

Initial Environmental Examination

April 2016

PNG: HIGHLANDS REGION ROAD IMPROVEMENT INVESTMENT PROGRAM

Gewa to Gembogl Road

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CURRENCY EQUIVALENTS

(as of August 2015)

Currency Unit – Kina (K)

K1.00 = \$0.37 \$1.00 = K2.70

ABBREVIATIONS

ADB	–	Asian Development Bank
AP	–	Affected people
BCD	–	Bid and contract documentation
BOQ	–	Bill of Quantities
CEMP	–	Construction Environmental Management Plan
CEPA	–	Conservation and Environment Protection Authority
CSC	–	Construction Supervision Consultant
DBST	–	Double bitumen surface treatment
DC	–	Design Consultant
DLPP	–	Department of Lands and Physical Planning
DOW	–	Department of Works
EA	–	Executing Agency
EARF		Environmental Assessment and Review Framework
EMP		Environmental Management Plan
ESSU		Environment and Social Safeguards Unit
EMU		Environmental Management Unit (in DOW's PIU)
EO		Environmental Officer (in DOW's ESSU)
EP		Environmental Permit
EHSO		Environmental, Health and Safety Officer (contractor)
EPAR		Environmental (Prescribed Activities) Regulation 2002
ESSU		Environmental and Social Safeguards Unit (in DOW)
GoPNG		Government of Papua New Guinea
GRM		Grievance and Redress Mechanism
HRMG		Highlands Region Maintenance Group
HRRIIP		Highlands Region Roads Improvement Investment Program
IA		Implementing Agency
IES		International Environmental Specialist (in DOW-ESSU)
IEE		Initial Environmental Examination
LLG		Local-Level Government
MFF		Multi-Tranche Financing Facility
NGO		Non-governmental organization
NRA		National Roads Authority
PFR		Periodic Financing Request
PIU		Project Implementation Unit (in DOW)
PNG		Papua New Guinea
QPR		Quarterly Progress Report
RE		Resident Engineer
SPS		Safeguard Policy Statement
SEC		Secretary of Conservation and Environment Protection Authority
RP		Resettlement Plan

EXECUTIVE SUMMARY

1. **Background.** The Government of Papua New Guinea (the government) has requested assistance from Asian Development Bank (ADB) in financing the Highlands Region Road Improvement Investment Program (HRRIP) through a Multi-tranche Financing Facility (MFF). The HRRIP is improving the Highlands Region Core Network (HRCN) in the Highland Provinces of Enga, Southern Highlands, Western Highlands, Eastern Highlands, Simbu, Jiwaka and Hela. The first tranche (Project) implemented improvements of two road sections and the second Project is about to commence upgrading and rehabilitating three road sections while Project 3 proposes the upgrading and rehabilitation of another four road sections of the HRCN.

2. **Regulatory framework.** The environmental protection framework of the government is based in the Environment Act 2000 and the Environment (Prescribed Activities) Regulation 2002 (EPAR) which categorizes activities and projects that need environmental assessment as “Prescribed Activities” in two schedules according to the anticipated potential environmental impact. Projects that are likely to have significant adverse environmental impact (Level 2 and Level 3) are required to obtain an environmental permit (EP) from the Conservation and Environment Protection Authority (CEPA) following environmental assessment. In addition to the government requirements, the HRRIP must comply with ADB’s Safeguard Policy Statement 2009 (SPS). An environmental assessment and review framework (EARF) has been prepared to guide the implementation of, and compliance with, environmental safeguards during Project 3. According to the SPS and understanding of impacts created and mitigated in Projects 1 and 2, the Gewa to Gembogl Road sub-project in Project 3 is a category B activity because the potential adverse environmental impacts are site-specific, few if any of them are irreversible, and mitigation measures can be readily designed.

3. **Scope and description of the sub-project.** This initial environmental examination (IEE) covers the 21.025 km long section of Gewa to Gembogl Road in Chimbu (also written as Simbu) Province as one subproject in Project 3. The works proposed for the upgrading and rehabilitation of the Gewa to Gembogl Road such as earthworks, establishment and operation of quarry sites and extraction of materials, minor civil works and discharge of wastewater are Level 2 activities under the EPAR and may require an EP depending on the duration and scale of those activities.

4. It is proposed to rehabilitate the existing road and provide a 6.0 meter wide carriageway with double bitumen surface treatment (DBST) and 1.0 meter wide gravel shoulders which will be sealed as necessary to prevent possible scour/erosion. The horizontal and vertical alignments will follow the existing alignments as much as possible with improvements limited to those consistent with meeting stopping sight distance requirements. The estimated cost of rehabilitation and upgrading of the Gewa to Gembogl Road is Kina 106,659,192.18. The construction period is expected to be 24 months.

5. **Impacts and mitigation.** The findings of the IEE are that the environmental impacts of the proposed rehabilitation of the Gewa to Gembogl Road will be limited to the works corridor, will be of minor scale and can be mitigated and/or managed provided that the measures established in the environmental management plan (EMP) are implemented thoroughly. The impacts will mostly occur during the construction phase and include dust, noise, materials sourcing, storage, and haulage, erosion control, sedimentation and run-off. The IEE also sets out the requirements for monitoring. The cost of EMP inclusive of the design, construction and operation phases for the sub-project is \$ 440,200.00. The costs of mitigation and monitoring will be included in the contractor’s bidding price.

6. **Consultation and Disclosure.** As required by the ADB's SPS and Public Communications Policy 2011, public consultations were undertaken during the preparation of this IEE and social safeguards documents. The main purpose of the consultations was to present the proposed sub-project, illicit issues and concerns that the people, stakeholders, and concerned parties in the impact area may have, and provide a mechanism for addressing those concerns and issues as far as possible.

7. The Project's communications and consultation plan will ensure that regular dialogue during all phases of project implementation is undertaken with stakeholders and communities. Through the Project's grievance redress mechanism (GRM), the project office on site will receive and document issues and concerns that stakeholders may have relative to the project and its implementation. Resolution of these issues and concerns will be undertaken expeditiously and according to the procedures of the GRM. The complaints/issues registry maintained at the site project office will be subject to monitoring.

8. **Institutional arrangements.** The sub-project will be implemented by Department of Works (DOW) and the Highlands Region Maintenance Group (HRMG). During the construction phase, a construction supervision consultant (CSC) will support the HRMG who will have the main responsibility for the overall management, monitoring and reporting on safeguards implementation for the subproject. The HRMG, supported by the CSC, will be tasked with: (i) securing all EPs and government clearances; (ii) implementing and monitoring of safeguards during construction and operation; (iii) providing induction training to contractors prior to preparation and submission of the construction EMP (CEMP) for each subproject; (iv) providing assistance for review and clearance of the CEMPs prior to commencement of construction; (v) monitoring compliance with the approved CEMP of each subproject; and (v) preparing reports on environmental safeguards activities as required by the EMP

9. **Monitoring and reporting.** Monitoring requirements are set out in the EMP. The contractor will report on implementation of the CEMP in its monthly reports. The DOW and HRMG will report on subproject progress to ADB on a quarterly basis and the quarterly progress reports will contain a section on compliance of the contractor with the CEMP based on the contractor's monthly reports and field inspections and spot checks. As noted above, the GRM and complaints/issues registry maintained at the site project office will be subject to monitoring. In addition, DOW will submit to ADB semi-annual safeguards monitoring reports which will report on implementation of safeguards measures (including land matters) and also cover training and capacity building. The safeguards monitoring reports will be disclosed on ADB's website.

10. **Conclusion.** This IEE concludes that there are no significant environmental impacts likely to result from the proposed works. The implementation of the EMP will ensure that anticipated impacts will be mitigated and managed and any residual impacts will be within acceptable levels. Through support from the CSC the environmental management and the capacity of DOW for environmental management will be improved.

I. INTRODUCTION

A. The Program

1. **Background.** The Highlands Region of Papua New Guinea (PNG), comprising the Provinces of Western Highlands, Southern Highlands, Eastern Highlands, Enga, Jiwaka and Chimbu, is a major contributor to the PNG economy through its agricultural production and mineral resources. A well-maintained road network is essential to facilitate the movement of goods and people. The Government of PNG (the government) has made significant investment in improving the road network but a lack of maintenance has resulted in deterioration of the roads such that the Highlands Core Road Network (HCRN) is now in poor condition.

2. In order to address the deterioration of the HCRN there is a clear need to: (i) implement a program of regular maintenance on all HCRN roads that are in good condition; and (ii) improve those roads that are in poor condition and ensure that maintenance begins on these roads as soon as the improvement works are completed.

3. The government is being supported by the Asian Development Bank (ADB) to implement a road network improvement program through multi-tranche financing facility with to implement the Highlands Region Road Improvement Investment Program (HRRIIP). The HRRIIP will include projects to improve the HCRN, the preparation of long-term maintenance contracts for the HCRN, and develop the capacity development of road agencies. Project 1 has included improvement to two road sections and Project 2 proposes to upgrade three road sections while Project 3 proposes to rehabilitate four road sections comprising 113.3 km of the HCRN. The Department of Works (DOW) is the executing agency and the implementing agency is the Highlands Road Maintenance Group (HRMG). Institutional strengthening will also be provided to the National Roads Authority (NRA)

4. **Objectives of the program.** The overall objective of the HRRIIP is firstly to improve the deteriorated sections of the HCRN and to establish sustainable maintenance programs for the HCRN, and secondly to strengthen the capacity of the DOW and NRA to manage these programs. The establishment of a sustainable transport system will provide a basis for increased economic and social development in the Highlands Region through improved access to ports, markets and livelihood opportunities together with reduced travel times and transport costs. The HRRIIP will support GoPNG's Development Strategic Plan 2010-2030 and the National Transport Development Plan. The HRRIIP will establish a sustainable maintenance program for the HCRN through the implementation of the following:

- (i) The improvement of 1,400Km of the HCRN to be funded through the four tranches under the MFF and to be implemented under contracts which will include the provision for 10 years of maintenance of the roads upon completion of the improvement works;
- (ii) Long term maintenance contracts for 1,100Km of the HCRN which are considered to be in a maintainable condition; and
- (iii) Capacity building and institutional strengthening of DOW, HRMG and NRA to ensure the future success and sustainability of the Program.

5. **The Sub-Project.** For the sub-project – Gewa to Gembogl Road - an environmental assessment has been undertaken of the proposed works for the upgrading and rehabilitation of

the 21.025 km to comply with the requirements of the government's Environment Act and ADB's Safeguard Policy Statement (SPS) 2009. This initial environmental examination (IEE) presents the environmental assessment for the upgrading and rehabilitation of the existing Gewa to Gembogl Road.

6. The upgrading and rehabilitation of Gewa to Gembogl Road is not a Level 3 of the "Prescribed Activities". However, certain project activities commonly associated with upgrading, improvement works such as earthworks, establish and operation of quarries, and materials extraction, minor civil works and discharge of wastewater are Level 2 activities that may require an environmental permit (EP) depending on the duration and scale of those activities. The Environmental and Social Safeguards Unit (ESSU) of DoW will review the IEE with regard to its Code of Practice for Environmental Assessment of Roads and Bridges and make the necessary notifications to Conservation and Environment Protection Agency (CEPA) (under Section 48 of Environment Act 2000) for determination on the need for an EP.

B. Overview and Context

7. **Rationale and need.** The creation and sustainable support to economic growth requires a good road network. A well-maintained transport infrastructure is a critical requirement for the efficient flow of consumer goods and services to and from villages and communities. This would ensure that vital connectivity between production areas and markets are existent which would make transport between centers fast, efficient and cost effective.

8. The majority of the population of PNG (85% of the total population as per the latest census of 2011) is in the highly dispersed and culturally diverse rural areas characterized by very rugged topography, swamps, and water bodies, which constrain the development of a national road transport and have resulted in a fragmented road network. Consequently, improvement of the transport service delivery, providing improved economic, and income opportunities are a priority undertaking of the GoPNG. The improvement of the existing rural road networks will result to the establishment of new markets, improve agricultural production, facilitate supply and market chain linkages with post-harvest and downstream processing facilities and export markets and more importantly, improve access to and expand education and health services. These initiatives are expected to create a significant increase in income and improvement in standard of living.

9. The existing Gewa-Gembogl road bench was established in the 1970s and there has been little improvement since then apart from the first 10 Km from the Kundiawa junction which has recently been upgraded through another ADB loan project. The road traverses mountainous terrain with the road bench, which averages 4 to 5 meters wide, being cut into steep sidelong ground. The existing horizontal and vertical alignment of the road is dictated by the mountainous nature of the terrain and the presence of significant outcrops of hard rock in the existing cut slopes. As a consequence, there are numerous tight radius horizontal curves and vertical gradients exceeding 10%, the improvement of which would not be economically justifiable. The existing road drainage is in poor condition with culverts frequently damaged and blocked and side drains lacking as a result of a lack of maintenance.

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A. Papua New Guinea Environmental Laws

10. **Country safeguard systems.** The Environment Act 2000 and Environment (Prescribed Activities) Regulation 2002 (EPAR) address environmental impact assessment and management. The Environment Act provides for the sustainable management of the biological and physical components of the land, air and water resources of the country. The CEPA administers both the Act and the EPAR. The EPAR categorizes projects as “Prescribed Activities” in two schedules according to the anticipated potential environmental impact. Schedule 1 consists of Level 2 activities that are subdivided into two categories (Category A and B). Category B has 13 sub-categories with sub-category 12 addressing Infrastructure Development. While item 12.5 includes construction of new national roads, there is no specific activity covering the upgrading or rehabilitation of existing roads. However, a number of activities associated with upgrading of existing roads such as quarrying, extraction of gravel etc. may require EPs from CEPA.

11. The CEPA, as the government’s environmental management agency, operates with the mission statement: To ensure PNG’s natural resources are managed to sustain environmental quality, human well-being and support improved standards of living (CEPA Corporate Plan (2009-2012). The CEPA consists of three divisions: Environment Protection responsible for environmental approvals; Sustainable Environment Management; and Policy Coordination and Evaluation.

12. CEPA has issued several guidelines including Guideline for submission of an application for an environmental permit to discharge waste (GL-Env/03/2004) which covers: noise discharges (IB-ENV/03/2004); air discharges (IB-ENV/02/2004); and water and land discharges (IB-ENV/04/2004).

13. CEPA operates at the national level from its office based in Port Moresby. It does not have offices and staff in the provinces. All environmental approvals are done in the central office in Port Moresby. As part of the GoPNG decentralization policy, CEPA has to work in close consultation with the provincial governments through the respective provincial administrations to ensure implementation of environmental legislation at the provincial level. Certain environmental management and monitoring functions are delegated to provincial administrations on an “if and when” they have the resources and capacity to conduct these activities.

14. The following legislation will also apply to the project:

- (i) **Public health.** The Public Health Act 1978 protects the general public by regulating and controlling the unplanned disposal of any environmental contaminants such as domestic or industrial waste and/or refuse that will have some kind of impact on the lives of people. The act regulates the proper and planned establishment of waste disposal points such as rubbish dumps and landfills so that such establishments are seen to be causing minimal inconvenience to people’s lives. The act also covers all the activities that pose risks and potential risks, and inconveniences to the usage of the environment surrounding the area of activity. As the subproject will affect the lives of people, especially the local community downstream, this act is applicable and has been taken into consideration;

- (ii) **Labor health and safety.** The Employment Act 1978 is an act relating to the employment of nationals and non-citizens. The act covers recruitment, conditions of employment as well as health and safety aspects and is administered by the Department of Labor and Employment. Conditions of this act are relevant to the health and safety of workers employed during construction and are reflected in the IEE;
- (iii) **Forestry.** The Forestry Act 1991 has the objective to manage, develop and protect PNG forest resources and environment in such a way as to conserve and renew them as an asset for succeeding generations;
- (iv) **Cultural resources.** The National Cultural Property Preservation Act 1965 covers the preservation and protection of objects of cultural or historical importance. This act is administered by the National Museum and Art Gallery. Should “chance finds” be made during construction this act will be triggered, provisions for this have been made in the EMP;
- (v) **Water quality.** Drinking water quality standards for raw (untreated) water are contained in the Public Health Drinking Water Quality Standards 1984 while the standards for aquatic life protection are listed in the Environment (Water Quality Criteria) Regulation 2002. Ranges of criteria are given for several parameters including turbidity, which should not exceed 25 NTU. Since many of the water courses in PNG are naturally quite turbid this standard appears to be unrealistic as it is close to drinking water standard. Therefore, the pre-project turbidity in the watercourse is suggested as the standard for assessing turbidity during construction.

15. Other related legislation administered by CEPA includes; the Fauna Protection and Control Act (1966), the Conservation Areas Act (1978), the International Fauna and Flora Trade Act (1978), and the National Parks Act (1984). PNG is a signatory to a number of international agreements (treaties and conventions). These are listed in Annex A.

B. Asian Development Bank Safeguard Requirements

16. **Safeguards.** In addition to complying with country safeguards Project 3 will also need to comply with ADB’s SPS (2009) which sets out the policies and principles for protecting the environment and people by wherever possible avoiding impacts and mitigating and/or compensating for impacts that cannot be avoided. ADB’s SPS is a policy document in respect of safeguards and avoiding, minimizing or mitigating adverse impacts on people and the environment. For projects with a number of components or subprojects, SPS requires the preparation of safeguards (environment and resettlement frameworks) which set out the processes to be followed for screening and assessment of each sub-project.

17. **The framework.** An EARF has been prepared for Project 3, setting out the procedures for complying with the principles and requirements of SPS. The EARF: (i) reflects the policy objectives and relevant policy principles and safeguard requirements governing preparation and implementation of projects and/or components; (ii) explains the general anticipated impacts of the project and/or components; (iii) specifies the requirements that will be followed for subproject screening and categorization, assessment, and planning, information disclosure, meaningful consultation, and grievance redress mechanism; (iv) describes implementation procedures, including budgets, institutional arrangements, and capacity development

requirements; (v) specifies monitoring and reporting requirements; and (vi) specifies the responsibilities and authorities of the government and ADB.

18. **Gap analysis and filling.** If gaps exist between ADB's requirements and country laws, or where gaps in borrower's capacity are apparent, the safeguard frameworks should include the details of the specific gap-filling requirements to ensure that policy principles and safeguard requirements are achieved. The EARF prepared for Project 3 sets out the capacity building measures that will be implemented during the Project. Under the SPS, the subproject is classified Category B because the potential adverse environmental impacts are site-specific, few if any of them are irreversible, and mitigation measures can be designed readily. The appropriate level of environmental assessment for environment category B is an IEE.

19. The objectives of this IEE are to: (i) identify and describe the existing environmental conditions in the project area including the identification of environmentally sensitive areas; (ii) assess the proposed works and activities to identify their potential impacts, evaluate the impacts, and determine their significance; and (iii) propose appropriate mitigation measures that can be incorporated into the proposed activities to minimize any adverse impacts, ensure that residual impacts are acceptable and establish the requirements for monitoring of the subproject.

20. **Structure of the report.** The IEE is based on primary and secondary sources of information and data obtained on-site through investigation, survey and interviews. The original study for the preparation of this IEE was undertaken in 2013 with updating and further studies being undertaken in March and November 2015. There are no environmental studies or inventory of plants and animals conducted in the road influence area, thus the team conducted an interview from the local people and leaders in the area to gather information/data needed for this report. During the field studies the existing roadway and immediate environment, including watercourses, were inspected and taking photos for documentations of the existing environment where the methodologies used in the preparation of this IEE report. Public consultations with government stakeholders and communities adjacent to the road were undertaken as part of the IEE process to determine community attitudes to the development and obtain relevant information. The report structure follows the format outlined in Appendix 1 of the SPS.

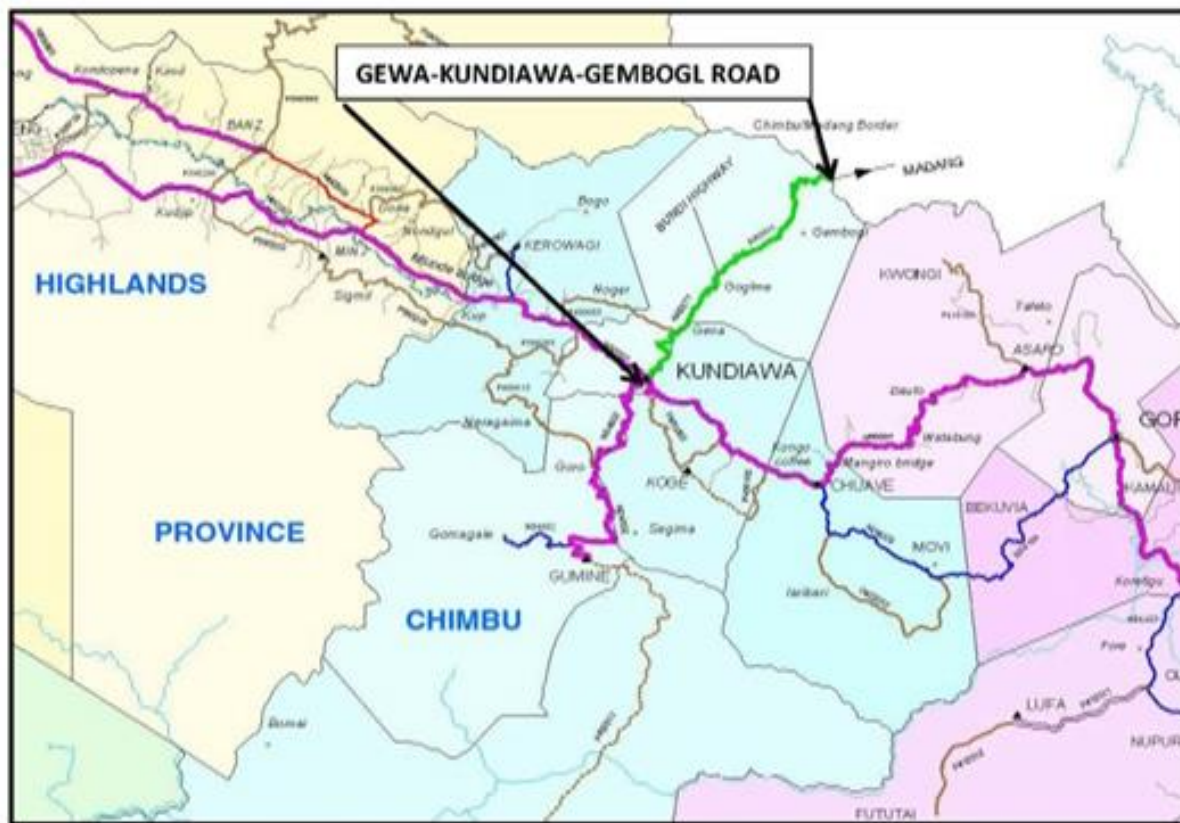
21. The IEE consists of eleven sections including the executive summary and this introduction. The following sections include; policy, legal and administrative framework; description of the sub-project; description of the environment; anticipated environmental impacts and mitigation measures; information disclosure, consultation, and participation; grievance redress mechanism; environmental management plan; and conclusions and recommendations. There are a series of annexes at the end of the report.

III. DESCRIPTION OF THE PROJECT

A. Description of the Sub-Project

22. The existing Gewa to Gembogl Road is the first part of the old Bundi Highway which runs in a north east direction from Kundiawa Town and eventually connects through to Bundi in Madang Province. The location of the Gewa-Gembogl Road is shown in Figure 3.1.

Figure 3.1 Location of Gewa to Gembogl Road



23. The first 10.6 kilometers from Kundiawa to Gewa has recently been improved. This report covers the next 21 km section from Kokonigle Bridge, Gewa to Gembogl Station. The road serves as the primary access for the remote rural populations living in the northern part of Simbu Province to the township of Kundiawa. The road is the only link to the major tourist destination of Mt. Wilhelm, a major trout farm industry, and is used by the people to transport cash crops, coffee in particular. This is also the main supply route to two mines, located near Gembogl. The upgrading of this road is expected to improve vital commercial trade and promote agricultural activity, improve living standards and facilitate access for government services to reach the people.

24. The alignment of the Gewa – Gembogl road runs along the valley of the Simbu River. The terrain is rugged and mountainous with very steep slopes and frequent rock outcrops. The road is benched into these slopes and there are steep drops to the river below and almost vertical cut faces above. The topography is such that sites for the development of settlements are limited. The alignment passes through 10 major and 12 minor villages/settlement areas, the largest of which is Womatne. These settlements are generally clusters of tribal houses, typically numbering around 15 to 20 with additional linear development in major villages. Elsewhere along the route there are occasional structures but the rugged terrain limits the areas where construction is feasible. Similarly, the opportunities for cultivation immediately adjacent to the road corridor are restricted.

25. The vegetation is dominated by wild grasses and shrubs scattered along the steep roadside slopes. There are occasional shade trees, mainly Casuarina and trees classified as

lesser known but useful trees including fruit bearing trees growing in the flatter portions in the vicinity of settlements and alongside creeks.

26. The horizontal and vertical alignment of the existing road is largely dictated by the mountainous and rocky nature of the terrain. There are numerous tight radii curves and significant lengths where the vertical gradient exceeds 10%. The existing formation is typically 4 to 5 meters wide and the road is benched into steep sidelong ground. Improvement of the horizontal and vertical alignments would require massive earthworks and rock-blasting that may not be economically justified. Improvements will therefore be limited to providing a 6.0 meter carriageway with 1.0 meter shoulders and appropriate stopping sight distances for the safety of road users. Widening of the existing road bench will be achieved through cutting into existing slopes rather than by the widening of embankments from the river level up to the road level.

27. The route crosses the Simbu River twice, at Seme and Kaer bridges, and has six further bridge crossings of creeks which flow into the Simbu River. All of the bridges will be retained with varying degrees of rehabilitation of the superstructures and replacement of the existing timber decking with steel plates.

B. Proposed Works

28. It is proposed to rehabilitate the existing road and provide a 6.0 meter wide carriageway with DBST and 1.0 meter wide gravel shoulders which will be sealed as necessary to prevent possible scour/erosion. The horizontal and vertical alignments will follow the existing alignments as much as possible with improvements limited to those consistent with meeting the required pavement width and stopping sight distance requirements. The route traverses through mountainous terrain and significant excavation will be required in existing cut slopes to widen the existing road bench to the required width. An average width of 2.5 m each side of the existing cleared area will be required to accommodate the earthworks. In practical terms this additional work will only be taken on one side of the road where cuttings will be made. It will also be necessary to provide slope protection and retaining structures to ensure the long term stability of the road.

29. A total volume of 480,000 cu.m. of excavation will be necessary to accommodate the carriageway, shoulder and drainage. Of this volume, 50,000 cu.m. will be reused in embankment, 130,000 is expected to be unsuitable which will need to be disposed of together with approximately 300,000 cu.m. of surplus material. The selection and management of disposal sites will be of the utmost importance in the execution of the earthworks.

30. There are nine existing bridges within the road section, details of which are given in the Table 3.1. All of the bridges are in maintainable condition and will only require minor repairs, clean and painting and the provision of steel decking (apart from Kaer 2 Bridge)

Table 3.1 Bridge Details of the Gewa to Gembogl Road

BRIDGE NAME	CHAINAGE	SPAN	TYPE
Gewa	11+860	22.24	Standard Bailey
Yombai	13+704	21.61	Standard Bailey
Seme	17+440	27.73	Compact 200
Nununige	20+048	12.41	Standard Bailey
Kaer 2	23+520	34.04	Compact 200 with Steel Deck
Davai	24+786	18.58	Standard Bailey
Kombukme	26+628	15.42	Standard Bailey
Bendam	28+346	15.42	Standard Bailey
Akonige	30+825	23.00	Steel Truss

31. All rivers and streams carry clear water in the dry season. Communities along the road depend heavily on water courses for their domestic activities. The civil works will therefore have a high impact on the community that dictates the necessity to coordinate construction adjacent to water courses with community needs.

32. The condition and extent of the existing drainage along the road is variable. There are 46 existing culverts which require removal and replacement due to their deteriorated condition or inadequate capacity. A further 46 culverts are to be provided as relief culverts to provide outlets for proposed roadside drains. Fifteen existing culverts are to be retained with extensions and/or improvements to inlet/outlet structures as necessary. The rehabilitation and upgrading would approximately take 24 months and would involve the following:

- (i) Transport, handling and storage of construction materials, fuel and machinery to site;
- (ii) Preparation of contractor's camp and work sites;
- (iii) Establishment of ancillary facilities, i.e. identification and establishment of suitable material sources/quarries, batching, crushing and asphalt plants, quarry sites, dumping areas;
- (iv) Clearing and grubbing (shoulders and drainage);
- (v) Excavate defective sections and improve side drains as required;
- (vi) Excavation and/or filling to widen the existing road bench
- (vii) Culvert removal, installation, extension and/ or replacement;
- (viii) Construct masonry retaining walls;
- (ix) Construction of gabion protection works;
- (x) Rehabilitate bridges which may include installation of new steel decks if necessary, earth works, removing rust and repainting, waste removal;
- (xi) Backfill and compact as required;
- (xii) Layout sub-base and base materials and, compaction;

- (xiii) Install road furniture required (guardrails, pavement markings, etc.);
- (xiv) Revegetation.
- (xv) Removal of several trees (bamboos, casuarina and few fruit bearing and mature trees); and
- (xvi) Pave roadway.

33. The upgrading and rehabilitation works for the Gewa to Gembogl Road would require 216 people of which 105 unskilled workers will be sourced from the local communities in the area. Various machinery and heavy equipment will be required in the rehabilitation and upgrading works. This would range from 4WD vehicles to bulldozers. Annex B presents the manpower complement and machinery and equipment required for the works.

34. The works require materials including fuel, lubricants, paint, bitumen, cement, aggregates, sand, timber, geotextile, steel plates, drainage pipes, gabion baskets, culvert pipes, trees and plants. All the materials will be sourced from approved suppliers whilst some locally procurable materials will be supplied by the community. Workers, including local women, will make gabions using local materials for embankment and bridge pier protection.

IV. DESCRIPTION OF THE ENVIRONMENT

A. Physical Environment

35. **Topography.** The Gewa-Gembogl Road section is located in Chimbu Province in the broad, mountainous core of PNG known as the Highlands Region, and which consists of numerous, sometimes large valleys at 1,100m to 1,800m above mean sea level (msl) with intervening ranges of hills and mountains (often steep and rugged) rising in many places to 3,000msl. Chimbu Province occupies roughly 6,000 km² of the PNG highlands. The province extends from Mt. Wilhelm (the highest mountain in PNG) in the north, to the lowlands south of Karimui. The Chimbu and Koronigl rivers flow south from the slopes of Mt Wilhelm into the Wahgi Valley. The plains and hills of the Wahgi Valley are densely settled, and this is one of the major smallholder coffee growing regions in the country. The relatively unoccupied southern part of the province is dominated by the Tua Valley and isolated peaks of the extinct volcano, Mt. Karimui. Altitude ranges from 300 m in the Purari Valley in the south of the province, to over 4,500 m on the summit of Mt Wilhelm. Most people live within an altitude range of 1,400 – 2,000 metres. Average annual rainfall varies from 2,200 to 4,000 mm, and increases from north to south. The six districts in Simbu are Chuave, Gumine, Karimui-Nomane, Kerowagi, Kundiawa and Sina-Sina-Yonggamugl.

36. Kundiawa District is in the northeast of the province and covers the Wahgi Valley south of Kundiawa, the Chimbu Valley and the mountains of the Sepik-Wahgi Divide, including Mt. Wilhelm. The high altitude areas of the Mt. Wilhelm Range are in the northwest of the district. Average annual rainfall ranges between 2,100 and 2,700 millimeters. Altitude varies from 1,300 m in the Wahgi Valley, to over 4,500 m on the upper slopes of Mt. Wilhelm. Most people live between 1,400 and 2,500 meters. Note that the district is sometimes called Kundiawa-Gembogl District.

37. The Highlands hills and mountain ranges are formed mainly on a wide range of sedimentary rock types of Mesozoic and Tertiary age. These rocks are predominantly fine grained mudstones and shale with some coarser poorly sorted sandstone. Massive limestone and quartzite also occur. There are several large andesitic volcanoes of late Tertiary and Quaternary age and the thick ash and lahar (i.e. debris avalanche) deposits produced by this mantle, the floors of the major highland valleys and their adjacent foot-slopes. The soils formed on these volcanic deposits are highly suitable for cultivation and much of both the subsistence and cash cropping agriculture (especially coffee and vegetables) in the highlands.

38. The route traverses mountainous terrain with high steep slopes, numerous deep valleys and fast flowing watercourses which present potential erosion problems. The first 8 Km of the alignment are dominated by the presence of the Chimbu Limestone formation with steep but stable slopes. There is evidence of numerous springs within the limestone faces and occasional cave formations are visible from the road. The succeeding section of the road passes through more volcanic materials which results in some instability being encountered. Where excavation of existing slopes is necessary to achieve the required road width, the specified slope angles are appropriate for the stability of the exposed material. Where slopes exceed 6 to 7 meters in height, berms are proposed together with berm drains to enhance stability.

39. Papua New Guinea lies in the collision zone between two major tectonic 'Plates', i.e. the Pacific and the Australian Plate, which is associated with earthquakes and volcanic activities. Overall, seismic activity in PNG is mostly evidenced by landslides and subsidence and to a lesser extent changes in watercourses. In the Highlands regions, there is no record of volcanic activity or recent large-scale devastation due to earthquakes. Smaller earthquakes, combined with heavy rainfall, are responsible for many deteriorated sections of all the national and rural roads, especially in Chimbu Province.

40. **Climate.** The subproject area is characterized all year round by warm to very warm days (temperatures in the mid to high 20s°C) and cool to warm nights (mid 10s to low 20s°C). Typically, the northwest and southeast trade winds dominate the broad-scale surface wind patterns over the Highlands Region. The northwest winds are predominant during the (monsoon) season, mostly between November and March. April and May are transitional months where the wind starts to shift to southerly. The southeasterly in contrast are dominant from months June to August with September and October being transitional months when wind is variable. Table 4.1 provides the average monthly and annual rainfall for the meteorological station in Kundiawa which covers the subproject area.

41. **Climate change.** Climate change is predicted to affect several climate attributes that influence the function, use and integrity of navigational infrastructure, including temperature, ocean acidification, sea level, and sea temperature. The International Panel on Climate Change's (IPCC)¹ projects that for the Pacific region, anthropogenic climate change will cause: (i) sea levels and sea water temperature to rise, contributing to greater incidence of coastal flooding; and (ii) increased cyclone intensity, with Category 4 and 5 cyclones more common, although with lower frequency. Globally, emissions are tracking at the upper emissions scenarios. "A2" Modeling refers to the schedule of emissions scenarios developed by the IPCC for its Special Report on Emissions Scenarios (SRES). Under A2 modeling (high emissions scenarios), air temperature is projected to increase more than 2.5°C, with sea level rise of 0.20m – 0.60m by 2090 (not accounting for ice sheet dynamics)².

International Panel on Climate Change: Climate Change – Fourth Assessment Report: Synthesis Report (2007)

² IPCC Working Group I: The Scientific Basis. <http://www.ipcc.ch/ipccreports/tar/wg1/029.htm>

42. The Pacific Climate Futures project has projected minimum temperature increases of 1.1°C by mid-century for PNG.³ The location of PNG near the Equator and its landforms contribute to high levels of variation in climate among various regions of the country. This climate variation means that accurate assessments of potential climate change impacts in PNG require regional context. However, at the national level, recent studies indicate that PNG's climate is indeed changing. For example:

- (i) Annual and seasonal ocean and land surface temperatures have increased by 0.6°C to 1.0°C since 1910;
- (ii) Since the 1970s, decadal average temperature has increased by 0.3°C-0.5°C.
- (iii) Significant increases have been observed in the annual number of hot days and warm nights, with significant decreases in the annual number of cool days and cold nights.

³ *Pacific Climate Change Program: Climate Change in the Pacific: Scientific Assessment and New Research*, CSIRO (2011)

Table 4.1.Average Monthly and Annual Rainfall, 1991-1995, Kundiawa Meteorological Station

STATION NO : **90022**
NAME : **KUNDIAWA**
LATITUDE : **06.02 SOUTH**
LONGITUDE : **144.97 EAST**
ELEVATION : **1,493.5 METERS**
UNIT : **MILLIMETERS**

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1991	221.6	255.6	118.4	172.6	120.2	57.8	218.4	173.2	128.2	243.2	206.2	354.8	2270.2
1992	216.6	409.2	398.6	315.4	209.2	63.4	39.8	113.0	105.6	208.4	112.2	187.8	2379.2
1993	336.0	142.6	263.6	192.8	29.4	117.2	239.0	85.0	145.8	208.4	263.0	385.4	2408.2
1994	244.0	202.4	198.4	171.4	312.0	129.8	219.8	175.8	251.8	104.4	178.2	245.8	2433.8
1995	309.4	203.8	310.0	136.0	98.0	139.6	166.2	249.6	256.2	372.2	301.4	293.8	2836.2

RAINFALL SUMMARY FOR PERIOD 1968 TO 1972, USING ALL AVAILABLE DATA													
TOTAL	1327.6	1213.6	1289.0	988.2	768.8	507.8	883.2	796.6	887.6	1136.6	1061.0	1467.6	12327.6
HIGHEST	336.0	409.2	398.6	315.4	312.0	139.6	239.0	249.6	256.2	372.2	301.4	385.4	2836.2
LOWEST	216.6	142.6	118.4	136.0	29.4	57.8	39.8	85.0	105.6	104.4	112.2	187.8	2270.2
YEARS	5	5	5	5	5	5	5	5	5	5	5	5	5

Source: National Weather Service, Jacksons Airport, Port Mo

43. The Pacific Climate Futures program has been preparing regionalized climate change projections for application at the national scale. Dynamic downscaling of Global Circulation Models (GCMs) to 60km and 8km grids undertaken for PNG provide summarized in Table 4.2. Given that the expected design life of the road improvements anticipated for this program is 20-30 years, these projections consider 2030 and 2055 timeframes only.

Table 4.2 Climate Change Projections for PNG for the A1B scenario

Climatic variable	2030 projections (annual averages)	2055 projections (annual averages)
Surface air temperature (°C)	+0.8°C	+1.45°C
Total rainfall (%)	+1.2%	+8.8%
Humidity (%)	+0.1%	+0.15%
Sea surface temperature (°C) ⁱ	+0.7 ±0.4	+1.3 ± 0.5
Mean sea level (cm)	+10 (5-14)	+20 (9-30)

Source: Pacific Climate Futures Program; Climate Futures Exploration Tool (February 2012).

Note: Ensemble mean data for 2030 and 2055 projections for A1B (medium emissions scenario).

44. Climate change parameters considered. This IEE specifically considers climate change projections for climatic variables relevant to vulnerability of road and bridge infrastructure in PNG including changes (increases) in rainfall and intensity and frequency of cyclones. The assessment considers the design and effective life of improvements over the coming 20-30 years. An increase in precipitation would increase the risk of the following: (i) landslides and the erosion of slopes; (ii) overtopping of bridges or damage to bridge substructure; (iii) overtopping/wash out of culverts; and (iv) scouring of drains and road shoulders.

45. Each of these aspects has been considered in the design process and due allowance made in the proposed works to minimize the potential risks due to rainfall events through the provision of a coherent drainage system and stable slopes as discussed in the following:

46. Slopes have been designed to appropriate angles for the soil types encountered with benches and bench drains where necessitated by the height of the slope. None of the bridges have been reported as being overtopped and site observations confirm that there appears to be adequate flood clearance at the existing bridges. Minor repairs will be required.

47. Based on the inventory of the existing culverts and observations of natural watercourses, replacement and additional culverts are provided to cater for the anticipated flows with an allowance for an increase in flow and some sedimentation in determining culvert diameters. To ensure smooth flow conditions and to minimize any risks of scour particular attention was given to the treatment of culvert inlet and outlet works.

48. Roadside drains are designed to cater for the anticipated run-off from the carriageway and adjacent slopes. Lined drains will be provided where the longitudinal gradient exceeds 3% or where the soil is considered susceptible to erosion. To prevent scour sealing of the carriageway will be extended to the shoulders at steep longitudinal gradients.

49. Water resources. The route of the Gewa – Gembogl road runs along the valley of the Simbu River and crosses the river twice in the subproject length. Both bridges have spans of 28 – 35 meters. The river is fast flowing and aggressive with generally clear water which becomes turbid during prolonged heavy rains in the catchment area. There are no records of the existing

bridges being overtopped but care needs to be taken to ensure that abutment protection is well maintained to prevent scour of the bridge foundations.

Within the subproject length, there are seven major creeks that discharge into the Simbu River. The bridge spans over these waterways vary between 12 and 23 meters (see Table 1 for details). The characteristics of these creeks are similar to those of the Simbu River i.e. fast flowing and generally clear water. Again there is no evidence of bridges having been overtopped but scour protection at bridge foundations must be well maintained. All of the existing bridges are to be retained with works limited to rehabilitation of the superstructures through painting, replacement of the existing timber decks with steel plates and local repairs to scour protection where necessary.

50. In addition to the river and creeks there are numerous watercourses crossing the road for which culverts have been provided. These occur where natural gullies in the terrain act as run-off channels for surface water discharge from adjacent slopes or from spring discharges. The water quality is generally good but can become turbid following prolonged rain, depending on the surface from which the run-off originates.

51. Air quality. Air quality in the Highlands Region is generally good. There are no industries producing discharges which result in atmospheric pollution and pollution from vehicular exhaust emissions are not significant given the low levels of traffic and absence of any traffic congestion. The only detrimental effect on air quality is the dust arising from the passage of vehicles over unsealed roads when the roads are dry. This is an intermittent problem with a minor effect over a limited area of 5 to 10 meters either side of the road.

52. Blasting will be required in sections of the road to remove rocky outcrops of limestone for widening of the existing road bench. This activity will result in the creation of significant amounts of dust but this cannot be avoided. The residents in the immediate vicinity of areas where blasting is required will be advised of the timing in advance of blasting operations and the measures to be taken to protect against the short term effects of dust.

B. Biological Environment

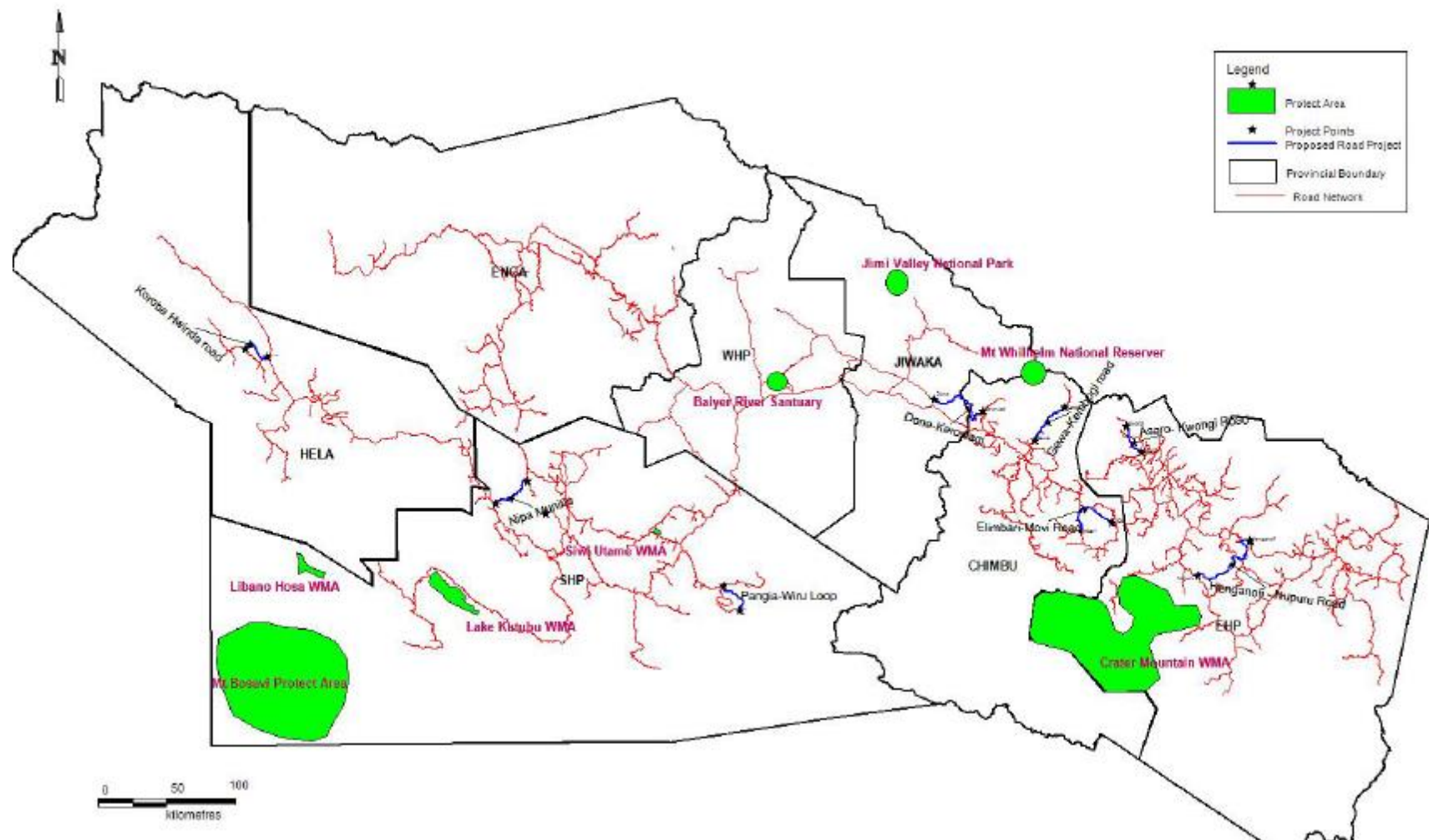
53. **Forest resources.** There are no forests concessions in any of the areas which are directly accessible from the roads currently under consideration for rehabilitation and upgrading by the DOW. Some logging does occur in the Highlands region, but it has been reported that this is only small-scale production of timber for local construction purposes. Such logging is unlikely to increase if the road is improved.

54. The road corridor is largely devoid of tree cover. The existing trees are generally confined to shade trees around settlements and homes, along the banks of creeks and some bush trees along the road. The lack of tree cover can contribute to soil erosion and dust from exposed slopes. Provision has been made in the proposed works for tree planting, the revegetation of slopes and the restoration of quarries, camp sites and waste disposal areas.

55. **Biodiversity and wildlife management areas.** The Gewa - Gembogl Road was established in the 1970s and passes through a landscape which is dominated by grasslands. In the immediate vicinity of the road corridor, the area has been disturbed by human encroachment and the strips of land on either side of the existing road, which will be affected by the proposed improvement works, do not constitute significant habitat areas for fauna. The nearest Wildlife Management Area or any Protected Area is the Mount Wilhelm National Reserve which is located some 20 km north of Gembogl (see Figure 4.1 overleaf). Mt

Gahavisuka Provincial Park is located some 40 km to the east of the subproject road while the Crater Mountain WMA is located approximately 60 km to the south of Gewa.

Figure 4.1 Wildlife Management Areas In The Highlands Region



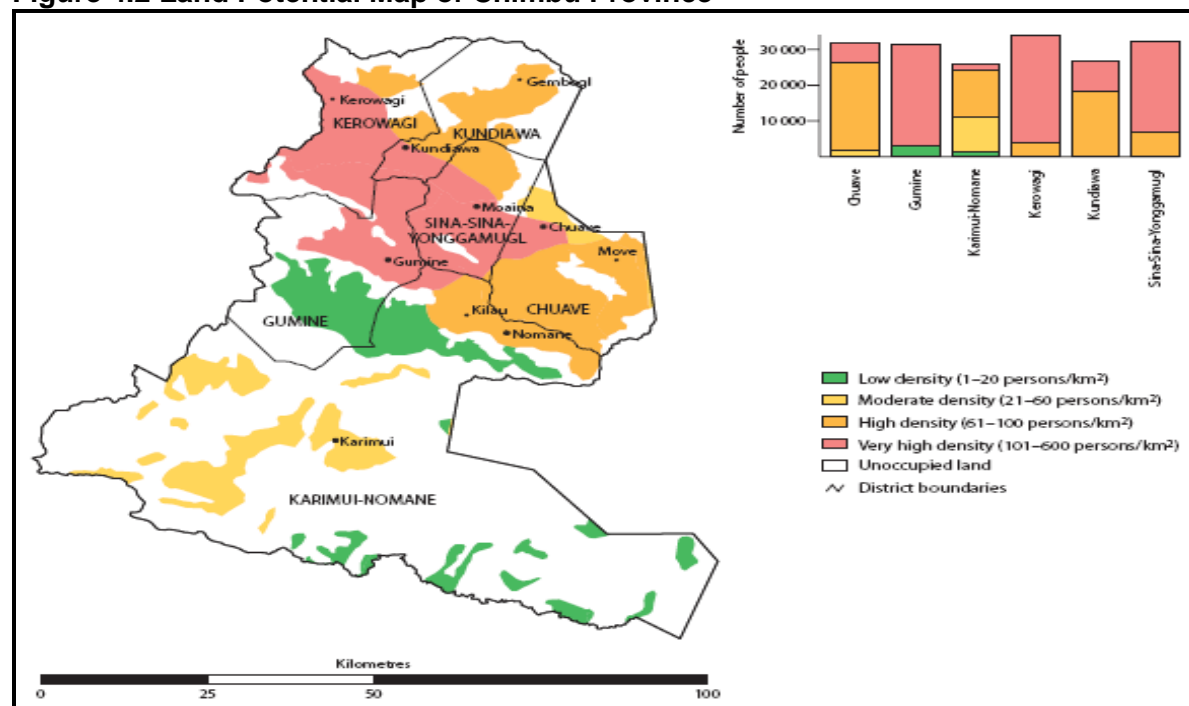
56. **Fauna.** The Birdlife International website indicates that PNG is an Endemic Bird Area and the data sheet for the Central Highlands states that there are 5 species in this area which can be considered threatened and a further 3 species that are vulnerable. The demise of three of the threatened species is considered to be due to hunting for feathers which are used in ceremonial headdresses. Information obtained from the local population along the road reveals sightings of parrots, pigeons, crows, hornbills and the very occasional bird of paradise which is located 10 km away from the road alignment and prohibited for hunting. Other birds with local names are also present in the area are as follows: hinawa, teduake, torwo, dengalaku, wiliwekta, auga, gotre, siuni, miuri, garden, kagl, wakambogl and congrage.

57. Based on the inspections and interviews with the local population, the Chimbu River is used primarily for subsistence fishing. Local people catch fish for their personal consumption.

C. Socio-Economic Environment

58. **Population and demography.** The population of the Highlands Region as per the preliminary figures of the 2011 census is placed at 3,001,598. This is 42.51% of the total population of the country placed at 7,059,653 for the same census. The growth rate (2000-2011) of the Highlands Region is 3.8% compared to that of PNG which is only 2.8%. Chimbu Province has an approximate population of 403,772 with 79,888 households. The improvement of the Gewa to Gembogl Road would mainly benefit the district of Kundiawa-Gembogl in Chimbu Province which has a total population of 81,042. Figure 4.3 shows the settlement map of Chimbu Province. Table 4.3 shows the population of the Highlands Region by Province while Table 4.4 presents the population and demography of Chimbu Province.

Figure 4.2 Land Potential Map of Chimbu Province

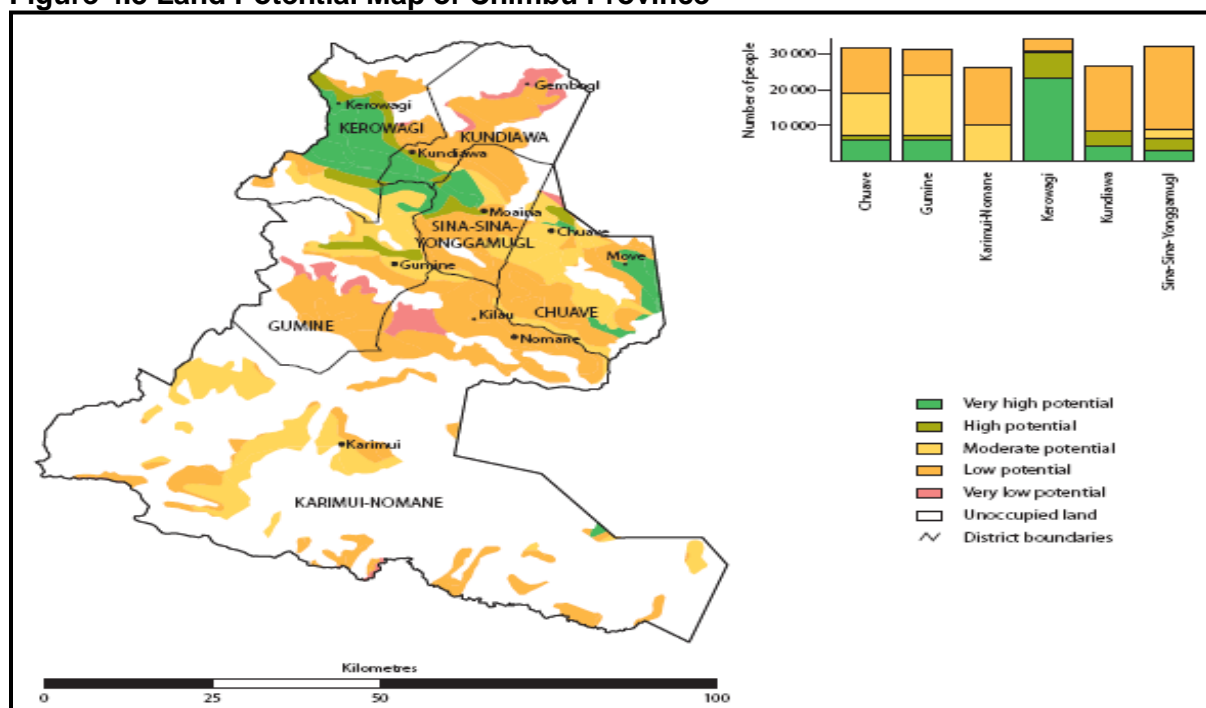


Source: PNG Rural Development Handbook, 2001

59. **Land use and vegetation.** The mid Wahgi Valley has very high land potential and is one of the most productive areas in PNG. Rainfall, slope and soils are ideal for the production of

many crops. Land improvement practices such as peanut rotations, drainage, tillage and small mounds maintain productivity. There is an area of very high land potential east of Mt. Elimbari. The lower Wahgi and Chimbu valleys have low to moderate land potential due to steep slopes, frequent cloud cover and low temperatures at higher altitudes. The south of the province has low to moderate land potential caused by high rainfall, frequent cloud cover and steep slopes. In some places land management practices such as mounding, tillage and bedding are used on steep slopes, causing increased soil erosion. In the Wahgi and lower Chimbu valleys, land potential is very high. Soils, slope, rainfall, temperature and light are ideal for the production of many crops. The upper Chimbu Valley has very low to low potential caused by steep slopes, frequent cloud cover, low temperatures and frost at higher altitudes. Figure 4.3 presents the Land Potential Map of Chimbu Province.

Figure 4.3 Land Potential Map of Chimbu Province



Source: PNG Rural Development Handbook, 2001

60. The predominant vegetation along the existing roadway is the native pitpit interspersed with casuarina trees. Flower and vegetable gardens, coffee trees, shrubs and grasses was also observed along the length of the roadway including avocado, banana, bamboo, eucalyptus, red pandanas, gum and plant lepa. No significant, rare, or threatened floral communities were observed along the subproject area. This is attributable to the fact that the area consists of mostly settlements. It should be noted that the Gewa to Gembogle Road was constructed in the early 1970s and as such, settlement along the length of the road has proliferated.

Table 4.3 Population Count and Growth

AREA	TOTAL POPULATION		GROWTH RATE (%) 2000-2011
	Households	Persons	
Papua New Guinea	1,424,835	7,059,653	2.8
Highlands Region	606,081	3,001,598	3.8
Southern Highlands	94,987	515,511	3.2
Hela	65,309	352,698	5.8
Enga	85,012	452,596	3.9
Western Highlands	116,476	352,934	3.0
Jiwaka	30,984	341,928	5.5
Chimbu	79,888	403,772	4.0
Eastern Highlands	133,425	582,159	2.7

Source: GoPNG – 2011 Census Preliminary Results (2012)

Table 4.4. Population and Demography of Chimbu Province

Total Population – Chimbu Province	403,772			
Average Annual Growth Rate Since 2000	4.00%			
Sex Ratio	110 males per 100 females			
Population Density	66.2 persons per square kilometer			
Average Household Size	5.1 persons			
PROVINCE/DISTRICT	Households	Persons	Males	Females
CHIMBU PROVINCE	97,888	403,772	211,926	191,846
CHUAVE	9,641	38,339	19,815	18,524
Chuave Rural	3,062	12,777	6,520	6,257
Elimbari Rural	3,218	12,896	6,637	6,259
Siane Rural	3,361	12,666	6,658	6,008
GUMINE	12,973	64,249	33,981	30,268
Bomai Gumai Rural	2,867	12,940	6,903	6,037
Gumani Rural	5,032	25,461	13,384	12,077
Mt Digne Rural	5,074	25,848	13,694	12,154
KARIMUI/NOMANE	10,770	54,907	28,688	26,219
Karimui Rural	4,530	23,400	12,402	10,998
Nomane Rural	1,809	7,872	4,055	3,817
Salt Rural	4,431	23,635	12,231	11,404
KEROWAGI	19,172	103,149	54,018	49,131
Gena Waugla Rural	7,617	42,207	22,004	20,203
Kerowagi Rural	6,279	30,718	16,069	14,649
Kup Rural	5,276	30,224	15,945	14,279
KUNDIAWA/GEMBOGL	14,938	81,042	42,975	38,067
Kundiawa Urban	2,133	11,455	6,044	5,411
Mitnande Rural	4,234	25,742	14,092	11,675
Niglkande Rural	3,164	16,592	8,772	7,820
Waiye	5,407	27,253	14,092	13,161
SINA SINA YONGGOMUGL	12,394	62,086	32,449	29,637
Tabare Rural	3,261	13,636	8,049	7,187
Suai Rural	4,997	26,230	13,636	12,594
Yonggomugl Rural	4,136	20,620	10,764	9,856

Source: GoPNG – 2011 Census Preliminary Results (2012)

61. **Health facilities.** Mortality rate in Chimbu Province is 73/1000 for under five year olds and 54/1000 for under one year olds. Life expectancy is 56.8 years for males and females. There are 37 aid posts and 31 health centers in Chimbu Province rendering coverage of 9,619 people per health center and 7,019 people per aid post.

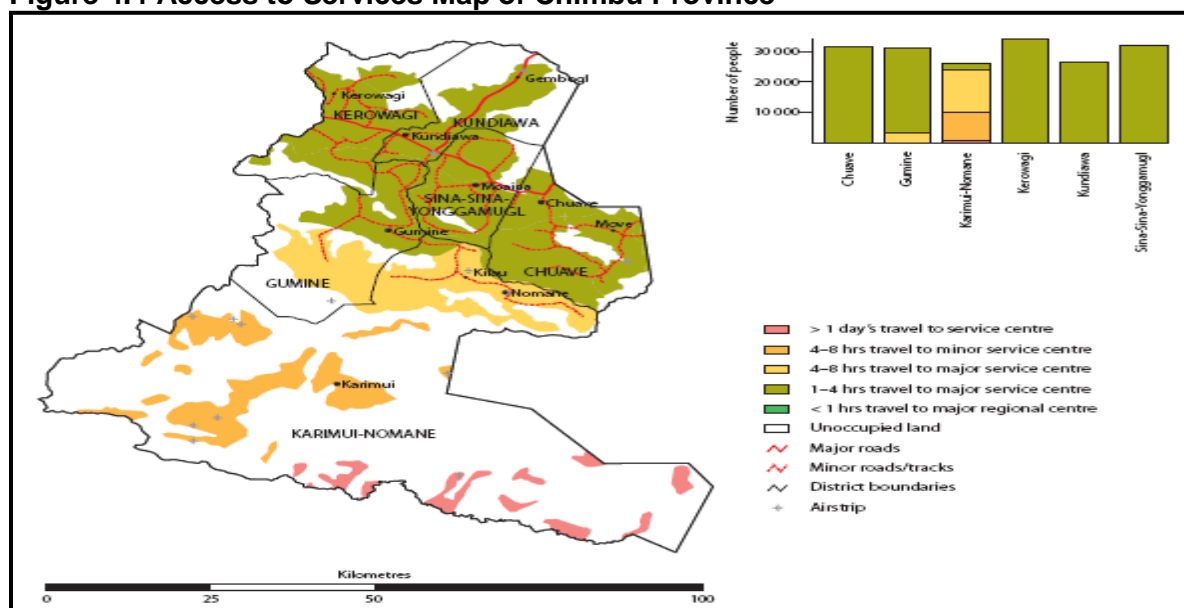
62. **Educational facilities.** Provincial education is managed independently from the Department of Education except for matters related to national standards and curriculum. Provincial education branches oversee education services. Shortage of supplies and trained teachers and high staff turnover in rural areas are of concern. The literacy rate in the Chimbu Province is 41.8%; with the males at 48.7% and the females at only 34.5% as compared to 55.0% (Total); 60.7% (Males); 48.5% (Females) for Kundiawa-Gembogl District. Table 4.5 presents the type and number of schools in the provinces and districts (subproject area). Figure 4.4 presents the access map to services for Chimbu Province.

Table 4.5.Type and Number of Schools

TYPE	chimbu	kundiawa-gembogl
Elementary	286	75
Community	36	3
Primary	105	24
Provincial High	13	3
Secondary	3	0
Vocational	9	2

PNG Rural Development Handbook, 2001

Figure 4.4 Access to Services Map of Chimbu Province



Source: PNG Rural Development Handbook, 2001

63. **Income sources.** Chimbu is a relatively poor province. Agriculture provides the main source of cash income through sales of smallholder coffee, fresh food and firewood. People in the mid Wahgi Valley northwest of Kundiawa and in areas along the highway southeast of Kundiawa have high incomes, while those in the Chuave, Gumine and Sina-Sina areas have low incomes. People in the rest of the province have very low incomes. The main non-agricultural sources of income in the province are PMVs and trade stores along the highway. In

contrast to Western Highlands and Eastern Highlands provinces, there are no large coffee plantations in Chimbu Province. Based on a socio-economic survey of a sample of 96 households along the road section, the average income was found to be K628 per person per month derived primarily from the sale of agricultural produce and roadside vending. Agricultural Development. Table 4.6 shows the levels in the sub-project area.

Table 4.6 Annual Households Income by Source

Income Source	Number of Reporting Households	Total Value (Kina)	Percentage by Source	Annual Average (Kina)
Agriculture	96	295,850.00	40.88%	3,081.77
Roadside Vending	40	136,340.00	18.84%	3,408.50
Business & Trading	10	76,500.00	10.57%	7,650.00
Remittance	31	75,660.00	10.45%	2,440.65
Government Employment	4	73,000.00	10.09%	18,250.00
Transport Business	2	32,000.00	4.42%	16,000.00
Paid Labor	9	17,020.00	2.35%	1,891.11
Small Enterprises	2	10,000.00	1.38%	5,000.00
Other Sources	4	4,100.00	0.57%	1,025.00
Hunting & Gathering	3	3,280.00	0.45%	1,093.33
Total		723,750.00	100.00%	7,539.06

Source: Socio-Economic Survey, November 2014

64. **Agricultural development and land use.** Moderate intensity sweet potato production characterizes agriculture in the northwestern part of Chimbu province. Typically, people make 2 - 5 consecutive plantings before a fallow period of 5–15 years. On the steep slopes of the Chimbu Valley, tillage, soil retention barriers and small mounds are used extensively. Banana and fruit trees such as avocado are planted in the road catchment.

65. Agriculture in the Tagari Valley around Tari and the Wage, Nembi, Mendi, Kagua and Erave valleys in the Southern Highlands Province is characterized by high intensity sweet potato production. Supplementary crops include banana and taro at lower altitudes, and potato at higher altitudes. Cultivation is continuous around Tari, while in other valleys people make more than 20 consecutive plantings before a fallow period of 1-4 years. Production is maintained through the use of drainage, composting, mounding and bedding. People in the Tagari, Lai and Iaro valleys use similar practices to cultivate moderate intensity sweet potato gardens. In the far south and southwest, people rely on sago production is supplemented by low intensity mixed staple gardens. Agriculture in the remaining areas of the province is characterized by low intensity sweet potato cultivation (Figure 4.5).

66. Agriculture in the upper Kagua Valley of the Ialibu-Pangia District is dominated by high intensity sweet potato cultivation. People make 2-4 plantings before a fallow period of 1-4 years. Production is maintained through the use of composting, tillage, drainage and bedding. People in the upper Iaro and Kaugel valleys cultivate moderate intensity sweet potato gardens and use composting and mounding. Those on the Poru Plateau and in Poru Basin make low intensity sweet potato gardens. Agriculture in the upper Erave, Kagua and Sugu valleys is dominated by high intensity sweet potato cultivation. There are 2-4 consecutive plantings before a fallow period of 1-4 years.

67. **Mineral and petroleum resources.** There is small scale mining of copper at the Kumbukkari mine and nickel at the Yandra mine, both located some 5 to 10 km beyond the end of the proposed improvements at Gembogl. The final extents of both deposits have still to be established but the improvement of the road access to the sites will be beneficial to both operations.

68. **Industrial development.** The economy of Papua New Guinea, which is highly dependent on imported goods and materials, has no major manufacturing and industrial concerns, especially in the highlands region. The relatively small domestic market, relatively high wages, lack of appropriate support facilities, unreliable power system, and high transport costs are constraints to industrial development. There are no industries in the road catchment. Business activities are trade stores, vehicle workshops and metal crushers.

69. **Transportation.** The Highlands Highway runs across the north of Chimbu Province, linking Kundiawa to Mt. Hagen in the west and to Goroka in the east. A good road network connects most areas in the north of the province with the highway. However, the condition of these roads deteriorated during the 1990s. South of Kundiawa, the province is divided by the deep and rugged Wahgi River gorge. A road which is only accessible to four-wheel drive vehicles and is frequently closed by landslides, runs from the upper Chimbu Valley down to Bundi in Madang Province. This road continues to the Ramu Highway, via Usino. There is a local network of poor quality roads around Karimui that are not connected to any other centre. People in the north of the province have good access to services, requiring less than four hours' travel to reach Kundiawa. People around Nomane, Kilau and Karimui require 4 - 8 hours' travel to reach the nearest service centre. People on the southern border of the province are very remote and need more than one day's travel to reach the nearest service centre.

70. All people in the district of Kundiawa-Gembogl require less than four hours' travel to reach Gembogl or Kundiawa Stations. The Highlands Highway runs through the southernmost part of the district and connects to a road that runs up the Chimbu Valley. There is a very rough road that extends from the upper Chimbu Valley at Gembogl through the Iwam Pass and down to Bundi in Madang Province. This road is frequently impassable to vehicles, because of landslides, but it is used by people travelling on foot. The road is extensively used by local communities, PMVs and transport of materials to 2 mine sites. PMVs operate from Gembogl to Kundiawa several times a day.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

71. The rehabilitation and upgrading of the Gewa to Gembogl Road will have few and limited adverse impacts. These impacts will mainly occur during the construction phase. Construction will create a range of expected minor impacts which can be readily addressed by conditions imposed in the environmental management plan (EMP). Assets that may be affected, such as gardens and fences, will be compensated based on existing procedures of the government and SPS as per the subproject's resettlement plan (RP). There will be no cultural or heritage sites that will be affected nor will any primary forest be cleared. There may be some impacts on water quality in the creeks and streams resulting from the bridgeworks and culvert works. These impacts can be satisfactorily mitigated and / or managed through the implementation of the EMP.

72. Determining the scale of impact depends on (i) spatial scale of the impact (site, local, regional, or national / international); (ii) time horizon of the impact (short, medium, or long term);

(iii) magnitude of the change in the environmental component brought about by the project activities (small, moderate, large); (iv) importance to local human populations; (v) compliance with international, national, provincial, or district environmental protection laws, standards, and regulations; and (vi) compliance with guidelines, policies, and regulations of PNG and ADB.

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

74. Direct impacts are caused by project activities, and occur at the same time and place and can be created during both project construction and operation. Indirect impacts, which may include growth-inducing impacts, are caused by a project activity, or the overall project, and while they are later in time or farther removed in distance, they are still reasonably foreseeable.

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

76. Impacts created during construction activities are dependent on a number of factors including the temporary use of land and its rehabilitation in post-construction, 'best practices' being employed during construction activities, coordination and cooperation with local authorities in terms of impact management, and strict enforcement of environmental clauses and conditions included in project bid documents, the contract and technical specifications and adherence to the EMP contained in the IEE and construction environmental management plan (CEMP) prepared by the contractor and submitted to, and approved by, ESSU. This process is explained further in Section 8.

A. Design and Pre-Construction Phase

77. There are no significant adverse environmental impacts during the pre-construction phase of the project, the following are the major activities during this phase.

78. **Land clearance.** This activity will be coordinated with activities undertaken for the RP. During the preparation of the RP, Memorandums of Agreement (MOAs) between the tribal owners of the customary lands through which the road passes and the DoW have been completed. These MOAs grant the DoW the use of the customary land for both the existing road and the land required for the improvements. The RP addresses resettlement and compensation issues. Implementation of the RP will be the responsibility of the DoW and all compensation payments must be completed before construction commences.

79. **Climate change adaptation.** Adaptation requirements for climate change in the design were considered for this project. In the Highlands Region of PNG, where the project road is located, rainfall and the potential effects of increased intensities on the sustainability of the roads would clearly be the dominant factor to be considered. An increase in precipitation would increase the risk of the following: (i) landslides and the erosion of slopes; (ii) overtopping of bridges or damage to bridge substructure; (iii) overtopping/wash out of culverts; and (iv) scouring of drains and road shoulders. Each of these aspects has been considered in the

design process and due allowance made in the proposed works to minimize the potential risks due to rainfall events through the provision of a coherent drainage system and stable slopes.

80. As such mitigation measures include:

- (i) Slopes have been designed to appropriate angles for the soil types encountered with benches and bench drains where necessitated by the height of the slope;
- (ii) None of the bridges have been reported as being overtopped and site observations confirm that there appears to be adequate flood clearance at the existing bridges;
- (iii) Minor repairs of bridges will be undertaken when necessary;
- (iv) Based on the inventory of the existing culverts and observations of natural watercourses, replacement and additional culverts have been provided to cater for the anticipated flows with an allowance for an increase in flow and some sedimentation in determining culvert diameters with particular attention to the treatment of culvert inlet and outlet works to ensure smooth flow conditions and to minimize any risks of scour;
- (v) Roadside drains have been designed to cater for the anticipated run-off from the carriageway and adjacent slopes with lined drains provided where the longitudinal gradient exceeds 3% or where the soil is considered susceptible to erosion; and
- (vi) Sealing of the carriageway will be extended to the shoulders where there is a steep longitudinal gradient or high super-elevation or a combination of both to protect the shoulders from scour.

81. **Review and update of the EMP.** Based on the EMP in this assessment, following detailed design the EMP will be updated as required and integrated into bid and contract documentation (BCD). Experience shows that inadequate application of the EMP by the contractor may occur due to weak linkages of the EMP with the contract document. The EMP is an integral part of the work program and will be addressed by the contractor. An outline of the requirements is provided below.

- (i) For the BCD section "Special Conditions of Contract" the following will be included: (i) prior to the tender being called the EMP will be revised and updated as required based on the detailed design; (ii) the updated EMP and provisions form the EMP section of the IEE will be extracted and will be attached to the BCD - Section 6 - Employer's Requirements; (iii) in Part 1 the Price Schedule 4 - Bill of Quantities, provisional sums will be included for the preparation and implementation of the construction environment management plan (CEMP) and for monitoring; and, (iv) in the BCD section "Special Conditions of Contract" the construction section of the EMP will form part of the BCD; and
- (ii) Inclusion of SPS Appendix 5 - Prohibited Investment Activities List in the BCD. In order that the subproject comply with the SPS, it will be necessary to include in the BCD reference to Appendix 5 - Prohibited Investment Activities List of the SPS.

82. **Bid evaluation and selection of contractor.** Selection of a competent contractor will ensure that the environmental integrity of the subproject is maintained. The contractors bidding for the contract will be required to provide a short statement attached to their bids that confirms the following:

- (i) That the CEMP to be prepared by the contractor in response to the EMP section has been costed into the bid price;
- (ii) The contractor is required to provide the name, details of qualifications and experience of the person on the contractor's team who will be responsible for the environmental compliance requirements and the preparation of CEMP. Should the contractor not provide these details, the bid will be considered to be non-compliant and the bid rejected;
- (iii) The contractor will take-up opportunities for capacity building in environmental management and particularly, prior to preparation of the CEMP, will undergo induction training on EMP requirements and provisions to be provided by the CSC and HRMG⁴; and
- (iv) The provision of training therefore is essential in the development of the CEMP and the eventual implementation of the CEMP. The capacity building of both the contractor and HRMG to monitor and implement CEMP is highly recommended.

83. **The construction EMP.** Before commencing work the contractor will be required to prepare a CEMP with detailed method statements sub-plans/sections in accordance with the EMP included in the BCD. The CEMP will amplify how the contractor specifically intends to address the activities and impacts. The contractor prepares the CEMP that establishes the contractor's management and compliance requirements with the construction section of the EMP. Once prepared, the CEMP will be reviewed by the CSC environmental specialist; s/he will also fix if there are gaps or areas for refinement. The final draft of CEMP will be approved by Manager-ESSU prior to any works commencing.

- (i) The CEMP will be up-dated, reviewed and signed off by CSC and the final approval will be given by ESSU, subject to meeting all requirements.
- (ii) Contractor identifies and secures necessary permits/compliance approval requirements and complies with all permitting requirements associated with the CEMP including quarry permits, approval/ requirements for establishment of batching plant, disposal sites and other related activities for submission and approval of HRMG/ESSU and CEPA.
- (iii) As required to meet the monitoring provisions of the EMP, the Contractor shall engage the services of environmental experts in the University of Technology in Lae and/or other qualified and capable organizations to collect baseline data for air quality, noise levels and water quality as defined in the EMP one month upon receipt of the Notice to Proceed. Monitoring for specific parameters and

⁴ Experience in the implementation of two road packages (Laiagam to Porgera and Mendi to Kandep Roads) in the contractor did not understand the environment compliance issues, the IEE and the purpose of CEMP, or the need for monitoring and reporting.

indicators will be conducted at the frequency specified in the EMP throughout the construction period. This will be reported in progress and monitoring reports.

84. **Induction of contractor to the site.** Following the selection of the contractor, the contractor will undergo training and prepare and submit the CEMP. Following approval of the CEMP by ESSU, the contractor together with the person on the contractor's staff who will be responsible for supervising and monitoring the CEMP and all the concerned staff of the contractor will meet the ESSU, HRMG and the CSC on-site where the CEMP requirements will be confirmed by the contractor. The contractor and their staff will also be made cognizant of the grievance redress mechanism (GRM) recording and resolution requirements and protocols for addressing complaints, issues and concerns raised by the stakeholders during the construction. The Contractor will also be advised of the responsibility of securing environment permits if needed and assessment of sources (quarries, river, etc.) of materials. All employees of the contractor will be made aware of the safeguards requirements and their obligations as stipulated in the CEMP.

85. **Mobilization of the contractor, construction camp and materials sites.** With the mobilisation of the contractor and initial establishment of site office, works yard and work sites will be presence of construction workers and associations with local people. Licenses and EPs for quarries and material extraction must also be obtained at this stage. With the mobilisation of the contractor and initial establishment of site office, works yard and work sites will be presence of construction workers and associations with local people.

86. Prior to contractor mobilization to the sites, ESSU and CSC will work with the contractor to establish the communications protocol between the project and communities as per the project's communications plan and assist the contractors to obtain necessary licenses for quarrying and gravel extraction. The contractor will identify one member of their staff to be the liaison between the village chiefs and elders and contractor, as well as between the contractor and ESSU. The contractor will also identify one staff to be the liaison between CEPA and/or ESSU with regards to licenses for quarries and sand and gravel extraction.

87. The construction camp accommodation, maintenance yard and other associated facilities such as quarry, crushers, batching plant, asphalt mixing plant-base shall be located outside any areas identified by the authorities to be protected for biodiversity or landscape values and shall be outside any designated protected areas or wildlife management areas..

88. **Mitigation measures.** The contractor will adopt good management practices to ensure that fuels and chemicals, raw sewage, wastewater effluent, and construction debris/scarified material is disposed of in controlled conditions to reduce the risk of contamination. Measures to minimize disturbance by construction workers and presence of the works site/area include:

- (i) Village protocols will be discussed with workers as part of awareness and mobilization training;
- (ii) The contractor is to ensure that workers' actions outside work site are controlled and village codes and rules of conduct are observed at all times;
- (iii) The contractor will identify one member of their staff to be the liaison between the village chiefs and elders and contractor, as well as between the contractor and ESSU;

- (iv) Worker camp location and facilities will be located at least 500m from settlements and agreed with local communities and facilities approved by ESSU and managed to minimize impacts;
- (v) Adequate signage and security provided at the site office and works yard and prevention of unauthorized people (especially children) entering the area;
- (vi) As many local workers as possible will be hired and trained;
- (vii) Provide adequate housing for all workers at the construction camps and establish clean canteen/eating and cooking areas;
- (viii) Construction camp(s) will be established in areas with adequate drainage in order to prevent water logging at the camp and formation of breeding sites for mosquitoes in order to facilitate flow of the treated effluents;
- (ix) Potable water, clean water for showers, hygienic sanitation facilities/toilets with sufficient water supply, worker canteen/rest area and first aid facilities will be provided. Separate toilets shall be provided for male and female workers;
- (x) Portable lavatories (or at least pit latrines in remote areas) shall be installed and open defecation shall be prohibited and use of lavatories encouraged by cleaning lavatories daily and by keeping lavatory facilities clean at all times;
- (xi) Wastewater effluent from contractors' workshops and equipment washing-yards will be passed through gravel/sand beds and all oil/grease contaminants will be removed before discharging it into natural streams. Oil and grease residues shall be stored in drums awaiting disposal in line with the agreed waste management section of the EMP;
- (xii) Predictable wastewater effluent discharges from construction works shall have the necessary permits from CEPA and local authorities before the works commence;
- (xiii) As much as possible, food shall be provided from farms nearby or imported to the area. Poaching of animals or birds for 'bush meat' will be banned;
- (xiv) Solid and liquid wastes will be managed in line with the provisions of the waste management section of the EMP;
- (xv) Use of guns and hunting equipment by workers will be banned and dismiss workers taking or using green timber or hunting or in possession of wildlife;
- (xvi) Entry to the protected and wildlife management areas and/or sensitive areas (forested areas and rivers) by workers will be banned; Provision of adequate protection to the general public in the vicinity of the work site, including advance notice of commencement of works, installing safety barriers as required by villagers, and signage or marking of the work areas;

- (xvii) Provision of safe access across the works site (particularly during construction of drains) to people whose village and access are temporarily affected during construction works;
- (xviii) At all times workers should respect village and land owner's boundaries and be recognize and follow village rules and terms of conduct (especially addressing women and elders);
- (xix) Avoid damage to productive trees and gardens, water resources and springs;
- (xx) The contractor will engage an approved service provider to deliver HIV/AIDS/STIs awareness and prevention for the contractor's workers and adjacent communities;
- (xxi) Land used for campsites shall be restored to the original condition as far as practicable and the area shall be planted with appropriate trees / shrubs as soon as practicable after it is vacated and cleaned;
- (xxii) Work and camp sites will be cleaned up to the satisfaction of and local community after use; and
- (xxiii) Licenses and EPs for materials extraction and spoil disposal will be obtained in advance and before work commences from the appropriate authorities including CEPA.

B. Construction Phase

89. The construction phase will commence after the pre-construction activities have been completed. The Contractor shall implement the approved CEMP and with due care and diligence, execute and maintain the works, provide all labor, including supervision thereof, equipment, materials and other facilities, whether temporary or permanent in nature, required for such execution of the Works.

90. The Contractor shall take full responsibility for the adequacy, stability and safety of all site operations and methods of construction. The Contractor shall limit the movement of his workmen and construction plant within right-of-way (ROW) so as to minimize damage to property. The Contractor shall be solely responsible for any damage to property resulting from its operations, whether on ROW or on land adjacent thereto.

1. Impacts on the Physical Environment

91. **Air quality.** The general trend is that activities in the construction and operation phases will influence the air quality. Short-term, low to significant impacts are expected during the construction phase, but long-term impacts are expected to occur during the operation. The potential sources of air pollution during the construction stage include: dust from earth works; emissions from the operation of construction equipment and machines; fugitive emissions from vehicles plying the road; fugitive emissions during the transport of construction materials; air pollution other than dust arise from combustion of hydrocarbons particularly from the hot mix plants, and localised increased traffic congestion in work areas. Most of the emissions will be in the form of coarse particulate matter and will settle down in close vicinity of construction site. Hot mix plant will generate carbon monoxide (CO), un-burnt hydrocarbon, sulphur di-oxide,

particulate matters, and nitrogen oxides (NOx) emissions. The impacts will be minor, local, short-term, direct and reversible.

92. The following are the identified projected impacts on the air quality of the receiving environment: (i) acute increased levels of emissions as a result of the operation of the various heavy equipment, vehicles and the operation of the batching and asphalt plants; (ii) increased levels of particulate matter as a result of the excavation works and dumping of materials which is projected to be particularly problematic during the dry periods; (iii) emissions of fumes from engine exhaust pipes and the hot mix plants; (iv) incidents of respiratory diseases due to inhalation of dust and fumes in the works areas and nearby settlement areas; (v) increased incidences of accidents due to poor visibility during dusty conditions in the work areas; and (vi) nuisance from dust to residents near haul roads due to construction traffic in the area.

93. **Mitigation measures.** The Contractor shall prepare and implement a plan for the management and minimization and/or suppression of dust created by construction activities in the affected work areas. This plan will address dust created by rehabilitation activities at the site, as well as by off-site hauling and disposal of construction wastes. It will include regular watering services during dry construction days in high-density population centres such as markets, schools and other sensitive entities such as hospitals, and on dust generators such as excavation/open cut areas. In order to minimize spillage during transport, dump trucks shall be properly covered with tarpaulins when transporting excavated soils to approved disposal sites, and shall not be overloaded.

94. Implementation of a traffic management plan as part of the CEMP will also help minimize emissions due to traffic congestion caused around the construction areas. The plan will ensure that vehicle passage is not hampered by unnecessary obstructions, especially in areas that have very limited maneuvering space. This plan shall identify resources required (i.e. traffic enforcers, warning signs, traffic advisory billboards, etc.). Construction equipment and vehicles shall not be parked longer than necessary on the road leading to the construction areas. The contractor's construction equipment and vehicles shall be properly maintained to meet existing ambient air quality standards.

95. Additional measures to be implemented to avoid, reduce or mitigate these impacts include:

- (i) Requisite air pollution control devices are to be installed in the ancillary facilities, i.e. batching and asphalt plants and mufflers are to be installed in all vehicles;
- (ii) Appropriate traffic signs shall be installed around residential areas advising approaching motorists to maintain slow speeds to prevent rising dust in these areas;
- (iii) Water sprinkling, water fogging, broom sweeping will be carried out in dust prone locations, unpaved haulage roads, earthworks, stockpiles including asphalt mixing plant areas;
- (iv) Open burning of solid wastes (plastic, paper, organic matters) will be prohibited;
- (v) Use of dust control methods (such as covers, water suppression paved or unpaved road surfaces, or increase moisture content for open materials storage piles) will be practiced;

- (vi) A regular vehicle maintenance and repair program will be implemented to reduce the emission of fumes from exhaust pipes;
- (vii) Masks and personal protective equipment (PPE) will be provided to the construction workers to protect workers from inhalation of dust and exhaust fumes;
- (viii) Mixing plants and asphalt (hot mix) plants including crushers and the batching plants will be located at least 1 km downwind from the nearest settlement only after receiving permission from the Construction Supervision Consultant (CSC). Hot mix plant will be fitted with stack /chimney of adequate height as prescribed by CSC to ensure enough dispersion of exit gases;
- (ix) Bitumen emulsion and bitumen heaters will be used to the extent feasible;
- (x) Diesel generating sets will be fitted with adequate stack height; and
- (xi) Low-sulphur diesel will be used in generator sets as well as other machinery.

96. **Noise and vibration.** Increase in noise and vibration levels are expected with the operation of the construction equipment, operation of the batching and asphalt plants and increased vehicular traffic. Sustained noise could lead to hearing impairment to construction crews directly operating or working near the equipment and residents in the area. This applies to all machinery, vehicles and construction sites where noise and vibration may affect susceptible receptors. The improvement/rehabilitation works would inadvertently result to increased noise levels in the area.

97. Among the impacts identified are the following: (i) during the works, the operation of heavy equipment and various construction machinery are primary noise generators. It is projected that noise levels could reach from 65 to 80 dB (A) at peak times; (ii) poor maintenance of equipment may cause very high noise levels. Faulty or damaged mufflers, loose engine parts, rattling screws, bolts, or metal plates all contribute to increasing the noise level of a machine as well as careless or improper handling and operation of equipment; and (iii) poor loading, unloading, excavation and hauling techniques may lead to increased noise levels.

98. **Mitigation measures.** The contractor will be responsible for ensuring that noise and vibration does not affect the surrounding communities. While it is unlikely that noise and vibration will be an issue due to the distance between the activities and the communities the contractor must be prepared to curtail work to daylight hours should the community find that any nighttime operations become a nuisance. Measures included in the EMP to achieve this objective are:

- (i) Temporary construction facilities such as labor camps, vehicle maintenance workshop and earth moving equipment will be located at least 1 km away from settlements and other sensitive areas as far as possible;
- (ii) Noise sources such as stone crushers, vehicles movements and stone quarry will be re-located to less sensitive areas and at least 1 km away to take advantage of distance and shielding;

- (iii) Opportunities will be explored to take advantage of the natural topography as a noise buffer such as behind the ridge that break the line of sight between the source of noise and the receptors during facility design;
- (iv) Silencers will be installed in construction equipment and machinery and maintained properly at all times;
- (v) Equipment and machinery with lower sound levels will be selected for the use;
- (vi) Protection devices such as ear plugs or ear muffs will be provided to the workers during period of operating high noise generating machines;
- (vii) Noise levels will be regularly measured during the peak of construction period in particular using portable noise meters to ensure the effectiveness of mitigation measures. Local youth will be trained to monitor the noise level and record relevant data;
- (viii) Noise generation activities will be carried out between 5 am to 6 pm only to avoid disturbance to nearby communities at night. Only in extreme instances will work beyond these hours be allowed after the Public Relations Officer (PRO) of the contractor have informed the community about change in work program well in advance;
- (ix) Noise barriers such as earth mounds or walls of wood, metal that form a solid obstacle between the road and roadside community will be used, especially in the schools and hospitals; and
- (x) Proper information and notification of the concerned local government unit will be conducted to prevent disturbance and nuisance to nearby settlement areas.

99. **Water quality.** Various impacts on water quality can occur during construction through an increase in suspended particulate matter because of the removal of covering vegetation and the increase in human and vehicular traffic in the area. Impacts include: (i) contamination of water bodies and the aquifer may also result due to the generation of solid and domestic waste from camps and offices; (ii) contamination of nearby water courses may result from accidental spills and improper storage of fuel and lubricants and construction materials; (iii) the generation of solid and domestic waste which may cause contamination of the nearby water courses and aquifer is a potential impact of this activity; (iv) lowered water quality from eroded material; (v) blockage of streams and changes in water courses may affect community access to water; (vi) impairment of water quality from uncontrolled runoff from the quarry and material fill sites; (vii) disruption in the hydrology of the water courses as a result of excavation of river beds; (viii) increased turbidity as a result of the disturbance of the channel or creek; and (ix) disruption of the hydrology and hydraulic characteristics of creeks as a result of laying of gabions and other water course protection works and river training works.

100. **Mitigation measures.** The measures to mitigate the foregoing impacts include:

- (i) The CEMP will include a detailed erosion and sedimentation control plan;
- (ii) Lubricants will be stored in containers / dedicated enclosures with a sealed floor >50m from water bodies;

- (iii) Work in rivers / streams will be scheduled during dry season and work duration shall be as short as possible. Bare slopes shall be stabilized immediately after works are completed;
- (iv) Stockpile areas and storage areas for hazardous substances shall be located away from water bodies;
- (v) Washing of machinery and vehicles in surface waters shall be prohibited;
- (vi) Sediment controls such as silt fences or other sediment reducing devices (rock dams or silt barriers), to prevent both siltation and silt migration during works being undertaken in the vicinity of streams and rivers;
- (vii) Sediment control devices will be cleaned and dewatered, discharges will not be to the rivers or streams. Consultation with land owners and village chiefs will identify suitable land-based areas for settling ponds or discharge areas;
- (viii) Diversion ditches will be dug around material stockpiles;
- (ix) Minimizing interference with natural water flow in rivers, water-courses or streams within or adjacent to work sites. Abstraction from rivers will only be allowed after permission from ESSU. Pollution of water resources will not be permitted;
- (x) Solid wastes, debris, spent oil or fuel from construction machinery or plant, construction material, or waste vegetation removed from work sites will not be dumped in or near streams, rivers or waterways;
- (xi) Discharge of sediment laden construction water or material (including dredged spoil) directly into the rivers, sea, inter-tidal area or surface waters will not be permitted. All such construction water will be discharged to settling ponds or settling tanks with sufficient capacity to provide holding times that will allow settlement, prior to final discharge;
- (xii) Discharge zones from culverts and drainage structures will be carefully identified, and structures will be lined with rip-rap. Down-drains and chutes will be lined with rip-rap, masonry or concrete. Spillage ways will be lined with rip-rap to prevent under-cutting;
- (xiii) Spoil and material stock piles will not be located near the coast or within 50 m of waterways, streams or rivers, or on the edge of slopes or hills above rivers or stream and will be surrounded by perimeter diversion drains;
- (xiv) Hydro-carbons, fuel, and other chemicals as required for the works, will be stored in secure containers or tanks located away from the coast, surface waters, or streams;
- (xv) Hydro-carbons, fuel, and oil spills will be contained and immediately cleaned up as per the requirements of the emergency response plan to be prepared as part

- of the CEMP by the contractor (and approved by ESSU at the pre-construction stage);
- (xvi) Surplus used oil and waste hydrocarbons will be disposed of at approved sites and under no circumstances should oil be discharged to soil;
 - (xvii) Contractor's site office and works yard are to be equipped with portable sanitary latrines that do not discharge directly to or pollute surface waters and waterways;
 - (xviii) All water, waste-water and other liquids used or generated by project works and activities will be collected and disposed of in an approved manner and in an approved location. Such disposal will not be permitted to cause either pollution or nuisance;
 - (xix) Plan works to be carried out over the creeks only for dry season;
 - (xx) Ensure that bunds are constructed to properly contain the construction activities and that the creek flows are not impeded;
 - (xxi) Plan operations to avoid creating downstream turbidity;
 - (xxii) Ensure that the creek channel is properly restored upon completion of the works;
 - (xxiii) The contractor has to ensure that spoils are properly contained and drained. Waste disposal areas for construction workers should also be contained and secured. The contractor can utilize composting or the use of pits for waste disposal. This waste disposal area should be situated far from the banks of the river; and
 - (xxiv) Workers should also be provided with toilet facilities including septic tank at the campsite and office. These toilet facilities should be sanitized and situated also far from the banks of water courses. The workers should also be oriented on the importance of environmental protection. Strict rules on waste disposal should be implemented. This is to discourage workers from negligent practices and attitude.

101. **Works in rivers and streams.** During the works it will be necessary to carry out excavation of existing road pavement materials and for culverts and drainage works in the vicinity of rivers and streams. Where culverts are required there could be the need to temporarily constrict water flows and dry out sections of streams depending on their size and water volumes carried, in order to place new structures. These activities can result in a risk of channel shifts and erosion, particularly of stream or river-banks that would lose their vegetation cover, most particularly during floods.

102. Stockpiled materials, if located within the floodplain, may be eroded and dispersed and patterns of water movements during 'normal' and flood flows affected. Movements of machinery and other activities can be expected to impact riverine fauna and flora, however because the rivers in the area are highly disturbed ecosystems, regularly subjected to flooding and channel shifts, impacts on these are likely to be minimal.

103. **Mitigation measures.** Potential impacts on the structure of river habitats, including their channels, banks and floodplains will be mitigated by:

- (i) Material stock-piles will not be located within riverbeds, any islands in the rivers, or within the current area of floodplain of river in areas subject to regular flooding (i.e. once per year or more). All land used for stockpiles will be rehabilitated to original or better condition upon completion;
- (ii) Scour protection will be used as temporary measures, as needed, to ensure temporary structures do not damage river configuration;
- (iii) Movements of vehicles and machinery in river beds within the riverine habitats will be minimised at all times to reduce disturbance;
- (iv) In the event that the contractor causes damage to the river bank or other structural parts of a river, the contractor is solely responsible for repairing the damage and/or paying compensation to the riparian owners;
- (v) Embankments and in-stream/river activities will be monitored for signs of erosion during construction;
- (vi) Re-vegetation with fast growing local species of trees, or other plants will be carried out incrementally and as quickly as possible after work within any river habitat has been completed after consultation with the land owners and village chiefs; and
- (vii) Spoils, rubbish or any other surplus material will not be disposed of within any river system including riverbed, banks or floodplain areas. Suitable disposal sites will be designated in consultation with the CSC Engineer and approved by village chiefs and ESSU.

104. **Soil and erosion.** During the construction period, there will be various temporary uses of land such as for contractor's facilities, office, worker camps, storage of equipment and materials, service area, quarries and batching plant areas, etc. The clearing and grubbing, excavation, boring and hauling operations may affect the soil quality of adjacent lands as there may be accidental spillage of solid matter, contaminants such as cement, wastewater from aggregate processing and concrete batching, debris, petroleum products and industrial waste. The natural landscape maybe damaged from unnecessary destruction, clearing and defacing of the natural surroundings. These are, however, minimal and temporal in nature and will be mitigated through measures established in the EMP.

105. Soil erosion is expected when site clearing commenced. Vegetation cover shall be removed exposing soil to the elements. During heavy rains, these loose soil materials will be carried away by run-off to the creeks and eventually to the river. The impacts during this phase will be of short duration and will be moderate. Cutting of elevated slopes during construction is expected to cause erosion and slides and sedimentation. Hence the landscape of the project site will be physically altered. The magnitude of the impact can be considered low although the impact is still negative because the landscape will be significantly changed. The duration of the impact is permanent.

106. Utilization of quarry and material fill sites by the contractor may result to various negative impacts. The DOW maintains several approved quarries and sites for fill material in the Highlands Region. The choice of quarry or fill material sites depends upon the requirements of

the contractor and the location of the work areas. The contractor may opt to utilize existing quarry and fill material sites, however, he may also decide to open new ones. If already opened sites are to be used by the contractor, they are to follow established procedures for these sites. Should the contractor need to open a new quarry or a fill material site this will first be discussed with the ESSU and CSC prior to the preparation of necessary documentation as required by the CEPA.

107. Mitigation measures. A number of the measures cited above to mitigate effects on water quality will also mitigate soil and erosion impacts. Additional measures include:

- (i) An erosion and sedimentation control plan in the CEMP;
- (ii) As far as possible construction works will be scheduled for the dry season and strictly follow the design requirements and specifications, particularly those dealing with slope stabilization. Schedule construction so that large areas of soil are not laid bare during wet seasons, and avoid excavating areas and operating machinery in wet ground conditions;
- (iii) As much as possible, ground disturbance (particularly for earthwork cuts) should be minimized, and stabilized either by benching, proper side sloping, vegetation, or any combination of these;
- (iv) It is important that the length of time during which bare surfaces are exposed is minimized. Re-vegetation is critical in steeply sloping embankment areas of the road sections where it will be immediately carried out on each completed section;
- (v) Excavated soils shall be prevented from being washed from the work area into nearby water bodies (especially during inclement weather) by immediately hauling these materials away and disposing of them in approved disposal sites. Work scheduling shall take into account potential weather disturbances and rainy days historically recorded in the area. This will allow worked areas to be properly managed and avoid large disturbed areas being exposed longer than necessary. Stockpiling of base and sub-base materials shall be also kept to a minimum to avoid these from being exposed longer than necessary;
- (vi) Topsoil is removed and stored in separate heaps that are located in stable areas for later re-use for site rehabilitation. Spoil is prohibited from being dumped over the side of slopes and hills;
- (vii) Excavated material is sorted as either suitable (able to be reused) and unsuitable (to be disposed of) materials. It is common in construction sites for the local people to request and utilize such materials for levelling of their property;
- (viii) Materials are not to be disposed/stockpiled less than 20 meters from water courses;
- (ix) Side-casting of materials shall not be undertaken especially during the wet season;
- (x) Concrete and asphalt batching areas are to be provided with bunds to control movement of runoff to waterways;

- (xi) Balance cut and fill requirements to minimize impacts from extraction of aggregates;
- (xii) Topsoil and overburden are to be stockpiled near the site and covered with tarpaulin fenced off for safety and security considerations and later reused to re- contour borrow pits after completion of works;
- (xiii) Adequate drainage shall be provided in the material source/quarry areas to prevent the accumulation of stagnant water during the operation;
- (xiv) Should stagnant water accumulate, the borrow pits shall immediately be de- watered to prevent the creation of mosquito breeding grounds;
- (xv) Material sources and quarry areas shall preferably located near the alignment to minimize hauling distance and time and disturbance to settlement areas along the haul roads;
- (xvi) Damage to access roads, garden plots, and other property resulting from the operation of the quarry, material sources and dump sites and transport of materials are to be reinstated after completion of works;
- (xvii) Existing quarry, material sources and dump areas are to be restored before a new site is opened;
- (xviii) Limit the extent of excavation to reduce potential for soil erosion;
- (xix) Install silt traps and other control structures to trap eroded sediments and control the loss of eroded materials;
- (xx) Engage soil conservation protection procedures in susceptible areas to avoid storm water runoff carrying eroded materials either, off-site to susceptible areas or, else onto already finished work areas;
- (xxi) The contractor will prepare a quarry management plan that meets the requirements of the DOW Code of Practice, which will include payment of a royalty to the landowners to extract materials from the site and closure of the site. It is important that the quarry management plan is approved by CSC prior to implementation;
- (xxii) Contain construction areas using a bund or trench, installation of sediment traps or isolate them from other surface run-off, and clean and rehabilitate them when construction is complete; and
- (xxiii) At completion of work dumping and excavated areas to be re-top-soiled and re-vegetated.

108. **Material extraction.** Sources of material (gravel, aggregate etc.) and quarry sites for the sub-project will be agreed and necessary licenses obtained prior to commencement of works. Quarry sites must not be occupied, prepared or operated before the necessary land occupation

permit and EPs have been obtained from the CEPA and any other authorities as required, by the contractor.

109. The contractor will be required to identify sources in the preconstruction phase and prepare a sustainable extraction plan, for all sources of material and spoil that will be used in road works. The aggregate extraction plan will be submitted to ESSU, which will approve and monitor implementation of the extraction plan. The contractor's extraction plan will only include quarries and borrow pits located outside areas for protecting biodiversity and/or wildlife management areas. The suitability of quarry and borrow pit sites will be designated in consultation with the CSC Engineer and if environmentally acceptable and structurally safe and land-owners and village chiefs have provided written permission endorsed by the CSC Engineer.

110. Establishment of quarries, crushers, concrete batching plant and asphalt mixing plant shall be disclosed to the CEPA and follow the requirements of Environment Act and EPAR and obtain an EP, as necessary and be in accordance with DOW's Code of Practice. Only permitted/licensed facilities and operations may provide material for the project.

111. The BCD will specifically require contractors to: (i) balance cut and fill requirements to minimize impacts from extraction of aggregates; (ii) prioritize use of existing quarry sites with suitable materials and update the list of quarries and borrow pits monthly and report to DOW and minimize impacts on other local resources; (iii) procure materials only from quarries and borrow sites acceptable to CEPA or licensed and authorized by CEPA; (iv) if the contractors shall operate the quarry site, required environmental licenses and permits shall be secured prior to operation of quarry/borrow areas; and (v) borrow/quarry sites shall not be located in productive land or forested areas or land subject to instabilities and landslides.

112. **Mitigation measures.** Mitigation measures identified in the EMP include necessary to control impacts from material extraction at quarries and borrow pits such as include:

- (i) Properly remove topsoil, overburden, and low-quality materials and stockpile near the site to be covered and preserved for rehabilitation;
- (ii) Stockpile topsoil for later use and fence and re-contour borrow pits after use;
- (iii) Use quarry with highest ratio between extractive capacity (both in terms of quality) and loss of natural state;
- (iv) Use quarry sites lying close to the alignment not on slopes, with a high level of accessibility and with a low hill gradient;
- (v) Provide adequate drainage to avoid accumulation of stagnant water during quarry/borrow site operation;
- (vi) Reinstate damaged access roads, agricultural land and other properties upon completion of construction works at each section, if damaged due to transport of quarry/borrow materials, other construction materials or any other project-related activities;
- (vii) Avoid use of quarry sites located on river beds. If it is not possible to locate quarries out of river beds, use only quarry sites lying on large rivers (>50m wide);

- (viii) Choose alluvial materials from at least 10m from the banks of the river and maintain the integrity of the flowing stream;
- (ix) Do not take gravel and alluvial materials from within 200m upstream or downstream of any bridge or river protection structure;
- (x) Choose alluvial terraces or alluvial deposits which lie on the river beds but not covered by water in normal hydrological conditions shall be preferred;
- (xi) Cut berms and terraces during and after extraction in quarries in the mountainous or hilly areas to stabilize slopes, wherever slopes are important, and implement a drainage system and vegetation cover for rehabilitation;
- (xii) Dewater and fence quarries and borrow pits as appropriate, upon completion of extraction activities to minimize health and safety risks;
- (xiii) Ensure borrow pits are left in a tidy state with stable side slopes and proper drainage in order to avoid creation of water bodies favourable for mosquito breeding;
- (xiv) Prevent accidental access and avoid drowning when pits become water-filled by implementing measures such as fencing, providing flotation devices such as a buoy tied to a rope;
- (xv) Additional extraction sites and/or borrow pits will not be opened without the restoration of those areas no longer in use;
- (xvi) Excavation and restoration of quarry sites and borrow areas, as well as their immediate surroundings, will be undertaken in an environmentally sound manner to the satisfaction of the ESSU. Sign-off to this effect by ESSU will be required before final acceptance and payment under the terms of the contract;
- (xvii) Refill borrow pits as required by CEPA using surplus inert material and excavated unsuitable soils. Additional extraction sites and/or borrow pits will not be opened without the restoration of those areas no longer in use; and
- (xviii) Mark refilled borrow pits and cover with topsoil and plant shrubs and trees to rehabilitate as required by CEPA.

113. **Spoil disposal.** In most locations the use of this immediately available material will reduce the need for additional extraction of rock based materials. The surplus material should be graded and the suitable cut materials directed for reuse as far as possible on the project roads and subsequently on other roads and other local infrastructure projects. This will reduce the need to extract other rock and gravel resources from vulnerable hillsides and river-beds. The surplus can then be stockpiled at locations agreed with local authorities for use on other local district projects or other nationally planned infrastructure. The surplus shall not be dumped or stockpiled at the side of the road or dumped over the crash barriers or side of slopes as is the current practice by some contractors. Areas for disposal shall be identified with local land owners, worked out and agreed with the village leaders and local authorities and checked for

environmental acceptability and engineering safety by the ESSU before they are used for any disposal or stockpiling.

114. The surplus rock and soil-based materials for disposal must be controlled to avoid potential impacts due to improper disposal. The CEMP submitted by the contractor will be based on the EMP in this IEE and will include a section on spoil disposal to ensure waste from projects road improvements is managed properly. Contractors will initially review the ESSU's options for stockpiling and disposal locations for cut surface materials and reconfirm or propose alternative disposal locations for agreement with the ESSU and local authorities. The CEMP will cover all aspects of construction waste disposal. It is preferred that government land is used for stockpiling and dumping of material. If private land is to be used for the purpose of dumping it shall commence only after written permission from the land owner is checked and recorded by the ESSU and agreeable to the village chief and CEPA.

115. **Mitigation measures.** Mitigation measures will seek to control the impacts at source in the first place. The CSC will be responsible to report to ESSU the monthly update of the cut and fill estimates in conjunction with asphalt and aggregate materials planning between the different areas and advise on overall balancing for cut and fill materials to minimize impacts on local resources. (Mitigation measures for cut slopes are covered under erosion control).

116. The spoil disposal section of the CEMP will include; (i) locations and quantities of spoil arising; (ii) agreed locations for disposal / endorsement from CEPA and local groups; (iii) methods of transportation to minimize interference with normal traffic; (iv) establishment of acceptable working hours and constraints; (v) agreement on time scale and programme for disposal and chain of custody; (vi) rehabilitation and bioengineering of spoil dump slopes after completion, (vii) programming issues including the time of year and available resources; (viii) discussion of the ESSU inspection/monitoring role; and (viii) links to the grievance redress mechanism and complaints management system for duration of the works.

117. Mitigation measures will seek to prevent slope collapse impacts and control the impacts at source in the first place. The ESSU assisted by the CSC will be responsible to monitor the progress of cutting slopes and the implementation of mitigation measures, to minimize impacts. The mitigation measures in the CEMP will include but not necessarily be limited to:

- (i) Spoil will be reused as far as possible for bulk filling;
- (ii) Spoil will not be disposed of in rivers and streams or other natural drainage path;
- (iii) Under no circumstances will spoil be dumped into any other watercourses (rivers, streams, drainage, irrigation canals, etc.);
- (iv) Spoil disposal shall not cause sedimentation and obstruction of flow of watercourses, damage to agricultural land and densely vegetated areas;
- (v) The surplus shall not be stockpiled at the side of the road or dumped over the crash barriers;
- (vi) Spoil will not be disposed of on fragile slopes, flood ways, wetland, farmland, forest, mangrove and associated salt flats, beaches, religious or other culturally sensitive areas or areas where a livelihood is derived;

- (vii) Surplus spoil will be used where practicable for local repair works to fill eroded gullies and depression areas and degraded land in consultation with local community;
- (viii) Spoils shall only be disposed to areas approved by local authority and land owner after approval by the CSC Engineer;
- (ix) Spoil disposal will be monitored by ESSU and recorded using a written chain of custody (trip-ticket) system to the designated disposal sites;
- (x) Random and uncontrolled tipping of spoil, or any material, will not be permitted;
- (xi) Suitable spoil dumping areas will be designated in consultation with the Engineer if environmentally acceptable and structurally safe only after land owners and village chiefs have provided written permission endorsed by the CSC Engineer. Before dumping commences spoil areas will be marked on a plan and in the field with marker poles / flags to define the agreed areas and limits for disposal; Spoil will be disposed of in disused quarries and abandoned borrow pits where practicable;
- (xii) Disposed spoil will be spread in 15 cm layers and compacted to optimum moisture content, covered with topsoil, landscaped and provided with drainage and vegetation to prevent erosion in line with best practice;
- (xiii) The spoil disposal site shall be located at least 50m from surface water courses and shall be protected from erosion by avoiding formation of steep slopes and grassing; and
- (xiv) Spoil disposal area slopes will be rehabilitated and re-vegetated when completed to the satisfaction of the CSC Engineer and endorsed by ESSU.

118. **Waste management.** During construction activities solid waste such as steel and timber off-cuts, sand and gravel, cement bags will be generated. If not properly collected and disposed, these materials may cause adverse impacts to the surrounding areas. The following are the identified impacts of this activity: (i) contamination of the land where the solid waste is deposited; (ii) decrease in water quality of nearby water courses and affect aquifers; (iii) the stockpile of solid waste may create habitation for rodents, pest and vermin which may present a health risk to workers and residents of nearby communities; (iv) health and safety impacts on local communities and reduced aesthetics as the heaps of solid waste in the area will be an eyesore.

119. **Mitigation measures.** The following mitigation measures will be implemented by the contractor:

- (i) Burning of waste associated with the project or the supporting activities is NOT allowed anywhere;
- (ii) Segregation of wastes shall be observed. Cleared foliage, shrubs and grasses may be given to local farmers for fodder and fuel. Organic (biodegradables) shall be collected and disposed of on-site by composting (burning waste not be allowed anywhere within the sub-project site footprint or in the camps);

- (iii) Recyclables shall be recovered and sold to recyclers;
- (iv) Solid waste from the camps will be properly collected and disposed only at the approved disposal sites;
- (v) The contractor will maximize the recycling of used materials to minimize generation of waste;
- (vi) It shall be endeavored that used wood and timber be reused for formworks and other appropriate works;
- (vii) Recovery of materials will be encouraged, however if these cannot be recovered for scrap value these materials are to be taken to an approved landfill sites for final disposition; and
- (viii) Waste materials from the removal of bridge or bridge components, especially the logs used for the old bridges will be removed and properly stored for disposal or given away for use by local people.

120. **Hazardous materials.** Use of hazardous substances such as oils and lubricants can cause significant impacts if uncontrolled or if waste is not disposed correctly. Oils and lubricants discharged to mangroves can kill the roots and destroy the mangrove. Mitigation measures will seek to control access to and the use of hazardous substances such as oils and lubricants and control waste disposal. The ESSU will be responsible to monitor the contractor's progress of implementing the hazardous materials and waste section of their CEMP to avoid or minimize impacts from use of hazardous substances such as oils and lubricants.

121. Improper storage and handling of hazardous materials may result in the pollution of the surrounding areas. The poor handling and storage of large quantities of construction materials will lead to the loss of aesthetic values of the environment.

122. The hazardous materials and waste management section of the CEMP will include consideration of all matters related to hazardous waste disposal including the following: (i) expected types and volumes of hazardous materials and waste; (ii) methods for treatment and disposal of all hazardous wastes; (iii) approvals and environmental licenses required; (iv) methods of transportation to minimize interference with normal traffic; and (v) establishment of regular disposal schedule as agreed or as condition of granting of environmental license.

123. **Mitigation measures.** The mitigation measures to be implemented by the contractor include:

- (i) Workers involved in the utilization of fuel and lubricants are to be properly trained in the handling, storage and dispensing of such materials;
- (ii) An emergency contingency plan will be prepared to address accidental spills and the occurrence of fire in the facilities;
- (iii) Fuel and oil will need to be stored in dedicated areas, security fenced and provided with oil and water separators with fuel hoses and shut off valves locked and at least 20m away from the water courses/bodies;

- (iv) The contractor must prepare a fuel handling procedure and employ trained personnel who are competent in fuel handling procedures;
- (v) The contractor will prepare an accidental spill response procedure to address accidental spills;
- (vi) Any major spill is to be reported to DOW and CEPA;
- (vii) Segregate hazardous wastes (oily wastes, used batteries, fuel drums) and ensure that storage, transport and disposal shall not cause pollution and shall be undertaken consistent with national and local regulations;
- (viii) Ensure all storage containers are in good condition with clear and proper labeling;
- (ix) Regularly check containers for leakage and undertake necessary repair or replacement;
- (x) Store hazardous materials above flood level;
- (xi) Discharge of oil contaminated water shall be prohibited;
- (xii) Ensure availability of spill clean-up materials (e.g., absorbent pads, etc.) specifically designed for petroleum products and other hazardous substances where such materials are being stored;
- (xiii) Spillage, if any, will be immediately cleared with utmost caution to leave no traces. Such incidences should be immediately reported to the CSC Engineer; and
- (xiv) The contractor will be required to display safety information in all work areas and to train workers in the safe use of these materials, including the provision of protective equipment for handling these substances.

2. Impacts on the Biological Environment

124. **Impacts on flora.** Minor impacts upon terrestrial habitats and flora of the project area are expected as a result of the works. Surveying and demarcation will cause minor degradation through the clearance of small areas of this vegetation. Plant species present within the impact area are either introduced species or ubiquitous native species, which are highly tolerant of disturbances. Although the project area is rural, no endangered and rare species of flora exist as mentioned in Chapter IV: Description of the Environment, according to the local people in the project area.

125. Construction activities will lead to the loss of vegetation including trees in the area. All vegetation that is present along the project corridor will be cleared to pave the way for the construction of the road. The vegetation thus removed is low to medium volume as there are several mature trees along the alignment. For most sections, the vegetation comprises of secondary growth from small to medium grown trees, shrubs and grasses.

126. Minor impacts upon terrestrial habitats and flora of the project area are expected as a result of the road rehabilitation. Habitat fragmentation occurs when a road cuts through an ecosystem; the project roads have existed for some time and though their original construction would have caused habitat fragmentation, ecosystems have re-established albeit as altered and/or smaller units around the road.

127. There will be limited and minor, if any, impacts on habitat. Rehabilitation work will directly cause minor degradation of local ecology through the clearance of small areas of vegetation at work sites and ancillary sites such as materials extraction sites, and material stockpiling areas. Construction activities will impact only a narrow band of vegetation within the existing road corridor. Plant species present within the impact area near the roads are either introduced species or ubiquitous native species, which are highly tolerant of disturbances. Much of the areas either side of the roads are planted almost up to the shoulders with coffee and cassava. There is no vegetation adjacent to the project road that has conservation significance, nor is it representative of the original vegetative cover but there are mature trees in many locations

128. There are some gardens, plantations and occasional individual trees, including mango, jackfruit, Casuarina and teak close to the road that may require removal. They are common and have no special characteristics to merit protection however in line with ESSU policy trees will be avoided wherever possible by minor adjustments to the centreline. Therefore, in light of the nature of the project and the types of works envisaged, there will be no significant loss of valuable flora or habitat. Rehabilitation activities will take place entirely within the existing ROW or within areas already subjected to clearing in the past.

129. **Mitigation measures.** Invasive species shall not be introduced. During replanting/revegetation works, new alien plant species (i.e., species not currently established in the region of the project) shall not be used unless carried out with the existing regulatory framework for such introduction. All replanting and compensatory tree planting will be planned in full agreement with the local forest authority. Measures to be included in the project to ensure minimization of impacts from vegetation removal include:

- (i) Trees that need to be cut will be included in an inventory by the contractor in the pre-construction stage and trees that must be removed will be agreed with ESSU prior to cutting;
- (ii) Vegetation clearing should be kept to a minimum, and occur only within the designated construction limits. Trees shall not be indiscriminately cut, but instead given root protection for replanting elsewhere if at all possible;
- (iii) Vegetation clearance during surveying and demarcation activities, especially of trees along the road-side, will be minimized. Major trees (especially in village areas) that to be removed will be clearly marked, only marked trees will be removed;
- (iv) The contractor will be responsible for providing adequate knowledge to construction workers in relation to existing laws and regulations regarding illegal logging. Contract documents and technical specifications will include clauses expressly prohibiting the felling of trees, not requiring to be cleared by the project, by construction workers for the term of the project;

- (v) Cut timber shall not be used for fuel by the contractor but shall be removed from the roadside and returned to the owner; and
- (vi) Construction workers will be informed about general environmental protection and the need to avoid un-necessary felling of trees wherever possible;
- (vii) Vegetation clearance during construction activities, especially of trees along the road-side, will be avoided minimized;
- (viii) The ESSU will supervise and monitor a ban on use of forest timber and workers shall be prohibited from cutting trees and mangrove for firewood or collecting wood from forest areas; and
- (ix) Under no circumstances is the contractor or any of their sub-contractors or employees permitted enter the forests to fell or remove trees or collect wood.

130. **Impacts on fauna.** Minimal effects on the mammals, birds, and reptiles found in the area is expected. Birds of Paradise of different varieties are located 20 to 40 km away from the project area. During the construction phase, dust generation is expected. This will have a negative impact on the avian population on the area. The generation of excessive dust for a longer period of time and dust can cause disturbance to some wildlife, but these species are mobile. Considering the type of subproject and the landscape that it will traverse through, no significant impacts on wildlife are expected in terms of impacts on fauna, there is the potential for construction workers to poach edible animals and birds of the locality in spite of prohibitions and poaching. The contractor will be responsible for providing enough food and adequate information to workers regarding the protection of fauna and imposing sanctions on workers trapping, killing or wounding birds or other wildlife. To avoid sudden and unsustainable loss of any wildlife resources the contractor will be required to address the issues listed below. This will be the responsibility of the contractor.

131. **Mitigation measures.** The mitigation measure include:

- (i) Labor employment agreement enforced by contractor that bans hunting and trading in wildlife by workers;
- (ii) Contractor is to provide nutritionally adequate food supplies and rations at the construction camp;
- (iii) Workers shall be prohibited from hunting or catching wildlife including fish; and
- (iv) The contractor will be responsible for providing adequate knowledge to construction workers in respect of fauna. Contract documents and technical specifications will include clauses expressly prohibiting the poaching of fauna by construction workers and making the contractor responsible for imposing sanctions on any workers who are caught trapping, killing, poaching, being in possession of or having poached fauna.

3. Impacts on the Socio-economic Environment

132. **Access and traffic safety.** The project will cause temporary negative impacts through presence of vehicles and equipment, including inconvenience, minor disruptions to traffic using

the road, and on local access to and from the villages along the project road during the construction period. Mitigation of impacts on access and traffic will include:

- (i) The contractor will prepare, and submit to ESSU, a traffic management plan detailing diversions and management measures;
- (ii) Signs and other appropriate safety features such as use of flag men will be used to indicate construction works are being undertaken;
- (iii) Contract clause specifying that care must be taken during the construction period to ensure that disruptions to access and traffic are minimized and that access to villages along the project road is maintained at all times; HRMG and village officials will be consulted in the event that access to a village has to be disrupted for any time and temporary access arrangements made;
- (iv) Construction vehicles will use local access roads, or negotiate access with land owners, rather than drive across vegetation or agricultural land, to obtain access to material extraction sites. Where local roads are used, they will be reinstated to their original condition after the completion of work;
- (v) The road will be kept free of debris, spoil, and any other material at all times;
- (vi) Disposal sites and haul routes will be identified and coordinated with local officials;
- (vii) Provision of adequate protection to the general public in the vicinity of the work site, including advance notice of commencement of works, installing safety barriers if required by villagers, and signage or marking of the work areas; and
- (viii) Provision of safe access across the works site to people whose villages and access are temporarily affected during road re-sheeting activities.

133. **Effects on existing services and utilities.** The ESSU and contractor will consult with all relevant authorities to ensure that they minimize any disruptions to existing infrastructure and services. This includes village water supplies, telecommunications infrastructure and electricity supply wherever applicable. Plans (if available) will be obtained from utility/service providers showing all underground facilities and/or services in order to avoid damage or disruption during works. Where plans and drawings are not available, the contractor will review by field observation and report locations to PMU in the pre-construction stage.

134. **Mitigation measures.** Mitigation measures to be included in the CEMP will require the contractor to:

- (i) Inform affected communities well in advance;
- (ii) Reconfirm power, water supply, telecommunications and irrigation systems likely to be interrupted by the works and any additional trees to be cut near utilities;
- (iii) Contact all relevant local authorities for utilities and local village groups to plan re-provisioning of power, water supply, telecommunications and irrigation systems;

- (iv) Relocate and reconnect utilities well ahead of commencement of construction works and coordinate with the relevant utility company at the district and district levels for relocation and reconnection well before works commence and include for compensatory planting for trees;
- (v) Arrange reconnection of utilities and irrigation channels in the shortest practicable time before construction commences; and
- (vi) If utilities are accidentally damaged during construction it shall be reported to the ESSU and DOW and utility authority and repairs arranged immediately at the contractor's expense.

135. **Worker health and safety.** The construction activities pose a range of health and safety risks. The SPS requires that health and safety impacts on workers and the community are identified and mitigation measures proposed that will meet the World Bank's Environmental Health and Safety Guidelines (EHSG).

136. Air pollution, noise and traffic safety aspects which also have a health and safety aspect, have already been discussed. The risk of spread of communicable disease is dealt with in the next section.

137. Worker occupational health and safety is generally governed by the Employment Act. The CEMP will address worker health and safety and will establish routine safety measures as required by EHSG and Employment Act and by good engineering practice. Observing general health and safety requirements, including provision of safety and protective gear and equipment to workers, will reduce the risk of accidents at the work sites. The construction camp will be equipped with a first aid and health-post which will include first-aid and basic medical supplies. To reduce the risk of incidents at the camp, access to construction camps by other than authorized workers and people will be prohibited.

138. **Mitigation measures.** The mitigation measures for reducing and avoiding impacts on worker health and safety include:

- (i) At least one month before construction commences the contractors will demonstrate to the ESSU they are properly resourced and a qualified/experienced environment and safety officer (ESO) will be identified by the contractors in the bid;
- (ii) Establishment of safety measures as required by law and by good engineering practice and provision of first aid facilities at work sites, in vehicles and establishment of a first aid/health post at the camp;
- (iii) The contractor will conduct of training (assisted by ESSU) for all workers on safety and environmental hygiene at no cost to the employees. The contractor will instruct workers in health and safety matters as required by law and by good engineering practice and provide first aid facilities;
- (iv) Instruction and induction of all workers shall be carried out for all operatives before they start work in health and safety matters, including road safety;

- (v) The contractor will instruct and induct all workers in health and safety matters (induction course) including construction camp rules and site agents will follow up with toolbox talks on a weekly basis. Workforce training for all workers starting on site will include safety and environmental hygiene;
- (vi) Workers shall receive a daily safety and work briefing from contractors called the tool box talk;
- (vii) Workers shall be provided with appropriate personnel protection equipment (PPE) such as safety boots, helmets, reflector vest, gloves, protective clothes, dust mask, goggles, and ear protection at no cost to the workers. Contractors will issue PPE on a daily basis to workers after the tool box talk;
- (viii) Fencing will be installed on all areas of excavation greater than 1m deep and sides of temporary works;
- (ix) Reversing signals (visual and audible) shall be installed on all construction vehicles and plant;
- (x) Provision of potable water supply shall be maintained at all times in all work locations;
- (xi) Fencing on all excavation, borrow pits and sides of temporary bridges;
- (xii) Scheduling of regular (e.g. weekly tool box talks) to orientate the workers on health and safety issues related to their activities as well as on proper use of PPE;
- (xiii) Where worker exposure to traffic cannot be completely eliminated, protective barriers and warning signs shall be provided to shield workers from passing vehicles. Another measure is to install channeling devices (e.g., traffic cones and barrels) to delineate the work zone and trained flag men at each end of the work current working zone; and
- (xiv) Construction camps shall be provided with toilets/sanitation facilities in accordance with local regulations to prevent any hazard to public health or contamination of land, surface or groundwater. These facilities shall be well maintained and cleaned regularly to encourage use and allow effective operation and emptied regularly so as never to overflow.

139. **Community health and safety.** The works could create various impacts on the health and safety of communities. The presence of construction workers and work camps can induce or increase risk of spread of communicable diseases Transmission of sexually transmitted infections (STIs) and Human Immuno-Deficiency Virus (HIV) and other communicable diseases is a potential impact of the construction phase posed by construction workers engaging in either commercial sex or sexual relationships with local people.

140. Potential sanitation and impacts from disease will need to be controlled by maintaining hygienic conditions in the worker camps and implementing the social and health awareness programs for the project.

141. Public safety, particularly of pedestrians and children can be threatened by the excavation of the trenches for side drain construction. Within 500m of settlements and towns fencing will be installed prior to excavation work commencing on all sides of temporary excavations. The plans will include provisions for site security and guards, trench barriers and covers to other holes and any other safety measures as necessary. The contractor will provide warning signs at the periphery of the site warning the public not to enter. The contractor will restrict the speed of project vehicles and also control traffic by contra-flow and provide flag-men and warning signs at either end of the works where the traveling lanes must be temporarily reduced.

142. The contractors will provide information boards near the work sites to inform and instruct the public on how to conduct themselves and to be aware of their surroundings if they must approach the works. Information boards will be refreshed as necessary and also show the name and telephone contacts in ESSU and contractors offices for complaints about the works. Information boards will also state that the ESSU and contractor have an open door policy as regards complaints.

143. **Mitigation measures.** The contractors will implement the following safety measures for the public:

- (i) The contractor will appoint an ESO to address health and safety concerns and liaise with the ESSU and villages within the sub-project area;
- (ii) Barriers (e.g., temporary fences) and signs shall be installed at construction areas to prevent pedestrian access except at designated crossing points. Adequate signage and security will be provided at the site office and works yard and prevention of unauthorized people (including children) entering work areas and camp. Warning signs will be provided at the periphery of the site warning the public not to enter;
- (iii) The general public/local residents shall not be allowed in high-risk areas, e.g., excavation sites and areas where heavy equipment is in operation and these sites will have a watchman at the entrance to keep public out;
- (iv) Speed restrictions shall be imposed on project vehicles and equipment traveling within 50m of villages and sensitive receptors (e.g. residential, schools, places of worship, etc.);
- (v) Provisions will be made for site security, barriers on trenches and covers to other holes and any other safety measures will be installed as necessary;
- (vi) Drivers will be educated on safe driving practices to minimize accidents and to prevent spill of spoil, hazardous substances (fuel and oil) and other construction materials during transport;
- (vii) Contractors will ensure that no wastewater is discharged to local rivers, streams, lakes and irrigation channels and any other water bodies;
- (viii) Measures to prevent proliferation of mosquitoes shall be implemented (e.g., provision of insecticide treated mosquito nets to workers, installation of proper

drainage to avoid formation of stagnant water. Standing water will not be allowed to accumulate in the temporary drainage facilities or along the roadside);

- (ix) The contractor shall make provision to ensure the construction workforce attends STI and HIV/AIDS prevention workshops provided through an approved service provider. The workshops will be delivered to the contractor's workforce prior to commencement of any civil works; and
- (x) Village-based community awareness raising about transmission of STIs and HIV, reproductive health and safe sex. The program will be implemented after contractor mobilization when training staff are in post and prior to construction works commencing.

144. **Physical cultural resources.** Any site clearance, digging and excavation activities undertaken during construction can unearth physical cultural resources (PCR) including lost or historical burial sites. In the event this occurs, work shall cease immediately and the relevant authorities shall be informed. Activities shall not re-commence until the authorities have signed-off that the site/resources have been dealt with appropriately and that work may continue. The contractor shall be responsible for complying with the requirements of authorities, and the ESSU shall monitor the same. The contractor will include a section on "chance finds" in the CEMP.

145. **Mitigation measures.** Mitigation measures for potential impacts on PCR include:

- (i) Site agents will be instructed to keep a watching brief for relics in excavations;
- (ii) Should any potential items be located, the PMU will immediately be contacted and work will be temporarily stopped in that area;
- (iii) The ESSU with the assistance of the CSC will determine if that item is of potential significance and contact DOW to pass the information to the relevant department in the government who will be invited to inspect the site;
- (iv) Work will be stopped to allow time for inspection, removal or in-situ preservation of the PCR and until the relevant government agency indicates works can re-commence; and
- (v) Until the government has responded to this invitation work will not re-commence in this location until agreement has been reached with the government and ESSU as to any required mitigation measures, which may include structured excavation.

C. Operation Phase

146. After the completion of the construction phase, the contractor will maintain and/or make correction on all defects in the implementation of the project for one year prior to hand-over to the DOW. Maintenance works will be properly implemented in the operation which includes: strengthening of the inspection and monitoring system, periodic inspection and assessment of road condition, timely implementation of repair works, asphalt removal, replace and re-seal, vegetation control, clearing of side ditches, repair of erosion protection works, and, periodic replacement/repainting of traffic safety signage.

1. Operation Impacts on Physical Environment

147. **Air quality - gaseous emissions.** Vehicle emissions as indicated by concentration of oxides of nitrogen will be the main air pollution sources during operation. Following the rehabilitation of the road its use will create modest amounts of air pollution such as hydrocarbons, carbon monoxide, nitrous compounds, sulphur dioxide and particulate matter.

The current volume of traffic and forecasted traffic growth are such that emissions will be low enough to not have a noticeable effect on ambient air quality. The anticipated levels of traffic, good capacity of the road network, and subsequent lack of congestion and concentration of traffic, are unlikely to result in adverse impacts on air quality. There will be few other sources of emissions near the project road other than from domestic fuel burning. Sensitive receivers are set far enough back from the project roads road to allow adequate dispersion that there will be no significant impacts at the sensitive receivers.

148. **Air quality - particulate emissions.** Particulate contamination such as dust and fumes will also be air pollution sources during operation however toxic residues from vehicle emissions near the project roads road are unlikely to accumulate or create significant impacts. Dust from the existing road will be reduced due to the better asphalt surface for the new road.

149. The conclusion in respect of air quality is that the project road is likely to continue to operate at well under its design capacity and no significant air quality impacts that warrant mitigating actions are anticipated.

150. **Run-off and soil erosion.** Soil erosion will be prevented by the engineering controls in the designs to prevent erosion and maintain slopes. The designs will be engineered to control erosion and flooding on either side of the embankments in case of heavy rains. Apart from affecting the community lands and resources, this would otherwise cause natural streams and irrigation channels to become silted.

151. Measures will also be taken during the operational phase to ensure that the frequency of maintenance is increased and that storm drains and highway drainage systems are periodically cleared to maintain clear drainage to allow rapid dispersal of storm water flow. An adequate system of monitoring, reporting and maintenance will be developed.

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

153. There is a very minor risk of impacts on sedimentation and water quality through improving drainage from the road and areas landward of it in the few months when there is significant rainfall. At other times there will be virtually no runoff but the drains will need to be kept clear of dry matter constricting the drains. The project will lead to longer term environmental benefits for water quality created by the project through proper compacting of the road and surface and reducing mobilisation of surface dust during rain. The dust that is re-suspended and mobilized will be captured where required in sediment traps to limit the amounts finding their way to rivers.

154. The maintenance contractor will be responsible for regular clearing of drainage structures to keep them effective. Additional plantings around drains will be appropriate and will help to retain surface particles on land. Water quality may show slight improvements after rehabilitation and maintenance due to reduced erosion from improved embankments on the

slopes, stabilization by rip-rap or gabion baskets, and re-vegetation to prevent erosion. However any improvements are unlikely to be detectable in water samples due to the infrequency of rainfall.

155. To cater for the times when there is heavy rain, the replacement of dilapidated or damaged culverts will facilitate passage of high flows and reduce scouring and remove overland flows, ensuring the integrity of the surface of the road pavement and removing a potential hazard from overflowing.

156. The area of impervious surface is not being significantly increased by sub-project and therefore increased runoff due to rehabilitation activities (if any) will be negligible in the project area.

157. **Routine and ongoing maintenance.** There are unlikely to be any significant impacts on soil during the operation phase of the project as long as the structures are properly maintained. Naturally occurring river bank erosion could in fact be reduced as a result of the project if selective road sealing, gabion baskets are used to stabilize the river banks and protect the road where it passes close to the rivers. Rip-rap, gabion baskets or bio-engineering alternatives will also be used to reduce scour and erosion in identified sections. These impacts and values can be maintained through good design as follows: (i) DOW/HRMG will ensure that all culverts and drainage structures are adequately maintained so that debris does not build up causing waters to deviate around the structures stranding them and resulting in severe erosion and loss of land; and (ii) scour protection is on-going and adaptive to changing river requirements.

158. Increasing awareness about the need to maintain vegetative cover of areas adjacent to the road in terms of both assisting in reducing silt-laden run-off to waterways and contributing to the stability of river-banks, can be included as a component of the project's communication plan and identified as part of the maintenance activities.

2. Operation Impacts on the Biological Environment

159. **Effects on flora and fauna.** The operation of the project is not likely to induce people to the area to poach or hunt timber, flora or fauna as it does not comprise provision of additional access to previously inaccessible areas. The road already exists and the patterns of travel and movement are already established and the projects will not provide any additional access to the interior forested areas.

160. Deforestation is not an impact attributable to the project because (i) single selective logging for traditional and/or cultural purposes is permitted; and (ii) logging companies purchase licenses to fell trees within prescribed areas and construct their own roads to provide access to these areas, and in any case logging has not been a major activity in the project areas. Therefore there will be no impacts on flora and fauna as a consequence of road rehabilitation during the operational phase.

161. There are no rare or endangered fauna near this sub-project road that could be impacted by the operation of a rehabilitated road. At present there is already a through-route and ready access for low traffic volumes, however it seems unlikely there will be any additional impacts from the road itself on flora and fauna. Most areas near the road are already heavily disturbed from traditional shifting agriculture and coffee plantations.

3. Operation Impacts on the Social Environment

162. **Noise.** Even under the most optimistic scenario of increased traffic, the ambient noise level after the completion of rehabilitation activities along the road (operational period) will not be of sufficient magnitude to require mitigation. As noise is a function of traffic numbers, ambient noise levels will not increase above acceptable levels due to the low forecast traffic.

163. Maintenance of vehicles to maintain an acceptable level of, or to reduce, noise emissions is beyond the scope of the project.

164. **Risk of spread communicable disease.** In terms of risk of transmission of communicable diseases during operation, roads have the potential to pose a risk as a pathway for disease transmission only if they carry a large volume of traffic, including high proportions of heavy traffic such as trucks, are routes that connect cities, towns or large numbers of villages, especially roads or highways with international borders where improved access to major markets can facilitate international trade, and there is a hospitality service industry established that is geared towards large numbers of truck drivers and mobile populations.

165. The road does not provide linkage to Indonesia. Therefore the conclusion, in terms of risk of transmission of communicable diseases during operation, is that the project road has the potential to pose, a low risk as a pathway for disease transmission. This small risk is considered to be mitigated by implementation of the sub-project's STIs/HIV/AIDS awareness and prevention campaign.

166. **Safety and access.** Following rehabilitation of the road, local access as well as the performance of a key route in the transport network will be improved. This will facilitate the flow of traffic, goods, and passengers between the sub-districts and two towns within the sub-project area and facilitate transportation to and from other areas in the Highlands. Access to social services and key community facilities will be improved as a result of the project. The implementation of the maintenance plan to be implemented by HRMG will ensure the sustainability of the road rehabilitation.

167. In general traffic safety will be improved following rehabilitation and routine maintenance of the road, inclusion of the shoulder for curve improvement will allow for safe passing of vehicles. An increased traffic volume and possibility of higher vehicle speeds can create the potential for accidents involving pedestrians and children. The sub-project overall includes road safety warning signs which will help mitigate this.

168. It should be noted that overgrown vegetation poses a traffic hazard, especially when it reduces sight-lines around corners. Vehicles are known to cross to the other side of the road to avoid heavily vegetated areas, posing accident risks to oncoming vehicles. Regular cutting and clearance of road-side vegetation should be included as part of the road maintenance program.

169. The rehabilitation of the project road is likely to increase the vehicle speed on the road. Increases in traffic flow indicate additional future traffic should be moderate and unlikely to create many community safety issues. Overall the condition of the road facilities will be enhanced and driving conditions should improve. Routine safety measures, signage and road markings should be introduced to reduce driving risk further in villages and accident prone areas and provide enhancements to driving conditions.

VI. ANALYSIS OF ALTERNATIVES

170. **With Project Alternative.** Currently, access to marketplaces, jobs, education, health care etc., is hampered by the poor conditions of the road, which is a result of a lack of road and bridge maintenance. Transport is more costly and more time consuming than it would be with a properly maintained road network, and in many parts of the Highlands Region some road connections have ceased to exist as the roads are no longer passable. More specifically, the subproject is expected to produce the following benefits:

- (i) **Road User Savings:** Savings in Vehicle Operating Costs are the major category of benefits and are the difference between the costs of operating vehicles on the sub- project road with the proposed improvement compared with the base case of the existing condition.
- (ii) **Generated Traffic Benefits:** Reductions in vehicle operating costs and travel times will result in more trips being taken, particularly by passenger motor vehicles (PMVs), trade, and service vehicles. These benefits from generated traffic are expected to arise as a result of increased economic and trip activity catalysed by reduced transport costs. The increase in generated traffic is expected to occur during the first year after completion of the rehabilitation works.
- (iii) **Exogenous Benefits and Costs:** In addition to benefits in vehicle operating cost savings, some limited additional benefits could arise as a result of net value added to the economy through marketing of vegetables and coffee over the current (without project) levels. Accessibility is currently constrained by the deteriorating condition of the existing road. Development benefits are covered by the increment of generated traffic as discussed above.
- (iv) **Diverted Traffic Benefits:** Benefits from diversion of existing traffic on to the upgraded road will be minimal, as the road is the only significant link serving the population in the area.
- (v) **Health Benefits:** Improvements in health and personal lifestyle will occur as a consequence of the reduction of dust nuisance and quickness in travel. It is also possible that health authorities and church entities may introduce new health facilities making use of the improved access.

171. **Without the Project Alternative.** As shown in the sections above, the subproject will be a definite improvement in connectivity for the local communities. Not implementing the subproject will delay the development opportunities and social benefits for the concerned communities using the Gewa to Gembogl road section.

172. **Technical Alternatives.** Two technical alternatives were analyzed using the RAMS/HDM-4 system: a 'Base option' (minimal maintenance of the existing road) and rehabilitation' of the proposed road section. The assessment of the alternatives shows that for the Gewa to Gembogl road section, rehabilitation is the preferred technical alternative.

173. **Alternative Alignments.** To avoid steep slopes and sharp curves, it could be considered to realign selected sections of the road and construct new road sections. However, this alternative is not preferable because of significant environmental and social impacts. It has

been agreed that possible land disputes and destruction of private/community property should be kept to the absolute minimum.

VII. INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

174. As required by the ADB's environmental and social safeguard requirements and Public Communications Policy, public consultations need to be undertaken for projects of this nature. The primary purpose of the consultations is to present the proposed development, illicit issues and concerns that the people, stakeholders, and concerned parties in the impact area may have relevant to the proposed development. Community consultations were held during site visits and data collection in December 2013. The purpose of the consultations was to inform the public about implementation of the HRRIP and the specific subproject and get the opinions, concerns and issues of the stakeholders for consideration in the design of subproject. The project team presented and defined to the participants the scope as well as explained the need for the rehabilitation of the Gewa to Gembogl Road. The project team explained also the environmental and social impacts and the requisite mitigating measures that will be established during the implementation of the subproject. After the presentation, issues and concerns of the stakeholders and participants were elicited, discussed, and noted for further inclusion in subproject design. The stakeholders were largely comprised of the concerned and affected people, provincial and local government officials, village leaders, youth and women. Annex C presents the photographs and participation lists of the consultations.

A. Results of Consultations

175. **Community consultations.** Meetings and consultations were held on 20 December 2013 with communities along the Gewa to Gembogl Road. Seven large community consultations were held. The date and locations of public consultations are shown in Table 7.1. A total of 182 community members participated in the meetings. The meetings involved an average of 26 participants including women (18.40%), youth leaders (7.70%), and elders (14.28%). Most of the participants were farmers and community leaders some employed as public servants. Majority of the stakeholders expressed the need for the upgrading and rehabilitation of the Gewa to Gembogl Road.

176. The improved road will result to better socio-economic conditions Land issues were raised however, people have realized that the improvement of the road is of greater importance than the land and the leaders agreed to identify and resolve land issues before the project is implemented. Short-term benefits identified by participants included community participation through employment and skills training, whilst in the long term an improved road would generally raise their living standards. Environmental issues involving dust and noise were minimal and the participants agreed the road rehabilitation would be of a far greater benefit to the people.

Table 7.1 Locations and Participants of Consultations

Date	Location	No. of participants		
		Male	Female	Total
20 December 2013	Gewa Village	10	0	10
	Bombanono Market	18	3	21
	Yombai Village	20	9	29
	Duglpagl Village	35	7	42

	Umbai Village	19	4	23
	Sumburu Village	25	5	30
	Womatne Village	22	5	27
Total		149	33	182

177. **Process and results.** The Provincial and Local Officials together with the primary stakeholders and directly and indirectly affected persons have confirmed the need for the rehabilitation of the road system during the public meetings. The concerned local level government units (LLGs) also concurred with the proposed rehabilitation. These positive responses from the beneficiaries and the concerned LLG's form the official acceptance of the subproject in the area. The concerns and other points of view elicited during the public consultations form part of the basis of this IEE, supplemented as necessary by the consultants' own observations. Table 7.2 presents the summary of the issues raised during the consultations.

Table 7.2. Issues Raised during the Public Consultations

Issues raised during Consultation	Response of the Team
There were several concerns regarding false commitment by various government agencies for the last 20 years, from several Prime Ministers and local MPs and this was a big obstacle and concern for the community to easily accept the proposed road project. Creating false expectations and commitment by various governments and politicians was an obstacle during the consultations, it made the people very frustrated and overwhelmingly welcomed ADB initiative.	The Team informed the participants that all commitments made in the gathering shall be fulfilled.
Every Community agrees that the Gewa to Gembogl Road need to be rehabilitated and upgraded	The Team expressed appreciation for the support of the Communities for the proposed development.
That an improved road will greatly enhance and improve travel and economic activities such as small enterprises, education, delivery of basic services and access to health services, etc. Some mothers raised their appreciation that the proposed road rehabilitation with ease their burden of not getting their produce to towns and markets in time for sales.	The Team reiterated that the improved road will greatly enhance development and delivery of basic services in the areas.
Discouragements of makeshift structures and improvements for seeking fast opportunistic cash earning was strongly emphasized. The people promised to cooperate to ensure that there is no unreasonable claims made for structures and improvements.	The Team thanked the participants for the cooperation and support that they will provide during the conduct of the survey for improvements and structures.
Awarding of construction contract to reputable contractor	It was explained that GoPNG bidding and procurement process would involve evaluation

Issues raised during Consultation	Response of the Team
	of capacity and track record of bidders. A reputable international company would be awarded the contract
Will affected persons (AP's) be properly compensated? Timely payments of improvement for the new development.	Yes. The project will conduct a thorough Census survey of losses including land investigation and AP's will be paid by the GoPNG through DoW before construction.
Will women or Youths be Employed?	Yes the project intends for both men and women to be employed during the road construction. This would be tasked to the contractor(s) as part of the contractual agreement.

Issues raised during Consultation	Response of the Team
Environmental damage caused during construction?	Environmental damage of dust and noise will be minimal and only during the time of construction.
Will the road be maintained? Who is responsible to maintain the road?	The project will include a maintenance contract to ensure that the rehabilitated road will be kept in passable condition throughout its design life. This will create local employment and small business opportunities on a long-term. The National Roads Authority will be the agency tasked to undertake the maintenance of the rehabilitated and upgraded roadway.
Waste disposal and regain land through appropriate waste management of waste earth was raised several times.	The Team informed the participants that recycling and reuse of resources shall be practiced during the works and that the appropriate methodologies shall be undertaken by the Contractors to minimize waste generation.

B. Ongoing Consultation and Disclosure

144. **Ongoing consultation and disclosure.** Public consultations will be conducted as the sub-project proceeds to explain the various processes that the sub-project will proceed through. A structured approach will be developed for additional public consultation that will focus more on awareness so that communities are informed of the project's plans, leading them through the compensation procedures and creating awareness concerning opportunities that the sub-project may present in terms of employment and marketing of produce to the contractor and workers. These meetings will also discuss the social risks of the construction phase with regard to the location of workers and HIV/AIDS infection that may be carried into their communities. The ADB will arrange for the IEE to be posted on the website of the Bank. Following approval of the IEE, a copy of the IEE document will be sent to all relevant local government offices. DoW will arrange for the IEEs to be posted on their website and copies will be made available to the public. Information regarding the rehabilitation of the Gewa to Gembogl Road and the proposed

environmental management measures will be posted at suitable locations in the subproject area.

VIII. GRIEVANCE REDRESS MECHANISM

178. During the course of the subproject it is possible that people will have, concerns with the project's environmental performance including the implementation of the EMP. Issues may occur during construction and again during operation. Any concerns will need to be addressed quickly and transparently, and without retribution to the AP. The grievance redress mechanism (GRM) that has been established for the resettlement plan will be utilized to address environment-related grievances. The following process is to be used and commences with an attempt to sort out the problem directly at sub-project level. If this cannot be resolved then the grievance moves to the resolution process outlined in Section 87 of the Environment Act 2000. This procedure is for addressing environmental issues. Any grievances dealing with land and compensation issues are to be directed to the Department of Lands and/or DOW who has established procedures for dealing with these issues. The process is shown as a flow chart in Figure 8.1.

179. **During construction.** Most complaints that may arise during construction are expected to be minor such as dust or noise that should be able to be resolved quite easily and acted upon immediately at the sub-project level by the CSC Engineer. Where the complaint is of a more serious nature the Engineer has up to two days to resolve the complaint.

180. Complainants will initially discuss their concern, grievance or complaint directly with the Ward Councilor in their village. If the Ward Councilor supports the complaint both persons take the complaint to the Engineer who will review the complaint within two days. All complaints arriving at the site office are to be entered in a register that is kept at site by; date, name, contact address and reason for the complaint. A duplicate copy of the entry is given to the complainant for their record at the time of registering the complaint. The register will show details such as who has been directed to deal with the complaint, the date when this was made together with the date when the complainant was informed of the decision and, how the decision was conveyed to the complainant. The register is then signed off by the person who is responsible for the decision and dated.

181. The register is to be kept at the front desk of the site office and is a public document. The duplicate copy of the entry is given to the AP will also show the procedure that will be followed in assessing the complaint, together with a statement affirming the rights of the complainant to make a complaint. Any person making a sub-project related complaint will not be charged. If the complaint is dismissed the complainant will be informed of their rights in taking it to the next step. A copy of the decision is to be sent to the HRMG.

182. Should the complainant not be satisfied with the decision of the Engineer or that s/he is unable to resolve the complaint, the matter will be forwarded to the Grievance Redress Committee (GRC) established at the province for resolution. The GRC will handle both environment and resettlement related grievances. The Committee shall be composed of the District Administrator, the LLG Council President, DOW represented by the HRMG, Environmental Officer, Community Relations Officer, a representative from civil society. There shall be only two hearings of the GRC, and the schedule of the final hearing should be not more than 10 days after the first hearing. Both parties may re-negotiate the offer made during the first hearing and may introduce new arguments and evidence to support their respective positions.

After the summation of their respective positions, the GRC shall decide the issues involved based on the policies governing HRRIP, prevailing laws of PNG and customary laws of the place where the dispute arose.

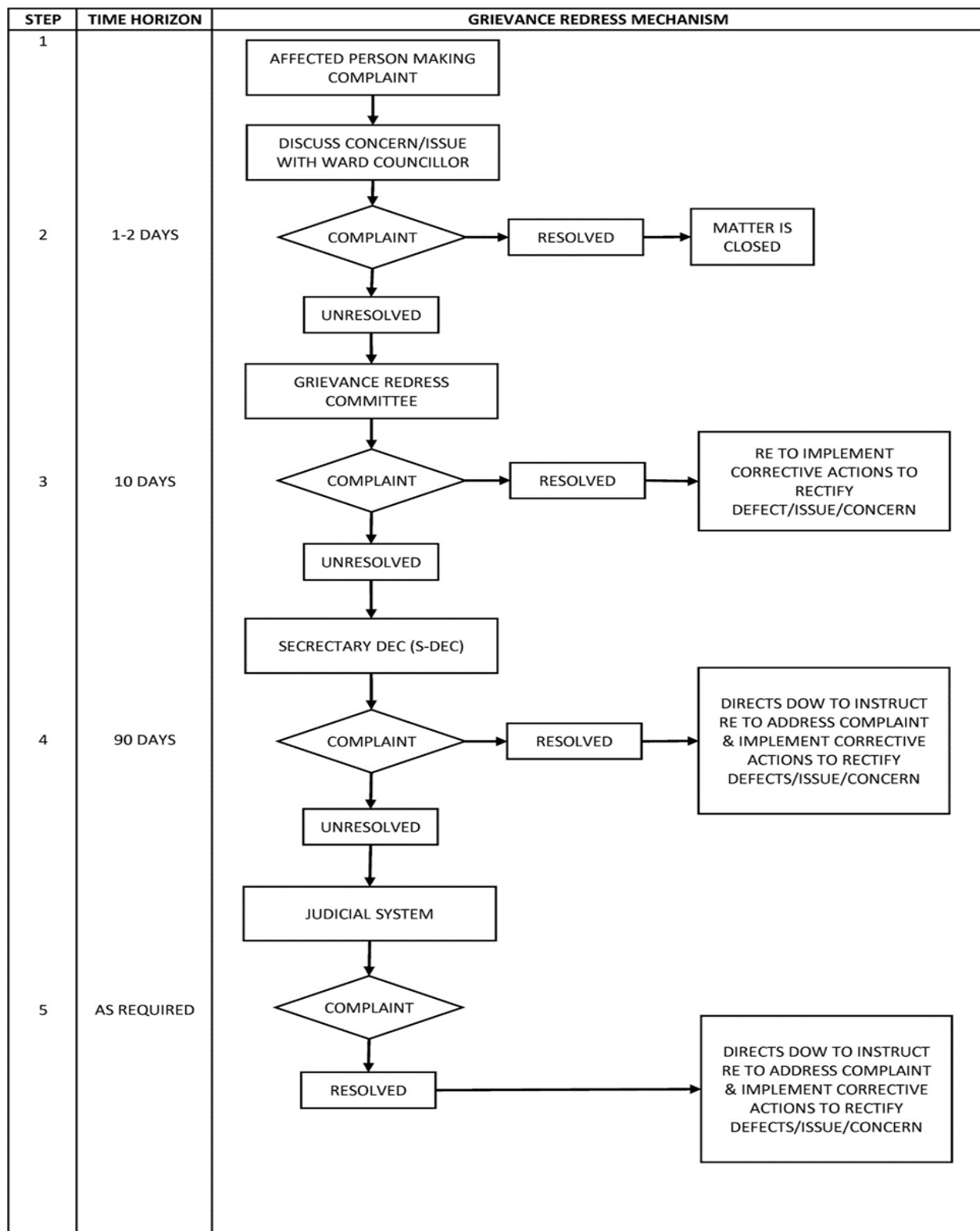
183. Should the complainant not be satisfied with the decision of the GRC, the complainant may take the complaint to the Secretary-CEPA and continue the grievance in accordance with Section 87 of the Environment Act 2000 i.e. procedure for dealing with compensation claims for environmental impacts. The procedure is set out as follows:

- (i) The complainant meets with the contractor and/or EP holder to formally register concern over impact and seek redress. A copy of the alleged impact is submitted to CEPA.
- (ii) EP holder has to determine whether the impact has occurred due to its activities.
- (iii) If EP holder accepts responsibility for the impact, it can negotiate a mutually acceptable settlement with AP within 90 days.
- (iv) If EP holder rejects responsibility for the impact, the complainant can request CEPA to carry out a verification investigation.
- (v) If CEPA confirms that the impact has occurred, he/she will advise the EP holder and complainant to negotiate a settlement within 90 days.
- (vi) If a negotiated settlement is not reached, the EP holder or complainant can request CEPA to formulate a determination. Once this request is made, SEC will have 90 days to reach a determination. If either party is dissatisfied with the determination, they can appeal to the National Court.
- (vii) Should the complainant not be satisfied with the ruling of the CEPA, the AP may at their discretion take the grievance to the PNG judicial system. This will be at the AP's cost but if the court shows that the CEPA or the administration have been negligent in making their determination the AP will be able to seek costs.

184. All of the foregoing steps will be recorded in an inventory/register and included in the contractor's monthly reports, quarterly progress reports (QPR) submitted to DOW and ADB and semiannual safeguards monitoring reports.

185. **During operation.** The same procedure and the same conditions apply; i.e. there are no fees attached to the AP for making a complaint, the complainant is free to make the complaint which will be treated in a transparent manner and the AP will not be subject to retribution for making the complaint.

Figure 8.1. Flowchart Outlining the Grievance Review Mechanism



IX. ENVIRONMENTAL MANAGEMENT PLAN

186. **Overview.** The environmental management plan (EMP) contains a number of components crucial to effective environmental management within the project, these include: (i) organizational responsibilities (for various aspects of EMP implementation); (ii) consultation and information disclosure; (iii) plan for mitigation of impacts (during pre-construction, construction and operation); and, (iv) monitoring. These are explained in detail in the sub-sections below.

A. Institutional Arrangements and Responsibilities

1. Department of Works

187. DOW had an Environmental Management Unit which was established under a World Bank project. The unit comprised two environmental officers (EOs) and support staff. Under Project 1 of the HRRIP, this unit has been expanded with the recruitment of an international social safeguards specialist (ISS). Arrangements are in place to recruit an international environment specialist (IES). Through this expansion the unit has developed into an Environmental and Social Safeguards Unit (ESSU). The ESSU-DOW has published two documents related to environmental assessment these are:

- (i) Environmental Impact Assessment Guidelines for Roads and Bridges (also referred to as the Code of Practice) which establishes the need for assessment, the methodology for preparing assessments and compiling the EMP. The Code of Practice is extensive and among other EMP requirements requires the contractor to prepare a CEMP, arrange HIV/AIDS awareness programs and prepare Quarry Management Plans. The ESSU is required to clear assessment and EMP documents submitted; and
- (ii) Environmental Appraisal Report - suggested outline establishes the contents of assessments and serves as a quick reference guide for verifying the reports contents.

188. The HRMG has recruited several EOs to monitor and manage the environment in the context of road developments. The EOs have received training and on-the-job capacity development through the implementation of Tranche 1 projects. Their capacity development will further be enhanced through the support provided by ESSU.

189. The capacity of the ESSU to manage all environmental concerns with regard to all sub-projects continues to be improved. In this regards, the mobilization of International Safeguards Specialist has been a positive development. Arrangements are being made to recruit an International Environment Specialist. Applications are being invited for three national social development officers. The international specialists will continue to provide on-the-job training for all staff of ESSU. While the local capacity is being improved, the international specialist will undertake much of the work such as contractor induction, compliance monitoring, training and reporting work. It is also proposed to send the Eos for short-term training.

190. The environmental safeguards and management system for Project 3 consists of:

- (i) The ESSU within the DOW which will be responsible for the overall management, monitoring and reporting on application of environmental safeguards;

- (ii) The HRMG which will be supported by the EO, under the supervision of the ESSU- DOW and based in Mount Hagen who will provide advice and assistance to the CSC in the implementation and monitoring of the CEMP;
- (iii) The contractor which will appoint two staff members as Environmental and Health and Safety Officer (EHSO) and a Public Relations Officer (PRO) who will be responsible for implementing and reporting on the CEMP. Terms of reference for these two positions are provided in Annex D.

191. The overall HRRIP will have oversight by a steering committee. The HRMG will be responsible for daily management and implementation of the subprojects under Project 3. The DOW will recruit the CSC which will support the HRMG in subproject implementation and ESSU-DOW will have the overall responsibility of supervising, monitoring and reporting EMP implementation. Table 9.1 sets out the responsibilities of each organization involved in subproject implementation.

Table 9.1 - Institutional Responsibilities for Environmental Safeguards

Organization	Implementation
DOW through the ESSU/ HRMG	<p>Prior to the commencement of civil works:</p> <ul style="list-style-type: none"> • Submit any of the environmental assessments required for regulatory approval of the CEPA and obtain approval, e.g., environmental clearance, environmental permit or permits from other statutory authorities as required by the Government. • Ensure that all regulatory clearances for the subproject that are obtained from the relevant government authorities are submitted promptly to ADB. • Ensure that the EMP is updated based on detailed design and included in the bidding document of the subproject and that all bidding contractors have access to the environmental assessments and EMP. • Ensure that the EMP and all required mitigation measures during construction, including conditions stipulated in the CEPA's clearance or environmental permit, are included in BCD with requirements to update the EMP in response to any unexpected impacts and that all selected contractors have agreed to implement the full suite of environmental mitigation measures prescribed in the EMP • Provide training as required to HRMG in Mt Hagen and contractor; • Receive environmental safeguard clearance on subproject(s). • Provide training to contractor prior to preparation of CEMP, safeguards requirements of ADB and regulatory requirements of CEPA. • Approve CEMP for the subproject, after being cleared by CSC. <p>During the implementation of civil works:</p> <ul style="list-style-type: none"> • Ensure that CEMP including all proposed mitigation measures and monitoring and relevant provisions of the environmental assessments is updated as required, and is properly implemented by the contractors;

	<ul style="list-style-type: none"> • In case unpredicted environmental impacts occur during project implementation, inform ADB, review the CEMP with the contractor, and implement corrective actions as required; • Submit the requisite reports on progress with social and environmental compliance and implementing the CEMP as required by the CEPA/ADB; • Ensure that ADB be given access to undertake environmental due diligence for all subprojects. However, the ESSU will have the main responsibility for undertaking environmental due diligence and monitoring of all the subprojects. The due diligence report as well as monitoring reports on CEMP implementation, as required, will be systematically prepared and be made available to the public, if requested.
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Organization	Implementation
Construction Supervision Consultant (CSC)	<ul style="list-style-type: none"> • Provide training and capacity building to MPW and PMU staff (including management) and provide training to contractors prior to the submission of contractor's CEMP • Incorporate into the project design the environmental protection and mitigation measures identified in the EMP for the design stage including climate change adaptation measures included in the IEE. • During detailed design phase provide all necessary information to the DOW to facilitate obtaining environmental permits/licenses from CEPA and ESSU clearance prior to award of civil works contracts. • During detailed design notify ESSU of any change in alignment or project design/components and provide all necessary information to the ESSU to facilitate preparation of any additional environmental assessment prior to project construction as required in the EMP (e.g., preparation of new or supplementary environmental assessment in case of change in alignment that will result to adverse environmental impacts that are not within the scope of the IEE prepared during loan processing, etc.) • Update, based on detailed design, the EMPs and other environmental protection and management measures to be incorporated in bid and contract documents • Assist ESSU in the review and approval of the contractor's CEMP for each road section • Assist ESSU to undertake monitoring of the implementation of the EMP (mitigation and monitoring measures) including incorporation of reports from the contractors • Assist ESSU to prepare quarterly progress reports and semi-annual safeguards monitoring reports for submission to ADB and DOW as necessary including incorporation of reports from the contractors and corrective action requests to contractor • Based on the results of CEMP monitoring, identify environmental corrective actions and prepare a corrective action plan, as necessary, for submission to ADB and other cofinanciers as necessary

Contractors	<ul style="list-style-type: none"> • Participate in training delivered by ESSU/HRMG and based on site specific conditions, prepare CEMP for the sub-project; • Implement the CEMP as part of the upgrading works; • Maintain site diary of daily and weekly inspections and activities of EHSO; • Prepare monthly CEMP report as part of progress reports and submit to • CSC. The report will also include the Monthly Accident Report.
ADB	<ul style="list-style-type: none"> • Reviewing regular and quarterly monitoring reports and disclosing the environmental assessments and monitoring reports including uploading to the ADB website. • Review and clear subproject IEEs. • Ensure that the HRMG will conduct the required consultations with project affected groups and local NGOs, and that the DOW as project sponsor disclose relevant environment information on the project's environmental issues in an appropriate form, manner, and language(s) accessible to
CEPA	<ul style="list-style-type: none"> • Administration and enforcement of the Environment Act 2000 and its regulations as it pertains to the project • Identify whether EPs (with or without conditions) required for any site • Review IEE and other documentation required • Administer Contractor Waste Disposal permit applications and performance

192. The ESSU will be responsible for coordinating implementation of the EARF and EMP. This will include, but not be limited to; (i) ensuring that the EARF procedures are strictly adhered to and that preparation of environmental assessments will be carried out in a timely and adequate manner, and (ii) environmental monitoring and institutional requirements will be fully met while meaningful public consultations are carried out satisfactorily. DOW will submit the categorization, environmental assessments, and monitoring reports to ADB for review in a timely manner. The ESSU will also provide support and training to the HRMG's unit based in Mt Hagen.

193. The ESSU will be tasked to (i) strengthen the environmental management of the Project during contract process, construction, and implementation, (ii) ensure that EMP requirements are integrated into BCD, submit documentation to CEPA and obtain EPs as advised by CEPA and (iii) supervise and guide the environmental assessment process for subprojects to be implemented in the subsequent tranches as part of the PFR. The HRMG, with the support and guidance of the ESSU, will (i) provide induction training to contractors prior to preparation and submission of the CEMP; (ii) provide assistance for review and clearance of the CEMP; (iii) monitor compliance with the approved CEMP; and (iv) prepare reports on environmental safeguards activities as required.

194. The CEPA is responsible for the administration and enforcement of the Environment Act 2000 and its regulations. The CEPA will make a determination of the requirements for EP application for subproject activities. CEPA may be involved in subproject monitoring as budget and time allows. Copies of the IEE will be sent by the PIU to the CEPA for its information.

195. The ADB will be responsible for the following tasks; (i) implementation of the Project Administration Manual which governs all aspects of Project implementation including safeguards; (ii) review and clearance of the IEEs produced under Project 3; (iii) evaluation of the

quarterly progress reports (QPR) and safeguards monitoring reports submitted by the CSC to DOW and ADB; (iv) providing advice and support on safeguards application as require; and (v) conduct of review missions including site inspections as required.

B. Environmental Monitoring and Reporting

196. Monitoring requirements are set out in detail (by parameter) in the EMP and summarized in Table 9.1. At the start of the project and before monitoring begins the HRMG, with guidance from the ESSU, will review the monitoring activities and update the monitoring requirements to conform with any changes that have been made to the subproject design and activities. The monitoring program will be conducted on three levels (i) baseline, (ii) monitoring to determine the extent of variations and changes in the levels of pollutants in the environment and other parameters and indicators during the implementation or operation of the project and (iii) compliance monitoring.

197. Measurement of the baseline values for the indicators defined in the CEMP will be conducted. The Contractor within one month receipt of the Notice to Proceed shall engage the services of the environmental specialist to measure primary indicators such as air quality, noise levels and water quality. The locations and procedures for baseline measurements shall be agreed with HRMG through the CSC.

198. The CSC/HRMG will conduct regular (quarterly) monitoring of the baseline indicators throughout the duration of the works. Measurements will be conducted on a monthly basis, or such other frequency as may be agreed with the CSC/HRMG, and the values obtained used to create a database for monitoring the changes in the baseline indicators.

199. The CSC/HRMG will monitor the contractor's compliance with the requirements of the CEMP to ensure that the values of the indicators do not exceed permissible levels and instruct the Contractor when remedial measures are necessary to achieve compliance.

200. The HRMG will have overall responsibility for the management, monitoring and reporting for the implementation of the EMPs for the subproject and will be supported by the CSC. The HRMG will be responsible for liaising with the contractor and providing training, advice and assistance in the preparation of the CEMP and its implementation as well as monitoring and reporting on implementation.

201. Monitoring will relate to compliance with construction contracts (including CEMP measures and provisions), the state and health of the nearby environmental resources, and the effectiveness of mitigation measures and complaints. The HRMG will be the primary entity responsible for reporting progress to DOW and ADB. Monitoring will include review of contractor's monthly reports that will cover progress of CEMP implementation and compliance (including general good practice). A section on safeguards activities and compliance with the CEMP for each subproject will also be included in QPR prepared for DOW and ADB. Semi-annual safeguards monitoring reports will also be prepared and submitted to ADB, these will be disclosed on ADB's website.

Table 9.2 - Summary of Monitoring Requirements

Environmental Monitoring Tasks	Implementation Responsibility	Implementation Schedule
Design Phase		
Monitor permitting	DOW-ESSU	Prior to construction
Monitor the preparation of project bidding documents to ensure IEE and EMP included in bids and environmental criteria are included in evaluation	DOW-ESSU and ADB	Prior to issue of bidding documents
Construction Phase		
Training and briefing of contractor's management, site agents with regards to all IEE and EMP requirements and approval of CEMP	ESSU/HRMG Contractor/CSC	First training prior to preparation of CEMP and commencement of each contract and refresher courses (CEMP monitoring and reporting) at yearly intervals throughout construction period
Monitor the performance of environmental training by contractor and briefings and of the environmental awareness of Contractors staff, tool box talks and & refresher courses. Contractor to report on CEMP implementation in Monthly Reports	ESSU/HRMG Contractor	Ongoing, prior to and during implementation of works and operation
Regular (monthly) monitoring and reporting (quarterly) of contractor's compliance with CEMP and statutory environmental requirements	HRMG and CSC	Continuous throughout construction period
Regular (monthly) monitoring and reporting (quarterly) of complaints and responses or environmental mitigation measures	DOW-ESSU	Continuous throughout construction period
Monitor adjustments to the CEMP for unexpected impacts and the thorough implementation of detailed CEMP	HRMG and CSC	During all phases of the subproject
Commissioning phase monitoring of road maintenance and facilities versus environmental contractual performance criteria. Check EP compliance	DOW-ESSU and CSC	At commissioning

Environmental Monitoring Tasks	Implementation Responsibility	Implementation Schedule
Semi-annual safeguards monitoring	DOW-ESSU	Twice per year
Operation and Maintenance Phase		
Observations during routine maintenance inspections of facilities. Inspections will include monitoring implementation of operational mitigation measures versus environmental criteria specified in EMP for operational impacts	DOW-ESSU	As per HRMG inspection schedules
Post construction monitoring of water quality at any sites where complaints about air/noise/water quality from works were justified in construction phase	DOW-ESSU	Monthly up to 3 months after completion of construction or until air/noise, water quality meets baseline conditions
Monitoring survival of trees / shrubs and grass in bioengineered slopes (e.g. at landslides, also transplanted / compensatory planted trees)	DOW-ESSU	During the first three years after installation or rehabilitation

202. The reporting will be as per the following schedule:

- A monthly report prepared during construction by the contractor reporting on progress of CEMP activities, issues and corrective actions. This will be based on the site diary maintained by the EHSO and compile notes of daily and weekly inspections;
- QPR prepared by HRMG every three months. The QPR will include a section on safeguards activities and CEMP compliance for the subproject and will summarize the monthly reports submitted by the contractor and any actions or citations made by the Engineer;
- A semi-annual safeguards monitoring report (prepared every six months) by the HRMG, submitted to DOW and ADB and disclosed; and
- The project completion report will include a section on safeguards implementation and make recommendations as required for modifications to the processes set out in the EARF and EMP procedures based on the review undertaken at the end of the project. The safeguards section will be prepared by the DOW-ESSU three months prior to the end of Project 3.

203. During operation monitoring will be carried out by the DOW, in coordination with the CEPA.

C. EMP and Monitoring Matrix

204. The monitoring of changes in the baseline indicator for the upgrading and rehabilitation of the Gewa to Gembogl Road is presented in Table 9.2 with the amount of (US\$179,800). The

budget for the EMP is itemized and presented in the Bill of Quantities (BOQ). Costs were calculated based on prevailing prices and in consultation with the cost/quantity engineer and is incorporated in the BOQ for the subproject. During construction, the contractor will be responsible for implementing the mitigation measures indicated in the EMP table (Table 9.3) which they will update based on their specific construction methodologies. The contractor will be responsible for purchase of the requisite environmental monitoring equipment and the laboratory analysis of the samples where required.

Table 9.3 - Estimated Cost for the Environmental Monitoring Plan

ITEM	STA	FREQUENCY			COST (US\$)	
Equipment		Pre-construction	Construction	Operation	UNIT	TOTAL
Water Quality (Portable Sampler)		1.00	0.00	0.00	3,500.00	3,500.00
Air Quality 3 Gas Analyzer PM 10 Sampler		1.00	0.00	0.00	5,000.00	5,000.00
		1.00	0.00	0.00	4,000.00	4,000.00
Ambient Noise (Portable Noise Meter)		1.00	0.00	0.00	2,000.00	2,000.00
SUB TOTAL A						14,500.00
Regular Monitoring/Field Sampling		Pre-construction	Construction	Operation	UNIT	TOTAL
Water Quality	9	1.00	24.00	4.00	300.00	78,300.00
Air Quality	1	1.00	24.00	4.00	200.00	63,800.00
Noise	1	1.00	24.00	4.00	100.00	31,900.00
SUB TOTAL B						174,000.00
Laboratory Analysis of Samples		Pre-construction	Construction	Operation	UNIT COST	TOTAL COST
Water Quality	9	1.00	24.00	4.00	600.00	156,000.00
Air Quality	1	1.00	24.00	4.00	300.00	95,700.00
Noise	1	1.00	24.00	4.00	0.00	0.00
SUB TOTAL C						251,700.00
GRAND TOTAL						440,200.00

Table 9.4 Environmental Management Plan (EMP) and the Monitoring Matrix

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
PRE-CONSTRUCTION STAGE						
Survey and land acquisition	Land clearance	<ul style="list-style-type: none"> • MOAs • RP/Due Diligence Report 	DOW	As per RP	As per RP	HRMG
Climate change adaptation	Flood return frequency is reduced. If structures are undersized there will be an early failure of the structures.	<ul style="list-style-type: none"> • Slopes have been designed to appropriate angles for the soil types encountered with benches and bench drains where necessitated by the height of the slope; • None of the bridges have been reported as being overtopped and site observations confirm that there appears to be adequate flood clearance at the existing bridges; • Minor repairs of bridges will be undertaken when necessary; Based on the inventory of the existing culverts and observations of natural watercourses, replacement and additional culverts have been provided to cater for the anticipated flows with an allowance for an increase in flow and some sedimentation in determining culvert diameters with particular attention to the treatment of culvert inlet and outlet works 	CSC and DOW	Part of detailed design – Project 3	Once at the design stage	DOW-ESSU

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
Review EMP and integrate construction section of EMP in BCD	Avoid loss of environmental competence in project	<p>to ensure smooth flow conditions and to minimize any risks of scour;</p> <ul style="list-style-type: none"> Roadside drains have been designed to cater for the anticipated run-off from the carriageway and adjacent slopes with lined drains provided where the longitudinal gradient exceeds 3% or where the soil is considered susceptible to erosion; and Sealing of the carriageway will be extended to the shoulders where there is a steep longitudinal gradient or high super-elevation or a combination of both to protect the shoulders from scour. For the BCD section "Special Conditions of Contract" the following will be included: (i) prior to the tender being called the EMP will be revised and updated as required based on the detailed design; (ii) the updated EMP and provisions form the EMP section of the IEE will be extracted and will be attached to the BCD - Section 6 - Employer's Requirements; (iii) in Part 1 the Price Schedule 4- 	ESSU and PIU	Project cost	Once during design stage	PIU Verified by DOW and ADB

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>Bill of Quantities, provisional sums will be included for the preparation and implementation of the construction environment management plan (CEMP) and for monitoring; and, (iv) in the BCD section "Special Conditions of Contract" the construction section of the EMP will form part of the BCD; and</p> <ul style="list-style-type: none"> • Inclusion of SPS Appendix 5 - Prohibited Investment Activities List in the BCD. In order that the subproject comply with the SPS, it will be necessary to include in the BCD reference to Appendix 5 - Prohibited Investment Activities List of the 				
Bid evaluation and selection of contractor	Selection of competent contractor will ensure that the environmental integrity of the subproject is maintained	<ul style="list-style-type: none"> • That the CEMP to be prepared by the contractor in response to the BCD EMP section has been costed into the bid price; • The contractor is required to provide the name, details of qualifications and experience of the person on the contractor's team who will be responsible for the environmental compliance requirements and the preparation of CEMP. Should the contractor not provide these details, the bid; 	PIU and ESSU	Project cost	Once during bidding process	PIU/ESSU

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>will be considered to be non-compliant and the bid rejected The contractor will take-up opportunities for capacity building in environmental management and particularly, prior to preparation of the CEMP, will undergo induction training on EMP requirements and provisions to be provided by the CSC and HRMG; and</p> <ul style="list-style-type: none"> The provision of training therefore is essential in the development of the CEMP and the eventual implementation of the CEMP. The capacity building of both the contractor and HRMG to monitor and implement CEMP is highly recommended 				
Construction EMP submitted and approved before work commences	Contractor inducted to site, provided training and reduced risk of non-compliance with requirements	<ul style="list-style-type: none"> Contractor identifies and secures necessary permits/compliance approval requirements and complies with all permitting requirements associated with the CEMP including quarry permits, approval/requirements for establishment of batching plant, disposal sites and other related activities for 	Contractor CSC/ESSU	Incl. in BOQ and Project	As per EMP	Contractor and ESSU

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>submission and approval of HRMG/ESSU and CEPA.</p> <ul style="list-style-type: none"> As required to meet the monitoring provisions of the EMP, the Contractor shall engage the services of environmental experts in the University of Technology in Lae and/or other qualified and capable organizations to collect baseline data for air quality, noise levels and water quality as defined in the EMP one month upon receipt of the Notice to Proceed. Monitoring for specific parameters and indicators will conducted at the frequency specified in the EMP throughout the construction period. This will be reported in progress and monitoring reports. 				
Induction of contractor to site	Maintenance of environmental values by ensuring that contractor understands and addresses the CEMP conditions	<ul style="list-style-type: none"> Contractor will undergo training and prepare and submit the CEMP; Contractor together with the person on the contractor's staff who will be responsible for supervising and monitoring the CEMP and all the concerned staff of the contractor will meet the ESSU, HRMG and the CSC 	Contractor PIU/HRMG	Project cost	Once; verify that induction has been carried out and contractor is competent to implement CEMP	PIU/ESSU

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>on- site where the CEMP requirements will be confirmed by the contractor;</p> <ul style="list-style-type: none"> Contractor and their staff will also be made cognizant of the grievance redress mechanism (GRM) recording and resolution requirements and protocols for addressing complaints, issues and concerns raised by the stakeholders during the construction; Contractor will also be advised of the responsibility of securing environment permits if needed and assessment of sources (quarries, river, etc.) of materials. All employees of the contractor will be made aware of the safeguards requirements 				
CONSTRUCTION STAGE						
Mobilization of the contractor, construction camp and works/materials sites prepared	Presence of construction workers affect community; Village protocols ignored and potential for conflict and unrest; Access to materials sites and any new	<ul style="list-style-type: none"> and their obligations as stipulated in the CEMP Village protocols will be discussed with workers as part of awareness and mobilization training; The contractor is to ensure that workers' actions outside work site are controlled and village observed at all times; 	Contractor CEP Village leaders and land/resource owners	Included in contract price	Weekly or as required until site has been established. Verify that clearance and excavation has met mitigation requirements.	Contractor, CSC/HRMG to verify Community members to monitor

MITIGATION					MONITOR	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
	operations not permitted or agreed creating conflicts and environmental impacts	<ul style="list-style-type: none"> The contractor will identify one member of their staff to be the liaison between the village chiefs and elders and contractor, as well as between the contractor and ESSU; Worker camp location and facilities will be located at least 500m from settlements and agreed with local communities and facilities approved by ESSU and managed to minimize impacts; Adequate signage and security provided at the site office and works yard and prevention of unauthorized people (especially children) entering the area; As many local workers as possible will be hired and trained; Provide adequate housing for all workers at the construction camps and establish clean canteen/eating and cooking areas; <p>Construction camp(s) will be established in areas with adequate drainage in order to prevent water logging at the</p>			<p>At start of site establishment, then as required</p> <p>Weekly or as required until site has been established. Verify that quarry and materials fill sites meet mitigation requirements.</p> <p>During conduct of rehabilitation work and when necessary</p>	

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>camp and formation of breeding sites for mosquitoes in order to facilitate flow of the treated effluents;</p> <ul style="list-style-type: none"> • Potable water, clean water for showers, hygienic sanitation facilities/toilets with sufficient water supply, worker canteen/rest area and first aid facilities will be provided. Separate toilets shall be provided for male and female workers; • Portable lavatories (or at least pit latrines in remote areas) shall be installed and open defecation shall be prohibited and use of lavatories encouraged by cleaning lavatories daily and by keeping lavatory facilities clean at all times; • Wastewater effluent from contractors' workshops and equipment washing-yards will be passed through gravel/sand beds and all oil/grease contaminants will be removed before discharging it into natural streams. Oil and grease residues shall be stored in 				

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>drums awaiting disposal in line with the agreed waste management section of the EMP;</p> <ul style="list-style-type: none"> • Predictable wastewater effluent discharges from construction works shall have the necessary permits from CEPA and local authorities before the works commence; • Provision of safe access across the works site (particularly during construction of drains) to people whose village and access are temporarily affected during construction works; • As much as possible, food shall be provided from farms nearby or imported to the area. Poaching of animals or birds for 'bush meat' will be banned; • Solid and liquid wastes will be managed in line with the provisions of the waste management section of the EMP; • Use of guns and hunting equipment by workers will be banned and dismiss workers taking or using green timber or 				

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>hunting or in possession of wildlife;</p> <ul style="list-style-type: none"> • Entry to the protected and wildlife management areas and/or sensitive areas (forested areas and rivers) by workers will be banned; • Provision of adequate protection to the general public in the vicinity of the work site, including advance notice of commencement of works, installing safety barriers as required by villagers, and signage or marking of the work areas; • At all times workers should respect village and land owner's boundaries and be recognize and follow village rules and terms of conduct (especially addressing women and elders); • Avoid damage to productive trees and gardens, water resources and springs; • The contractor will engage an approved service provider to deliver HIV/AIDS/STIs condition as far as practicable and the area shall be planted 				

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>Land used for campsites shall be restored to the original adjacent communities; awareness and prevention for the contractor's workers and with appropriate trees / shrubs as soon as practicable after it is vacated and cleaned;</p> <ul style="list-style-type: none"> • Work and camp sites will be cleaned up to the satisfaction of and local community after use; and • Licenses and EPs for materials extraction and spoil disposal will be obtained in advance and before work commences from the appropriate authorities including CEPA 				
Operation of the various heavy equipment, vehicles and the operation of the batching and asphalt plants creating dust nuisance	Impacts on air quality	<ul style="list-style-type: none"> • Requisite air pollution control devices are to be installed in the ancillary facilities, i.e. batching and asphalt plants and mufflers are to be installed in all vehicles; <p>Appropriate traffic signs shall be installed around residential areas advising approaching motorists to maintain slow speeds to prevent rising dust in these areas;</p>	Contractor	Included in contract price	As determined by wind and site conditions. ii. Complaints from communities (GRM and records)	Contractor, CSC/HRMG to verify Community members to monitor air quality after training by HRMG

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<ul style="list-style-type: none"> • Water sprinkling, water fogging, broom sweeping will be carried out in dust prone locations, unpaved haulage roads, earthworks, stockpiles including asphalt mixing plant areas; • Open burning of solid wastes (plastic, paper, organic matters) will be prohibited. Use of dust control methods (such as covers, water suppression s, or increase moisture content for open materials storage piles) will be practiced. • A regular vehicle maintenance and repair program will be implemented to reduce the emission of fumes from exhaust pipes. • Masks and personal protective equipment (PPE) will be provided to the construction workers to protect workers from inhalation of dust and exhaust fumes • Mixing plants and asphalt (hot mix) plants including crushers and the batching plants will be located at least 1 km downwind from the nearest settlement only 				

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>after receiving permission from the Construction Supervision Consultant (CSC). Hot mix plant will be fitted with stack /chimney of adequate height as prescribed by CSC to ensure enough dispersion of exit gases.</p> <ul style="list-style-type: none"> • Bitumen emulsion and bitumen heaters will be used to the extent feasible. • Diesel generating sets will be fitted with adequate stack height; and • Low-sulphur diesel will be used in generator sets as well as other machinery 				
Operation of plant and vehicles; works using machinery	Noise and vibration	<ul style="list-style-type: none"> • Temporary construction facilities such as labor camps, vehicle maintenance workshop and earth moving equipment will be located at least 1 km away from settlements and other sensitive areas as far as possible. Noise sources such as stone crushers, vehicles movements and stone quarry will be re-located to less sensitive areas and at least 1 km away to take advantage of distance and shielding. 	Contractor	Included in contract price	As determined by village protocols and site conditions. ii. Complaints from communities (GRM and records)	Contractor, CSC/HRMG to verify Community members to monitor ambient noise levels after training by HRMG

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<ul style="list-style-type: none"> • Opportunities will be explored to take advantage of the natural topography as a noise buffer such as behind the ridge that break the line of sight between the source of noise and the receptors during facility design. • Silencers will be installed in construction equipment and machinery and maintained properly at all times. • Equipment and machinery with lower sound levels will be selected for the use. Protection devices such as ear plugs or ear muffs will be provided to the workers during period of operating high noise generating machines. • Noise levels will be regularly measured during the peak of construction period in particular using portable noise meters to ensure the effectiveness of mitigation measures. Local youth will be trained to monitor the noise level and record relevant data. • Noise generation activities will be carried out between 5 am to 6 				

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>pm only to avoid disturbance to nearby communities at night. Only in extreme instances will work beyond these hours be allowed after the Public Relations Officer (PRO) of the contractor have informed the community about change in work program well in advance.</p> <ul style="list-style-type: none"> Noise barriers such as earth mounds or walls of wood, metal that form a solid obstacle between the road and roadside community will be used, especially in the schools and hospitals. Proper information and notification of the concerned local government unit will be conducted to prevent disturbance and nuisance to nearby settlement areas. 				
Works adjacent to streams and rivers; accidental spills	Water quality impacts - contamination of nearby water courses; blocked streams and rivers; sedimentation and turbidity	<ul style="list-style-type: none"> The CEMP will include a detailed erosion and sedimentation control plan; Lubricants will be stored in containers / dedicated enclosures with a sealed floor 50m from water bodies; Work in rivers / streams will be scheduled during dry season 	Contractor	Included in contract price	As determined by EMP	Contractor, CSC/HRMG to verify Community members to monitor water quality after training by HRMG

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<ul style="list-style-type: none"> • and work duration shall be as short as possible. Bare slopes shall be stabilized immediately after works are completed; • Stockpile areas and storage areas for hazardous substances shall be located away from water bodies; • Washing of machinery and vehicles in surface waters shall be prohibited; <p>Sediment controls such as silt fences or other sediment reducing devices (rock dams or silt barriers), to prevent both siltation and silt migration during works being undertaken in the vicinity of streams and rivers;</p> <ul style="list-style-type: none"> • Sediment control devices will be cleaned and dewatered, discharges will not be to the rivers or streams. Consultation with land owners and village chiefs will identify suitable land-based areas for settling ponds or discharge areas; • Diversion ditches will be dug around material stockpiles; • Minimizing interference with natural water flow in rivers, 				

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>water-courses or streams within or adjacent to work sites. Abstraction from rivers will only be allowed after permission from ESSU. Pollution of water resources will not be permitted;</p> <ul style="list-style-type: none"> • Solid wastes, debris, spent oil or fuel from construction machinery or plant, construction material, or waste vegetation removed from work sites will not be dumped in or near streams, rivers or waterways • Discharge of sediment laden construction water or material (including dredged spoil) directly into the rivers, sea, inter-tidal area or surface waters will not be permitted. All such construction water will be discharged to settling ponds or settling tanks with sufficient capacity to provide holding times that will allow settlement, prior to final discharge; • Discharge zones from culverts and drainage structures will be carefully identified, and structures will be lined with rip-rap. Down- drains and chutes 				

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>will be lined with rip-rap, masonry or concrete. Spillage ways will be lined with rip-rap to prevent under-cutting;</p> <ul style="list-style-type: none"> Spoil and material stock piles will not be located near the coast or within 50 m of waterways, streams or rivers, or on the edge of slopes or hills above rivers or stream and will be surrounded by perimeter diversion drains; <p>Hydro-carbons, fuel, and other chemicals as required for the works, will be stored in secure containers or tanks located away from the coast, surface waters, or streams;</p> <p>Hydro-carbons, fuel, and oil spills will be contained and immediately cleaned up as per the requirements of the emergency response plan to be prepared as part of the CEMP by the contractor (and approved by ESSU at the pre-construction stage);</p> <ul style="list-style-type: none"> Surplus used oil and waste hydrocarbons will be disposed of at approved sites and under 				

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>no circumstances should oil be discharged to soil;</p> <ul style="list-style-type: none"> Contractor's site office and works yard to be equipped with portable sanitary latrines that do not discharge directly to or pollute surface waters and waterways; and Contractor's site office and works yard to be equipped with portable sanitary latrines that do not discharge directly to or pollute surface waters and waterways; and All water, waste-water and other liquids used or generated by project works and activities will be collected and disposed of in an approved manner and in an approved location. Such disposal will not be permitted to cause either pollution or nuisance. Plan works to be carried out over the creeks only for dry season; <p>Ensure that bunds are constructed to properly contain the construction activities and that the creek flows are not impeded.</p>				

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<ul style="list-style-type: none"> Plan operations to avoid creating downstream turbidity; Ensure that the creek channel is properly restored upon completion of the works. The contractor has to ensure that spoils are properly contained and drained. Waste disposal areas for construction workers should also be contained and secured. The contractor can utilize composting or the use of pits for waste disposal. This waste disposal area should be situated far from the banks of the river. Workers should also be provided with toilet facilities including septic tank at the campsite and office. These toilet facilities should be sanitized and situated also far from the banks of water courses. The workers should also be oriented on the importance of environmental protection. Strict rules on waste disposal should be implemented. This is to discourage workers from negligent practices and attitude. 				

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<ul style="list-style-type: none"> • Material stock-piles will not be located within riverbeds, any islands in the rivers, or within the current area of floodplain of river in areas subject to regular flooding (i.e. once per year or more). All land used for stockpiles will be rehabilitated to original or better condition upon completion; • Scour protection will be used as temporary measures, as needed, to ensure temporary structures do not damage river configuration; • Movements of vehicles and machinery in river beds within the riverine habitats will be minimised at all times to reduce disturbance; • In the event that the contractor causes damage to the river bank or other structural parts of a river, the contractor is solely responsible for repairing the damage and/or paying compensation to the riparian owners; • Embankments and in-stream/river activities will be monitored for signs of erosion 				

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<ul style="list-style-type: none"> during construction; Re-vegetation with local fast growing species, or other plants will be carried out incrementally and as quickly as possible after work within any river habitat has been completed after consultation with the land owners and village chiefs; and Spoils, rubbish or any other surplus material will not be disposed of within any river system including riverbed, banks or floodplain areas. Suitable disposal sites will be designated in consultation with the CSC Engineer and approved by village chiefs and ESSU. 				
Earthworks, land clearance, materials storage/stock-piles	Erosion, sedimentation, run-off	<ul style="list-style-type: none"> Include an erosion and sedimentation control plan in the CEMP; As far as possible construction works will be scheduled for the dry season and strictly follow the design requirements and specifications, particularly those dealing with slope stabilization. Schedule construction so that large areas of soil are not laid bare during wet seasons, and avoid excavating areas and 	Contractor	Included in contract price	As per EMP Requirements;	Contractor, CSC/HRMG to verify

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>operating machinery in wet ground conditions;</p> <ul style="list-style-type: none"> • As much as possible, ground disturbance (particularly for earthwork cuts) should be minimized, and stabilized either by benching, proper side sloping, vegetation, or any combination of these; • It is important that the length of time during which bare surfaces are exposed is minimized. Re-vegetation is critical in steeply sloping embankment areas of the road sections where it will be immediately carried out on each completed section; • Excavated soils shall be prevented from being washed from the work area into nearby water bodies (especially during inclement weather) by immediately hauling these materials away and disposing of them in approved disposal sites. Work scheduling shall take into account potential weather disturbances and rainy days historically recorded in the area. This will allow worked areas to. 				

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>be properly managed and avoid large disturbed areas being exposed longer than necessary and sub-base materials shall be also kept to a minimum to avoid these from being exposed longer than necessary;</p> <ul style="list-style-type: none"> • Topsoil is removed and stored in separate heaps that are located in stable areas for later re-use for site rehabilitation. Spoil is prohibited from being dumped over the side of slopes and hills; • Excavated material is sorted as either suitable (able to be reused) and unsuitable (to be disposed of) materials. It is common in construction sites for the local people to request and utilize such materials for levelling of their property; • Materials are not to be disposed/stockpiled less than 20 meters from water courses; • Side-casting of materials shall not be undertaken especially during the wet season; • Concrete and asphalt batching areas are to be provided with bunds to control movement of runoff to waterways; 				

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<ul style="list-style-type: none"> • Topsoil and overburden are to be stockpiled near the site and covered with tarpaulin fenced off for safety and security considerations and later reused to re-contour borrow pits after completion of works; • Adequate drainage shall be provided in the material source/quarry areas to prevent the accumulation of stagnant water during the operation; • Should stagnant water accumulate, the borrow pits shall immediately be de-watered to prevent the creation of mosquito breeding grounds; • Material sources and quarry areas shall preferably located near the alignment to minimize hauling distance and time and disturbance to settlement areas along the haul roads; • Damage to access roads, garden plots, and other property resulting from the operation of the quarry, material sources and dump sites and transport of materials are to be reinstated after completion of works; • Existing quarry, material sources and dump areas are to be 				

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>restored before a new site is opened;</p> <ul style="list-style-type: none"> • Limit the extent of excavation to reduce potential for soil erosion; • Install silt traps and other control structures to trap eroded sediments and control the loss of eroded materials; • Engage soil conservation protection procedures in susceptible areas to avoid storm water runoff carrying eroded materials either, off-site to susceptible areas or, else onto already finished work areas; • The contractor will prepare a quarry management plan that meets the requirements of the DOW Code of Practice, which will include payment of a royalty to the landowners to extract materials from the site and closure of the site. It is important that the quarry management plan is approved by CSC prior to implementation; • Contain construction areas using a bund or trench, installation of sediment traps or isolate them from other surface run-off, and clean and rehabilitate them when construction is complete; and 				

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
Material extraction and quarry sites	Access to and use of materials sites and any new operations not permitted or agreed creating conflicts and environmental impacts	<ul style="list-style-type: none"> • At completion of work dumping and excavated areas to be re-top-soiled and re-vegetated. Properly remove topsoil, overburden, and low-quality materials and stockpile near the site to be covered and preserved for rehabilitation: • Stockpile topsoil for later use and fence and re-contour borrow pits after use: • Use quarry with highest ratio between extractive capacity (both in terms of quality) and loss of natural state: • Use quarry sites lying close to the alignment not on slopes, with a high level of accessibility and with a low hill gradient; • Provide adequate drainage to avoid accumulation of stagnant water during quarry/borrow site operation; • Reinstate damaged access roads, agricultural land and other properties upon completion of construction works at each section, if damaged due to transport of quarry/borrow materials, other construction materials or any other project- 	Contractor ESSU-DOW, HRMG CEPA	In BOQ and BCD provisions Incl. in project	As per EMP and quarry extraction plans, permits and license/permit conditions	Contractor ESSU-DOW, HRMG CEPA

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of	Monitoring responsibility
		related activities; • Avoid use of quarry sites located on river beds. If it is not possible to locate quarries out of river beds, use only quarry				
Spoil disposal	Impacts on rivers/streams, soil stability, community/agri. land through incorrect spoil disposal	• Spoil will be reused as far as possible for bulk filling; • Spoil will not be disposed of in rivers and streams or other natural drainage path; • Under no circumstances will spoil be dumped into any other watercourses (rivers, streams, drainage, irrigation canals, etc.); • Spoil disposal shall not cause sedimentation and obstruction of flow of watercourses, damage to agricultural land and densely vegetated areas; • The surplus shall not be stockpiled at the side of the road or dumped over the crash barriers; • Spoil will not be disposed of on fragile slopes, flood ways, wetland, farmland, forest, mangrove and associated salt flats, beaches, religious or other culturally sensitive areas or areas where a livelihood is derived; Surplus spoil will be used where practicable for	Contractor	In BOQ	As per EMP GRM	Contractor HRMG ESSU

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>local repair works to fill eroded gullies and depression areas and degraded land in consultation with local community;</p> <ul style="list-style-type: none"> • Spoils shall only be disposed to areas approved by local authority an land owner after approval by the CSC Engineer; • Spoil disposal will be monitored by ESSU and recorded using a written chain of custody (trip-ticket) system to the designated disposal sites; • Random and uncontrolled tipping of spoil, or any material, will not be permitted. Suitable spoil dumping areas will be designated in consultation with the Engineer if environmentally acceptable and structurally safe only after land owners and village chiefs have provided written permission endorsed by the CSC Engineer. Before dumping commences spoil areas will be marked on a plan and in the field with marker poles / flags to define the agreed areas and limits for disposal. Spoil will be disposed of in disused 				

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		quarries and abandoned borrow pits where practicable; <ul style="list-style-type: none"> • Disposed spoil will be spread in 15 cm layers and compacted to optimum moisture content, covered with topsoil, landscaped and provided with drainage and vegetation to prevent erosion in line with best practice; • The spoil disposal site shall be located at least 50m from surface water courses and shall be protected from erosion by avoiding formation of steep slopes and grassing; and • Spoil disposal area slopes will be rehabilitated and re-vegetated when completed to the satisfaction of the CSC Engineer and endorsed by ESSU. 				
Waste management	Nuisance, health and safety impacts, land and/or water contamination from improper storage and disposal	<ul style="list-style-type: none"> • Recyclables shall be recovered and sold to recyclers; • Solid waste from the camps will be properly collected and disposed only at the approved disposal sites; • The contractor will maximize the recycling of used materials 	Contractor - CLO	Included in contract price	As per EMP GRM Initially once to approve storage and handling procedures then as required	Contractor, CSC/HRMG to verify

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>to minimize generation of waste;</p> <ul style="list-style-type: none"> • Used wood and timber be reused for formworks and other appropriate works; • Recovery of materials will be encouraged, however if these cannot be recovered for scrap value these materials are to be taken to an approved landfill sites for final disposition; and • Waste materials from the removal of bridge or bridge components, especially the logs used for the old bridges will be removed and properly store for disposal or given away for use by local people. 			Verify waste management plan and implementation of measures meet these requirements	
Use of hazardous materials; storage and handling of fuel, lubricants and bitumen.	<p>Improper storage and handling of these materials results in pollution of the surrounding areas (land and soil) and contamination of water bodies and aquifers</p> <p>Health and safety issues</p>	<ul style="list-style-type: none"> • Workers involved in the utilization of fuel and lubricants are to be properly trained in the handling, storage and dispensing of such materials; • An emergency contingency plan will be prepared to address accidental spills and the occurrence of fire in the facilities; • Fuel and oil will need to be stored in dedicated areas, security fenced and provided with oil and water separators 	Contractor - CLO	Included in contract price	<p>At start of work and whenever any hazardous compounds are to be brought to site. No Appendix 5 activities initiated</p> <p>Initially once to approve storage and handling</p>	Contractor, CSC/HRMG to verify

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>with fuel hoses and shut off valves locked and at least 20m away from the water courses/bodies;</p> <ul style="list-style-type: none"> • The contractor must prepare a fuel handling procedure and employ trained personnel who are competent in fuel handling procedures; • The contractor will prepare an accidental spill response procedure to address accidental spills; • Any major spill is to be reported to DOW and CEPA; • Segregate hazardous wastes (oily wastes, used batteries, fuel drums) and ensure that storage, transport and disposal shall not cause pollution and shall be undertaken consistent with national and local regulations; • Ensure all storage containers are in good condition with clear and proper labeling; • Regularly check containers for leakage and undertake necessary repair or replacement; • Store hazardous materials above flood level; 			procedures then as required. Verify that storage and handling of construction materials, fuel and lubricants meet these requirements	

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<ul style="list-style-type: none"> Discharge of oil contaminated water shall be prohibited; Ensure availability of spill clean-up materials (e.g., absorbent pads, etc.) specifically designed for petroleum products and other hazardous substances where such materials are being stored; Spillage, if any, will be immediately cleared with utmost caution to leave no traces. Such incidences should be immediately reported to the CSC Engineer; and <p>The contractor will be required to display safety information in all work areas and to train workers in the safe use of these materials, including the provision of protective equipment for handling these substances.</p>				
Vegetation removal, tree clearing; re-vegetation	Impacts on flora; Accidental introduction of invasive species	<ul style="list-style-type: none"> Trees that need to be cut will be included in an inventory by the contractor in the pre-construction stage and trees that must be removed will be agreed with ESSU prior to cutting; Vegetation clearing should be kept to a minimum, and occur only within the designated 	Contractor	Included in contract price	At start of clearing work; Only marked trees removed; Re-vegetation plan	Contractor, CSC/HRMG to verify

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>construction limits. Trees shall not be indiscriminately cut, but instead given root protection for replanting elsewhere if at all possible;</p> <ul style="list-style-type: none"> • Vegetation clearance during surveying and demarcation activities, especially of trees along the road-side, will be minimized. Major trees (especially in village areas) that to be removed will be clearly marked, only marked trees will be removed; • The contractor will be responsible for providing adequate knowledge to construction workers in relation to existing laws and regulations regarding illegal logging. Contract documents and technical specifications will include clauses expressly prohibiting the felling of trees, not requiring to be cleared by the project, by construction workers for the term of the project; • Cut timber shall not be used for fuel by the contractor but shall be removed from the 				

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		roadside and returned to the owner; and <ul style="list-style-type: none"> • Construction workers will be informed about general environmental protection and the need to avoid un-necessary felling of trees wherever possible Vegetation clearance during construction activities, especially of trees along the road- side, will be avoided minimized; • The ESSU will supervise and monitor a ban on use of forest timber and workers shall be prohibited from cutting trees and mangrove for firewood or collecting wood from forest areas; and • Under no circumstances is the contractor or any of their sub-contractors or employees permitted enter the forests to fell or remove trees or collect wood. 				
Disturbance to habitats from works or presence of workers	Impacts on flora	<ul style="list-style-type: none"> • Labor employment agreement enforced by contractor that bans hunting and trading in wildlife by workers; • Contractor is to provide nutritionally adequate food supplies and rations at the 	Contractor	Included in contract price	At start of clearing work and through-pout activities; GRM and other	Contractor, CSC/HRMG to verify

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		construction camp; <ul style="list-style-type: none"> Workers shall be prohibited from hunting or catching wildlife including fish; and The contractor will be responsible for providing adequate knowledge to construction workers in respect of fauna. Contract documents and technical specifications will include clauses expressly prohibiting the poaching of fauna by construction workers and making the contractor responsible for imposing sanctions on any workers who are caught trapping, killing, poaching, being in possession of 				
Control of invasive species	Loss of indigenous vegetation and or endemic fauna	<ul style="list-style-type: none"> Any potential seed sources such as earth and organic material that may be attached to machinery will be removed and disposed appropriately. During replanting/re-vegetation works, new alien plant species (i.e., species not currently established in the region of the project) shall not be used. Only endemic species of vegetation are to be utilized for this purpose; The contractor, CSC and HRMG 	Contractor	Included in contract price	Monthly during wet season or as required until site has been cleared of introduced invasive species. Verify that contractor has washed down machinery	Contractor, CSC/HRMG to verify

MITIGATION MEASURES					• MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<ul style="list-style-type: none"> will be required to observe for any infestations Should infestations occur on construction sites that are due or are not due to the contractor's activities the contractor will be required to control the infestation 				
Access and traffic safety	Presence of work sites, haulage of materials and plant, vehicles and machinery operating in areas	<ul style="list-style-type: none"> The contractor will prepare, and submit to ESSU, a traffic management plan detailing diversions and management measures Signs and other appropriate safety features such as use of flag men will be used to indicate construction works are being undertaken; Contract clause specifying that care must be taken during the construction period to ensure that disruptions to access and traffic are minimized and that access to villages along the project road is maintained at all times; HRMG and village officials will be consulted in the event that access to a village has to be disrupted for any time and temporary access arrangements made; 	Contractor - CLO	Included in contract price	Weekly or as required until site has been established. Verify that	Contractor, CSC/HRMG to verify Community members

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>Construction vehicles will use local access roads, or negotiate access with land owners, rather than drive across vegetation or agricultural land, to obtain access to material extraction sites. Where local roads are used, they will be reinstated to their original condition after the completion of work;</p> <ul style="list-style-type: none"> • The road will kept free of debris, spoil, and any other material at all times; • Disposal sites and haul routes will be identified and coordinated with local officials; • Provision of adequate protection to the general public in the vicinity of the work site, including advance notice of commencement of works, installing safety barriers if required by villagers, and signage or marking of the work areas; and • Provision of safe access across the works site to people whose villages and access are temporarily affected during road re-sheeting activities. 			activities meet mitigation requirements. GRM	to monitor

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
Activities/works affect services or provisioning	Services disrupted	<ul style="list-style-type: none"> • Inform affected communities well in advance; Reconfirm power, water supply, telecommunications and irrigation systems likely to be interrupted by the works and any additional trees to be cut near utilities; • Contact all relevant local authorities for utilities and local village groups to plan re-provisioning of power, water supply, telecommunications and irrigation systems; • Relocate and reconnect utilities well ahead of commencement of construction works and coordinate with the relevant utility company at the district and district levels for relocation and reconnection well before works commence and include for compensatory planting for trees; • Arrange reconnection of utilities and irrigation channels in the shortest practicable time before construction commences; and If utilities are accidentally damaged during construction it shall be reported to the ESSU 	Contract or DOW-ESSU	As per agreements	As per the plan or requirements of utility providers	Contract or DOW-ESSU Utility providers GRM

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<ul style="list-style-type: none"> and DOW and utility authority and repairs arranged immediately at the contractor's expense. 				
Any works and activities	Worker health and safety	<ul style="list-style-type: none"> At least one month before construction commences the contractors will demonstrate to the ESSU they are properly resourced and a qualified/experienced environment and safety officer (ESO) will be identified by the contractors in the bid; Establishment of safety measures as required by law and by good engineering practice and provision of first aid facilities at work sites, in vehicles and establishment of an first aid/health post at the camp; The contractor will conduct of training (assisted by ESSU) for all workers on safety and environmental hygiene at no cost to the employees. The contractor will instruct workers in health and safety matters as required by law and by good engineering practice and provide first aid facilities; Instruction and induction of all 	Contractor – workers	Included in contract price	Weekly or as required until site has been established. Verify that EHSG measures meet requirements; Accident/incident registry	Contractor, CSC/HRM G to verify Workers to monitor

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<ul style="list-style-type: none"> workers shall be carried out for all operatives before they start work in health and safety matters, including road safety; The contractor will instruct and induct all workers in health and safety matters (induction course) including construction camp rules and site agents will follow up with toolbox talks on a weekly basis. Workforce training for all workers starting on site will include safety and environmental hygiene; Workers shall receive a daily safety and work briefing from contractors called the tool box talk; Workers shall be provided with appropriate personnel protection equipment (PPE) such as safety boots, helmets, reflector vest, gloves, protective clothes, dust mask, goggles, and ear protection at no cost to the workers. Contractors will issue PPE on a daily basis to workers after the tool box talk; Fencing will be installed on all areas of excavation greater than 1m deep and sides of temporary 				

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<p>works;</p> <ul style="list-style-type: none"> • Reversing signals (visual and audible) shall be installed on all construction vehicles and plant; • Provision of potable water supply shall be maintained at all times in all work locations; • Fencing on all excavation, borrow pits and sides of temporary bridges; • Scheduling of regular (e.g. weekly tool box talks) to orientate the workers on health and safety issues related to their activities as well as on proper use of PPE; • Where worker exposure to traffic cannot be completely eliminated, protective barriers and warning signs shall be provided to shield workers from passing vehicles. Another measure is to install channelling devices (e.g., traffic cones and barrels) to delineate the work zone and trained flag men at each end of the work current working zone; and • Construction camps shall be provided with toilets/sanitation facilities in accordance with local regulations to prevent any 				

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		hazard to public health or contamination of land, surface or groundwater. These facilities shall be well maintained and cleaned regularly to encourage use and allow effective operation and emptied regularly so as never to overflow.				
Any works and activities	Community health and safety	<ul style="list-style-type: none"> The contractor will appoint an ESO to address health and safety concerns and liaise with the ESSU and villages within the sub-project area; Barriers (e.g., temporary fences) and signs shall be installed at construction areas to prevent pedestrian access except at designated crossing points. Adequate signage and security will be provided at the site office and works yard and prevention of unauthorized people (including children) entering work areas and camp. Warning signs will be provided at the periphery of the site warning the public not to enter; The general public/local residents shall not be allowed in high-risk areas, e.g., excavation sites and areas where heavy equipment is 	Contractor – CLO/GRC	Included in contract price	Weekly or as required until site has been established. Verify that EHSG measures meet requirements; Accident/incident registry	Contractor, CSC/HRMG to verify Workers to monitor

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
		<ul style="list-style-type: none"> • in operation and these sites will have a watchman at the entrance • at no wastewater is discharged to local rivers, streams, lakes and irrigation channels and any other water bodies; Measures to prevent proliferation of mosquitoes shall be implemented (e.g., provision of insecticide treated mosquito nets to workers, installation of proper drainage to avoid formation of stagnant water. Standing water will not be allowed to accumulate in the temporary drainage facilities or along the roadside); • The contractor shall make provision to ensure the construction workforce attends STI and HIV/AIDS prevention workshops provided through an approved service provider. The workshops will be delivered to the contractor's workforce prior to commencement of any civil works; and • Village-based community awareness raising about transmission of STIs and HIV, reproductive health and safe. 				

MITIGATION MEASURES					MONITORING	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
Excavation and clearance works	Chance finds of physical cultural resources	<p>sex. The program will be implemented after contractor mobilization when training staff are in post and prior to construction works commencing Contractor to include "chance finds " in CEMP;</p> <ul style="list-style-type: none"> • Site agents will be instructed to keep a watching brief for relics in excavations; • Should any potential items be located, the PMU will immediately be contacted and work will be temporarily stopped in that area; • The ESSU with the assistance of the CSC will determine if that item is of potential significance and contact DOW to pass the information to the relevant department in the government who will be invited to inspect the site; and • Work will be stopped to allow time for inspection, removal or in-situ preservation of the PCR and until the relevant government agency indicates works can re-commence. 	Contract or, CSC/HR MG. CEPA/National Museum	Included in contract price	As required	Contractor, CSC/HRMG to verify

MITIGATION					MONITOR	
Activity	Environmental impact	Proposed mitigation measures	Implementing responsibility	Mitigation cost	Frequency and means of monitoring	Monitoring responsibility
Operation Stage						
		<ul style="list-style-type: none"> Until the government has responded to this invitation work will not re-commence in this location until agreement has been reached with the government and ESSU as to any required mitigation measures, which may include structured excavation. 				
Infrastructure Maintenance	Lowering of soil and water quality	<ul style="list-style-type: none"> All maintenance waste collected Site kept tidy and no waste allowed to accumulate in yard or sites 	DOW	DOW operating cost	During conduct of maintenance works	PIU-ESSU
Noise and emissions Control	Increase levels of noise and emission	<ul style="list-style-type: none"> Not a major concern due to low volume. If traffic increases significantly, provision of noise/dust fence barriers at selected locations (school and hospital). If required quarterly measurements to be undertaken. 	DOW/CEPA	DOW operating cost	TBC	PIU-ESSU
Public Safety	Safety issues from increased traffic	<ul style="list-style-type: none"> Traffic calming measures (e.g. speed bumps) at selected sites i.e. schools, markets, and densely populated areas. Provision of off-road let down stops for vehicles Proper road signage and pavement markings, particularly accident-prone spots 	DOW/CEPA	DOW operating cost	Duration of operation	PIU-ESSU

X. CONCLUSION AND RECOMMENDATION

205. The project will rehabilitate and upgrade the existing Gewa to Gembogl Road and enhance connectivity between the rural areas in the district of Kondiawa/Gewa. This will result in substantial improvement in living conditions in the areas where access is currently hindered by poor road conditions. Implementation of the project will be beneficial to the Province and it is environmentally, socially and economically essential as these will improve the traffic flow and delivery of services, thus contributing to economic growth.

206. The IEE has reviewed the environmental impacts associated with the sub-project where it is confirmed that the positive impacts outweigh the negative impacts. The assessment also confirmed that there are no significant environmental issues arising from the sub-project as the existing road alignment and the immediate environment is already heavily disturbed. The sub-project does not impact on sensitive wildlife, biodiversity and significant forest areas as there are no such sensitive areas near the road alignment. No significant flora or fauna will be affected by the project, and the road does not traverse any biodiversity conservation areas or areas of significant habitat that require further study or evaluation. The IEE has developed a comprehensive EMP to address negative impacts brought about by the construction activities of the sub-project. The IEE concludes that the few adverse environmental impacts arising from the rehabilitation and upgrading of the Gewa to Gembogl Road can be minimized through the implementation of various measures proposed. The subproject is classified as a Category B project as the impacts are site-specific, few, if any, are irreversible and most impacts can be readily mitigated by the measures set out in the EMP.

207. Compliance with the requirements through the implementation of the contractor's approved CEMP will be monitored and reported on by the CSC and HRMG. Learning from the two previous projects, it is important that all aspects of monitoring are properly documented with photos where available. It is also necessary that ESSU provides further training on CEMP monitoring to project staff and the contractor.

208. Based on the experiences of projects 1 and 2, the capacity and capabilities of the HRMG will require strengthening through the following:

The deployment of additional Environmental Officers to HRMG

"In house" training to be provided by ESSU covering all aspects of monitoring and reporting on environmental matters with possible short term overseas educational visits to support the "in-house" training

209. The provision of adequate logistical support to HRMG such as training materials. It is recommended that the recruitment of appropriate support to ESSU and CSC is fast-tracked in order to fill the current gaps in environmental training, management and reporting issues.

ANNEXES

Annex A: List of International Treaties and Agreements to which PNG is a Signatory

Annex B: Estimated Workforce and Machinery and Equipment Requirements

Annex C: Documentation of the Public Consultations Conducted for the Proposed Rehabilitation of the Gewa to Gembogl Road

Annex D: Terms of References for Contractor's Staff
Environment, Health and Safety Officer (EHSO)
Community Liaison Officer (CLO)

Annex A: List of International Treaties and Agreements TO WHICH PNG is a Signatory

1. International Convention on Biological Diversity, Rio de Janeiro 1992
2. International Plant Protection Convention, Rome 1951
International Convention for the Prevention of Pollution of the Sea by Oil, London 1954
3. Plant Protection Agreement for the South East Asia and Pacific Region, Rome 1956
4. International Convention on Civil Liability for Oil Pollution Damage, Brussels 1969
RAMSAR Convention on Wetlands of International Importance, especially waterfowl habitat 1971
5. International Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter, London, Mexico City, Moscow 1972
Convention on the World Cultural Heritage and Natural Heritage, 1972
6. International Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington 1973 (CITES Treaty).
International Convention on the Conservation of Migratory Species of Wild fauna and Flora, 1973
7. International Convention on the Conservation of Nature in the South Pacific, Apia 1976
8. International Convention on the Prohibition of Military or any other Hostile Use of Environmental Modification Techniques, New York 1976
9. United Nations Convention on the Law of the Sea, Montego Bay 1982 International Convention for the Protection of the Natural Resources and Environment of the South Pacific, 1986 (SPREP Convention)

Annex B: Worker Complement and Machinery and Equipment**Estimated Workforce Requirements for the Rehabilitation of the Gewa to Gembogl Road**

WORKER	NUMBER
Professionals	34
Project Manager	1
Deputy Project Manager	2
Project Engineer	1
Deputy Project Engineer/Lab Manager	1
Equipment Manager	1
Civil Engineer	2
Pavement Engineer	1
Materials/Quality Assurance/Quality Control Engineer	1
Surveyor	2
Survey Assistant	4
Quality Assurance/Quality Control Assistant	4
Administration Manager	1
Budget and Contract Manager	1
Accountant	1
Book Keeper	1
Administration Assistant	2
Secretary	1
Staff Officer	2
Environmental Officer	1
Public Liaison Officer	2
Compensation Officer	1
HIV Trainer	1
Skilled	77
Supervisor	5
Foremen	11
Equipment Operators	12
Carpenter	10
Mechanic	8
Storemen	4
Laboratory Technicians	9
Drivers	15
Cook	4
Unskilled	105
Laborers	90
Security Guard	10
Cleaner	5
TOTAL	216

Estimated Machinery/Equipment Required for the Rehabilitation of the Gewa to Gembogl Road

MACHINERY	NUMBER
Bulldozer D9	1
Bulldozer D6	2
Excavator	3
Front End Loader	4
Grader	2
Vibratory Roller	2
Tip Truck	8
Flat Bed Truck	1
Low Loader	1
Crane 40 Ton	1
Welding Machine	2
Mechanical Workshop	1
Testing Laboratory	1
Survey Equipment	3
Fuel Truck	2
Scaffolding	1
Compressor	2
Rock Drills	1
Spray Painters	2
Bitumen Truck	1
Water Truck	2
Bitumen Kettles	1
Demountable Buildings	3
Camp Buildings	1
Gravel Screening Plant	1
Crushing Plant	2
Concrete Mixer Large	2
Concrete Mixer Small	2
4WD Vehicles	8
TOTAL	63

Annex C: Documentation of the Public Consultations Conducted for the Proposed Rehabilitation of the Kundiawa to Gewa to Gembogl Road



Stakeholders being addressed during public consultation at Kair area (Womatne)



Public Consultation at Augenilge at Gembogl



Consultations with people at Goglme Parish



Community people at Womatne Catholic Church



Ward Councilor John Maugla taking lead in giving his speech at Womatne Catholic Church



Ward Councilor Mrs. Sebastian Komb giving her speech and word of acceptance for the project at Goglime Station

20th December 2013**Gewa Village**

NO.	NAME	GENder	OCCUPATION
1	John Waiange	M	Chief Community Leader
2	Peter Mangre	M	Community Leader
3	Tobby Aur	M	Subsistence Farmer
4	Miugle Gabriel	M	Subsistence Farmer
5	Paulus	M	Youth
6	John Mandai	M	Youth
7	Mondo Taia	M	Youth
8	Koglua Gabriel	M	Subsistence Farmer
9	Gende John	M	Subsistence Farmer
10	Masta Arnold	M	Subsistence Farmer
11	Gamb James	M	Village Court Magistrate
12	Brigitha Waithose	F	LLG Women Representative
13	Mana Dekene	F	Subsistence Farmer
14	Aglum Taia	F	Subsistence Farmer
15	Lala Billy	F	Youth
16	Kerenga Mathew	M	Youth
17	Baundo Billy	M	Subsistence Farmer
18	Arnold Miugle	M	Community Elder
19	Goltre Eno	M	Subsistence Farmer
20	Miugle	M	Subsistence Farmer
21	Mondo Stiu	M	Subsistence Farmer
22	Kimbe Dominic	M	Subsistence Farmer
23	Pita Lus	M	Subsistence Farmer
24	Koglua Gabriel	M	Village Court Magistrate
25	Jenny Billy	F	Youth
26	Boi Rotta	M	Youth
27	Klaus	M	Youth Leader

20th December 2013**Bombanono Market**

No.	Name	Gender	Occupation
1	Kondango Alois	M	Community Leader
2	Gabriel Bonny	M	Village Court Magistrate
3	Sakare Bath	M	LLG Councilor
4	Joe Kagl	M	Youth Leader
5	Dadi Peter Wii	M	JDC/BPC Representative
6	Bingo Maria	F	Housewife
7	Maugla	M	Community Leader
8	Bepi Gemb	F	Housewife
9	Gabriel Kaugla	M	Community Leader
10	Naru Enn	M	Teacher
11	Kawagle Andon	M	Farmer
12	Boni Jisas	M	Farmer
13	Nais Witne	M	Farmer
14	Kondango Alus	M	Community Leader
15	Henry Kaiono	M	Community Leader
16	Manita Leo	F	LLG Women Representative
17	Kuri Bath	M	Youth
18	Wari John	F	Housewife
19	Benny Gaips	M	Youth
20	Martin Bath	M	Farmer
21	Paul Ambane	M	Community Leader
22	Kuglame John	M	Farmer
23	Tony Paul	M	Community Leader
24	Enn Yainde	M	Community Leader
25	Witne Gabriel	M	Community Leader
26	John Beua	M	Teacher
27	Balpina Boni	F	Community Leader
28	Mendua Mark	M	Community Leader
29	Waiange Paul	M	Community Leader
30	Koma Benjamin	M	Policeman

20th December 2013**Yombai Village**

No.	Name	Gender	Occupation
1	John Gemba	M	Subsistence Farmer
2	Kua John	M	Subsistence Farmer
3	Palus Umba	M	Subsistence Farmer
4	Endeyomba Gawagl	M	Subsistence Farmer
5	Mende Thomas	M	Community Leader
6	Willy Andrew	M	Subsistence Farmer
7	Bungo Palus	M	Subsistence Farmer
8	Kinduwai Raphael	M	Subsistence Farmer
9	Inne Peter	M	Subsistence Farmer
10	Aglua Mathew	M	Subsistence Farmer
11	Yuainde Mathew	M	Subsistence Farmer
12	Betha Boi	F	Subsistence Farmer
13	Saina Kua	F	Subsistence Farmer
14	Bongugl Balpina	F	LLG Women Representative
15	Bii Clara	F	Subsistence Farmer
16	Gende Maima	M	Youth Leader
17	Mondo Raphael	M	Subsistence Farmer
18	Gende Lawrence	M	Subsistence Farmer
19	Joe Kaugla	M	Subsistence Farmer
20	Gumba Aur Michael	M	Community Leader
21	Guagl Pius	M	Subsistence Farmer
22	John Aire	M	Subsistence Farmer
23	John Giul	M	Retired District Administrator

20th December 2013**Duglpagl Village**

No.	Name	Gender	Occupation
1	Aur Baka	M	Chief Community Leader
2	Umba Tobias	M	Land Disputes Mediator
3	Ippa Stopit	M	Subsistence Farmer
4	John Tongrol	M	Subsistence Farmer
5	Attam Bigla Koma	M	Subsistence Farmer
6	William Kaugla	M	Subsistence Farmer
7	Mondo Lazarus	M	Subsistence Farmer
8	Tango John	M	Subsistence Farmer
9	Marang Peter	M	Subsistence Farmer
10	Peter Kumbo	M	Subsistence Farmer
11	Mondo Baka	M	Village Court Magistrate
12	Saimon	M	Subsistence Farmer
13	James Apston	M	Subsistence Farmer
14	Nime Wela	M	Subsistence Farmer
15	Peter Eglwe	M	Subsistence Farmer
16	Ambai Guand	M	Subsistence Farmer
17	Wawe Warmugl	M	Subsistence Farmer
18	Caspar Bregogl	M	Subsistence Farmer
19	Willy Vincent	M	Subsistence Farmer
20	Aur Umba	M	Subsistence Farmer
21	Kagl Kawagle	M	Subsistence Farmer
22	Yoanis Yongamugl	M	Subsistence Farmer
23	Peter Kewande	M	Subsistence Farmer
24	Bos Noglai	M	Subsistence Farmer
25	Peter Wawe	M	Subsistence Farmer
26	Paul Jas	M	Village Court Magistrate
27	Ekenmo Kua	M	Subsistence Farmer
28	Alois Nime	M	Subsistence Farmer
29	Ps. Vincent	M	Subsistence Farmer
30	Poka Paul	M	Subsistence Farmer
31	Alphonse Tangil	M	Ex- LLG Councilor
32	Boi Aundo	M	Young Community Leader
33	Angigl Balpina	F	Subsistence Farmer
34	Salome Tomtai	F	Subsistence Farmer
35	Eli Gende	F	Subsistence Farmer
36	Christina Hapston	F	Subsistence Farmer
37	Bepi Egluwe	F	Subsistence Farmer
38	Anna Josepha	F	Subsistence Farmer
39	Kiak SK	M	Subsistence Farmer
40	Wangantua Umba	M	Subsistence Farmer
41	Kuglsua Wau	M	Subsistence Farmer
42	Bepi Anton	F	Subsistence Farmer

20th December 2013**Umbai Village**

No.	Name	Gender	Occupation
1	George Kaima	M	Young Village Leader
2	Agnes John	F	Subsistence Farmer
3	Maria Pogli	F	Subsistence Farmer
4	Samson Kassy	M	Subsistence Farmer
5	Thomas Gende	M	Subsistence Farmer
6	Willy Onguglo	M	Subsistence Farmer
7	John Tee	M	Subsistence Farmer
8	Kunma Komba	M	Subsistence Farmer
9	Kaspar Koglkia	M	Subsistence Farmer
10	Ben Paul	M	Subsistence Farmer
11	Dilu Joseph	M	Subsistence Farmer
12	Philip Gambrame	M	Subsistence Farmer
13	Mathias Kindui	M	Subsistence Farmer
14	Clara Kindui	M	Subsistence Farmer
15	John Mirr	M	Ex- LLG Councilor
16	Bonny Gende	M	Subsistence Farmer
17	Josepha Gende	M	Subsistence Farmer
18	Cathy Deglemba	F	Subsistence Farmer
19	Kawagle Bruno	M	Subsistence Farmer
20	Ambai Peter	F	Subsistence Farmer
21	Brigita Boni	F	Subsistence Farmer
22	Eva John	F	Subsistence Farmer
23	John Kemba	M	Subsistence Farmer
24	John Geregl	M	Subsistence Farmer
25	Enrica Kens	F	Subsistence Farmer
26	Christina David	F	Subsistence Farmer
27	David Yuiainde	M	Subsistence Farmer
28	Alois Baka	M	Subsistence Farmer
29	Mary Siune	F	Teacher

20th December 2013**Sumburu Village**

No.	Name	Gender	Occupation
1	August Goiye	M	Village Courts Peace Officer
2	John Kumba	M	Community Leader
3	John Simbai	M	Subsistence Farmer
4	Anton Siaman	M	Subsistence Farmer
5	Siure Gende	M	Subsistence Farmer
6	Solomon Kuman	M	Subsistence Farmer
7	Atin Karagl	M	Subsistence Farmer
8	Vero Sam	F	Subsistence Farmer
9	Bare Snepa	M	Subsistence Farmer
10	David Kua	M	Subsistence Farmer
11	Joe Gande	M	Young Community Leader
12	Samuel Gambrame	M	Subsistence Farmer
13	John Kela	M	Subsistence Farmer
14	Betty Ronna	F	Subsistence Farmer
15	Ps. Jack Gumbi	M	Subsistence Farmer
16	Tony Kawia	M	Subsistence Farmer
17	Simbai Onguglo	M	Subsistence Farmer
18	Vero Nick	F	Subsistence Farmer
19	Peter Paglau	M	Subsistence Farmer
20	Chris Gundu	M	Subsistence Farmer
21	Sam Ulka	M	HIV AIDS Center Coordinator

20th December 2013**Womatne Village**

No.	Name	Gender	Occupation
1	Peter Kanua	M	Subsistence Farmer
2	William Dua	M	Subsistence Farmer
3	Bepi Sen	M	Subsistence Farmer
4	David Mangau	M	Subsistence Farmer
5	Gene Gin	M	Subsistence Farmer
6	Michael Kerenga	M	Subsistence Farmer
7	Steven Mondo	M	Subsistence Farmer
8	Kamgru	M	Subsistence Farmer
9	John Pupu	M	Subsistence Farmer
10	Batre Michael	M	LLG Councilor
11	Henk Dua	M	Subsistence Farmer
12	Kerenga Michael	M	Subsistence Farmer
13	James Bare	M	Subsistence Farmer
14	Peter Kepma	M	Subsistence Farmer
15	John Sie	M	Subsistence Farmer
16	Peter Goma	M	Subsistence Farmer
17	Dua Koima	M	Subsistence Farmer
18	Stanley	M	Subsistence Farmer
19	Kamtai Geregl	M	Subsistence Farmer
20	Miugle Goiye	M	LLG councilor
21	Herman Soruko	M	Subsistence Farmer
22	Mondo Anton	M	Subsistence Farmer
23	Peter Andy	M	Subsistence Farmer
24	John Duglo	M	Subsistence Farmer
25	Peter Pepsi	M	Subsistence Farmer

**Annex D: Terms of References for Contractor's Staff
Environment, Health and Safety Officer (EHSO)
Community Liaison Officer (CLO) –Contractor's Staff**

I. The Contractor's Staff.

1. The contractor is to appoint two staff as fulltime positions; environmental, health and safety officer and community liaison officer. These staff will be located at the construction site.

A. Environmental and Health and Safety Officer

2. The environmental, health and safety officer (EHSO) will be responsible for the contractor's staff complying with (i) the construction environmental management plan (CEMP) and (ii) health and safety requirements; and (iii) prevailing laws of Papua New Guinea and Asian Development Bank's Safeguard Policy Statement. The EHSO will have suitable qualifications and be experienced in both of these areas. The EHSO will report to the contractor's Site Engineer and will be responsible for the following:

- Based on the EMP in the approved IEE, conditions and requirements set out in the bid and contract documentation, and construction methods to be employed by the contractor, prepare the construction environmental management plan (CEMP) and support to Department of Works (DOW) for approval;
- Ensuring the contractor and any sub-contractors comply with the CEMP requirements;
- Preparation of Emergency Response Procedure (ERP) as a specific section or part of the CEMP to be submitted to the DOW one week before work begins on site.
- Induction and training of contractor's personnel and any sub-contractors in CEMP provisions and ERP;
- Monitoring of contractor's works and implementation of the CEMP and taking correction action as required to address issues arising;
- Preparation of summary of CEMP provisions as a 'work statement' before a new activity commences. Work statements will be delivered to workers at site and regular meetings;
- Issuing of safety gear and personal protective equipment (PPE);
- Induction of workers and visitors to site;
- Liaising with the DOW's Environmental Officer (EO) and the Project's international environmental specialist (IES) as required on all environmental and health and safety issues.
- Maintaining a site diary compiling notes of daily and weekly inspections and other activities including provisions of training to workers
- Preparing a monthly environmental, health and safety report and submitting the report to the Site Engineer, based on the site diary. The environmental, health and safety report will be incorporated into the contractor's Monthly Report submitted to DOW and PIU.

B. Community Liaison Officer (CLO)

3. The CLO will be appointed by the contractor and will be responsible for ensuring that good community relationships are developed between the contractor and the affected communities. The CLO reports to the SE and will be responsible for the following:

- Preparation of a community liaison program that encapsulates the requirements of the IEE, the Gov PNG and the DoW requirements.
 - Before the contractor commences work the CLO will arrange meetings with the affected communities and explain the work program to them including its hazards and benefits in terms of recruiting workers. Establishment of the HIV/AIDS program with the Ministry of Health.
-