CHAPTER 16 IMPLEMENTATION STRATEGY

16.1 Strategic Policy Coordination between Development Plans

16.1.1 Strategies for Coordinated Development Planning

(1) Formulation of Provincial Integrated Economic and Social Development Strategic Plan with a target period of 10 to 20 years

PNG has a dual development planning regime with economic and social development plans and physical plans. Department of National Planning and Monitoring (DNPM) formulates economic and social development plans, while Department of Land and Physical Planning (DLPP) is in charge of formulation of physical plans. It seems that both plans are not closely linked to one another.

Currently, a provincial economic and social development plan called "Morobe Integrated Development Plan" has been formulated with a target period of five years. There are district economic and social development plans for all districts in the planning area of the Project also with ktarget periods of five years corresponding to the previous Medium Term Development Plan. For the physical plans, an urban development plan, namely Lae-Nadzab Urban Development Plan (LNUDP) for 2005-2015, was formulated for the period of ten years. A draft of the next LNUDP (2016-2025) is being formulated by the Project. Other physical plans stipulated in Physical Planning Act 1989, such as local development plans and subject development plans, have not been formulated.

Land use and infrastructure development proposed in the urban development plan have to contribute to achievement of economic and social development of the target area. It is proposed that a provincial economic and social development strategic plan should be formulated with a target period of ten to twenty years so that the urban development plan with a target period of ten years can be formulated based on the provincial economic and social development strategic plan and implementation of the urban development plan will surely contribute to realising strategies contained in the provincial economic and social development strategic plan.

Based on the urban development plan, subject development plans, such as infrastructure development plans, utility service development plans, housing development plans, public transport plans, and local development plan have to be formulated to show how to realise the urban development plan in detail. Local development plans have to be formulated referring to respective District Integrated Development Plans (economic and social development plans) as well.

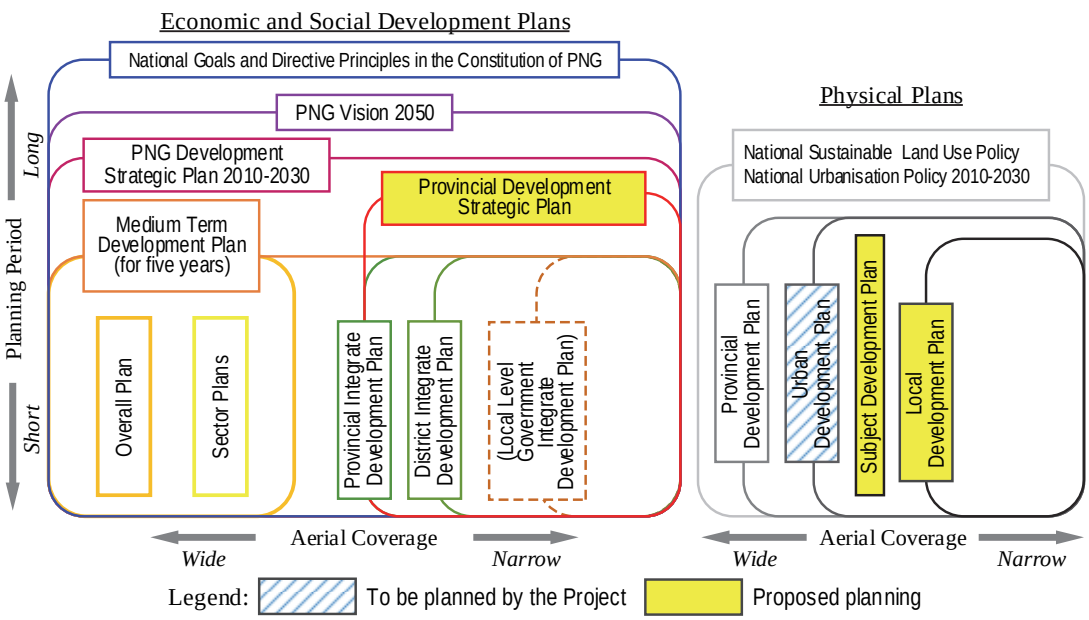


Figure 16.1.1 Existing and Proposed Development Plans of Papua New Guinea

(2) Formulation of Local Development and Subject Plans

Most of the structural plan and conceptual land use plans of the current LNUDP have not been implemented. One of the reasons for non-implementation would be lack of detailed implementation plans to realise LNUDP. Generally, physical plans are composed with hierarchy shown in Table 16.1.1. LNUDP is a master plan with a planning period of ten years. For the implementation of the next LNUDP, implementation plans, land use (zoning) plan - local development plan, and project plans - subject development plans have to be formulated and implemented.

Table 16.1.1 General Hierarchy of Physical Plans

Type/Level of Plan	Contents	Typical Planning Period
Basic Concept	* Vison of the area	20 years
Master Plan	* Land use plan * Infrastructure development plan * Project list	10 years
Implementation Plan	* Land use regulation (Zoning) * Project plan	5 yeas

Source: "City Planning", Tadashi Higasa and Yasuo Hibata, Kyouritsu Shuppan Co., Ltd.

After Lae-Nadzab Urban Development Plan is finalised, several local development plans, as provided in the Physical Planning Act, have to be prepared with target periods of five to ten years with participation of local stakeholders, based on which zoning can be enforced. For local development or detailed zoning plans, the Lae-Nadzab urban area can be divided into several planning areas, for example, 1) LULLG jurisdiction, 2) Ahi Rural LLG jurisdiction, 3) three planning areas for Wamper LLG (i) northwest Wamper; around Nadzab Airport, ii) middle Wamper; Yalu – Igam Area, and iii) south Wamper; Tidal Basin North – Gabensis), 4) Nabak Rural LLG and 5) Labuta Rural LLG. A local development plan also has to contain land use (zoning) plans for informal settlements and traditional villages as well.

(3) Formulation of Infrastructure Development Plans and Public Investment Programmes based on Physical Development Plans

Subject development plans may include housing development plans, detailed plans for economic, social and amenity/community infrastructure development plans, utility service development plans, housing plans, public transport plans, etc. These plans generally have to be formulated based on physical plans as locations and physical extensions of the objects of these plans can be determined in the context of the physical development of the areas. Infrastructure development plans and utility service development plans have to be formulated within the framework of the urban development plans in order to realise the urban development plan. For this end, agencies responsible for infrastructure development and utility services, including regional offices of National Housing Corporation, PNG Port, PNG Power and PNG Water, have to participate in urban development planning.

As subject (infrastructure) development plans are essential elements of public investment programmes and annual budgets, physical plans have to be referred to when public investment programmes and annual budgets are prepared to secure necessary funds for infrastructure and utility network development.

(4) Enhancement of Linkage between Physical Development Planning, Economic and Social Development Planning, Public Investment Programming and Budget Allocation

For integrated and efficient implementation of urban development plans, planning, implementation and monitoring/evaluation activities have to be well coordinated. Development actions have to be prioritised for the optimal use of limited human and financial resources through coordination. The planning, implementation and monitoring/evaluation activities have to be coordinated by DNPM at the national level and Morobe Provincial Administration (MPA) at the level of the urban development planning area.

To the meetings for formulation of economic and social development plans organised by DNPM at the national level and MPA at the provincial level, organizations related to physical planning have to participate, while organizations in charge of economic and social development plans have to attend the meetings for formulation of physical planning.

For formulation of infrastructure development plans, relevant organizations in charge of economic infrastructure (such as transport infrastructure), social infrastructure (such as educational and public health facilities), utility services (such as water/sanitation and power), amenity/community infrastructure (such as parks/sport facilities, community centres, etc.), and solid waste management facilities have to refer to physical plans and infrastructure development strategies/plans included in physical plans of the areas as bases of detailed sector infrastructure development plans.

DNPM has to check the consistence of economic and social development plans with physical plans, and ask DLPP to check conformity of draft public investment programme (PIP) of each year to existing physical plans before submission of the draft PIP to Department of Treasury.

16.1.2 Strategies for Coordinated Implementation of Lae-Nadzab Urban Development Plan

Until now LNUDP has not effectively implemented causing problems on urban development. Major problems and strategies for the implementation of LNUDP are depicted in Table 16.1.2. Detailed descriptions of strategies for land mobilization and organization development are given in the following sections.

Table 16.1.2 Strategies for Implementation of LNUDP

Lae-Nadzab Urban Development Plan (LNUDP, 2005-2015) has not effectively implemented.	LNUDP (2016-2025) is fully implemented.
Major Problems	*Strategies for Implementation*
< Land Mobilization >	
There is no effective scheme/method for land development.	Land readjustment scheme is introduced for effective land development.
Customary land is not available for urban development.	Land group incorporation and customary land registration are promoted.
	A Taskforce for Land Group Incorporation and Customary Land Registration coordinates activities for promotion of land group incorporation and customary land registration for urban development.
Informal settlements are scattered and living conditions there are inadequate.	Settlers' associations are formed, tenure security and self-help housing is supported, and labour-intensive infrastructure development scheme and community development programmes are promoted.
	A Platform for Improvement of Settlement coordinates activities for improvement of informal settlements with facilitation by non-governmental organizations (NGOs).
< Organization Development >	
Implementation of LNUDP is not monitored or evaluated.	Management cycle is established for planning, implementation, monitoring, and evaluation of physical development.
Land use (zoning) and building regulations are not enforced.	A Taskforce for Land Use and Building Regulation and Patrol Units are established and control land use and enforce building regulations.
Industries are not effectively promoted by the public administration.	A section for industrial promotion is established and coordinates industrial promotion activities by related agencies.
Public transport services do not meet the requirements of the urban development.	A new section comprehensively regulates public transport corresponding to urban development.
No structural flood control measures are taken in the Lae-Nadzab urban area.	A new section for river improvement is established and implements structural flood control measures.

Source: JICA Project Team

16.2 Strategies for Land Mobilization

16.2.1 Issues on the Existing Land Development Methods

It was clarified that no common and effective urban development methods for customary land is established yet through review of methods applied in PNG. After opinions at Public Consultation Meeting in line with Strategic Environmental Assessment method in this Project and past examples were analysed, following points are listed to deliberate for the realization of urban development.

(1) To Secure Land Right of Landowners

Opinions of landowners adhere to land ownership, therefore tradition of land rights should be maintained.

(2) To Secure the Livelihood of Residents in the Development Area

Resettlement of residents and rebuilding of livelihood in the development area should be planned in order to improve living conditions of settlers and villagers.

(3) To Encourage the Awareness and Participation of Development Planning Process

Awareness on the urban development planning has to be raised and participation in the planning has to be encouraged.

(4) To Study Feasibility of the Projects

Economic and technical feasibility of the urban development plans has to be studied before launching the projects. The feasibility will be the determinant factor to judge whether the project is eligible as a loan project or not. In the meeting with residents, their attitudes toward the urban development depended on the magnitudes that how much they could gain benefits from the projects.

(5) To Secure Budget at Initial and Implementation Stages of the Projects

It is necessary to secure the budget at the initial and implementation stages of the project. For instance, the following expenditure and costs will be incurred in land development projects.

Table 16.2.1 Expenditure and Revenue Incurred in Land Development Projects

Expenditure	Initial stage:	Consulting fee and engineering fee Cost for meeting Communication cost
	Implementing stage	Construction cost Supervision cost Cost for environmental and social countermeasures Cost for public relations
	After project stage	Cost for management Selling cost OM cost
Revenue	After project stage	Sales income Revenue from public facilities

Source: JICA Project Team

Generally, timing of expenditure and revenue do not coincide. It is necessary to prepare revenue and expenditure plan beforehand. As almost no revenue expected at initial and implementing stages of the Project, legal background for public loan and subsidy scheme, or private loan scheme for the Project is necessary.

(6) To be Intervened by Government

It can be reasonably expected for urban development projects to generate income. However, governmental intervention would be necessary to secure the budget at initial stage and to control the projects.

(7) To Arrange Technical and Financial Support

Roads, water supply, sewerage, solid waste management, and power supply facilities are necessary for urban development. Therefore, technical and financial supports will be necessary for the planning and construction based on the design standards to secure the quality of the facilities and services.

(8) To Improve Land Registration System and Land Market

Landownership has to be clearly identified based on the survey of lands as a precondition of the projects, and ownership after the projects is necessary to be clearly defined. Therefore, land registration system and land market have to be improved.

16.2.2 Formulation of Land Improvement System in Lae-Nadzab Urban Area

(1) Concept

An urban land development method is proposed based on lessons learned from advanced land development in Abongtu area. The concept is basically same as land readjustment method or land pooling system in other countries. The purposes of the land readjustment method cover following aspects by providing necessary infrastructures in compliance with a unified layout plan and enhance the value of the land parcels.

- Organised development of suburban areas in advance of urbanisation
- Improvement of previously urbanised areas
- Integration of large infrastructure facilities into existing urban areas
- Rehabilitation of disaster areas

The features of the land readjustment are following.

(2) Involvement of Landowners

Landowners are organised into Incorporated Land Groups (ILGs), business groups, governments, governmental agencies and/or development companies, which enable participation in decision-making.

(3) Maintaining Existing Community

The landowners and lessees can stay in the s, thus allowing existing communities to remain.

(4) Cost Sharing

Project cost is financed by landowners through contribution of their land in principle.

(5) Equalisation of Land Exchange, Subdivision and Amalgamation

Systematic exchange, subdivision and amalgamation of lands are to be attained by equalisation of economic effects born by the implementation of the Project in principle.

(6) Statutory Powers of the Implementing Bodies

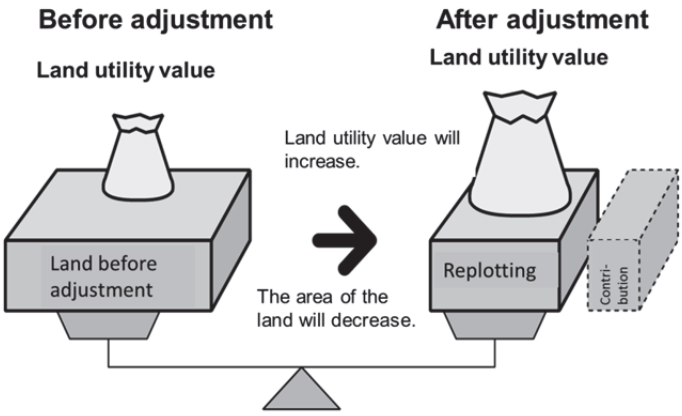
Implementing bodies are allowed to practice compulsory actions for the effective implementation of the projects.

16.2.3 Introduction of Land Readjustment Method

In PNG, appropriate urban development or urban area improvement methods concerning land ownership constraints, fund raising, utilization of private sector initiative, and coordination among sub-sectors are still in the development phase. Land readjustment system for urban development or urban area improvement as a precedent method is shown in this section. In consideration of land readjustment, existing PNG laws, “Land Act 1996” and “Land Group Incorporation (Amendment) Act 2009” can be the base for the method.

(1) Contribution

Contributed lands by landowners in land readjustment scheme are composed of lands necessary for public facilities and those for acquiring financial sources. The lands to acquire financial sources will be sold to obtain revenue to cover land readjustment project costs. As the land utility value will increase, landowners will not lose value even if they contribute some portions of their lands.



Source: City Planning Div., Civil Engineering Dept., Miyagi Prefecture - Material for the Counterpart Training in Japan

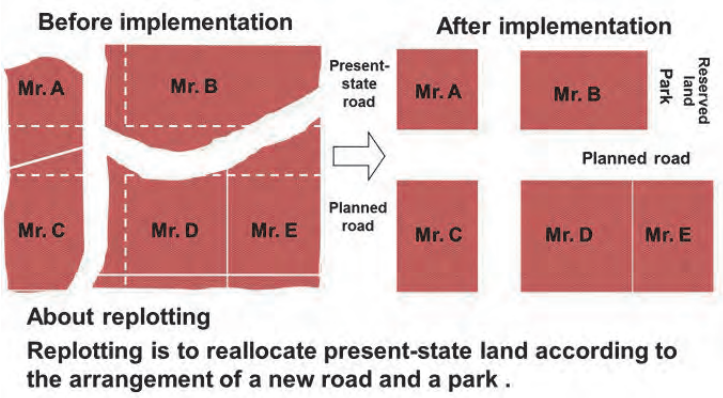
Figure 16.2.1 Contribution of Land and Land Value Increase

(2) Lands to Acquire Financial Sources

Lands for acquiring financial source are a part of the contribution of landowners. Lands contributed by landowners are assembled in a number of locations with different purposes, depending on their marketability. These are then sold in the market to obtain revenue to cover the project cost, which consists of construction cost of public facilities, compensation cost, building and activity cost as well as project management cost.

(3) Replotting

Replotting ensures that all rights and encumbrances attached to land will be untouched and carried over from the original plots to replots.



Source: City Planning Div., Civil Engineering Dept., Miyagi Prefecture - Material for the Counterpart Training in Japan

Figure 16.2.2 Concept of Land Replotting

(4) Public/Private Responsibility Sharing

Land readjustment method is a joint undertaking of all concerned, including landowners, those other than landowners who own various rights on the lands, government and its affiliated agencies who are responsible for the development and maintenance of the area and private utility/public service companies related to the area.

(5) Statutory Powers of the Implementing Body

Implementing bodies of land readjustment projects are normally granted certain statutory powers to ensure smooth and effective implementation. For example, the implementing bodies, either the local authorities or landowner associations, are given powers as to when the concerned building will be demolished or relocated in accordance with the readjustment plan.

(6) Public Participation and Consensus Building

Public participation and consensus building among landowners is an important factor for the success of the project. Formal and informal mechanisms are to be provided to achieve this. Implementation of the project is permitted by law in case the majority agrees with the project in some countries. Then, all the landowners are obliged to participate in the Project. If landowners do not want to participate, they can either sell their lands in the market anytime even after the official approval of the project or request the implementing body to acquire their lands.

(7) Implementing Bodies of Land Readjustment

In case a company becomes an implementing body, shareholders of the company must be land title holders. It is proposed that private developer cannot be the landowner (group) implementing body in case it does not have any land rights.

Table 16.2.2 Implementing Bodies of Land Readjustment

Implementing body	Contents
Individuals/ ILGs	Land title holder(s) implement(s) individually.
Cooperative (ILGs or Cooperative of ILG)	Land title holders create a cooperative that implements the land readjustment project
Company created by the ILG(s)	A company, of which shareholders are land title holders, implements the land readjustment project.

Source: JICA Project Team

Other than the above, the provincial, district or the central government can be an implementing body jointly with the individuals, ILG, the cooperative or the company in case that the lands are composed of state land and customary land.

(8) Flow of the Project

General flow of a land readjustment project is shown below.

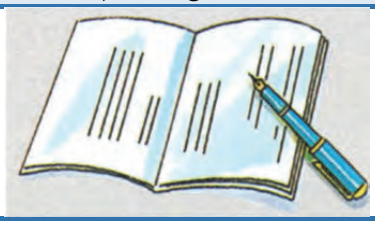
Table 16.2.3 General Flow of Land Readjustment

1) At the beginning of the Project

* Briefing meeting(s) will be held.
* The target Project Area will be determined by taking into account residents' opinions.

2) Survey and investigation

3) ILG registration



4) Inspection and determination of the plan

* The project plan should be inspected and authorized by the organization concerned.

5) Various investigations

6) Declaration of rights

* It is possible to declare unregistered rights, other than ownership, to the implementer.

7) Land readjustment council

* Readjustment of the land should be discussed at the land readjustment council.

8) Formulation of a replotting design plan

* Land right conversion plan will be explained to the land title holders.

9) Specification of provisional replotting

* Provisional replotting and specifications will be announced to the land title holders.

10) Construction work

11) Relocation and demolition

* As the result of relocation or demolition of housing, the loss of properties can be compensated. Such properties include buildings, manufactured equipment, trees, soil and stone, mobile assets, a provisional residence, business, and miscellaneous expenses.

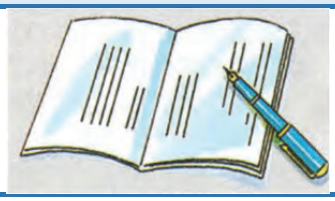
12) Determination of replotting plan

* By taking opinions of the council and evaluators into consideration, replotting design, written replotting details, and written details of settlement of money according to rights are determined and included in the replotting plan.

13) Notification and official announcement of replotting

* From the next day of the date of official announcement of the replotting, all of the rights and duties attributed to the previous residential land are transferred to the replotted land.

14) Registration



15) Settlement of Money

* Settlement of money is for correcting the imbalance generated among replotted lands in the land adjustment area.

Source: City Planning Div., Civil Engineering Dept., Miyagi Prefecture - Material for the Counterpart Training in Japan, modification by JICA Project Team

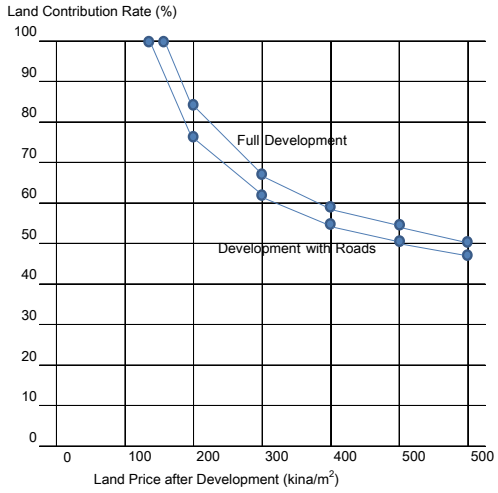
(9) Institutional Background

As no statutory framework of customary land development is established yet, government(s) and public bodies shall accommodate the Project case by case. Though physical plans show zonings plans for land use, no methods or schemes to achieve designated land use are shown in the plans. In case roads, parks, etc., which are in line with a physical plan and considered to be implemented by the governments, can be incorporated in a land readjustment project, then governmental support for the project can be justifiable. In such case, it is recommended that the land readjustment project be included in a local development plan and the preferential loan or subsidy be given.

(10) Business Plan and Fund Raising

Loans and subsidies for the project implementation at preparation stage and construction stage from financial viewpoint are considered as governmental supports for sharing the project cost. From the technical viewpoint, government support for the Project at preparation stage is confined only to help developing appropriate business plan and the compiling feasibility report. Manuals for formulation of business plans, feasibility studies, preparation of Project plans and Project evaluation have to be prepared by Division of Lands of MPA or the regional office of DLPP.

The following graph is an example of relationship between land contribution rate and price of land to cover the project cost for Abongtu Land Development. It can be seen that if the level of land development is lowered with less portion of land for public infrastructure, price of the land can be lowered. By way of these financial examinations, sales risk in the land market will be reduced.



Note: Land Contribution Rate (%): Percentage of land contributed by the landowners (group) for a land readjustment project to the total land property of the landowners (group) before the land readjustment project
Source: JICA Project Team

Figure 16.2.3 Relationship between Land Contribution Rate and Price of Land to Cover the Project Cost

A project is implementable when revenue gained by the project and expenditure for the project are balanced. However, for realisation of an urban development plan and reduction of external diseconomies, governmental financial support will be justifiable. Besides, landowners of customary lands are usually exempted from taxes relating to the land ownership, and local governments tend to neglect to secure the budget for subsidizing public facility improvement.

Measures of governmental financial support are considered following:

- Governmental loans: Loans at low interest rates for implementation of land readjustment project
- Governmental subsidies: Subsidies for public facility improvement (construction cost for road, etc.)

(11) Operation and Management

Two major operation and maintenance bodies of public facilities can be presumed as those after the project. One is an implementing body of the project that will continue the operation and maintenance (O&M), and another is a public body will succeed the O&M. It is recommendable to entrust operation and maintenance to the water PNG, PNG Power, Provincial/District Administration, and Telikom PNG for better O&M at appropriate costs.

Table 16.2.4 Title Holders (Land, Building and Facilities) - Example of Abongtu Land Development

	Before the Project	After the Project (not yet implemented)
Land type	Customary land	Customary land, however leased to the state for 99 years, and the land will be leased to the private sector
Land title	Original owner is Hulu clan. An ILG is formed and hold the land ownership.	ILG, Joint Venture (JV) company, private sector
Building	Only the houses for landowner family are existing. However, some small houses are located in the area according to satellite image.	To be removed
Water supply facilities	Boreholes or rainwater harvesting facilities	Piped water by JV company, then transferred to water PNG
Road	Earth roads/foot path	Roads constructed by JV company
Power supply facilities	Power is not supplied despite power grid exists.	PNG Power
Sewerage facilities	Stand alone	By JV company
Drainage	There is drainage ditch outside of the site.	By JV company
Telephone (fixed phone)	Not existing	By Telikom

Source: JICA Project Team

(12) Taxes

Before land readjustment projects, no tax is levied, while after the projects, waste collection fee, business tax (IRC), and land tax will be levied.

16.2.4 Promotion of Incorporation of Land Group

There have been little systematic efforts by public administration to promote land group incorporation and customary land registration in the planning area of LNUDP. Few ILGs and registered customary lands have hindered proper urban development by providing enough lands for the development and have caused informal settlement scattered around Lae City as well as less attraction of industrial investment in the area due to difficulty in finding available and suitable land and high lease fee for the land. The efforts should be made for encouragement of incorporation of land group/registration of customary land and for the discussion/dissemination of the Lae-Nadzab Urban Development Plan and Local (Zoning)/Subject (Project) Development Plans with/among the customary landowners. Following sections describe the procedures of promoting common awareness of the purposes/implications and merits/demerits of land group incorporation and Draft Urban Development Strategies/Plans, and Local (Zoning) / Subject (Project) Development Plans.

(1) Explanation on Purposes/Implications and Merits/Demerits of Land Group Incorporation and Customary Land Registration

At first, public administration organizations, under coordination proposed in Section 16.3.3 of this chapter, have to explain the followings immediately to all clans in the planning area of LNUDP in their language for them to really understand by heart:

i) Purposes/necessities and implications/consequences of land group incorporation and customary land registration based on the laws/regulations as well as guidelines to be prepared by National Land Development Taskforce (NLDTF) or DLPP.

ii) Merits and demerits or past successful and unsuccessful examples of land group incorporation and customary land registration. Explanations of unsuccessful examples have to be accompanied by actual or possible solutions against the problems that led to the unsuccessful cases.

iii) Processes for land group incorporation based on the relevant laws/regulations and guidelines/handbook

One-day meetings have to be held by a Rural Local Government (Rural LLG, namely, Ahi, Wamper, Nabak and Labuta) with explanation from public administration, questions from customary landowners, answers by the public administration, and discussions by all participants to solve obstacles and problems on land group incorporation and customary land registration.

Prior to the explanation meetings, it would be better for relevant public organizations to ask NLDT and DLPP to check the programmes of the meetings and explanation/presentation materials. As the matters are not limited to Lae-Nadzab urban area, NLDT and DLPP should prepare a standard programme and explanation/presentation materials, which should be translated into respective local languages and modified according to the local conditions by decentralised public administration. NLDT or DLPP would be better to conduct training of staff of local public administration organizations for promotion of land group incorporation and customary land registration.

After the explanation meetings, feedbacks to land mobilization and administration over the country have to be carried out based on the results of the discussions on obstacles/problems and their solutions. For this purpose, relevant local administration organizations have to report to NLDT and DLPP. NLDT and DLPP should hold a meeting on possible revision of measures, guidelines or regulations on land administration with participation of representatives of relevant local organizations after series of local explanation meetings in different areas.

(2) Explanation on Draft Urban Development Strategies/Plans, and Local (Zoning) / Subject (Project) Development Plans for Customary Land Mobilization

After the submission of the final report by JICA Project Team, Morobe Provincial Physical Planning Board (MPPPB) and National Physical Planning Board (NPPB) have to finalise LNUDP (2016-2025). The following procedure would be recommendable.

i) The draft LNUDP has to be discussed by MPPPB, which should include all necessary members including PNG Power Lae and PNG Port Lae, and NPPB in accordance with the procedure stipulated in the Physical Planning Act and Regulation.

ii) The draft also has to be discussed in the District Councils (Lae and Huon Gulf). The district administrations have to explain at respective councillors meetings in councillors' languages for their full understanding. In case that some district council recommends a modification, MPPPB has to consider the modification. If the recommendation is not reflected in the final draft of LNUDP, MPPPB and the district administration have to explain to the councillors the reason(s) why the recommendation is not reflected.

iii) The final draft has to be displayed in the public places according to the Physical Planning Act. In case some comment or objection is raised, MPPPB has to consider the comment or objection. If the comment or objection is not reflected in the final LNUDP, MPPPB has to explain the reason(s) of non-reflection by displaying in the same places.

iv) MPPPB and NPPB have to take other necessary process to finalise and gazette the LNUDP in accordance with the Physical Planning Act and Regulation.

After finalisation of LNUDP, MPPPB has to start formulation of local/subject development, zoning and project plans as recommended in Section 16.1.1 above. For local development and zoning plans, the Lae-Nadzab urban area can be divided into several planning areas as proposed in Section 16.1.1 (2). Subject development plans may include detailed plans for economic, social and amenity/ community infrastructure development as well as a housing development plan and a public transport plan.

For the formulation of local (zoning)/subject (project) development plans, district administrations, with supports of relevant national and provincial organizations and managers of Lae Urban Local-level Government (LULLG) and Rural Local-level Governments (LLGs), have to explain to the relevant customary landowners in their language about draft local (zoning)/subject (project) development plans. One-day meeting has to be held for each of the several planning areas as mentioned above as well as for each subject with explanation on the contents of the draft plans, questions/comments from customary landowners, answers by the public administration, and

discussions by all participants on necessity of modification of the draft plans.

Prior to the explanation meetings, MPPPB has to prepare explanation materials for the translation of respective CEOs or Administrators of the Districts, and LLG Managers. After the explanation meetings, MPPPB has to examine the results of the discussion and modify the drafts if necessary. In case MPPPB does not modify despite a conclusion of necessity at some meeting, MPPPB has to explain to the meeting participants by sending letters to the meeting participants.

16.2.5 Encouragement of Registration of Customary Land for Urban Development

Ahi Land Mobilization Policy (formulated in 2001) was an epoch-making policy for mobilization of customary land for urban development, and the review of implementation of the Policy triggered modification to the current Land Group Incorporation (Amendment) Act 2009 and Land Registration (Amendment) Act 2009. The National Land Development Programme (NLDP) was formulated based on a report prepared by the National Land Development Task Force (NLTF) regarding reform processes that began with a National Land Summit (held in Lae in August 2005), considering the review of implementation of the Policy. Having these as backgrounds, Lae could be a model city for customary land mobilization for urban development.

In parallel with the explanation on land group incorporation, relevant organizations, under coordination of a Taskforce for Land Group Incorporation and Customary Land Registration proposed in Section 16.3.3 below, have to explain about customary land registration and subsequent businesses on their land. At first, basic knowledge, benefits and risks of real estate businesses, which customary landowners will run after the registration of their land, have to be well explained in their language to customary landowners.

Since incorporated land group are not familiar with doing businesses, the followings are recommended.

i) Businesses by the customary landowners should be limited to the real estate business (leasing their land to persons or companies for dwelling, industrial or commercial purposes for a certain period of time), especially at initial stages. It is recommended for customary landowners not to sell their lands.

ii) It is also recommend for the landowning families to estimate and to forecast their annual/ monthly expenditure by expenditure item, such as food/drink, dwelling, utilities, education, health, leisure, etc. Some public administration organization or non-governmental organization (NGO) should preferably provide guidance for this purpose.

iii) Customary landowners have to be explained in their own languages and trained on basic knowledge, benefits and risks of real estate businesses.

iv) Public organizations have to support for organising business groups of customary landowners and for preparation of the business plans. For the support of the above 3), a unit has to be established in Division of Land and Physical Planning of MPA composed of a few staffs, who may be employed through special contracts as there are no civil servants with this expertise at present

The relevant organizations also have i) to explain necessary steps for customary land registration according to the laws/regulation and guidelines/handbook, ii) to support for preparation of applications and other necessary documents for customary land registration, iii) to provide technical support for land survey, and iv) to support for land dispute solutions, which are necessary before the land registry.

16.2.6 Improvement of Informal Settlements

Informal settlements are scattered all over the jurisdiction of Ahi Rural LLG, and recently they extend even to peripheral areas of Nabak Rural LLG jurisdiction for subsistent gardening of urban informal settlers. Informal settlements spread in all urban areas of PNG due to unsuccessful land mobilization for urban development and ineffective provisions of affordable houses to low-middle income migrants to urban areas.

Most of informal settlements in Lae-Nadzab urban areas are located in customary lands, where landowners and settlers conclude verbal/informal contracts for land lease, settles pay small amount of lease fees, and landowners do not want to make the contracts formal, waiting formal development by some investors/developers. In informal settlements, landowners generally do not want infrastructure and utility network to be developed, fearing that the infrastructure and utility service development may prolong the stay of informal settlers on their lands.

Although promotion of land group incorporation and customary land registration and affordable housing programme by the government or housing projects for middle income groups by private developers could stop growth of informal settlements, specific actions are required to improve the existing informal settlements. Measures described below are recommendable.

Until several years ago, an international non-governmental organization (NGO) named Habitat for Humanity Japan and/or International, which recently closed its office in Papua New Guinea, had been active to improve informal settlements in Lae. As public administration entities might not be good at improvement of informal settlements, it would better to search for or to support formation of NGOs for the improvement and community development in the settlements.

(1) Formation of Association of Settlers

As a start of actions for the improvement, it would be better for the NGO, the relevant public organization and the platform proposed in Section 16.3.4 to encourage settlers to form their associations/committees. The associations/committees can take basic role in the improvement actions described below and can be the counterpart to the platform, to the relevant public administration, to ILGs in case that the settlements are in customary lands and to Alienated Land Section of Momase Regional Office of DLPP in case that the settlements are in the state lands.

As migrant families in a settlement are generally of same original villages, it would be easy for the settlers to form a settler associations/committee for the settlement. In case that migrants of a settlement are from different villages, a settler associations/committee has to be established for each original village.

(2) Improvement in Tenure Security

For local development (zoning) planning, informal settlements as well as traditional villages are not necessarily be dealt as exceptions, and land use and major infrastructure development plans, such as those for trunk roads and major access roads, can be formulated in the same way as other residential areas in principle. However, specific considerations have to be given to holly or ceremonial places in the traditional village areas at the time of decision of infrastructure locations. Special regulations on land area per lot, building coverage ratio (BCR), or floor-area ratio (FAR), if applicable, would better be considered for informal settlements.

Landowners and settlers have to be invited at the time of discussion on local development (zoning) planning after draft preparation by the relevant public administration. After finalization of the local development (zoning) plan, participatory meetings have to be organized by the NGOs for detailed subdivision/plotting/repotting planning inviting relevant stakeholders listed in Section 16.3.4. After agreement on the detailed subdivision/plotting repotting plans between the landowning groups and the settler group, the ILG can register their land having rough ideas of prospective lessees and income for the leasing.

After the registration, the ILG or the development company established by the ILG and the settler group are to be encouraged to conclude an agreement for lease contract. The contract should be written for the security of settlers with specific period of lease period, while lease fee per square meter should be higher than the current one for the benefit of the ILG. Although contracts between individual landowning families and individual settler families can be concluded, a group contract between the ILG and the settler association/committee would better be promoted for secured payment of the lease fee with mutual help among the settles and for avoiding border dispute among the landowning families. Land readjustment has to be promoted as far as possible for better subdivision/plotting/repotting and settlement improvement as proposed in Section 16.2.1 above. As land prices near urban centre are high and not suitable for subsistence gardening of

informal settlers, separation of subsistence gardening areas from dwelling areas is to be encouraged searching waste land to clear and cultivate for subsistence gardening areas in suburban areas.

(3) Improvement in Housing

Self-help housing would be principal measure for housing improvement in informal settlements in terms of floor area/dweller, durability, in-house circumstances, etc. while private-led housing projects would be feasible for middle to high income settlers. Following steps would be recommendable.

i) Several standard designs are to be prepared by local volunteer professional architects for typical low income families according to the local conditions. Design competition could be a good option. Several standards are to be set by family types (number families, number of family members, member generation (composition of children, adolescents, adults and the aged), etc.).

ii) House building kits (a set of materials with construction manual) are to be prepared by the architects group for respective types of the standard designs

iii) Through negotiations with construction material dealers by the platform proposed in 16.3.4 below, a substantial number of kits are to be procured for selling to informal settlers with cheap prices, taking advantage of bulk trades.

iv) Houses in the settlements are to be constructed by the settlers themselves or carpenters employed by the settler group.

Housing finance schemes have to be set-up for informal settlers as follows:

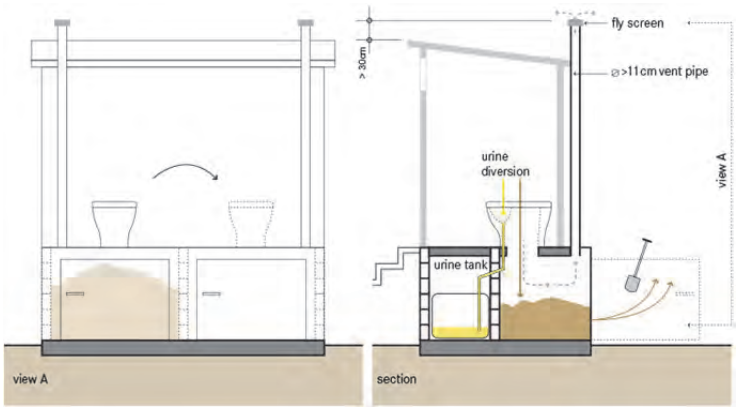
- Save and loan programmes, where the families save money every month, have to be set-up for the settler groups. If an account for a settler family reached some amount, 25% of the cost of housing for example, the family will be eligible for a loan to build their house.
- Funds raised by the public administration will be used as deposits for revolving funds managed by settler committees/associations supervised by the NGOs and the platform.
- Some of eligible families will be selected for loans by lottery.
- Repayment will be secured by group. In case that a family cannot repay, the relatives or the whole group are responsible for the repayment.

Private-sector led housing for middle-income groups should also be encouragement giving incentive of tax credit for infrastructure development. In case that a private developer construct public infrastructure, such as a trunk road, an access road, a drain, or community/amenity infrastructure (a park, a community hall, etc.), the corporate tax of the developer will be reduced by the cost of the infrastructure development. Financing schemes have to be prepared for the settlers that will buy houses built by private developers as well.

(4) Improvement in infrastructure

Labour-intensive infrastructure (roads, drains, playing grounds, etc.) development has to be promoted in the informal settlements, where public administration provide materials (gravel, cobble, sand, sacs, etc.) and tools (shovels, pickaxes, etc.) for infrastructure development and settlers construct infrastructure with schemes of ‘cash for work’ under supervision of engineers of the NGOs or public administration organizations.

For access to safe water in informal settlements, it is recommended for PNG Water to provide public taps to be managed by the settler committees/associations, which are responsible for maintenance of the taps and payment of water tariff to PNG Water. Installment of ecological sanitation (EcoSan) toilets or ventilated improved pit latrines has to be encouraged. Relevant public administration organizations in charge of public health and/or community development have to provide materials for the construction of the toilets, and the settler committees/associations will have to construct and maintain the toilets with support of the NGOs. Training on hygienic water use, in-house storage and use of toilet should be conducted by the NGOs.



Source: https://en.wikipedia.org/wiki/Urine-diverting_dry_toilet#/media/File:Schematic_of_the_Dehydration_Vaults.png

Figure 16.2.4 Example of Ecological Sanitation (EcoSan) Toilet

(5) Community Development

In addition to the above actions, community development can be encouraged for i) promotion of income generation activities with development of informal sector, ii) security and safety enhancement, such as fire or crime prevention, iii) construction of community hall, iv) adult literacy education, v) formation of women's associations and youth groups, etc., under facilitation of the NGOs.

16.3 Organization Development Strategies

16.3.1 Reinforcement of Planning, Implementation, Monitoring and Evaluation of Physical Development

There are many organizations related to formulation and implementation of LNUDP, including Momase Regional Office of DLPP, Division of Land and Physical Planning of MPA, Section of Infrastructure and Strategic Planning of LULLG, other organizations that are members of MPPPB, organizations related to infrastructure development and utility services, etc. It may be said as "Everyone's business is no one's business." It is necessary to check whether every related task is done properly as planned, i.e., to monitor. Good plans can be formulated only after careful analyses of what were done well and what were not, and why those were well done and why the others were not, i.e., evaluation.

Periodical (biannual) monitoring on implementation of LNUDP, local and subject development plans, and feedback of the monitoring results to implementation have to be conducted with coordination by MPPPB with cooperation of all relevant organizations. In the monitoring meeting, MPPPB should check all monitoring reports prepared by the relevant taskforces and organization.

After the checking, MPPPB should review all programmes, plans, schemes, action plans and projects related the LNUDP, local development plans (zoning), and subject (project) development plans. MPPPB should give recommendations for better implementation of the programmes, plans, schemes, action plans and projects and/or their modifications.

Third party evaluation would preferably be introduced. The evaluation committee may include members from the academic sector, such as deans of related faculties of University of Technology, the representatives of private developers/investors, settlers, customary landowners, NGOs, etc.

16.3.2 Strengthening of Land Use and Building Regulation

Land use and building construction are not effectively regulated or controlled in Lae-Nadzab urban area. It is generally not easy to regulate land uses and building construction. Recent publication of National Research Institute (NRI) points out that "Prohibition, which requires enforcement, is very weak in PNG".

It is recommended to form a Taskforce for Land Use and Building Regulation chaired by Senior Physical Planner of MPA and composed of the representatives of the following public administration

organizations. The Taskforce at first has to discuss on effective land use and building regulation, and on clarification of roles, responsibilities and demarcation of the relevant organizations.

- Momase Regional Office of DLPP,
- Division of Land and Physical Planning of MPA,
- Section of Infrastructure and Strategic Planning of LULLG
- Section of Regulatory Services of LULLG
- Rural LLG (Ahi, Wamper, Nabak and Labuta)

Land Use and Building Patrol Units have to be formed, or staffs for the patrol have to be designated at District level, and the Units or the staffs have to check the conformity of land use with zoning and of buildings with the Building Act and Regulation in their jurisdiction and to report results of the patrol to the Taskforce for Land Use and Building Regulation. Capacity on land use and building regulation of relevant organizations, such as the Taskforce and the Patrol Units, has to be developed by DLPP.

Information dissemination and campaign programmes on zoning and building regulations have to be conducted with the general public including customary landowners. For the effective enforcement of zoning and building regulations, discussion meetings have to be held by the Taskforce regarding the enforcement of the relevant laws and regulations, obstacles that block the enforcement and solutions of the obstacles with all stakeholders.

16.3.3 Enhancement of Land Group Incorporation and Customary Land Registration for Urban Development

Currently land mobilization is one of the most critical bottlenecks for the implementation of LNUDP as well as urban development plans in PNG. Proper mobilization of customary lands is essential for the implementation of the next LNUDP.

It is proposed to form of a Taskforce for Land Group Incorporation and Customary Land Registration chaired by Customary Land Officer of Momase Regional Office of DLPP with members from the following organizations:

- Momase Regional Office of DLPP
- Division of Land and Physical Planning of MPA
- Division of Community Development Services of MPA
- Section of Regulatory Services of LULLG,
- Section of Social Services (Community Development) of Lae District
- Rural LLG (Ahi, Wamper, Nabak and Labuta).

The Taskforce for Land Group Incorporation and Customary Land Registration has at first to discuss on effective promotion of land group incorporation and customary land registration and to clarify roles, responsibilities and demarcation of the relevant organizations. Training of the Taskforce members and staffs of the relevant organizations for land group incorporation and customary land registration has to be conducted by the NLDT.

Annual action plans for promotion of land group incorporation and customary land registration based on the LNUDP, and local development plans as well as on NLDP have to be prepared by the relevant organizations and finalised under the coordination of the Taskforce. The action plans are to be implemented by relevant organizations in the Taskforce. The implementation is to be periodically (quarterly) monitored by the Taskforce. The monitoring results are to be fed-back to implementation by the relevant organizations. The results of the implementation are to be evaluated before planning of action plans for the next year.

16.3.4 Establishment of a Platform for Improvement of Settlement

A platform involving the following members have to be organised.

- Momase Regional Office of DLPP
- Division of Land and Physical Planning of MPA (presiding organisation)
- Division of Community Development Services of MPA

- Section of Social Services (Community Development) of Districts Administrations and LULLG
- Section of Infrastructure and Strategic Planning of LULLG
- Section of Regulatory Services of LULLG
- Rural LLG (Ahi, Wamper, Nabak and Labuta)
- NGOs capable and willing to support for improvement of settlement
- Micro Financial Institutes
- Lae Office of Housing Corporation
- Professional Organizations (such as Engineers, Architects, Building Companies and Carpenters Associations) in Lae (if existing, and preferably to be organised if missing)
- Association of Construction Material Dealers in Lae (to be organised if missing)

At first, the Platform has to discuss and determine roles, responsibilities and demarcation of the relevant organizations. The Platform also has to discuss with customary landowners and settlers, and to decide programmes, schemes, action plans, resolutions. The programmes, schemes, actions (such as those for labour infrastructure development and self-help housing in low income group settlements as proposed above in Section 16.2.3 above) are to be implemented the relevant organisations. Besides, monitoring of the implementation is to be conducted by the Platform, the results of the monitoring are to be fed-back to the implementation by the relevant organizations, and the evaluation is to be carried out by the Platform.

16.3.5 Establishment of an Organization In Charge of Industrial Promotion

Currently, Investment Promotion Agency (IPA) is not much active in Lae, receiving applications from local companies and just forwarding them to Port Moresby though it has a branch office in Lae. Deconcentration of IPA is necessary, giving more authority to its branch offices and enhancing/ developing their capacities. Although Lae is recognised as the industrial centre of PNG, Small Business Development Corporation (SBDC) has not an office in Lae. Its regional office should be established in Lae.

A section, whose staff composition is shown in Table 16.3.1, has to be established under Deputy Provincial Administrator for Social Services, Infrastructure and Growth Centre of Morobe Province for effective industrial promotion. Employment of experts with rich experiences is the key for the successful industrial promotion. Special employment contracts with different salary scales from ordinary staffs can be recommended for the establishment of the section, except research assistants, who will learn knowledge and skills from the manager, specialists and advisors, and will take these posts in future, as there is no experienced staff in this field in MPA at the present.

Table 16.3.1 Staff Composition of Industry Promotion Section in the MPA

Post	Duties
Section Manager	- Formulation of policies and action plans for industrial promotion - Management of the section
Attraction Specialist	- Attraction of entrepreneurs/investors to the province
Financial Advisor	- Provision of financial/accounting advice to entrepreneurs/investors in the province including prospective ones
Legal Advisor	- Provision of legal advice to entrepreneurs/investors in the province including prospective ones
Tax Advisor	- Provision of advices on taxes, levies, charges, etc., to entrepreneurs/investors in the province including prospective ones
Land mobilization Advisor	- Provision of information and advice on land to entrepreneurs/investors in the province including prospective ones - Mediation for land mobilization between landowners and entrepreneurs
Research Assistant	- Assistance for researches studies conducted by prospective entrepreneurs/investors

Source: JICA Project Team

After establishment of the section, the section should be the core agency of industry promotion group, which will be composed of the section itself, regional offices of IPA and SBDC and other relevant local organisations, such as Lae Chamber of Commerce and Industry, and coordinate all activities for industrial promotion and investment/enterprises attraction in the Lae-Nadzab area.

16.3.6 Establishment of an Organization in Charge of Public Transport Regulation

Public transport, which means bus transport in Lae at the moment, is operated by individual persons, who generally own only one or two buses. There are no effective control over the bus transport in Lae-Nadzab urban area though National Road Transport Board is in charge of deciding bus routes and licensing operation by the private sector and LULLG is maintaining the bus terminals. The following problems have appeared and hinder proper urban development.

- Operation of bus terminals is not well controlled and traffic congestion occurs frequently around the terminals.
- Bus routes are not well organised and bus transport does not fully meet needs of the people.
- Bus operation is not well regulated, which hampers smooth traffic, such as commuting, of the people.

A regulatory organization for comprehensive and appropriate control of public transport operated by the private sector has to be established, preferably in MPA due to a necessity to comprehensively regulate both bus routes within the city and those that extend to suburban areas outside the city, with functions listed below:

- Planning of Bus Routes
- Licensing of Operators
- Monitoring and Regulation of Operations
- Operation of Bus Terminals and Bus Stops (Construction and maintenance of bus terminals and bus stops will be undertaken by Provincial Works according to the plans formulated this regulatory section.)

The section has to be established under Deputy Provincial Administrator for Social Services, Infrastructure and Growth Centre, or Deputy Provincial Administrator for Corporate Governance and Management. In addition to the establishment of the section, tasks for construction and maintenance of bus terminals and bus stops have to be enhanced by Provincial Works according to the proposals of draft LNUDP.

16.3.7 Establishment of an Organization for River Improvement

Although river improvement projects, such as embankment or excavation of water courses, are proposed in draft LNUDP, there would be no organization to conduct feasibility study or to order and supervise the works to be undertaken by contractors. It is necessary to establish a section that can deal with the matter. Since river improvement or structural measures for flood control, such as embankment, construction of retarding basins and excavation of water courses, are a new concept in the Lae-Nadzab Urban Area as well as in PNG, a new organization has to be established.

As implementation of structural measures for flood control requires high expertise and huge costs, the section is to be established at the national level. Due to the necessity of civil engineering knowledge and skills of high level, the section has to be created in the Department of Works (DoW). Although the section could be established in Conservation and Environment Protection Authority (CEPA), which is in charge of water resources management, establishment in DoW is recommended as flood control works are ones of the civil works and CEPA does not have know-how of construction of the civil works. Though PNG water has experiences in hydraulic works construction, the organization does not have expertise on flood water and will be evolved into financially independent organization, at least at operation level, and no revenue or income can be expected from construction, operation and maintenance of flood control structures.

Staffs newly appointed for the section have to be trained through intensive and extensive training including those conducted through technical assistance by foreign countries, which have abundant experiences in river improvement, such as Japan. Technical assistance projects from these countries are essential for the proper establishment of the section. Projects for structural measures of flood control will have to be studied, designed and implemented with procurement of foreign consultants and contractors. For appropriate selection of the consultants and contractors, the above-mentioned technical assistance is necessary.

After the establishment of the new section, a coordination system has to be embodied with organizations in charge of non-structural flood control measures for the integrated flood control and disaster management.

PART III

PRE-FEASIBILITY STUDY OF PRIORITY PROJECT

CHAPTER 17 SCOPE OF THE PROJECT

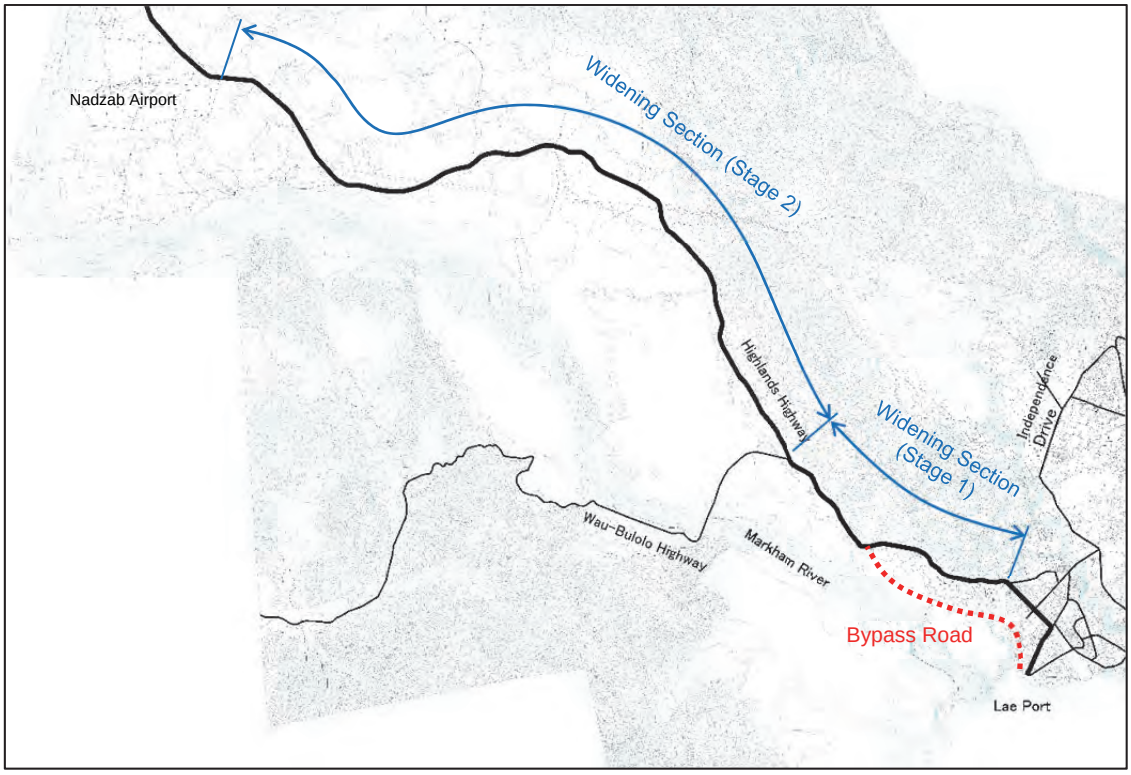
17.1 Project Objectives

The Highlands Highway is the most important highway in the country serving as a "backbone infrastructure" connecting PNG's biggest port at Lae with the inland highland provinces which account for about 40% of the country's population and have vast natural resources. Construction is in progress to widen the section between the Bugandi Roundabout (intersection with Boundary Road) and Nadzab Airport into four lanes. However, since there are no plans to widen the section from the Bugandi Roundabout to Lae Port, this will remain the same and be congested in the near feature.

Furthermore, Lae Tidal Basin Project is also on-going and includes development of its hinterland into an industrial area, therefore, the traffic demand of this two lane section will be rapidly increased.

Under such situation, the bypass road connecting Lae Port to the Highlands Highway is really required, and it is expected as follows:

- ✓ To separate port related traffic, especially heavy trailers, from general traffic in Lae central area,
- ✓ To guide future urbanization and function as an arterial road of the expected development area, and
- ✓ To prepare alternative route of the Highlands Highway for emergencies.



Source: JICA Project Team

Figure 17.1.1 Location of the Bypass

This Project for Construction of Bypass Highway behind Lae Tidal Basin (hereinafter the Bypass) was selected from several priority projects proposed in the Master Plan and approved for a target of pre-feasibility study by the third Join Coordination Committee held on 27 April 2016.

17.2 Circumstances

17.2.1 Related Infrastructure Developments

(1) Highlands Highway Reconstruction & Upgrading Project

As explained in also the chapter 6.1, the Highlands Highway from Bugandi roundabout till Nadzab Airport junction is being widened to four lanes under the funding of PNG Government. The widening project is separated into two stages as follows:

- Stage 1: from Bugandi roundabout at 2 miles to Wau junction at 9 miles: 8.6 km

  Expected construction period: September 2014 – September 2016

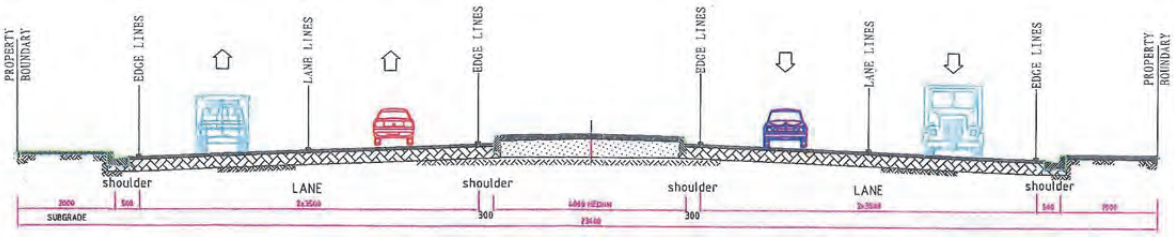
  Contractor: China Railway International

- Stage 2: from Wau junction at 9 miles to Nadzab Airport junction: 25.9 km

  Expected construction period: November 2015 – November 2017

  Contractor: Not awarded yet

The right of way is 20 meter wide for each side from the centre line, and the typical cross section is shown in Figure 17.2.1.



Source: Highlands Highway Reconstruction & Upgrading Project

Figure 17.2.1 Typical Cross Section of Stage 1

(2) Lae Tidal Basin Project

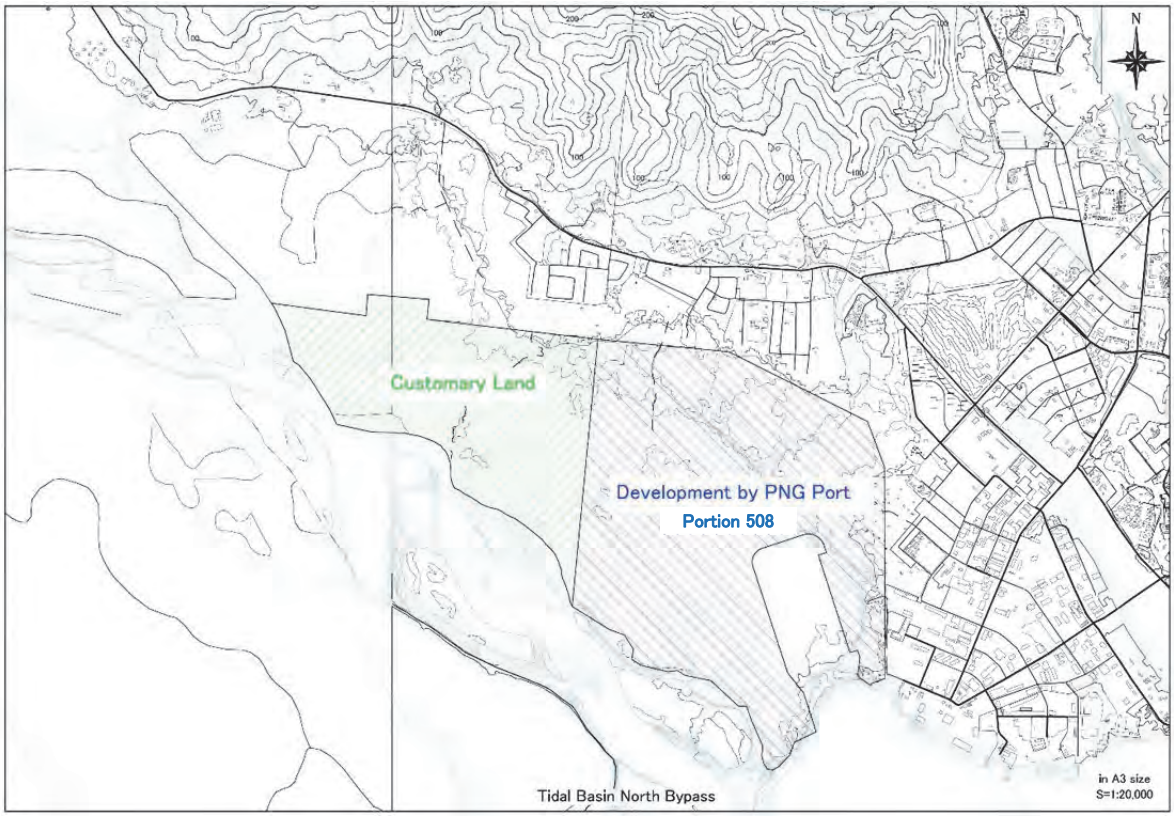
As explained in Chapter 6.2, Lae Port is being expanded by ADB loan with dredging of the marine tidal basin and construction of a new wharf beside tidal basin in order to facilitate large container vessels. The project is separated into two phases, and the first phase has been completed in December 2014 and the operation has been started. In the second phase, the tidal basin and the wharf will be extended in order to be capable of catering for much larger vessels.

17.2.2 Topographical Conditions

As the area targeted for the Bypass is close to Markham River, the land is low-lying, swampy and often flooded. Although, the northern area where is relatively high and close to the Highlands Highway has been developed as a residential area, southern area where is close to the river and always swampy had a few houses.

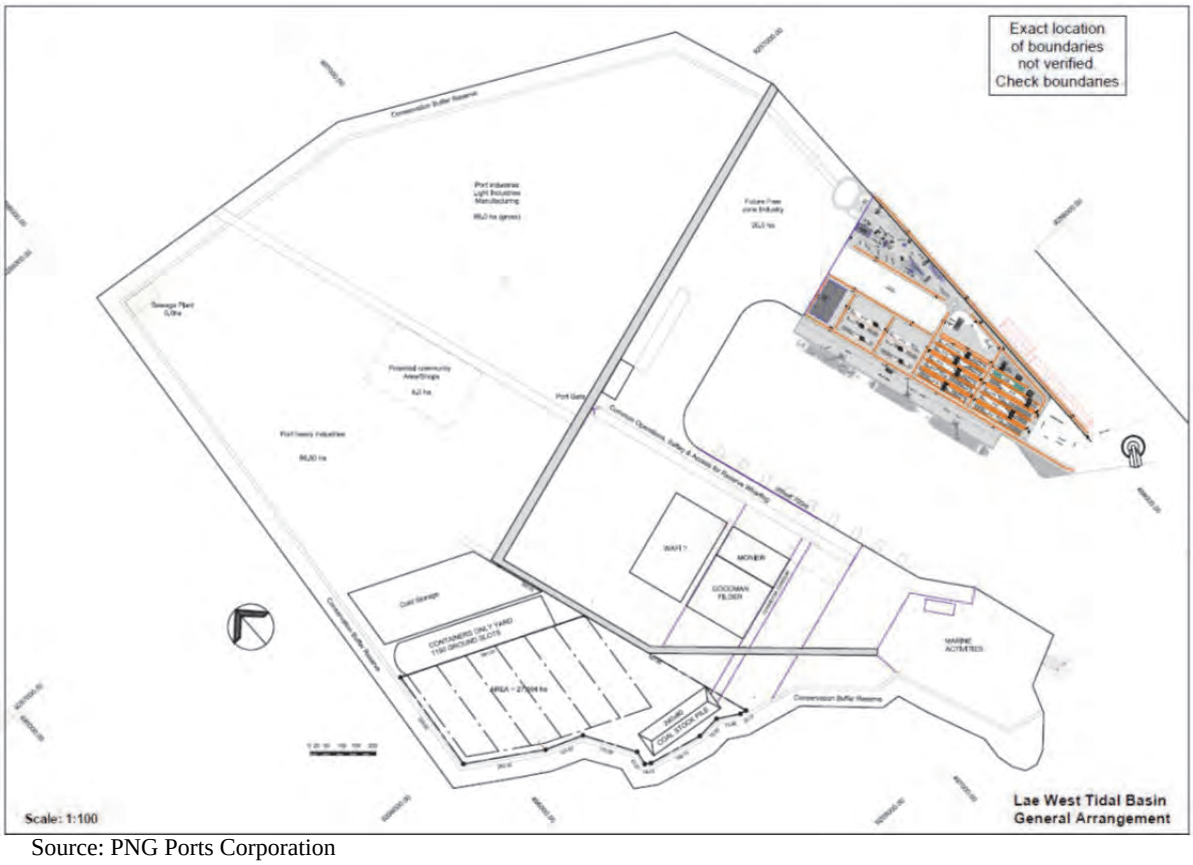
As shown on Figure 17.2.2, the area coloured in blue including Lae Tidal Basin Project Area has been entrusted to PNG Ports Corporation to be developed into industrial area, and the area was named as Portion 508 (refer to Figure 17.2.3). The area has been acquired and the resettlement of the residents has been completed by ADB. However, a few houses were come back to this area after the resettlement (see Figure 17.2.4), and one small village remains as it is (see Figure 17.2.5). In order to avoid further invasion of peoples, PNG Ports Corporation has built the fence along the boundary of Portion 508 together with access road (see Figure 17.2.6).

As shown on Figure 17.2.2, the area coloured in green located west side of the Portion 508 is customary land and it is under dispute between two clans who insist that it is their own property.



Source: JICA Project Team

Figure 17.2.2 Location Map



Source: PNG Ports Corporation

Figure 17.2.3 Tentative Layout Plan of Portion 508

Source: JICA Project Team

Figure 17.2.4 House within Portion 508

Source: JICA Project Team

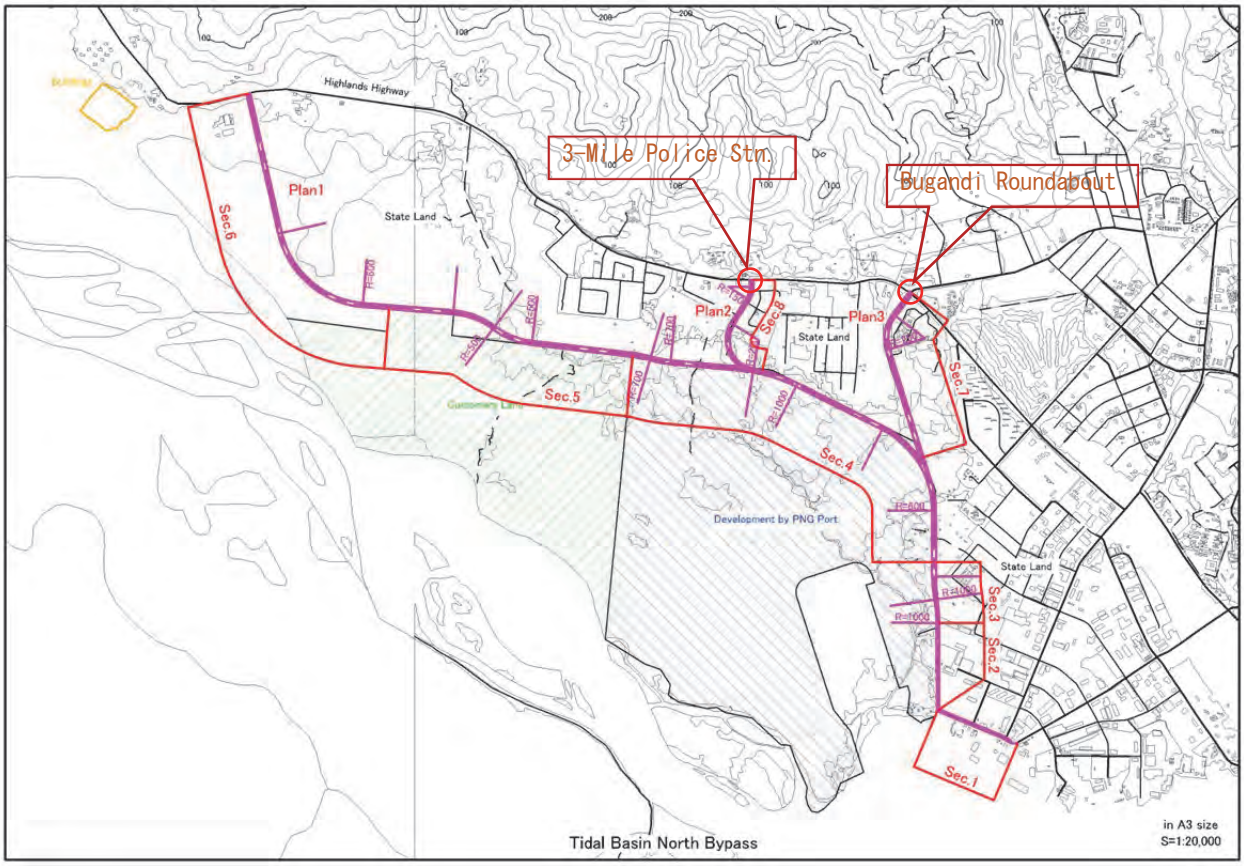
Figure 17.2.5 Remaining Village in Portion 508

Source: JICA Project Team

Figure 17.2.6 Fence along Portion 508 Boundary

17.3 Outline of the Project

Taking account of circumstances mentioned above, the Bypass could be proposed from Lae Port to Highlands Highway 6 mile where urban area is ended and space for the road development is available, and it could be set along the boundary of Portion 508 and the customary land. However, based on the expected future development, and possibility of funding constraints, two more alternative routes of the Bypass are proposed, which could be connected with the Highlands Highway at 3 mile police station and Bugandi roundabout. According to PNG Ports, the full development of Lae Tidal Basin is expected to take 15 to 20 years. Therefore, the road may be constructed in phases taking into account the level of port development and subsequent traffic growth, and availability of the fund.



Source: JICA Project Team

Figure 17.3.1 Alternative Routes of Bypass

CHAPTER 18 TRAFFIC DEMAND FORECAST

This chapter evaluates the total travel time that could be saved and the total travel distance that could be reduced by the construction of each of the alternative bypass roads proposed in Section 17.3. It also analyses how fluctuation in the future traffic demand may affect the performance (in terms of saved time and reduced distance) of each of the above options. Based on these results, Chapter 22 assesses the feasibility of each alternative, and compares the three alternatives.

18.1 Long-term Traffic Demand

The future traffic demand up to 2025 is based on the details of the development plans specified in the Master Plan. The traffic volume expected in 2025 is, therefore, calculated based on the planned land use changes in each zone as well as the expected socioeconomic development. The pre-feasibility study of the bypass road, however, requires a longer span (up to the year 2050) future traffic analysis.

It is difficult to get zone-level land use changes beyond the Master Plan target year (2025). The future traffic demand beyond 2025 is, therefore, based on the socioeconomic trend. The passenger traffic is estimated on the assumption that population will grow at the current average annual growth rate of 2.5%, and the passenger traffic will also grow at the same rate.

Although currently the share of public motor vehicles (PMV) is very high, accounting for 75% of motorized trips (excluding trucks), this share is expected to decrease with economic growth and subsequent motorization. The future share of the PMV would depend on many factors, particularly government policies. It is, therefore, assumed that the share of the cars would increase from its current 25% to 60% by 2050 as the government would adopt policies that would protect the PMV share from getting below 40% by 2050.

Truck traffic growth is closely linked to the economic growth. The Lae Tidal Basin appraisal is based on average growth of 6% of cargo traffic. This rate is developed based on the cargo and economic growth trends. This Study has adopted the same rate (6%) to forecast the future truck traffic.

18.2 Alternative Routes

As mentioned at the beginning, the three alternative routes are considered (see Section 17.3). The three alternatives are as follows:

Route 1: A 7.7-kilometre road that starts from the port area and intersects the Highlands Highway at 6-Mile

Route 2: A 4.2-kilometre road that starts from the port area and intersects the Highlands Highways at 3-Mile Police Station.

Route 3: A 3.4-kilometre road that starts from the port area and intersects the Highlands Highways at Bugandi Roundabout.

Figure 18.2.1 to Figure 18.2.3 show the bypass traffic in 2025, for each of the above three alternatives. In addition, Table 18.2.1 shows the traffics forecast up to 2050 by route. The following sections analyze the impact of each alternative in detail.

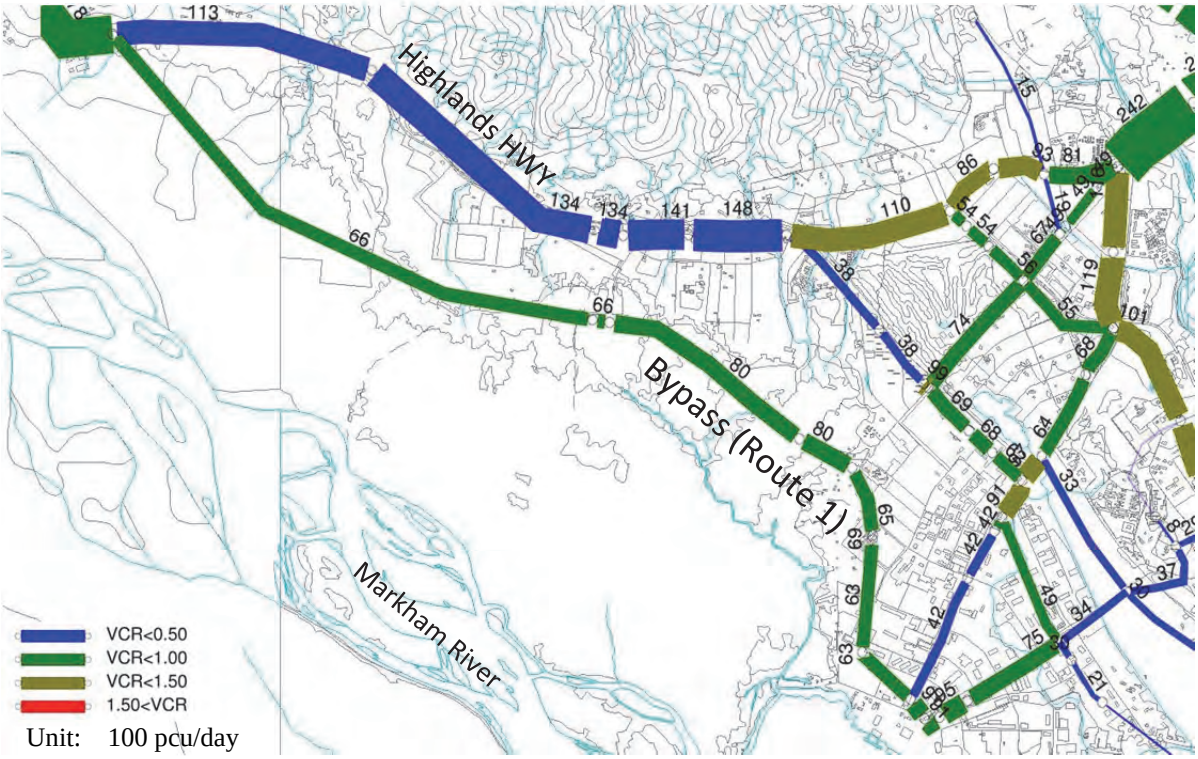


Figure 18.2.1 Daily Bypass Traffic in 2025 (Route 1)

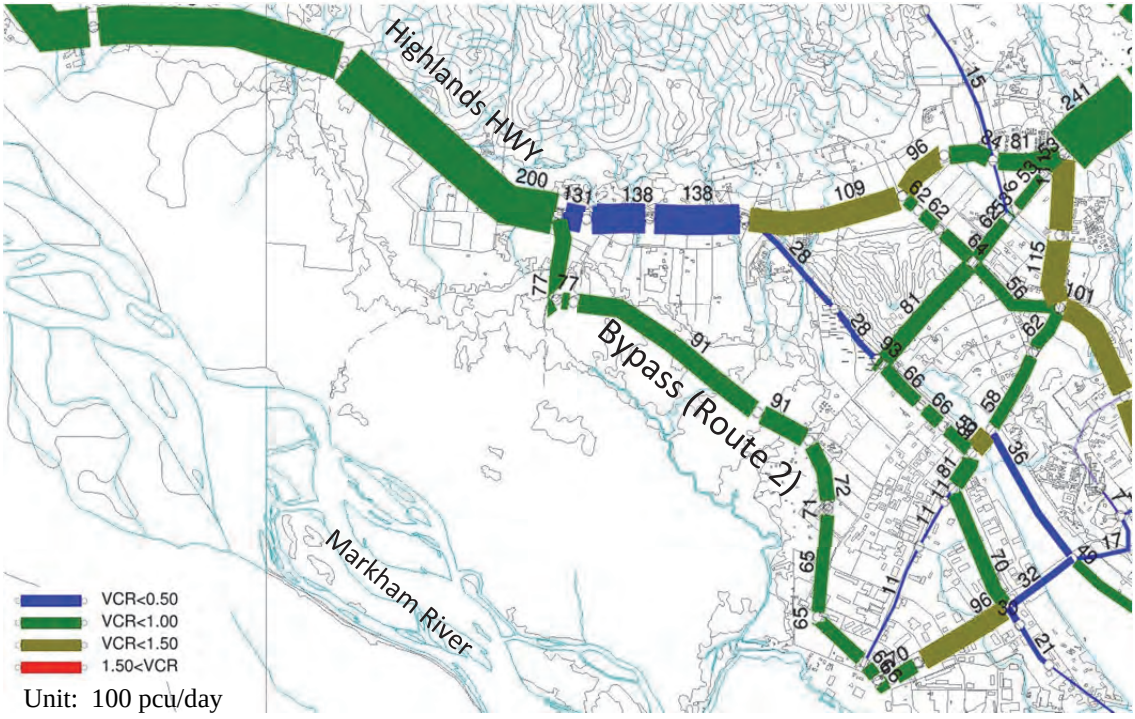


Figure 18.2.2 Daily Bypass Traffic in 2025 (Route 2)

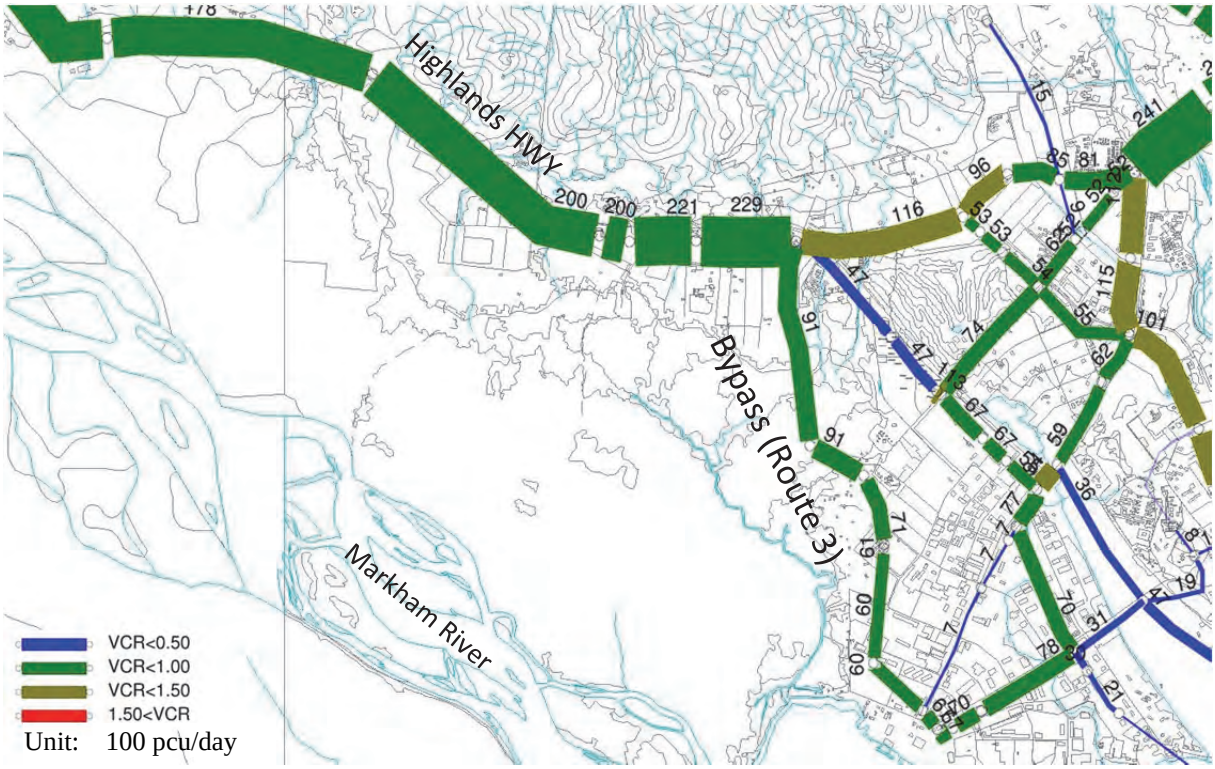


Figure 18.2.3 Daily Bypass Traffic in 2025 (Route 3)

Table 18.2.1 Daily Bypass Traffic by Year

Alternative	Maximum Traffic by Year (pcu/day)				
	2020	2025	2030	2040	2050
Route 1	6,193	8,039	9,254	11,917	15,078
Route 2	7,116	9,137	10,600	13,041	15,882
Route 3	7,375	9,121	11,141	12,951	16,189

18.3 Future Network

The bypass road is expected to be completed by 2020. Therefore, the impact of the bypass road is evaluated at ten-year intervals, starting from the expected opening year (2020) until 2050. Although the expected network changes in the base case were considered for the years up to 2030, the base network beyond 2030 is assumed to remain unchanged.

The following sections evaluate how each of the above alternatives affects the overall performance (in terms of travel time, and travel distance).

18.4 Traffic Analysis: Route 1

(1) Passenger Traffic

The performance indicators (total travel time, total travel distance) of the network are calculated for two cases: with bypass and without bypass cases. The performance indicators are calculated in 10-year intervals, *i.e.*, for the years 2020, 2030, 2040 and 2050. The results of the two cases (with and without cases) are compared, and Table 18.4.1 and Table 18.4.2 show the results.

Table 18.4.1 Daily Travel Time Changes of Passenger Traffic (Route 1)

Year	Mode	Without Bypass			With Bypass			Difference: *With-Without* (pass-hr)
		Travel time			Travel time			
		pcu-hr	veh-hr	pass-hr	pcu-hr	veh-hr	pass-hr	
2020	Car	5,129	5,129	21,850	5,036	5,036	21,453	-396
	PMV	6,552	3,276	57,107	6,433	3,217	56,070	-1,037
2030	Car	8,693	8,693	37,032	8,460	8,460	36,040	-993
	PMV	7,472	3,736	65,126	7,280	3,640	63,453	-1,673
2040	Car	13,243	13,243	56,415	12,708	12,708	54,136	-2,279
	PMV	7,412	3,706	64,603	7,126	3,563	62,110	-2,493
2050	Car	20,604	20,604	87,773	19,179	19,179	81,703	-6,071
	PMV	8,720	4,360	76,004	8,167	4,084	71,184	-4,820

pcu: passenger car unit ; PMV (public motor vehicles) = 2 pcu

Table 18.4.2 Daily Travel Distance Changes of Passenger Traffic (Route 1)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without* (Veh-km)
		Travel distance		Travel distance		
		pcu-km	veh-km	pcu-km	veh-km	
2020	Car	239,766	239,766	238,799	238,799	-967
	PMV	312,164	156,082	310,968	155,484	-598
2030	Car	403,463	403,463	401,661	401,661	-1,802
	PMV	356,279	178,140	354,875	177,438	-702
2040	Car	590,866	590,866	587,574	587,574	-3,292
	PMV	339,760	169,880	338,057	169,029	-852
2050	Car	858,664	858,664	851,856	851,856	-6,808
	PMV	385,024	192,512	382,627	191,314	-1,199

pcu: passenger car unit; PMV (public motor vehicles) = 2 pcu

(2) Truck Traffic

Table 18.4.3 and Table 18.4.4 show the changes in total travel time and travel distance of trucks, respectively. As the results show, both total travel time and travel distance decrease with the introduction of route 1. Both the saved time and reduced travel distance increase gradually as the traffic increases from 2020 to 2050.

Table 18.4.3 Daily Travel Time Changes of Truck Traffic (Route 1)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without* (veh-hr)
		Travel time		Travel time		
		pcu-hr	veh-hr	pcu-hr	veh-hr	
2020	Truck	3,040	1,520	2,948	1,474	-46
2030	Truck	4,401	2,201	4,247	2,124	-77
2040	Truck	5,928	2,964	5,661	2,831	-134
2050	Truck	7,831	3,916	7,299	3,650	-266

Truck = 2 pcu

Table 18.4.4 Daily Travel Distance Changes of Truck Traffic (Route 1)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without* (veh-km)
		Travel distance		Travel distance		
		pcu-km	veh-km	pcu-km	veh-km	
2020	Truck	142,441	71,221	139,101	69,551	-1,670
2030	Truck	206,526	103,263	201,897	100,949	-2,315
2040	Truck	270,685	135,343	264,591	132,296	-3,047
2050	Truck	336,300	168,150	327,942	163,971	-4,179

Truck = 2 pcu

18.5 Traffic Analysis: Route 2

(1) Passenger Traffic

Similar to the Route 1 case, the changes in the performance of the network were evaluated by comparing the performance indicators of the network with and without Route 2. Table 18.5.1 shows the changes in total travel time, and Table 18.5.2 shows the changes in total travel distance.

Table 18.5.1 Daily Travel Time Changes of Passenger Traffic (Route 2)

Year	Mode	Without Bypass			With Bypass			Difference: *With-Without* (pass-hr)
		Travel time			Travel time			
		pcu-hr	veh-hr	pass-hr	pcu-hr	veh-hr	pass-hr	
2,020	Car	5,129	5,129	21,850	5,032	5,032	21,436	-413
	PMV	6,552	3,276	57,107	6,431	3,216	56,053	-1,055
2,030	Car	8,693	8,693	37,032	8,455	8,455	36,018	-1,014
	PMV	7,472	3,736	65,126	7,280	3,640	63,453	-1,673
2,040	Car	13,243	13,243	56,415	12,718	12,718	54,179	-2,237
	PMV	7,412	3,706	64,603	7,135	3,568	62,189	-2,414
2,050	Car	20,604	20,604	87,773	19,164	19,164	81,639	-6,134
	PMV	8,720	4,360	76,004	8,170	4,085	71,210	-4,794

Table 18.5.2 Daily Travel Distance Changes of Passenger Traffic (Route 2)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without (veh-km)*
		Travel distance		Travel distance		
		pcu-km	veh-km	pcu-km	veh-km	
2020	Car	239,766	239,766	238,549	238,549	-1,217
	PMV	312,164	156,082	310,665	155,333	-750
2030	Car	403,463	403,463	401,060	401,060	-2,403
	PMV	356,279	178,140	354,391	177,196	-944
2040	Car	590,866	590,866	586,742	586,742	-4,124
	PMV	339,760	169,880	337,621	168,811	-1,070
2050	Car	858,664	858,664	849,314	849,314	-9,350
	PMV	385,024	192,512	381,659	190,830	-1,683

(2) Truck Traffic

The total daily travel time that truck traffic could save by the construction of the Route 2 is shown in Table 18.5.3. Table 18.5.4 shows the corresponding reduction in total daily travel distance from 2020 to 2050. The results show a trend similar to that of Route 1 explained earlier, although the values, especially the reduced travel distances of this route are slightly higher.

Table 18.5.3 Daily Travel Time Changes of Truck Traffic (Route 2)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without* (veh-hr)
		Travel time		Travel time		
		pcu-hr	veh-hr	pcu-hr	veh-hr	
2020	Truck	3,040	1,520	2,937	1,469	-52
2030	Truck	4,401	2,201	4,229	2,115	-86
2040	Truck	5,928	2,964	5,644	2,822	-142
2050	Truck	7,831	3,916	7,268	3,634	-282

Table 18.5.4 Daily Travel Distance Changes of Truck Traffic (Route 2)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without* (veh-km)
		Travel distance		Travel distance		
		pcu-km	veh-km	pcu-km	veh-km	
2020	Truck	142,441	71,221	138,637	69,319	-1,902
2030	Truck	206,526	103,263	201,069	100,535	-2,729
2040	Truck	270,685	135,343	263,511	131,756	-3,587
2050	Truck	336,300	168,150	326,557	163,279	-4,872

18.6 Traffic Analysis: Route 3

(1) Passenger Traffic

Table 18.6.1 and Table 18.6.2 show, respectively, the daily travel time and that could be saved and the daily travel distance that could be reduced by the construction of the Route 3 bypass road. In general, the travel time saved in this case is lower that of the other two alternatives. Changes in travel distance also show similar trend, as the reduced travel distance in this case is lower than that of the other two alternatives, in general.

Table 18.6.1 Daily Travel Time Changes of Passenger Traffic (Route 3)

Year	Mode	Without Bypass			With Bypass			Difference: *With-Without* (pass-hr)
		Travel time			Travel time			
		pcu-hr	veh-hr	pass-hr	pcu-hr	veh-hr	pass-hr	
2020	Car	5,129	5,129	21,850	5,057	5,057	21,543	-307
	PMV	6,552	3,276	57,107	6,466	3,233	56,358	-750
2030	Car	8,693	8,693	37,032	8,500	8,500	36,210	-822
	PMV	7,472	3,736	65,126	7,319	3,660	63,793	-1,334
2040	Car	13,243	13,243	56,415	12,789	12,789	54,481	-1,934
	PMV	7,412	3,706	64,603	7,175	3,588	62,538	-2,066
2050	Car	20,604	20,604	87,773	19,318	19,318	82,295	-5,478
	PMV	8,720	4,360	76,004	8,232	4,116	71,750	-4,253

Table 18.6.2 Daily Travel Distance Changes of Passenger Traffic (Route 3)

Year	Mode	Without Bypass		With Bypass		Difference: With-Without (veh-km)
		Travel distance		Travel distance		
		pcu-km	veh-km	pcu-km	veh-km	
2020	Car	239,766	239,766	239,723	239,723	-43
	PMV	312,164	156,082	312,181	156,091	9
2030	Car	403,463	403,463	403,065	403,065	-398
	PMV	356,279	178,140	356,047	178,024	-116
2040	Car	590,866	590,866	589,478	589,478	-1,388
	PMV	339,760	169,880	339,136	169,568	-312
2050	Car	858,664	858,664	854,328	854,328	-4,336
	PMV	385,024	192,512	383,685	191,843	-670

(2) Truck Traffic

Table 18.6.3 and Table 18.6.4 summarize, respectively, the travel time and travel distance changes that could be observed by the construction of the Route 3 bypass road. The trend of the saved time is similar to that of the other two alternatives, in general, while the degree of reduction of daily travel distance is similar to that of the Route 2 (alternative 2).

Table 18.6.3 Daily Travel Time Changes of Truck Traffic (Route 3)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without (veh-hr)*
		Travel time		Travel time		
		pcu-hr	veh-hr	pcu-hr	veh-hr	
2020	Truck	3,040	1,520	2,940	1,470	-50
2030	Truck	4,401	2,201	4,222	2,111	-90
2040	Truck	5,928	2,964	5,649	2,825	-140
2050	Truck	7,831	3,916	7,295	3,648	-268

Table 18.6.4 Daily Travel Distance Changes of Truck Traffic (Route 3)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without* (Veh-km)
		Travel distance		Travel distance		
		pcu-km	Veh-km	pcu-km	Veh-km	
2020	Truck	142,441	71,221	138,723	69,362	-1,859
2030	Truck	206,526	103,263	200,800	100,400	-2,863
2040	Truck	270,685	135,343	263,518	131,759	-3,584
2050	Truck	336,300	168,150	326,883	163,442	-4,709

18.7 Impact of Future Traffic Fluctuation

The future traffic demand is subject to certain degree of uncertainty. To account for this, how the fluctuation in demand may affect the performance of the network is evaluated. The following sections show how the total daily travel time and travel distance may change if the traffic growth decreases or increase by 20%. This section prepares the base data for the sensitivity analysis of the benefit-cost analysis in the chapter 22.

18.7.1 Impact of Decrease in Traffic Growth

How the reduction of the traffic by 20% may affect the travel time and travel distance by alternative and by travel mode are shown in Table 18.7.1 to Table 18.7.12.

Table 18.7.1 Daily Travel Time Changes of Passenger Traffic in Case Traffic Growth Decreases by 20% (Route 1)

Year	Mode	Without Bypass			With Bypass			Difference: *With-Without* (pass-hr)
		Travel time			Travel time			
		pcu-hr	veh-hr	pass-hr	pcu-hr	veh-hr	pass-hr	
2,020	Car	5,129	5,129	21,850	5,036	5,036	21,453	-396
	PMV	6,552	3,276	57,107	6,433	3,217	56,070	-1,037
2,030	Car	8,273	8,273	35,243	8,064	8,064	34,353	-890
	PMV	7,124	3,562	62,093	6,951	3,476	60,585	-1,508
2,040	Car	12,446	12,446	53,020	11,974	11,974	51,009	-2,011
	PMV	7,512	3,756	65,475	7,247	3,624	63,165	-2,310
2,050	Car	17,920	17,920	76,339	16,955	16,955	72,228	-4,111
	PMV	7,622	3,811	66,434	7,249	3,625	63,183	-3,251

Table 18.7.2 Daily Travel Distance Changes of Passenger Traffic in Case Traffic Growth Decreases by 20% (Route 1)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without* (veh-km)
		Travel distance		Travel distance		
		pcu-km	veh-km	pcu-km	veh-km	
2020	Car	239,766	239,766	238,799	238,799	-967
	PMV	312,164	156,082	310,968	155,484	-598
2030	Car	385,186	385,186	383,383	383,383	-1,803
	PMV	340,558	170,279	339,134	169,567	-712
2040	Car	563,156	563,156	559,708	559,708	-3,448
	PMV	352,960	176,480	351,141	175,571	-910
2050	Car	775,842	775,842	769,852	769,852	-5,990
	PMV	348,303	174,152	346,227	173,114	-1,038

Table 18.7.3 Daily Travel Time Changes of Truck Traffic in Case Traffic Growth Decreases by 20% (Route 1)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without (veh-hr)*
		Travel time		Travel time		
		pcu-hr	veh-hr	pcu-hr	veh-hr	
2020	Truck	3,040	1,520	2,948	1,474	-46
2030	Truck	4,126	2,063	3,987	1,994	-70
2040	Truck	5,375	2,688	5,147	2,574	-114
2050	Truck	6,635	3,318	6,270	3,135	-183

Table 18.7.4 Daily Travel Distance Changes of Passenger Traffic in Case Traffic Growth Decreases by 20% (Route 1)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without* (veh-km)
		Travel distance		Travel distance		
		pcu-km	veh-km	pcu-km	veh-km	
2020	Truck	142,441	71,221	139,101	69,551	-1,670
2030	Truck	194,148	97,074	189,955	94,978	-2,097
2040	Truck	247,577	123,789	242,021	121,011	-2,778
2050	Truck	294,640	147,320	287,585	143,793	-3,528

Table 18.7.5 Daily Travel Time Changes of Passenger Traffic in Case Traffic Growth Decreases by 20% (Route 2)

Year	Mode	Without Bypass			With Bypass			Difference: *With-Without (pass-hr)*
		Travel time			Travel time			
		pcu-hr	veh-hr	pass-hr	pcu-hr	veh-hr	pass-hr	
2,020	Car	5,129	5,129	21,850	5,032	5,032	21,436	-413
	PMV	6,552	3,276	57,107	6,431	3,216	56,053	-1,055
2,030	Car	8,273	8,273	35,243	8,061	8,061	34,340	-903
	PMV	7,124	3,562	62,093	6,952	3,476	60,594	-1,499
2,040	Car	12,446	12,446	53,020	11,980	11,980	51,035	-1,985
	PMV	7,512	3,756	65,475	7,254	3,627	63,226	-2,249
2,050	Car	17,920	17,920	76,339	16,970	16,970	72,292	-4,047
	PMV	7,622	3,811	66,434	7,262	3,631	63,296	-3,138

Table 18.7.6 Daily Travel Distance Changes of Passenger Traffic in Case Traffic Growth Decreases by 20% (Route 2)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without* (veh-km)
		Travel distance		Travel distance		
		pcu-km	veh-km	pcu-km	veh-km	
2020	Car	239,766	239,766	238,549	238,549	-1,217
	PMV	312,164	156,082	310,665	155,333	-750
2030	Car	385,186	385,186	383,164	383,164	-2,022
	PMV	340,558	170,279	338,953	169,477	-803
2040	Car	563,156	563,156	558,983	558,983	-4,173
	PMV	352,960	176,480	350,728	175,364	-1,116
2050	Car	775,842	775,842	768,812	768,812	-7,030
	PMV	348,303	174,152	345,839	172,920	-1,232

Table 18.7.7 Daily Travel Time Changes of Truck Traffic in Case Traffic Growth Decreases by 20% (Route 2)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without (veh-hr)*
		Travel time		Travel time		
		pcu-hr	veh-hr	pcu-hr	veh-hr	
2020	Truck	3,040	1,520	2,937	1,469	-52
2030	Truck	4,126	2,063	3,973	1,987	-77
2040	Truck	5,375	2,688	5,128	2,564	-124
2050	Truck	6,635	3,318	6,248	3,124	-194

Table 18.7.8 Daily Travel Distance Changes of Passenger Traffic in Case Traffic Growth Decreases by 20% (Route 2)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without* (veh-km)
		Travel distance		Travel distance		
		pcu-km	veh-km	pcu-km	veh-km	
2020	Truck	142,441	71221	138,637	69,319	-1,902
2030	Truck	194,148	97074	189,272	94,636	-2,438
2040	Truck	247,577	123789	241,000	120,500	-3,289
2050	Truck	294,640	147320	286,543	143,272	-4,049

Table 18.7.9 Daily Travel Time Changes of Passenger Traffic in Case Traffic Growth Decreases by 20% (Route 3)

Year	Mode	Without Bypass			With Bypass			Difference: *With-Without (pass-hr)*
		Travel time			Travel time			
		pcu-hr	veh-hr	pass-hr	pcu-hr	veh-hr	pass-hr	
2,020	Car	5,129	5,129	21,850	5,057	5,057	21,543	-307
	PMV	6,552	3,276	57,107	6,466	3,233	56,358	-750
2,030	Car	8,273	8,273	35,243	8,108	8,108	34,540	-703
	PMV	7,124	3,562	62,093	6,995	3,498	60,969	-1,124
2,040	Car	12,446	12,446	53,020	12,048	12,048	51,324	-1,695
	PMV	7,512	3,756	65,475	7,297	3,649	63,601	-1,874
2,050	Car	17,920	17,920	76,339	17,058	17,058	72,667	-3,672
	PMV	7,622	3,811	66,434	7,299	3,650	63,618	-2,815

Table 18.7.10 Daily Travel Distance Changes of Passenger Traffic in Case Traffic Growth Decreases by 20% (Route 3)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without* (veh-km)
		Travel distance		Travel distance		
		pcu-km	veh-km	pcu-km	veh-km	
2020	Car	239,766	239,766	239,723	239,723	-43
	PMV	312,164	156,082	312,181	156,091	9
2030	Car	385,186	385,186	385,252	385,252	66
	PMV	340,558	170,279	340,693	170,347	68
2040	Car	563,156	563,156	561,916	561,916	-1,240
	PMV	352,960	176,480	352,443	176,222	-259
2050	Car	775,842	775,842	772,232	772,232	-3,610
	PMV	348,303	174,152	347,256	173,628	-524

Table 18.7.11 Daily Travel Time Changes of Truck Traffic in Case Traffic Growth Decreases by 20% (Route 3)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without (veh-hr)*
		Travel time		Travel time		
		pcu-hr	veh-hr	pcu-hr	veh-hr	
2020	Truck	3,040	1,520	2,940	1,470	-50
2030	Truck	4,126	2,063	3,967	1,984	-80
2040	Truck	5,375	2,688	5,135	2,568	-120
2050	Truck	6,635	3,318	6,247	3,124	-194

Table 18.7.12 Daily Travel Distance Changes of Passenger Traffic in Case Traffic Growth Decreases by 20% (Route 3)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without* (veh-km)
		Travel distance		Travel distance		
		pcu-km	veh-km	pcu-km	veh-km	
2020	Truck	142,441	71,221	138,723	69,362	-1,859
2030	Truck	194,148	97,074	189,034	94,517	-2,557
2040	Truck	247,577	123,789	241,132	120,566	-3,223
2050	Truck	294,640	147,320	286,284	143,142	-4,178

18.7.2 Impact of Increase in Traffic Growth

How the increase of the traffic by 20% may affect the travel time and travel distance by alternative and by travel mode are shown in Table 18.7.13 to Table 18.7.24.

Table 18.7.13 Daily Travel Time Changes of Passenger Traffic in Case Traffic Growth Increases by 20% (Route 1)

Year	Mode	Without Bypass			With Bypass			Difference: *With-Without (pass-hr)*
		Travel time			Travel time			
		pcu-hr	veh-hr	pass-hr	pcu-hr	veh-hr	pass-hr	
2020	Car	5,129	5,129	21,850	5,036	5,036	21,453	-396
	PMV	6,552	3,276	57,107	6,433	3,217	56,070	-1,037
2030	Car	9,157	9,157	39,009	8,887	8,887	37,859	-1,150
	PMV	7,849	3,925	68,412	7,627	3,814	66,477	-1,935
2040	Car	14,901	14,901	63,478	14,175	14,175	60,386	-3,093
	PMV	8,905	4,453	77,616	8,500	4,250	74,086	-3,530
2050	Car	23,683	23,683	100,890	21,570	21,570	91,888	-9,001
	PMV	9,913	4,957	86,402	9,095	4,548	79,272	-7,130

Table 18.7.14 Daily Travel Distance Changes of Passenger Traffic in Case Traffic Growth Increases by 20% (Route 1)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without* (veh-km)
		Travel distance		Travel distance		
		pcu-km	veh-km	pcu-km	veh-km	
2020	Car	239,766	239,766	238,799	238,799	-967
	PMV	312,164	156,082	310,968	155,484	-598
2030	Car	423,363	423,363	421,109	421,109	-2,254
	PMV	372,760	186,380	370,993	185,497	-884
2040	Car	655,829	655,829	650,989	650,989	-4,840
	PMV	408,011	204,006	405,496	202,748	-1,258
2050	Car	940,263	940,263	932,746	932,746	-7,517
	PMV	419,103	209,552	416,407	208,204	-1,348

Table 18.7.15 Daily Travel Time Changes of Truck Traffic in Case Traffic Growth Increases by 20% (Route 1)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without (veh-hr)*
		Travel time		Travel time		
		pcu-hr	veh-hr	pcu-hr	veh-hr	
2020	Truck	3,040	1,520	2,948	1,474	-46
2030	Truck	4,642	2,321	4,474	2,237	-84
2040	Truck	6,553	3,277	6,206	3,103	-174
2050	Truck	9,201	4,601	8,449	4,225	-376

Table 18.7.16 Daily Travel Distance Changes of Passenger Traffic in Case Traffic Growth Increases by 20% (Route 1)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without* (veh-km)
		Travel distance		Travel distance		
		pcu-km	veh-km	pcu-km	veh-km	
2020	Truck	142,441	71,221	139,101	69,551	-1,670
2030	Truck	217,128	108,564	212,182	106,091	-2,473
2040	Truck	294,554	147,277	286,909	143,455	-3,823
2050	Truck	378,751	189,376	369,864	184,932	-4,444

Table 18.7.17 Daily Travel Time Changes of Passenger Traffic in Case Traffic Growth Increases by 20% (Route 2)

Year	Mode	Without Bypass			With Bypass			Difference: *With-Without (pass-hr)*
		Travel time			Travel time			
		pcu-hr	veh-hr	pass-hr	pcu-hr	veh-hr	pass-hr	
2,020	Car	5,129	5,129	21,850	5,032	5,032	21,436	-413
	PMV	6,552	3,276	57,107	6,431	3,216	56,053	-1,055
2,030	Car	9,157	9,157	39,009	8,884	8,884	37,846	-1,163
	PMV	7,849	3,925	68,412	7,629	3,815	66,495	-1,918
2,040	Car	14,901	14,901	63,478	14,192	14,192	60,458	-3,020
	PMV	8,905	4,453	77,616	8,514	4,257	74,208	-3,408
2,050	Car	23,683	23,683	100,890	21,593	21,593	91,986	-8,903
	PMV	9,913	4,957	86,402	9,113	4,557	79,429	-6,973

Table 18.7.18 Daily Travel Distance Changes of Passenger Traffic in Case Traffic Growth Increases by 20% (Route 2)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without* (veh-km)
		Travel distance		Travel distance		
		pcu-km	veh-km	pcu-km	veh-km	
2020	Car	239,766	239,766	238,549	238,549	-1,217
	PMV	312,164	156,082	310,665	155,333	-750
2030	Car	423,363	423,363	420,439	420,439	-2,924
	PMV	372,760	186,380	370,460	185,230	-1,150
2040	Car	655,829	655,829	650,612	650,612	-5,217
	PMV	408,011	204,006	405,265	202,633	-1,373
2050	Car	940,263	940,263	930,294	930,294	-9,969
	PMV	419,103	209,552	415,514	207,757	-1,795

Table 18.7.19 Daily Travel Time Changes of Truck Traffic in Case Traffic Growth Increases by 20% (Route 2)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without (veh-hr)*
		Travel time		Travel time		
		pcu-hr	veh-hr	pcu-hr	veh-hr	
2020	Truck	3,040	1,520	2,937	1,469	-52
2030	Truck	4,642	2,321	4,457	2,229	-93
2040	Truck	6,553	3,277	6,190	3,095	-182
2050	Truck	9,201	4,601	8,422	4,211	-390

Table 18.7.20 Daily Travel Distance Changes of Passenger Traffic in Case Traffic Growth Increases by 20% (Route 2)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without* (veh-km)
		Travel distance		Travel distance		
		pcu-km	veh-km	pcu-km	veh-km	
2020	Truck	142,441	71,221	138,637	69,319	-1,902
2030	Truck	217,128	108,564	211,374	105,687	-2,877
2040	Truck	294,554	147,277	286,030	143,015	-4,262
2050	Truck	378,751	189,376	368,248	184,124	-5,252

Table 18.7.21 Daily Travel Time Changes of Passenger Traffic in Case Traffic Growth Increases by 20% (Route 3)

Year	Mode	Without Bypass			With Bypass			Difference: *With-Without (pass-hr)*
		Travel time			Travel time			
		pcu-hr	veh-hr	pass-hr	pcu-hr	veh-hr	pass-hr	
2020	Car	5,129	5,129	21,850	5,057	5,057	21,543	-307
	PMV	6,552	3,276	57,107	6,466	3,233	56,358	-750
2030	Car	9,157	9,157	39,009	8,931	8,931	38,046	-963
	PMV	7,849	3,925	68,412	7,670	3,835	66,852	-1,560
2040	Car	14,901	14,901	63,478	14,290	14,290	60,875	-2,603
	PMV	8,905	4,453	77,616	8,573	4,287	74,723	-2,894
2050	Car	23,683	23,683	100,890	21,870	21,870	93,166	-7,723
	PMV	9,913	4,957	86,402	9,222	4,611	80,379	-6,023

Table 18.7.22 Daily Travel Distance Changes of Passenger Traffic in Case Traffic Growth Increases by 20% (Route 3)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without* (veh-km)
		Travel distance		Travel distance		
		pcu-km	veh-km	pcu-km	veh-km	
2020	Car	239,766	239,766	239,723	239,723	-43
	PMV	312,164	156,082	312,181	156,091	9
2030	Car	423,363	423,363	422,522	422,522	-841
	PMV	372,760	186,380	372,180	186,090	-290
2040	Car	655,829	655,829	653,711	653,711	-2,118
	PMV	408,011	204,006	407,114	203,557	-449
2050	Car	940,263	940,263	937,741	937,741	-2,522
	PMV	419,103	209,552	418,466	209,233	-319

Table 18.7.23 Daily Travel Time Changes of Truck Traffic in Case Traffic Growth Increases by 20% (Route 3)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without (veh-hr)*
		Travel time		Travel time		
		pcu-hr	veh-hr	pcu-hr	veh-hr	
2020	Truck	3,040	1,520	2,940	1,470	-50
2030	Truck	4,642	2,321	4,452	2,226	-95
2040	Truck	6,553	3,277	6,204	3,102	-175
2050	Truck	9,201	4,601	8,505	4,253	-348

Table 18.7.24 Daily Travel Distance Changes of Passenger Traffic in Case Traffic Growth Increases by 20% (Route 3)

Year	Mode	Without Bypass		With Bypass		Difference: *With-Without* (veh-km)
		Travel distance		Travel distance		
		pcu-km	veh-km	pcu-km	veh-km	
2020	Truck	142,441	71,221	138,723	69,362	-1,859
2030	Truck	217,128	108,564	211,084	105,542	-3,022
2040	Truck	294,554	147,277	286,186	143,093	-4,184
2050	Truck	378,751	189,376	370,471	185,236	-4,140

CHAPTER 19 PRELIMINARY DESIGN

19.1 Route Planning

(1) Alternative routes

The Bypass shown in the Master Plan starts at the entrance of the new Lae Port, and heads north-west along the border of the Portion 508. The Bypass then proceeds toward west, partly touching the northern edge of customary land, and finally heads north-west again before intersecting with Highlands Highways at a point in 8 Mile (about 8 miles from the city centre). The cost of the project is expected to be significantly high; therefore, the study team proposed the following three (3) alternatives:

Route 1: Route given in the Master Plan
Sec.1 - Sec.2 - Sec.3 - Sec.4 - Sec.5 - Sec.6 (L = 7.70 kilometres)

Route 2: Route connecting to Highlands Highway at the 3 Mile Police Station
Sec.1 - Sec.2 - Sec.3 - Sec.4 - Sec.8 (L = 4.15 kilometres)

Route 3: Route connecting to Bugandi Roundabout (the junction of Highlands Highway and Boundary Road)
Sec.1 - Sec.2 - Sec.3 - Sec.4 - Sec.7 (L=3.35 kilometres)

The locations of each route and sections are shown in Figure 19.1.1.

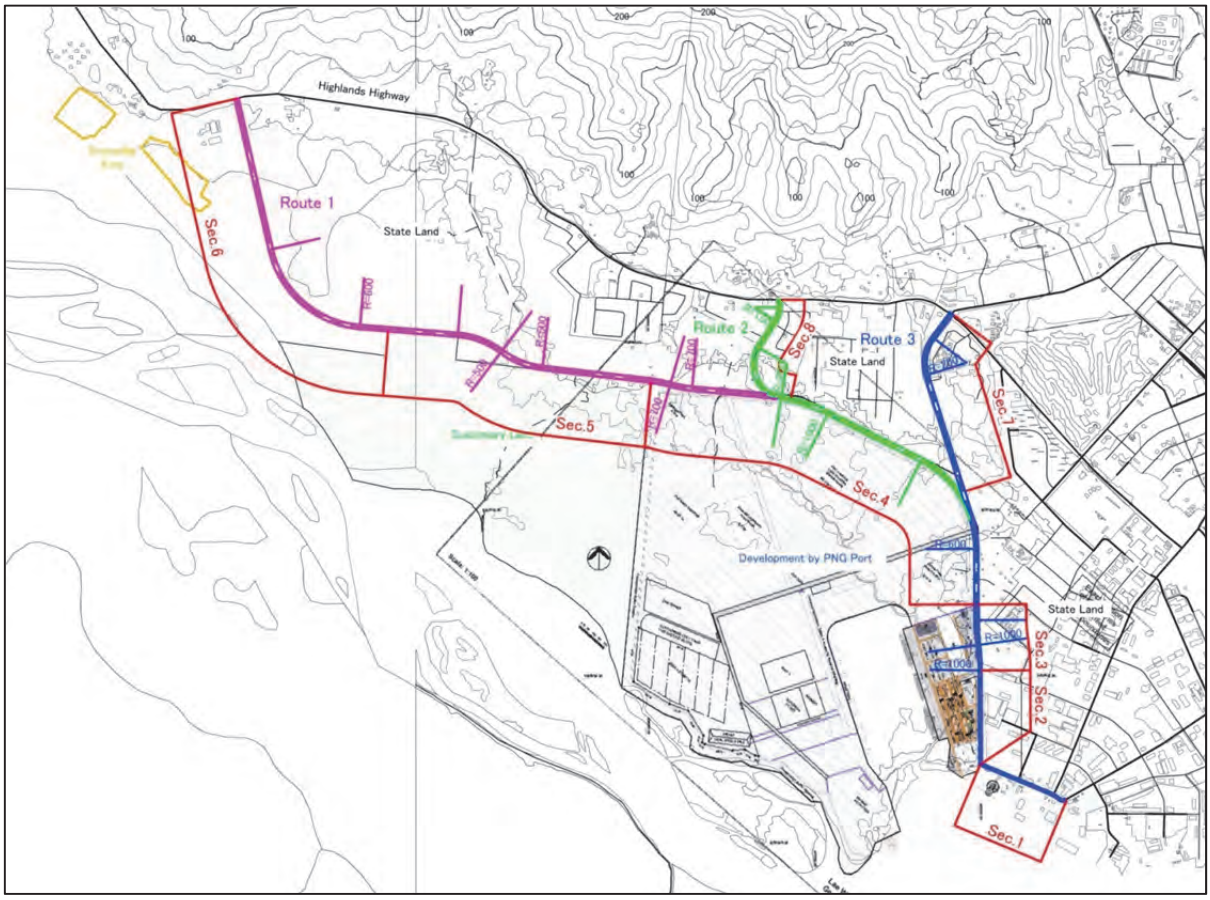


Figure 19.1.1 Alternative Routes

(2) Current conditions of each section

The current conditions of the three alternative routes are described in the following eight route sections in detail.

1) Section 1

In this section, there is a two-lane main road (passing in front of old Lae Port, passenger port and Aigris Market) connecting the New Lae Port with logistics area, and the central city area.
The condition of this road is so bad that large trailers, which are the main traffic on this road, cannot drive smoothly. Therefore, the improvement of this road is included as a part of the Bypass project to ensure the smooth flow of the traffic from the logistics area into the Bypass. Since the existing right of way is 20 to 27 metres wide, no construction obstacles in this regard are expected.


New Lae Tidal Basin Gate


Road in front of Aigris Market

2) Section 2

Section 2 has been reserved for future road construction. The phase 1 of the Lae Tidal Basin port project, which has started operation, lies on the west side of this section. There are logistics centres and buildings on the east side of this section. The width of the existing road is approximately 16 metres; therefore, it is sufficient for the planned Bypass, which is fifteen 15 metres wide.


Beginning of Section 2


Middle of Section 2

3) Section 3

The site planned for the phase 2 development of the Lae Tidal Basin port is on the west side of this section, and a settlement area is on the east side. The right of way of this section is not properly secured, and there are many small houses in the settlement area. However, PNG Ports informally agreed to the Study team proposal to make the alignment of this section inside the port area to avoid the houses after discussing it with the team. As a result, since the Bypass will be inside the port area (i.e., along the east edge), not construction obstacles are expected in this section.


Settlement Road outside Lae Port Area


Settlement outside Lae Port Area

4) Section 4

There are many houses outside the Lae Tidal Basin port area, and it will cost a lot of money and time to relocate these houses. Basically, the Lae Tidal Basin port area has been cleared of settlements, and the PNG Ports accepted the Bypass to be inside the port area after the discussion with the study team. However, although the PNG Ports has built a fences to protect its boundary, there are still several houses within the planned right of way and about 20 houses along the neighbouring areas. The owners of the houses have already received indemnity, but not moved out yet. These settlements are expected to move out by the Bypass construction stage. If they do not move out by then, the alignment of the Bypass can be changed to avoid these settlements.


A house in the Lae Port Area


Settlement in the Lae Port Area

5) Section 5

The Bypass is set at the northern edge of the customary land away from northern settlement and the customary land. Since 5 to 10 houses are built in the eastern part of this section, the relocation of several houses may be needed.


Houses near PNG Port and customary land

6) Section 6

The Bypass of this section is located inside the state land, away from the crocodile firms, and there are no houses in this area. Some buildings such as a chicken firm and a wheat factory exist along the Highlands Highway. The Bypass will intersect with Highlands Highway at a right angle (creating a T-shaped intersection) without affecting the buildings along the highway.

Chicken firm along the Highlands Highway

Section 6 of the Bypass

7) Section 7

This section, which is part of Route 3, branches from section 4 and connects with the Bugandi Roundabout. There is a gas station on the west of this section; there also a river crossing the Highlands Highway on the western side of the gas station. The Bypass is located along the eastern side of the river to avoid the crowded residence area on the western side.

The Bypass alignment from the gas station

Bird eye view of section 7

8) Section 8

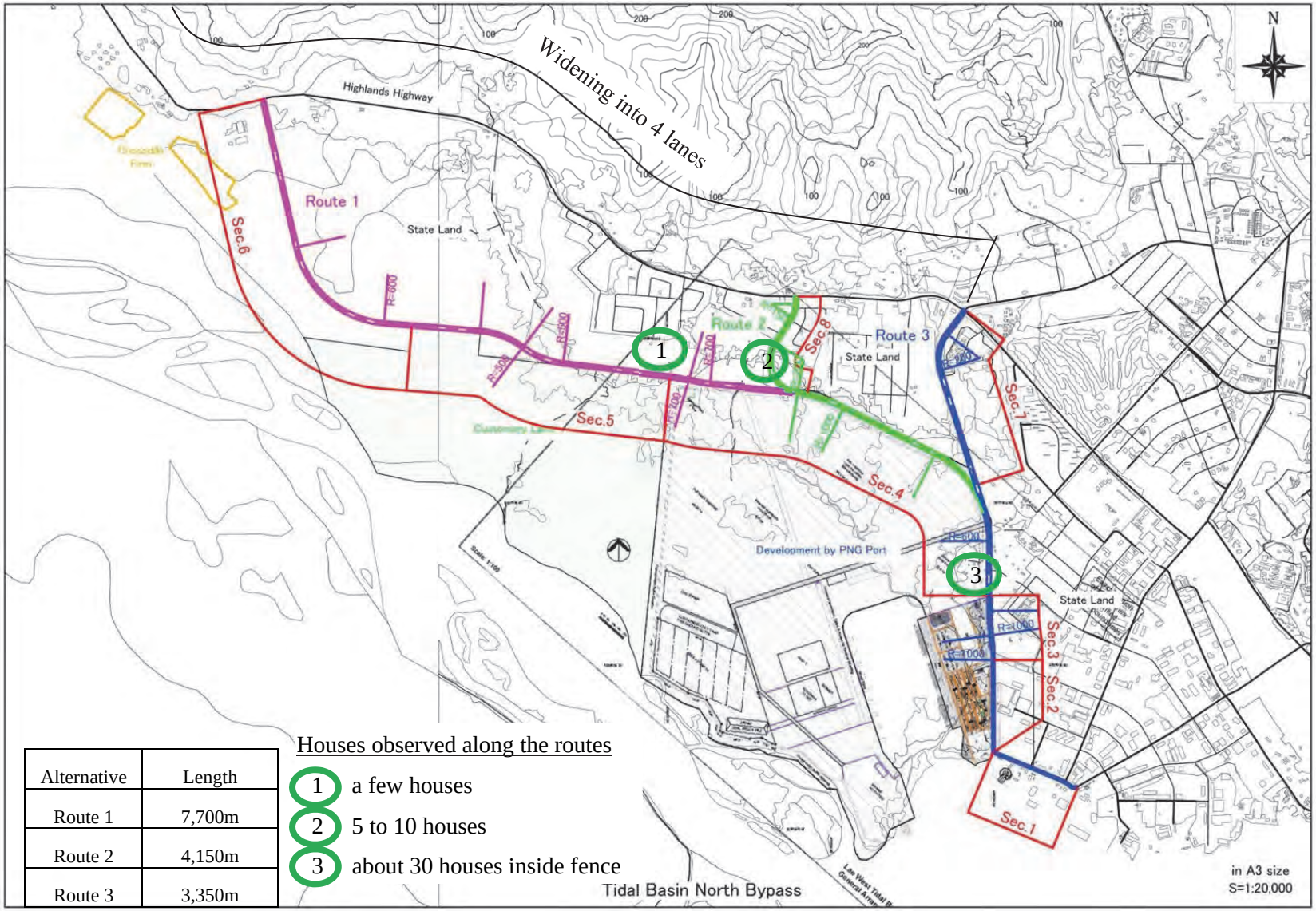
Section 8, which is a part of Route 2, branches from section 4 and connects with the Highlands Highway at the 3 Mile Police Station. This section widens an existing 7–11-metre wide road to 15 metres. Therefore, land acquisition including the relocation of 5 to 10 houses will be needed.

Highlands Highway intersection area

Existing condition of Section 8

Table 19.1.1 Comparative Table of the Bypass Routes

	Route 1	Route 2	Route 3
Objective	The bypass passes the Lae Tidal Basin port development Project Area internal circumference vicinity, from the road in front of Aigris market and makes them connect to 8 miles point on the Highlands Highway away from crocodile firms via northern edge of the customary land.	The bypass passes the Lae Tidal Basin port development Project Area internal circumference vicinity, from the road in front of Aigris market and makes them connect to 3 miles police box point on the Highlands Highway.	The bypass passes the Lae Tidal Basin port development Project Area internal circumference vicinity, from the road in front of Aigris market and norths just as it is, and makes them connect to the Bugandi Roundabout in the Highlands Highway.
Length	7.70 kilometres	4.15 kilometres	3.35 kilometres
Function of the bypass	Since the route is connected around 8 miles away from commerce, industries and houses on the Highlands Highway, it is planned for the dissociation with the city traffic and the tidal basin related traffic.	It is planned for the dissociation with the city traffic and the tidal basin related traffic in the central city area, but it is mixed traffics of city and tidal basin traffic from western part of 3 miles point on the Highlands Highway.	It is planned for the dissociation with the city traffic and the tidal basin related traffic in the central city area, but it is mixed traffics of city and tidal basin traffic from western part of the Bugandi Roundabout on the Highlands Highway.
Effect on Urban Development	The bypass has potential to make commerce, industries and houses related with the Lae Tidal Basin port development from 4.2 kilometres to the end point.	Since the route passes the Lae Tidal Basin port development Project Area internal circumference vicinity and existing housing area, it is difficult to develop a new city zone.	Same as left However, there is undeveloped area on the east side on the bypass 500 metres long. So the area has potential to make small scale city zone.
Effect on Transportation	The bypass will work for not only traffic related to Lae Port but also traffic related to north-west development areas. It will also work as an alternative route of Highlands Highway between Bugandi Roundabout and Lae Port which will not be widened.	The bypass will work for traffic related to Lae Port, however, comparing with Route 1, an effect on traffic related to north-west development areas is relatively small. It will also work as an alternative route of Highlands Highway between Bugandi Roundabout and Lae Port which will not be widened.	The bypass will work for traffic related to Lae Port, however, comparing with Route 1 & 2, an effect on traffic related to north-west development areas is small. It will also work as an alternative route of Highlands Highway between Bugandi Roundabout and Lae Port which will not be widened.
Land Acquisition & Resettlement	Since the bypass passes existing roads and edges of the Lae Tidal Basin port project from beginning point to 4.2 kilometres point, it is not necessary to be resettled. There are 3 or 4 small huts (see location no. 1 of observed houses shown in Figure 9.1.2). The bypass travels in state land, no settlement or houses are seen.	Since the bypass passes existing roads and edges of the Lae Tidal Basin port project from beginning point to 3.4 kilometres point, it is necessary to be resettled 5 to 10 houses in section 8 (see location no. 2 of observed houses shown in Figure 9.1.2).	Since the bypass passes existing roads and edges of the Lae Tidal Basin port project from beginning point to2.0 kilometres point, it is not necessary to be resettled. The bypass travels 1.3kilometres in grassland from that point to the Bugandi Roundabout. So it is not necessary to be resettled.
	Several small huts stand inside Lae Tidal Basin phase II area, but these huts will be removed until the bypass starts construction (see location no. 2 of observed houses shown in Figure 9.1.2).		
Project Cost (refer to Chap. 21)	PGK 230 million	PGK 112 million	PGK 97 million



Houses observed along the routes

1 a few houses

2 5 to 10 houses

3 about 30 houses inside fence

Alternative	Length
Route 1	7,700m
Route 2	4,150m
Route 3	3,350m

Figure 19.1.2 Bypass Route Map

Figure 19.1.3 Bypass Route Map with Satellite Image

19.2 Geometric Planning

(1) Profile

The topography from the beginning point of the bypass to the end point is flat. This area is flooded with maximum 1 meter above the ground in rainy season, according to hearing from residents. Therefore, proposed height of the Bypass to be developed on flood area is set at 1.5 metres above the ground level taking account of the floods. Proposed height of the Bypass to be developed on existing roads is 0.5 metres high considering the approach between housing area and existing road.

General profile of the bypass is shown in Figure 19.2.1.

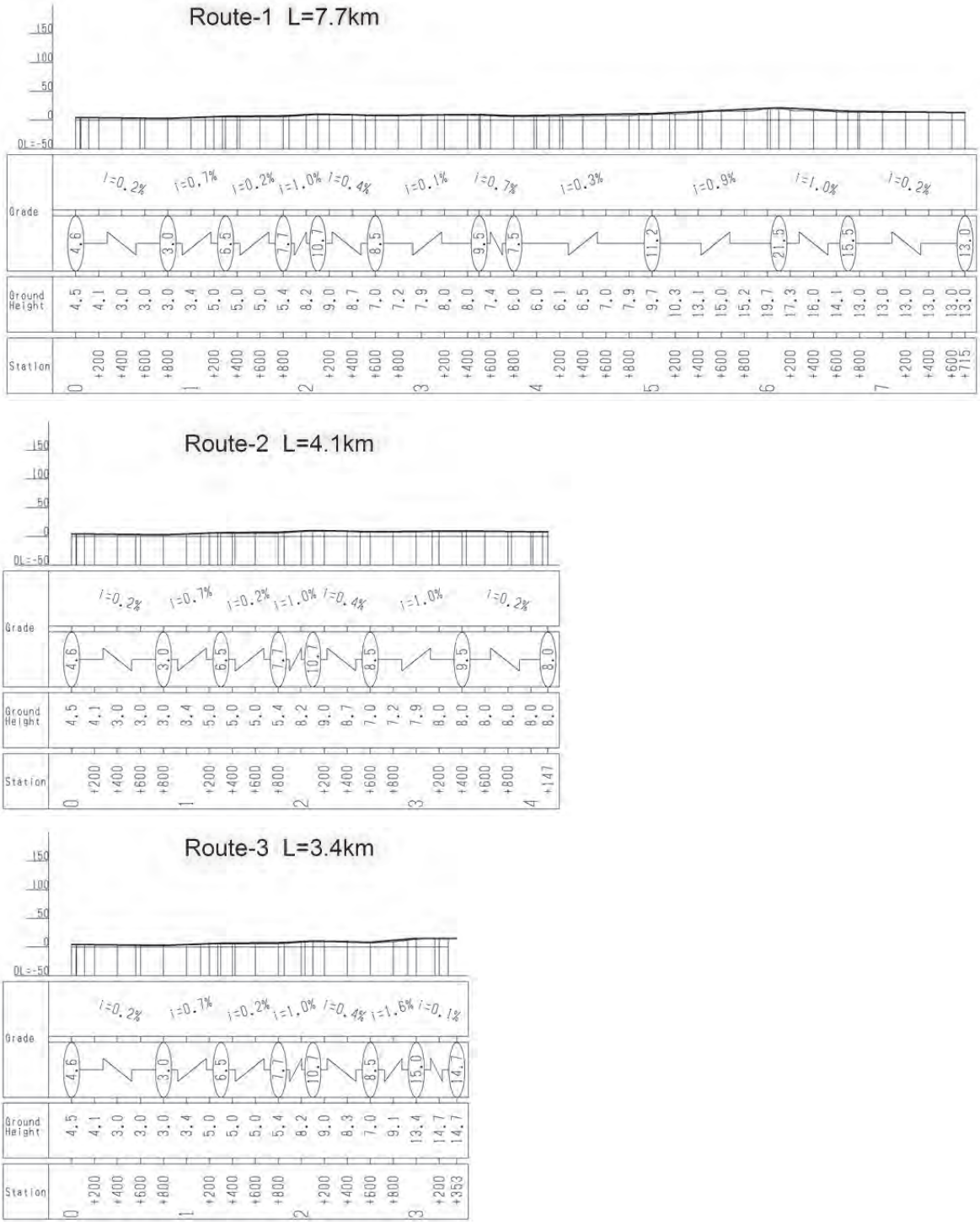


Figure 19.2.1 General Profile of the Bypass

(2) Typical cross section

Since expected traffic is about 9,000 PCU/day, the Bypass has two lanes with both directions. A lane is set 3.5 metres wide and shoulder is set 1.5 metres wide, and median strip is set 1.0m wide because large size truck traffic is much. Sidewalks are set 2.5 metres wide at both sides. Total width of the bypass is 15 metres. The ground condition in this area is soft (hearing from PNG port authority). So, it is assumed that the settlement is 1.0 metres per 1.5 metres of embankment height. The sand mat of thickness 50 centimetres is set on the ground to promote settlement.
The pavement structure is based on the standard note of DOW, and the typical cross section is shown in Figure 19.2.2.

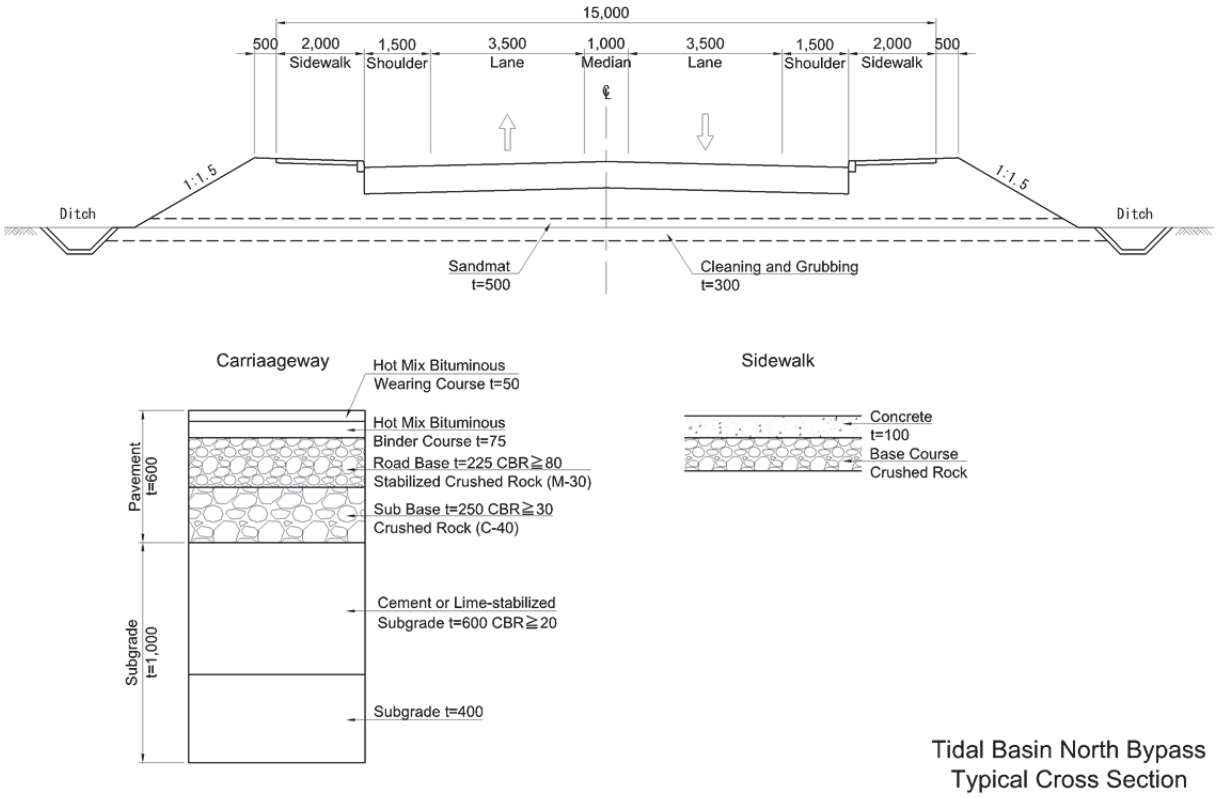


Figure 19.2.2 Typical Cross Section of the Tidal Basin North Bypass

19.3 Drainage Planning

Lae is the fifth wettest city on earth with more than 4,000 millimetres of annual rainfall.
Lae has a tropical climate; dry season tends to be from November to April, wet/rainy season from May to October.
Average rainfall is shown in Figure 19.3.1.

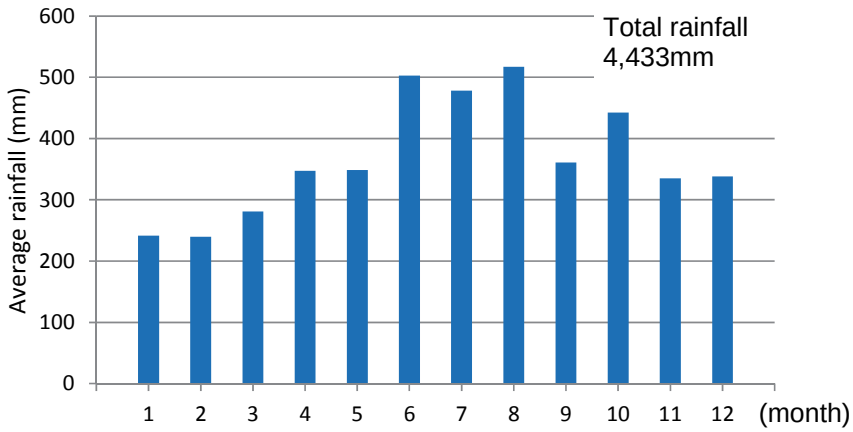


Figure 19.3.1 Average rainfall in Lae (World meteorological Organization)

The topography of this area consists of 2 types. Northern part is a hill area, southern part is a flat area, and the Highlands Highway is passing the foot of the hill in east and west.
The cross sections of north-south is shown in Figure 19.3.2.

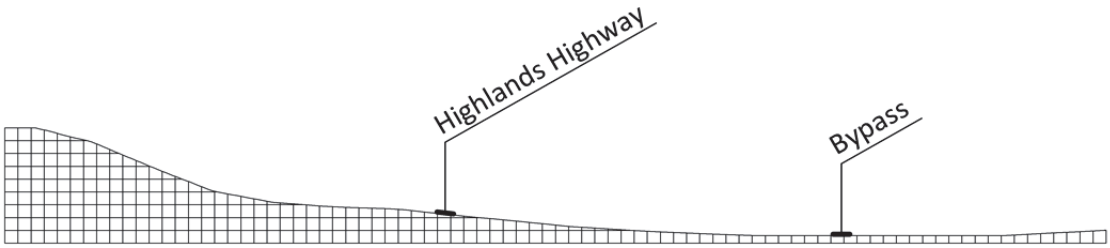


Figure 19.3.2 Cross Sections of North-South Topography

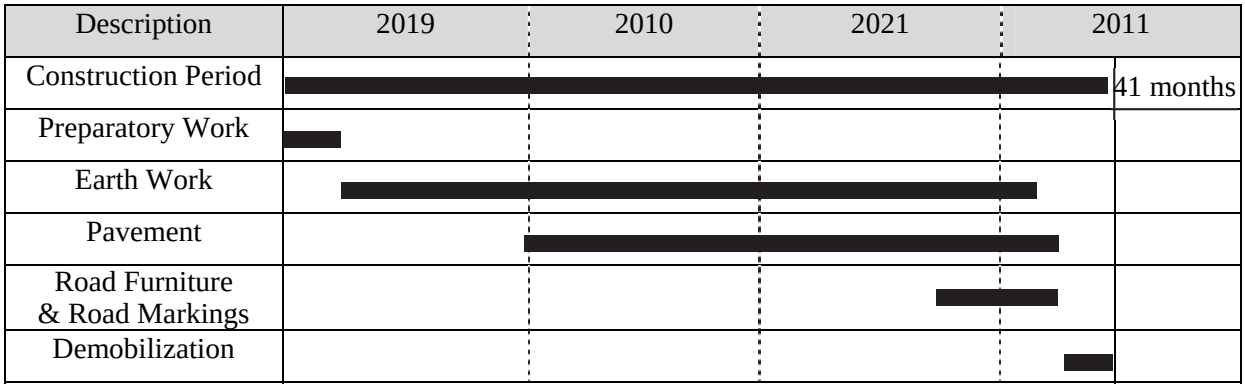
Rainwater flows through valley on a hill, then, crosses drainage system of the Highlands Highway, and flows to the flat area where a few canals exist.
Side ditches are applied at both sides of the Bypass, and pipe culverts (diameter 1,000) across the Bypass at 100-metre intervals are to be installed. In next design stage, it is necessary to adjust the drainage plans based on detail rainfall data and information of Lae Tidal Basin project.

CHAPTER 20 CONSTRUCTION PLAN

20.1 Work Plan

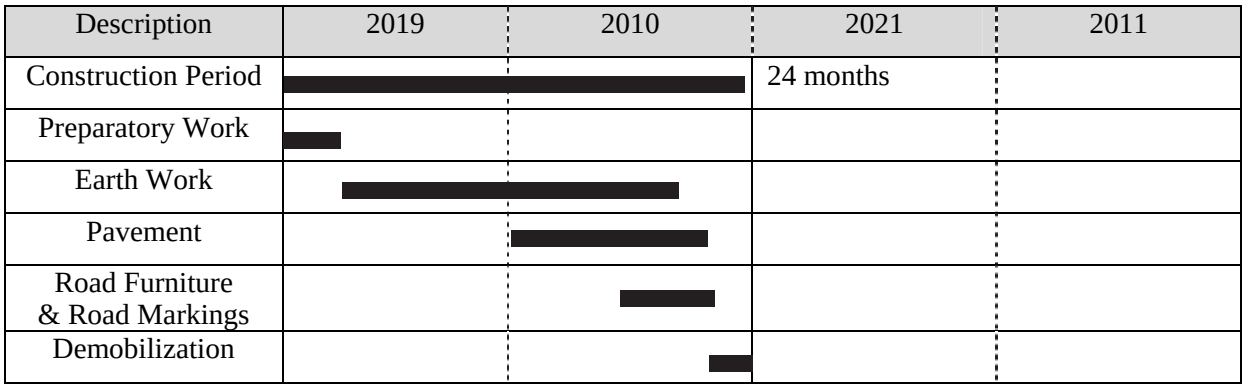
20.1.1 Construction Schedule

As the construction period depends on the length of constructed road, it is variable for each route. The construction periods of route 1, 2 and 3 are assumed to be 41 months, 24 months and 20 months respectively. The work schedules are shown in Figure 20.1.1 to Figure 20.1.3.



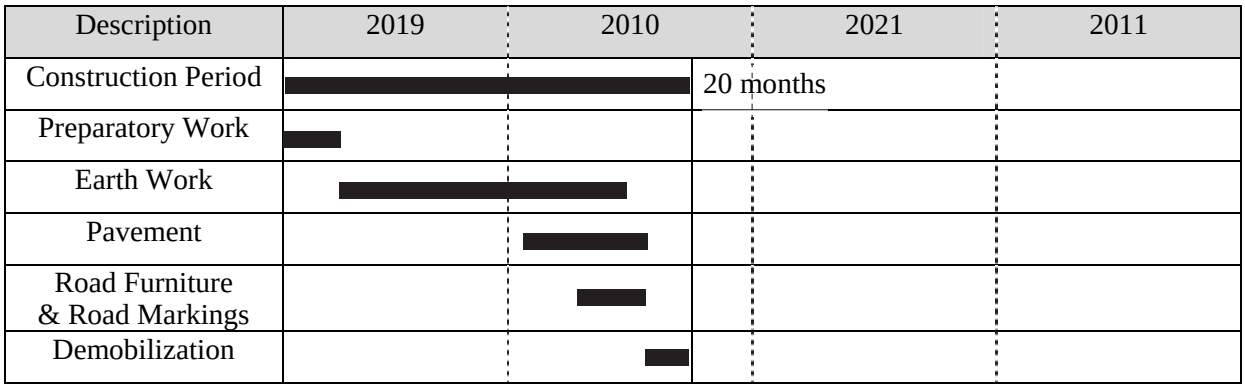
Source: JICA Study team

Figure 20.1.1 Construction Schedule of Route 1 (41 months)



Source: JICA Study team

Figure 20.1.2 Construction Schedule of Route 2 (24 months)

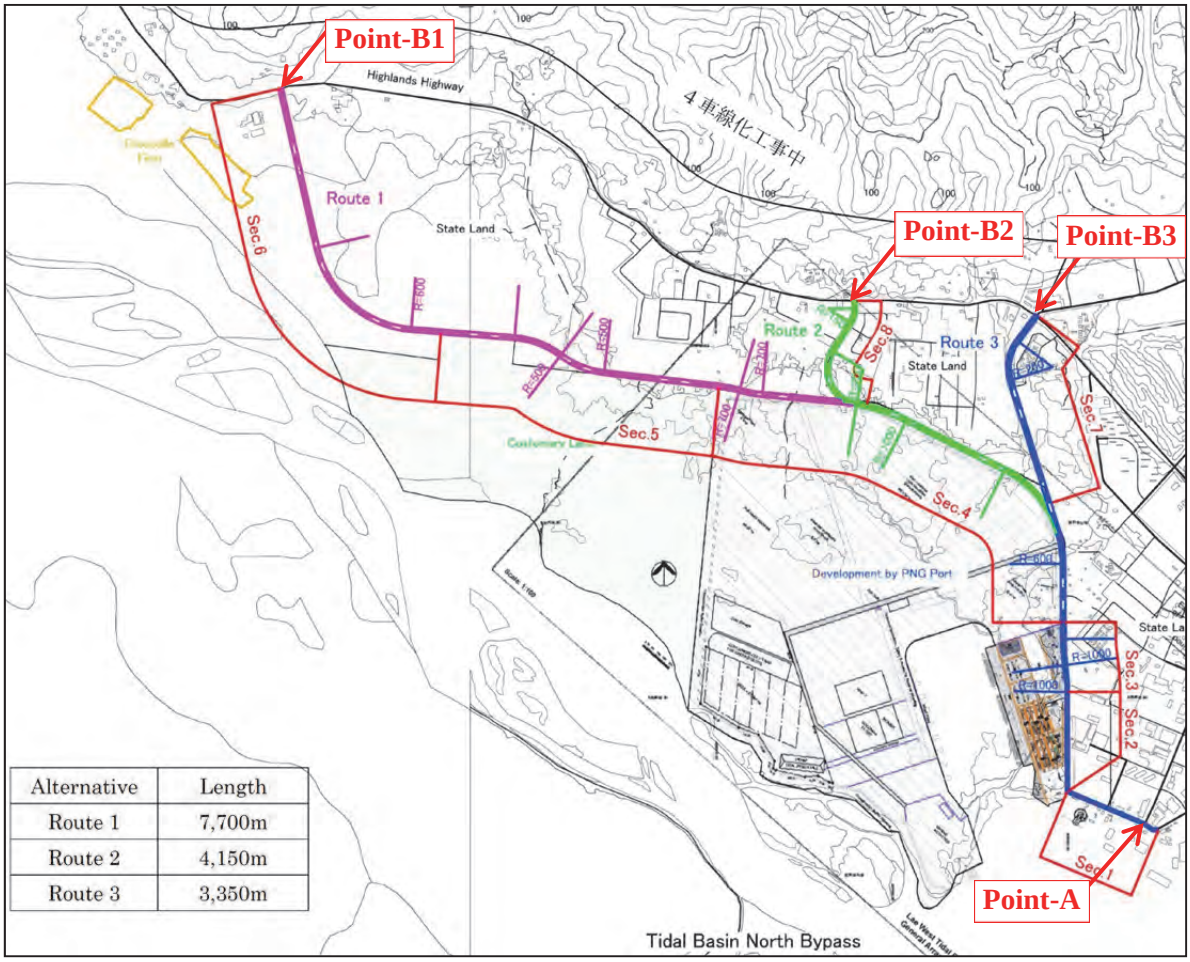


Source: JICA Study team

Figure 20.1.3 Construction Schedule of Route 3 (20 months)

20.1.2 Access Road

Since the Bypass is new road in almost vacant land except for the east end part which is reconstruction of the existing road, access to the construction is easy. Both ends of each route can be the access points as shown in Figure 20.1.4



Alternative	Length
Route 1	7,700m
Route 2	4,150m
Route 3	3,350m

Source: JICA Study team

Figure 20.1.4 Access Points for Construction

20.2 Equipment and Materials Procurement Plan

(1) Fill Material

Since fill material for the earth work should be high-quality, it is assumed to be purchased. However, if dredged soil of the tidal basin is available and suitable for the earth work, the cost would be reduced. In such case, it is required to coordinate the construction schedule with PNG Ports and check whether it is suitable for fill material.

On the other hand, excavated soil of the Bypass construction may be soft, it is assumed to be dumped. However, depending on the soil test at site, it might be diverted to fill material. In this stage, excavated soil is assumed to be dumped within the Portion 508.

(2) Clearing and Grubbing

Disposal of materials generated from clearing and grubbing is assumed to be as follows:

- Topsoil: to be utilize for surface soil of slope
- Logged trees: to be utilized for domestic fuel
- Grubbed stump: to be utilized for fertilizer after chipped

(3) Concrete and Asphalt

As shown in Table 20.2.1, there are four major suppliers in Lae City, supplying concrete, crushed stones and asphalt. Cement clinker producing cement from imported raw materials is also available in Lae City. Straight asphalt and asphalt emulsion are imported.

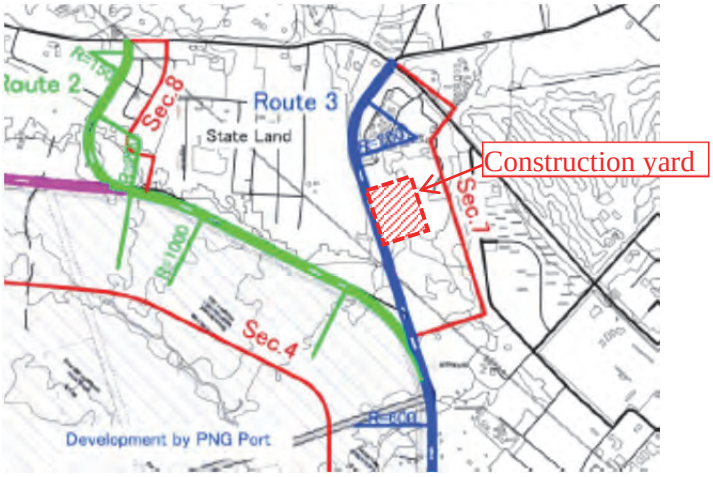
Table 20.2.1 List of Suppliers

Supplier Name	Holding Facilities
Shorncliffe PNG Ltd	Concrete batching plant, Asphalt plant, Crushing plant
JV PNG Investment Ltd	Concrete batching plant, Asphalt plant, Crushing plant
Dekenai Construction Ltd	Concrete batching plant, Crushing plant
Ready Mixed Concrete PNG Ltd	Concrete batching plant, Crushing plant

Source: JICA Study team

(4) Establishment of Construction Yard

Construction yard is assumed to be located in the site shown in Figure 20.2.1. Even if it is not available, still there are several places available for the construction yard around the construction site.



Source: JICA Study team

Figure 20.2.1 Candidate Site for Construction Yard

CHAPTER 21 PROJECT COST

21.1 Cost Elements

21.1.1 Study for Cost Estimation

In order to estimate the costs of the Project proposed for the Tidal Basin North Bypass, a study was carried out in the follow manner:

- Data related to the Project and construction costs were collected through concerned organizations. Due to the current circumstances in Papua New Guinea (PNG), the availability of such data was limited, so the data were also collected through the internet.
- The collected data were compared to determine reasonable unit rates.
- On the other hand, the outline of the proposed Project was studied to specify the necessary cost items with their quantities.
- Finally, the Project cost was estimated based on the quantities and the unit rates.

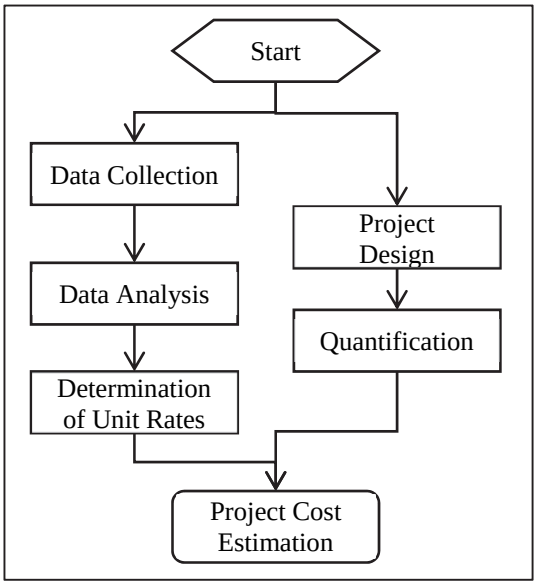


Figure 21.1.1 Procedure Cost Estimation

21.1.2 Data Collection

Although effort was made to collect as many data as possible, collected data were limited. The collected materials are summarized in Table 21.1.1 .

Table 21.1.1 Materials Collected for Cost Estimation

No.	Materials	Source
Documents for Estimation		
1	BOQ of Tidal Basin North Bypass	DOW
2	BOQ of *Highlands Highway Reconstruction and Upgrading Project*	DOW
3	Unit Costs in Lae City	Local Contractors
4	Material Cost and Machinery Hire in Port Moresby	Local Contractors
5	Construction & Material Costs in Japan 2015	CPC
Reference Document		
1	Specification for Road and Bridge Works (June 2015)	DOW
2	Standard Engineering Drawings, Road Drawings	DOW
3	Employment Law	Internet

Abbreviation:
DOW: Department of Works
CPC: Construction Prices Committee in Japan

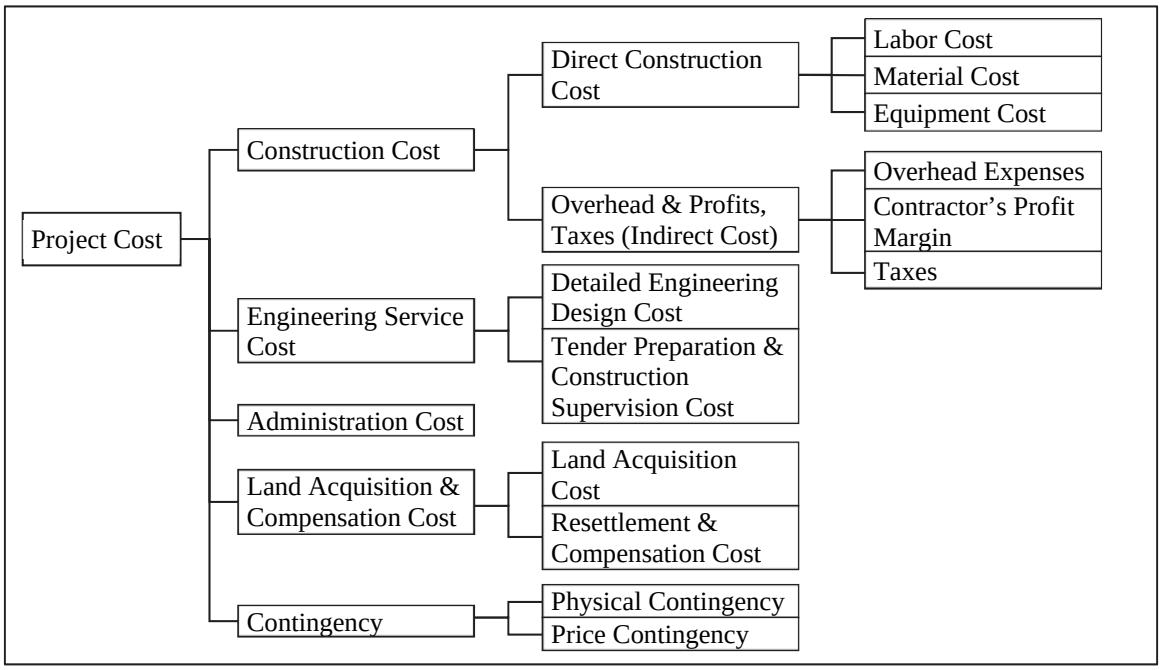
Source: JICA Project Team

Besides the above, data obtained through interviewing other ministries and organizations, and data obtained by reviewing Project reports and information obtained through internet, etc. were also used for the cost estimation.

21.1.3 Data Analysis

(1) Composition of Project Cost

In general, the Project cost is composed of the elements shown in Figure 21.1.1below.



Source: JICA Project Team

Figure 21.1.1 Composition of Project Cost

Construction cost consists of direct and indirect costs. The direct cost is a combination of material cost, labor cost and equipment cost based on the productivity of the work, while indirect cost covers the contractor's overhead & profits and taxes. The overhead includes costs of mobilization, administration, security measures, material and equipment storage, etc.

Engineering service cost is the cost for detailed engineering design, tender preparation and construction supervision.

Land acquisition and compensation cost is the cost to acquire the required land and the cost to compensate for resettlement, and other negative impacts.

Contingency can be classified into physical and financial contingencies. The former cover the expenses caused by inaccuracy of the preliminary design and changes in site conditions at the time of implementation, while the latter covers the risks of fluctuation of the costs.

(2) Labor Costs

Table 21.1.2 and Table 21.1.3 show the normal working hours and wage rates in Papua New Guinea, respectively. The normal working hours in Papua New Guinea is 8 hours per day, and when employees work outside the normal working hours or on public holidays an extra wage has to be paid (Table 21.3). This Project plans to carry out the construction during daytime, and not during nighttime or public holidays.

Table 21.1.2 Standard Working Hours in PNG

	Monday to Friday	Saturday	Sunday	Total work hours
Government employees	7:45 am to 4:06 pm (8 hours per day)	-	-	80 hours per 2 weeks 160 hours per month
Private company employees	8:00 am to 5:00 pm (8 hours per day)	8:00 am to 12:00 am (4 hours per day)	-	84 hours per 2 week 168 hours per month

Source: Employment Act

Table 21.1.3 Wages in PNG

Type of job	Hourly rate (PGK) Normal working hours	Outside normal working hours	PNG public holidays
Foreman	30.0	45.0	60.0
Skilled labor	13.0	19.5	26.0
Unskilled labor	10.0	15.0	20.0

Source: DOW

(3) Material Costs

Table 21.1.4 shows the construction material costs provided by four local contractor companies in Lae. There is little variation in the material costs, except the cost of bituminous concrete. Most of the construction materials are locally available.

Table 21.1.4 Overall Condition of Material Costs

Material type	Specification	Unit	Material costs (PGK) before tax			
			A Co.	B Co.	C Co.	D Co.
Mixed concrete	30 MPa	m3	528.90	460.00	440.00	-
	25 MPa	m3	465.10	445.00	435.00	-
	20 MPa	m3	447.00	425.00	410.00	400.00
Sand	Sand, 6.5mm	m3	112.70	96.2	175.00	-
Crushed road base	RC-40, CBR≥30%	m3	90.20	77.25	85.00	120.00
	M-30, CBR≥80%	m3	109.25	85.10	95.00	130.00
Bituminous concrete asphalt	Hot mixed	m3	1,802.40	-	1,768.00	3,500.00

Source: JICA Project Team

However, cement, asphalt, steel, street light pole, road marking material, and fuel needed for the construction are imported, and the custom duties shown in Table 21.1.5 are levied on them.

Table 21.1.5 Duty and GST Rates in PNG

Tariff item	Good description	Duty rate	GST rate
25.23	Cement	10%	10%
2714	Asphalt	10%	10%
8429.11.00	Bulldozers	Free	10%
8429.20.00	Graders	Free	10%
8512.00.00	Lightings	Free	10%
7308.90.90	Street poles/pillars	15%	10%

Source: JICA Project Team

(4) Mobilization Cost

The Study Team has confirmed that the local contractors have enough machineries for implementing this Project. But this comes with a high risk of making the number of the remaining machineries insufficient for other public and private construction works. The situation is similar for the concrete batcher and asphalt plants.

Therefore, the cost of mobilizing construction equipment and machineries from Port Moresby was included in the mobilization cost.

Table 21.1.6 Mobilization Items

Term	Item of expense
Mobilization	Premiums for insurances as required under the conditions of contract Mobilization of contractors, including plants, equipment Maintenance of contractors, including plants, equipment Demobilization of contractors, including plants, and equipment Supply and erection of Project notice boards

Source: JICA Project Team

(5) Indirect Cost

Table 21.1.7 shows the current indirect cost of the construction, and it includes overhead and profits.

Table 21.1.7 Expense of Construction

Term	Items of expense
General	Allow for expenses to conform with the conditions of contract and Group 1 of the DOW Specification, except for those given below. Execution of HIV/AIDS awareness program approved by the contractor Supply and erection of temporary traffic control signs, barricades, and warning lights including provision of side tracks and detour roads Preparation and implementation of quality assurance plan and environmental management plan Coordination with service authorities to locate and protect existing services (Telikom conduits, PNG Power poles and conduits, Water PNG pipes, Sewerage pipes, etc.) Relocation of existing services, i.e., Telikom conduits & pits, PNG Power poles and conduits, Water PNG pipes, Sewerage pipes, etc. Demolition of illegal structures and encroachments within the right-of-way including provision of security.

Source: JICA Project Team

(6) Land Acquisition and Compensation Cost

Since the Tidal Basin North Bypass passes through state land, there is no land acquisition cost. The Project, however, includes resettlement cost.

(7) Other Costs

The Project cost includes engineering and administration costs as well as contingency and tax. The engineering cost includes detailed engineering design and construction supervision costs. Administration cost refers to the operation cost of the counterpart. The contingency includes physical and financial contingencies. The proportion of each of the above costs is as follows:

- Engineering Cost: 10%
- Administration Cost: 2.5%
- Contingency: 15%
- Tax (GST): 10%

21.1.4 Unit Rates

Unit rates are estimated as follows:

- Unit rates estimated by the Department of Works were checked.
- Additional items that should be considered in the indirect cost were identified through interviews with a Japanese companies engaged in Papua New Guinea.
- Unit rates obtained from Company X, a local contractor in Port Moresby, were evaluated.
- The Material unit rates from local contractors in Lae (A Comp. to D Comp.) were used comparison appropriate rates (refer to Table 21.1.9).
- The unit rates were checked against the unit rates of calculated bases on the standard costs of the construction institute of Japan.
- The unit prices and specification of the *Highlands Highway Reconstruction and Upgrading Project* provided by DOW were used as reference for checking the unit prices. Although this road, which is being built by the China Railway International Limited, is very close to the site, the construction condition of the Bypass is different.

Table 21.1.8 Unit Rate for General Works, Mobilization, and Clearing and Grubbing

	Description	Unit	Base of unit rate				Reason for selecting	Selected unit rate
			DOW	Company X	Highlands Highway	Japanese rate		
1 General								
1.1	Allow for expenses to conform with the conditions of contract and Group 1 of the DOW Specification, except for those given below.	LS	96,525	1,000,000	1,662,402		Assuming an insurance premium of more than 0.5%, the rate of Company X, which satisfied this condition, was adopted.	1,000,000
1.2	Execution of HIV/AIDS awareness program approved by the contractor	LS	20,790	0	22,905		The rate provided by DOW, which is similar to that of the Highlands Highway, was selected.	20,790
1.3	Supply and erection of temporary traffic control signs, barricades, and warning lights including provision of side tracks and detour roads	LS	37,125	540,000	1,399,663		Rates of DOW are relatively low, and Company X unit rates, which their sum are close to that of the Highlands Highway, are selected.	540,000
1.4	Preparation and implementation of quality assurance plan and environmental management plan	LS	44,550	1,102,275				1,102,275
1.5	Coordination with service authorities to locate and protect existing services (Telikom conduits, PNG Power poles and conduits, Water PNG pipes, Sewerage pipes, etc.)	LS	0	180,000			This is an additional item, and unit rate of company X was adopted.	180,000
1.6	Relocation of existing services, i.e., Telikom conduits & pits, PNG Power poles and conduits, Water PNG pipes, Sewerage pipes, etc.	PS	0	1,000,000			Ditto	1,000,000
1.7	Community liaison officer	Month	3,500	500,000/LS			Unit rate of DOW is not significantly different from that of Company X, and it is considered appropriate.	3,500
1.8	Community support works	LS	300,000					300,000
2 Mobilization								
2.1	Premiums for insurances as required under the conditions of contract	LS		1,500,000			This is an additional item, and unit rate of company X was adopted.	1,500,000
2.2	Mobilization of contractors, including plants, equipment	LS	1,200,000	1,250,000	4,865,166		Unit rate of DOW is not significantly different from that of Company X, and it is considered appropriate.	1,200,000
2.3	Maintenance of contractors, including plants, equipment	Month	40,021	180,000	705,069		The unit rate of DOW does not include security guard, and therefore Company X rate including security cost is selected.	180,000
2.4	Demobilization of contractors, including plants, and equipment	LS	490,050	500,000			Unit rate of DOW is not significantly different from that of Company X, and it is considered appropriate.	490,050
2.5	Erection of Project notice boards	Nos.	3,713	6,500			Ditto	3,713
2.6	Dismantle and disposal of Project notice boards	Nos.	2,300					2,300
3 Clearing And Grubbing								
3.1	Clearing and grubbing (t = 300 mm)	Ha.		50,000	145,219		The unit rate of the DOW does not include the disposal cost, and therefore Company X rate including this cost is adopted.	
		m3	20	25	0	21		40

: Selected unit rate

Source: JICA Project Team

Table 21.1.9 Unit Rate of Earthwork and Pavement (PGK)

Description		Unit	Base of unit rate				Material price				Reason for selecting	Selected unit rate
			DOW	Company X	Highlands Highway	Japanese price	A Comp.	B Comp.	C Comp.	D Comp.		
4 Earthwork												
4.1	Sand mat (t = 500 mm)	m3	25	295.00	0	58	175.00		85.10	112.70	Unit rate of Company X is adopted because the rate of DOW does not include sand material cost.	295
4.2	Embankment	m3	13	90.00	150	50					Unit rate of Company X is adopted because the rate of DOW does not include soil transportation cost.	90
4.3	Cutting	m3	55	30.00	69	51					Unit rate of DOW, which is similar to that of the Highlands Highway, is considered appropriate.	55
4.4	Stabilized Subgrade, (t = 600 mm)	m3	110	200.00	0	64					Unit rate of Company X is adopted because the rate of DOW does not include soil transportation cost.	200
5 Pavement												
5.1	Sub-base (CBR≧30, t = 250mm)	m3	180	200	136	211	85.00	120.00	96.20	90.20	Unit rate of DOW is not significantly different from that of Company X, and it is considered appropriate.	180
5.2	Road base (CBR≧80, t = 225mm)	m3	210	250	0	238	95.00	130.00	85.10	109.25	Ditto	210
5.3	Bituminous binder course (t = 75 mm)	m3	2,660	4,667	0	481	1,768.00	3,500.00		1,802.40	Unit rate adopted DOW rate because bituminous material 80 to 90 percent unite rate in Japan	2,660
5.4	Bituminous wearing course (t = 50 mm)	m3	2,750	4,800	3,376	971	1,768.00	3,500.00		1,802.40	Ditto	2,750
5.5	Prime coat	m2	15	25	19	4		10.00			Unit rate of DOW, which is similar to that of the Highlands Highway, is considered appropriate. Ditto	15
5.6	Tack coat	m2	12	15	15	2		10.00				12

: Selected unit rate

Source: JICA Project Team

Table 21.1.10 Unit Rate of Road Furniture and Road Markings (PGK)

Description		Unit	Base of unit rate				Reason for selecting	Selected unit rate
			DOW	Company X	Highlands Highway	Japanese price		
7 Road Furniture And Road Markings								
7.1	Concrete curb	m	138	140	256	178	Unit rate of DOW is not significantly different from that of Company X, and it is considered appropriate.	138
7.2	Sidewalk pavement concrete surface	m3	310	2,000	879	1,093	Unit rate of company X is adopted because the rate of DOW does not include steel mesh material cost.	2,000
7.3	Sidewalk pavement (base crushed rock)	m3	210	400	879	486	Unit rate of company X is adopted because even in Japan the rate is twice of that of the carriageway.	400
7.4	7.4 Road marking (white)	m2	40	50	37	48	Unit rate of DOW, which is similar to that of the Highlands Highway, is considered appropriate.	40
7.5	7.5 Road marking (yellow)	m2	40	80	0	48	Unit rate of DOW is adopted because the road marking material is imported and no cost variation by color.	40
7.6	7.6 Street light	Nos.	2,300	30,000	26,390	23,920	Unit rate of company X is adopted because the rate of DOW rate is based on the cost of only light fixtures and does not cover the cost of electricity access utilities.	30,000

: Selected unit rate

Source: JICA Project Team

21.2 Project Cost

21.2.1 Summary of Estimated Project Cost

Summary of the estimated cost of the Tidal Basin North Bypass is shown in Table 21.2.1 (refer to Appendix 10 for more details).

This cost is estimated assuming that a local contractor will carry out the Project. However, if an overseas company will carry out the Project, then the cost has to be increased by 25% to 30%. The additional cost is for covering office, housing, labor, mobilization and security expenses.

Table 21.2.1 Project Cost of Tidal Basin North Bypass (Unit: PGK)

Description		Route 1		Route 2		Route 3	
		7.70 km		4.15 km		3.35 km	
		Amount	%	Amount	%	Amount	%
A Construction cost							
1.General		6,821,235	4.07	4,227,065	5.16	3,639,679	5.18
2.Establishment		11,145,209	6.66	6,802,076	8.31	5,792,919	8.24
3.Clearing and Grubbing		1,737,120	1.04	597,960	0.73	588,720	0.84
4.Earth work		61,773,950	36.89	23,930,188	29.24	22,252,025	31.64
5.Pavement		38,644,375	23.08	20,827,813	25.45	16,812,813	23.91
6. Drainage		21,629,400	12.92	11,604,950	14.18	10,046,900	14.29
7. Road furniture & road markings		25,718,000	15.36	13,861,000	16.93	11,189,000	15.91
a1. Sub-total		167,469,289	100.00	81,851,051	100.00	70,322,056	100.00
a2. Contingency (a1x10 %)		16,746,929		8,185,105		7,032,206	
Total (Construction cost) a1+a2		184,216,217		90,036,156		77,354,261	
B. Engineering Cost							
b1. Engineering Cost (a1x10%)		18,421,622		9,003,616		7,735,426	
b2. Contingency (b1x10 %)		1,842,162		900,362		773,543	
Total (Engineering Cost) b1+b2		20,263,784		9,903,977		8,508,969	
C Administration Cost {(A+B)x2.5 %}		5,112,000		2,498,503		2,146,581	
D Total (A+B+C)		209,592,001		102,438,637		88,009,811	
E Compensation cost		0		0		0.00	
F GST {(A+B)x10 %}		20,448,000		9,994,013		8,586,323	
Project cost	(D+E+F)	230,040,001		112,432,650		96,596,134	
	(Mil. PGK)	230.04		112.43		96.60	
	(Mil. JPY)*1	7,931.78		3,876.68		3,330.63	

*1: 1PGK=34.48JPY, Average for the three months before June 2016
Source: JICA Project Team

21.2.2 Cost Reduction Recommendation

The embankment cost is estimated based on the fill material cost. The fill material cost includes the costs of excavation and transportation from a borrow pit to the site. These costs may be reduced by using dredged soil from the Tidal Basin if the construction schedule of the Project properly overlaps with that of the Basin. The suitability of the dredged soil, however, should be confirmed in advance.

21.3 Operation & Maintenance Cost

After the completion of the Tidal Basin North Bypass construction, the Morobe Provincial Government will be responsible for the operation and maintenance of the road. The maintenance is divided into routine maintenance carried out every year, and repair work periodic maintenance carried out every two or five years. Table 21.3.1 shows the operation and maintenance cost of the Bypass.

Table 21.3.1 Operation & Maintenance Cost

Description			Operation & maintenance cost (thousand PGK)			Ratio to Construction Cost	
			Route 1	Route 2	Route 3	Annual Cost	Cost par once
Construction cost			184,000	90,000	77,000	-	-
Routine maintenance		every year	460	225	193	0.25%	-
Repair work	Drainage	every 2 years	552	270	231	0.15%	0.30%
	Pavement, Shoulder, Ancillary facilities	every 5 years	1,840	900	770	0.20%	1.00%

Source: JICA Project Team

CHAPTER 22 ECONOMIC AND FINANCIAL ANALYSIS

22.1 Economic Analysis

22.1.1 Objective of Economic Analysis

The objective of the economic analysis is to assess the Project from the economic view point of the country by applying the cost-benefit analysis. For the cost-benefit analysis, "Economic Internal Rate of Return (EIRR)" is calculated so as to ascertain the economic feasibility of the Project. The analysis is carried out for three alternatives separately, that are, Route-1, Route-2 and Route-3.

22.1.2 Preconditions and Assumptions

The preconditions and assumptions presented in Table 22.1.1 are applied for estimating the cost and benefit, and for economic analysis of the Project.

Table 22.1.1 Preconditions and Assumptions

Items	Preconditions and Assumptions	Sources and Remarks
1. Base Price	Price of year 2016	
2. Population and growth rate of the Project Area	➢ Population: 189,000 (2011 census) 216,000 (estimate of 2016) ➢ Growth: 2.7% per annum afterwards ➢ Family size: 6.2 persons	Chapter 4.1 Chapter 9.2 Chapter 4.1
3. Household (HH) income of the Project Area	➢ HH income surveyed ➢ Classifying into two classes by income level: - Low and lower middle class: < PGK 5,000 /month - Upper middle and high class : > PGK 5,000 /month	Chapter 4.2.3
4. Per-capita income	➢ HH income / Family size - Low and lower middle class: PGK 1,400 - Upper middle and high class: PGK 1,700 ➢ Estimate of per-capita income growth: - By applying the growth of national compensation account as described below that is a part of the national accounts (GDP) Growth rate (note-1) of compensation Note-1: 46% to GDP growth (6.6% until 2019, 7.5% until 2024, 6% thereafter)	Above items: 2 & 3 GDP and the related: National Statistics Office (NSO) Rates of the note-1 and note-2 are average over 6 years from 2006 up to 2011 based on the NSO data and NRI report.
5. Unit value of truck cargo	PGK 90,000 /TEU: averaged with loading of clothing and grain	Interview to companies
6. Unit profit derived from truck freight	PGK 50 /hour	Interview to companies
7. Tax and duties	➢ General service tax: 10% ➢ Import duties: 10% (cement and asphalt) and 15% (street light pole and the likes)	Customs House
8. Conversion factor (CF)	➢ Standard CF: 0.90, estimated based on the external trade and custom duties, and also referred to Projects of ADB ➢ Shadow wage rate for unskilled labor: 0.76 estimated based on the unemployment data	External trade: CIA Custom duties: Government budget Unemployment data: Chapter 3.3
9. Economic life of capital investment assets	35 years (the life could be more than 60 years if continuous adequate maintenance work is made ; however it is set generally at shorter period from 30 to 40 years for the contingent reason that might occur)	JICA Project Team
10. Opportunity cost of capital	12%: referring to the ADB Projects in PNG.	JICA Project Team
11. Evaluation time horizon	30 years	JICA Project Team
12. Salvaged value	The residue value of capital investment costs are salvaged at the 30th year taking into consideration the remaining economic life.	JICA Project Team

Source: JICA Project Team

22.1.3 Benefit

The Project will generate several kinds of benefit, which can be classified into two categories: 1) monetarily quantifiable benefit and 2) qualitative benefit (that is, monetarily non-quantifiable). The monetarily quantifiable benefit (simply benefit hereinafter) are used for the cost-benefit analysis. The details of the qualitative benefit are described in Chapter 22.6. .

The followings five kinds of benefit are selected and defined for this cost-benefit analysis accordingly.

- Saving of Passengers' Travel-time Value
- Saving of Truck Cargo-hour Value
- Saving of Truck-Freight-hour Value
- Saving of Vehicle Operation Cost
- Reduction of Repair and Maintenance Cost

The manner how to estimate the above benefit is described below respectively.

(1) Saving of Passengers' Travel-time Value

= (Saving of passengers' travel-hours in a year) X (Per-capita income/hour for working purpose)

Passengers' travel-hours saved in a year are summarized as presented in Table 22.1.2 (see the details in Chapter 18 of this report).

Table 22.1.2 Passengers' Travel-hours saved in a Year (Unit: .000 passenger-hours)

Road	Vehicle	2020	2030	2040	2050
Route-1	PMV*	9,086	14,660	21,837	42,223
	Car	3,471	8,695	19,965	53,178
Route-2	PMV*	9,239	14,660	21,150	41,994
	Car	3,620	8,882	16,592	53,737
Route -3	PMV*	6,566	10,689	13,591	37,260
	Car	2,687	7,202	16,942	47,990

Note: * Public Motor Vehicle (public transport mode)
Source: JICA Project Team

Per-capita income per hour for working purpose is estimated as presented in Table 22.1.3.

Table 22.1.3 Per-capita Income per Hour for Working Purpose

Items	Vehicle	2016	2020	2030	2040	2050
		Base Year	Projection[1)]			
Per-capita income of passengers in a year (PGK/year)	PMV	1,444	1,503	2,173	3,079	4,363
	Car	1,841	2,170	3,075	4,357	6,174
General working time (for the purpose of computing per-capita income per hour)	-	47 weeks a year				
	-	5 days a week				
	-	8 hours a day				
Proportion (%) of working purpose trip[2)]	-	50% : a + b + c (a) for work 17%, (b) for business 12% , (c) = (a + b) x 30%				

Note: 1) Increase in line with GDP growth rate, 2) Trip survey by JICA Project team
Source: JICA Project Team

PMV passengers' per-capita income is applied with low class and lower-middle class level as shown in Table 22.1.1. Meanwhile, car passengers' income is computed as follows.

Car passengers' income = (1. Car owner income) + (2.Other passengers' income)

1 = 1.9 times * more than all classes' aggregated average income, PGK 1,685
2 = Lower and lower middle class income as shown in Table 22.1.1.

Note: * Elaborated by JICA Project Team based on the trip survey

(2) Saving of Truck Cargo-hour Value

= (Saving of Truck travel-hours in a year) X (Cargo price/hour) X (Bank interest rate)

Truck travel-hours saved in a year are summarized as presented in Table 22.1.4 (see the details in Chapter 18 of this report).

Table 22.1.4 Truck Travel-hours saved in a Year (Unit: .000 hours)

Road	Vehicle	2020	2030	2040	2050
Route-1	Truck	403	675	1,169	2,330
Route-2		451	753	1,244	2,466
Route -3		438	784	1,222	2,348

Note: Public Motor Vehicle (public transport mode)
Source: JICA Project Team

Cargo value per hour is estimated by using the criteria as presented in Table 22.1.5.

Table 22.1.5 Estimate of Cargo Value per hour

1.Cargo price per hour		
1) Goods loaded	Clothing: business shirt	Grain: rice
2) Retail price [1)]	PGK 20 /shirt (size: 30cmx25cmx5cm)	PGK 4 /kg
3) Wholesale price [2)]	60% of retail price	70% of retail price
4) TEU loading [2)]	90% of cubic capacity (39m^3)	90% of maximum payload (21.6 ton)
5) Goods value	PGK 112,000/TEU	PGK 68,000/TEU
6) Proportion of each good[2)]	50%	50%
7) Average loaded value	PGK 90,000/TEU	
2. Bank interest rate	6.5% a year[3)], equivalent to 0.000742% per hour	
3. Value per hour	PGK 0.67	

Source: 1) Price survey at market, 2) JICA Project Team based on the interviews to companies, 3) business loan of National Development Bank of PNG

(3) Saving of Truck Freight-hour Value

= (Saving of Truck travel-hours in a year) X (Trips /year) X (Heavy truck traffic ratio) X (Net

Truck travel-hours saved in a year are the same as illustrated in Table 22.1.4. Freight value per hour is computed by applying the data as presented in Table 22.1.6.

Table 22.1.6 Data for estimating Truck Freight-hour Value

1.Trips per year [1)]	(2 times/week) x (48 weeks/year)	-
2.Heavy truck traffic ratio [2)]	Heavy trucks / all trucks	20%
3.Net profit/trip	Freight rate: Lae - Mount Hagen [1)]	PGK 8,900
	Travel hours between Lae and Mount Hagen [1)]	27 hours/round trip
	Freight rate per hour	PGK 330/hour
	Profit margin of freight company [1)]	20%

Source: 1) Interview to transport companies, 2) Traffic survey by JICA Project Team

(4) Saving of Vehicle Operation Cost

The saving of vehicle operation cost (VOC) is estimated as follows.

= (Vehicle-travel-distance per year) X (VOC/km)

Table 22.1.7 presents "vehicle-travel-distance per year" (see the details in Chapter 18 of this report).

Table 22.1.7 Vehicle-travel-distance a Year (Unit: .000 vehicle-km)

Road	Vehicle	2020	2030	2040	2050
Route-1	PMV note	218	256	311	437
	Car	353	658	1,202	2,485
	Truck	610	845	1,112	1,525
Route-2	PMV note	274	345	390	614
	Car	444	877	1,505	3,413
	Truck	694	996	1,309	1,778
Route -3	PMV note	-3	42	114	244
	Car	16	145	507	1,583
	Truck	679	1,045	1,308	1,719

Source: JICA Project Team

Table 22.1.8 presents the breakdowns of VOC.

Table 22.1.8 Vehicle Operation Cost

Items	Particulars	Unit	PMV	Car	Truck	
					Light	Heavy
1.Operation Distance		Km/year	32,850	9,125	16,425	57,600
2.Operation Cost						
1)Remuneration	(1)Driver	PGK/year	23,040	-	23,040	23,040
	(2)Assistance		11.520	-	-	-
	Total		34,560	-	23,040	23,040
2)Repair and Maintenance	(1)Spare parts		9,000	1,500	6,000	20,000
	(2)Tire		4,548	608	3,032	127,008
	(3)Fuel		16.797	2,979	5,999	106,885
	(4)Oil		1,080	142	1,350	10,416
	Total		31,426	5,229	16,381	264,310
3) Insurance			890	590	1,173	1,173
4)Overhead			3,299	-	2,091	14,367
5)Depreciation			18,000	15,000	12,000	40,000
Total			88,875	20,819	57,085	342,890
Operation Cost/vehicle		PGK/km	2.7	2.3	3.5	6.0

Source: Elaborated by JICA Project Team based on the interview and questionnaire to the transport companies

(5) Reduction Repair and Maintenance Cost

The by-bass road (with-Project) will reduce the periodical repair and maintenance cost of highland highway (with-out Project), particularly for resurfacing, road shoulder and incidental facilities, by prolonging the interval of the maintenance work period from every 5 years to 10 years. The reduced cost as presented in Table 22.1.9 is counted as benefit from the 6th year afterwards after the completion year of construction.

Table 22.1.9 Annualized Reduction of Cost

Item	Unit	Route-1	Route-2	Route-3
Reduction amount in 25 years	PGK million	6.53	2.91	1.76
Annualized reduction amount	PGK million/year	0.26	0.12	0.07

Source: JICA Project Team based on the repair and maintenance cost of the Highlands Highway

22.1.4 Economic Project Cost

The economic Project cost consists of 1) capital investment cost and 2) repair and maintenance (R&M) cost. Price escalation and the taxes such as import duties and general service tax (GST) are disregarded in the economic Project cost. The local cost is discounted by applying the conversion factor (CF) as presented in Table 22.1.1.

(1) Capital Investment Cost

For the economic analysis, financial cost is converted to economic cost. The financial cost of the capital investment is estimated in Chapter 21.2. Table 22.1.10 presents the economic cost converted from the financial cost.

Table 22.1.10 Capital Investment Cost (Unit: PGK million)

Cost	Route	Year 1	Year 2	Year 3	Year 4	Total
Economic cost	Route-1	22.3	73.6	73.6	30.2	199.7
	Route-2	23.1	74.8	-	-	97.9
	Route-3	27.3	56.8	-	-	84.1
Financial cost for reference	Route-1	26.7	90.8	90.8	37.3	245.6
	Route-2	28.0	92.0	-	-	120.0
	Route-3	33.1	70.0	-	-	103.1

Source: JICA Project Team

(2) Repair and Maintenance Cost

The financial cost of repair and maintenance is studied in Chapter 21.3. Table 22.11 shows the economic cost of the repair and maintenance converted from the financial cost.

Table 22.1.11 Repair and Maintenance Cost (Unit: PGK million)

Cost	Route	Inspection	Culvert	Resurfacing, etc.
		Ever year	Every 2 years	Every 5 years
Economic cost	Route-1	0.43	0.51	1.71
	Route-2	0.21	0.25	0.83
	Route-3	0.18	0.21	0.72
Financial cost for reference	Route-1	0.47	0.57	1.90
	Route-2	0.23	0.28	0.93
	Route-3	0.20	0.24	0.80

Source: JICA Project Team

22.1.5 Economic Analysis

(1) Results of Base Case

Economic analysis is conducted based on the above benefit and economic Project cost. Table 22.12 presents the result of the analysis (for details, see Appendix 11). Route-1 shows comparatively lower EIRR compared to Route-2 and Route-3. Meanwhile, the EIRRs of Route-2 and Route-3 show larger than 17% respectively: as a result, both routes are judged to be economically feasible.

Table 22.1.12 Results of Economic Analysis (Base Case)

Route	EIRR	B/C	NPV
Route-1	10.9%	0.86	- PGK 16.8 million
Route-2	17.8%	1.76	PGK 49.8 million
Route-3	17.0%	1.62	PGK 35.7 million

Note: B/C – Benefit-Cost Ratio, NPV – Net Present Value
Source: JICA Project Team

(2) Sensitivity Analysis

Sensitive analysis is conducted taking into consideration the probable risks or uncertainty. The most vital elements in the above three routes probably relate to initial capital investment costs and traffic demand, therefore these two elements are applied for the analysis.

Route-1

Table 22.1.13 presents the results of sensitive analysis of Route-1.

Table 22.1.13 Results of Sensitive Analysis of Route-1

Scenario		EIRR	B/C	NPV
Scenario-1	With decrease of capital inv. costs: 15%	12.1%	1.0	PGK 1.4 million
Scenerio-2	With increase of traffic demand: 20%	12.3%	1.0	PGK 5.4 million

Source: JICA Project Team

The following conclusions can be reached based on the sensitivity analysis.

- The EIRR of the base case of Route-1 is 10.9%, below the opportunity cost of capital of 12% as presented in Table 22.1.12.
- The decrease of capital cost by 15% with Scenario 1 elevates the EIRR to 12.1%, and the Project comes economically feasible accordingly.
- Increasing traffic demand by 20% with the Scenario 2 also puts up the EIRR to 12.3%. The Project also comes to attain economically feasible level.

Route-2 and Route-3

Table 22.1.14 illustrates the results of sensitive analysis of Route-2 and Route-3.

Table 22.1.14 Results of Sensitive Analysis of Route-2 and Route-3

Route	Scenario		EIRR	B/C	NPV
Route-2	Senario-1	With increase of capital inv. costs: 70%	12.3%	1.0	PGK 3.7 million
	Scenario-2	With decrease of traffic demand: 20%	16.5%	1.5	PGK 34.0 million
Route-3	Senario-1	With increase of capital inv. costs: 60%	12.2%	1.0	PGK 1.7 million
	Scenario-2	With decrease of traffic demand: 20%	15.8%	1.5	PGK 25.5 million

Source: JICA Project Team

The conclusions can be drawn down based on sensitivity analysis as follows.

- The base case of both Route-2 and Route-3 is economically feasible showing the EIRR higher than 12% as presented in Table 22.1.12.
- Even though high increase of capital investment cost by 70% and 60% respectively with the Scenario 1, the Projects remain economically feasible.
- Decreasing traffic demand by 20% with Scenario 2 reduces the EIRR; however, the Projects still remain economically feasible.

22.1.6 Qualitative Benefit

The implementation of this Project will have various social and economic effects as assumed in Table 22.1.15 However, these effects can be hardly evaluated quantitatively, *i.e.*, converted into a monetary value. To evaluate the Project comprehensively, it is necessary to take into consideration this implicit perspective.

Table 22.1.15 Qualitative Benefit Considerable for this Project

Classification		Benefit difficult to evaluate in monetary basis
Benefit of users	Traffic and daily living circumstances	Improvement of safety and standard of living
		Increase of accessibility and time certainty
Ripple effect	Economic activities	Increase of productivity
		Increase of production
		Increase of tax revenue
		Increase of income
		Increase of employment
	Land valuation	Change of land use
		Increase of land value

Source: JICA Project Team

22.2 Financial Analysis

As presented in Table 22.1.10, the capital investment costs of the Project is summarized as follows.

- Route-1: PGK 245.6 million
- Route-2: PGK 120.0 million
- Route-3: PGK 103.1 million

These costs are extremely larger than the capital expenditure budget of the Morobe provincial government that is only PGK 129 million in 2016 (see Table 13.2.3) : consequently, for the implementation of the Project, the capital investment costs should be shared with or granted by the Central Government or the donors.

CHAPTER 23 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

After comparison of the three alternative routes of the proposed bypass from viewpoints of social impacts, technical standards and fund raising, in addition to the economic analysis, Route 3 is considered to be most feasible. In this chapter, environmental and social considerations are conducted focusing on Route 3.

23.1 Environmental and Social Considerations

23.1.1 Outline of Proposed Project Components

The construction of a new bypass highway connecting Lae Port to the Highlands Highway was selected for the feasibility study. This new bypass will function as an alternative road of the Highlands Highway to exclude through traffic between Lae Port and Nadzab or Highland area from Lae City. The project site is located in the area behind the Lae Tidal Basin and between the Highlands Highway and Markham River

The length of the proposed bypass road is 3.35km with 15m width. The proposed bypass will be at 1.5m above the ground level taking account of the floods. Side ditches are applied at both sides of the bypass, and pipe culverts across the bypass will be installed at 100m intervals. The details of the selected project components are described in Chapter 17 Scope of the Project, Chapter 19 Preliminary Design and Chapter 20 Construction Plan.

23.1.2 Summary of the Natural and Social Environments

The details of the natural and social conditions in the proposed Bypass Project Area, the Lae Urban District and the Morobe Province in general are described in Chapter 2 Physical and Climate Characteristics, Chapter 3 Economic Characteristics, Chapter 4 Social Characteristics, Chapter 5 Current Land Use and Tenure, and Chapter 6 Existing Infrastructure and Services. The summary of the natural and social conditions in the proposed bypass Project Area is described in Table 23.1.1.

Table 23.1.1 Summary of the Natural and Social Environments

Natural Environment	
Climate	Humid tropical climate, with an annual precipitation of 4,500 mm, evenly distributed through the year, and with an average annual temperature of 27 ℃, the hottest months are from November to February.
Topography	Altitude: 8m above sea level. The proposed site is on the eastern side of the Markham River near the coast.
Geology/Soils	Lae city is located on the Pacific Ring of Fire and geologic instability has produced numerous faults and earthquakes. Much of the soil types of the Project Area are Entisols, Inceptisols, and Mollisols.
Protected Areas	There is no protected area near the proposed site.
Ecosystem	Coastal marshlands along the Markham River, now consisting of highly degraded secondary plant growth. The Australian Saltwater crocodile (*Crocodylus porosus*) has been recorded in the rivers of the Huon coast. Fauna species and bird life were limited both in species and abundance[1].
Social Environment	
Administrative Division	Lae Urban Local Level Government, the capital of the Morobe Province
Socio-economic Activities	Lae is the second largest city of PNG. Major employment composition of the Lae Urban is agriculture/hunting/forestry, whole/retail trade sales, and real estate renting/business service activities.
Land Use	The land along the proposed bypass route is state land. Lae Tidal Basin Project financed by ADB is on-going on the west side of the proposed bypass route. The proposed bypass route runs for about 1.6km along the fenced property of the Tidal Basin Project. Residential areas including some informal settlers and Bugandi High school, a

[1] Summary Environmental Impact Assessment for PNG: Lae Port Development Project, 2007, ADB

	gas station are present along of the proposed bypass route.
Living Conditions	There are some structures and houses along the proposed route. Structures are either raised-floor style or on the ground and the majority are single storied. Some structures are with water supply but most of them without power supply. Most of the residents are working either in the vicinity or Lae City as paid workers or self-employees.
Heritage	There is no heritage near the proposed site.
Hazard Risks	Earthquakes, flooding of the Markham River.

Source: JICA Project Team

Figure 23.1.1 shows the conditions along the proposed bypass project.

Existing road within the Proposed Bypass Route Site

Land within the proposed Bypass Route (the Lae Tidal Basin Project property on the left)

Settlement along the Proposed Bypass Route

Some settlements along the Proposed Bypass Route

The Proposed Bypass Route by the Bugandi High School

Near the Boundary Round-About at the end of the Proposed Bypass Route.

Source: JICA Project Team

Figure 23.1.1 Conditions along the Proposed Bypass Route

23.1.3 Legal and Administrative Framework of Environmental and Social Considerations

The legal and administrative frameworks of environmental and social considerations in PNG are described in Chapter 14.1 PNG Social Environmental Assessment System.

(1) Legal Framework

According to Category Number 14.1 under Level 3 Activities of the Environment (Prescribed Activities) Regulation 2002, it is stated that Activities involving investment of a capital cost of more than PGK 50 million, except where such investment is made in pursuing an activity otherwise dealt with in this Regulation in which case that category of activity will apply to the investment.

As for the Proposed Bypass Project, the project cost is estimated around PGK 96 million. However, from the interview with Mr. Maino Virobo, Director of CEPA, the above mentioned item concerning Level 3 Activities will not be applicable to the proposed project, but rather, the proposed project is likely to be categorized as Category B of Level 2 Activities. The Environment Act 2000 requires any development of a Level 2 and Level 3 activities to acquire an environment permit from the CEPA. The proponent intends to carry out a Level 2 or Level 3 activity is required to register that intention by submitting Notification of Preparatory Work on Level 2 or Level 3 Activities to the Director of Environment at least one month prior to commencing any preparatory work in relation to the proposed activity. Weather the proposed Bypass Project requires EIA or not must be confirmed with CEPA by registering the project, at the earliest stage of the Proposed Bypass Project.

Gaps between PNG legislations and the JICA Guidelines for Environmental and Social Considerations are analyzed in Table 14.1.3 in Chapter 14.

(2) Administrative Framework

Provincial Planner under Cooperate Governance and Management of the Morobe Provincial Government is the responsible body for environmental and social considerations of projects. As for projects under the Master Plan, such as the proposed bypass project, a Project Management Unit will be established and within this PMU, the person who will be responsible to oversee environmental and social considerations of the proposed project should be appointed.

23.1.4 Alternative Analysis

The proposed Bypass Project is expected to have the following functions:

- To separate port related traffic, especially heavy trailers, from general traffic in Lae central area,
- To guide future urbanization and function as arterial road of expected development area, and
- To prepare alternative route of the Highlands Highway for emergency.

If the zero option (without project) is selected, none of the above function will be achieved and the economic activities and developments that are depending on the smooth operation of the Highlands Highway may be hindered. In case that the Highlands Highway becomes not passable, e.g. due to disasters, without an alternative route, transportation of commodities and people will be suspended.

Three alternative routes for the propose Bypass Project were examined in terms of environmental, social, technical and financial aspects. The details of the analysis are described in Chapter 19.1 Route Planning. In sum, Route 1 is the least optimum because it has the highest project cost and more impacts in terms of the natural and social environments. About 30 houses may be relocated. Some of the required land for this route is within the customary land; hence it is most likely to cause some adverse impacts on social environment, possibly to face some objections from local communities or at least to trigger dispute over the demarcation of the land. Between Route 2 and Route 3, the project cost for Route 2 is slightly higher than that of Route 3, while their impacts on the natural and social environments are relatively same in the types and scale. For both Routes, the required land is within state land. Route 2 may require relocation of 10 houses, while Route 3 requires 2 to 3 houses, which may be even avoided completely by adjusting the route alignment. Hence, Route 3 is considered the

most optimum option at this stage, while Route 2 is also a possible option, if any unforeseen problem arises with Route 3.

23.1.5 Preliminary Scoping and Draft ToR for Environmental and Social Considerations

Preliminary Scoping was carried out based on a possible case as result of the implementation of the proposed Bypass Project. Impacted items, selected based on the JICA Guidelines for Environmental and Social Considerations 2010 (hereinafter JICA Guidelines), are examined against impact factors. Each impact is evaluated whether if it is positive or adverse and also examined its possible extents and severities. Table 23.1.2 is the result of the preliminary Scoping.

Table 23.1.2 Preliminary Scoping

Item			Planning Stage	Construction Stage	Operation Stage	Reasons for rating
Social Environment	1	Involuntary Resettlement	C/-B	D	D	Resettlement of few structures, trees, crops may be triggered. Further investigation is needed to confirm if resettlement will be triggered.
	2	Living and Livelihood	C/-B	D	+B	Changes in living and livelihood of the project affected households due to resettlement of may be triggered. Further investigation is needed to confirm if resettlement will be triggered. Construction of a new bypass is expected to bring positive impacts, such as better transportation and an alternative route in case of emergency.
	3	Utilization of Land and Local Resources	-B	D	+B	Construction of a new bypass will alter the land use within the route. Presence of a new bypass is expected to improve local land and resource use.
	4	Social Institutions such as Social Capital and Local Decision-making Institution	D	D	D	No impacts are expected.
	5	Existing Social Infrastructures and Services	-B	-B	+B	During planning and construction stage, the existing infrastructures such as the high school, the Highland Highway, nearby residential areas. may be affected by construction activities. Construction of a new bypass is expected to bring positive impacts, such as better transportation and an alternative route in case of emergency.
	6	Ethnic Minorities, Indigenous Peoples, Gender and Children's Rights	C	-B	D	Project Affected Households may include women headed households or vulnerable groups. Further investigation is needed to confirm the presence of such households. During construction stage, there may be gender inequality of employment or child labor may happen.

Item			Planning Stage	Construction Stage	Operation Stage	Reasons for rating
	7	Equality of Benefits and Losses	D	D	D	No impact is expected.
	8	Heritage	D	D	D	No such site is present.
	9	Local Conflicts of Interest	D	D	D	No impact is expected.
	10	Water Right/Common	D	D	D	No impact is expected.
	11	Social Consensus	D	D	D	No impact is expected.
	12	Public Health	D	-B	D	During construction stage, public health may be affected if proper sanitation facilities are not in place at the construction site.
	13	Infectious Diseases(AIDS/HIV)	D	-B	D	During construction stage, infectious diseases may be occurred or increased by influx of workers if proper preventative measures are not in place.
	14	Working Environment	D	-B	D	During construction stage, poor working environment may occur if appropriate measures are not in place.
Natural Environment	15	Topography and Geology	D	-B	D	During construction stage, building embankment using about 130,000m^{3}of earth causes changes in topography, although minor.
	16	Land Erosion	D	D	D	No impact is expected.
	17	Ground Water	D	D	D	No impact is expected.
	18	Hydrology	D	C	-B	During construction stage, building embankment causes changes in draining pattern in the area, although it is unknown at this stage. During operation, flooding the area may occur if proper drainage system is not in place. .
	19	Protected Areas	D	D	D	No protected area is present near the project site.
	20	Ecosystem	C	C	C	Although the existing data indicates there is no rare/important species in the area, further investigation is needed to confirm.
	21	Climate	D	D	D	No impact is expected.
	22	Landscape	D	D	D	No impact is expected.
	23	Global Warming	D	D	D	No impact is expected.
Pollution	24	Air Quality	D	-B	D	During construction stage, emission of air pollutants by vehicles and machines will occur, although it can be mitigated and temporary
	25	Water Quality	D	-B	-B	During construction stage, emission of water pollutants by construction activities and presence of workers will occur, although it can be mitigated and temporary Slope of the embankment will be covered with vegetation to prevent soil runoff.

Item			Planning Stage	Construction Stage	Operation Stage	Reasons for rating
	26	Soil Contamination	D	D	D	No impact is expected.
	27	Wastes	D	-B	D	During construction stage, waste may be generated by construction activities and presence of workers, although it can be mitigated and temporary.
	28	Noise and Vibration	D	-B	-B	During construction stage, noise will be generated by construction activities and operation of vehicles and machines, although it can be mitigated and temporary. During operation stage, the traffic on the new bypass road will cause noise.
	29	Subsidence	D	C/-B	D	Since the land of the proposed project site is expected to be soft, subsidence may occur. Further investigation is needed to confirm.
	30	Odor	D	D	D	No impact is expected.
	31	Sediment	D	D	D	No impact is expected.
	32	Accident	D	-B	-B	During construction stage, accidents may be happened. During operation stage, road accidents may occur on the new bypass road.

+: Positive impact. -: Adverse impact.
A: Significant impact is expected. B: Some impact is expected. C: Impact is unknown. D: No impact is expected.
Source: JICA Project Team

If EIA is required for the proposed Bypass Project, the following items will be studied and evaluated. EIA should be carried out in adherence to the relevant legislations of PNG and the JICA Guidelines.

Table 23.1.3 Draft TOR for Environmental and Social Considerations for the Proposed Project

Item		Study Items	Study Methods
Analysis of Alternative		1) Options for bypass route	1) Selection of the route to avoid, minimize the occurrence of involuntary resettlement, tree cutting and impacts on ecosystem and surrounding communities.
Stakeholder meetings		Organize meetings at two stages (or as required by the relevant authority of PNG) 1) Scoping stage 2) Draft Final Report of EIA	Individual interviews, group interview, public consultations, etc. as required by the relevant authority of PNG.
Field Study			
1	Involuntary Resettlement	1) Relevant laws/regulations of PNG 2) Resettlement Plan and implementation for Lae Tidal Basin Project by ADB 3) The Number of affected structures, trees, crops, etc. 4) Socio-Economic status of affected households 5) Preparation of an Abbreviated Resettlement Action Plan (ARAP) if resettlement is triggered	1) and 2) Reviewing the relevant laws/regulations, the existing data/documents/reports, interviewing relevant institutions/experts/NGOs, site visits, etc. 3) and4) Census and socio-economic survey with Project Affected Households and enumeration of affected structures, trees, crops, etc. 5) Preparation of an ARAP in accordance with PNG laws/regulations, JICA Guidelines and World Bank Operational Policy 4.12, etc.

Item		Study Items	Study Methods
2	Living and Livelihood	1) Living and livelihoods of Project Affected Persons/Households	1) Reviewing the existing data/documents, interviewing, site visits, etc. 2) Census and socio-economic survey with Project Affected Households.
3	Utilization of Land and Local Resources	1) Present land use in the proposed area 2) Land use and development plan in the area	1) and 2) Reviewing the existing data/documents, interviewing, site visits, etc.
5	Existing Social Infrastructures and Services	1) Presence of houses, schools, hospitals, pipelines, etc.	1) Reviewing the existing data/documents, interviewing, site visits, etc.
6	Ethnic Minorities, Indigenous Peoples, Gender and Children's Rights	1) Presence of vulnerable groups 2) Employment by the project	1) Reviewing the existing data/documents, interviewing, site visits, etc. 2) Relevant laws/regulations concerning child labors, gender equalities, considerations for vulnerable groups, etc.
12	Public Health	1) Sanitation and waste management at the construction site	1) Case study of similar construction projects.
13	Infectious Diseases(AIDS /HIV)	1) Disease rate for infectious diseases	1) Reviewing the existing data/documents, interviewing relevant institutions, etc.
14	Working Environment	1) Environment, Health and Safety measures	1) Case study of similar construction projects (examination of the contents of contracts for the contractor).
15	Topography and Geology	1) Flooding, drainage and fragile land of the area 2) Design and construction plan of embankment	1) Reviewing the existing data/documents, interviewing relevant institutions/experts, site visit etc. 2) Case study of similar construction projects.
18	Hydrology	1) Flooding and drainage of the area 2) Design and construction plan of drainages and culverts	1) Reviewing the existing data/documents, interviewing relevant institutions/experts, site visit etc. 2) Case study of similar construction projects
20	Ecosystem	1) Presence of protected/rare fauna and flora species	1) Reviewing the existing data/documents, interviewing relevant institutions/NGO/Experts, site visit etc.
24	Air Quality	1) Air quality standards of PNG 2) Baseline of air quality 3) Major air pollution sources 4) Operation plan for construction vehicle and machines	1) Reviewing the existing data/document. 2) Field survey and hearing on existing air pollution and collection of baseline data by field measurement of air quality such as SO_2, NO_2, TSP, PM10. 3) Estimation air pollutants emission by using data about number of construction vehicles, machines and time of operation etc. 4) Case study of similar construction projects for mitigations.
25	Water Quality	1) Water quality standards of PNG 2) Baseline of water quality 3) Major air pollution sources and water use	1) Reviewing the existing data/document. 2) Field survey and hearing on existing water pollution and collection of baseline data by field measurement and sample analysis of water quality such as water temperature, pH, turbidity, DO, SS, BOD, COD, oil and grease, salinity, anions, heavy metals, Coliform etc. 3) Estimation water pollutants during construction period and case study of similar construction projects for mitigations.

Item		Study Items	Study Methods
27	Wastes	1) Regulation of waste treatment and disposal 2) Waste management plan during construction	1) Reviewing the existing data/document. 2) Case study of similar construction projects (examination of the contents of contracts for the contractor) for mitigations.
28	Noise and Vibration	1) Environmental standards for noise pollution 2) Baseline of noise level 3) Major noise source and affected area	1) Reviewing the existing data/document. 2) Collection of baseline data bay field measurement. 3) Estimation noise causing activities during construction period and case study of similar construction projects for mitigations.
29	Subsidence	1) Flooding, drainage and fragile land of the area 2) Design and construction plan of embankment	1) Reviewing the existing data/documents, interviewing relevant institutions/experts, site visit etc. 2) Case study of similar construction projects.
32	Accident	1) Accidents during construction work	1) Case study of similar construction projects (examination of the contents of contracts for the contractor).

Source: JICA Project Team

23.1.6 Expected Impacts and Proposed Mitigation Measures

Overall, adverse impacts by the implementation of the projects are expected to be minimum and last only during the planning and construction stages and they are also expected to be limited to the site. These predicted adverse impacts are very common in any road construction activities and there are readily applicable and effective mitigation measures. In case of involuntary resettlement, an appropriate compensation plan should be made in accordance with the laws/regulations of PNG, the JICA Guideline and the compensation scheme by Lae Tidal Basin Project. During the operation stage, positive impacts in terms of improving economic and development activities along the bypass and Highlands Highway are expected. Table 23.1.4 proposes general mitigation measures applied for road projects. These measures must be modified to meet the actual conditions once the propose Bypass Project is implemented.

Table 23.1.4 General Mitigation Measures

Item		Proposed Mitigation Measures
1	Involuntary Resettlement	Proper preparation and consensus making with project affected persons on resettlement planning. Proper implementation of the agreed resettlement plan.
2	Living and Livelihood	Proper preparation and consensus making with project affected persons on resettlement planning. Proper implementation of the agreed resettlement plan.
3	Utilization of Land and Local Resources	Sharing the information about the project objectives and construction activities and consensus making with stakeholder on the land use.
5	Existing Social Infrastructures and Services	Sharing the information about the project objectives and construction activities and consensus making with stakeholder on the land use.
6	Ethnic Minorities, Indigenous Peoples, Gender and Children's Rights	Proper preparation and consensus making with project affected persons on resettlement planning. Proper implementation of the agreed resettlement plan. Strict observing of the labor laws.
12	Public Health	Setting temporary toilets for workers. Proper management of solid waste.
13	Infectious Diseases(AIDS/HIV)	Education of workers on the prevention of infectious diseases.
14	Working Environment	Ensuring proper Environment, Health and Safety management by the contractor. Providing safety equipment and continuous instruction on safety to workers.

Item		Proposed Mitigation Measures
15	Topography and Geology	Proper designing and construction planning of embankment.
18	Hydrology	Applying technically accepted construction methods and design to avoid flooding in the area caused by the presence of the Bypass and embankment.
20	Ecosystem	Applying adaptive management approach, if any species to be considered is discovered.
24	Air Quality	Using well maintained vehicles and machines that meet the national requirements. No idling of vehicles/machines. Proper storage/transportation of materials. Watering the construction site to reduce dust.
25	Water Quality	Proper storage/transportation of materials. Proper disposal of waste water and water pollutants.
27	Wastes	Observing the laws/regulations of waste treatment and disposal. Applying proper waste management plan during construction.
28	Noise and Vibration	Using well maintained vehicles and machines that meet the national requirements. No idling of vehicles/machines. No construction activities that causes noises at night.
29	Subsidence	Proper designing and construction planning of embankment.
32	Accident	Education of workers on accident prevention. Proper safety measures during construction. Applying traffic control including installation of appropriate traffic control signs.

Source: JICA Project Team

23.1.7 Monitoring Plan

The Environmental Act 2000 stipulates that the project proponent is responsible for designing and conducting an environmental monitoring plan. The monitoring plan should be examined and developed based on the predicted impacts and the availability of equipment and facilities in the country. Some of the items expected to be monitored for the proposed Bypass Project are:

- Implementation of Resettlement Action Plan (if triggered): Compensation is made as agreed with the Project Affected Persons prior to the commencement of the construction activities.
- Air quality, water quality and noise: Measured values of monitored items are complied with national environmental standards. In the absence of such standards, international standards should be referred.

23.1.8 Stakeholder Meetings

A series of stakeholder meetings were conducted during the Lae-Nadzab Urban Develop Planning from June 2015 to June 2016. For the proposed Bypass Project, meetings with local stakeholders and directly affected parties should be carried out in future during environmental approval process and preparation of resettlement plan, once the details of the Project are fixed and the actual project scope is determined.

23.2 Land Acquisition and Resettlement

23.2.1 Land Acquisition and Resettlement

The proposed Bypass Project passes state land; hence land acquisition is not triggered. However, it is advisable to obtain an authorization on the Project plan by the relevant authorities for smooth implementation of the Project.

The proposed Bypass Project site runs along the boundary of Lae Tidal Basin Project, supported by ADB. Lae Tidal Basin Project has been implementing its Resettlement Action Plan (RAP), and the land is fenced to avoid an influx of settlers, but there are some settlers who returned to occupy. Within the proposed Bypass route, there are two to three houses and they may be avoided by adjusting the route alignment. Compensation for trees and crops within the proposed route may be needed.

23.2.2 Legal Frame for Land Acquisition and Resettlement

Relevant legislation for land acquisition and resettlement in PNG are:

- Land Act 1996: concerning any matters relating land, land lease and/or acquisition for development,
- Integrated Land Group Act 1974: concerning a mandatory requirement for customary landowners to register their groups and their land,
- Physical Planning Act 1989: concerning all matters relating to urban development, and,
- Environment Act 2000: mentioning land acquisition and compensation

In PNG, there is no legislation stipulating preparation of Resettlement Action Plan.

Gaps between PNG legislations and the JICA Guidelines for Environmental and Social Considerations are analysed in Table 14.1.3 in Chapter 14.

The resettlement for the proposed Project is expected by a very small scale, if nothing at all. In case of resettlement, an Abbreviated Resettlement Action Plan (ARAP) will be prepared in accordance with the legislation of PNG and the JICA Guidelines. Since Lae Tidal Basin Project site is adjacent to the proposed Bypass route, the RAP for Lae Tidal Basin Project should be referred.

The key authority for land management and relevant issues in the area is Department of Lands and Physical Planning of Momase Regional Office.

23.2.3 Scale of Land Acquisition and Resettlement

The proposed Bypass road is estimated to be 3.35km in distance Other than national roads, of which the Right of Way is set at 40m in width, there is no regulation to stipulate for the Right of Way of other types of roads. The width of the proposed Bypass road should be about 25m including the embankment and side ditches on the both sides, hence, the land for the proposed Bypass road will be secured for at least 25m in width, and up to 40m wherever possible by taking future expansion into consideration.

As mentioned above, there may be two to three houses within the route[2].

23.2.4 Compensation and Assistance Measures

As mentioned above, Lae Tidal Basin Project has developed and has been implementing its RAP. In case resettlement is triggered for the proposed Bypass Project, entitlement and conditions for compensations should be in line with those of the RAP for Lae Tidal Basin Project as much as possible, in order to keep the equality among the people affected by these projects.

23.2.5 Grievance Mechanism

Grievance mechanism should be clearly stated in the ARAP and explained to Project Affected Persons. The mechanism used for Lae Tidal Basin Project should be inherited if appropriate.

23.2.6 Implementing Organization

The Proponent of the proposed Project, the Morobe Provincial Government, is most likely to be the organization responsible for implementing the ARAP. This will be confirmed once Project Management Unit is established for the Project

23.2.7 Implementing Schedule

Schedule for implementing the ARAP should be clearly stated in the ARAP and explained to Project Affected Persons. Compensation payment should be completed and an adequate period must be set for relocation before the commencement of the actual work

23.2.8 Cost and Financing

[2] According to the field survey, the average household size in the area is 6 parsons per household.

Securing the cost for implementation of the ARAP and compensation payment is responsibility of the PNG side. Morobe Provincial Government is working on securing budget for the implementation of LNUDP.

23.2.9 Monitoring Organization

The Proponent of the proposed Project, the Morobe Provincial Government, is most likely to be the organization responsible for monitoring the implementation of the ARAP. This will be confirmed once Project Management Unit is established for the Project

23.2.10 Stakeholder Meetings

Meetings with Project Affected Persons will be held during preparation of the ARAP in order to explain about the purpose of the Project and scope of resettlement, and to build consensus on entitlement and policies of compensation, etc. The records of meetings will be attached to the ARAP.

23.3 Environmental Checklist

Environmental Checklist was prepared as Table 23.3.1.

Table 23.3.1Environmental Checklist

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a)N (b)N (c)N (d)N	(a)~(d) Environmental approval process for this Project is not yet started. The Proponent, the Morobe Provincial Government should submit Notification of Preparatory Work on Level 2 and Level 3 Activities to confirm if EIA is required or not. If EIA is required, it will be conducted and report will be prepared in accordance with the PNG legislation and the JICA Guidelines for Environmental and Social Considerations (2010) .
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a)Y/N (b)Y/N	(a)~(b) Stakeholder meetings at SEA level were conducted during the Lae-Nadzab Urban Development Plan Study. Stakeholder meetings for the selected Bypass project will be conducted during environmental approval process, in accordance with the PNG legislation and the JICA Guidelines for Environmental and Social Considerations (2010) .

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a)Y	(a)Three alternative routes and "without project" option were examined. Although two of the options are almost equal in terms of environmental, financial and technical aspects, one of them is more suitable because of fewer number of possible resettlement cases.
Pollution Control	(1) Air Quality	(a) Is there a possibility that air pollutants emitted from the project related sources, such as vehicles traffic will affect ambient air quality? Does ambient air quality comply with the country's air quality standards? Are any mitigating measures taken? (b) Where industrial areas already exist near the route, is there a possibility that the project will make air pollution worse?	(a)Y (b)N	(a)There is a possibility that vehicles and machines will emit air pollutant during construction activities. Mitigations measures, such as use of well-maintained vehicles and machines, no idling of machines/vehicles, watering of construction site, etc. will be in place. (b)There is no industrial area.
	(2) Water Quality	(a) Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? (b) Is there a possibility that surface runoff from roads will contaminate water sources, such as groundwater? (c) Do effluents from various facilities, such as parking areas/service areas comply with the country's effluent standards and ambient water quality standards? Is there a possibility that the effluents will cause areas not to comply with the country's ambient water quality standards?	(a)Y (b)N (c)NA	(a)The slope of the embankment will be covered with vegetation to prevent soil runoff. (b) Side ditches will be constructed to avoid runoff from roads to contaminate stream or marshland. (c) No such facility is included in the project.
	(3) Wastes	(a) Are wastes generated from the project facilities, such as parking areas/service areas, properly treated and disposed of in accordance with the country's regulations?	(a)NA	(a)No such facility is included in the project.
	(4) Noise and Vibration	(a) Do noise and vibrations from the vehicle and train traffic comply with the country's standards?	(a)Y	(a)The proposed route runs along the port project property and away from sensitive receptors (e.g. hospitals).

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a)N	(a)There are no protected areas near the proposed project site.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Are adequate protection measures taken to prevent impacts, such as disruption of migration routes, habitat fragmentation, and traffic accident of wildlife and livestock? (e) Is there a possibility that installation of roads will cause impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystems due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered? (f) In cases the project site is located at undeveloped areas, is there a possibility that the new development will result in extensive loss of natural environments?	(a)N (b)N (c)NA (d)NA (e)NA (f)NA	(a) There is no such habitat near the project site. (b) There is no protected habitat near the project site. (c) No significant impacts are anticipated. (d) No such impacts are anticipated. (e) No such impacts are anticipated. (f) The proposed project site is along the on-going Port Development project.
	(3) Hydrology	(a) Is there a possibility that alteration of topographic features and installation of structures, such as tunnels will adversely affect surface water and groundwater flows?	(a)Y	(a)Embankment of 1.5 m above the ground level will be built. Culverts and side ditches will be constructed to avoid flooding and adverse effect on surface water flows.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(4) Topography and Geology	(a) Is there any soft ground on the route that may cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides, where needed? (b) Is there a possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? (c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?	(a)Y (b)NA (c)NA	(a)The proposed site may be on soft ground. It is assumed that the settlement is 1.0 m per 1.5 m of embankment height. The sand mat of thickness 50 cm is set on the ground to promote settlement. (b) No such impact is anticipated. (c) No such impact is anticipated.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are the compensations going to be paid prior to the resettlement? (e) Are the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement?	(a)Y? (b)Y (c)Y (d)Y (e)Y (f)Y (g)Y (h)Y (i)Y (j)Y	(a)Two to three houses might be resettled, however, they may be avoided by adjusting the route alignment. (b)~(j) If resettlement is triggered, it will be only 2 or 3 houses. An Abbreviated Resettlement Action Plan will be prepared in accordance with PNG legislation and the JICA guidelines. RAP for Lae Tidal Basin Project funded by ADB will be referred as well.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?		
	(2) Living and Livelihood	(a) Where roads are newly installed, is there a possibility that the project will affect the existing means of transportation and the associated workers? Is there a possibility that the project will cause significant impacts, such as extensive alteration of existing land uses, changes in sources of livelihood, or unemployment? Are adequate measures considered for preventing these impacts? (b) Is there any possibility that the project will adversely affect the living conditions of the inhabitants other than the target population? Are adequate measures considered to reduce the impacts, if necessary? (c) Is there any possibility that diseases, including infectious diseases, such as HIV will be brought due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary? (d) Is there any possibility that the project will adversely affect road traffic in the surrounding areas (e.g., increase of traffic congestion and traffic accidents)? (e) Is there any possibility that roads will impede the movement of inhabitants? (f) Is there any possibility that structures associated with roads	(a)Y (b)N (c)Y (d)N (e)N (f)NA	(a)The objective of the Bypass road is to reduce port related traffic from the Highlands Highway. Positive impacts, such as better transportation, alternative route in emergency, etc. are anticipated. (b)No such impact is anticipated. (c)Awareness and education opportunities on disease preventions will be provided to workers throughout the construction stage. (d)The objective of the Bypass road is to reduce port related traffic from the Highlands Highway. (e)There are not many houses along the proposed route. (f)No such structure is included in the project.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(such as bridges) will cause a sun shading and radio interference?		
4 Social Environment	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a)NA	(a)No such heritage is present in the area.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a)N	(a)No such impact is anticipated.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources to be respected?	(a)NA (b)NA	(a)No such impact is anticipated. (b)No such impact is anticipated.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures being taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a)N (b)Y (c)Y (d)Y	(a)The proponent is not violating any laws. (b)Workers will be provided with safety equipment and continuous instructions on safety. (c)Environment, Health and Safety management will be provided by the contractor. (d)Security guards will be instructed not to violate safety of other individuals involved or local residents.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a)Y (b)N (c)Y	(a)Mitigation measures to reduce impacts during construction will be planned and put in place during the project implementation. (b)No such impact is anticipated. (c)If that is the case, mitigation measures will be applied.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a)Y (b)NA (c)Y (d)Y	(a)The Morobe Provincial Government will develop and implement monitoring programs during the proposed Project implementation. (b)The monitoring items will be examined during the process of obtaining the environment permit. They are most likely implementation of resettlement (if any), air quality, water quality, noise, working environment, infectious disease, etc. (c)The Morobe Provincial Government will secure the budget for the implementation of the project including monitoring program. (d)There is no specific regulatory requirement to monitoring system in PNG, except that monitoring and reporting are responsible of the proponent. The format and frequency of reports may be determined during environmental approval process.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Forestry Projects checklist should also be checked (e.g., projects including large areas of deforestation) .(b) Where necessary, pertinent items described in the Power Transmission and	NA	No such impact is anticipated.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		Distribution Lines checklist should also be checked (e.g., projects including installation of power transmission lines and/or electric distribution facilities).		
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed, if necessary (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	NA	No such impact is anticipated.