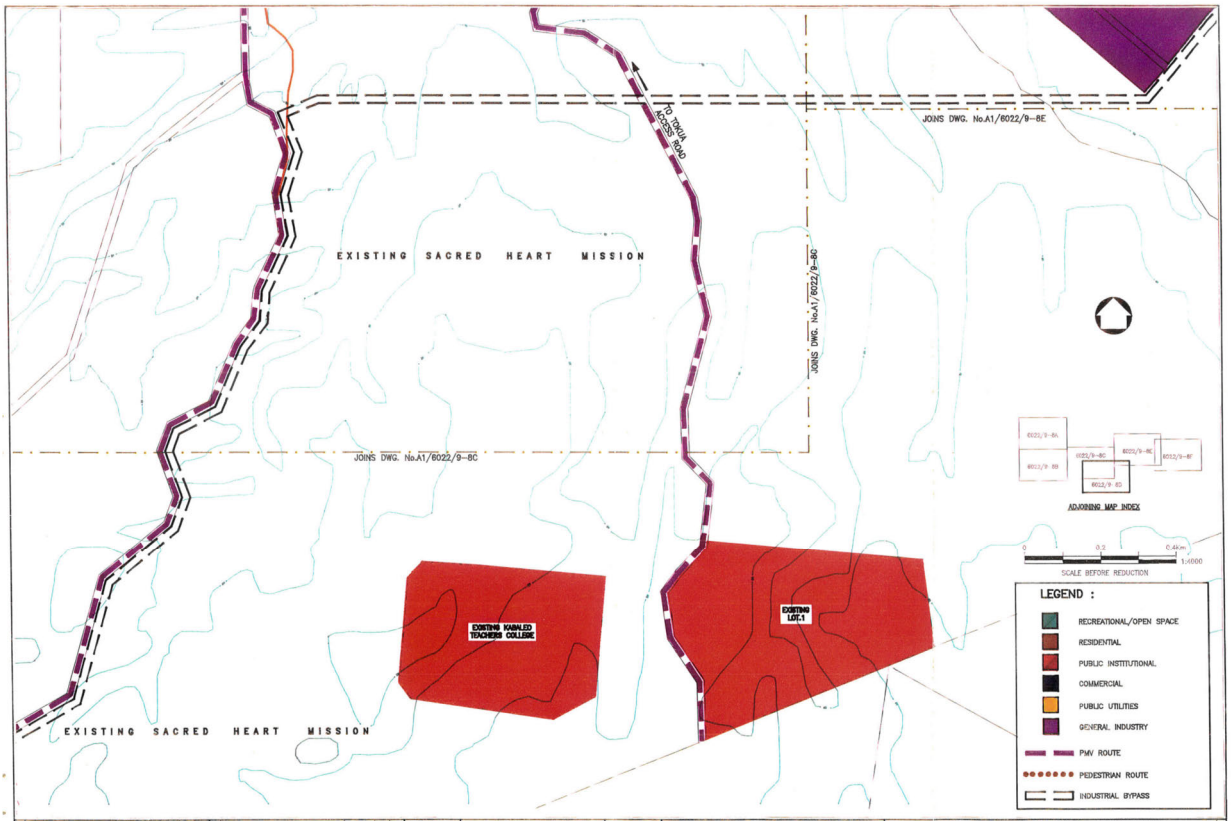
Source: Cardno & Davies PNG Pty Ltd, 1995, Kokopo Urban Developemnt Plan Final Report

Figure 10.2.11 Detailed Plan (Map Area "B") for Coastal Corridor in Kokopo Urban Development Plan 1995



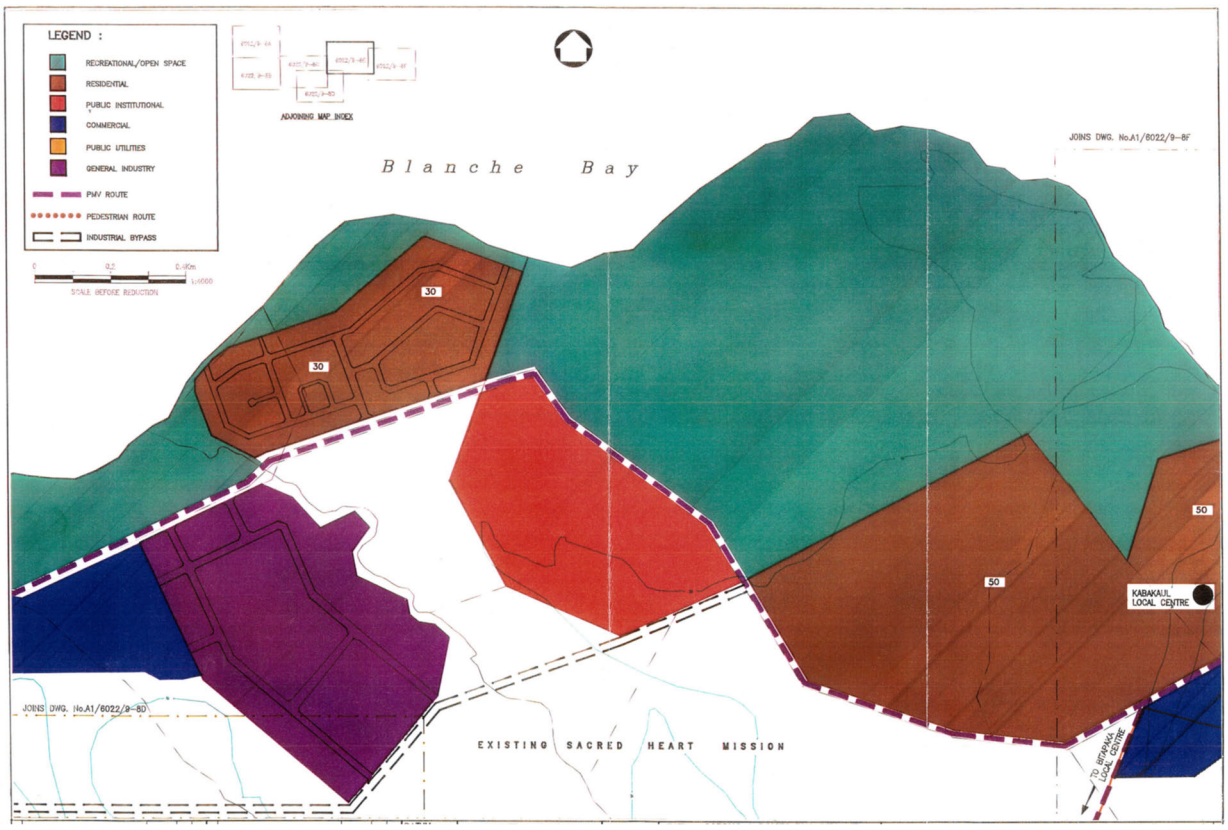
Source: Cardno & Davies PNG Pty Ltd, 1995, Kokopo Urban Developemnt Plan Final Report

Figure 10.2.12 Detailed Plan (Map Area "C") for Coastal Corridor in Kokopo Urban Development Plan 1995



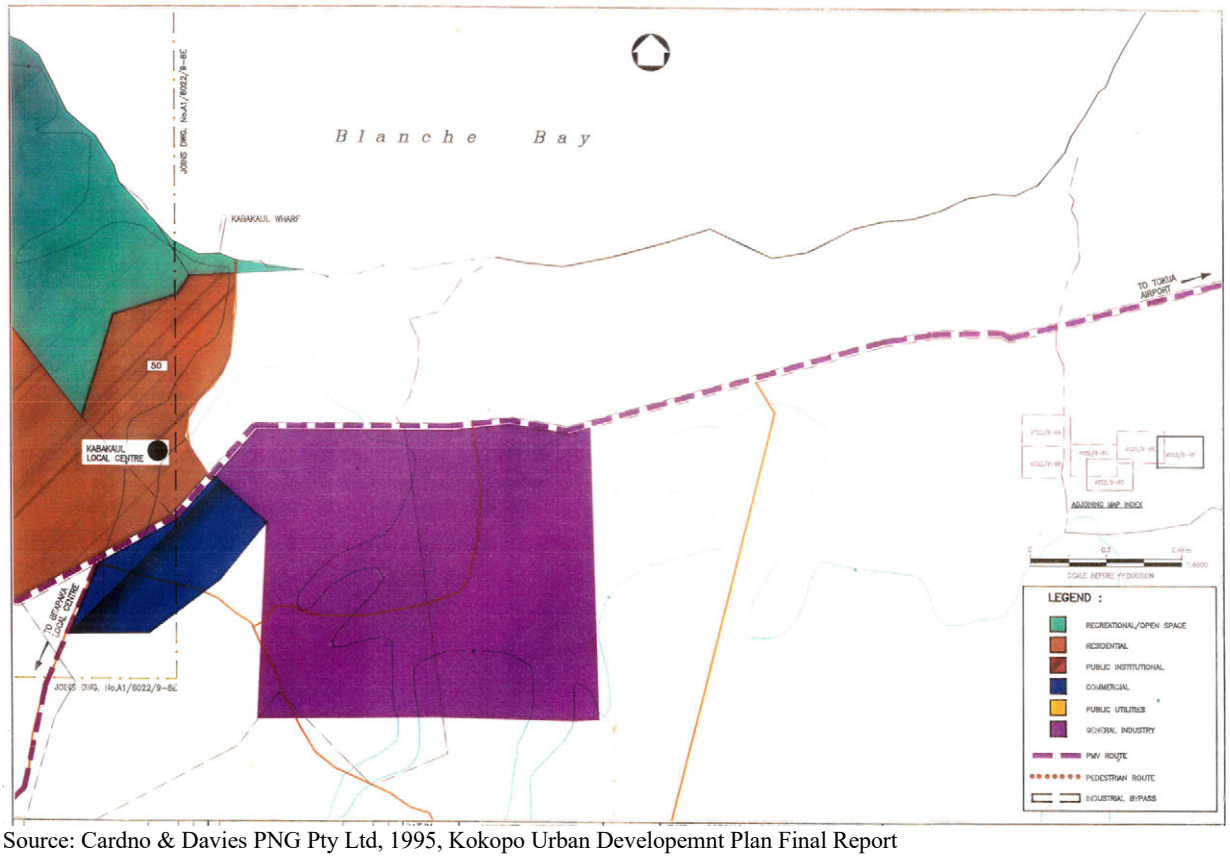
Source: Cardno & Davies PNG Pty Ltd, 1995, Kokopo Urban Developemnt Plan Final Report

Figure 10.2.13 Detailed Plan (Map Area "D") for Coastal Corridor in Kokopo Urban Development Plan 1995



Source: Cardno & Davies PNG Pty Ltd, 1995, Kokopo Urban Developemnt Plan Final Report

Figure 10.2.14 Detailed Plan (Map Area "E") for Coastal Corridor in Kokopo Urban Development Plan 1995



Source: Cardno & Davies PNG Pty Ltd, 1995, Kokopo Urban Developemnt Plan Final Report

Figure 10.2.15 Detailed Plan (Map Area "F") for Coastal Corridor in Kokopo Urban Development Plan 1995

10.2.3 Kokopo-Tokua Corridor Subject Development Plan 2016 (KTCSDP 2016)

(1) Background

The Kokopo-Tokua Corridor (KTC) Subject Development Plan was formulated in 2016. It is a ten-year plan with the target year 2026. This plan is a revision of the Kokopo-Tokua Corridor Subject Development Plan 2003 which was formulated in 2003 to review and revise the urban planning structure which was prepared in 1995 without enough consideration on relocation of residents and businesses as well as the airport to Kokopo District. However, the former plan expired in 2013, and a review was commissioned in 2015.

The area covered by the plan is shown in Figure 10.2.16.

Source: Planpac Group PNG, 2016, Kokopo-Tokua Corridor Subject Development Plan 2016

Figure 10.2.16 Location of Kokopo-Tokua Corridor

(2) Visions, Goals and Objectives

The vision for KTCSDP 2016 is as below:

- To provide for an integrated community offering lifestyle choices that are supported by a sustainable and diverse economy and to establish itself as an international gateway to world-class tourist attraction.

There are 11 goals listed together with the objectives as measure of change in order to achieve the vision. The 11 goals along with the objectives are as shown in Table 10.2.2.

Table 10.2.2 Goals and Objectives for Kokopo-Tokua Corridor Subject Development Plan 2016

Goals	Objectives
Goal 1: To create an inclusive and connected community	• To encourage a cohesive community through activities that support and enable unity, community networking and encourage community capacity building. • To improve and enhance essential community amenities and facilities • To increase community access to all facilities and encourage active participation • To establish functional public recreation spaces • To improve essential infrastructure
Goal 2: To encourage economic opportunities while providing an appropriate mix of accommodation types for residents as well as recognizing the importance of rural activities.	• To protect and enhance residents lifestyles • To encourage innovative residential developments • To provide adequate opportunity for local employment • To provide a variety of business to support the day to day needs of residents and the agricultural community • To create commercial nodes that are appropriately located and are functional and attractive • To provide an adequate mix of housing, including affordable housing for current and future needs of residents • To attract and provide support for the rural/farm community
Goal 3: To preserve and enhance the KTC's natural features, historic character, traditional sites, open spaces and amenities	• To recognize significant landforms including Blanche Bay foreshore • To work with the natural assets of the KTC • To preserve the riparian zone adjacent to all major waterways in the corridor • To identify a safe and convenient pathway system that links open spaces and recreational resources and land uses • To conserve and to promote the KTC's cultural and heritage resources
Goal 4: To ensure the KTC's residents' safety and security is adequately provided for.	• To provide adequate lighting levels (streetlights) • To provide adequate police presence • To provide safe and secure urban environments
Goal 5: To provide adequate infrastructure services to enable preferred growth strategies.	• To ensure safe water supply and environmentally effective wastewater disposal systems • To provide a range of recreational and leisure facilities • To provide accessibility to communications • To ensure safe vehicular traffic movement • To provide adequate fire services • To ensure connectivity and a system of footpaths and pathways to encourage pedestrian • To protect existing preferred developments and prohibit inappropriate development in flood prone areas
Goal 6: To provide directives that maximize the KTC's competitiveness and facilitate economic growth.	• To enhance economic growth by developing partnerships with the private sector and nongovernmental organisations • To advance responsible economic growth and trade • To enhance the availability of key economic and demographic data to facilitate effective decision-making • To provide investments and technical assistance for economic development projects • To promote private and public sector investment in minority businesses • To encourage participation in international markets through exports initiatives • To collect analyse, and disseminate demographic and economic data • To provide leadership through promotion, economic development, and economic analysis
Goal 7: To observe, protect, and manage the KTC's resources to promote environmental stewardship.	• To understand the KTC's physical environment essential to facilitate positive outcomes for the economic, social, and urban growth needs • To enhance the conservation and management of coastal and marine resources
Goal 8: To promote an active, flexible and tropical lifestyle to be enjoyed by the community to live, work and play.	• To provide improved access and connectivity to all facilities • To provide a range of facilities appropriate to community lifestyles • To create a sense of place and community • To increase family friendly activities and recreational and leisure experiences • To create commercial hubs to service the community's needs • To provide meeting places for the community
Goal 9: To promote sustainability to protect the environment, lifestyle and facilitate community initiatives to embrace change.	• To implement strategies that addresses climate change • To extend reticulated water services and introduce a reticulated sewerage system • To reduce waste to landfill dependence • To increase awareness of the biodiversity opportunities within the KTC
Goal 10: To preserve historic and cultural diversity through community activities	• To increase promotion of key civic and cultural activities and events • To promote arts and cultural diversity as a tourist attraction • To increase public awareness of the importance of cultural diversity

Goals	Objectives
Goal 11: To promote effective, collaborative and responsible governance.	• To provide a KTCSDP that is workable and establish mechanisms to facilitate its effective implementation • To improve relations and cooperation within all levels of government • To increase engagement with the community through consultative processes • To demonstrate strong and effective leadership and governance processes

Source: Planpac Group PNG, 2016, Kokopo-Tokua Corridor Subject Development Plan 2016

(3) Planning for Growth

Key elements that are fundamental to achieving strategic land use outcomes are assessed for achieving the highest and best economic, social and environmental outcomes for the KTC.

1) Economic Development

The following economic sectors identified have growth potential:

- Alternative agriculture activities and cash crops
- Tourism
- Fisheries
- Manufacturing
- Construction
- General Industry
- Small-medium size enterprises

Among the above economic sectors, tourism is identified as an important sector for achieving economic diversification. Therefore, the updated KTCSDP aims to provide opportunities for tourism development in strategic locations as an economic driver and diversification of the KTC's economic base.

2) Sustainable Community Development

The sustainable community development principles considered in KTCSDP include the following:

- Enabling a cooperative relationship between all neighbourhood districts
- Focusing on establishing an integrated, people orientated and place-based approach
- Providing neighbourhood safe environments
- Providing community facilities which provide safety and well-being to local people
- Providing efficient connectivity between all activity nodes
- Providing quality parks, recreational and sporting opportunities that contributes to the health and well-being of communities

Informal settlements are also acknowledged as a growing problem causing social issue in some areas in KTC. Following principles are considered for affordable housing:

- Establish a well-designed system of land and infrastructure management, dedicated to providing people with affordable houses and land
- Ensure convenient access to local jobs through an efficient public transport system
- Provide a sense of community ownership and cohesion

3) Land Use Management Principles

Core land use planning principles considered in KTCSDP include the following:

- Facilitating proactive development strategies to provide residences, businesses, industries, infrastructure and services that are required in the KTC, by allocating sufficient areas suitable for development
- Seeking excellence in urban sensitive design outcomes and a good standard of amenity for all

existing and future residents

- Promoting urban nodes and the long term sustainable viability of these areas
- Recognising the characteristics of natural features
- Supporting established traditional rural communities
- Protecting good quality agricultural land

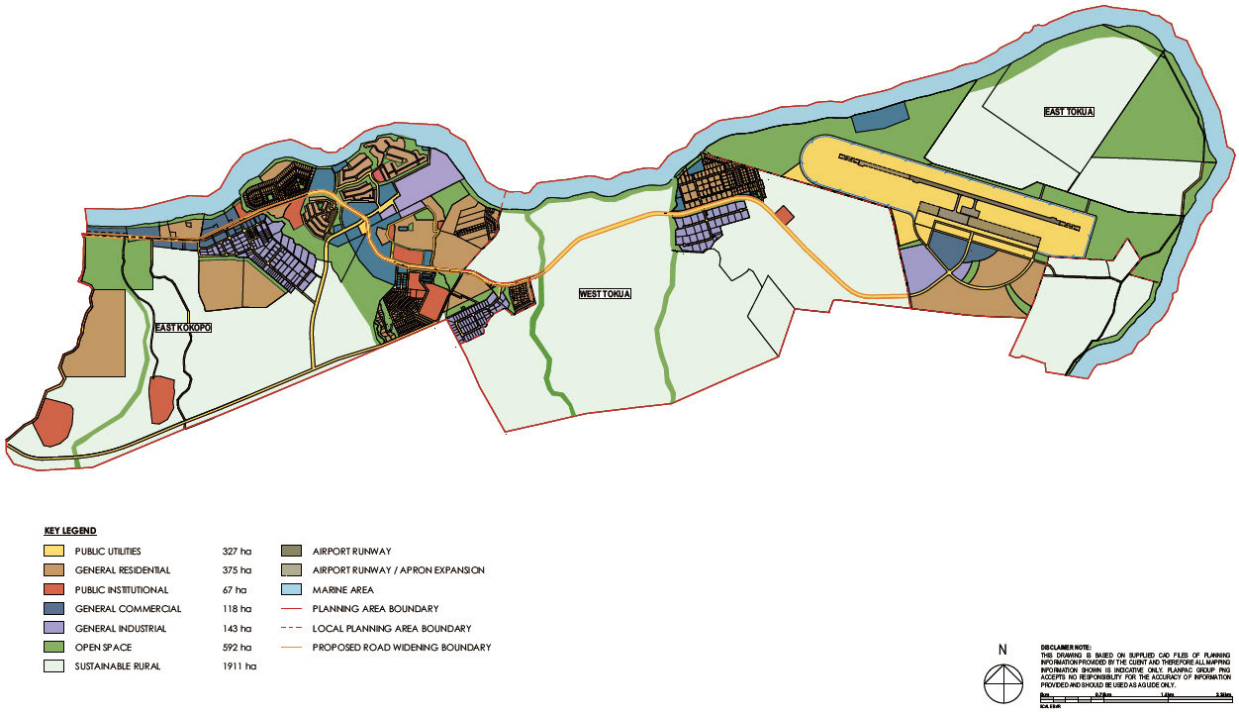
4) Ecologically Sustainable Development

The following principles are considered for effective ecologically sustainable development:

- Protecting and enhancing valued landscapes, geological conservation interests and soils
- Identifying the wider benefits of ecosystem services
- Establishing coherent ecological networks resilient to current and future strains
- Preventing both new and existing development from contributing to environmental harm
- Promoting preservation of priority habitats and ecological networks
- Safeguarding the contributions made by the historic environment to the character of the area

(4) Land Use Plan

The proposed KTCSDP 2016 contains six out of the 10 zones and sub-zoned defined in the Physical Planning Regulation 2007, being General Residential, General Commercial, General Industrial, Sustainable Rural, Public Institutional, Open Space and Public Utilities. The zoning plan proposed in the KTCSDP 2016 is shown in Figure 10.2.17.



Source: Planpac Group PNG, 2016, Kokopo-Tokua Corridor Subject Development Plan 2016

Figure 10.2.17 Zoning Plan in Kokopo-Tokua Corridor Subject Development Plan 2016

(5) Infrastructure

Priority infrastructure services are also recommended in the KTCSDP 2016 for the following sectors:

- Roads
- Water
- Electricity

- Sewerage
- Telecommunications

The recommendations for each infrastructure are summarised in Table 10.2.3.

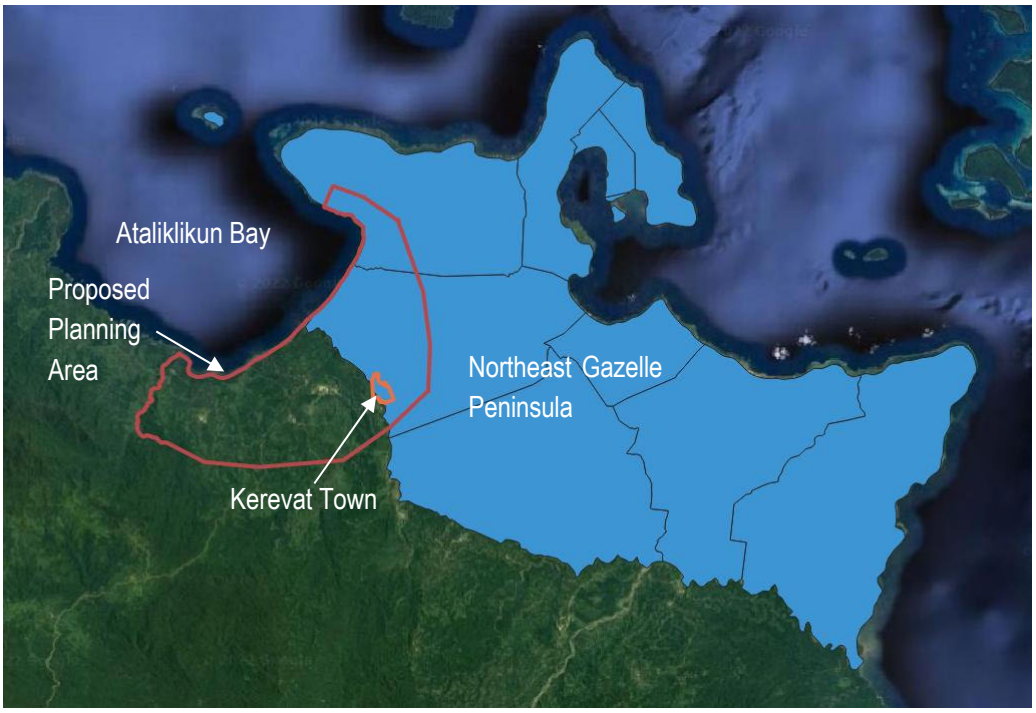
Table 10.2.3 Servicing Priorities of Recommended Infrastructure in Kokopo-Tokua Corridor Subject Development Plan 2016

Roads	• Internal road networks for new subdivisions (Ples Balus, Rapopo Plantation and Materes) are developed in accordance with the future road hierarchy • Tokua Road widening is surveyed, approved and constructed • Internal road networks for new subdivision at Rabaul-Tokua Airport are developed in accordance with the future road hierarchy • Kokopo By-pass Road widening is surveyed, approved and constructed
Water	• Trunk mains are constructed in the Tokua Road reserve (based on survey for Tokua Road widening) • Trunk main is extended to ICDC • Water PNG services future subdivisions (Ples Balus, Rapopo Plantation and Materes) • Trunk main is extended to Rabaul-Tokua Airport • Water PNG services future development at Rabaul-Tokua Airport and Tokua Plantation
Electricity	• Electricity infrastructure is maintained in the widened Tokua Road reserve • Future development at Ples Balus, Rapopo Plantation, Materes and Rabaul-Tokua Airport is serviced by PNG Power
Sewerage	• Full survey, design and approval of sewerage reticulation network • Site for sewerage treatment plant is selected that has minimal impact on surrounding areas • Construction of sewerage trunk main in Tokua Road reserve • Construction of feeder lines to existing and future urban areas
Telecommunications	• Future development at Ples Balus, Rapopo Plantation, Materes and Rabaul-Tokua Airport is serviced by Telikom

Source: Planpac Group PNG, 2016, Kokopo-Tokua Corridor Subject Development Plan 2016

10.2.4 Urban Development Plan for Kerevat

Gazelle District does not have an existing spatial plan. The area considered for the formulation of the plan is shown in Figure 10.2.18. Half of the area is outside Northeast Gazelle Peninsula, and the area proposed to be included in the planning area is quite large.



Source: JICA Expert Team based on the data from Division of Lands and Physical Planning, ENBPA

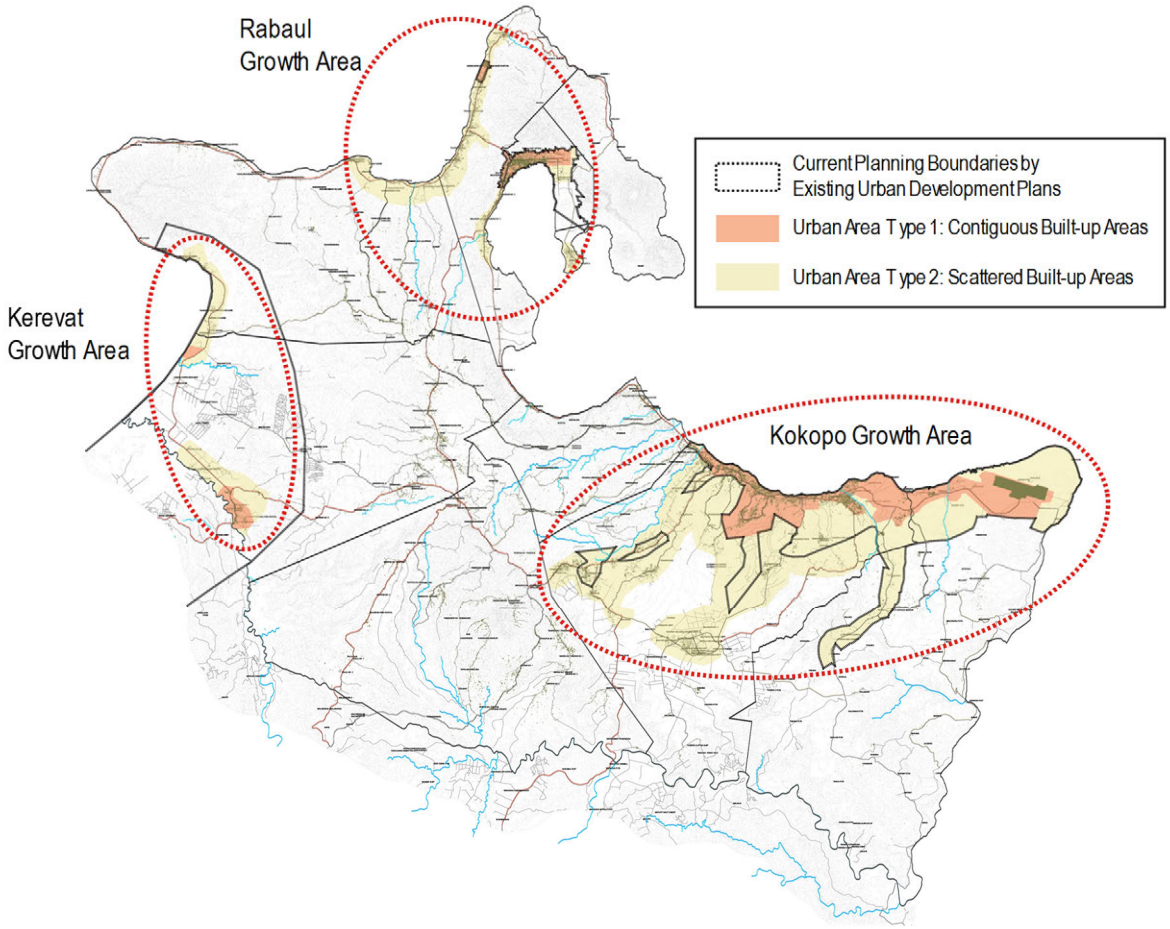
Figure 10.2.18 Kerevat Town and Area Considered for Urban Plan in Gazelle District

10.3 Future Urban Areas for Northeast Gazelle Peninsula and Planning Areas for Urban Infrastructure

10.3.1 Growth Areas in Northeast Gazelle Peninsula and Future Urban Areas

(1) Criteria Considered for Future Urban Areas

The three growth areas proposed in the future regional spatial structure of Northeast Gazelle Peninsula are the areas where development should be promoted as shown in Figure 10.3.1.



Source: JICA Expert Team

Figure 10.3.1 Growth Areas and Proposed Future Urban Areas in Northeast Gazelle Peninsula

To determine the areas of future urban areas in these growth areas, the following aspects were considered:

- Existing urban planning boundaries
- Present situation of urbanisation
- Proposed urban centres in the future regional spatial structure
- Regional infrastructure to be upgraded in the future regional spatial structure
- Natural conditions, such as rivers and terrain

(2) Two Types of Urban Areas in Northeast Gazelle Peninsula

In Northeast Gazelle Peninsula, the major contiguous built-up areas are along the Kokopo-Tokua Corridor including Kokopo Town in Kokopo District, Rabaul Town in Rabaul District, and Kerevat Town in Gazelle District. The other built-up areas are scattered along the major roads. Therefore, two types of urban areas will be determined in Northeast Gazelle Peninsula. The first

type is where the urban economic activities take place with functions such as business, commercial and administrative, and major facilities for education and health sectors. The residential areas in this type of urban area are built relatively close to each other compared with other areas in Northeast Gazelle Peninsula. This area will be called Urban Area Type 1. The second type is where citizens are engaged in urban economic activities as their main source of income, but living in low density areas where some agriculture activities also still remain. This area will be called Urban Area Type 2.

The urbanisation in Kokopo Growth Area is expected to become one contiguous area, while the urbanisation in Rabaul Growth Area and Kerevat Growth Area are to be promoted in separated areas mixed with non-development areas.

The proposed future urban areas are determined in alignment with the future regional spatial structure in 2032.

(3) Future Employed Population Engaged in Non-Agriculture Activities and Manufacturing

The future employed population engaged in non-agriculture activities and the manufacturing sector are assumed based on the future population framework set in Chapter 7.

In Northeast Gazelle Peninsula, approximately 35% of the population are the employed population in 2011 according to the population and housing census. Using this 35%, the employed population in 2022 and 2032 are assumed to be approximately 90 thousand in 2022 and 120 thousand in 2032.

The employed population by sector are projected by LLG by setting the share of employed population in each sector based on the actual situation in 2011, present situation and development potential as shown in Table 10.3.1.

Table 10.3.1 Future Employed Population by Sector in Northeast Gazelle Peninsula

LLG	Unit	2011 (Census)			2022 (Projection)			2032 (Projection)		
		Primary	Secondary	Tertiary	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary
Bitapaka	Persons	6,969	322	1,278	6,384	532	3,724	5,292	1,323	6,615
	%	81.3	3.8	14.9	60.0	5.0	35.0	40.0	10.0	50.0
Kokopo/Vunamami	Persons	6,899	638	3,098	6,062	1,515	7,577	4,839	2,903	11,613
	%	64.9	6.0	29.1	40.0	10.0	50.0	25.0	15.0	60.0
Raluana	Persons	4,642	461	2,143	4,340	868	3,472	4,340	1,085	5,425
	%	64.1	6.4	29.6	50.0	10.0	40.0	40.0	10.0	50.0
Balanataman	Persons	4,293	434	2,427	3,626	907	4,533	2,826	1,696	6,783
	%	60.0	6.1	33.9	40.0	10.0	50.0	25.0	15.0	60.0
Kombiu	Persons	2,655	366	1,216	2,114	529	2,643	1,628	977	3,906
	%	62.7	8.6	28.7	40.0	10.0	50.0	25.0	15.0	60.0
Rabaul	Persons	388	157	833	336	336	1,568	147	588	2,205
	%	28.2	11.4	60.4	15.0	15.0	70.0	5.0	20.0	75.0
Central Gazelle	Persons	6,800	440	2,524	7,854	655	4,582	6,594	2,473	7,418
	%	69.6	4.5	25.9	60.0	5.0	35.0	40.0	15.0	45.0
Livuan/Reimber	Persons	7,979	453	2,117	8,022	669	4,680	6,804	1,701	8,505
	%	75.6	4.3	20.1	60.0	5.0	35.0	40.0	10.0	50.0
Vunadidir/Toma	Persons	8,839	675	2,822	8757	730	5108	7,210	1,803	9,013
	%	71.7	5.5	22.9	60.0	5.0	35.0	40.0	10.0	50.0
Northeast Gazelle Peninsula	Persons	49,455	3,946	18,458	47,495	6,741	37,886	39,680	14,549	61,483
	%	68.8	5.5	25.7	51.6	7.3	41.1	34.3	12.6	53.1

Source: JICA Expert Team

The employed population in the non-agriculture sector is projected to become approximately 75 thousand in 2032. In 2011, there were only 22 thousand employed population engaged in the non-agriculture sector and it is projected there are 45 thousand employed population engaged in the non-agriculture sector, so there could be an increase of 30 thousand employed population engaged

in the non-agriculture sector. The Urban Area Type 1 in Kokopo Urban Growth Area, Rabaul Urban Growth Area and Kerevat Urban Growth Area should accommodate jobs for the non-agriculture sector workers by increasing in the next decade.

In 2011, the employed population engaged in the manufacturing sector among the employed population in secondary sector was 30% with 1,181 persons.

Therefore, it can be assumed that there are currently approximately 2,000 workers engaged in the manufacturing sector and this will increase to 4,400 in 2032. Considering the size of the population, present development situation and developable land, 60% (approximately 2,600 jobs) of the manufacturing sector jobs shall be allocated in Kokopo Urban Growth Area and 20% (900 jobs) each in Rabaul and Kerevat Urban Growth Areas.

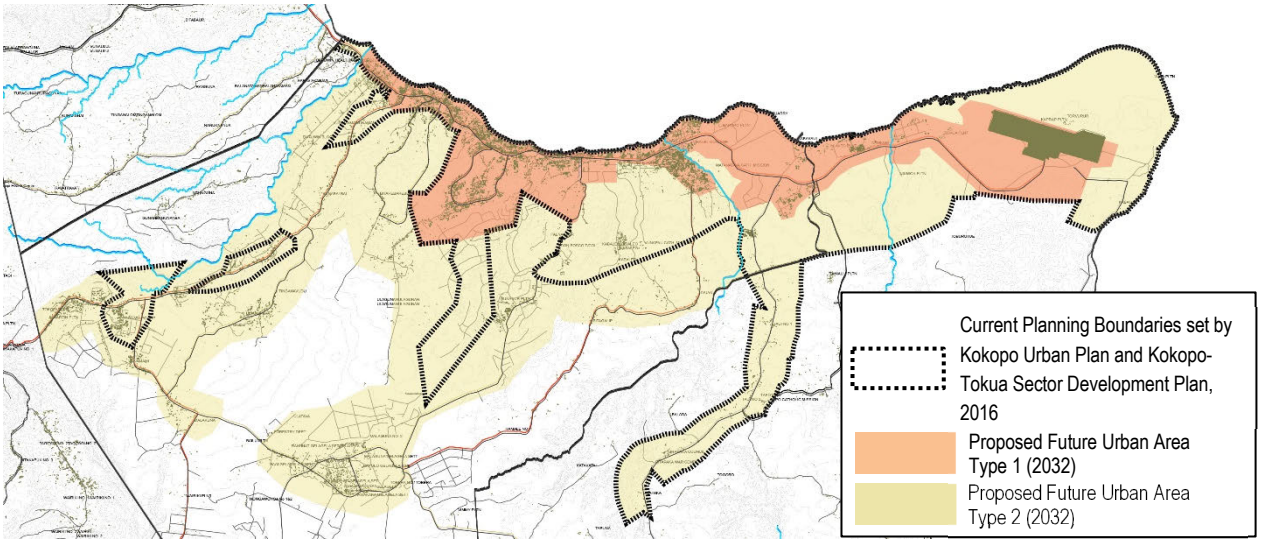
10.3.2 Future Urban Areas in Kokopo Growth Area

The proposed future Urban Area Type 2 for 2032 in Kokopo Growth Area is an expansion of the existing urban planning boundaries. This urban planning boundaries were set by Kokopo Urban Development Plan 1995, almost three decades ago. Since then, Kokopo has expanded urban areas surrounding the CBD of the provincial capital. Kokopo/Vunamami LLG has been upgraded to be an urban LLG. Considering the future development in Northeast Gazelle Peninsula, more land for development will become necessary in Kokopo District.

The proposed Urban Area Type 2 is expanded mostly in Kokopo/Vunamami Urban LLG to the south. The expanded areas are areas along the trunk roads. The boundary of the urban area in the west is set to the river.

The population in Kokopo/Vunamami Urban LLG and Bitapaka Rural LLG are estimated to increase from approximately 43 thousand to 55 thousand and from approximately 30 thousand to 38 thousand between 2022 to 2032, respectively, which is an increase of approximately 20,000 population in total in the next 10 years. Therefore, the hinterland of Kokopo Town is expected to develop to accommodate the increasing number of residents.

Within the Urban Area Type 2, areas where urban economic activities are expected to expand by 2032 are determined as future Urban Area Type 1. The areas are in Kokopo Town, Vunamami, Takubar, Ulaveo and Tokua as shown in Figure 10.3.2.



Source: JICA Expert Team

Figure 10.3.2 Proposed Future Urban Area in Kokopo Growth Area (2032)

Based on the future manufacturing jobs necessary projected for 2032, 2,600 jobs will be needed in Kokopo Urban Growth Area as estimated in the section above. It is assumed that there are 1,200

jobs for the manufacturing sector in 2022 within Kokopo Urban Growth Area. Therefore, 1,400 manufacturing jobs should be provided in the proposed future Urban Area Type 1.

10.3.3 Future Urban Areas in Rabaul Growth Area

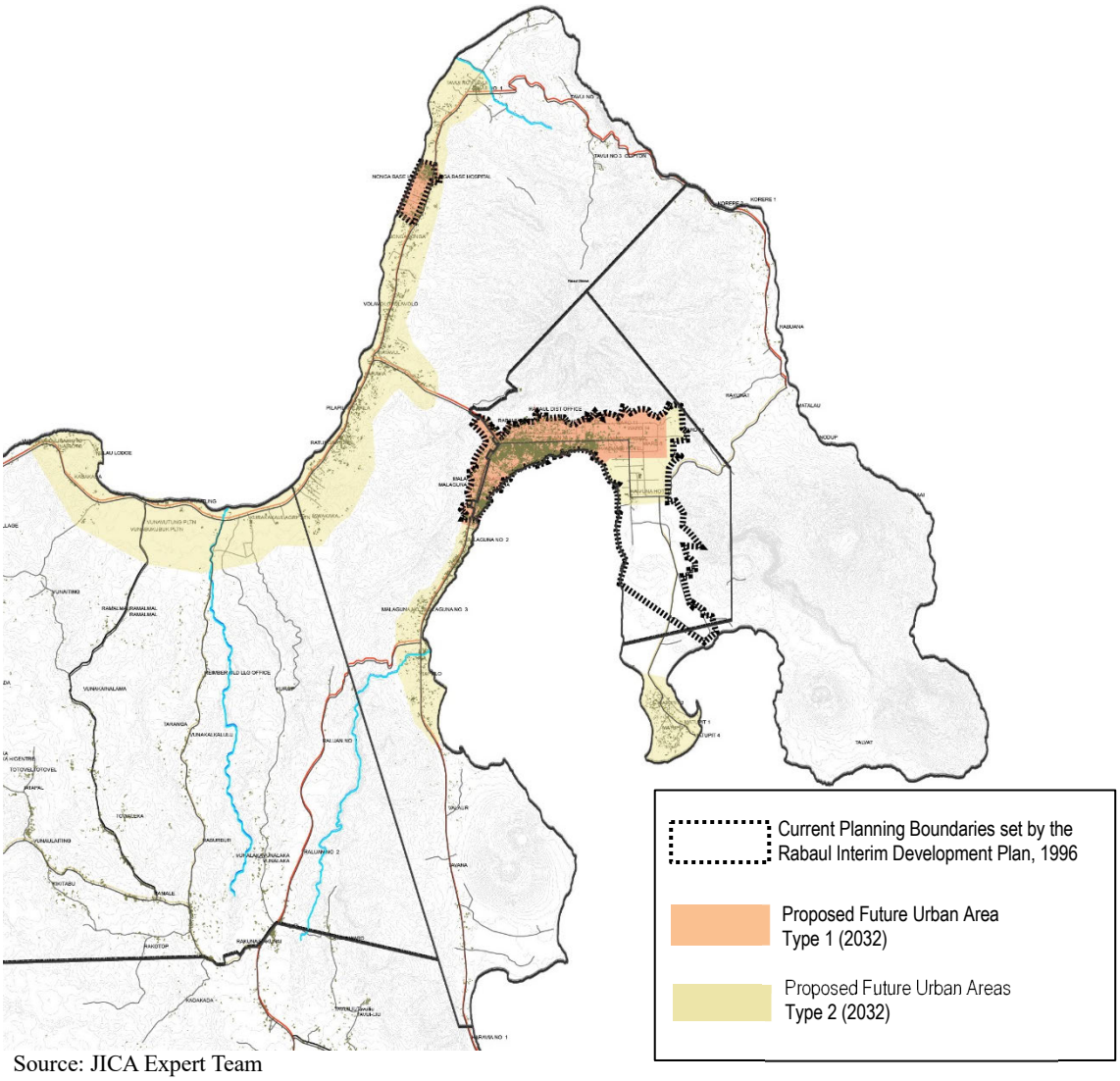
The proposed future urban areas type 2 for 2032 in Rabaul Growth Area are separated in three areas.

The main urban area is the area in Rabaul Town and its expansion to the west. In this area, the existing urban planning area includes the area known as Sector 3 which is decided to become a non-development area after the volcanic eruption in 1994 is included. Therefore, the future urban area will also eliminate this area from the urban area.

The other urban areas type 2 are the area between Nonga and Kurakakakul in the west of Rabaul Town, and Matupit in the south. The urbanisation along the western coastal area is also expected to expand beyond Kurakakaul. This is due to the proposed upgraded primary trunk road to be developed through Kurakakaul. Matupit is a unique area which did not get any damage during the volcanic eruption in 1994 due to the wind direction. The people living in this area also did not wish to move to resettlement areas provided by the government. As a result, this area has been increasing its population in the past decade and has become relatively dense area that should be served with urban infrastructure.

The population in Rabaul Urban LLG and Balanataman Rural LLG are estimated to increase from approximately 6 thousand to 8 thousand and from approximately 26 thousand to 32 thousand between 2022 to 2032, respectively, which is an increase of approximately 8,000 people in total in the next 10 years. However, most areas in Rabaul District are covered with mountains. Therefore, it is expected to develop along the coastal areas to the south from Rabaul Town and along the North Coastal Road.

Within the Urban Area Type 2, areas where urban economic activities are expected in 2032 are determined as future Urban Area Type 1. The areas are in Rabaul Town Sector 1 and the northern part of Sector 2, and Nonga as shown in Figure 10.3.3.



Source: JICA Expert Team

Figure 10.3.3 Proposed Future Urban Area in Rabaul Growth Area (2032)

Based on the future manufacturing jobs necessary projected for 2032, 900 jobs will be needed in Rabaul Urban Growth Area as estimated in the section above. It is assumed that there are 400 jobs for the manufacturing sector in 2022 within the Rabaul Urban Growth Area. Therefore, 500 manufacturing jobs should be provided in the proposed future Urban Area Type 1,

10.3.4 Future Urban Areas for Kerevat Growth Area

The proposed future Urban Area Type 2 for 2032 in Kerevat Growth Area is separated into two areas. The one is the Kerevat Town Area and its surrounding area, and the other is an eastern part of the Ataliklikun Bay.

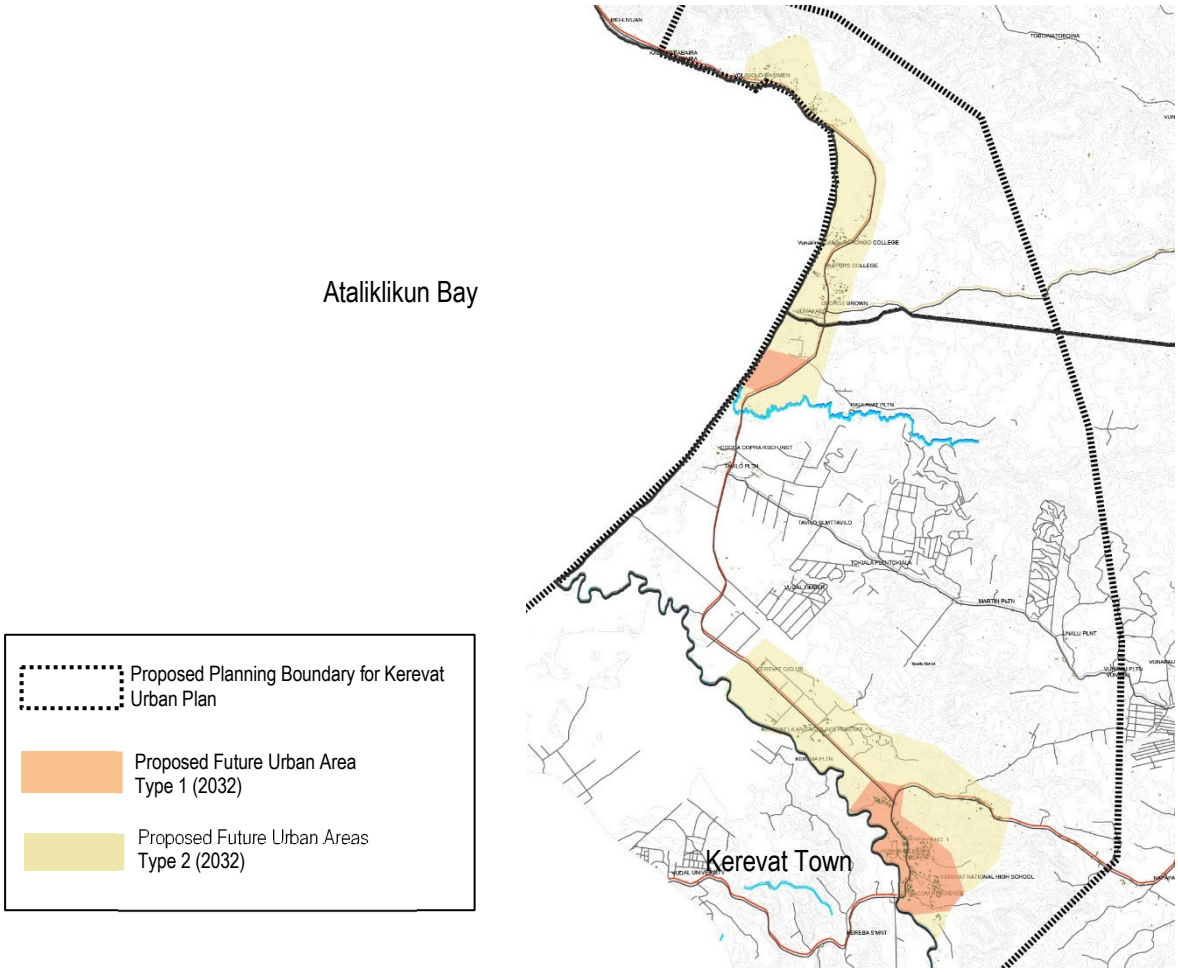
Although ENBPA intended to formulate an urban development plan for Kerevat, it was suspended due to land ownership issues. Therefore, no urban development plan has been formulated yet in this area.

The future urbanisation in the Kerevat Growth Area will depend highly on the location selected for the development of Gazelle Agro-Industry SEZ. The future urban areas for Kerevat Growth Area should be considered again once the location and size of the SEZ, as well as the site for the proposed new port are determined.

The population in Central Gazelle, Livuan and Reimber Rural LLGs are estimated to increase from approximately 37 thousand to 47 thousand, from approximately 18 thousand to 23 thousand and

from approximately 20 thousand to 26 thousand between 2022 to 2032, respectively, which is an increase of approximately 21 thousand people in total in the next 10 years. The development is expected to take place around Kerevat Town Area and along the coastal areas between Tavilo and Kabaira.

Within the Urban Area Type 2, areas where urban economic activities are expected in 2032 are determined as future Urban Area Type 1. The areas are in Kerevat Town and its expansion as shown in Figure 10.3.4, and the location where the SEZ would be developed.



Note: Proposed Future Urban Area Type 1 on Ataliklikun Bay will change depending on the actual site of the Gazelle Agro-Industtry SEZ to be implemented.
Source: JICA Expert Team

Figure 10.3.4 Proposed Future Urban Area in Kerevat Growth Area (2032)

Based on the future manufacturing jobs necessary projected for 2032, 900 jobs will be needed in the Kerevat Urban Growth Area as estimated in the section above. It is assumed that there are 400 jobs for the manufacturing sector in 2022 within the Kerevat Urban Growth Area. Therefore, 500 manufacturing jobs should be provided in the proposed future Urban Area Type 1.

10.3.5 Planning Areas for Urban Infrastructure in NEGID-Plan

The planning areas for urban infrastructure in the NEGID-Plan will be considered for the future urban areas in the Kokopo Growth Area, Rabaul Growth Area and Kerevat Growth Area.

Although the formulation of the urban infrastructure plan for the Kerevat Growth Area is not included in the scope of the project of NEGID-Plan, the development direction and future demand of urban infrastructure will be proposed for Kerevat Urban Growth Area.

For water supply, Urban Area Type 1will be the planning area.

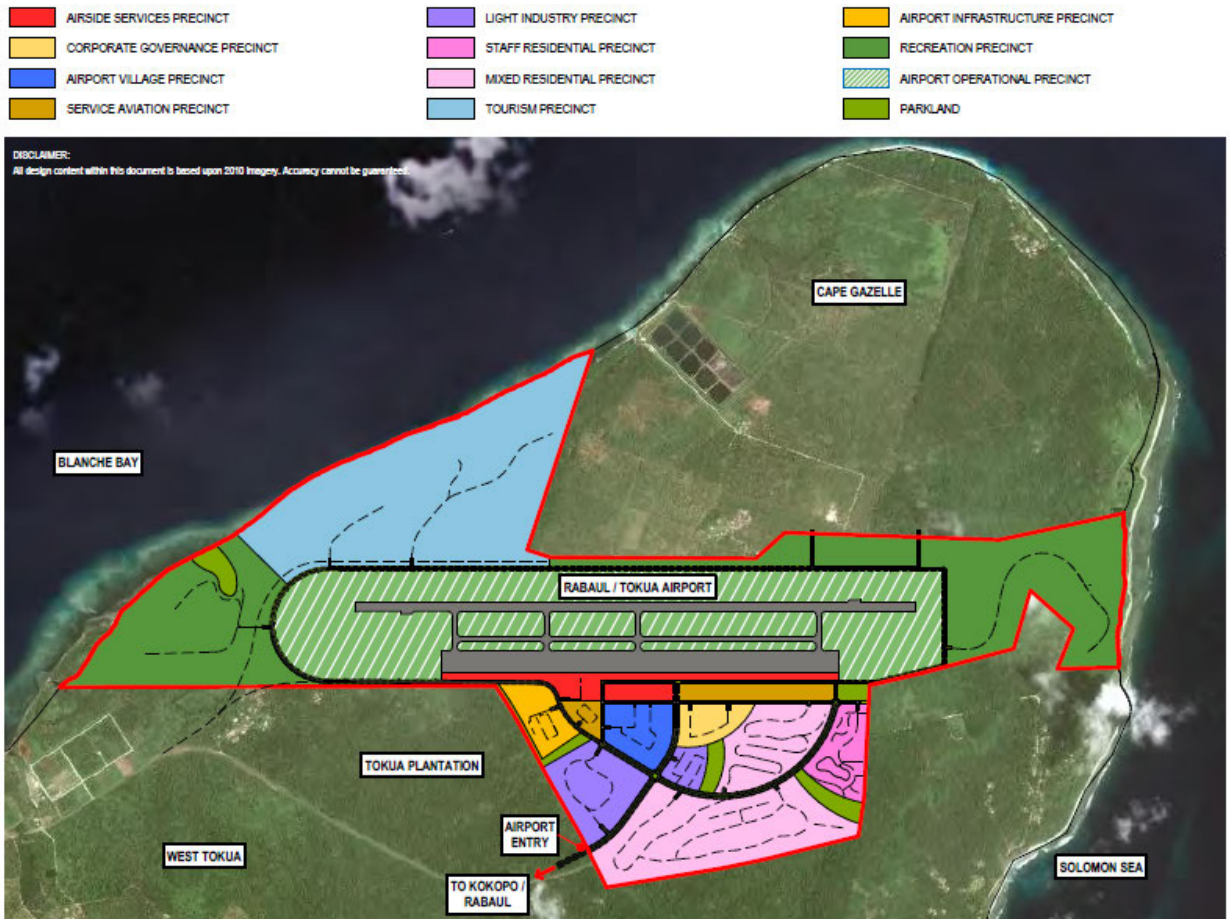
For urban roads and power supply, Urban Area Type 2 will be the planning area.

10.4 Ideas for Urban Development Plan for Kokopo Urban Growth Area

To develop the Kokopo Urban Growth Area which includes the primary urban centre and Tokua Airport providing the necessary land for services, jobs and housing, and development for the future, it is necessary to develop not only along the Kokopo-Tokua Corridor, but developing its hinterland is also important.

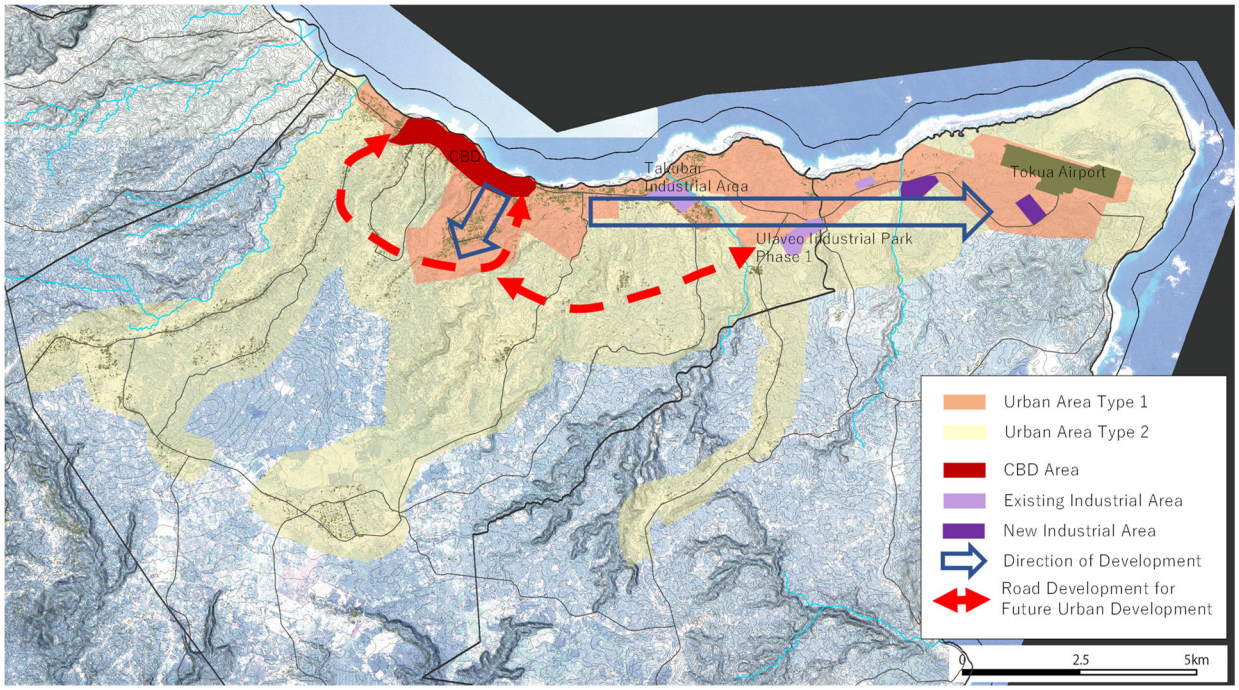
For the target year 2032, the direction of development is proposed to shift toward the east towards Tokua. There are also existing plans such as Kokopo-Tokua Corridor Subject Development Plan (See Figure 10.2.17.) and Tokua Airport City Master Plan 2030-2050 (Updated in 2023) (See Figure 10.4.1.) which propose the development of new industrial areas in Tokua and Ulaveo. As projected in Section 10.3.2, it is necessary for the Kokopo Urban Area to accommodate 1,400 more jobs for manufacturing sector by 2032. Although there are still some vacant lots available at Ulaveo Industrial Park, it is important for these new sites proposed as industrial area to be prepared. Each site is approximately 40 ha. Assuming 1 ha of land accommodates 20 jobs, 80 ha of land will provide 1,600 jobs.

Furthermore, although the area designated as Urban Area Type 1 for 2032 in the hinterland of Kokopo is limited, it is necessary to implement new urban roads for future urban development in Urban Area Type 2. The proposed urban road development ideas are shown in Figure 10.4.2. Details on these roads are described in Chapter 15.



Source: Tokua Airport City Master Plan 2023-2050 (2023), by updating "Planpac Group PNG, 2012, Rabaul Tokua Strategic Master Plan, NAC"

Figure 10.4.1 Tokua Airport City Master Plan, Updated Version 2023



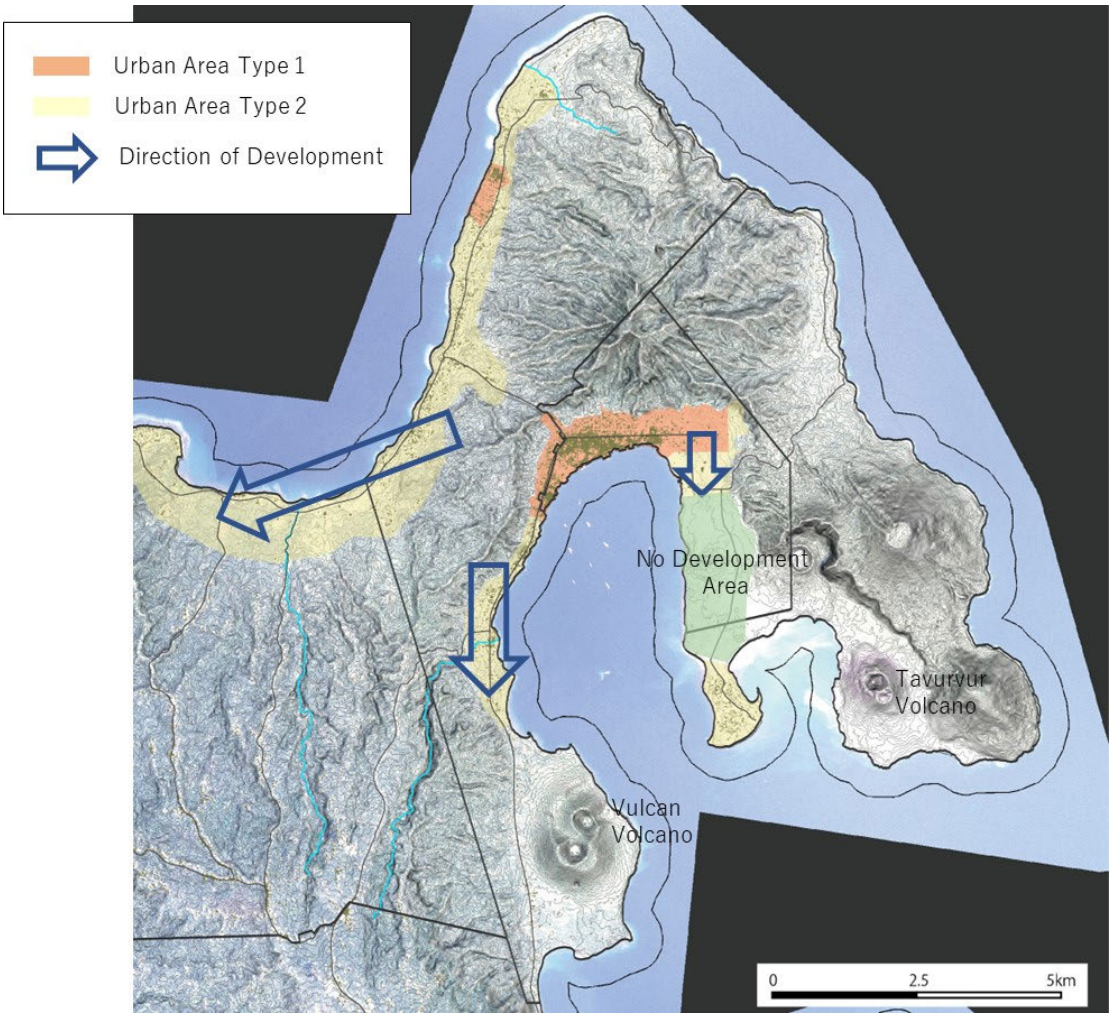
Source: JICA Expert Team

Figure 10.4.2 Ideas on Urban Development in Kokopo Urban Area

10.5 Ideas for Urban Development Plan for Rabaul Urban Growth Area

Since the volcanic eruption in 1994, the direction of development in Rabaul has shifted to the western coastal area and towards the south from Rabaul Town towards Kokopo.

For the target year 2032, the direction of development is proposed to continue the development along the coastal area since Rabaul has limited land that can be utilised in the hinterland of these coastal areas. Due to such natural conditions, available land in Rabaul is quite small. Therefore, the area in Sector 2 could be strategically used for urban development. It has been almost 30 years since the volcanic eruption which destroyed the town, and citizens are now eager to revitalise and develop Rabaul, which once was not only the provincial capital but also the national capital. (See Figure 10.5.1.)

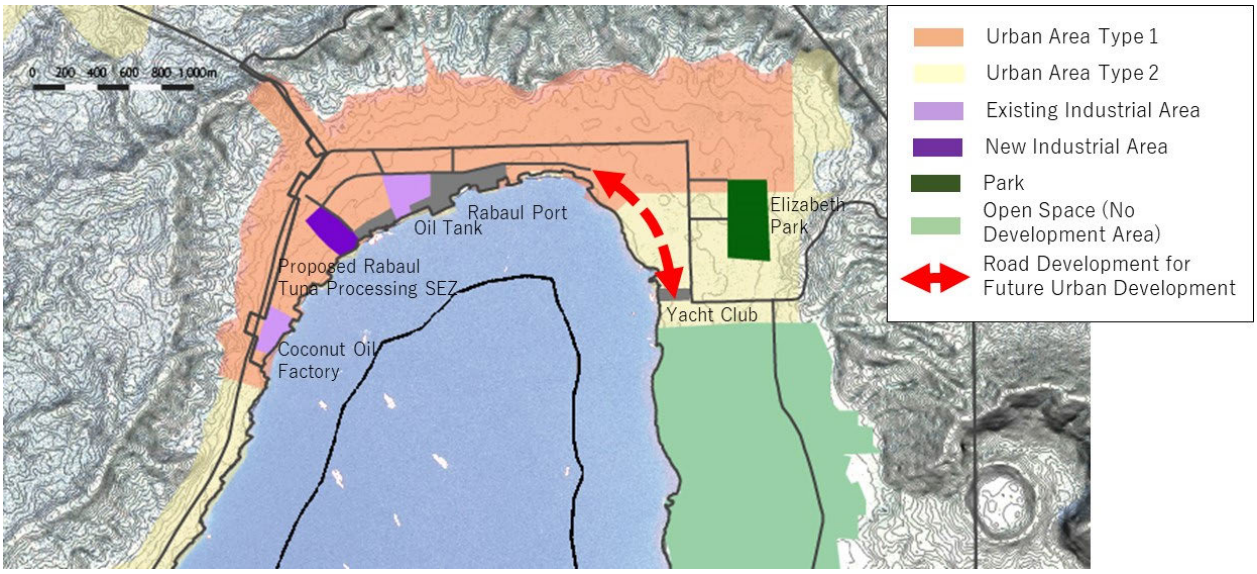


Source: JICA Expert Team

Figure 10.5.1 Ideas on Urban Development in Rabaul Urban Area

There is an existing idea in ENBPA to develop the land west of Rabaul Port to Rabaul Tuna Processing SEZ as shown in Figure 10.3.3. As projected in Section 10.3.3, it is necessary for Rabaul Urban Area to accommodate 500 more jobs for manufacturing sector by 2032. The proposed site is approximately 5 ha. Assuming 1ha of land accommodates 20 jobs, 5 ha of land will provide 100 jobs, which is not sufficient to provide 500 jobs. Since the new industrial areas in Kokopo could accommodate 1,600 jobs, it may be wiser to consider accommodating 200 more jobs in Kerevat Urban Area since land is limited in Rabaul.

For future urban development in Urban Area Type 2, it would be necessary to rehabilitate Blanche Street. This would provide more land available for development. The location of Blanche Street is shown in Figure 10.5.2. Details on the rehabilitation of Blanche Street is described in Chapter 15.



Source: JICA Expert Team

Figure 10.5.2 Ideas on Urban Development in Rabaul Town

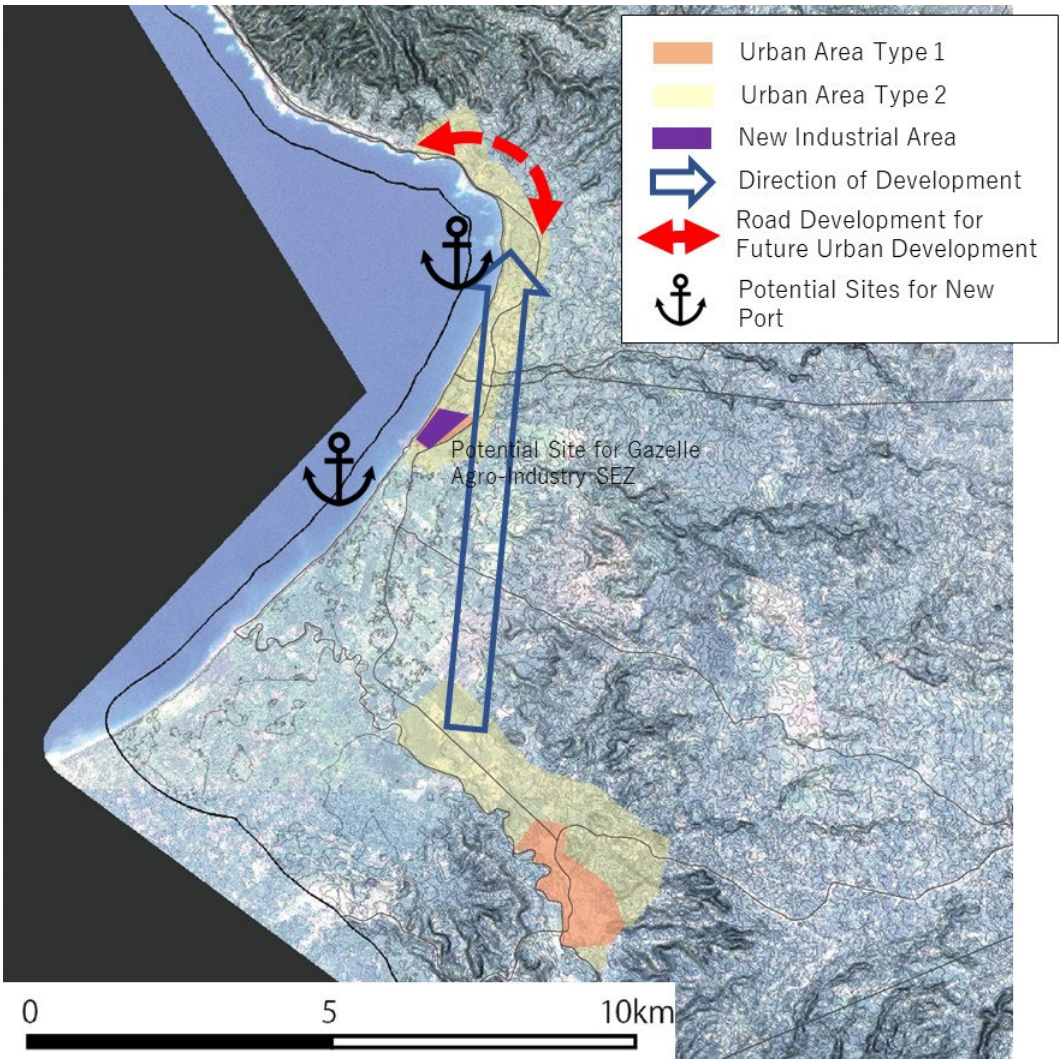
10.6 Ideas for Urban Development Plan for Kerevat Urban Growth Area

To develop the Kerevat Urban Growth Area, urbanisation on Ataliklikun Bay is proposed.

For the target year 2032, the direction of development is proposed to shift toward the northeast towards Kabaira. Also, there are ideas in ENBPA to develop Gazelle Agro-Industry SEZ as well as implement an alternative port in case Rabaul Port is not functional during the next volcanic eruption or any other natural disaster which may prevent the operation of Rabaul Port. The locations of these facilities are still under consideration.

As projected in Section 10.3.4, it is necessary for the Kerevat Urban Area to accommodate 700 more jobs for the manufacturing sector by 2032 Assuming 1 ha of land accommodates 20 jobs, 35 ha of land will be necessary for the first phase of SEZ development.

Furthermore, although the area designated as Urban Area Type 1 for 2032 in the hinterland of Kabaira is limited, implementing new urban roads for future urban development in Urban Area Type 2 as shown in Figure 10.6.1 can help expand the urban area.



Source: JICA Expert Team

Figure 10.6.1 Ideas on Urban Development in Gazelle Urban Area

10.7 General Land Use Plan

The general land use plans for Kokopo Urban Growth Area and Rabaul Urban Growth Area are proposed based on the existing plans reviewed in Sections 10.2.2 and 10.2.3, and the ideas for new urban development discussed in Sections 10.4 and 10.5.

The land use categories used are as follows:

- Public Institutional
- Public Utilities
- Transportation
- Industrial
- Commercial
- Residential
- Mixed Use
- Open Space

10.7.1 General Land Use Plan for Kokopo Urban Growth Area

The general land use plan for Kokopo Urban Growth Area is prepared to guide the future development of the Kokopo-Tokua Corridor and the hinterland of the existing urban areas of Kokopo Town and Takubar.

The general land use plan is divided in two parts and the western part (Kokopo Town to Takubar) is shown in Figure 10.7.1 and the eastern part (Takubar to Tokua) is shown in Figure 10.7.2.

To develop the hinterland of the existing urban areas of Kokopo Town and Takubar industrial area, mixed use development is proposed along the new bypass road and the ring road. The width of the mixed use area is set as 50m from the edge of the road. In addition, Kinabot area is proposed to change its land use from residential to mixed use. This area was originally developed as residential area in Kokopo Town, but some companies are using the existing building as their offices and is now shifting to mixed use area.

For areas which are assumed to have the risk of landslide are proposed as Proposed Open Space to maintain its land use with trees. The areas which are designated as proposed open space are as follows:

- Upstream of rivers in Kokopo District
- Area along Karavi River as buffer

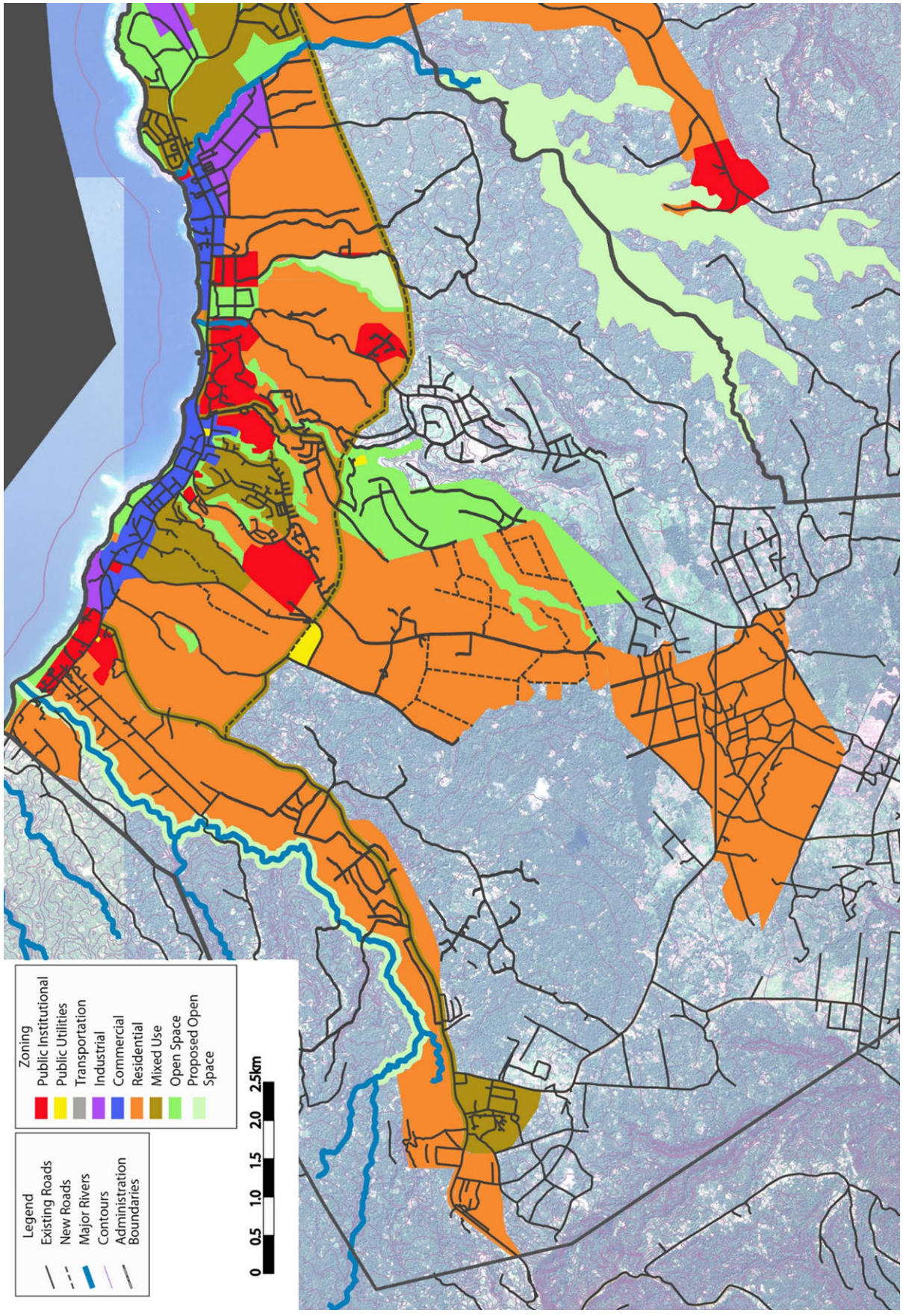
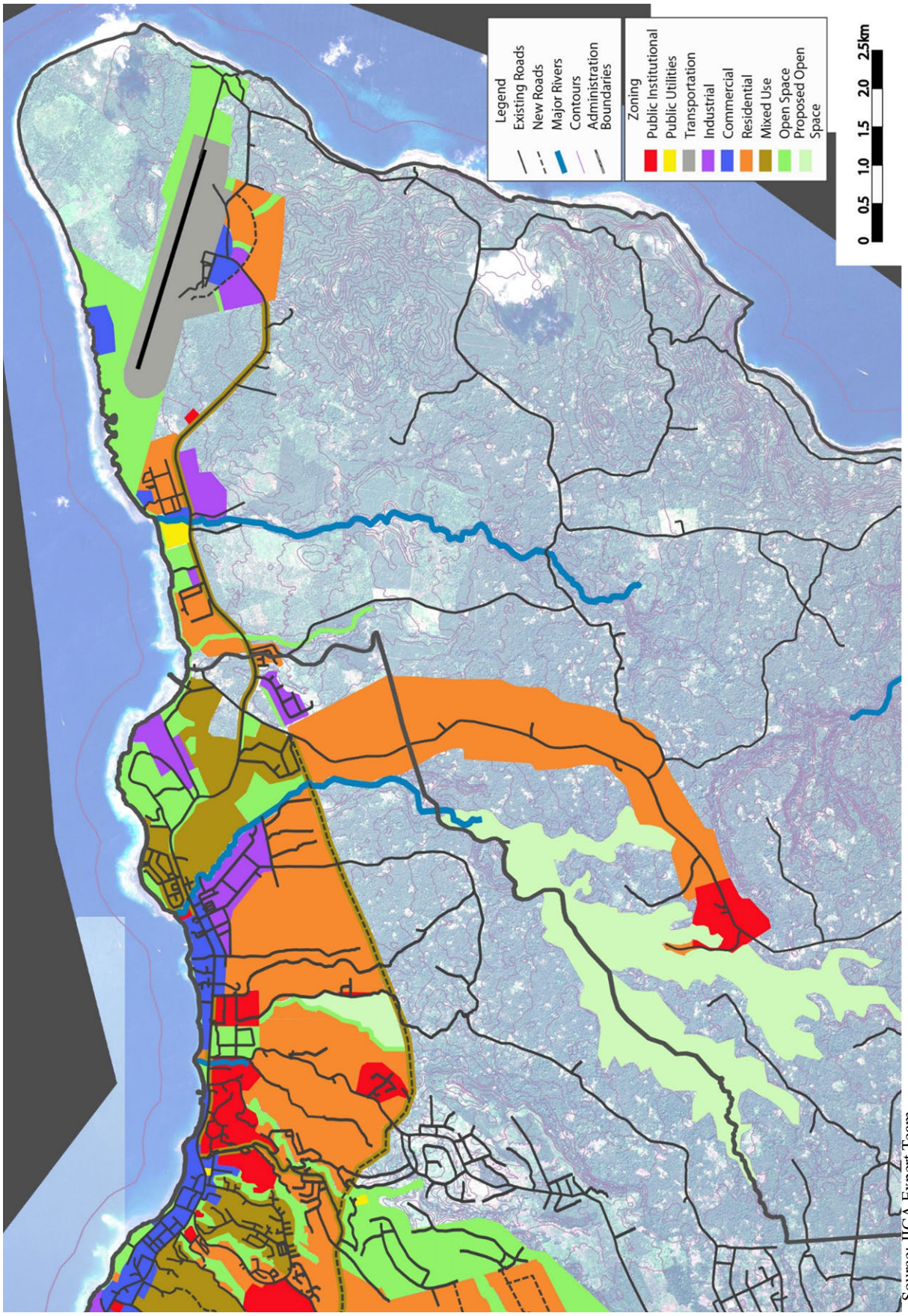


Figure 10.7.1 General Land Use Plan for Kokopo (Kokopo Town to Takubar)

Source: JICA Expert Team



Source: JICA Expert Team

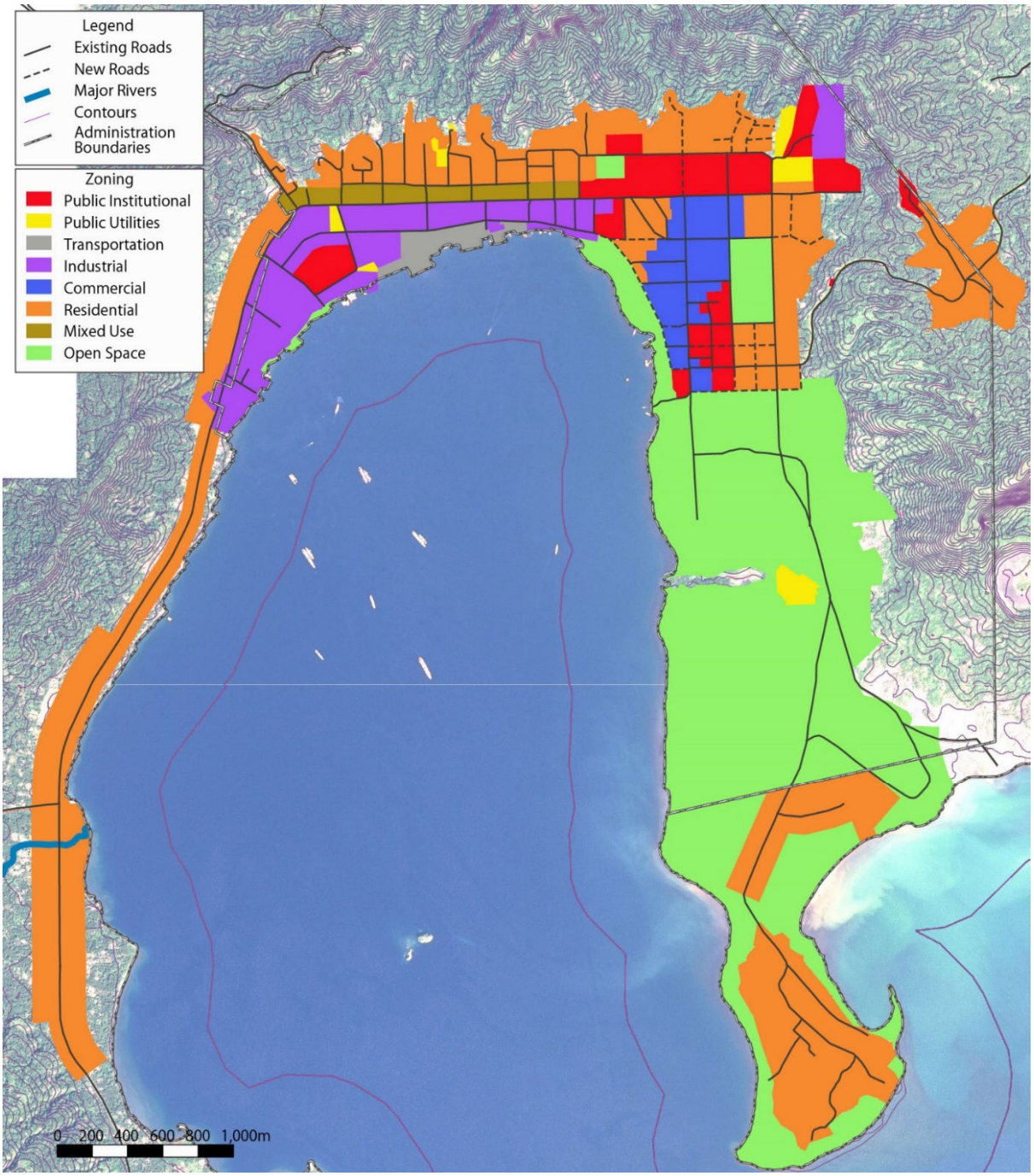
Figure 10.7.2 General Land Use Plan for Kokopo (Takubar to Tokua)

10.7.2 General Land Use Plan for Rabaul Urban Growth Area

The general land use plan for Rabaul Urban Growth Area is prepared to guide the future development of the existing urban area of Rabaul Town and the area along Kokopo Road to Burmah Junction, and the area along North Coast Road between Nonga and Kurakakaul.

The general land use plan is divided in two parts. The area covering Rabaul Town and its surrounding areas are shown in Figure 10.7.3 and the area along North Coastal Road is shown in Figure 10.7.4.

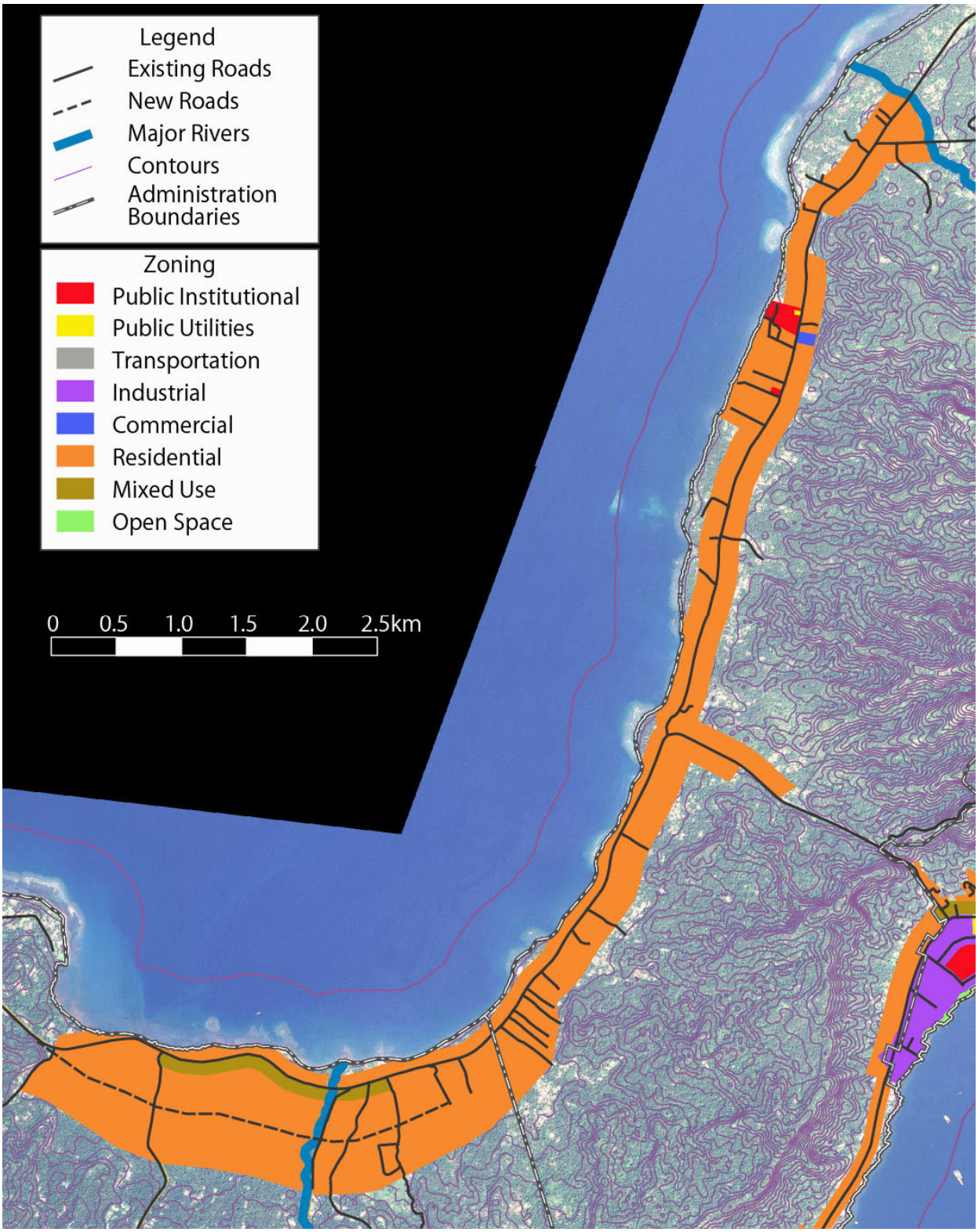
The area which was designated as Sector 3 (no development zone) in 1995 is suggested to remains as open space in the general land use plan. However, considering the current development in and around Matupit Island, certain area along the access road to Maupit and areas in Matupit Island are proposed as residential area.



Source: JICA Expert Team

Figure 10.7.3 General Land Use Plan for Rabaul Town

In Kurakakaul-Nonga areas the slopes are relatively steep. Therefore, the area possible for development is limited to along the North Coast Road. However, around Kurakakaul, where Rabaul District Government Office is located, the slope is gentle and urban development is possible. Therefore, a new road for urban development is proposed for residential development, and mixed use is proposed for the area along the North Coast Road.



Source: JICA Expert Team

Figure 10.7.4 General Land Use Plan for Kurakakaul-Nonga Area

PART VII

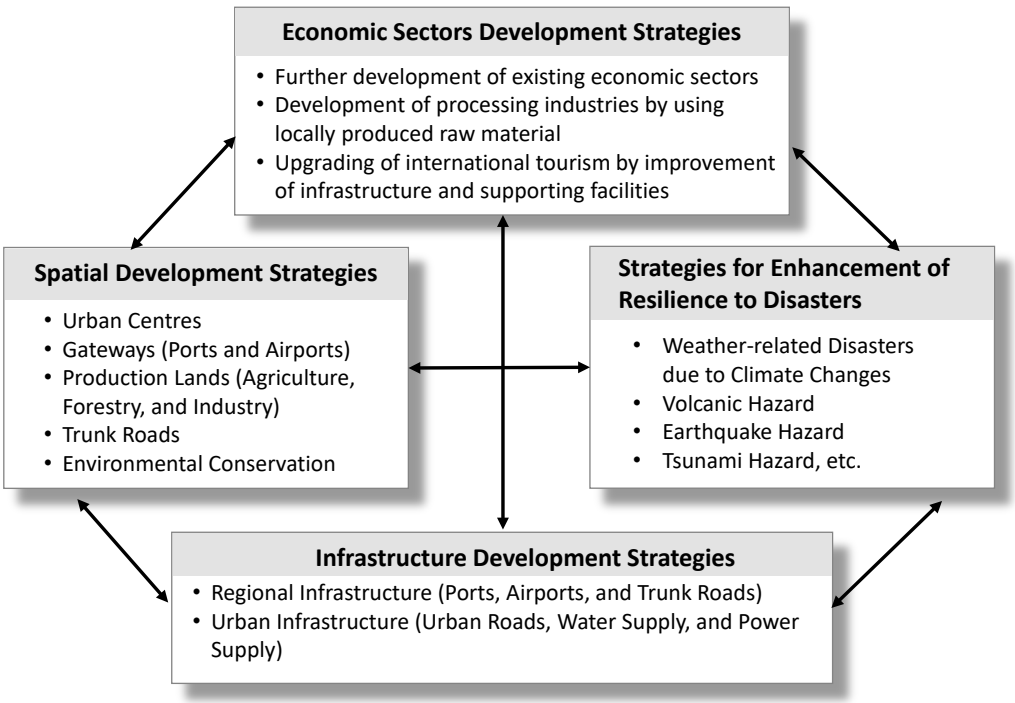
INFRASTRUCTURE DEVELOPMENT PLAN FOR NORTHEAST GAZELLE PENINSULA

Chapter 11 Objectives for Infrastructure Development and Integrated Strategies for Regional Development in Northeast Gazelle Peninsula

11.1 Objectives for Infrastructure Development in Northeast Gazelle Peninsula

Considering the relationship between infrastructure development and other major aspects shown in Figure 11.1.1, the following objectives for infrastructure development in Northeast Gazelle Peninsula are identified:

- To support sustainability of socio-economic activities in the region by maintaining and rehabilitating infrastructures
- To promote development of economic sectors by expanding the coverage of infrastructures and by upgrading them for fully and efficiently utilising wide areas of the region
- To make infrastructures withstand disasters for enhancing resilience of wide areas and important functions of the region
- To provide infrastructures to induce socio-economic development in lower-hazardous areas against disasters
- To provide infrastructures to promote environmental conservation based on natural characteristics of different areas of the region in formulation of the future regional spatial structure



Source: JICA Expert Team

Figure 11.1.1 Major Aspects and Relations Considered in Formulating Regional Development Strategies in Northeast Gazelle Peninsula

11.2 Integrated Strategies for Regional Development with Emphasis of Infrastructure Development by Paying Attention to Different Areas in Northeast Gazelle Peninsula

In Chapters 12 through 18 of "Part VII: Infrastructure Development Plan for Northeast Gazelle Peninsula," a set of development plans for different infrastructure sectors is described sector by sector. On the other hand, this section shows **area-oriented integrated regional development strategies with emphasis of infrastructure development**, considering various aspects (economic sectors, spatial structure, and resilience against disasters) on regional development discussed in Chapter 6.

The following integrated regional development strategies are formulated by **paying attention to different areas of Northeast Gazelle Peninsula** for achieving the vision, goals, and development objectives:

- Basic Strategy 1: Extension and Upgrading of Trunk Road Network for Expanding the Production of Export-Oriented Agriculture and Forestry Sectors and Improving Accessibility of Urban Centres, and for Enhancing Resilience Against Disaster Risks in the Region
- Basic Strategy 2: Renovation of Rabaul Port and Revitalisation of Rabaul Town
- Basic Strategy 3: Industrialisation and Port Gateway Development in Ataliklikun Bay
- Basic Strategy 4: Upgrading of Kokopo-Tokua Urban Corridor as the Primary Centre not only of ENBP, but also of Islands Region
- Basic Strategy 5: Upgrading of Research and Higher Education Functions, with Focus on Volcanos and Marine Environment, and Hospitality Fields
- Basic Strategy 6: Strengthening of ICT Infrastructure and Services in Kokopo, Rabaul and Kerevat Growth Areas
- Basic Strategy 7: Strengthening of Disaster Risk Reduction in Emergency Response, Enhancement of Preparedness and Implementation of Mitigation Structural Measures

These basic strategies for regional development are supported by development efforts at various infrastructures in different locations. Brief outline for each basic strategy is given below.

(1) Basic Strategy 1: Extension and Upgrading of Trunk Road Network for Expanding the Production of Export-Oriented Agriculture and Forestry Sectors and Improving Accessibility to Urban Centres

For promoting wider and more efficient utilisation of lands and other natural resources available in the region, the following kinds of road development are part of the road development strategies in the region:

- To extend the coverage of the trunk road network
- To upgrade backbone roads of the trunk road network

(2) Basic Strategy 2: Renovation of Rabaul Port and Revitalisation of Rabaul Town

1) Renovation of Rabaul Port

Relocation of part or all of Rabaul Port functions might be a choice for the future of the central port of Northeast Gazelle Peninsula (by starting relocation to a new port by 2042, and by establishing a prime port function at a new port by 2052, as proposed in Chapter 13 on Development Plan for Ports), considering the possible impact of a prospective volcanic eruption to Rabaul Town and access roads to Rabaul Port. However, currently the operators are not willing to move the fuel terminal adjacent to Rabaul Port to a new port site. Moreover, the cruise ships are also not pleased to move away from Rabaul because Tavurvur Volcano is their major target attraction for tourists.

Moreover, when it comes to the construction of a new port by relocating the whole function of Rabaul Port, it takes over 10 years to conduct a series of necessary actions for port relocation (not only a survey for environmental impact on the marine environment, regional consultative process, and basic design work for a new port, but also a detailed design work and actual construction of a new port in a new location). Therefore, it is a good option to maintain part of the existing port functions at the current location, to continue handle container cargos, bulk fuels and cruise ships, while implementing renovation works at Rabaul Port.

In order to respond to the increasing overseas container cargos for import and export and bulk fuels for the fuel terminal in Rabaul (not only for Northeast Gazelle Peninsula but also for surrounding island provinces), as well as to the increasing cruise ship arrivals, the following renovation works of the infrastructure of Rabaul Port are necessary in the short and medium terms:

- Rehabilitation (restoration) of ageing and deteriorated infrastructure (Berth 1, Berth 2 and other facilities) of Rabaul Port
- Upgrading of Berth 2 for increasing cargo handling capacities of overseas containers, break bulks and bulk fuels

2) Revitalisation of Rabaul Town in Relation to International Tourism

In the selected "Spatial Structure 3" discussed in Chapter 9, part of Rabaul Port functions including the berth for cruise ship calls, will remain in the current location. Taking advantage of this cruise ship tourism opportunity, the following measures should be taken for improvement and upgrading of international tourist destinations of Rabaul for the purpose of diversifying target tourist segments:

- To rehabilitate the water supply system of Rabaul Town for the purpose of providing stable water supply to cruise ships calling at Rabaul Port
- To conduct beautification and amenity improvement of streets, parks, and marketplaces in Rabaul Town as part of international tourist destinations (and to implement a pilot project for amenity improvement by installing street furniture in Rabaul Town)
- To diversify tourist market segments from the current narrow segment of cruise ship tourists to a wide range of international tourists seeking exotic tropical island resort experiences, eco-tourists, sun and beach tourists, and budget tourists
- To attract high-grade hotels for international tourists and business travelers, as well as budget tourist hotels and guesthouses in Rabaul Town

3) Development of Tuna Processing Industries in the Tuna Processing Special Economic Zone (SEZ) to Be Located Adjacent to the Rabaul Port

- To officially establish an area of SEZ adjacent to Rabaul Port
- To develop an industrial park with necessary infrastructure for attracting and enabling the operation of tuna processing industries in the SEZ
- To provide stable water supply by rehabilitating and upgrading the water supply system of Rabaul Town
- To provide stable power supply to the Tuna Processing SEZ by strengthening power generation and power transmission capacities of the Gazelle Power Grid

(3) Basic Strategy 3: Industrialisation and Port Gateway Development in Ataliklikun Bay

After the volcanic eruptions in Rabaul, ENBPA had sought alternative areas for urban centres and industrial centres away from Rabaul Town in the process of formulating the Urban and Regional Development Plan 2006, ENBP Economic Development Plan 2003-2033, and ENBP Strategic Development Plan 2011-2021. In the course of these planning studies and processes, ENBPA

identified Ataliklikun Bay Area in Gazelle District as a potential alternative location of port and industrial park, which is considered safely away from Rabaul volcanos.

At the same time, the development of an Export Processing Zone (now a Special Economic Zone) for agro-processing industries has been considered and proposed at the area of Ataliklikun Bay in the last decade. In the beginning of 2022, the National Executive Council (NEC) approved the launching of a project for establishing the SEZ. ENBPA and Gazelle District's preference of Ataliklikun Bay as an alternative location for the port and SEZ is derived from the availability of a large tract of church lands along Ataliklikun Bay.

For locating the port function (by relocating part or all of Rabaul Port functions) and SEZ function, the following actions are necessary:

- Improvement of access road (Northern Coastal Road) to Ataliklikun Bay Area
- Provision of stable power supply to Ataliklikun Bay Area
- Provision of water supply to Ataliklikun Bay Area

(4) Basic Strategy 4: Upgrading of Kokopo-Tokua Urban Corridor as the Primary Centre not only of ENBP, but also of Islands Region

Since the relocation of the provincial capital from Rabaul Town after the 1994 volcanic eruptions, Kokopo Town has been playing functions of provincial capital for ENBP and regional capital for Islands Region. When Tokua Airport will be upgraded to an international airport, Kokopo will play an international gateway not only to Kokopo in Northeast Gazelle Peninsula, but also to surrounding island provinces.

Kokopo Town has a potentiality to be upgraded as a regional centre not only for regional administrative functions, export-import business functions, and regional headquarters for business corporations. For accommodating such expansion of urban areas and upgrading of urban functions, Kokopo Town and its surrounding areas (including Takubar and Tokua Areas) should be strongly connected by a town ring road. With this town ring road, urban areas will be expanded to accommodate the prospective expansion of CBD in Kokopo-Tokua Urban Corridor.

(5) Basic Strategy 5: Upgrading of Research and Higher Education Functions, with Focus on Volcanos and Marine Environment, and Hospitality Fields

The ENBP Economic Development Plan 2003-2033 and ENBP Strategic Development Plan 2011-2021 provide ideas on institutional development for research and higher education functions. Considering the potentials and constraints due to volcanos, marine environment and international tourism, Kokopo Town, Rabaul Town and Kerevat Town are potential sites for research and higher education, specifically:

- Kokopo Town for higher education on hospitality business and international tourism
- Rabaul Town for research and higher education on volcanos and thermal energy based on Rabaul Volcanological Observatory
- Kerevat Town for marine environment research and higher education based on Papua New Guinea University of Natural Resources and Environment

(6) Basic Strategy 6: Strengthening of ICT Infrastructure and Services in Kokopo, Rabaul and Kerevat Growth Areas

In comparison with other developed provinces, ENBP has relatively poor telecommunication network and ICT infrastructure. The people and businesses in ENBP have less accessibility to ICT services. For advancement of more economic sectors, especially processing industries, upgraded international tourism, and regional business centre functions, ICT infrastructure and services should be upgraded, especially in the three growth areas (Kokopo, Rabaul and Kerevat Growth Areas).

(7) Basic Strategy 7: Strengthening of Disaster Risk Reduction in Emergency Response, Enhancement of Preparedness and Implementation of Mitigation Structural Measures

Since the 1980s, Rabaul Volcanological Observatory (RVO) has played an important role for monitoring and researching volcanic activities and volcanic hazards. At the same time, RVO put its effort at raising people's awareness of volcanic risks.

However, in recent years, RVO's assistance funding from international development partners has been decreasing. The technical equipment for volcano monitoring has become obsolete and deteriorated.

Monitoring and early warning, as well as analysis of volcanic hazard and risks, are essential for the region (Northeast Gazelle Peninsula) to be prepared for future potential volcanic eruptions and their disaster risks to the people, assets and economic activities. In this sense, it is necessary to update the technical equipment for volcanic monitoring and revitalise its research activities and functions in the context of sustainable and resilient development of the region.

Chapter 12 Development Plan for Trunk Roads

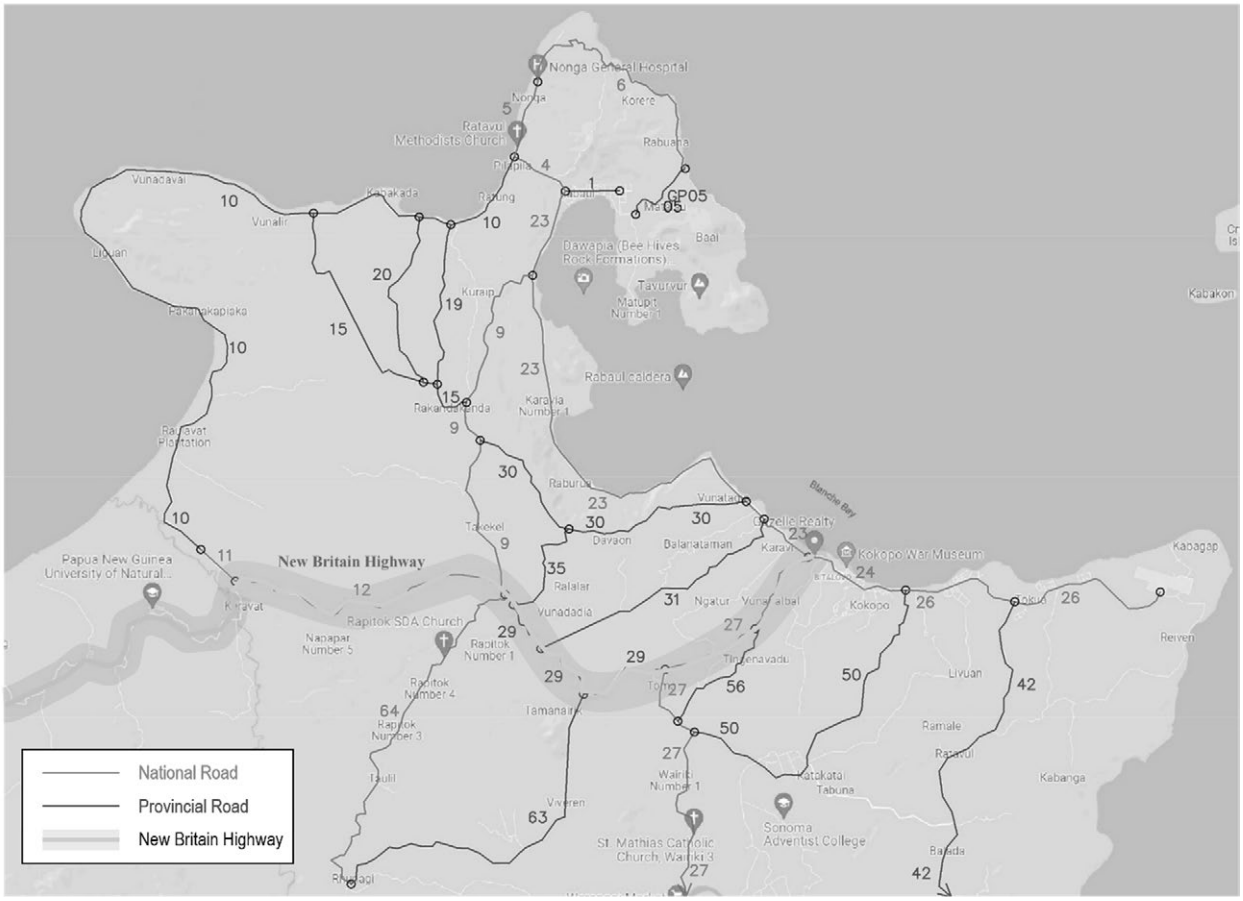
12.1 Present Situation of Trunk Roads and Land Transport

12.1.1 Road Classification

In PNG, all roads managed by the government are classified into National Roads or Provincial Roads. This classification is based on the ownership of the assets and the source of funding for the road's initial construction and maintenance. The roads that come under the National Government's responsibility (National Roads) are further classified as National Route (NR), National Main Road (NMR), National District Road (NDR), or Institutional Road (NI). Those that are looked after by the Provincial Government (Provincial Roads) are Provincial Trunk (PT), District Feeder (DF), Local Access (LA), Local Town (LT) and Private Roads (P).

East New Britain Province has 1,564 km of roads, which account for 5.7% of all the roads in PNG. Of this total length of roads, 204 km comprised of National Roads and 1,360 km of Provincial Roads.

In Northeast Gazelle Peninsula, the 25 roads shown in Figure 12.1.1 and Table 12.1.2 are categorised as trunk roads.



Source: JICA Expert Team in Consultation with Technical Working Group for Roads of NEGID-Plan

Figure 12.1.1 Proposed Trunk Roads in Northeast Gazelle Peninsula

Table 12.1.1 Trunk Roads Proposed by JICA Expert Team in Consultation with Technical Working Group of NEGID-Plan for Northeast Gazelle Peninsula, 2022

NO. in Inventory 2003	NO. in Inventory 1990	ROAD NAME	ROAD		ROAD LENGTH		LENGTH (KM)	LLG AREA	ROAD CONDITION	CLASSIFICATION
			TYPE	STATUS	START	END				
1	GP01	MALAGUNA	TRUNK	SEALED	TUNNEL HILL	OLD MARKET	5.9	RABAUL ULLG	GOOD	PROVINCIAL TRUNK
4	GP02	TUNNEL HILL	TRUNK	SEALED	TUNNEL HILL	TOLEAP	2.7	RABAUL/BALA	GOOD	NATIONAL ROUTE
5	GP03	NONGA	TRUNK	SEALED	TOLEAP	NONGA HOSP.	3.4	BALANATAMAN	GOOD	NATIONAL DISTRICT RD
6	-	KORERE	FEEDER	SEALED	NONGA HOSP.	MATALAU	10.5	BALA/KOMBIU	POOR	NATIONAL DISTRICT RD
9	GP11	BURMAH	TRUNK	SEALED	BURMAH JUNC.	TOKARONGON	14.2	BALA/CENTRAL	GOOD	NATIONAL ROUTE
10	GP12	NORTH COAST	TRUNK	SEALED	TOLEAP	LAES	39.7	BALA/LIVUAN/CENT	GOOD	PROVINCIAL TRUNK
11	GP12	LAES	TRUNK	SEALED	LAES	KEREVAT	2.1	CENTRAL	GOOD	INSTITUTIONAL ROAD
12	GP13	KEREVAT	TRUNK	SEALED	TOKARONGON	KEREVAT	14	CENTRAL	GOOD	NATIONAL DISTRICT RD
15	-	VUNAPAKA	FEEDER	SEALED/DIRT	RAKUNAI	VUNALIR	13.6	REIMBER/LIVUAN	FAIR	PROVINCIAL TRUNK
19	-	KAVAVAR	FEEDER	SEALED	KAVAVAR	KURAKAKAUL	7.05	REIMBER/LIVUAN	FAIR	PROVINCIAL TRUNK
20	-	RAMALMAL	FEEDER	SEALED	RAMALE	VUNAVUTUNG	7.08	REIMBER/LIVUAN	FAIR	PROVINCIAL TRUNK
23	GP10, GP22	KOKOPO	TRUNK	SEALED/DIRT	TUNNEL HILL	KOKOPO H/SCH	25.9	BALA/RAL/KPO/VM	GOOD	NATIONAL MAIN ROAD
24	-	WILLIAMS RD	4 LANE	SEALED	KOKOPO H/SCH	VUNAPOPOE	3	KPO ULLG	GOOD	NATIONAL MAIN ROAD
26	-	TOKUA	TRUNK	SEALED	VUNAPOPOE	TOKUA	9	KPO/VM/BITAPAKA	GOOD	NATIONAL MAIN ROAD
27	GP23, GP40	WARONGOI	TRUNK	SEALED	KOKOPO H/SCH	WARONGOI D	28.9	KPO/VM/TOMA/SINIVIT	GOOD	NATIONAL MAIN ROAD
29	GP23	TOMA	TRUNK	SEALED	BALIORA	TOKARONGON	10.1	TOMA/VUNADIDIR	GOOD	PROVINCIAL TRUNK
30	-	KURADUI	FEEDER	SEALED	KURADUI	NAVUNARAM	13.1	RALUANA/CENTRAL	GOOD	PROVINCIAL TRUNK
31	-	MALAPAU	FEEDER	SEALED	MALAPAU	TOMAVATUR	12.3	RAL/VDR/TOMA	GOOD	PROVINCIAL TRUNK
35	-	VUNADIDIR	FEEDER	DIRT	VUNADIDIR	NANGANANGA	8.1	VDR/RALUANA	FAIR	PROVINCIAL TRUNK
42	GP34, GP35	GANAI	TRUNK	SEALED/DIRT	KABAKAUL	SIGUTE	25.5	BITAPAKA	FAIR	PROVINCIAL TRUNK
50	GP43	BAILU	TRUNK	SEALED	BAILU	VUNAPOPE	15	VUNAMAMI	POOR	PROVINCIAL TRUNK
56	-	BITAVAVAR	ACCESS	SEALED/GRAVEL	BITAVAVAR	MALAKUNA 4	5.6	VUNAMAMI	FAIR	PROVINCIAL TRUNK
63	-	RATUNUR	FEEDER	SEALED/GRAVEL	TOMA JUNCTION	GAULIM	17	TOMA/INLAND BAIN	POOR	PROVINCIAL TRUNK
64	GP50	GAULIM	TRUNK	SEALED/GRAVEL	TOKARONGON	GAULIM	16.7	TOMA/INLAND BAIN	FAIR	NATIONAL ROUTE
-	GP05	MATALAU	TRUNK	SEALED/DIRT	MATALAU	NAMANULA	4.5	KOMBIU	POOR	PROVINCIAL TRUNK

Source: JICA Expert Team in Consultation with Technical Working Group for Road of NEGID-Plan

12.1.2 Traffic Volume on Trunk Roads

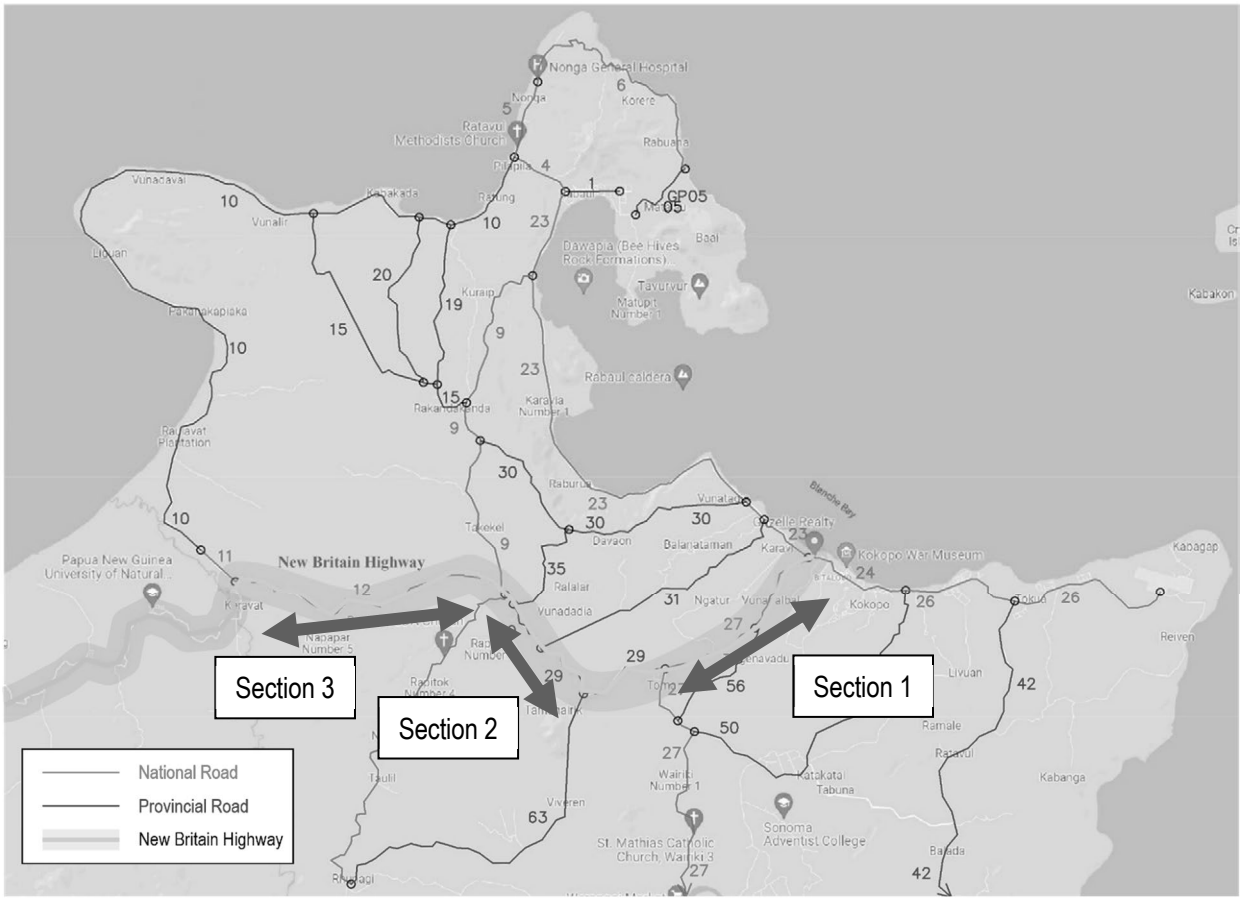
(1) Traffic Volume of New Britain Highway

The major national road in Northeast Gazelle Peninsula is the New Britain Highway, which is being constructed to connect the provincial capital of ENBP, Kokopo to the provincial capital of WNBP, Kimbe. The road is still under construction, but the sections from Kokopo beyond Kerevat and Papua New Guinea University of Natural Resources and Environment are in good condition.

Traffic survey of New Britain Highway by the Department of Works was conducted in January to February 2021. The Project for NEGID-Plan also conducted traffic survey covering Northeast Gazelle Peninsula in October to November 2023.

The data was collected in both surveys to understand number of vehicles in the three sections of the New Britain Highway as shown in Figure 12.1.2. The average number of vehicles from the two surveys are compared in Table 12.1.2. The traffic volume on New Britain Highway is higher near Kokopo and decreased as it moves towards Kerevat.

The number of vehicles on New Britain Highway has increased by 15% to 40% depending on the section in approximately three years between February 2021 and October/November 2023. The number of vehicles in February 2021 may have been affected by COVID-19. Although, in February 2021, there were no lockdown period, the immigration restriction measures were still in place, and it is assumed that the number of foreigners and tourists were less than the period before and after COVID-19.



Source: JICA Expert Team

Figure 12.1.2 New Britain Highway and Sections for Traffic Volume

Table 12.1.2 Changes in Traffic Volume on New Britain Highway (Kokopo Secondary School – Kerevat)

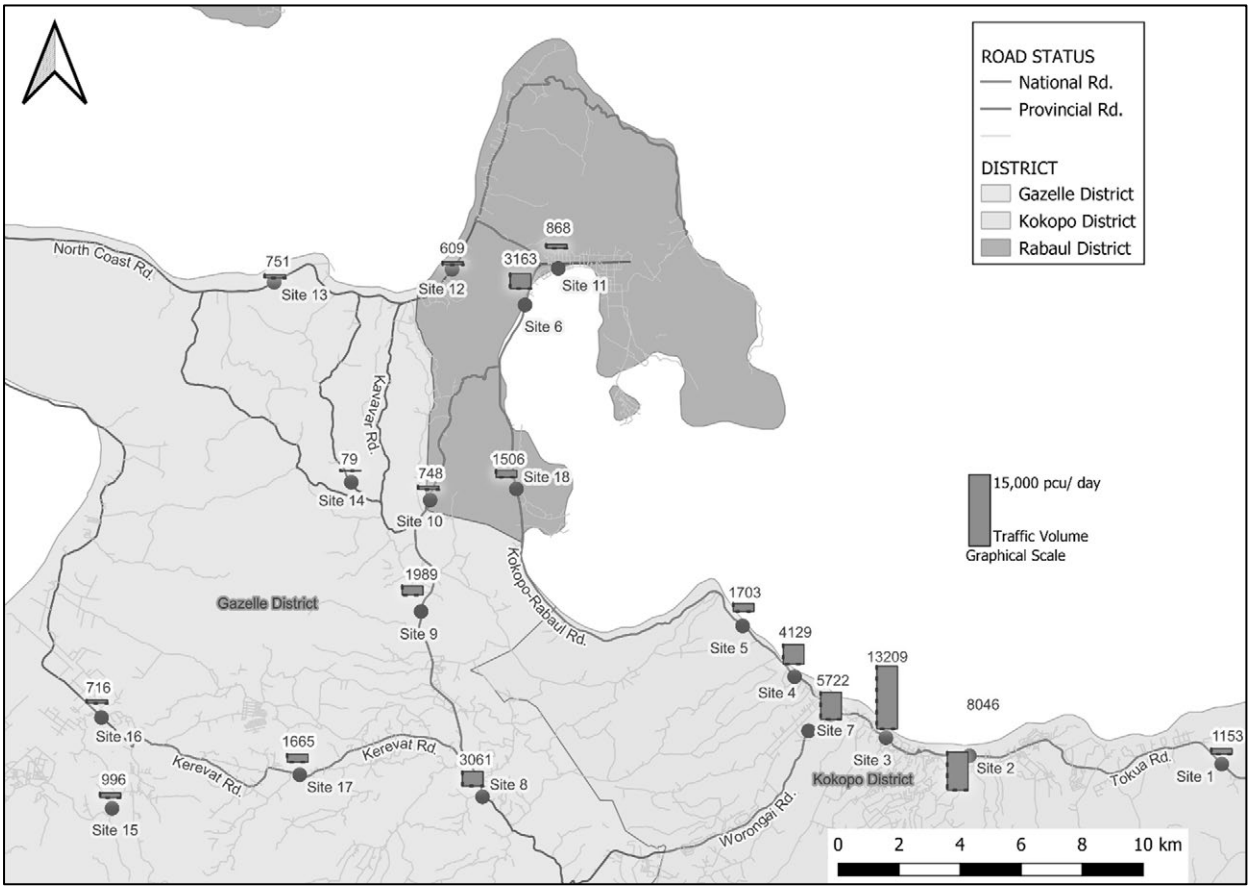
Section	Directions	Jan. & Feb. 2021[1] (vehicle/day)	Oct. & Nov. 2023[2] (vehicle/day)	Growth Rate (%)
Section 1	From Kokopo to Baliora	2,010	2,483	23.5%
	From Baliora to Kokopo	1,954	2,418	23.7%
Section 2	From Toma to Tokarongon	906	1,251	38.1%
	From Tokarongon to Toma	1,055	1,215	15.2%
Section 3	From Tokarongon to Kerevat	461	641	39.0%
	From Kerevat to Tokarongon	474	633	33.5%

Note: Average number of vehicles of Wednseday, Thursday and Friday is used for the data in 2021. Average number of vehicle of Tuesday and Thursday is used for the data in 2023.
Source 1: Department of Works, 2021
Source 2: JICA Expert Team

(2) Traffic Volume on Other Major Trunk Roads in Northeast Gazelle Peninsula

The result of the traffic survey conducted in the Project for NEGID-Plan is shown in Figure 12.1.3. The detail of the traffic survey is written in the Appendix.

The largest traffic volume in Northeast Gazelle Peninsula is seen on Williams Road in Kokopo Town with over 13,000 pcu/day. On Kokopo-Rabaul Coastal Road, around 1,500 to 1,700 pcu/day can be seen. On the other hand, around 2,000 to 3,000 puc/day is travelling on Top Road from Kosec Junction at Kokopo Secondary School to Rakunai Junction. The number of vehicles decreases on Burmah Road. However, during the period of the survey, there were riots in Rabaul Town and the number of vehicles travelling to and from Rabaul could have been less than usual. The number of vehicles on Kokopo-Tokua Corridor is around 1,150 pcu/day, but this figure also could have been affected by the changes in flight schedules at Tokua Airport.



Source: JICA Expert Team

Figure 12.1.3 Traffic Volume on Major Trunk Roads in Northeast Gazelle Peninsula

12.1.3 Land Transport

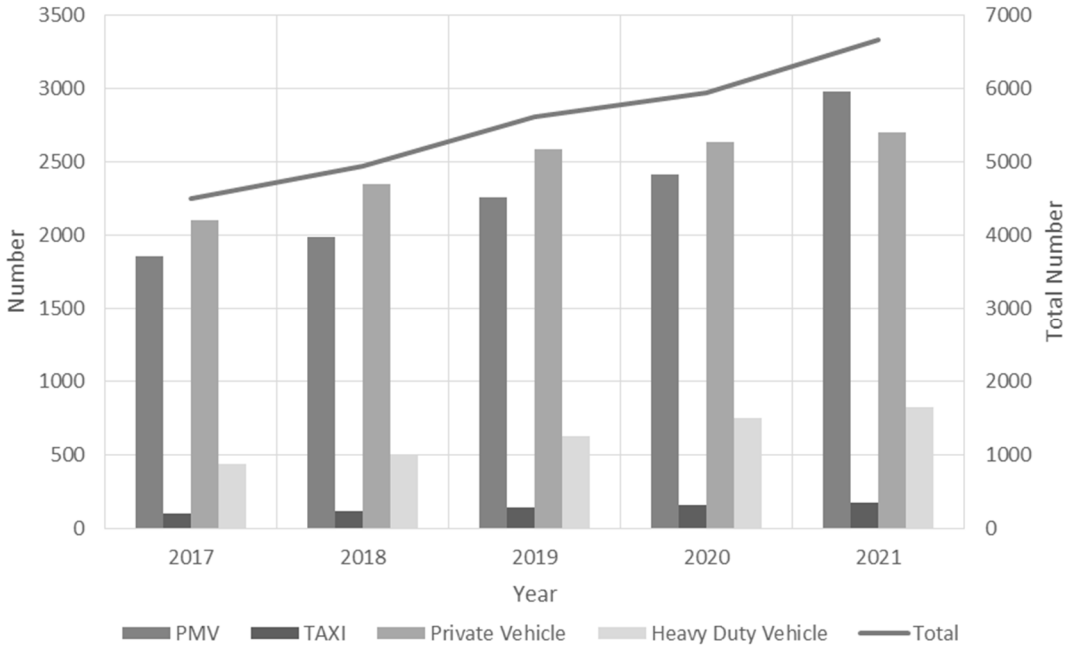
Division of Finance manages the land transport and maritime transport. Managing land transport involves the registration of motor vehicles and issuance of vehicle insurances. In relation to management of maritime transport, said office, instead of the National Maritime and Safety Authority (NMSA), operates three boat stops in ENBP and monitor overloading and wearing of lifejacket.

The table and figure below show the number of registered vehicles in ENBP in the past 5 years. The number of registered motor vehicles increased from 2017 to 2021.

Table 12.1.3 Number of Registered Vehicles in ENBP

Year	PMV	Taxis	Private Vehicles	Heavy-Duty Vehicles	Total	Annual Increase Rate (% p.a.)
2017	1,856	101	2,101	435	4,493	-
2018	1,983	120	2,343	500	4,946	10.1%
2019	2,255	143	2,584	625	5,607	13.4%
2020	2,410	156	2,630	750	5,946	6.0%
2021	2,975	170	2,702	820	6,667	12.1%
Annual Average Increase Rate by Vehicle Type 2017-2021 (% p.a.)	12.5%	13.9%	6.5%	17.2%	10.4%	-

Source: Division of Finance, ENBPA



Source: Division of Finance, ENBPA

Figure 12.1.4 Number of Registered Vehicles in ENBP

Private vehicles have white licence plates on and are mostly owned by companies and private individuals. Taxis have yellow plates on and are mostly sedans and double cab utility vehicles which can carry up to 5 people only. Passenger Motor Vehicles (PMV) are 15-seater vans and trucks with bench which carry passengers in ENBP and usually have blue registration plates on. 25-seater buses are also used for PMV in large cities, such as Port Moresby and Lae. Heavy-duty vehicles are ferry cargoes and are mostly owned by companies that carry cargoes from the wharf at Rabaul to Kokopo. Some are used for carrying balsa, logging and oil palm operations.

In ENBP, the main types of land transportation are private cars, taxis and PMV, and the mostly used vehicle type is PMV. Based on the hearing survey with venders of Kokopo Market, most

venders use PMV to carry their products to Kokopo Market. Although the number of registered vehicles is increasing, according to the Division of Finance, some PMV drivers lost their jobs due to the COVID-19 pandemic.

PMV

Taxi

Private Car

Heavy Duty Vehicle

Source: JICA Expert Team

Figure 12.1.5 Vehicle Types Used in ENBP

PMVs are operated in the fixed route as city buses. PMVs are not organised by companies or by the local government. They are owned and operated by individuals. Each driver pays PGK200 to Division of Finance of ENBP for registration. Then the drivers select the service routes considering traffic demand, development situation of surrounding areas and road conditions.

Passengers pay PGK1~5 per trip. There are stops in the PMV routes. The passengers can get off on fixed locations. The PMV routes and locations of PMV stops are planned by Division of Finance and approved by the Transport Board of ENBPA. Shelters for passengers at PMV stops are installed by Division of Technical Services of ENBPA.

PMV Stop (at Kokopo Market)

PMV Stop (at Navunaram)

Source: JICA Expert Team

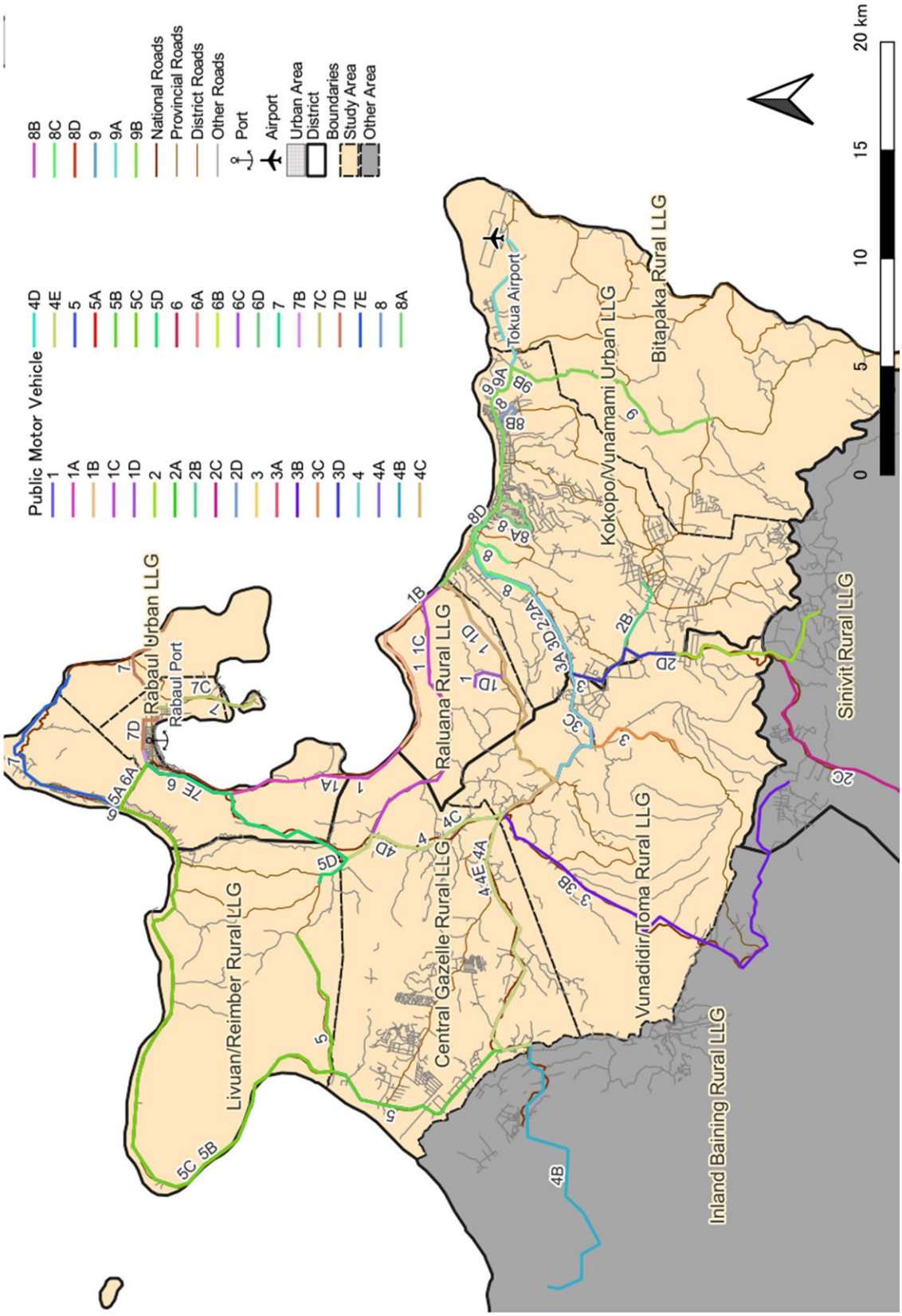
Figure 12.1.6 Bus Stops in Northeast Gazelle Peninsula

There are nine PMV routes in ENBP, and each route has branch routes. The table and figure below show routes of PMV and distances. The number which shows PMV routes is written on the front and back of PMVs.

Table 12.1.4 PMV Routes and Distances in Northeast Gazelle Peninsula

Route	Departure	Destination	Distance (km)
1A	Kokopo	Rabaul Town	26.3
1B	Kokopo	Raluana / Raburua	13.7
1C	Kokopo	Nangananga / Navunaram	18.6
1D	Kokopo	Tinganalom / Tapipipi	16.7
2A	Kokopo	Baliora	9.91
2B	Kokopo	WarangoiTownship	32.8
2C	Kokopo	Sikut Settlement	24.3
3A	Kokopo	Tokarongon Junction	19.7
3B	Kokopo	Rapitok / Malabunga / Gaulim	47.4
3C	Kokopo	Bitakapuk/Viviran	18.9
3D	Kokopo	Wairiki	15.5
4A	Kokopo	Kerevat	33.3
4B	Kokopo	Utmei	19.5
4C	Kokopo	Tomaringa / Navunaram / Rakunai	28.2
4D	Rabaul	Navunaram / Tomaringa / Tokarongon	19.3
4E	Rabaul	Kerevat	32.7
5A	Rabaul	Livuan via North Coast Rd	21.8
5B	Rabaul	Kerevat via North Coast	45.8
5C	Rabaul	Iatapal via Burmah Road	42
5D	Rabaul	Ramale Junction	13.4
6A	Rabaul	Kurakakaul	6.9
6B	Rabaul	Nonga / Tavui	7.79
6C	Rabaul	within Rabaul Town	1.85
6D	Rabaul	Rapolo	4.54
2B	Kokopo	Gelegele	17.2
7A	Rabaul	within Rabaul Town	-
7B	Rabaul	Rapolo	4.54
7C	Rabaul	Matupit	7.24
7D	Rabaul	Baai	10
7E	Rabaul	Korere	14
8A	Kokopo	Kenabot	5.37
8B	Kokopo	Takubar / Seaview	6.83
8C	Kokopo	V'mami / Bitavavar	10.4
8D	Kokopo	Butuwin / Malapau	4.46
9A	Kokopo	Tokua Airport	14.2
9B	Kokopo	Bitapaka / Ralubang	18.4

Source: JICA Expert Team, based on information from ENBPA's Division of Finance and Division of Technical Services and other sources



Source: JICA Expert Team based on information from ENBPA's Division of Financ and Division of Technical Services, as well as from other sources

Figure 12.1.7 Road Map of PMV Routes in Northeast Gazelle Peninsula

12.2 Issues on Development of Trunk Roads

(1) Necessity of Maintenance and Rehabilitation of Trunk Roads

A trunk road network should enable vehicles to have reasonable travel speed and keep maintenance costs as low as possible for the purpose of supporting socioeconomic activities and promoting economic development in Northeast Gazelle Peninsula. All trunk roads identified by the JICA Expert Team, in consultation with the Technical Working Group for Roads of NEGID-Plan, should be maintained or rehabilitated in good condition for this purpose.

However, these trunk roads currently have any or combination of the following problems:

- No proper drainage facilities
- Not enough road width
- No sidewalk
- No proper horizontal or vertical alignment
- Presence of soil erosion along roads

The present conditions of the trunk roads are shown in Appendix D.

(2) Necessity of Expansion of Trunk Roads

Northeast Gazelle Peninsula's current major economic sectors are export-oriented agriculture and forestry, and fertile soil from volcanic rocks is suitable for such agricultural and forestry production. However, as the population continues to grow in the region, accessible arable lands become limited. Therefore, it is necessary to expand the coverage of a well-conditioned trunk road network.

In the last decade, the following national roads have been improved for expanding the trunk road network:

- National Road between Kokopo Town CBD and Tokua Airport
- National Road between Kokopo Town CBD and Open Bay
- National Road between Kokopo Town CBD and Warangoi (where a hydropower generation plant is located)
- National Road between Kokopo and Gaulim

It is necessary to further continue expand the trunk road network in order to cover wider areas with higher density.

(3) Necessity of Upgrading Functions of Trunk Roads for Primary Centres in the Regional Spatial Structure

There are four locations that serve as primary centres within the region (Northeast Gazelle Peninsula):

- Kokopo Town CBD, which is the provincial administrative centre and commercial centre of the region
- Rabaul Port, a transport hub for imports and exports
- Tokua Airport, a hub for inter-provincial passenger transportation

These three primary centres need to have good road connectivity across the region. However, the present conditions of the trunk roads do not always satisfy good connectivity for primary centres in the regional spatial structure. Therefore, it is necessary to upgrade trunk road functions in response to the regional spatial structure.

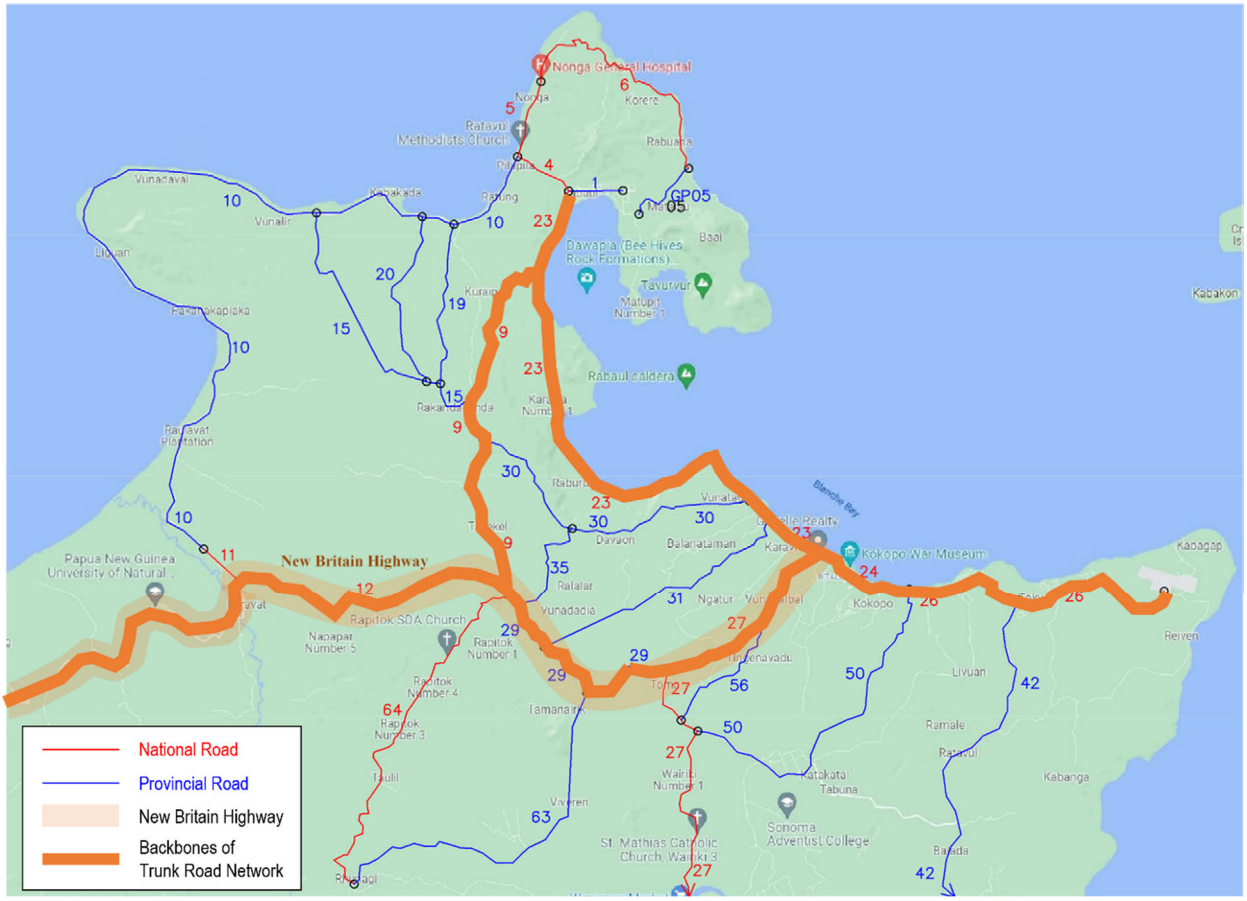
Furthermore, if some functions of Rabaul Port are to be relocated to a new site, the locations of these primary centres will change. As a result, the trunk road network and its primary roads will also change. Therefore, it is necessary to upgrade trunk road functions in response to the transformation of the regional spatial structure.

(4) Disaster Vulnerability and Low Transport Functionality of Current Backbones of Trunk Roads

Among the trunk roads in Northeast Gazelle Peninsula, the following three roads are particularly important at present, and they are classified as the present primary trunk roads (the backbones of trunk roads) in the region:

- Coastal Road from Kokopo Town CBD to Rabaul Port, which is currently the one mostly used by trucks. However, this coastal road is vulnerable to volcanic ashfall in case of large volcanic eruption, as well as to seasonal heavy rainfall.
- Top Road from Kokopo Town CBD to Rabaul Port, which is an inland route, is an all-weather road. However, there is a narrow winding and steep slope section near Burma Junction, where heavy trucks cannot pass.
- Road from Kokopo Town CBD to Tokua Airport is a road in a relatively good condition. However, the future increase of traffic demand in Kokopo Town might disturb smooth traffic flow through the main street of Kokopo Town CBD.
- Road from Kokopo Town CBD, Rabaul Port and Tokua Airport via Kerevat to Open Bay and farther to Kimbe, the capital city of West New Britain Province. The section between Kerevat and Open Bay has not yet been well constructed as a primary trunk road.

Therefore, these four roads need to be developed into roads with high functionality as primary trunk roads (backbones) in the region.



Source: JICA Expert Team

Figure 12.2.1 Backbones of Trunk Road Network in Northeast Gazelle Peninsula at Present and in the Next Decade until 2032

12.3 Objectives of Development of Trunk Roads

In response to the identified issues on development of trunk roads and the overall objectives of regional development for Northeast Gazelle Peninsula, the following objectives of development of trunk roads are identified:

- To support sustainability of socio-economic activities of people and economic sectors of the region by maintaining and rehabilitating the trunk roads
- To enhance the disaster resilience of wide areas of the region by improving the resilience of trunk roads against disasters including redundancy of the trunk road network in the region
- To promote the development of economic sectors in the region by upgrading the primary routes and secondary routes of the trunk road network in the region
- To widely and efficiently utilise lands in the region for promoting the development of economic sectors by expanding the trunk road network in the region

12.4 Strategies for Development of Trunk Roads

In order to achieve the objectives of development of trunk roads described in the previous section, the following strategies are formulated:

(1) To Maintain and Rehabilitate Trunk Roads for Supporting Sustainability of Socio-Economic Activities of People and Economic Sectors of the Region

The 25 trunk roads identified by the ENBPA and Technical Working Group for Roads have a variety of problems as described in Appendix D. It is necessary to maintain and rehabilitate the trunk roads to keep them in good condition.

(2) To Enhance the Resilience of Trunk Roads for Improving Disaster Resilience of Wide Areas of the Region

It is necessary to enhance the resilience of trunk roads against the two disasters described below and adopt the following measures:

1) Sediment Disaster By Improving Drainage Facilities and Vertical Alignment

In this aspect, it is necessary to pay attention to Kokopo-Rabaul Coastal Road.

2) Volcanic Ash Disaster By Improving the Redundancy of the Trunk Road Network in the Region for Enhancing the Disaster Resilience of Wide Areas of the Region

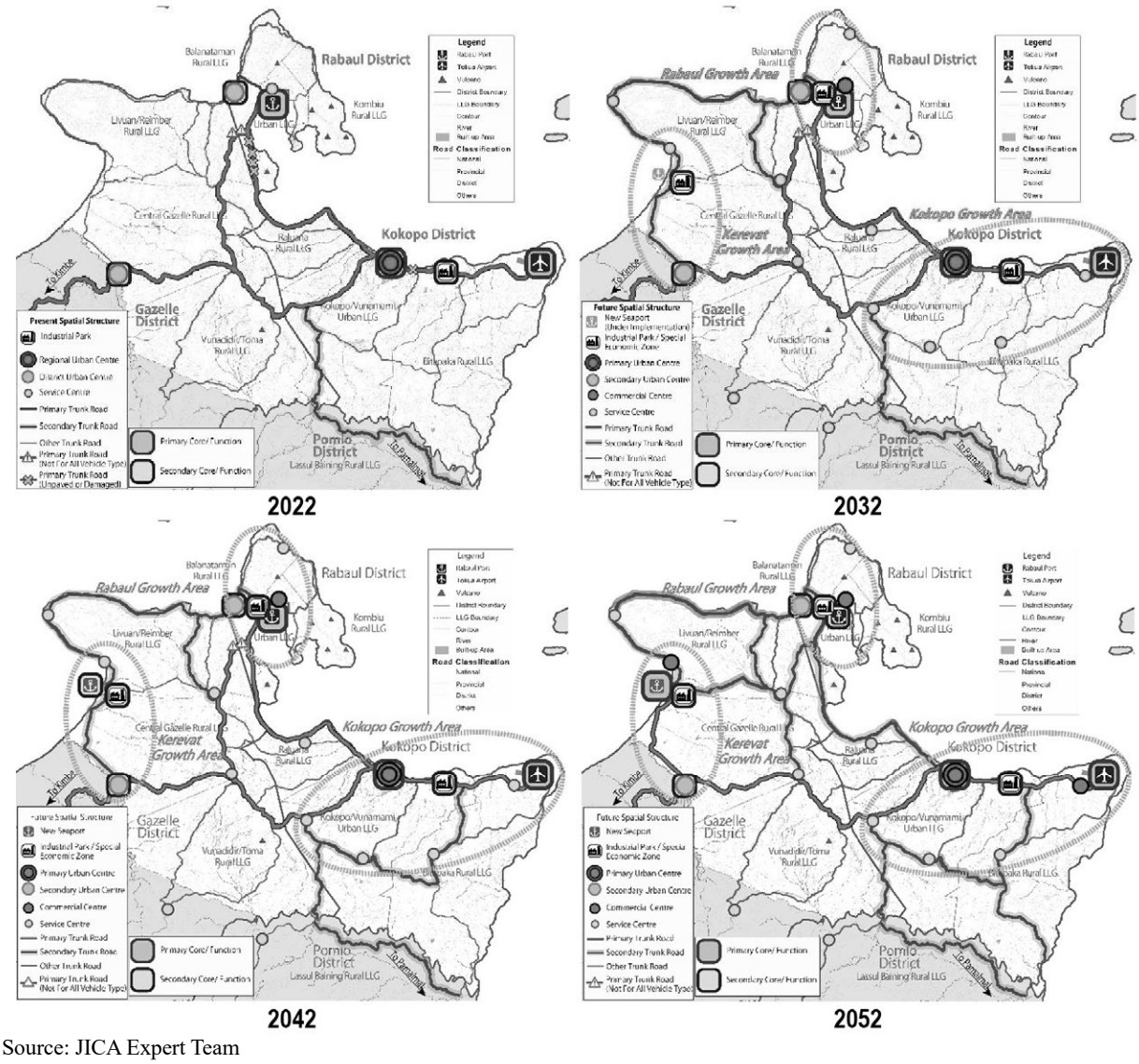
It is important to secure emergency road transport routes in the event of large-scale volcanic eruption. The risk of road closure caused by large volcanic ash deposits is high in some sections of the Kokopo-Rabaul Coastal Road near Vulcan Volcano. However, road sections with high risk have not been developed to increase resilience against such disaster.

At present, the trunk road network in this area is not well prepared in the event of large volcanic eruption in the future. Securing redundancy in the event of such disaster is necessary for roads that are important backbones of the region. For example, it is necessary to increase preparedness so that road connectivity from Rabaul Port to various parts of the region can be secured even in the event of future large-scale volcanic eruption. Relief supplies for disaster emergency response arrive at Rabaul Port. The region's fuel terminals (fuel depots) are also adjacent to Rabaul Port. It is important to develop alternative routes for transporting fuel from the fuel terminal adjacent to Rabaul Port to various parts of the region, as well as for transporting emergency supplies.

(3) To Expand and Upgrade Primary Routes and Secondary Routes of the Trunk Road Network not only for Promoting the Development of Economic Sectors in the Region, but also for Enhancing Disaster Resilience in the Region

A future regional spatial structure for Northeast Gazelle Peninsula has been proposed for year 2052 in "Chapter 9 Present and Future Regional Spatial Structure of Northeast Gazelle Peninsula". A phased development plan has been also proposed for the regional spatial structure between 2022 and 2052, as shown in Figure 12.4.1.

In each phase, the upgrading to secondary trunk roads or to primary trunk roads are recommended. Priority projects for development of trunk roads are proposed based on the phased transformation of the regional spatial structure.



Source: JICA Expert Team

Figure 12.4.1 Phased Development Plan of Regional Spatial Structures for Northeast Gazelle Peninsula

12.5 Trunk Road Projects

12.5.1 Important Trunk Road Projects

To sustain the socio-economic activities, it is important to improve all trunk roads in the region. The current road conditions and proposed improvements are shown in Appendix D.

12.5.2 Priority Trunk Road Projects

(1) Priority Trunk Road Projects for Year 2025 to 2032

The following 3 projects are selected as the priority projects for Year 2025 to 2032 based on the phased development plan in 2032.

1) [TR-01] Project for Strengthening of Kokopo-Rabaul Coastal Road

Primary trunk roads play a role as the backbone of the region. Among the backbone trunk roads, the most important trunk road is the coastal road between Kokopo and Rabaul (Kokopo Road, or Kokopo-Rabaul Coastal Road), which is not in good condition.

This road connects the central port of the region, Rabaul Port, and Kokopo Town CBD (which has functions of provincial capital and central commercial and service functions) in the shortest distance. However, there are many road portions where drainage for rainwater is not well installed. There is also a section in a low-lying area that is prone to sediment disaster. This section has not been paved.

The mountain side road (locally called Top Road, or Kokopo-Rabaul Top Road), which serves as an alternative road (from the viewpoint of redundancy) of the Kokopo-Rabaul Coastal Road, also has the status of national road, and is in good pavement condition. However, the section going up inland from Burmah Junction, which is the intersection with the coastal road, is a steep, narrow and winding road. Lorries carrying heavy containers or fuels from Rabaul Port or Rabaul Fuel Terminal to Kokopo Tow cannot pass it.

Therefore, it is important to strengthen Kokopo-Rabaul Coastal Road, Primary Trunk Road in 2032, as the most important trunk road in the region.

2) [TR-02] Project for Upgrading of Rabaul-Kurakakaul-Rakunai Road (Alternative Road to the Kokopo-Rabaul Coastal Road and to Kokopo-Rabaul Top Road)

It is necessary to secure emergency road transport routes in the event of large-scale volcanic eruption. The risk of road closures caused by large volcanic ash deposits is high on the sections of the Kokopo-Rabaul Coastal Road near Vulcan Volcano. However, road sections with high risk have not been developed to increase resilience against such disaster.

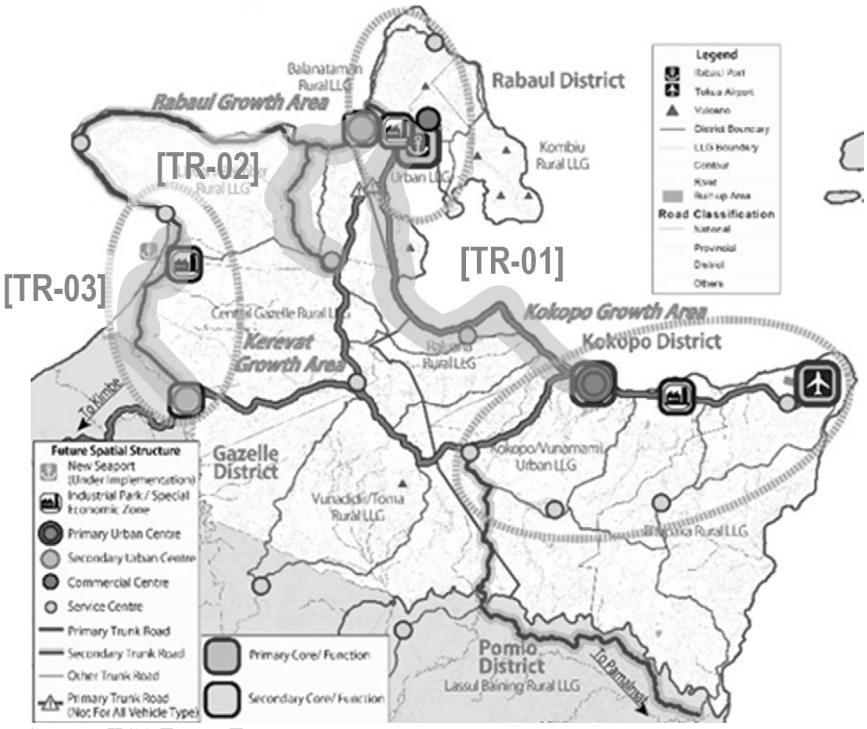
At present, the trunk road network in this area is not well prepared in the event of large volcanic eruption in the future. Securing redundancy in the event of such disaster is necessary for roads that are important backbones of the region. For example, it is necessary to increase preparedness so that road connectivity from Rabaul Port to various parts of the region can be secured even in the event of future large-scale volcanic eruption. Relief supplies for disaster emergency response arrive at Rabaul Port. The region's fuel terminals (fuel depots) are also adjacent to Rabaul Port. It is important to develop alternative routes for transporting fuel from the fuel terminal adjacent to Rabaul Port to various parts of the region, as well as for transporting emergency supplies.

Therefore, it is important to upgrade Rabaul-Kurakakaul-Rakunai Road to a Secondary Trunk Road in 2032, as an alternative road to the Kokopo-Rabaul Coastal Road and to Kokopo-Rabaul Top Road.

3) [TR-03] Project for Upgrading of North Coast Road between Kabaira (Ataliklikun Bay) and Kerevat Town

It is planned to develop Agro-Industry SEZ at Kabaira (Ataliklikun Bay) in the phased development plan 2032. It is proposed that North Coast Road between Kabaira (Ataliklikun Bay) and Kerevat Town is upgraded to Secondary Trunk Road.

This road also has a role as an alternative road to the Kokopo-Rabaul Coastal Road and to Kokopo-Rabaul Top Road, as well as to Rabaul-Kurakakaul-Rakunai Road, in the event of large volcanic eruption.



Source: JICA Expert Team

Figure 12.5.1 Priority Trunk Road Projects for Year 2025 to 2032

(2) Priority Trunk Road Projects for Year 2033 to 2042

The following 3 projects are selected as the priority projects for Year 2033 to 2042 based on the phased development plan in 2042.

1) [TR-04] Project for Upgrading of Kurakakaul-Kabaira (Ataliklikun Bay) Section of North Coast Road

Together with [TR-03], this road is upgraded to Secondary Trunk Road by 2042 as an access road from/to Agro-Industry SEZ at Kabaira (Ataliklikun Bay).

This road also has a role as an alternative road to the Kokopo-Rabaul Coastal Road and to Kokopo-Rabaul Top Road in the event of large volcanic eruption.

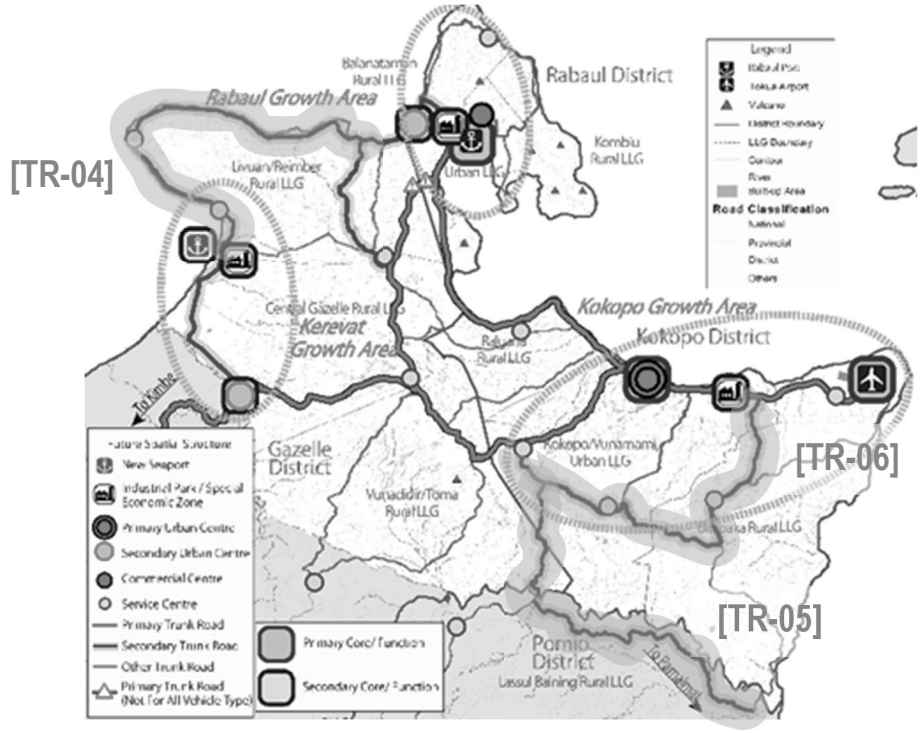
2) [TR-05] Project for Upgrading of Malakuna-Putput Road

This road is a trunk road connecting Malakuna and Putput. This priority project will upgrade this road to a Secondary Trunk Road for improving the connectivity between Kokopo and the Southern Coastal Corridor of the ENBP.

It is planned that this road is upgraded to Secondary Trunk Road by 2032. However, it will be utilised without any upgrade by 2032, as the road condition is kept fair at present. This road will be upgraded by 2042.

3) [TR-06] Project for Upgrading of Kabakaul-Toma Road

This road is a trunk road connecting Kabakaul and Toma. This road is upgraded to a Secondary Trunk Road based on the Phased Development Plan 2042.



Source: JICA Expert Team

Figure 12.5.2 Priority Trunk Road Projects for Year 2033 to 2042

(3) Priority Trunk Road Projects for Year 2043 to 2052

Other primary trunk roads and secondary trunk roads shown in Figure 12.4.1 should be upgraded by 2052.

(4) Other Priority Projects for Year 2023 to 2032

Other than priority trunk roads projects, it is proposed to implement the following projects by 2032.

1) Project for Rehabilitation of Roundabout between Tokua Road (No. 26) and Bailu Road (No. 50)

Roundabout between Tokua Road and Bailu Road is severely damaged, as much rainwater gather to this roundabout from Bailu Road during rainfall.

Tokua Road is one of the Primary Trunk Roads for 2032, and the important road connecting Kokopo and Tokua Airport in the region. Thus, it is proposed to rehabilitate this roundabout as a priority project for Year 2023 to 2032.

2) Project for Construction of Sidewalk Near the School in Warongoi Road (No. 27)

Much high-speed traffic use Warongoi Road, as this road is a part of New Britain Highway. There is a school along this road. However, sidewalk is not provided, thus students walk on the shoulder.

It is proposed to provide sidewalk on the section between the school and villages to ensure the safety of students.

(5) Brief Profile of Priority Projects for Year 2025 to 2032

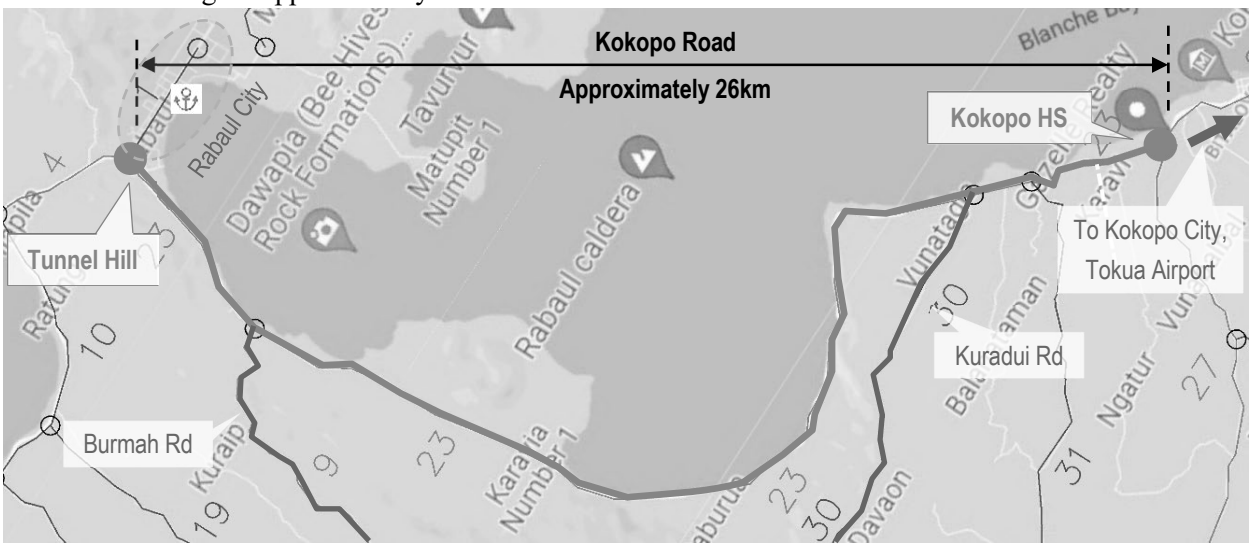
1) [TR-01] Project for Strengthening of Kokopo-Rabaul Coastal Road

(a) Project Name

Kokopo-Rabaul Coastal Road Rehabilitation Project

(b) Project Location and Road Length

- Location: Tunnel Hill to Kokopo High School (See Figure 12.5.3)
- Length: Approximately 24km



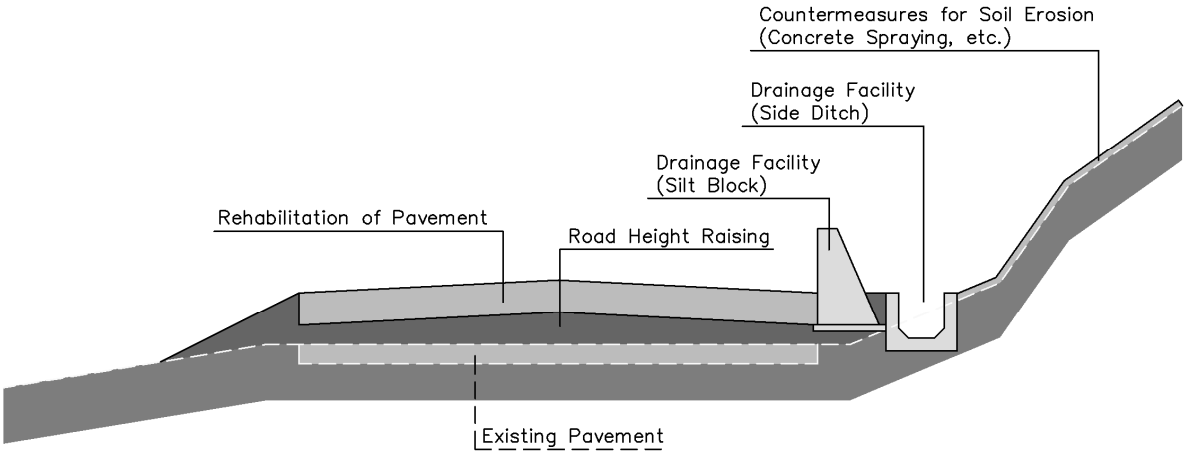
Source: JICA Expert Team

Figure 12.5.3 Location Map of Kokopo-Rabaul Coastal Road Rehabilitation Project

(c) Contents of Priority Project

The project includes the following:

- Rehabilitation of Pavement
- Road Height Raising
- Construction of Drainage Facilities
- Construction of Countermeasures for Soil Erosion



Source: JICA Expert Team

Figure 12.5.4 Cross Section of Kokopo-Rabaul Coastal Road Rehabilitation Project

i) Rehabilitation of Pavement

All roads in New Britain Island have been paved with DBST (Double Bituminous Surface Treatment). As DBST does not have enough durability against water and heavy load, some sections of roads have been severely damaged.

It is proposed that Kokopo-Rabaul Coastal Road is upgraded to asphalt concrete pavement based on the analysis of future traffic demand so that enough durability can be provided.

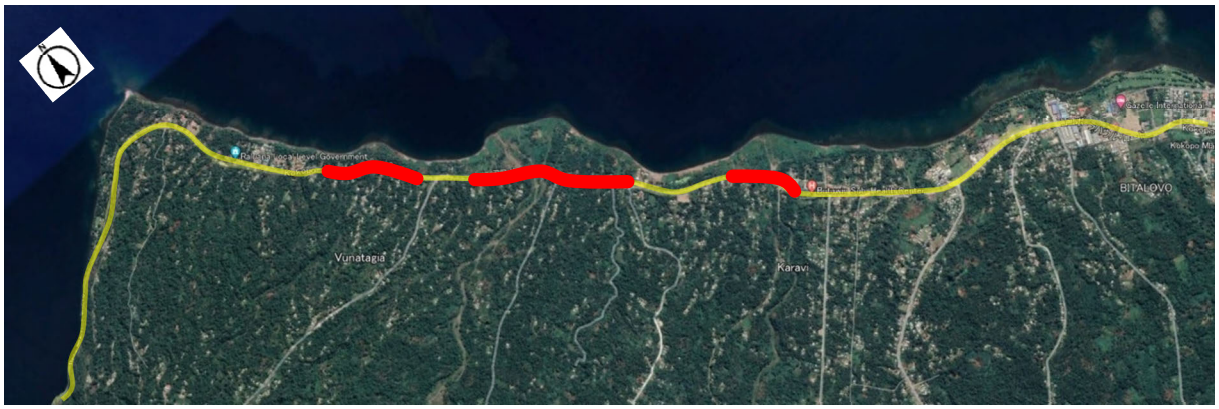
However, the cost of asphalt concrete pavement may be very high, as there is no asphalt plant in New Britain Island. Type of pavement (Asphalt or DBST) for the rehabilitation should be determined in consideration of the budget.

ii) Road Height Raising

Water remains on the road surface at low sections in Kokopo Road during rain. This is a cause of severe pavement damage.

It is proposed that Kokopo Road is raised at existing low sections. It is also proposed to provide sufficient cross fall to discharge surface water properly.

About 2km section in Vunatagia to Karavi might need to be raised according to the results of the field survey (see red line in Figure 12.5.5). However, the location of road height raising should be determined based on the hydrological survey and analysis results in the feasibility study.



Source: JICA Expert Team based on the satelite image of Google Earth

Figure 12.5.5 Location of Road Height Raising (Proposed)

iii) Construction of Drainage Facilities

Kokopo Road has side drainage ditches and cross drainage culverts at some limited sections only. And those have not been functioning properly due to lack of maintenance.

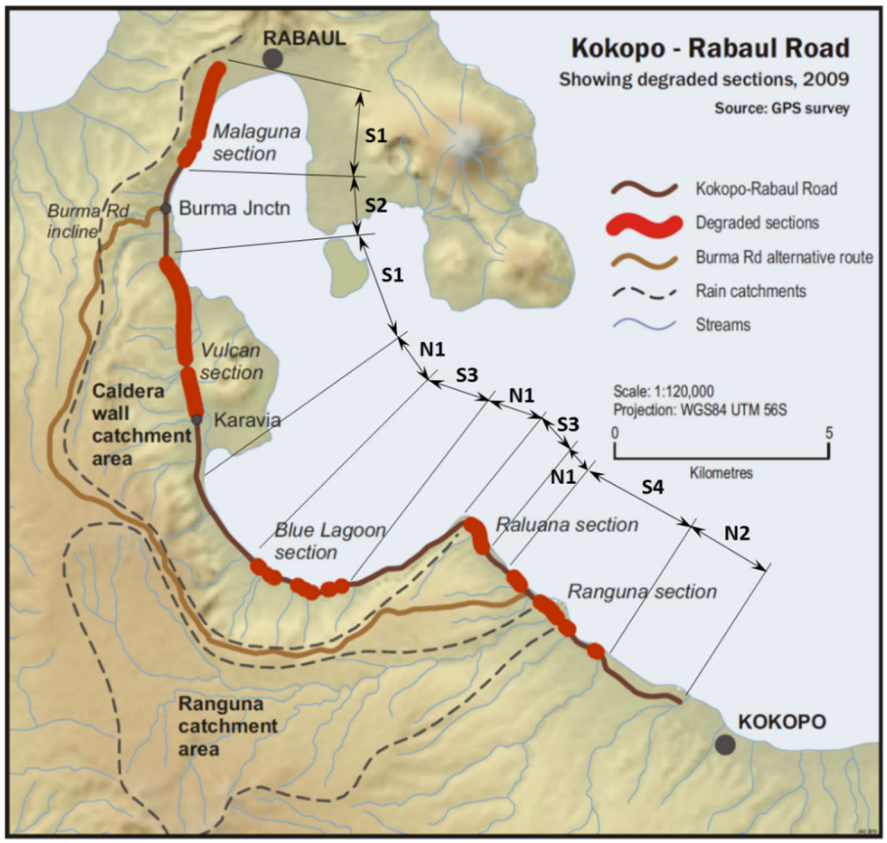
It is proposed that side drainage ditches and drainage culverts are constructed in the whole sections in order to discharge road surface water properly, as well as to avoid flowing of water from the road side area onto the road surface during rain.

In addition, the road is divided into road sections based on six types of drainage conditions as shown in Table 12.5.1and Figure 12.5.6. For the six types of drainage conditions, different drainage measures should be taken as shown in Section 12.3.3.

Table 12.5.1 Six Types of Drainage Measures (Sediment Measures) for Different Drainage Conditions of Roads

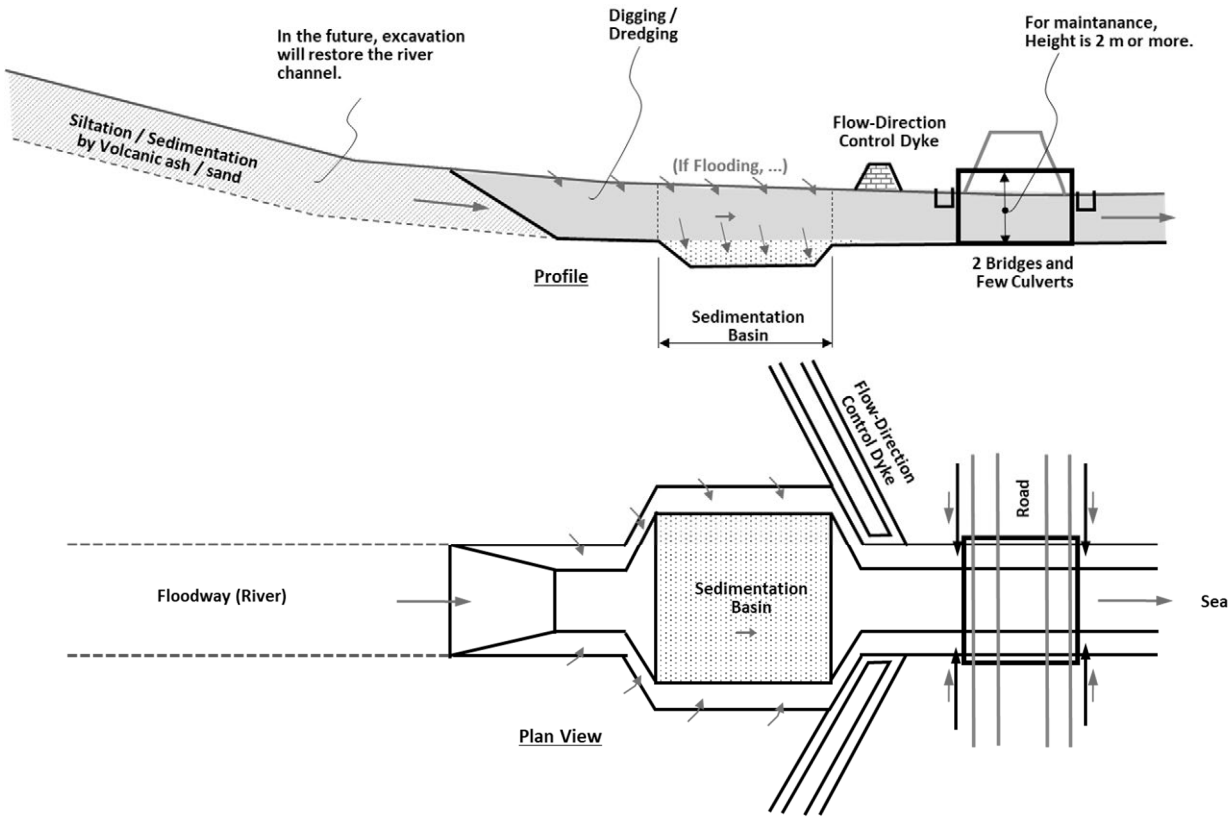
Types of Drainage Conditions of Road Sections	Ash Fall	Slope of Road Hinterland	Drainage Measures (Sediment Measures)	Drainage Channel Capacity	Debris / Mudflow Countermeasures
S1	Many	Steep	Large Silt Trap	Design Discharge X 2.0	Concrete Barrier
S2	Many	Steep	Large Silt Traps in Culverts, 1 Sedimentation Basin in Rapolo River	Design Discharge X 2.0	Concrete Barrier
S3	< 20mm	Steep	Slightly Larger Silt Trap	Design Discharge X 1.5	-
S4	< 20mm	Low	Large Silt Trap in Culverts, 3 Sedimentation Basins in 3 Rivers	Design Discharge X 1.2	-
N1	< 20mm	Steep	Slightly Larger Silt Trap	Design Discharge X 1.5	-
N2	< 20mm	Low	Normal Size Silt Trap	Design Discharge X1.2	-

Source: JICA Expert Team



Source: Roads in Gazelle Peninsula Development (2010, Aus AID)

Figure 12.5.6 Present Drainage Conditions: Six Different Types of Drainage Conditions



Source: JICA Expert Team

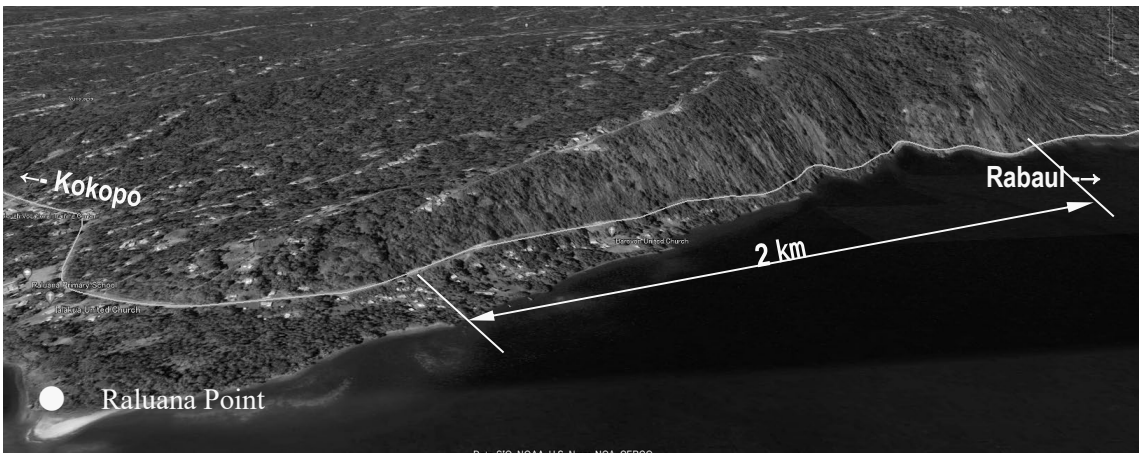
Figure 12.5.7 Image of Sedimentation Basin

iv) Construction of Countermeasures for Soil Erosion

The mountain body is thought to be composed mainly of pumiceous pyroclastic flow deposits ejected by the Rabaul volcanic activity more than 10,000 years ago and is in a consolidated condition. However, it is vulnerable to weathering, and the surface of the outcrops has been softened by weathering.

Along the Kokopo-Rabaul Road from Kokopo City to Raluana Point, there are several small cliffs 5 to 10 metres high that were cut almost vertically from the foot of the mountain when the road was constructed, and the total length of these cliffs is about 1 km. Because the cut slope is nearly vertical, there is no concentrated flow of rainwater, and the whole surface has gradually set back due to weathering. The top is overhanging with rooted vegetation remaining (right picture). The stripped sediment accumulates at the bottom of the cliff and fills the roadside ditches in many places.

The steep cliffs of the caldera wall of the Rabaul Caldera are close to the road in the section of about 2 km from Raluana Point towards Rabaul (below picture). The average slope is about 45 degrees, and it can be roughly classified into two cases: one with a cut slope along the road with vegetation covering the slope above, and the other with a gentle slope (with collapsed soil) covered with vegetation below and a steep cliff rising high in the back. The steep slopes along the road were cut during road construction, but above are natural slopes where gully-like ditches have developed due to erosion over the years and discharge from the ridge road above.



Erosion control measures require a method that covers the entire slope surface that stops the weathering process and prevents direct erosion of the ground by water flow.

Specifically, concrete spraying construction method is suitable as slope protection works.

As an alternative method, there are products that do not require skilled labour, such as concrete canvas, which can be installed simply by fastening a sheet on the slope and applying water to solidify it.

2) [TR-02] Project for Upgrading of Rabaul-Kurakakaul-Rakunai Road (Alternative Road to the Kokopo-Rabaul Coastal Road and to Kokopo-Rabaul Top Road)

This project includes the rehabilitation of Tunnel Hill Road (No. 4), a part of North Coast Road (No. 10) and Ramalmal Road (No.20).

Tunnel Hill Road (No. 4) is kept in good condition at most sections, but there are some potholes. The following rehabilitation works should be made for Tunnel Hill Road.

- Providing DBST with sufficient cross fall
- Installing roadside drainage and cross drainage culvert

North Coast Road (No. 10) is mostly kept in good condition, but is not sealed at some sections. The following rehabilitation works should be made for North Coast Road.

- Providing DBST with sufficient cross fall
- Installing roadside drainage and cross drainage culvert

Ramalmal Road (No.20) is mostly severely damaged and has narrow width and steep gradient at some sections. The following rehabilitation works should be made for Ramalmal Road.

- Providing DBST with sufficient cross fall
- Installing roadside drainage and cross drainage culvert
- Widening the road at narrow section
- Changing alignment to reduce the gradient at steep gradient sections
- Providing countermeasures for soil erosion

3) [TR-03] Project for Upgrading of North Coast Road between Kabaira (Ataliklikun Bay) and Kerevat Town

This project includes the rehabilitation of a part of North Coast Road (No. 10).

North Coast Road (No. 10) is severely damaged at most sections. The following rehabilitation works should be made for North Coast Road.

- Providing DBST with sufficient cross fall

- Installing roadside drainage and cross drainage culvert

(6) Pre-Feasibility Study or Full-Scale Feasibility Study on Priority Project

It is proposed that a pre-feasibility study (Pre-F/S) or a full-scale feasibility study should be conducted for "Project for Strengthening of Kokopo-Rabaul Coastal Road" to move to implementation without delay. As stated above, it is planned that the following work items are included in the project. However, location and type of each work item to be provided in the project will be determined in the Pre-F/S or F/S.

- Rehabilitation of Pavement (asphalt concrete or DBST according to the traffic demand and budget)
- Road Height Raising (at low-lying sections)
- Construction of Drainage Facilities (side ditch, cross culvert, silt block, silt trap, sedimentation basin, etc.)
- Construction of Countermeasures for Soil Erosion (concrete spraying, slope vegetation base spraying, removing unstable part, removing overhanging part, etc.)

Chapter 13 Development Plan for Ports

13.1 Present Situation and Issues on Development of Ports

This section begins by identifying major issues of the port sector. Then possible development directions for this sector, specifically by identifying ways to solve the identified major issues, are considered and proposed.

13.1.1 Present Situation and Issues Specific to Rabaul Port

(1) Ageing and Deteriorated Port Infrastructure of Rabaul Port

The infrastructure of Rabaul Port is ageing and deteriorating. Major rehabilitation works have not been done for Rabaul Port in the last 35 years (or probably longer than that). "Berth 1" was constructed in 1964, and its last rehabilitation was done in 1984. "Berth 2" was constructed in 1968, and its rehabilitation was conducted in 1983. The requirement for major rehabilitation works of the two berths, sheds, utilities and other buildings was described in the 2014 condition assessment study. However, no actions have been taken in response to these recommendations for repair and restoration.

Possible Development Directions

- Immediate rehabilitations of deteriorated elements of the port infrastructure are required for the purpose of maintaining the important functions and role of Rabaul as the main regional port, not only for Northeast Gazelle Peninsula, but also for the Islands Region.
- It is necessary to consider how to combine immediate rehabilitation with the need to upgrade some of the port functions of Rabaul Port
- Combining immediate rehabilitation works with upgrading of some selected functions of Rabaul Port should be considered for implementation.

(2) Low Productivity of Cargo Handling at Rabaul Port

Table 13.1.1 shows the current service hours and cargo handling productivity estimated for different vessel types at Rabaul Port.

Table 13.1.1 Service Hours and Productivity in Rabaul Port

	Overseas Container	Overseas Cruise	Overseas Tanker	Overseas General
Delayed Hours to Berth (hours)	7.1	0.8	13.2	7.5
Dwell Time in Berth (hours)	28.6	11.3	26.7	28.9
Work Delay (hours)	1.9		5.7	1.8
Sailing Delay (hours)	1.6		4.4	1.6
Actual Working Hours (hours)	25.5		22.0	28.1
TEU Handling (TEU/hour)	6.2			
Number of TEU Handled Per Vessel (TEU/Vessel)	163			

Sources: PNG Ports and JICA Expert Team

Based on the above table, the productivity of container handling is 6.2 TEU/hour on the average which can be considered very low. One of the main reasons is that in Rabaul Port, two stevedoring companies do not share their resources (e.g., equipment). In Rabaul Port, there are two forklifts and one reach stacker in total. Each stevedoring company performs cargo operations based on the ship's origin. One of the companies (ENB Port Services) handles the vessels bound for Australia. The other company (Rabtrans Stevedoring Ltd.) operates for the ships bound for coastal ports and Southeast Asia. One stevedoring company remains idle when the other one is working. Therefore, the efficiency of the port operations is compromised. In managing port operations, contracting with multiple stevedoring companies should be abolished in favour of a uniform port operator for all cargo operations. This way, the resources that are available in Rabaul Port will be fully utilised and not remain idle at times.

Additionally, the sorting/loading of the containers onto vessels is based on the weight of the container rather than the port of unloading. The heavy containers are placed below, while lighter ones are put on top. Because of this unplanned container loading, the unloading operations are inefficiently performed with increased berth time.

Furthermore, the efficiency of the port operations can be increased with the procurement of state-of-the-art cargo handling equipment such as quay cranes or mobile cranes for berth operations, and reach stackers, tractors, or rubber-tired gantry cranes for yard operations. However, due to loading restrictions on Berths No.1 and No.2, before mobilising a crane, rehabilitation and improvement of the berths are required to support the crane loading on the berths. In general, financial viability of procurement of quay crane can be feasible when the range of annual handling volume is 50 to 100 thousand TEU containers. Such procurement should be considered when the cargoes will increase in the future.

Containerisation of cargoes and container traffic have made significant progress in the world. Shipping of containerised cargo has become the primary mode of transportation method in sea transportation. It is mainly preferred to increase efficiencies of the cargo operations (sorting, storing, loading, unloading, etc.) in both berth and yard operations. With the increasing rate of containerisation, Rabaul Port should expect to receive more and more containers. However, due to the limited capacity of Berths No.1 and No.2 (in terms of loading, efficiency and depth), the throughput of Rabaul Port may remain the same in the absence of a rehabilitation and development project. Such development project should include increasing the allowable loading capacity on the deck structures, procurement of cargo handling equipment (e.g., mobile cranes) for efficient operations, berth deepening and dredging, and infrastructure (pavement, safety, etc.) improvements. With the introduction of a yard management system, port operations can be further enhanced.

There can be possible improvements with customs, clearance, immigration, security, and testing. Currently, in Rabaul Port, it is considered that the bottleneck is not generated by customs or immigration activities. However, with the enhancement of port operations, these activities may become the bottlenecks in port operations. Therefore, methodologies to improve the customs and immigration functions and facilities should be considered along with the development of Rabaul Port.

(3) Burden on Berth Occupancy due to Fishing Vessels

Fishing boats, while bringing revenue for Rabaul Port, have minimal contribution to the local economy. These vessels require supplies (water, fuel, etc.) and a place in the port to repair nets that may take up to 5 days. These vessels have a draft of around 4-5 m. Therefore, an additional small berthing facility for fishing vessels may considerably lower berth occupancy. The area next to Berth No.1 (Wreckage site - Figure 13.1.1) is a viable location to develop an additional berthing facility. PNG Ports in Rabaul Port also considers developing facilities in this area to lower the burden of fishing vessels on berth occupancy and provide them a free room to maintain their nets. As the National Maritime Safety Authority (NMSA) is the responsible entity for shipwrecks in

PNG's waters, a collaboration between PNG Ports and NMSA is necessary to remove the wrecks from Rabaul Port's premises.

Source: JICA Expert Team

Figure 13.1.1 Wreckage Site at the Eastern Side of Berth No.1 - A Possible Berthing Location for Fishing Vessels

(4) Dust Problem in Rabaul Port

Dust problem is noticeable at Rabaul Port. During dry season, Rabaul Port is very dusty, as shown in Figure 13.1.2 and Figure 13.1.3. PNG Ports is considering to hire a local contractor to perform levelling; however, there is no plan for constructing a pavement.

Regarding the development of pavement, Rabaul Port is fourth in the priority list after Kimbe, Vanimo, and Medang Ports, considering the budget since 2017. PNG Ports thinks that the yard operations can be more effective after pavement construction by installing a Terminal Operating System (TOS), painting the pavements, and a yard addressing system.

Source: JICA Expert Team

Figure 13.1.2 Reach Stacker Operations and Dusty Container Yard in Rabaul Port – 1st November 2022

Source: JICA Expert Team

Figure 13.1.3 Trailer Bringing Container to Berth No.2 in Dusty Conditions - 31st October 2022

(5) Existence of Private Facilities

It has been recognised that there are many private facilities in the region for loading and unloading agricultural products to vessels. Unless there are pilotage needs, PNG Ports does not earn any profit from these businesses (e.g., palm oil). It is foreseen that the private sector will choose to bring their products to Rabaul Port if it is cheaper to do so and more accessible.

PNG Ports should enhance the arrangements with the stakeholders who avoid using Rabaul Port facilities. These stakeholders can benefit from the improved functions of Rabaul Port by utilising bigger vessels with higher efficiency to increase the revenue of both port users and the port itself. To realise this beneficial trade, PNG Ports should determine an optimum procurement strategy and port tariffs considering the berth's utilisation rates. It is essential to make Rabaul Port attractive for port users by ensuring the availability and capacity of Rabaul Port. PNG Ports is already thinking that Kimbe Port is an excellent option for attracting exporters to use the port.

On the other hand, the agricultural product growers should be able to bring their products to Rabaul Port much more easily. To achieve this, the development of road networks and infrastructure is the main priority.

13.1.2 Present Situation and Issues Related to Relocation of Port Functions from Rabaul Port

(1) Consideration of Disaster Risks in Determining the Necessity of Relocating Rabaul Port to a Safer Place

Although Northeast Gazelle Peninsula is prone to various disasters, port location and regional disaster prevention measures have not been sufficiently considered from the perspective of comprehensive and long-term future disaster prevention. In fact, the ENBPA is still working on a disaster profile of ENBP.

On the other hand, there was a discussion within PNG Ports about relocating Rabaul Port. The 2014 Rabaul Port Master Plan, and the 2021 Rabaul Port Detailed Infrastructure Master Plan set out policies for relocation to the area near Kabakaul in Kokopo. However, in the process of formulating these master plans, there was no exchange of opinions with the ENBPA or discussions and consultations with various stakeholders.

Possible Development Directions in Relation to the Relocation of Functions of Rabaul Port

- Comparative analysis of alternative locations for relocating Rabaul Port's functions is required. These locations include Ataliklikun Bay, which is proposed in the ENBP Economic Development Plan 2003-2030 and ENBP Strategic Development 2010-2030.
- This comparative analysis should include the case of relocating some functions to another port (to be newly constructed in some locations) and maintaining other functions at Rabaul Port.

(2) Limited Cargo Handling Capacity Despite Increasing Cargo Throughputs Handled at Rabaul Port

Berth 1 has become shallow (7.0 m deep) due to sedimentation of silt caused by drainage from the port hinterland (hinterland Rabaul Town and mountain), and now it is only Berth 2 (10.2 m deep) that enables large vessels to dock. Thus, Berth 1 is used for coastal vessels and Berth 2 is for overseas vessels.

The berth utilisation rates are as follows:

- Berth 1: 50%
- Berth 2: 48%

The total volume of cargo handled at Rabaul Port has increased at a high growth rate of 6.1% in the last 10 years (2010-2020), and at a higher rate of 7.9 % in the recent 5-year period (2015-2020).

The amount of overseas export container cargoes accounts for 11.6% out of the grand total amount of overseas and coastal cargoes (both outward and inward bound). The overseas export container cargoes increased at an average annual rate of 20% per year (probably higher) in the recent five-year period (2015-2020).

The amount of overseas import containers accounts for 24.3% out of the grand total amount of overseas and coastal cargoes (both outward and inward bound). The overseas import container cargoes increased at an average annual rate of 4.5% per year in the recent 5-year period (2015-2020).

The overseas import bulk fuel accounts for 18.0% out of the grand total amount of overseas and coastal cargoes (both outward and inward bound). The overseas import bulk fuel also has a high growth rate of 9.8% per year in the recent 5-year period (2015-2020).

Possible Development Directions of Port Functions

- **Need for Upgrading Export and Import Functions:** Major economic sectors supporting economic growth in the Northeast Gazelle Peninsula are export oriented. Regional and local economies of this region should be well connected by transport function to other provinces in PNG, as well as to other countries. In this sense, ports are some of the most important infrastructures supporting overseas and coastal maritime transport. In response to an increasing volume of export and import, as well as coastal shipping, it is necessary to expand the cargo handling capacities, especially for container cargoes, which have been on the rise in recent years.
- **Increasing Importance of Fuel Terminal Not Only for Northeast Gazelle Peninsula, But Also for Surrounding Island Provinces**: Fuel to support the regional economies is imported from overseas or brought in from refineries in POM, stored in fuel depots beside Rabaul Port, and delivered for consumption in the provinces. Rabaul Port has played the fuel terminal function of transporting fuel to surrounding island provinces. Over the past five years, the volume of fuel handled at Rabaul Port has increased, and Rabaul Port has a growing role as the fuel terminal in the Island Region and beyond.

- **Maintaining the Tuna Fishing Base Function of Simpson Bay and Rabaul Port**: Tuna fishing vessels working in the Bismarck Sea use Simpson Bay, where the waves are calm, for conducting ship-to-ship transfer of fish catch to reefer ships. Simpson Bay is where reefer ships wait for the fishing boats bringing tuna catch. Reefer ships dock to get water and fuel from Rabaul Port. Simpson Bay and Rabaul Port thus composed a fishing base. This fishing base function is expected to be maintained at Simpson Bay and Rabaul Port even if some functions of Rabaul Port are transferred to other ports.

Table 13.1.2 Summary of Cargo Volumes and Growth Rates by Cargo Type in 2010-2020

	2010-2020	2010-2020	2010-2020	2010-2020	2010-2020	2010-2020
		% of Grand Total (Overseas and Coastal)	Average Annual Growth Rate (% per annua)		% of Grand Total (Overseas and Coastal)	Average Annual Growth Rate (% per annua)
Overseas Container (Export)	548,943	11.6%	12.2%			
Overseas Break Bulk (Export)	286,602	6.0%	0.9%			
Overseas Bulk Fuel (Export)	2,831	0.1%	N,A,			
Overseas Total Cargo (Export)				838,376	17.6%	8.8%
Coastal Container (Outward)	343,568	7.2%	6.8%			
Coastal Break Bulk (Outward)	93,031	2.0%	-4.3%			
Coastal Bulk Fuel (Outward)	223,811	4.7%	N,A,			
Coastal Total Cargo (Outward)				660,410	13.9%	8.8%
Overseas Container (Import)	1,072,589	22.6%	10.9%			
Overseas Break Bulk (Import)	180,687	3.8%	-6.4%			
Overseas Bulk Fuel (Import)	695,933	14.6%	13.3%			
Overseas Total Cargo (Import)				1,949,209	41.0%	12.7%
Coastal Container (Inward)	796,773	16.8%	-2.9%			
Coastal Break Bulk (Inward)	157,778	3.3%	-7.8%			
Coastal Bulk Fuel (Inward)	349,613	7.4%	-0.5%			
Coastal Total Cargo (Inward)				1,304,164	27.4%	-2.7%
Grand Total (Overseas and Coastal)	4,752,159	59.0%		4,752,159	100.0%	6.1%

Source: JICA Expert Team, based on data from PNG Ports

Table 13.1.3 Summary of Cargo Volumes and Growth Rates by Cargo Type in 2015-2020

	2015-2020	2015-2020	2015-2020	2015-2020	2015-2020	2015-2020
		% of Grand Total (Overseas and Coastal)	Average Annual Growth Rate (% per annua)		% of Grand Total (Overseas and Coastal)	Average Annual Growth Rate (% per annua)
Overseas Container (Export)	347,466	11.6%	20.6%			
Overseas Break Bulk (Export)	168,728	5.6%	5.6%			
Overseas Bulk Fuel (Export)	2,691	0.1%	N,A,			
Overseas Total Cargo (Export)				518,886	17.4%	15.9%
Coastal Container (Outward)	213,526	7.1%	8.2%			
Coastal Break Bulk (Outward)	43,116	1.4%	15.6%			
Coastal Bulk Fuel (Outward)	222,050	7.4%	50.4%			
Coastal Total Cargo (Outward)				478,692	16.0%	16.4%
Overseas Container (Import)	724,993	24.3%	4.5%			
Overseas Break Bulk (Import)	73,967	2.5%	-2.6%			
Overseas Bulk Fuel (Import)	539,160	18.0%	9.8%			
Overseas Total Cargo (Import)				1,338,120	44.8%	5.9%
Coastal Container (Inward)	392,280	13.1%	-2.0%			
Coastal Break Bulk (Inward)	62,066	2.1%	5.7%			
Coastal Bulk Fuel (Inward)	198,786	6.7%	5.1%			
Coastal Total Cargo (Inward)				653,131	21.9%	0.6%
Grand Total (Overseas and Coastal)	2,988,828	55.2%		2,988,828	100.0%	7.9%

Source: JICA Expert Team, based on data from PNG Ports

(3) Problematic Access to Rabaul Port Within Northeast Gazelle Peninsula

There are two major access roads between Rabaul Port and Kokopo Provincial Capital (administrative and commercial centre). One is the coastal route between Rabaul Town and Kokopo Town. The other is the inland route between the two centres. Although these two roads composed an important set of access roads to Rabaul Port within the region of Northeast Gazelle Peninsula, both of them have weak points.

1) Unpaved Section of Rabaul-Kokopo Coastal Road (Kokopo Road)

The Rabaul-Kokopo Coastal Road has an unpaved section located in a low-lying area. Since the soils in this region are basically made of volcanic rocks and volcanic ashes, they are generally susceptible to landslide due to heavy rainfall. Said unpaved section is located at a downstream area of the somma of caldera created by Rabaul volcanos. The section tends to be prone to landslides and washed out from flooding.

2) Steep-Slope Winding Section of Inland Road Between Rabaul Port and Kokopo Town

Another route of the access road to Rabaul Port from Kokopo Town was built to cross the rim of the Rabaul volcano caldera and approach Rabaul Port, which is located inside the great caldera. The inland road connecting Rabaul Port and Kokopo Town has a steep slope section consisting of winding roads near Burmah Junction. Heavy-loaded lorries cannot pass this steep-slope winding section in the direction from Rabaul Port to Kokopo Town. As a result, such heavy-loaded lorries from Rabaul Port have to go through the coastal road.

3) Possible Impact of Volcanic Ash Accumulation on the Road Section Near Vulcan Volcano

In addition to the two weak points of the major access roads to Rabaul Port, there is another one related to volcanic ash accumulation on the road. While Rabaul Port is located in a distance of 6.3|~6.5 km from Vulcan Volcano and Tavurvur Volcano, it might be possible for Rabaul Port Office to remove volcanic ash from sheds and other structures of the port area. However, the road section closed to Vulcan Volcano might suffer a huge amount of accumulated volcanic ash on the road section and its surrounding areas. This situation will result in a long period of road closure to Rabaul Port.

Based on the understanding of the weak points of access roads to Rabaul Port, the following possible development directions are considered.

Possible Development Directions in Relation to Access Roads to Rabaul Port

- **Upgrading of Rabaul-Kokopo Coastal Road** with special attention to enhancement of resilience of Rabaul-Kokopo Coastal Road, especially in the low-lying sections
- **Establishment and upgrading of an alternative route** for the existing two access roads (Rabaul-Kokopo Coastal Road and Inland Road). One candidate route is the road going from Rabaul Port through Pilapila, Kurakakaul (Rabaul District Headquarter Office) and Rakunai
- **Consideration of relocation of selected functions or all functions of Rabaul Port** to other locations, due to the possible negative impacts of future volcanic eruptions on the access roads to Rabaul Port

(4) Lower Commercial Viability of Rabaul Port

Lae Port, Port Moresby Port and Kimbe Port deal with the first, second and third largest volumes of cargo throughputs in PNG, respectively. They are regarded as commercially viable because they are able to make profits by operating the ports.[1]

On the other hand, the operation of Rabaul Port, although a major port that handles the fourth largest amount of cargo throughputs in PNG, is not commercially viable yet. Therefore, upgrading and expansion of the next level of main ports (Rabaul, Wewak, Madang, Oro Bay and Alotau Ports) should be evaluated and justified on the basis of national economic benefit. Moreover, it is necessary for PNG Ports or Department of Transport to find external assistance (grant aid or concessional loans) for Rabaul Port.

Possible Development Directions of the Port Sector in Relation to Northeast Gazelle Peninsula

Important Perspectives of Economic and Spatial Development in the Northeast Gazelle Peninsula (Region). Consideration of national and regional economic benefits to be generated by the upgrading and expansion works, as well as rehabilitation, is required. Hence, it is necessary to consider the port upgrading and expansion, including relocation, from a wide range of perspectives of regional economic and spatial development, as well as sustainable and inclusive development.

13.2 Objectives of Development of Ports

Ports always play an important role in regional economy, specifically in maintaining and improving living standards of residents by enabling the transport of cargoes from overseas and from other regions in the country. The function and capacity of exporting cargoes will primarily contribute to the industrial development of the region. It is particularly emphasised that the role

[1] Medium Term Transport Plan (MTTP) 2014-2018.

of the port is highly important for Kokopo / Rabaul where land transportation, such as road and railway connecting with other regions, is undeveloped.

The objectives of the ports in this region, including Rabaul Port and other ports, are identified to conduct suitable development taking into account the following:

1) The existing port should be properly maintained. Facilities are to be regularly inspected with maintenance record and sufficient repairing should be conducted with short/medium/long term maintenance plan.

2) Port handling efficiency should be improved by introducing new equipment, operation systems, and by reorganisation of port operation.

3) The port should be expanded in accordance with the increase in port demand.

4) The port should provide uninterrupted services even upon occurrence of disaster due to volcanic eruption or tsunami. The existing Rabaul Port should be prepared for strengthening its resilience against such disasters.

5) A new port should be planned to take into account risk of volcanic disaster and the future industrial development of the region.

6) Rabaul is functioning as oil storage and distribution centre of the region. This function must be maintained and strengthened near a new port to be established in a low disaster risk area in the middle and long terms.

7) Simpson Harbour is an attractive location for tourists. Rabaul Port should accommodate cruise ships and provide quality services to passengers and ships.

8) Simpson Harbour should continue to play a role in the trading of tuna fish between fishing boats and reefer ships. At the same time, Rabaul Port and its surrounding area should accommodate the development of a tuna fish processing SEZ by utilising this existing advantageous condition.

13.3 Strategies for Development of Ports

13.3.1 Port Development Strategy in Overall Regional Development

(1) Port Development Strategy in the Regional Strategy for Enhancing Resilience against Disaster Risks of Volcanic Eruption

After the last large volcanic eruption in 1994, the ENBP's provincial capital was relocated to Kokopo Town, the Rabaul Airport was relocated to Tokua Area, and the Rabaul District's headquarters was relocated to Kurakakaul Area. In response to these relocations, necessary trunk roads have been developed. However, even after the 1994 volcanic eruption, the Rabaul Port and fuel depots have remained at their original places.

In the last 28 years (after 1994 volcanic eruption), the region's infrastructure has been restored and the regional economies have largely expanded. For this reason, prospective physical and financial losses due to possible damage to Rabaul Port by future volcanic eruption could be huge in comparison to 1994 eruption. Therefore, it is necessary to take necessary mitigation measures for ports in Northeast Gazelle Peninsula, including the relocation of some functions of Rabaul Port to a lower disaster risk area.

(2) Long-Term Relocation Strategy of Some Functions of Rabaul Port to a Lower Disaster Risk Area

The necessity of relocating Rabaul Port to an area safer from volcanic hazard has been considered and the subject of debates for many years, especially after each volcanic eruption in Rabaul. The relocation of Rabaul Port was discussed in the Rabaul Port Master Plan Report (November 2014)

by PNG Ports, in which the Kokopo area was proposed as the new port location. The same relocation plan was updated by Detailed Infrastructure Master Plan of Rabaul Port (February 2021). As another alternative port location, the west side of Gazelle peninsula (Ataliklikun Bay) is proposed in this report considering a future industrial development potential of the region such as SEZ.

However, it is necessary to consider the commercial viability of Rabaul Port relocation or its expansion and upgrading. For instance, the volume of cargo handling in 2020 showed that Rabaul Port had cargo throughputs consisting of 203,000 tons of coastal cargo, and 365,000 tons of overseas cargo including container cargoes of only 14,000 TEU. The cargo volume seems to be too small to make the expansion and upgrading of Rabaul Port commercially viable, the same point which the PNG's Medium Term Transport Plan (MTTP) 2014-2018 mentioned.

Moreover, aside from the insufficient volume of cargoes handled by Rabaul Port, the scale of the economy in this region is also not large enough. Furthermore, it is considered that "regional economic benefits" brought about by the relocation of all functions of Rabaul Port are not sufficiently large to make the full port relocation economically feasible.

Therefore, it would take 20 or more years for Rabaul Port's cargo volume and the regional economy to become sufficiently large to make the regional economic benefits from the full-scale port relocation. Even so, preparation is needed for the risk of volcanic disaster, which is said to occur in 40 or 50 years after the last eruption in 1994. Assuming that the disaster might come in around 2032 ~ 2042, the scale of cargo volume as well as the regional economy would not reach sufficient level for the full-scale port relocation to be feasible.

(3) Strategy of Developing a New Primary Port in a Lower Disaster Risk Area and Remaining Some Functions in Rabaul Port

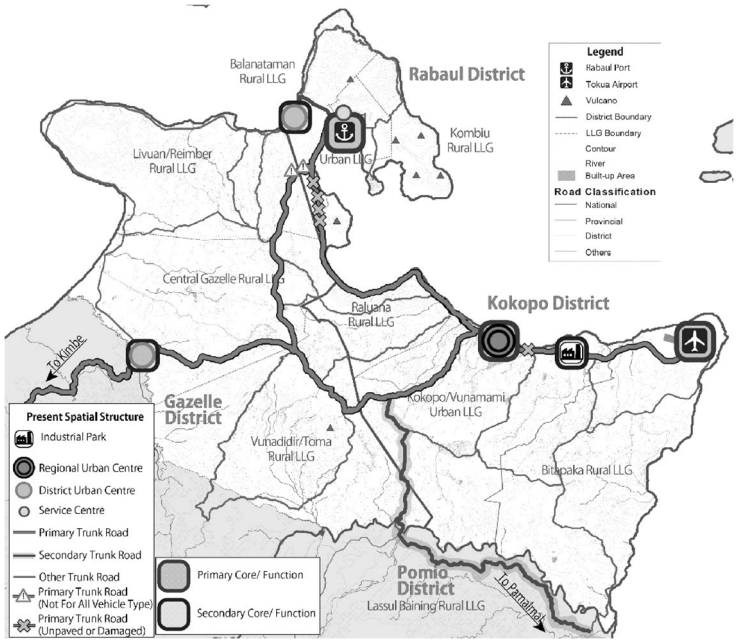
Instead of relocating the whole function of Rabaul Port to a disaster safer area, it is necessary to formulate an alternative combined strategy to reduce volcanic disaster risks by maintaining part of Rabaul Port functions in Rabaul with the establishment of a new port in a hazard safer area. That means, some measures will be adopted to keep partial function of the Rabaul Port at the current site while rehabilitating and upgrading its ageing and deteriorated infrastructure in a disaster safer area.

For realising this alternative strategy for the port sector development in Northeast Gazelle Peninsula, it is also necessary to conduct rehabilitation and upgrading of the existing infrastructure of Rabaul Port because the demand for export and import cargoes is somehow on the increase. Notably, the region of Northeast Gazelle Peninsula has depended on export-oriented economic sectors, including primary production of agricultural, forestry and fisheries products.

In the next section, the proposed port development strategy will be described in relation to phased development for "Regional Spatial Structure 3 (Selected Alternative)" described in Chapter 6).

13.3.2 Phased Development of Port Facilities in Northeast Gazelle Peninsula

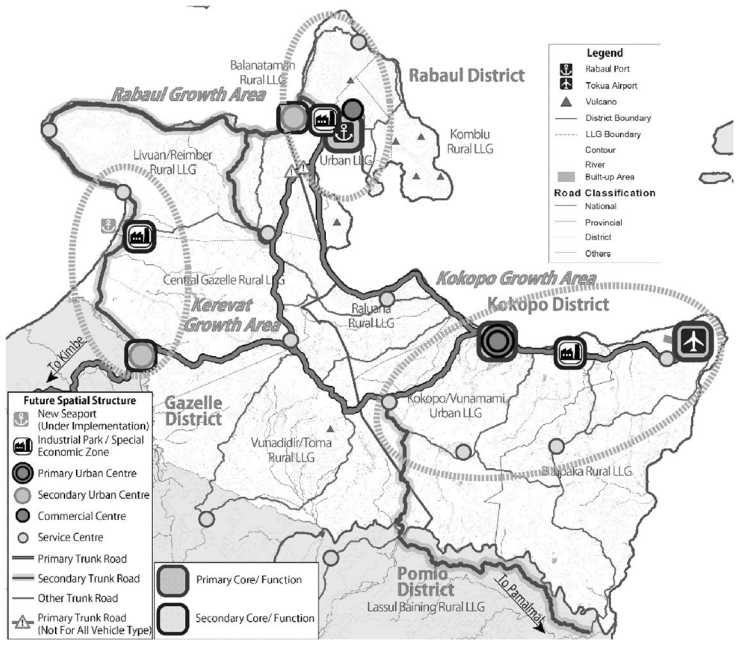
(1) 2022: At Present



The existing Rabaul Port is performing all functions of cargo import/export, as well as those of coastal cargo. Liquid cargo, such as fuel, is also handled at Rabaul Port.

The main consumers and shippers are in Kokopo Town to /from where cargoes are transported by trucks. The present main issues to be tackled include 1) rehabilitation of aged and deteriorated port facilities, 2) upgrading of some port facilities to respond to a continuing port cargo demand, 3) strengthening of the coastal road between Kokopo and Rabaul, 4) strengthening of the access road (within Rabaul Town) to Rabaul Port.

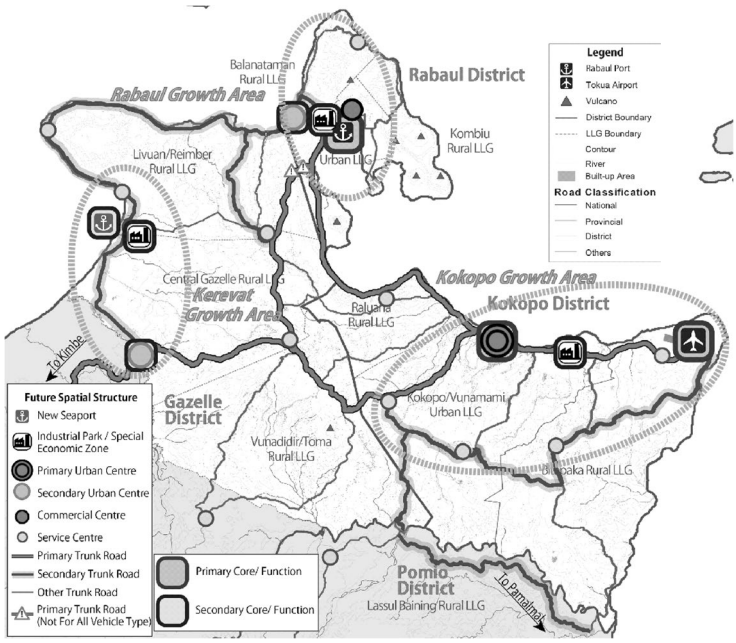
(2) By 2032: 10 Years from the Present



It is considered that development of tuna fish processing industry will commence at a SEZ established in the Rabaul Growth Area. Similarly, in Kerevat Growth Area, an Agro-Industry SEZ industrial will be started.

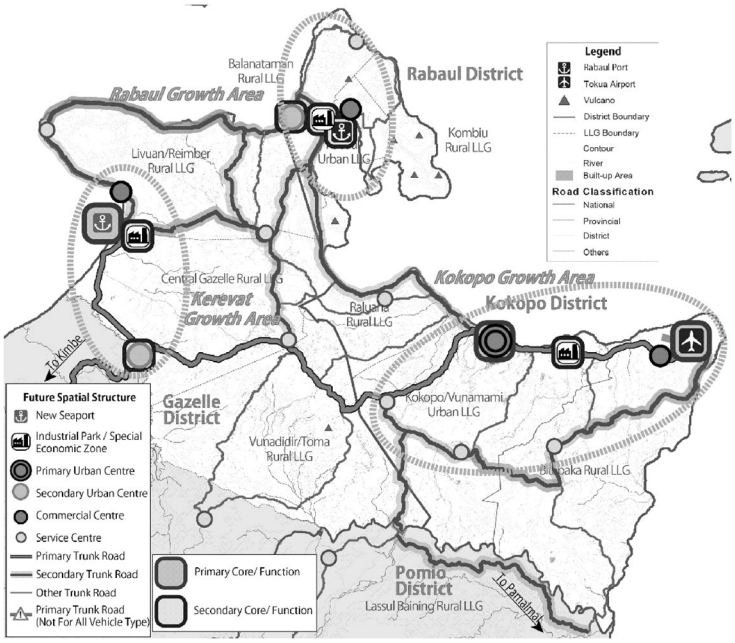
Most of the port functions will still exist in Rabaul Port. However, small-scale port development should be completed in a new port location (highly probably in Ataliklikun Bay). By 2032, initial new port development will be aimed to support the emergency response to possible events of disasters due to volcanic eruption.

(3) By 2042: 20 Years from the Present



By 2042, a new port will be developed to accommodate relocated port functions (general cargo handling function) from Rabaul Port. However, Rabaul Port will continue to be a prime port of the region in this phase.

(4) By 2052: 30 Years from the Present



Two ports will handle regional cargoes. The new port will play the role of a prime port of the region.

Industrial development will be fully operational, by which import/ export cargoes will be much increased.

(5) Port Functions Relocated to New Port

A proposed time schedule for phased development of ports, including relocation of selected functions of Rabaul Port to the new port, is shown in Table 13.3.1.

Table 13.3.1 Timeline for Division of Functions of Rabaul Port and New Port

Year / Port Function	2025 ~ 2032	2032 ~ 2042	2042 ~ 2052	2052 ~
Rabaul Port				
1) Container Cargo	★	★	★	
2) Bulk Cargo	★	★	★	
3) General Cargo	★	★	★	★
4) Liquid Cargo	★	★	★	
5) Tuna Fishing Boat	★	★	★	★
6) Cruise Ship Terminal	★	★	★	★
New Port				
1) Container Cargo			★	★
2) Bulk Cargo			★	★
3) General Cargo		★	★	★
4) Liquid Cargo (Fuel)			★	★
5) Tuna Fishing Boat				
6) Cruise Ship Terminal				
7) Emergency Response Purpose Jetty	★			

Source: JICA Expert Team

1) Container Cargo

Although container cargo throughput of Rabaul Port is only 20,000TEU per year at present, the container cargo volume has been rapidly increasing more than other types of cargoes. The new port should have the function of container terminal, and it should be equipped with quay cranes, yard cranes and tractor/chassis for efficient handling operation. Increase of container cargoes will come not only from the growth of general import but also from industrial products to export. The cargo volume will increase along with the SEZ development.

2) Bulk Cargo

The main bulk cargoes handled at Rabaul Port at present are for exporting copra and cocoa. This port function should also be relocated to the new port. The reason is that new port should be equipped with loading/unloading quay crane, by which cargo handling speed will be significantly improved.

3) General Cargo

General cargo is usually identified as cargo which is not suitable for container transport, such as construction material, large and heavy machineries, etc. Rabaul Port is assumed to continue holding the functions of supporting port for Tuna fishing industry in the Bismarck Sea. The certain scale of general cargo handling function should be maintained at Rabaul Port. The new port should have the function of general cargo.

4) Liquid Cargo (Fuel)

At present, Rabaul Port is the centre of fuel import and distribution not only for Northeast Gazelle Peninsula, but also for surrounding island provinces of the Island Region. Considering the disaster risk of volcanic eruption, function of liquid cargo port should be relocated to the new port which is safer than the place in Rabaul. The main hurdle to be overcome to relocate this function is the fact that on-shore facilities such as tanks and pipelines are owned by private firms. Hence, relocation of oil depot facilities should be also by private sectors' investment. Nevertheless, the

relocation of fuel depots to a low risk area is essential to strengthen the resilience of regional economy and industrial activities by relocating them to the new port. Public sector should consider supporting private sector by means of some subsidies to help such relocations.

5) Tuna Fishing Boats

Simpson Harbour in front of Rabaul Port is a place for tuna fish trading, where direct loading of frozen tuna from fishing boats to reefer vessels occur. Because Simpson Harbour has very wide calm water surface sheltered by land strip peninsula with volcanoes, this ship-to-ship trading activities will continue in Simpson Harbour even after the new port is developed.

There is a plan for establishing a Tuna Processing SEZ near Rabaul Port. Even after its establishment, the direct loading of frozen tuna from fishing boats will continue in Simpson Harbour.

The activities of fishing boats, such as fuel bunkering and fishing net repairing will also continue, hence necessary port facilities should be re-established at Rabaul Port.

6) Cruise Ship Terminal

Simpson Harbour is a very attractive tourism resource, holding the demand for cruise ship docking. Considering the cruise ship passengers' convenience, this function will remain at Rabaul Port even after the new port is developed. A new modernised passenger terminal should rather be developed to enhance the charm for tourists and to contribute to increase future tourism demand.

ENBPA has considered to establish a cruise ship terminal next to Rabaul Yacht Club in the eastern coastal area of Simpson Harbour. Then this new cruise ship terminal might be owned and managed by ENBPA. However, it is considered the development and operation of such a single cruise ship wharf is not efficient and not financially feasible. It is recommended to keep the cruise ship operation within Rabaul Port.

13.3.3 Port Cargo Demand Forecast and Phased Development of Ports in Northeast Gazelle Peninsula

As shown in Table 13.1.2 and Table 13.1.3, in the last five to ten years, the volume of overseas container cargo (import and export) and overseas bulk fuel cargo (import) have increased largely and rapidly. As a result, the utilisation rate of Berth 2 (used by overseas large vessels) is considered to increase rapidly from the 2019 situation (48% utilisation rate).

According to the port trade forecast (cargo demand forecast) by the 2021 Rabaul Port Detailed Master Plan, the utilisation rates of Berth 2 (overseas) of Rabaul Port are estimated for year 2032, 2037 and 2042, as shown in Table 13.3.2. Moreover, the JICA Expert Team also conducted a port cargo demand forecast based on data for the past 10 years of different types of cargo. Similarly, by using this port cargo demand forecast, the utilisation rates of Bert 2 are estimated, as shown in Table 13.3.3.

Generally, it is considered that these two port demand forecasts can support the following proposed timing for upgrading the capacity of Rabaul Port in handling overseas large vessels, and the proposed timing for relocating some of the port functions from Rabaul Port to a new port in a low disaster risk area.

- Between 2024 and 2032: Upgrading of capacity of Rabaul Port for handling overseas large vessels (including oil tankers, container ships, and break bulk cargo ships)
- Between 2032 and 2042: Starting the relocation of some port functions from Rabaul Port to a new port
- Between 2042 and 2052: Establishment of a primary port function at a new port, while maintaining some limited functions (accommodating cruise ships, fishing vessels and reefer vessels) in Rabaul Port.

Doing the medium-term and long-term cargo demand forecasts for ports in Northeast Gazelle Peninsula is difficult because statistics or estimated GRDP for ENBP are not available. Also, there are no available detailed port cargo statistics of Rabaul Port about origins of cargo, such as containers, cacao and copra from surrounding island provinces.

Table 13.3.2 Demand Forecast of Overseas Container Cargo (Export and Import) and Expected Utilisation Rate of Berth 2 (Overseas)

PNG Ports, 2021 Rabaul Port Detailed Infrastructure Master Plan's Forecast about Overseas Container			Utilisation Rate of Berth 2 of Rabaul Port	
Total of Export and Import of the Region				
Yera	(tons)	Year 2019-100.0	Year	%
2010 Actual	90,305	49.4		
2015 Actual	163,257	89.4		
2019 Actual	182,674	100.0	2019 Actual	48%
2020 Forecast	212,268	116.2		
2025 Forecast	256,825	140.6		
2030 Forecast	304,209	166.5		
2032 Forecast	323,163	176.9	2032 Extimated	85%
2035 Forecast	351,593	192.5		
2037 Forecast	370,547	202.8	2037 Estimated	97%
2040 Forecast	398,977	218,4		
2042 Forecast	417,931	228.8	2042 Estimated	110%
2045 Forecast	446,361	244.3		
2050 Forecast	493,746	270.3		

Source: JICA Expert Team, based on PNG Ports, 2021, Rabaul Port Detailed Master Plan

Table 13.3.3 Demand Forecast of Overseas Cargo (Export and Import) consisting of Container Cargo, Break Bulk Cargo, and Bulk Fuel, and Expected Utilisation Rate of Berth 2 (Overseas)

JICA Expert Team NEGID^Plan's Forecast about Overseas Cargo (Container, Break Bulk and Bulk Fuel)			Utilisation Rate of Berth 2 of Rabaul Port	
Total of Export and Import of the Region				
Yera	(tons)	Year 2019-100.0	Year	%
2010 Actual	140,140	42.8		
2015 Actual	256,793	78.5		
2019 Actual	327,199	100.0	2019 Actual	48%
2020 Forecast	398,666	121.8		
2025 Forecast	525,681	160.7		
2030 Forecast	695,437	212.5		
2032 Forecast	778,436	237.9	2032 Forecast	114%
2035 Forecast	922,597	282.0		
2037 Forecast	1,033,753	315.9	2037 Forecast	152%
2040 Forecast	1,226,927	375.0		
2042 Forecast	1,375,954	420.5	2042 Forecast	202%

Source: JICA Expert Team

13.3.4 Rehabilitation and Upgrading of Rabaul Port

Rabaul Port's infrastructure is heavily deteriorated and aged. The port operations are ongoing under unfavourable conditions. An urgent rehabilitation is long overdue.

Due to the deterioration of the structural elements (e.g., piles), loading restrictions are in effect for Berth 1 and Berth 2. Hence, the port operations only allow light equipment like trailers and forklifts to the deck structure of Berth 2. The fenders, bollards, kerbs, pavements, and other utilities are in poor condition in both berths.

In particular, Berth 1 has a problem of siltation from an outfall of city drainage. This siltation and a lack of dredging activities in front of the berth limit the size of ships allowed to moor. Therefore, the majority of vessels, such as container ships, oil tankers, or cruise ships, moor to Berth 2. Consequently, the berth occupancy of Berth 2 is considered to be very high, especially before the COVID-19 pandemic. The maximum ship size allowed to Berth 1 is 115m LOA. Despite the fact

that the berth was designed for 11m, it is currently 5 to 6 metres deep only at the eastern end. Hence, it cannot be fully utilised.

In February 2021, Rabaul Port Detailed Infrastructure Master Plan was prepared by PNG Ports, and it highlighted the poor conditions of the existing structure. Some immediate repair activities were recommended, especially for Berth 1, to increase the structural capacity of the aged elements. Other rehabilitation activities were noted for fenders, bollards, pavements, and buildings. In addition, to ease the high berth occupancy ratio at Berth 2, the master plan proposed to extend it to add a new bulk fuel facility. This proposal is aimed to accommodate two large vessels at the same time at Berth 2.

In accordance with the port development strategy proposed by the NEGID-Plan, Rabaul Port will remain to serve as the primary port of the region for at least 20 more years. Furthermore, after developing a new port with its functions, Rabaul Port is considered to serve some sectors such as fishing and cruise ship industries.

In the coming years, with the growth of the region and expected investments in the development of SEZ, the demand from Rabaul Port is expected to increase significantly. By 2042, the overall cargo throughput is expected to grow to about 280% of the cargo throughput in 2022. Rabaul Port should be rehabilitated, developed, and upgraded to cope with the anticipated increase in cargo volumes. Managing the next 20 years is the immediate priority for Rabaul Port.

(1) Immediate Rehabilitation of Rabaul Port

Strengthening the structural capacities of Berth 1 and Berth 2 is a primary requirement to maintain the port operations in Rabaul Port. The decks, approach structures, and piles of both berths must be repaired immediately. As imminent earthquake and volcanic hazards characterise the region, rehabilitating these structures is crucial to ensure the safety and integrity of the facilities. Furthermore, by lifting loading restrictions on the facilities, the port operations can allow heavy equipment to the decks for increased efficiency.

A general restoration of utilities (power, water supply, etc.), aids-to-navigation, pavements, and other miscellaneous items (fenders, bollards, kerbs, etc.) is required. Furthermore, from the safety point of view, the fire-fighting system needs urgent rehabilitation and improvement. Due to its proximity to an active volcano and nearby oil tanks, Rabaul Port is considered a very high-risk port for fire hazard.

The buildings and sheds require particular renovations due to structural damages. Within the port premises, there are many abandoned buildings. As urgent rehabilitation, demolishing abandoned buildings and restoring existing ones are recommended.

Following the strengthening of Berth 1, a dredging activity is recommended to a level that is possible to allow vessels with a large draft. With this idea, the high-occupancy rate of Berth 2 is expected to be resolved significantly. Under the current circumstances, Rabaul Port operates as if it only has one operational berth, Berth 2. As per the analysis of the berth occupancy ratio before the pandemic, Berth 2 had an occupancy ratio of around 47.5% in 2019. Therefore, in the absence of any rehabilitation to Berth 1 to receive calls from large ships (e.g., container and general cargo vessels), the upward trend of cargo volumes may cause congestion in Rabaul Port.

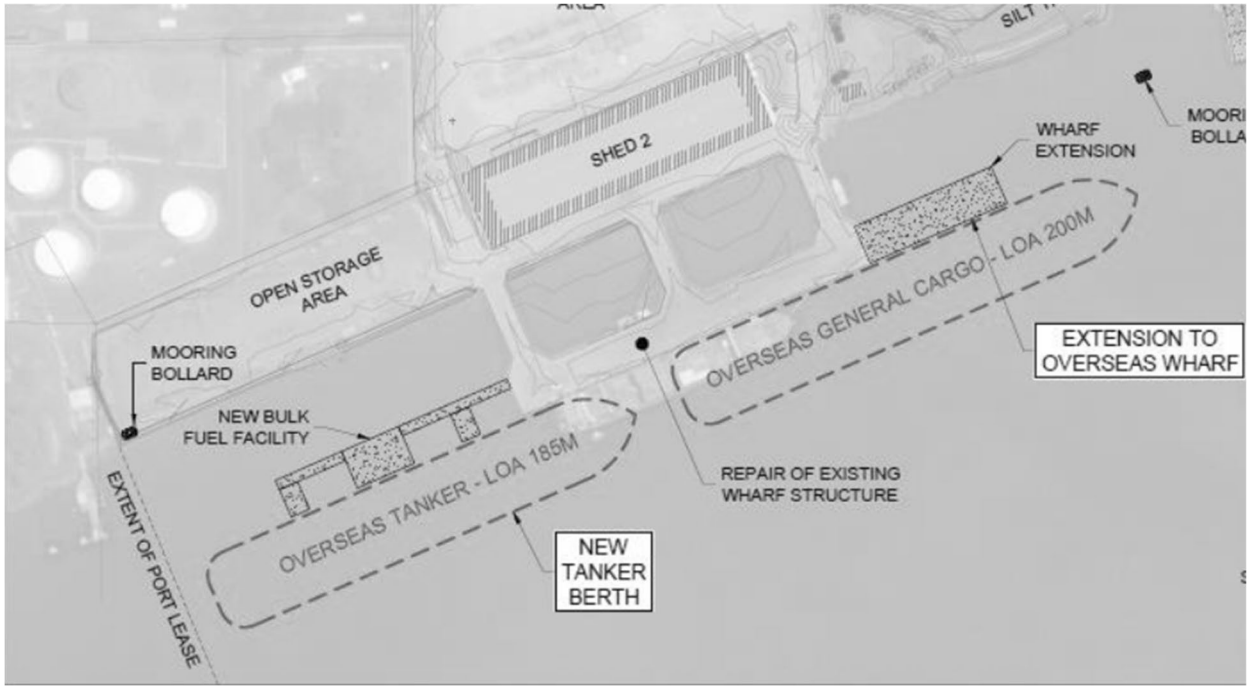
Even under current conditions, the siltation causes a significant loss of revenue for PNG Ports by maintenance activities of the silt curtain. The drainage problem is recommended to be fixed to prevent such financial loss and continuous siltation of Berth 1. In coordination with Rabaul City, an alternative discharge location for the drainage outflow can help to avoid siltation at Berth 1. Such a solution is expected to keep the seabed elevation stable and low for large ships to moor at Berth 1.

(2) Upgrading of Rabaul Port (Within 5 to 10 Years)

Currently, the port operations in Rabaul Port are highly inefficient, as described previously in Section 13.2 "Issues on Development of Ports", due to various reasons. Assuming that the structural capacity of the berths will be increased with their rehabilitation, it may be possible to allow heavy cargo handling equipment to operate in both berths. Based on the demand forecast analysis, the cargo throughput is expected to increase to 165% within ten years and to 280% within twenty years of the cargo volume in 2022. Therefore, the efficiency of the port operations will become highly critical. Even if the berths are extended or their number increased, to cope with such an increased cargo volume, the efficiencies of port operations are anticipated to be much more critical to reduce turnaround times, increase productivity and minimise bottlenecks. Therefore, several strategies can be used to improve port efficiency and increase port capacities, such as procuring mobile or quay cranes. For example, the average container handling productivity is estimated at 6.4 TEU/hour. Low productivity increases the vessels' turnaround time and causes a high-berth occupancy. With the introduction of mobile cranes, productivity is anticipated to be improved with decreased turnaround time. As an addition, a terminal operating system may be recommended to increase the yard's efficiency. Due to the earthquake hazard, the containers are not stacked high in Rabaul Port. Therefore, the available area in Rabaul Port is required to be utilised efficiently. It is recommended that the container stacking areas be designated with paintings and to introduce a terminal operating system to utilise the available yard most effectively.

An extension of Berth 2 is an idea to allow more vessels simultaneously in it. In February 2021, Rabaul Port Detailed Infrastructure Master Plan, also recommended extending Berth 2 to ease its high occupancy ratio. The master plan demonstrates the idea with a figure with one Overseas General Cargo Vessel with 200m LOA and one Overseas Tanker vessel with 180m LOA. While these vessels represent the largest vessels of their kind, they are not the largest vessels calling at Rabaul Port. Based on the statistics provided by PNG Ports, Cruise Ships with 294m LOA are the longest vessels calling at Rabaul Port. Rabaul Port will receive more cruise ship calls if the industry is assumed to recover following the COVID-19 pandemic. Before the pandemic, Rabaul Port received cruise ship calls 1.31 times per month on the average. These vessels occupy Berth 2 for around 12 hours. Therefore, Rabaul Port may not benefit from an investment in berth extension during the cruise ship berthing with LOA of 294m. Also, the size of the calling ships may increase.

On the other hand, there are vessels regularly calling at Berth 2. The number of actual working hours on overseas tanker vessels (2.83 calls/month) is 22 hours, on Overseas Container Vessels (4.42 calls/month) is 25.5 hours, and on Overseas General Vessels (1.02 calls/month) is 28.1 hours on the average. These figures indicate that Overseas Container, General, and Tanker vessels occupy Berth 2 most of the time. Additionally, the waiting times of these vessels are around 7 to 13 hours on the average. Therefore, a berth extension may provide enough time to continue the port operations for another 10-20 years. Still, a comparison of alternatives with the time and cost is recommended.



Source: PNG Ports, 2021, Rabaul Port Detailed Infrastructure Master Plan

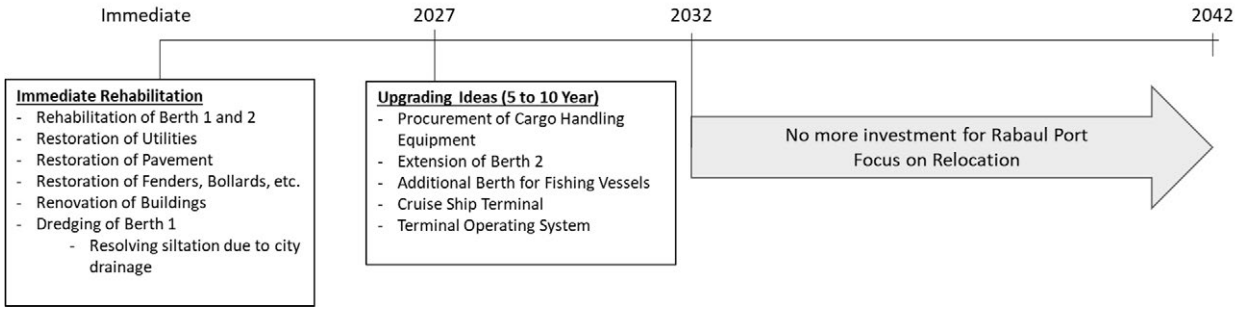
Figure 13.3.1 Conceptual Plan for New Tanker Berth and Extension of Berth 2

The fishing vessels are one of the primary occupiers of the berths in Rabaul Port, especially Berth 1. These vessels do not load or unload cargoes at these berths. They usually berth for utilities, fuel, and net repair. Due to these time-consuming tasks, the berths remain occupied for long hours by the fishing vessels. Therefore, a new berth with a limited draft and length can reduce the fishing vessels' burden on Rabaul Port. An area east of Berth 1, where there is a shipwreck, is considered a promising development location. But coordination with NMSA is required to remove the wreckage from this site.

Rabaul Port will continue to be operational even after the full development of a new port is completed. The function to receive calls from the cruise ship industry should remain at Rabaul Port even after the new port development. As noted before, following COVID-19 pandemic, it is expected that Rabaul Port will continue to receive cruise ship calls with an increasing trend. Rabaul Port is located in a scenic location from which tourists can enjoy a beautiful view of stunning volcanoes, including Mount Tavurvur, which erupted in 1994. In Rabaul Port, cruise ship operations (e.g., customs, immigration) are handled with temporary facilities. To amplify the tourism potential of Rabaul, a state-of-the-art cruise ship terminal for passengers is recommended to be developed.

Finally, the cost of the above-mentioned rehabilitation and upgrading ideas depends on the size or the extent of rehabilitation and upgrading. For example, rehabilitation of Berth 1 can be costly if complete restoration and a new berth construction are envisaged. Therefore, considering the phased development of the spatial structure, Berth 1 is recommended to be lightly repaired and rehabilitated instead of having an overall new construction. Hence, a minor extent of rehabilitation may become cheaper considering the remaining lifetime of Rabaul Port following the port strategy. This methodology can be utilised to decide on the scope of the rehabilitation and upgrading projects for Rabaul Port to reduce costs.

After 2032, any investment in Rabaul Port may not be viable due to the phased development for spatial structure. Therefore, rehabilitation and upgrading ideas should be implemented before 2032. And after 2032, the focus should be shifted to relocating port functions to the new port.



Source: JICA Expert Team

Figure 13.3.2 Proposed Rehabilitation and Upgrading of Rabaul Port

13.3.5 Discussion of New Port Locations in Northeast Gazelle Peninsula

(1) New Port Development in Northeast Gazelle Peninsula

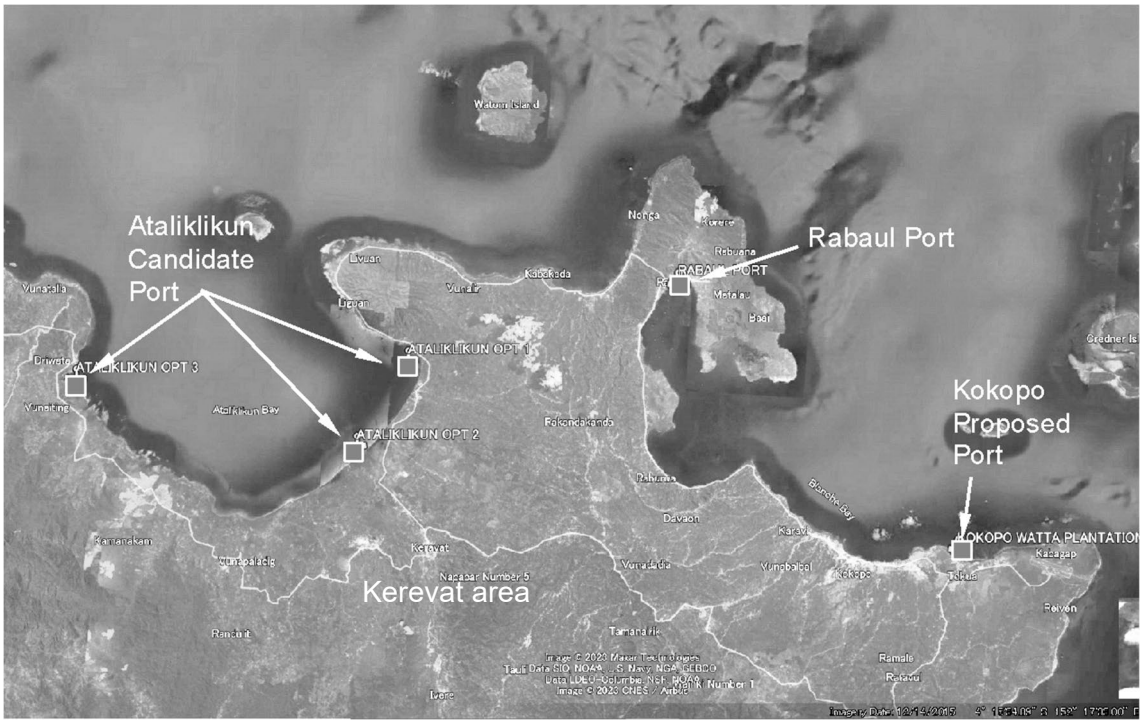
In 1994 the eruption of Mount Tavurvur and Mount Vulcan generated a huge amount of volcanic ash, which heavily damaged the buildings and urban infrastructure of Rabaul Town, Rabaul Airport, and the access roads and seaside access to Rabaul Port. Even before the 1994 volcanic eruptions, a new port development in a low risk place was being discussed among concerned parties, such as the national government, PNG Ports, East New Britain Province, as well as relevant stakeholders of the region around Rabaul. In 2014, PNG Ports issued a Rabaul Port Master Plan Report, in which a new port development was proposed in Kabakaul Area of Kokopo District. One of the reasons why the plan has not commenced up to now was due to the required large investment cost exceeding 100 million USD. Nonetheless, it is true that the existing Rabaul Port is still well performing as the regional port, and that port users and citizens in Rabaul District do not fully agree to the relocation of the port.

Certainly, the risk of port closure due to volcanic eruption would strongly affect the regional economy. Therefore, some of the functions of Rabaul Port are thought to be preferable to be moved to the new port. However, the financial viability of the new port investment should be carefully considered. The cargo demand of Rabaul Port is increasing in accordance with the current port statistics, in which an increase of container throughput for import, in addition to export agricultural/forestry products and agro/forestry-processing products, are supporting the growth of the port businesses. However, it is considered that the last decade's rapid increase of port cargo demand might be able to cover part of investment for expansion or renewal of the existing port, but it will be not easy to cover a new port development cost by port revenues because the totally new port development means the abandoning of the existing port properties.

Recently, a development plan of Agro-Industry SEZ in the Kerevat Area has been discussed in the region. Such new industrial development might contribute to the increase of port cargo demand, which will ensure the financial viability of new port development. The new industrial development can be based on ENBP's agricultural products, such as cacao and balsa wood. Additionally, it should be noted also that major large-scale agricultural farms are distributed in the west side of the peninsula. From these points, Ataliklikun Bay is considered to be another strong candidate for new port development.

Later in this chapter, Ataliklikun Bay and Kokopo Area, as well as Rabaul Port, are compared in terms of suitability as port locations in Northeast Gazelle Peninsula.

Figure 13.3.3 shows candidate port locations, as well as Rabaul Port, in Northeast Gazelle Peninsula. There are three candidate locations in Ataliklikun Bay, which are discussed in the next Section 13.3.6.



Source: JICA Expert Team

Figure 13.3.3 Alternative Port Locations including Rabaul Port

(2) Comparison Criteria for Evaluating Alternative Locations for New Port Development in Northeast Gazelle Peninsula

The following criteria are discussed in comparing three different port locations, namely, Rabaul, Kokopo and Ataliklikun:

1) Risk of Volcanic Eruption
2) Risk of Tsunami
3) Seasonal Wave Condition
4) Depth of Water
5) Topography of Hinterland
6) Accessibility

6)-1 Accessibility to Consumption Areas of Import Goods

6)-2 Accessibility to Production Areas of Export Goods

6)-3 Accessibility to Fishery Products (Tuna and Its Processed Food)

7) Planned Industrial Areas including SEZs
8) Ease of Land Acquisition
9) Development Cost
10) Existing Infrastructure

10)-1 Access Roads

10)-2 Power Supply

10)-3 Water Supply

11) Environment

11)-1 Noise, Pollution, and Risk of Traffic Accidents

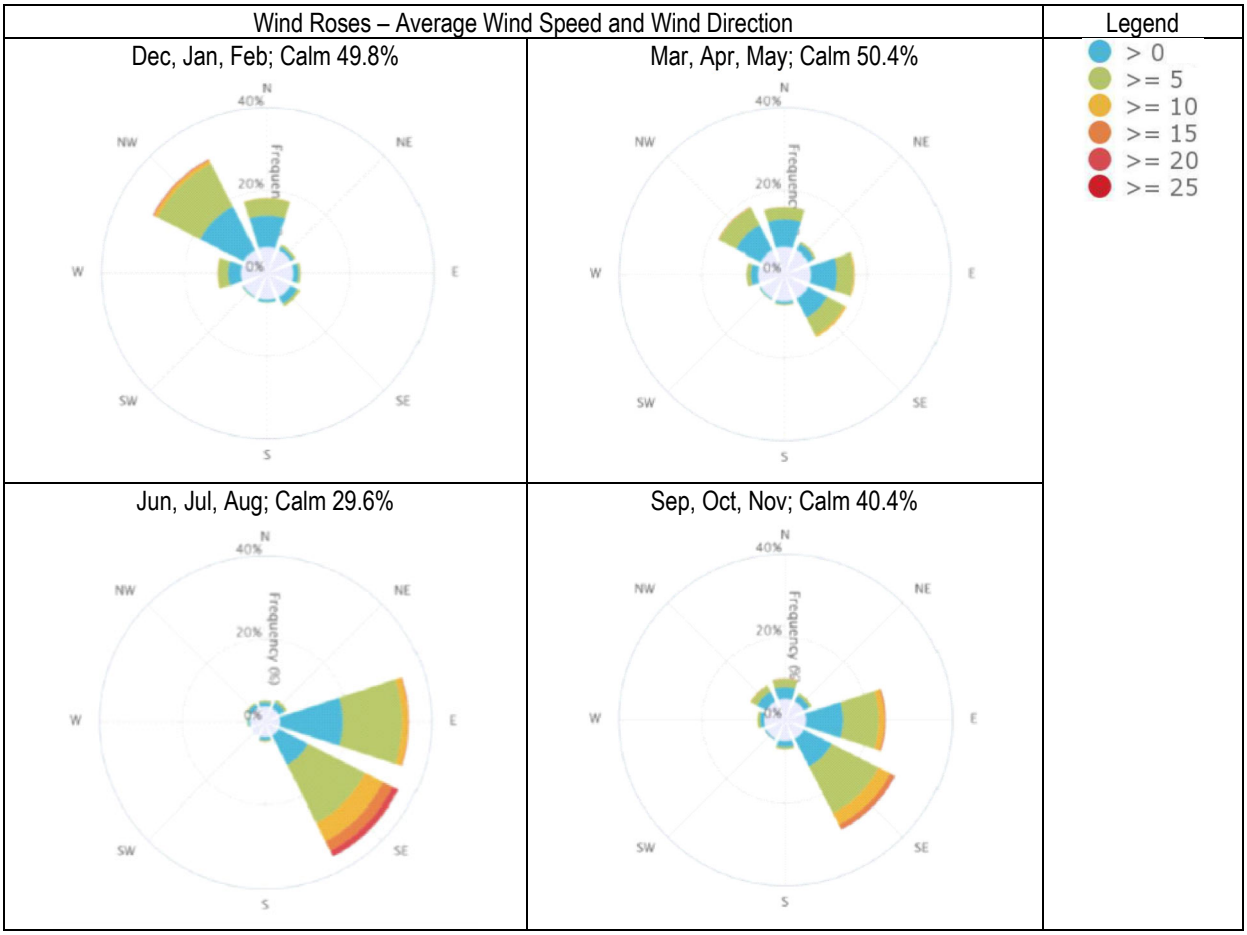
11)-2 Natural Environment

11)-3 Social Environment

1) Risk of Volcanic Eruption

The most critical effect of volcanic eruption is the risk of ashfall at the port area. When Mount Tavurvur erupts, volcanic ash is carried by the wind and falls to the port area. The risk of ashfall should be reduced with the longer distance from the volcano. The following table shows seasonal wind directions and their intensities. In accordance with these data, the wind during June – November will carry volcanic ash from Mount Tavurvur, in which probability of east wind is about 25~30% and maximum wind speed is less than 10 m/sec.

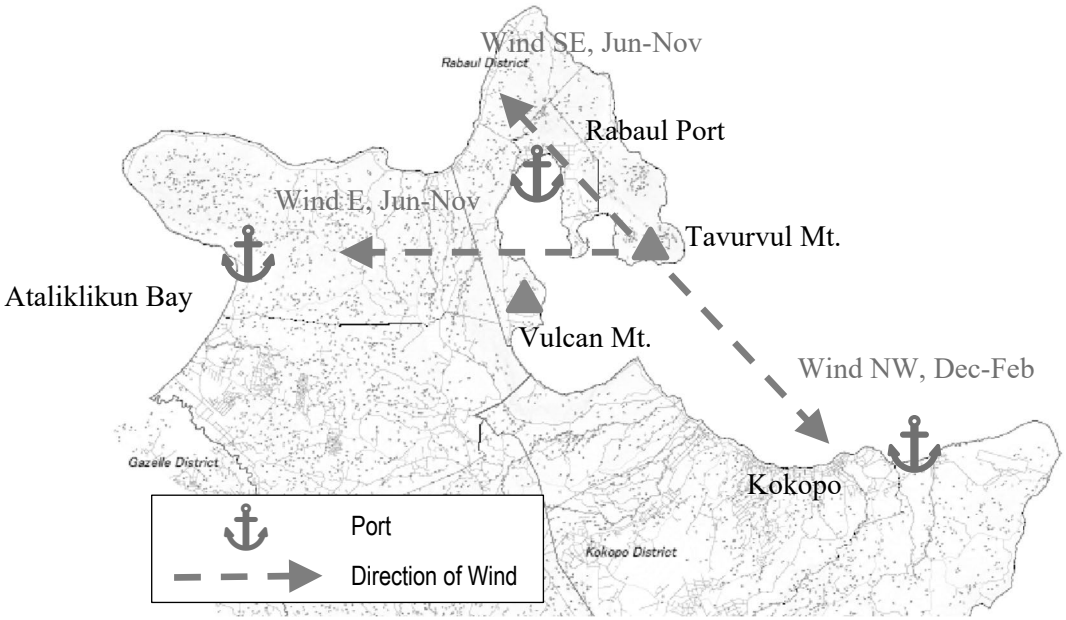
Table 13.3.4 Wind Rose of Kokopo-Rabaul Area



Source: PNG National Weather Service, 1973 - 1977

These seasonal wind directions and periods are plotted on the following figure. It should be noted that Rabaul Port suffers from SE wind between June and November (almost a half year), and the distance from Mount Tavurvur is about 6km. Hence, the risk of ash fall is very high. The disaster of eruption which caused serious damage to Rabaul in 1994 begun in September. At this time, it was supposed that seasonal SE wind carried ash and stones into the area of Rabaul Port.

The distance from the volcanos to Kokopo port candidate area is 17km, whereas to Ataliklikun port candidate area is 20km ~ 40km. Because large particles of ashes fall in the short distance from volcanos, and fine particles are carried to farther place, a larger distance from volcanos also reduces the quantity of ash fall. The risk of ash falls in both Kokopo and Ataliklikun is estimated to be quite lower than the area of Rabaul Port.



Source: JICA Expert Team

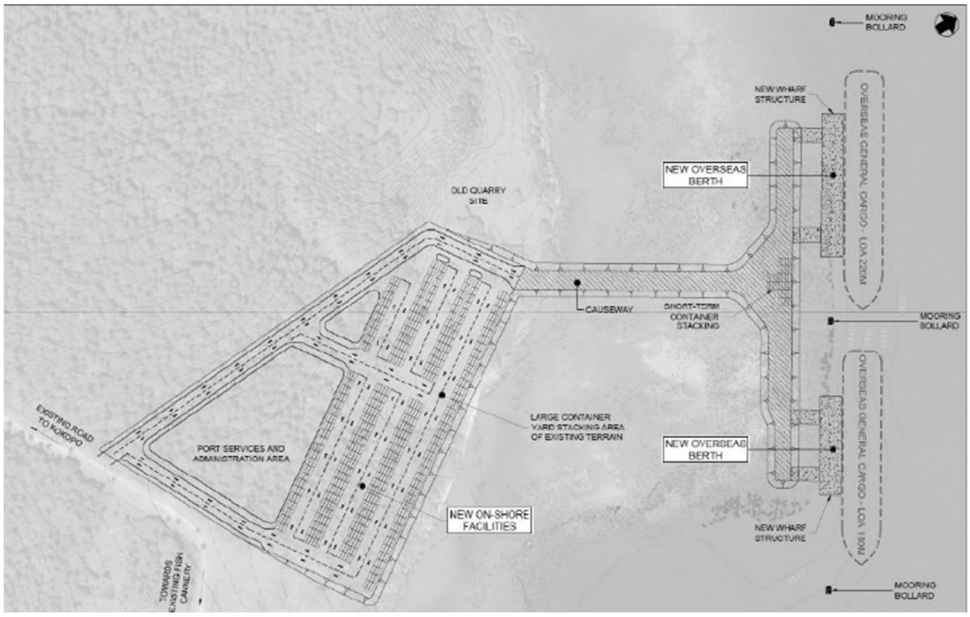
Figure 13.3.4 Seasonal Directions of Wind

2) Risk of Tsunami

In surrounding seas of ENBP, there are two major sources of tsunami. One is the southern trench and the other is the trench at the edge with Bismarck Sea. When Kokopo receives tsunami's impact, Rabaul Port will experience the impact of the same tsunami. At this time, the impact of the tsunami will be smaller in Ataliklikun Bay. On the other hand, when Ataliklikun Bay receives tsunami's impact, Kokopo and Rabaul Port will receive smaller impact of the tsunami. Since the new port development strategy is adopted by maintaining some functions of Rabaul Port, either Rabaul Port or a new port in Ataliklikun Bay will survive from any heavy tsunami disaster.

3) Seasonal Wave Condition

Although wave calmness of the port has to be evaluated by numerical wave analyses, it is roughly estimated by wind intensity and direction with land configurations.



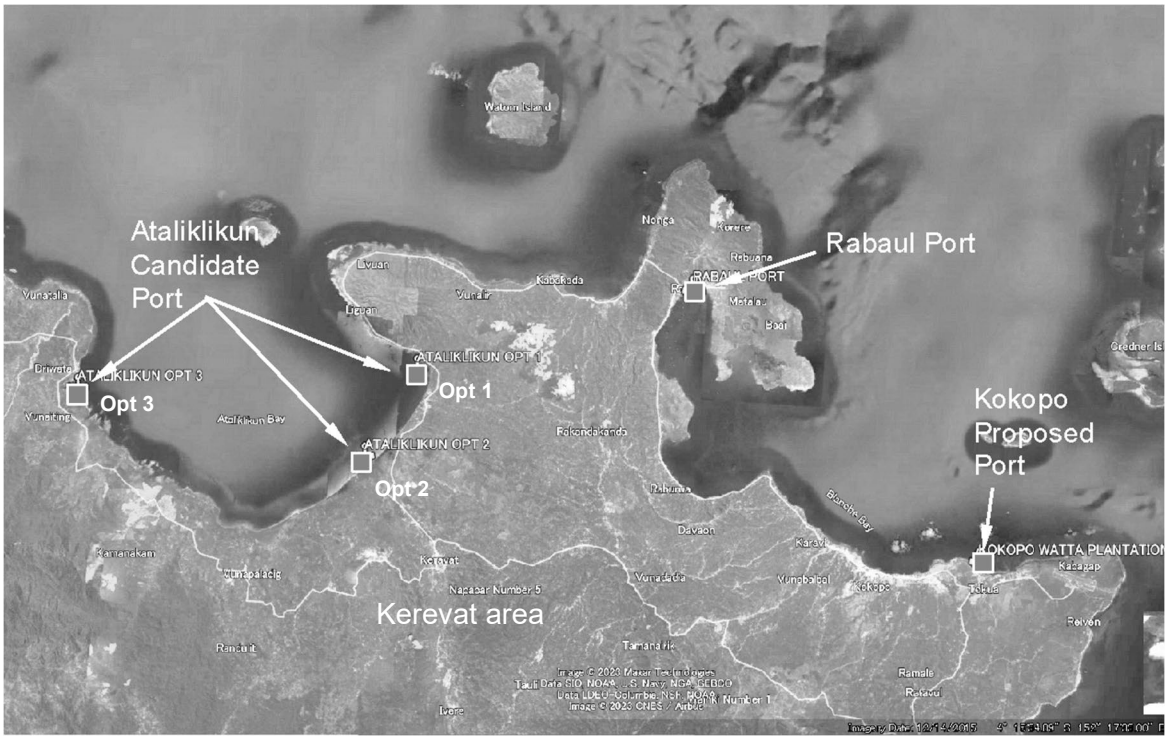
Source: Detailed Infrastructure Master Plan February 2021, PNG Port

Figure 13.3.5 Port Layout Plan in Kokopo

Rabaul Port is located at the north bottom of Simpson Harbour. The harbour is opening toward south, but there is no significant wind direction throughout the year. Also, the port is very calm all year round.

Kokopo port candidate area faces open sea towards north direction. The area receives wind from NW from December to February (3 months). The location receives wind from the East from June to November (6 months). From June to February, i.e., 3/4 of the year, the port might have waves affecting port operation.

In Ataliklikun Bay, three optional locations (Option 1 ~ Option 3 in Figure 13.3.6) are considered. The bay is about 20km wide, in which certain waves are generated by the winds from the West or the East. Option 1 and Option 2 receive the wind from NW from December to February (3 months). Option 3 receives the wind from the East from June to November (6 months). The plan of effective breakwater is difficult to carry out due to the depth of the sea; therefore, the wave analysis is necessary to determine how the surrounding land and seabed configuration will make reduction of wave intensity due to wave refraction.



Source: JICA Expert Team

Figure 13.3.6 Port Candidate Locations in Kokopo and Ataliklikun Bay

As an overview of the rough comparison of port locations by wind directions and intensities, the risk of waves for both Kokopo and Ataliklikun Bay seems similar.

4) Depth of Water

All port candidate locations have deep sea of more than -50m, except the area within 200m distance from the shoreline. Deep water has advantages in port development such as enabling free ship maneuvering and no dredging is needed for basin construction. But the disadvantage is the difficulty to build breakwater to protect the port basin from high waves.

5) Topography of Hinterland

In the vicinity of Kokopo port candidate area, there is a certain flat unused land with area of about 100ha. Though land acquisition will be required in the future, there is a good potential for expansion of the port according to the raise in port demand. This is a good advantage of Kokopo, comparing that Rabaul Port faces the urban area in which expansion of the port to hinterland will

be difficult. Similarly, to Kokopo, Ataliklikun candidate port areas have sufficient flat expansion areas.

6) Accessibility

6)-1 Accessibility to Import Goods Consumption Areas

At present, the major consumption areas holding a lot of residential houses and commercial stores are located in Kokopo Town and surrounding areas. Therefore, Kokopo is the most convenient location for distributing import goods to consumers.

The distance from Rabaul to Kokopo is 27km, whereas the distance from Ataliklikun to Kokopo is 40 ~ 70km depending on the candidate locations.

6)-2 Accessibility to Export Goods Production Areas

Coconut plantations and smallholder farms spread over the Rabaul, Kokopo and Gazelle Districts. Furthermore, plantations are expanding to Pomio District.

Coconut fruits processed into copra are bought by brokers from each farmer and transported to the port warehouse. It is thought that there is not much difference in the accessibility of Kokopo, Rabaul and Ataliklikun to copra production areas.

Many cacao farms and processing facilities are distributed around the Ataliklikun Bay and Kerevat Area. For exporting cacao, Ataliklikun Bay has the advantage in terms of accessibility.

Oil palm plantations are distributed on the west side of Ataliklikun Bay and northern area of Pomio District. However, the export product is liquid cargo loaded into cargo ships from shores, hence not using port facilities.

Balsa wood comes mainly from the middle to west parts of the peninsula. The wood logs are transported to the processing factories located in Kokopo Town and Takubar. Export goods are loaded to containers and transported to the port. Therefore, Kokopo is the most advantageous in terms of accessibility from the factories to the port.

6)-3 Accessibility to Fishery Products (Tuna and Its Processed Form)

Tuna processing factory is planned to be developed at Rabaul, which should be the nearest port to export tuna products.

7) Existing and Planned Industrial Areas Including SEZs

Currently, a SEZ development is planned in the Kerevat Area. Although there is no detailed development plan at present, it is assumed that SEZ will produce export products comprised of agricultural products cultivated near Kerevat or in the farm areas around Ataliklikun Bay. From this point of view, all candidate ports at Ataliklikun Bay are very advantageous because of short distance from SEZ to port.

If it is assumed that the SEZ will be developed near Kerevat Area, Kokopo and Rabaul have longer distance from it than Ataliklikun Bay.

8) Ease of Land Acquisition

Even after the 2014 Rabaul Port Master Plan was formulated, major provincial and local stakeholders had not been consulted about the relocation of Rabaul Port in Kabakaul Area (the selected port area). From site observation, there is an unused land area available behind the port candidate area. It is considered that there is no serious obstruction for land acquisition if support of landowners is obtained.

As for the candidate port locations around the Ataliklikun Bay, there are large tracts of lands owned by a church organisation in some areas, but there are also a lot of customary lands along Ataliklikun Bay. It is relatively easier to acquire necessary lands for the new port development

from the church organisation. Also, it is usually considered quite difficult to acquire lands for public infrastructure, such as ports, from customary land areas.

9) Development Costs

PNG Port Master Plan of December 2014 estimates the development cost to be PGK 313,332,500 (equivalent to 128 million AUD with the rate AUD = 2.45 PGK), assuming 30% contingency cost is included.

To estimate development cost for the candidate port at Ataliklikun Bay, bathymetric/topographic survey and soil investigations will be required. From overviews of GoogleEarth image, a similar scale of development cost to the above Kokopo new port development will be required. In addition, the access roads and power/water supply for the new port will require additional development cost.

10) Existing Infrastructure

10)-1 Access Roads

Kokopo candidate port is located at the northern coast along Kokopo-Rabaul Road. Distance from port to the road is less than 1 km, for which new access road has to be developed.

Ataliklikun Bay candidate ports, Option 1 and Option 2, are located along the North Coast Road. However, the condition of North Coast Road is not good, which requires widening and pavement improvements. Access to Option 3 is worse than the other two options, in which about 38km new road development will be required.

10)-2 Power Supply

Kokopo area holds advantage of ease for power connection as the candidate port is located in the urban area.

Ataliklikun Bay area has existing power supply in Option 1 and Option 2, but it has insufficient capacity as the existing supply is only for few houses, shops and schools. Installation of new power cables for the new port will be necessary. For Option 3, there is no power supply around the area based on site visit observation.

10)-3Water Supply

The city's water supply is obtained from ground wells. Similar facilities should be newly installed for port development. Particularly, the water supply facility around Ataliklikun Bay Area is poor at present and needs improvement.

11) Environment

11)-1 Noise, Pollution, and Risk of Traffic Accidents

During port construction, there is risk of noise due to operations of building equipment such as cranes, dump trucks, piling equipment, etc. Meanwhile, risk of water pollution often becomes a matter of monitoring particularly when dredging and reclamation take place.

When the port becomes operational, noise is usually caused by cargo handling equipment. Main sources of pollution during this phase are exhaust gases from these equipment and wastewater discharges from cleaning and maintenance of the equipment, among other activities.

These risks on the environment should be carefully monitored both during construction and operations phases. However, comparing Kokopo and Ataliklikun Bay in terms of these issues, Kokopo area should require more strict attention because its location is in the vicinity of residential and commercial areas.

The risk of traffic accidents will be generally determined based on the cargo transport vehicles on public roads to the port. Such risk will be higher at Kokopo Area as the public roads will become congested with cargo vehicles in addition to commercial and private car traffic.

11)-2 Natural Environment

In order to estimate precise environmental impact, detailed survey and study will be needed. Observing by site exploration, the main burden to natural environment seems to be an existence of coral reefs along the shoreline. Detailed survey should confirm whether any particular species requiring conservation exists or not.

In this NEGID-Plan Project, a marine and terrestrial environmental study was conducted to determine the baseline of the marine environmental situation of four areas (Kabakaul Bay of Kokopo and Kabaira Bay, Gazelle River Mounth, and Ragaga Bay of Atalilikun Bay Aera) in Northeast Gazelle Peninsula.

Some mangrove vegetation is observed in the vicinity of the shoreline. If port development will require cutting of important species, a mitigation measure should be considered.

These environmental issues exist for both Kokopo area and Ataliklikun Bay area.

However, it is pointed out that the Kokopo area has waters inhabited by wild dolphins. Furthermore, the Kokopo candidate port location is also the tourism spot for diving and swimming with dolphins. It should be noted that the port development in Kokopo holds the risk of affecting the ecosystem with wild dolphins and resource asset of tourism.

11)-3 Social Environment

Major concern on the social environment is whether resettlement of inhabitants will be required or not. In the case of areas being presently cultivated for farming, compensations to the farmers are necessary.

As discussed in the section on land acquisition, Kokopo area has extensive unused area. There seems to be less impact on social environment in Kokopo Area, but negotiations and engagement with landowners are needed.

In Ataliklikun Bay area, there are some residents or farm areas. These shall be carefully discussed during future planning phase.

(3) Summary of Comparison of Three Port Locations in Northeast Gazelle Peninsula

There is no doubt about the point of suitability for port that Rabaul is a good natural harbour in terms of calmness of the sea. It is also pointed out that Rabaul has the highest risk of ashfall caused by volcanic eruption. On the other hand, the risks of volcanic ashfall disaster for both Kokopo and Ataliklikun Bay are moderate.

Kokopo Area has the advantage of accessibility to existing commercial areas, whereas Ataliklikun Bay Area has advantage in terms of future industrial development such as the Agro-Industrial SEZ.

Ataliklikun Bay holds the factor of higher development cost, in which modernisation of basic infrastructures, such as access roads, power supply and water supply will require additional costs. However, it should be pointed out that this additional investment will provide regional economic benefit to society.

From an environmental point of view, Kokopo Town and surrounding areas are not recommended with respect to both the marine ecosystem and nature tourism assets/resources, such as wild dolphins.

In general, new port development in the vicinity of commercial and residential areas like in Kokopo Town is not recommended because of the risk of traffic accidents related to port cargo traffic and the difficulty of future port expansion potentials.

From the above discussions, the JICA Expert Team recommends that the new port development should proceed in the Ataliklikun Bay Area.

Table 13.3.5 shows a summary of evaluation results by the comparative criteria described above. In this table, for each selected comparison criterion, a rating score is given on a three-point scale. Then, all the evaluation scores are simply added to form an overall evaluation of the three potential port sites. In the overall evaluation, no weight is given to the rating score for any comparison criterion.

Table 13.3.5 Summary of Comparative Evaluation of Three Candidate Locations in Northeast Gazelle Peninsula

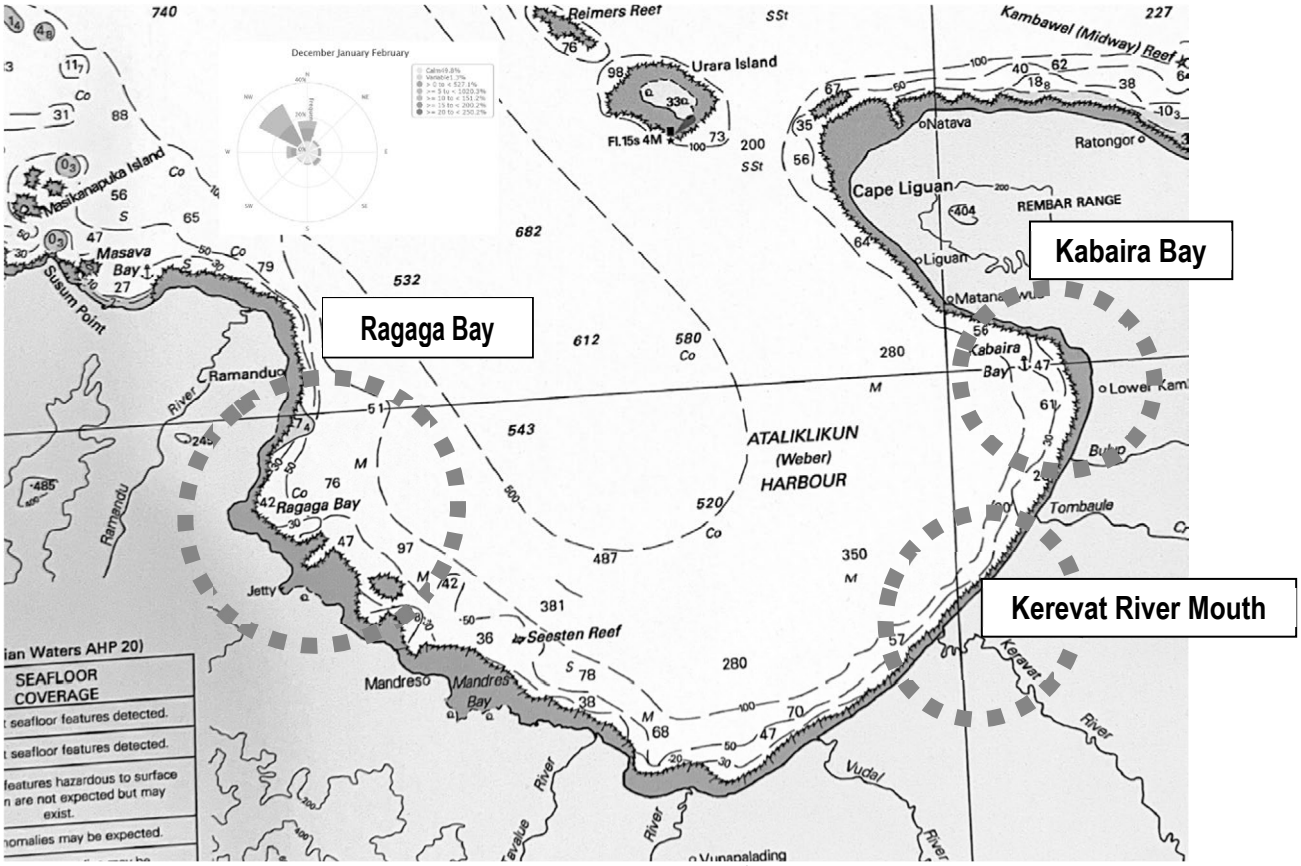
Comparison Factor	Kokopo	Ataliklikun Bay	Rabaul Port
1) Risk of Volcano Eruption	2	2	1
2) Risk of Tsunami	1	2	1
3) Seasonal Wave Condition	2	2	3
4) Depth of Water	3	3	3
5) Topography of Hinterland	3	3	1
6) Accessibility	2.3	2.0	2.3
6)-1 Accessibility to Import Goods Consumption Areas	3	2	2
6)-2 Accessibility to Export Goods Production Areas	3	3	2
6)-3 Accessibility to Fishery Products (Tuna and its Processed Food)	1	1	3
7) Existing and Planned Industrial Areas including SEZs	3	3	2
8) Ease of Land Acquisition	1	3	2
9) Development Cost	3	2	2
10) Existing Infrastructure	2.7	2.0	2.7
10)-1 Access Roads	3	2	3
10)-2 Power Supply	3	2	3
10)-3 Water Supply	2	2	2
11) Environment	1.0	2.7	2.0
11)-1 Noise, Pollution, Risk of Traffic Accidents	1	3	2
11)-2 Natural Environment	1	2	2
11)-3 Social Environment	1	3	2
Total	24.0	26.7	22.0

Source: JICA Expert Team

13.3.6 Suitable New Port Location in Ataliklikun Bay Area

(1) Three Candidate Locations in Ataliklikun Bay Area

Ataliklikun Bay is located at the north coast of Gazelle Peninsula, and forms a wide inland bay sized of 20km E-W and 15km N-W. The width of the mouth of the bay is 14km and there is a small island (Urara Island) at the east side of the mouth. The bay mouth opens to NNW wider and deeper Bismarck Sea. Water is deep in the middle of the bay at about -600m. Seabed of the water along the shoreline is steep, in which depth reaches -50m about 200 ~ 300m distance from the shoreline. In accordance with the wind data, the bay suffers from NW wind with average 5 ~ 10m/sec (approx. 15% frequency) in the season of December, January and February. During this season, the coast of the bay receives rather higher waves entering from Bismarck Sea.



Source: JICA Expert Team, based on the Australian Hydrographic Office, 7th February 2020, Nautical Chart PNG 545 – Rabaul to Cape Lambert,

Figure 13.3.7 Three Candidate Locations in Ataliklikun Bay Area

Based on the above-mentioned topographic/oceanographic features of the bay coast and seasonal wind directions, the following three candidate locations were considered for further detailed comparison:

1. **Kabaira Bay**: Located at east side of the bay. The water area is sheltered by land stretch towards Cape Liguan. From sea chart, this water might have been used as an anchoring area in the past.
2. **Kerevat River Mouth**: Located at the middle of the bay and near the Kerevat river mouth. Here, deep water (>50m) is close to the shoreline. The site holds the advantage of proximity to Kerevat Town.
3. **Ragaga Bay**: Located at the west side of the bay. The water area is sheltered by land stretch along the west of the bay. From site visit in November 2022, a small RoRo ship was anchored along the shore to take in vehicle loaded with balsa wood. (See Figure 13.3.8).

Kabaira Bay in Ataliklikun Bay Area

Kerevat River Mouth in Ataliklikun Bay Area

Ragaga Bay (1) in Ataliklikun Bay Area

Ragaga Bay (2) in Ataliklikun Bay Area

Source: JICA Expert Team

Figure 13.3.8 Photos of Three Candidate Locations in Ataliklikun Bay Area

(2) Schematic Port Layout Plans of the Three Candidate Locations in Ataliklikun Bay Area

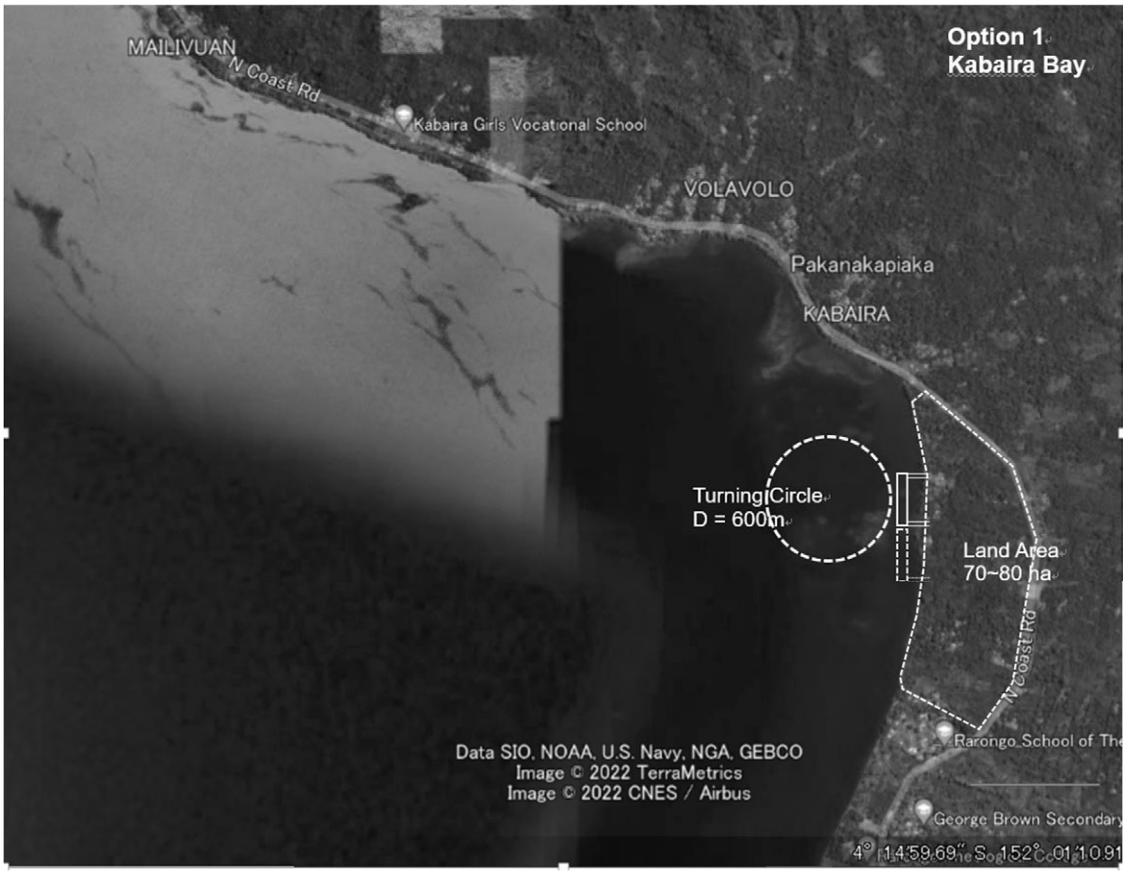
For the purpose of comparing the three locations in terms of suitability for port development, preliminary schematic port layout plans were drawn (see Figure 13.3.9 to Figure 13.3.11). Characteristics of each layout plan are described below.

1) Kabaira Bay in Ataliklikun Bay Area

Observing the sea depth indicated by the available sea chart around this area, the sea water depth is deeper than -50m except for 200~300m distance from the shoreline. Berthing structure should be plotted in parallel to the shoreline connecting to land area by a trestle bridge. This layout plan is similar to the existing Rabaul Port.

Construction of breakwaters is difficult because the sea depth of Kabaira Bay is very deep. On the other hand, vessel turning area has no restriction in front of the possible berth area at Kabaira Bay.

In Figure 13.3.9, land area of the port is plotted assuming that land acquisition is possible between the shoreline and North Coast Road. The size of land area is roughly estimated to be 70-80 ha.



Source: JICA Expert Team

Figure 13.3.9 Port Layout Plan for Kabaira Bay in Ataliklikun Bay Area

2) Kerevat River Mouth in Ataliklikun Bay Area

Sea depth configuration of this area is similar to Kabaira Bay, in which the water depth is more than -50m except for 200~300m distance from the shoreline. Considering seasonal wind and wave direction, the shoreline will suffer from considerable high waves. Therefore, construction of breakwater will be necessary. Breakwater can be plotted only at 200m distance from the shoreline due to water depth, from which berthing structure should be located on an inland excavated water area. As the structure of berth, the gravity seawall or sheet-pile wall will be appropriate.

Land area of the port is plotted assuming that the land between the shoreline and North Coast Road will be acquired. The size of land area is roughly estimated at 250 ~ 300 ha.

Kerevat River Mouth is located at the south end of the possible port area. The risk of sedimentation should be carefully estimated to determine the requirement for maintenance dredging after port construction.

Source: JICA Expert Team

Figure 13.3.10 Port Layout Plan for Kerevat River Mouth Area in Ataliklikun Bay

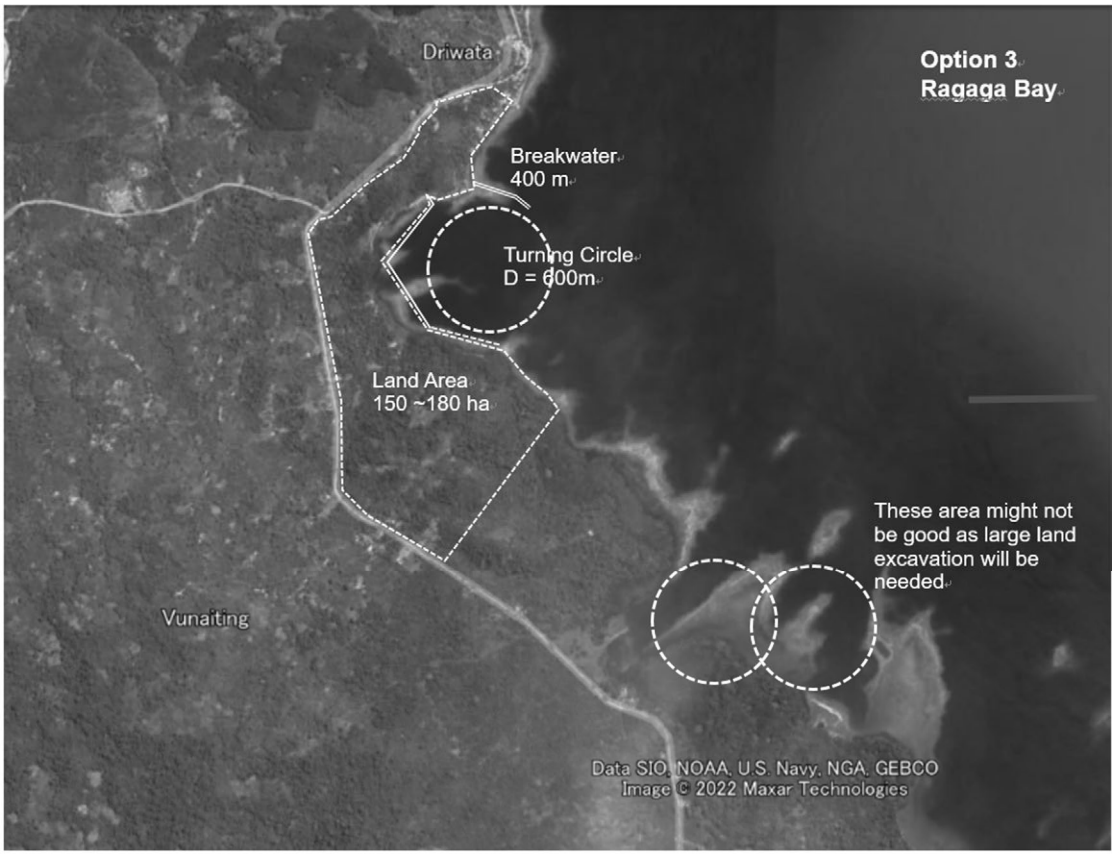
3) Ragaga Bay in Ataliklikun Bay Area

Shoreline configuration around this area is observed as intricate terrain. Several suitable locations for port area are observed, but the Ragaga Bay seems the most appropriate for the port area, considering the size of the vessels.

Because the bay seems very deep, berthing structure should be plotted in line along the shoreline. As the structure of berth, the gravity seawall or sheet-pile wall will be appropriate.

It might be possible to construct a small breakwater by using stretch of shallow reef at the north end of the bay. This should be very effective to keep calm water area sheltered from seasonal wind and waves.

Land area of the port is plotted assuming that the land will be acquired between the shoreline and the coastal road. The size of land area is roughly estimated at 150 ~ 180 ha.



Source: JICA Expert Team

Figure 13.3.11 Port Layout Plan for Ragaga Bay in Ataliklikun Bay

(3) Comparison of Three Candidate Port Locations in Ataliklikun Bay Area

1) Risk of Volcanic Eruption

The most critical risk of volcanic eruption will be occurrence of ashfall at the port area and in the surrounding areas of the port. When Mount Tavurvur and Mount Vulcan erupt, volcanic ash will be carried by the wind and fall at the port area. The risk of ash fall should be reduced by the longer distance from the volcanos. The following table shows seasonal wind directions and their intensities. In accordance with these data, the wind during June –November will carry volcanic ash from Mount Tavurvur and Mount Vulcan, in which probability of east wind is about 25~30% and maximum wind speed is less than 10 m/sec.

2) Risk of Tsunami

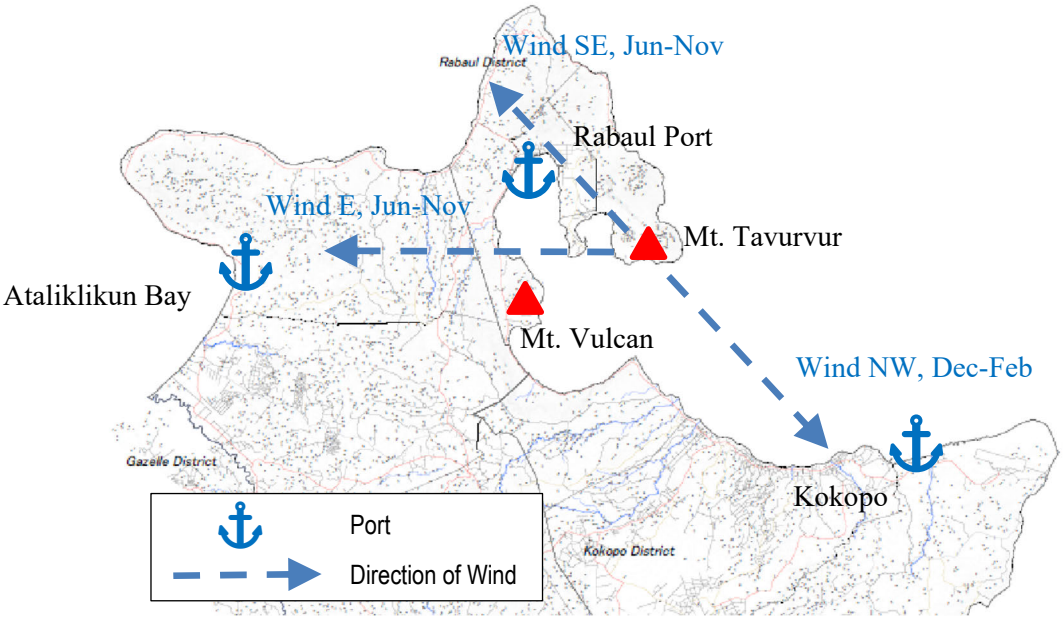
Tsunami hazard is the same for the three locations inside Ataliklikun Bay.

Table 13.3.6 Wind Rose of Kokopo-Rabaul Area

Wind Roses – Average Wind Speed and Wind Direction		Legend
Dec, Jan, Feb; Calm 49.8%	Mar, Apr, May; Calm 50.4%	> 0 >= 5 >= 10 >= 15 >= 20 >= 25
Jun, Jul, Aug; Calm 29.6%	Sep, Oct, Nov; Calm 40.4%	

Source: PNG National Weather Service, Rabaul Weather Office for 1973 – 1977 (Latitude: -4.22, Longitude: 152.20)

The distance between Mt. Tavurvur and Ataliklikun Bay is about 20km. It is considered that there will be a risk of volcanic ash fall if Mt. Tavurvur will erupt in the season between June and November, but the amount of the ash fall will be much less than in Rabaul Port area considering the distance of 20km. From the locations of Kerevat River Mouth and Ragaga Bay, the risk of ash fall on these port locations will be much less than on Kabaira Bay.



Source: JICA Expert Team based on data from PNG National Weather Service, Rabaul Weather Office for 1973 – 1977 (Latitude: -4.22, Longitude: 152.20)

Figure 13.3.12 Seasonal Direction of Wind – Risk of Ashfall

3) Risk of Seasonal Wave Condition

Since there are no data on wave conditions at present, the only way is to estimate based on the wind direction data. Ataliklikun Bay opens to the ocean at north mouth, from which it is predicted that the bay would suffer from unusual wave condition when the seasonal wind direction is from North to North-West, i.e., from December to February.

Kerevat River Mouth is located in the middle of Ataliklikun Bay, where the port will receive seasonal waves during that season. Kabaira Bay is located in the north side of the bay, where northern arm of the peninsula will be able to protect such direct exposure to the waves. There are no good water areas to build breakwaters due to sea depth conditions.

Ragaga Bay is located in the south-west end of the bay, where a southern arm of the peninsula protects the wave coming from South-West. There seems to be a good stretch of shallow reef on which a small breakwater might be constructed.

Since the primary wave direction of the bay is considered to come from North-West, Ragaga Bay is the most appropriate place for port development; the second is Kabaira Bay; and the third is Kerevat River Mouth considering seasonal wave conditions.

4) Depth of Water

Observing from the sea chart and visual image of drone pictures, deep sea more than -50m is very close to the shoreline. The width along the shore coast with water shallower than -15m seems to be about 200m ~ 300m distance from the shoreline. Shallow areas seem to form as a trail of coral reefs. Port facilities such as berth and breakwater can be constructed within the area whose water depth is shallower than -15m.

5) Topography of Hinterland

For the three locations, flat land areas for cargo yards and sheds are available between the coastal road and shoreline. The available flat land areas are estimated as follows:

- Kabaira Bay: 70 ~80 ha
- Kerevat River Mouth: 250 ~300 ha
- Ragaga Bay: 150 ~ 180 ha

6) Accessibility to Import Goods Consumption Areas and Export Goods Production Areas

6)-1 Accessibility to Import Goods Consumption Areas

Assuming that the major import goods consumption area is Kokopo area, the distance from each candidate port location to Kokopo City Centre is found in the table below. Compared with the distance from Rabaul to Kokopo, three candidate port locations are better. Particularly, from Ragaga Bay to Kokopo the distance is 70km, which is 2.6 times the distance between Rabaul and Kokopo.

Table 13.3.7 Distance between Port Location and Kokopo City Centre

From / To	Kabaira Bay (km)	Kerevat River Mouth (km)	Ragaga Bay (km)	Rabaul Port (km)
Kerevat・North Coast Road Junction	11.68	5.38	38.34	-
Kokopo City Centre	44.29	37.99	70.95	27.31

Source: JICA Expert Team

6)-2 Accessibility to Export Goods Production Areas

The major farms of agricultural products (copra, cacao, palm oil, balsa) are mainly distributed in Gazelle District including the wide land strips surrounding Ataliklikun Bay. At present,

approximately 40 ~ 50km road transportation is needed for the purpose of exporting from Rabaul Port from the main agricultural production sites in part of Gazelle District, such as Livuan/Reimber and Inland Baining LLGs. The candidate ports at Ataliklikun Bay are very close to these farms. Thus, the three locations at Ataliklikun Bay have good advantage over Rabaul Port in terms of transportation distance for such farm in Gazelle District. On the other hand,

6)-3 Fishery Products (Tuna and Its Processed Form)

Tuna fishing boats and reefer carrier ships are anchoring in the Rabaul Bay for trading of export at present. Rabaul Bay is quite suitable for this kind of activities because of calmness of the sea, where the bay is well sheltered from ocean waves in all seasons. Due to this advantage of the bay, fishery products should be developed in the Rabaul Area.

7) Existing and Planned Industrial Areas including SEZs

Currently, a SEZ development is planned in the Kerevat Area. Although there is no detailed development plan at present, it is assumed that SEZ will produce export cargo based on agricultural products cultivated near Kerevat or the farm area around the Ataliklikun Bay. From this point of view, the candidate port areas at Kabaira Bay and Kerevat River Mouth are very advantageous because of short distance from SEZ and port. On the other hand, Ragaga Bay is approximately 38km away from the new planned SEZ. Furthermore, Ragaga Bay is also far from the existing industrial areas in Kokopo compared with the other candidate areas.

8) Ease of Land Acquisition[2]

The following observations are obtained by the JICA Expert Team through interpretation of satellite imagery of Google Earth and site visit. However, at the time of site visit and report preparation, there are no sufficient information on land tenure in these three areas.

Kabaira Bay

The area is mainly forest. A school is located at the south boundary. There are several houses observed in the forest.

[2] These observations should be cross-checked by local informants, as well as by district offices.

Source: JICA Expert Team using SPOT 2019/20 satelite imagery and site visits

Figure 13.3.13 Satellite Image of Candidate Port Area at Kabaira Bay

Kerevat River Mouth

The area is mainly cocoa farm and forest. There is "Cocoa Board of PNG (Cocoa Research, Extension & Development Services Division)" located at the north boundary.

(Land ownership information should be added.)

Source: JICA Exprt Team by using SPOT 2019/20 satelite imagery and site visits

Figure 13.3.14 Satellite Image of Candidate Port Area at Kerevat River Mouth

Ragaga Bay

The area is mainly forest. A school is located at the south boundary. There are several houses observed in the forest.

Source: JICA Exprt Team by using satelite imagery of Google Earth and site visits

Figure 13.3.15 Satellite Image of Candidate Port Area at Ragaga Bay

9) Development Cost

Kabaira Bay

Typical concrete deck with pile structure should be suitable. Breakwater will not be planned due to deep water. Land area is rather compact. The area is facing North Coastal Road, thus new road construction will not be necessary, though improvement/widening of North Coastal Road will be needed.

Development cost seems to be lower than those for the other two candidate locations.

Kerevat River Mouth

Breakwater and inland excavation will require high investment cost. The area is facing North Coastal Road, thus new road construction will not be necessary, though improvement/widening of North Coastal Road will be needed.

Ragaga Bay

Berth structure should be conventional. Breakwater will not be a large investment. However, regional road access to Kerevat Junction is unpaved and in bad condition. About 38km road development will be needed to put up a port at this place.

10) Existing Infrastructure

10)-1 Access Roads

Kabaira Bay and Kerevat River Mouth are both facing the North Coast Road. Due to poor condition of the North Coast Road in some sections, improvement of it will be needed.

Ragaga Bay requires new road development from port location to Kerevat Junction for about 38km.

10)-2 Power Supply

It is observed that the areas of Kabaira Bay and Kerevat River Mouth are connected to the regional power supply. However, new installation of power should be needed for the purpose of new port development.

The area of Ragaga Bay does not have regional power supply. Most of the facilities for agriculture development seems to utilise self-power generation by means of generator units. New installation of power facilities should be needed for the purpose of new port development.

10)-3 Water Supply

Regional water supply comes from the ground well. Three locations for port development require additional wells for water supply.

11) Environment

11)-1 Natural Environment

In order to estimate precise environmental impact, detailed survey and study will be needed. Observing by site explorations, the main burden of natural environment seems to be an existence of coral reefs along the shoreline. Detailed survey should confirm whether any particular species to be conserved exist or not. During this NEGID-Plan Project, a marine and terrestrial survey covering the three areas of Ataliklikun Bay, as well as Kabakaul Bay of Kokopo, was conducted. This survey revealed that there are seagrass areas where Dugong use for their habitat in Kabaira Bay and Ragaga Bay. Therefore, it is evaluated that Kabaira Bay and Ragaga Bay are less suitable than Kerevat River Mouth because of the presence of valuable vegetation for Dugong.

Some mangrove vegetation is observed in the vicinity of the shoreline. If port development will require cutting or clearing of important species, mitigation measures should be adopted.

11)-2 Social Environment

Major concern of social environment is whether resettlement of inhabitants will be required. In this case, the area is presently a cultivated farm area, hence compensations for the farmers are necessary.

Kabaira Bay area seems to have some residential houses. On the other hand, Kerevat River Mouth area holds wide areas of cocoa farms. Both areas may require resettlement or compensations for farmers. Ragaga Bay area seems natural forest, but balsa wood might be planted in the area, which should be surveyed in detail.

12) Summary of Comparison of Three Candidate Locations in Ataliklikun Bay Area

Kerevat River Mouth has wider hinterland development area than others. This is an important factor for port development as the port usually requires access to cargo storage area and its relevant private cargo storage functions. Kerevat River Mouth is also the nearest to Kokopo consumers' areas. However, this candidate location is prone to higher waves than other locations. Due to depth of the sea, breakwater must be plotted near the shoreline, from which considerable land excavation will be necessary. Investment cost for this will be the highest among the three candidate locations.

Kabaira Bay is rather a good location considering the fundamental conditions for suitable port development. However, it has the disadvantages of having difficulties in breakwater construction.

Ragaga Bay looks the most suitable for the new port among the three candidate locations from the viewpoint of fundamental conditions for suitable port development, specifically land-sea topography and sea calmness. However, its disadvantage is the poor access road, which requires large burden of investment and distance from consumer areas.

According to the summary of comparative evaluation (by simple numerical scoring) of the three candidate locations in Ataliklikun Bay, shown in Table 13.3.8, Kerevat River Mouth and Kabaira

Bay are better than Ragaga Bay. However, at this moment, there is no corroborative information on land tenure of these three areas (whether they are customary lands or freehold lands).

Table 13.3.8 Summary of Comparative Evaluation of Three Candidate Locations in Ataliklikun Bay Area

Comparison Factor	Kabaira Bay	Kerevat River Mouth	Ragaga Bay
1) Risk of Volcano Eruption	2.0	3.0	3.0
2) Risk of Tsunami	2.0	2.0	2.0
3) Seasonal Wave Condition	2.0	2.0	3.0
4) Depth of Water	3.0	3.0	3.0
5) Topography of Hinterland	2.0	3.0	3.0
6) Accessibility	2.0	2.3	1.5
6)-1 Accessibility to Import Goods Consumption Areas	2.0	3.0	1.5
6)-2 Accessibility to Export Goods Production Areas	3.0	3.0	2.0
6)-3 Accessibility to Fishery Products (Tuna and its Processed Food)	1.0	1.0	1.0
7) Existing and Planned Industrial Areas including SEZs	2.0	2.0	1.0
8) Ease of Land Acquisition	2.0	2.0	2.0
9) Development Cost	3.0	1.0	1.5
10) Existing Infrastructure	1.7	1.7	1.2
10)-1 Access Roads	2.0	2.0	1.0
10)-2 Power Supply	2.0	2.0	1.5
10)-3 Water Supply	1.0	1.0	1.0
11) Environment	2.0	2.5	2.0
11)-1 Natural Environment	2.0	3.0	2.0
11)-2 Social Environment	2.0	2.0	2.0
Total	23.7	24.5	23.2

Source: JICA Expert Team

13.4 Projects for Development of Ports

13.4.1 Important Projects for Development of Ports

As discussed in the previous sections, the important projects of the ports in Northeast Gazelle Peninsula region are summarised below.

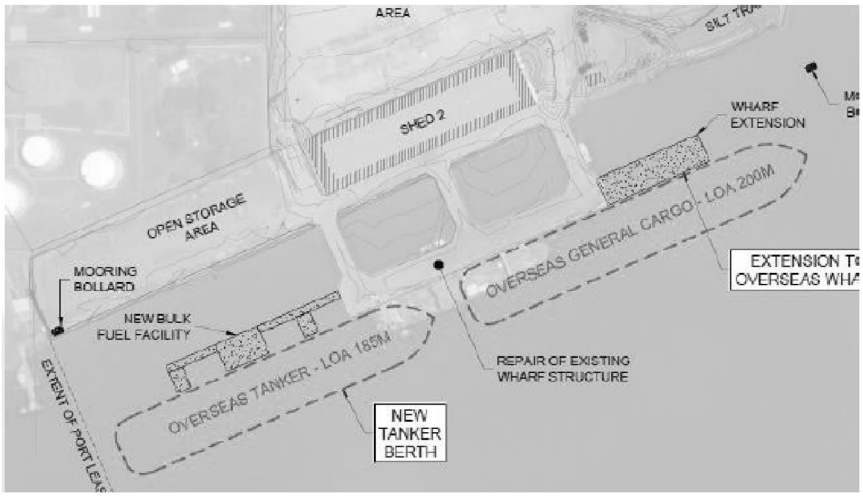
(1) [SP01] Project for Rehabilitation of Rabaul Port Infrastructure

Following the discussion in Section 13.3, it should be considered that the existing Rabaul Port will continue to be utilised even if a new port will be developed in the future, probably after 2042. Overviewing the existing condition of the port facilities and increase of cargoes like demand forecast, the aged and damaged facilities have to be repaired and properly maintained. Such rehabilitation should consider its lifetime to be more than 30 years.

(2) [SP-02] Project for Upgrading of Rabaul Port Berth 2

As discussed in the Section 13.4.2, the new port development will be realised by 2042, then its port operation will be started. According to the demand forecast discussed in Section 13.4.1, the port demand is estimated to increase by about 2.8 times of the present cargo volume. Considering the berth occupancy rate of Berth 1 and Berth 2 is about 50% at present, upgrading of port must be needed. In order to handle such increase of cargoes, one more berth will be required. However, it should be considered that the cargoes of Rabaul Port are assumed to decrease after new port development. Hence, it will not be necessary to invest large cost for this upgrading. It is

recommended to implement the upgrading plan (Proposal-3) proposed in the Detailed Master Plan 2021 by PNG Ports.



Source: PNG Ports, 2021, Rabaul Port Detailed Infrastructure Master Plan

Figure 13.4.1 Conceptual Plan for New Tanker Berth at Rabaul Port (Proposal - 3)

(3) [SP-03] Project for Basic Study on New Port Development in Ataliklikun Bay

A further detailed study is necessary to determine the location of the new port in a low-risk area within Ataliklikun Bay as the regional primary port. The basic study shall include the following:

- - Oceanographic Survey, Topographic Survey
- - Survey for Land Acquisition
- - Environmental Survey
- - Study of Fixing Port Location
- - Feasibility Study (Economic and Financial)

(4) [SP-04] Project for Development of Berth specially for Fishing Vessels (for providing water, fuels and others)

For the efficient utilisation of Rabaul Port, it is necessary to avoid fishing vessels from occupying Berth 2 which is upgraded in [SP-02] for supplying water and fuel to the fishing vessels. Therefore, Berth 1 should be upgraded for the fishing vessels.

(5) [SP-05] Project for New Port Development in Ataliklikun Bay

In this report, a new port development in Ataliklikun Bay Area is recommended. Discussion in Section 13.3.2 suggests that the development should start with the initial small-scale jetty and the improvement of road and utility infrastructures. This port will function as an emergency facility for probable volcanic disasters that will affect Rabaul Port and Rabaul Town.

Then the port should be expanded along with the regional economic growth and industrial development.

13.4.2 Priority Projects for Port Development in Northeast Gazelle Peninsula

The aforesaid (1) Rehabilitation of Rabaul Port Infrastructure has the highest priority, and (2) Upgrading of Rabaul Port is the next priority. Considering the required time for implementation and that the completion should be before the port demand will reach the port capacity, detailed design of facilities should commence immediately. For (3) New Port Development, the works have to start with oceanographic and topographic surveys to fix the port location. The presurvey of land acquisition and environmental survey should be done also in parallel. The conduct of feasibility study will be the next step.

Based on the Regional Spatial Structure 3, phased development of ports for Northeast Gazelle Peninsula is discussed in Section 13.3.2. This phased port development is planned by implementing the three priority projects as shown in Table 13.4.1.

Table 13.4.1 Summary of Phased Implementation of Priority Projects for Port Development in Northeast Gazelle Peninsula

Timeline	Priority 1 **[SP-01] Project for Rehabilitation of Rabaul Port Infrastructure**	Priority 2 **[SP-02] Project for Upgrading of Rabaul Port Berth 2**	Priority 3 **[SP-05] Project for Construction of New Port in Ataliklikun Bay**
2023~2032	- Detailed Design - Tendering for the Project - Implementation of Rehabilitation Work	- Detailed Design - Tendering for the Project - Implementation of Upgrading Work	**[SP-03] Project for Basic Study on New Port Development in Ataliklikun Bay** - Oceanographic Survey - Topographic Survey - Survey for Land Acquisition - Environmental Survey - Study of Fixing Port Location - Feasibility Study (Economic and Financial) - Small Scaled Initial Implementation
2033~2042			- Detailed Design of Port Expansion - Tendering for the Project - Implementation of New Port Construction Work
2043~2052			- New Port Operation

Source: JICA Expert Team