

Project Administration Manual

Project Number: 49026-003
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Socialist Republic of Viet Nam: Basic Infrastructure
for Inclusive Growth in the North Central Provinces
Sector Project

ABBREVIATIONS

ADB	–	Asian Development Bank
COL	–	concessional ordinary lending
CSB	–	Commune Supervision Board
DARD	–	Department of Agriculture and Rural Development
DED	–	detailed engineering design
DMF	–	design monitoring framework
DOF	–	Department of Finance
DOIT	–	Department of Industry and Trade
DOST	–	Department of Science and Technology
DPI	–	Department of Planning and Investment
EA	–	executing agency
EARF	–	environmental assessment and review framework
EIRR	–	economic internal rate of return
EMP	–	environmental management plan
FS	–	feasibility study
GAP	–	gender action plan
GMS	–	Greater Mekong Subregion
GOV	–	Government of Viet Nam
IA	–	implementing agency
IEE	–	initial environmental examination
LIC	–	loan implementation consultants
M&E	–	monitoring and evaluation
MOF	–	Ministry of Finance
MOT	–	Ministry of Transport
MPI	–	Ministry of Planning and Investment
NCB	–	National Competitive Bidding
NCP	–	north central Provinces
NGO	–	nongovernment organization
OCR	–	ordinary capital resources
ODA	–	Official Development Assistance
PAM	–	project administration manual
PCU	–	passenger car units
PMU	–	project management unit
PPC	–	Provincial Peoples Committee
PPMS	–	Project Performance Management System
PPTA	–	project preparation technical assistance
QCBS	–	quality and cost based selection
RE MDF	–	resettlement and ethnic minority framework
REMDP	–	resettlement and ethnic minority development plan
RDWS	–	rural domestic water supply
SBV	–	State Bank of Vietnam
SEDP	–	Socio-Economic Development Plan
SOE	–	statement of expenditure
SRM	–	staff review meeting
TNA	–	Training Needs Assessment
WB	–	World Bank
WU	–	women's union

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Project Administration Manual Purpose and Process

The project administration manual (PAM) describes the essential administrative and management requirements to implement the project on time, within budget, and in accordance with the policies and procedures of the government and Asian Development Bank (ADB). The PAM includes references to all available templates and instructions either through linkages to relevant URLs or directly incorporated in the PAM.

The Provincial People's Committees (PPCs) of four north central provinces¹ which are the executing agencies (EAs), and their Provincial Departments of Planning and Investment (DPis) which are the implementing agencies (IAs) or project owners are wholly responsible for the implementation of ADB-financed projects, as agreed jointly between the borrower and ADB, and in accordance with the policies and procedures of the government and ADB. ADB staff is responsible for supporting implementation including compliance by PPCs and DPis of their obligations and responsibilities for project implementation in accordance with ADB's policies and procedures.

At loan negotiations, the borrower and ADB shall agree to the PAM and ensure consistency with the loan agreement. Such agreement shall be reflected in the minutes of the loan negotiations. In the event of any discrepancy or contradiction between the PAM and the loan agreement, the provisions of the loan agreement shall prevail.

After ADB Board approval of the project's report and recommendations of the President (RRP), changes in implementation arrangements are subject to agreement and approval pursuant to relevant government and ADB administrative procedures (including the Project Administration Instructions) and upon such approval, they will be subsequently incorporated in the PAM.

¹ Ha Tinh, Nghe An, Quang Binh, and Quang Tri provinces

I. PROJECT DESCRIPTION

1. The project will improve service delivery in Ha Tinh, Nghe An, Quang Binh, and Quang Tri provinces, through which it will accelerate Socio-economic development of NCPs in accordance with the Provincial Socio-economic Development Plans through 2020, with a vision to 2030 (Provincial SEDP) and the Master Plan on Socio-economic Development of Viet Nam's Central Northern and Coastal Region through to 2020 (Master Plan).

2. The proposed project will (i) rehabilitate and upgrade provincial road and district roads in the four north central provinces (NCPs); (ii) support productive and business infrastructure including water supply networks, sea and river protection and drainage works with associated river transport infrastructure, and supporting flood and irrigation command areas; and (iii) establish a decentralized public asset management processes for road, water supply and irrigation infrastructure.²

3. Following Asian Development Bank (ADB)'s sector modality, the project will be implemented in approximately 32 subprojects for outputs 1 and 2. Feasibility studies (FS) have been prepared for the four representative subprojects – demonstrating subproject viability, and consequently overall project feasibility. Criteria for the eligibility, election, prioritization and preparation of additional subprojects have been agreed. A long list of additional subprojects has been identified, and the NCPs and ADB will carry out field screening to agree upon their inclusion in the project.

A. Impact and Outcome

4. The project is aligned to the following impact: socio-economic development of Ha Tinh, Nghe An, Quang Binh, and Quang Tri Provinces accelerated. The outcome will be service delivery in NCPs improved.

B. Outputs

5. **Output 1: Transport infrastructure improved** through upgrading and constructing around 214 km of district roads, which will improve connectivity and transport access to more than 900,000 beneficiaries. The roads will integrate rural productive or remote areas with the areas driving economic growth. Traffic calming measures, to reduce velocities at critical road sections, such as schools and hospitals, will be included in road design, as well as safety programs for vulnerable road users.

6. **Output 2: Productive infrastructure for business development improved** will benefit 340,000 people, by the construction, upgrading, rehabilitation or stabilizing with climate resilient measures of (i) two rural domestic water supply (RDWS) schemes that will provide water to households, that are currently consuming ground water contaminated with naturally occurring heavy metals; (ii) coastal defences to protect lives, public and private property, and businesses from extreme weather, aggravated by climate change, by upgrading sea and river defences, including dykes, embankments and canals; (iii) one river port upgraded to enhance fish processing and improve tourism logistics; and (iv) a reservoir that provides irrigation and agricultural support infrastructure to enhance production such as the lining of canals and improving rural access.

² ADB provided project preparatory technical assistance for preparing the Basic Infrastructure for Inclusive Growth in Northeast Provinces Sector Project (TA-8957-VIE).

7. **Output 3: Decentralized public asset management processes established** to support the implementation of the decentralized public asset management program which is one pillar of ADB's support for the public finance management program. The four NCPs will select, procure and operate asset management systems which are in line with the decentralized public asset management program for (i) roads; (ii) RDWS schemes; and (iii) irrigation. These processes will minimize life cycle costs and enable the transition to efficient operation and maintenance of provincial assets and include indicators and tools to allow monitoring of annual maintenance budgets and their funding, and improve value for money decisions.

C. Subprojects

8. The following table presents the number of candidate subprojects identified during the project preparatory technical assistance (PPTA). Not all additional subprojects will be implemented as not all will be found feasible. It is estimated that overall 24 subprojects will be implemented.

Table 1: List of Subprojects

Output	Nghe An	Ha Tinh	Quang Binh	Quang Tri	Total
1. Transport Infrastructure Improved					
Representative subproject prepared with FS	1		1	1	3
Additional subprojects	5	8	4	4	21
Number of additional subproject FS prepared by PPTA		1			1
2. Productive Infrastructure for Business Development Improved					
Representative subproject prepared with FS		1			1
Additional subprojects	2	2	2	1	7
Number of additional subproject FS prepared by PPTA	1		1	1	3

D. Subproject eligibility, selection, feasibility and approval processes

9. Subproject general eligibility criteria:

- (i) included in the provincial medium-term investment plan or approved by Provincial People's Council;
- (ii) aligned with the Master Plan on Socio-Economic Development of the Central Viet Nam's Northern and Coastal Region through 2020; and
- (iii) endorsed by the provincial people's committees (PPCs) for inclusion in the project.

10. Subproject field screening by the government and ADB for a prima facie check of adherence to:

- (i) Prioritize the preservation, improvement and sustainability of the current asset base over new construction;
- (ii) Appear to be within ADB safeguard categories B and C;

- (iii) Have relatively simple and logical designs;
- (iv) Be capable of completion with a minimum of civil works contract packages;
- (v) Be within the local capacity to maintain and manage;
- (vi) Have a sustainability focus, taking into consideration capacity building needs and training needed to develop, manage, and use the infrastructure;
- (vii) Provincial and district governments formally commit to (a) ensuring funding for operation and maintenance compliance and (b) providing counterpart funding.
- (viii) **Output 1: Transport infrastructure improved-subprojects:** Road infrastructure at the provincial, district and local levels will represent the bulk of investment. Investments may include: (a) lengths of road sections; (b) bridges and other cross drainage structures; (c) measures to stabilize the environment around the assets. All transport subprojects will include road and traffic safety interventions. The road subprojects will
 - a. Contribute to the cross-provincial, common development plan and goal agreed during PPTA processing and inception;
 - b. Contribute to increased private sector participation, including improvement in the environment for private sector investment and development;
 - c. Contribute to improved road safety outcomes in the district/province;
 - d. All subprojects will be category B or C in ADB safeguard categories;
 - e. Be consistent with the medium and long-term sector and socio-economic development plans at the provincial and district levels;
 - f. Supports inclusive development by promoting engagement of rural communities as beneficiaries of subprojects;
 - g. The subproject economic internal rate of return (EIRR) is equal or greater than 9%;
 - h. Have investment levels estimated in the range from \$4 million to \$15 million; and
 - i. Include climate change design considerations (Annex 7).
- (ix) **Output 2: Productive and business development infrastructure Improved-subprojects:**
 - a. Include in the Provincial SEDP and part of the respective district plans;
 - b. For water supply schemes the water source will be identified with supporting hydrological records;
 - c. The primary outcome of the subproject is inclusiveness in economic and social benefits and environmental protection;
 - d. All subprojects will be category B or C in ADB safeguard categories;
 - e. Clear ownership of the assets will be established once the subproject is completed;
 - f. Assets for the speculation of land value and sales are not eligible;
 - g. Climate change considerations into the subproject Detailed Engineering Designs (DEDs) consistent with government standards (Annex 7);
 - h. The subproject economic internal rate of return (EIRR) is equal or greater than 9%; and
 - i. The subprojects will have investment levels estimated in the range from \$1 million to \$5 million (with any exceptions specifically justified).

11. Indicative subprojects are likely to include sea dykes, river embankments, drainage and irrigation canals, water supply and sanitation schemes, environmental protection and waste

management systems, flood evacuation and irrigation infrastructure, and water transport infrastructure.

12. Subprojects feasibility studies (FS) will be carried out in conformity with the approach applied to the representative subprojects with the above criteria. The FS will determine if the subproject meets all relevant ADB and government due diligence requirements and thresholds. Only subprojects with an approved FS will be eligible for moving to DED process that will require updated safeguard, costs and viability assessments prior to receiving ADB financing:

- (i) Met the above described field screening criteria;
- (ii) Adhere to relevant Vietnamese national standards and specifications as minimum standard;
- (iii) Comply with the government and ADB safeguard guidelines and involve a minimum of negative environmental and social/resettlement impacts, i.e. only ADB Safeguard Category B or C should be considered;
- (iv) Climate change considerations into the subproject DEDs consistent with government standards (Annex 7);
- (v) Are for roads and productive infrastructure be economically feasible per the agreed ADB criteria for economic internal rate of return of 9% for economic development and 6% if there is prior agreement with ADB regarding the social impact of the proposed investment;
- (vi) Procurement packages have been clearly identified in conformity with the procurement plan as well as the method of procurement, cost estimates have been clearly identified and recorded;
- (vii) Public hearings on the subproject proposal have been held in concerned communes and measures for future public consultation and supervision by the CSB are clearly spelled out with each consultation recorded as validation; and
- (viii) For road subprojects include road and traffic safety considerations into the design and for vulnerable road users.

13. The long list of subprojects, that represent the scope of the project investment in output 1 and 2, including the representative subprojects, is presented in Annex 3.

II. IMPLEMENTATION PLANS

14. The project readiness activities are presented below in section A, and the implementation schedules are presented below in section B. For output 1 and 2, the schedules are mostly linked to procurement activities that lead to civil works programs.

A. Project Readiness Activities

Table 2: Viet Nam Project Readiness Filter

Updated on: 21 August 2017

Project Name: Basic Infrastructure for Inclusive Growth in the North Central Provinces Sector Project

Summary of Project Readiness					
<ul style="list-style-type: none"> - Advance actions agreed and included in the Government's Investment Policies approved by Prime Minister (PM) - PAM prepared - PMU organization structure and staffing proposed and included in PAM - Government's Project Proposal has been approved. - Government's Investment Policies has been approved by PM. 					
Actions	Date of Action Completed	By Whom	By When	Status	Projected date for meeting milestone and actions required
1.1 Concept Paper includes an assessment of required readiness level of the project (high level readiness vs. low level). - Management and team to agree on the required level of readiness, timeline for project processing and possible funding source for Detailed Design. - For large infrastructure type projects, a separate funding (such as an ongoing loan, a TA loan or Project Preparation and Start-up Support Facility) or piggybacking from the ongoing loan is identified (so that the recruitment of DD consultants can be processed before the project's approval). - Safeguard categories are discussed and agreed.		ADB	Concept Paper Stage	Completed	

Actions	Date of Action Completed	By Whom	By When	Status	Projected date for meeting milestone and actions required
1.2 Advance actions agreed to be included in Government's Investment Policy or Pre FS <ul style="list-style-type: none"> - Joint proposal of EA/ADB to this effect reflected in the mission Aide Memoire - Advance Actions to include preparation and approval of procurement related activities and resettlement framework/plan. 		EA/ADB	Concept Paper Stage	<ul style="list-style-type: none"> - Advance actions (AAs) reflected in the Reconnaissance Memorandum of Understanding (MoU) - AAs include the preparation of DEDs, selection of supervision consultants, and 	
2.1 Investment Policy or Pre-FS submitted to the Prime Minister <ul style="list-style-type: none"> - Agreed advance actions included - Proposed financial conditions and mechanism applied to the project, repayment method and financial capacity of EA included 	19 April 2017	EA	Before Fact Finding	Completed	Investment Policy submitted to Prime Minister by MPI on 19 April 2017
2.2 Investment Policy or Pre-FS approved by the Prime Minister Appraisal Committee provides its recommendation to Prime Minister with inputs from MPI, MOF, SBV and other relevant ministries	08 May 2017	EA/ Prime Minister	Before SRM	Completed	Investment Policy approved by Prime Minister on 8 May 2017
2.2.1 Financial mechanism and on-lending modality reviewed by MOF as a part of inputs to the Appraisal Committee's recommendation	December 2016	MOF	Before SRM	Completed	
2.3 Project Administration Manual prepared and agreed to with ADB (PAM to include the following 2.3.1 to 2.3.4)		EA/ADB	Before SRM	PAM submitted to ADB and being updated	
2.3.1 Procurement Plan detailing contract packages, procurement modality, decision making structure and schedule are ready; agreed to with ADB		EA/ADB	Before SRM	Procurement plan prepared and included in PAM	

Actions	Date of Action Completed	By Whom	By When	Status	Projected date for meeting milestone and actions required
2.3.2 Financial management system, audit arrangement, fund flow oversight established: agreed to with ADB		EA/ADB	Before SRM	Included in PAM	
2.3.3 Resettlement Framework/Plan and Ethnic Minorities Development Framework/Plan (if relevant) are prepared and agreed to with ADB	15 June 2017	EA/ADB	Before SRM	REDMF, RPs/REMDPs prepared & agreed with ADB	
2.3.4 Environment Safeguard Documents are prepared and agreed to with ADB - Environment Impact Assessment (EIA), incl. Environment Management Plan (EMP) for Category A Projects - Initial Environment Examination, including EMP for Category B Projects	15 June 2017	EA/ADB	Before SRM	- EARF prepared and agreed with ADB - 4 IEEs prepared and agreed with ADB	
2.4 Funding source for DED agreed between EA and ADB, and draft detailed TORs for DED consultants and project supervision consultants ready		EA/ADB	Before SRM/MRM	- DEDs to be funded from Counterpart Funds including (i) Government funds and (ii) PPSSF - TORs have been prepared for DED and construction supervision consultants	
2.5 Fund mobilization plan for land acquisition and resettlement plan prepared	7 July 2017	EA/ADB	Before SRM/MRM	Completed	

Actions	Date of Action Completed	By Whom	By When	Status	Projected date for meeting milestone and actions required
<p>2.6 Government's Feasibility Study is completed and approved by the competent authority.</p> <ul style="list-style-type: none"> - EA assigns Project Owner to complete the FS; MPI, MOF and other related agencies to provide opinions - Agreed procurement plan to be included to avoid a separate approval process - EIA/EMP of government to be included to avoid a separate approval process 	May 2017	National Assembly for National Projects EAs for Projects category A, B, C	Before SRM/MRM	Completed and approved	
<p>2.6.1 For on-lending to State owned enterprises: The Ministry of Finance and on-lending agency complete appraising the financial capacity of sub-borrower and project repayment ability (this criterion will be revised when new Decree on on-lending is approved by the Prime Minister). The appraisal is only started once the Prime Minister approves the investment policy and EA complete FS of Project.</p>		MOF	By Loan Negotiations	N/A	N/A
<p>3.1 PMU establishment officially announced with core PMU staff in place</p>		EA	By Loan Negotiations	PMU structure and staffing included in PAM and reflected in Memorandum of Understanding (MoU)	
<p>3.2 Call for Expression of Interest and/or Request for Proposal for DED consultancy work and project supervision consultants advertised or issued</p>		EA	By Loan Negotiations		Expected to be advertised/issued in Q4/2017 for DEDs, and Q2/2018 for supervision consultants

Notes:

1. Advanced Actions (Article 19, Decree 16 on ODA). Line agency may implement advanced actions during the preparation phase of programs/projects, including:

a. After the competent authority issues the decision on investment policy, the line agency will assign the agency proposing program/project to (i) Prepare and submit to competent authorities for approval of the Resettlement Policy Framework during the appraisal process of program/project documents and investment decision;

(ii) Develop procurement plans; prepare documents for expression of interest, pre-qualification documents, bidding documents and Request for Proposal for consultant recruitment.

b. After the investment decision is issued by competent authorities and until a specific international agreement of ODA and concessional loan program/project is effective, line agency shall implement the following activities (i) appraise and approve procurement plans, documents for expression of interest, pre-qualification documents, bidding documents and Request for Proposal, select bidders, appraise and approve results of selection, negotiate and finalize contracts for packages of goods procurement and constructions for activities to be implemented during the first 12 months of the programs and projects, and consulting service packages (project management consultants, technical design consultants, supervision consultants, resettlement, environment and social safeguards consultants); (ii) Contracts on goods, constructions and consulting services as prescribed in part a of this Article can only be signed after the effectiveness of the specific international treaty on ODA and concessional loans of the program or project.

c. Financing resources for implementation of advanced actions is allocated by project owner from project preparation funds or advanced and reimbursed retroactively from project funds on the basis of prior agreement with donors.

2. For Category C project, not required but ADB staff conducts desk review.

3. Decree 18/ND-CP: "Environmental Protection Planning, Strategic Environmental Assessment, Environmental Impact Assessment" guides how to prepare EIA and EMP in Government format.

4. ADB's Terminology: Fact Finding: Mission to confirm the project/program design, costs, financing plan, implementation arrangements, and design and monitoring framework, among other, by examining the project/program from technical, financial, economic, environmental, social, and management viewpoints. SRM is held to seek Management approval for (i) the project/program design (including all of the above confirmed at fact-finding) and (ii) proceeding to loan negotiation.

5. Milestone actions can be initiated and/or completed well before milestones event occurs.

B. Overall Project Implementation Plan

Indicative Activities	2017				2018				2019				2020				2021				2022				2023					
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3			
Loan Approval																														
Loan Effectiveness																														
Output 1: Transport infrastructure improved																														
1.1 Prepare FS for remaining subprojects																														
1.2 <u>Stage 1:</u> Subproject processing - RSP DED																														
1.3 Award works contracts for RSP																														
1.4 Work contract implementation																														
1.5 <u>Stage 2:</u> Priority additional subproject DED																														
1.6 Award works contracts for priority additional subprojects																														
1.7 Work contract implementation																														
1.8 <u>Stage 3:</u> Additional Subproject DED (to use remaining funds)																														
1.9 Award works contracts for final additional subprojects																														
1.10 Work contract implementation																														
Output 2: Productive and business infrastructure improved																														
2.1 Prepare FS for additional subprojects																														
2.2 <u>Stage 1:</u> RSP DED																														
2.3 Award works contracts for RSP																														
2.4 Works contract implementation																														
2.5 <u>Stage 2:</u> Priority additional subproject DED																														
2.6 Award works contracts for priority additional subprojects																														
2.7 Works contract implementation																														
2.8 <u>Stage 3:</u> Additional Subproject DED (to use remaining funds)																														
2.9 Award works contracts for final additional subprojects																														
2.10 Works contract implementation																														
2.11 Establish operation and maintenance capability																														
Output 3: Decentralised public asset management processes established																														
3.1 Implement road network asset planning systems by Dec 2023																														
3.2 Implement Rural Water Supply asset planning																														
3.3 Extend Decentralized Irrigation Asset Management																														

III. PROJECT MANAGEMENT ARRANGEMENTS

A. Project Implementation Organizations – Roles and Responsibilities

1. Ministry of Finance (MOF)

15. The MOF is the borrower's representative accountable for managing all funds received for the implementation of the overall project. MOF will provide all onlending agreements for Provincial Department of Treasury.

2. Executing Agencies (EA)

16. Each PPC will be an EA. The PPCs shall assign one PPC member with a rank of Chairperson/Vice-chairperson to assume overall responsibility for implementation coordination within each province. For key project activities, the Chairperson/Vice-chairperson will be the approving authority.

3. Implementing Agencies (IA) – Project Owner

17. The Department of Planning and Investment (DPI) is assigned the role of Project Owner (the equivalent to an ADB Implementing Agencies [IA]) as per Decree 16.³ The IA has authority and the delegated responsibility to form a provincial project management unit (PMU) and is legally required to do so within 30 days of loan signing.

4. Provincial Project Steering Committee (PPSC)

18. Each PPC will form a provincial level steering committee under the leadership of a PPC Vice-chairperson and the Project Director of the project management unit (PMU). The PPSC will include Directors from each of the associated provincial departments: DPI, Department of Transport (DOT), Department of Natural Resources and Environment (DONRE), Department of Finance, Provincial People's Committee Office, Chairpersons of District People's Committees, Department of Construction (DOC), Women's Union (for EM) and Department of Agriculture and Rural Development (DARD), and other relevant agencies, as decided by the PPCs. The PPSC shall meet as decided by the PPC, as part of the project planning and review process and meet on request of the Project Director.

5. Project Management Unit

19. Each province will have its own PMU – the implementing unit formed or assigned by the PPC or DPI. The PMU through the Project Director will be directly responsible to the PPC – the structure and staffing of each PMU is outlined in Section D below. Following Decree 16, within 30 working days after Project approval, the project owner shall issue a decision on establishment of the PMU. When establishing the PMU, each of the Provincial project owners have indicated their intention to either create a new PMU that will second from the relevant technical PMUs or to use an established PMU in one of the participating provincial technical departments. The PMU will be under overall authority of the PPC.

20. The Project Director of the PMU will be a director or deputy director from DPI appointed

³ Government of Viet Nam. 2016. *Decree No. 16/2016/ND-CP dated 16 March 2016 on Management and Utilization of Official Development Assistance and Concessional Loans of international donors*. Hanoi.

by the PPC. S/he will have experience in the management and implementation of official development assistance (ODA) projects and will be familiar with ADB requirements and procedures. The PPC through DPI will provide office support to the unit. The PMUs will provide day to day project implementation management. The government should ensure that the PMUs have proficient capacity to work in the English language both for oral and written communication with the ADB. The importance of counterpart staff with substantial relevant experience in key positions is agreed.

6. Project Coordination Unit

21. A coordination unit will be established in Quang Tri PMU. The unit operation costs will be shared among provinces. The coordination unit will support PMUs and be responsible for consolidating work plan, consolidating quarterly and annual progress reports, coordinating ADB missions, and supporting for project coordination meetings, as needed.

Table 3: Management Roles and Responsibilities

Project Implementation Organizations	Management Roles and Responsibilities
Borrower Ministry of Finance (MOF)	<ul style="list-style-type: none"> ➤ MOF will sign the on-lending agreements for each Province. ➤ MOF controls the disbursement and sign on WAs to allow disbursement
Executing Agencies Provincial People's Committee (PPC)	<ul style="list-style-type: none"> ➤ The PPC of each Project province will be responsible for overseeing the project activities within their province. They will coordinate with each other through the project steering committee. ➤ Each PPC will appoint one Vice-chairperson to be responsible for the project. ➤ Each PPC will ensure the availability of counterpart funding on time. ➤ The EAs of each province will be the approving authority for procurement plan; and subproject detailed designs after appraised by competent authorities;
Implementing Agencies (IAs) Department of Planning and Investment (DPI)	<ul style="list-style-type: none"> ➤ The DPIs as project owner (and IAs) of each province will be responsible for the implementation of the project activities within their province. The IAs will coordinate with each other under the leadership of the coordinating unit established in Quang Tri PMU through the coordination unit. ➤ The IAs will ensure that its staff structure has sufficient expertise in all sectors involved in the project, especially transport and water supply and for functional roles in procurement and financial management ➤ The IAs will coordinate and consult with DOTs and DOC, DARD, and other departments under their respective PPCs on technical matters, especially procurement, recruitment of consultants and implementation of works on road, rural water supply, related to subproject implementation. ➤ The IAs will be responsible for implementing the GAP and report on its implementation status to ADB on regular basis. ➤ The IAs will: <ul style="list-style-type: none"> • Have overall responsibility for the implementation of the

Project Implementation Organizations	Management Roles and Responsibilities
	<p>project;</p> <ul style="list-style-type: none"> • Prepare annual work plans with supporting budget projections; • Ensure compliance with loan covenants; • Submit disbursement projections and ensure counterpart fund allocation; • Have overall financial management; • Ensure that project implementation complies with ADBs safeguard policy and provisions in the EMPs, REMDPs/RPs, and GAP; • Review design of sub-projects; • Propose changes to project design, scope or implementation arrangements, if and when required; • Approve procurement outcomes and sign contracts; and • Approve and submit progress reports and project work plans.
<p>Implementing Units Provincial Project Management Units (PMU)</p>	<p>➤ Each IA will establish a PMU to be responsible for the day to day implementation of project activities. Among others, the PMU will be responsible for:</p> <ul style="list-style-type: none"> • Establishing a project advance account at a commercial bank nominated by State Bank of Vietnam and acceptable to ADB for disbursement of eligible expenditures under the loan; • Managing, replenishing, and liquidating the account; and be fully accountable and responsible for the proper use of advances to the advance account; • Preparing and signing WAs; • Day to day operation and management of the project; • Advance actions for recruitment of consultants for preparation of detailed designs, bid documents, and contract administration and construction supervision; • Recruitment of project implementation consultants; • Preparation of subproject detailed designs including organizing verification and submission of design, cost estimate and bidding document; • Supervising the preparation of additional subproject feasibility reports, their review and approval; • Preparing bidding arrangements/documents and evaluating bids for the procurement of subproject civil works contracts; • Supervising civil works contractors; • Updating social and environment safeguard documents and submit to ADB for clearance prior to implementation; • Monitoring implementation of REMDPs/RPs; • Ensuring environmental protection and mitigation measures (in the EMPs) are incorporated in detailed designs and contract awards;

Project Implementation Organizations	Management Roles and Responsibilities
	<ul style="list-style-type: none"> • Ensuring implementation of the EMPs and submit regular monitoring reports through the IAs to the EAs and ADB; • Assisting in obtaining necessary environmental approvals from competence authorities prior to awarding civil works contracts; • Submitting regular (quarterly and annual) project reports to BIIG coordination unit and ADB; • Implementing GAP, Poverty Reduction and Social Strategy, Stakeholder Participation Plan and report results to ADB regularly as required by ADB; • Setting up and maintaining project financial system and be responsible for project payments through the approved bank accounts; • Coordinating and liaising with line agencies and other agencies as appropriate on common policy, regulatory context, implementation procedures and financial issues; • Day to day coordination and liaison between the four PMUs and communications to the Project Steering Committee and other relevant agencies; • Undertaking quality control inspections of the project facilities during construction and on completion; • Managing project facilities handover O&M related agencies; • Organization of training programs; • Procurement of office equipment, goods as needed etc.,
Project Coordination Unit – Quang Tri	<ul style="list-style-type: none"> ➤ The Project Coordination Unit (PCU) will report directly to the Project Director PMU of Quang Tri. ➤ Responsible for supporting the project coordination meetings when called by the four NCPs in terms of logistic support, minute taking and distribution. ➤ Support the PD Quang Tri to convene, run and record Project level planning and progress meetings within the assigned time periods of (i) within two months of the end of the year and (ii) 30 days of the mid-year. ➤ Support PMU PD's to meet, consolidate and report quarterly progress reports to ADB and the PPCs. ➤ Maintain Project level records and documentation including the Project level PPMS data sets, archived reports and documentation. ➤ Support ADB missions in terms of coordination and logistics. ➤ Consolidate the project financial statements for audit.
PMU Staff to be reviewed for Government – ADB concurrence	<p>Project Director of Coordinating Province⁴</p> <p>Qualification: University degree in relevant subject; a senior government official at a level of at least department deputy director; English language fluency is preferred or an effective arrangement for</p>

⁴ The EA (i.e. Quang Tri PPC) will provide sufficient evidence that their proposed Project Director responsible for Project Coordination meets the requirements prior to Loan Effectiveness

Project Implementation Organizations	Management Roles and Responsibilities
	<p>interpretation is put in place.</p> <p>Experience: 15 years of project management experience in rural infrastructure and a minimum of 5 years of experience in managing multilateral donor projects with responsibility for directing project implementation.</p> <p>Responsibilities:</p> <ul style="list-style-type: none"> ➤ Provide leadership and responsibility for managing the coordination of project management requirements as defined by (a) the Government of Viet Nam and the Asian Development as detailed in the Loan Agreements and on-lending agreements, (b) the Project Administration Manual and its supporting annexes. ➤ Ensure the timely preparation of project level planning systems, through the establishment of work planning formats, timing of agreed plans, and the consolidation of planning documents from all four provinces ➤ Maintain open communication and consultation with Executing Agencies and Project Owners within all four provinces to ensure that deadlines, implementation constraints, and Donor / Government of Viet Nam reporting and management information systems ➤ Consult with all Provincial Management Units and Project Directors to identify implementation constraints, to ensure that activities that are either delayed or no longer possible are identified with proactive management proposals presented to ADB in a timely manner ➤ Provide day to day management oversight to staff assigned to the Project coordination unit including the provision of quality assurance of documentation in terms of (i) accuracy and completeness of content, (ii) timeliness of inputs and outputs, (iii) language adequacy. Be able to ensure that the requirement of ADB submissions are achieved ➤ Provide feedback and reporting to all four Project Owners on implementation issues and risks that may determine project success ➤ Be responsible for annual project reports that consolidate project information across the four EAs and present this in the required format for ADB. ➤ Provide supervision and Project Owner linkages for the Deputy Director of the Project Management Unit responsible for managing the implementation of the Provincial investment program.
<p>Community Investment Supervision Board (CISB) with guidance of the Commune Fatherland Front Committee</p>	<ul style="list-style-type: none"> ➤ The CISB with support and guidance of PMUs, will be responsible for implementation of: <ul style="list-style-type: none"> • all community development activities under GAP and REMDPs/RPs; • organizing public consultations; • design and implementation monitoring as guided by the supervision engineer; and • grievance redress mechanism

Project Implementation Organizations	Management Roles and Responsibilities
Asian Development Bank (ADB)	<ul style="list-style-type: none"> ➤ ADB is the principal financier and will: <ul style="list-style-type: none"> • provide loan financing for the project; • monitor overall project implementation, disbursement, procurement, consultant selection, and reporting; • monitor schedules of activities, including funds flow; • review compliance with agreed procurement procedures; • review compliance with loan covenants; • monitor effectiveness of safeguard procedures (including GAP); • monitor conformity with ADB anti-corruption policies; • undertake periodic review missions, including midterm; and • provide review of documentation for prior approval of procurement and contracting procedures within the agreed service standards.

ADB = Asian Development Bank; DPI = Department of Planning and Investment; DOT = Department of Transport; DARD = Department of Agriculture and Rural Development; MOF = Ministry of Finance; PPC = provincial people's committees; CSB = Commune Steering Board; PMU = Provincial Project Management Unit; WA = withdrawal application

Source: PPTA

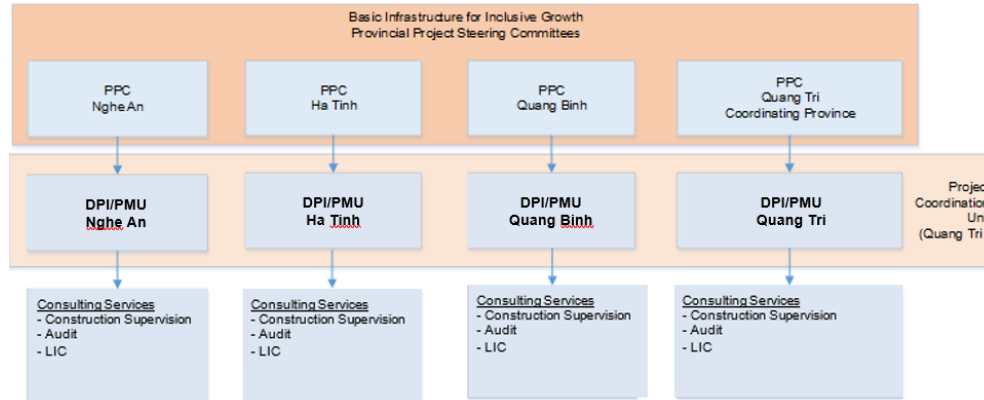
B. Project Coordination

22. At the provincial level, the Project will operate under the oversight of a steering committee that will be under the chairmanship of the PPC and will have representation from (i) DPI, (ii) PMU Project Director and (iii) participation from other agencies such as DOT, DARD, Department of Labour, Invalids, and Social Affairs (DOLISA), DOIT. The Steering committee will review progress, proposed work plans and provide direction and guidance in four NCPs subregional policy and national program initiatives.

23. Compilation of work plan and reporting to ADB will be supervised by Quang Tri Province which the government has delegated responsibility for overall project coordination. Each provincial PMU Project Director will conduct their own provincial level planning and biannual reviews and then use these as inputs to the overall project planning and review reports. The overall project plans and reviews will be developed in at least two meetings to be convened under the chairmanship of the Project Director (Quang Tri).

24. All project management, administration, and procurement will be decentralized to each of the four NCP PMUs as per the directives of Decree 16 with the final approvals for procurement being at the PPC or Project Owner (IA).

Figure 1: Project Coordination Arrangements



C. Subproject Implementation Procedures

25. Subproject Implementation (see Annex 4 for a detailed breakout of all steps involved in the implementation of subprojects (both representative and additional) will include the following steps:

- (i) Preparation of subproject feasibility studies, including associated: (a) safeguards including IEEs, EMPs, REMDPs; (b) GAP; (c) preliminary engineering designs and supporting bill of quantities and detailed cost estimates; (d) financial (where required) and economic assessments. The subproject FSs will follow the example of the FSs of representative subproject(s) as agreed between the government and ADB;
- (ii) PMU conduct technical review and consultant updates;
- (iii) PMU/DPI submission of the FS for approval by PPCs;
- (iv) Implementation plan prepared;
- (v) ADB conduct review of FS for ADB safeguard compliance, and adherence to the agreed upon FS structure;
- (vi) FS and supporting implementation plan submitted to PPC for approval;
- (vii) Detailed designs contracted;
- (viii) Preparation of DEDs;
- (ix) Approval of Detailed Designs by PPC after technical review;
- (x) Tendering for civil works;
- (xi) Construction, including technical and safeguard supervision and monitoring; and
- (xii) Commissioning, training and handover.

26. FS for additional subprojects will be prepared by the consultants recruited by the PMUs. They shall be responsible for the technical aspects of the FS including the economic and financial analysis, all social and safeguard issues and land acquisition assessments required for preparing the IEEs as required and where appropriate RPs/REMDPs, GAP, and Poverty and Social Assessments, and inclusion of road safety and climate resilient measures in accordance with government standard(s).

27. This will ensure that appropriate measures to (i) build and strengthen the inclusiveness of subprojects, and (ii) to mitigate any negative social impacts including special measures for land acquisition, compensation, ethnic minorities specific actions if required, and special measures to improve the participation of women and other disadvantaged groups as beneficiaries are taken.

28. Each PMU upon completion of the FS that are not covered under PPTA or PPSSF, shall use the consultant services provided through the loan implementation consultant (LIC), recruited using counterpart funds by each province, to review the FS to ensure that: (i) appropriate technical standards are incorporated in the design and that the costs applied reflect realistic market estimates; and (ii) ADB's and the Government's social and environmental safeguards requirements are duly addressed. Once reviewed, the PMU will inform the project owner - DPI of the feasibility's acceptance. DPI will then submit the FS to the PPC for approval. ADB will review all FS and associated documents. ADB's comments will be incorporated for safeguard compliance. Ultimate responsibility for FS compliance rests with each EA.

29. All additional subproject FS for plain, rural and mountainous roads will include a traffic forecast derived from traffic counts of baseline traffic demand. The traffic forecasts will be presented in the summary of each feasibility study for the economic life of the proposed road investment. The technical design standard for the road engineering must be consistent with the assessed traffic demand - specified in daily PCU terms according to the Viet Nam Design Specification TCVN 4054 – see table 4.

30. Where the road traffic forecast spans more than one PCU category the standard to be applied will be based on the design category that is consistent with the traffic forecast at year 10 of the projection. Where the indicated design category differs from the Provincial master plan or the proposed subproject design standard indicated in the Government Investment Proposal (IP) the PMU/PPC will confirm the design standard to be used as the standard indicated by the traffic forecast under regulation TCVN 4054.

31. The economic assessment of the subproject must utilize the same traffic forecast data to ensure capital investment costs are consistent with the expected benefit streams. This requirement will remove bias of inflated EIRR estimates from the use of a higher traffic forecast, or alternately, applying a capital investment that is insufficient to construct the category of road required by the traffic forecast and the estimated project economic benefits.

Table 4: Road Design Categorisation by Traffic Demand Forecasts (Daily PCU)

Design Category (TCVN 4054 – 2005)	Design Traffic Volume (Daily PCU)
I	>15,000
II	>6,000
III	>3,000
IV	>500
V	>200
VI	<200

32. For urban and city roads, the FS will confirm in the summary that the technical design standard is consistent with the traffic demand forecast based on the Road Categorization Design standard TCXDVN 104:2007 see Table 5 below.

Table 5: Urban and City Road PCU rating for Road Design Categorization under TCXDVN 104: 2007 (Unit: PCU//hr)

<i>Type of Urban Roads</i>	<i>PCU/hour</i>	<i>Max PCU</i>
2 – lane, 2-, 2 carriage ways	Xcqđ/h.2 lane ^(*)	2800
3 – lane, 2-directions	Xcqđ/h.3 lane	4000 - 4400 ^(**)
Multi-lane road with undivided strip	Xcqđ/h.lane	1600
Multi-lane road with dividing strip	Xcqđ/h.lane	1800
<p><i>Notices:</i> ^(*)Xcqđ/h.2 lane means PCU converted per hour for 2 lane urban road. ^(**)The lower limit value is applied when the center lane is used to make a pass, turn left, U-turn ...; The upper value is applied when the traffic organization is lane deviated (1 direction 2 lanes, 1 direction 1 lane)</p>		

33. All additional subproject feasibility studies for city and urban roads will include a traffic forecast derived from traffic counts of baseline traffic demand. The traffic forecasts will be presented in the summary of each feasibility study for the economic life of the proposed road investment. The technical design standard for the road engineering must be consistent with the assessed traffic demand - specified in hourly PCU terms according to the Viet Nam Design Specification TCXDVN 2007 – see table 5.

34. Where the road traffic forecast spans more than one PCU category the standard to be applied will be based on the design category that is consistent with the traffic forecast at year 10 of the projection. Where the indicated design category differs from the Provincial master plan or the proposed subproject design standard indicated in the Government Investment Proposal (IP) the PMU/PPC will confirm the design standard to be used as the standard indicated by the traffic forecast under regulation TCXDVN 2007.

35. The economic assessment of the subproject must utilize the same traffic forecast data used to establish the design construction category to ensure capital investment costs are consistent with the expected benefit streams. This requirement will remove bias from increasing benefits from the use of a higher traffic forecast, or alternately, applying a capital investment that is insufficient to construct the category of road required by the traffic forecast and the estimated project economic benefits.

36. ADB will confirm with a formal note to file for each subproject feasibility study that the road subproject feasibility assessment has a traffic forecast that is consistent with the proposed construction design category, and the projected traffic benefits used in the economic assessment.

37. Where there is inconsistency the ADB will notify the PMU/DPI that the subproject feasibility is not accepted and the subproject is ineligible for ADB financing.

38. Key Persons Involved in Implementation

Executing Agency

Provincial People's Committee of
Ha Tinh Province

Officer's Name: Dang Quoc Khanh
Position: Chairman
Telephone: (+84 239) 3855581
Email address: vanphongubndht@gmail.com
Office Address: No.01, Nguyen Tat Thanh street, Ha Tinh city,
Ha Tinh Province

Provincial People's Committee of
Nghe An Province

Officer's Name: Nguyen Xuan Duong
Position: Chairman
Telephone: (+84 238) 3844859
Email address: vpubnd@nghean.gov.vn
Office Address: No.03 Truong Thi street, Vinh city, Nghe An
Province

Provincial People's Committee of
Quang Binh Province

Officer's Name: Nguyen Huu Hoai
Position: Chairman
Telephone: (+84 232) 3813076
Email address: nguyenhuuhoaiqb@gmail.com
Office Address: No.6, Hung Vuong street, Dong Hoi city, Quang
Binh Province

Provincial People's Committee of
Quang Tri Province

Officer's Name: Nguyen Duc Chinh
Position: Chairman
Telephone: (+84 913) 485 193
Email address: vpubndt@quangtri.gov.vn
Office Address: No. 45, Hung Vuong street, Dong Ha city,
Quang Tri Province

Asian Development Bank

Viet Nam Resident Mission

Staff Name: Mr. Eric Sidgwick
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Environment, Natural Resources
& Agriculture Division, Southeast
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Staff Name: Mr. Jiangfeng Zhang
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Mission Leaders

Staff's Name: Mr. Charles David Salter
Position: Principal Natural Resources and Agriculture
Specialist
Telephone No.: (+856 21) 250 444
Email address: dsalter@adb.org

Staff's Name: Ms. Khuc Thi Lan Huong
Position: Project Officer
Telephone No.: (+84 24) 3933 1374
Email address: kthuong@adb.org

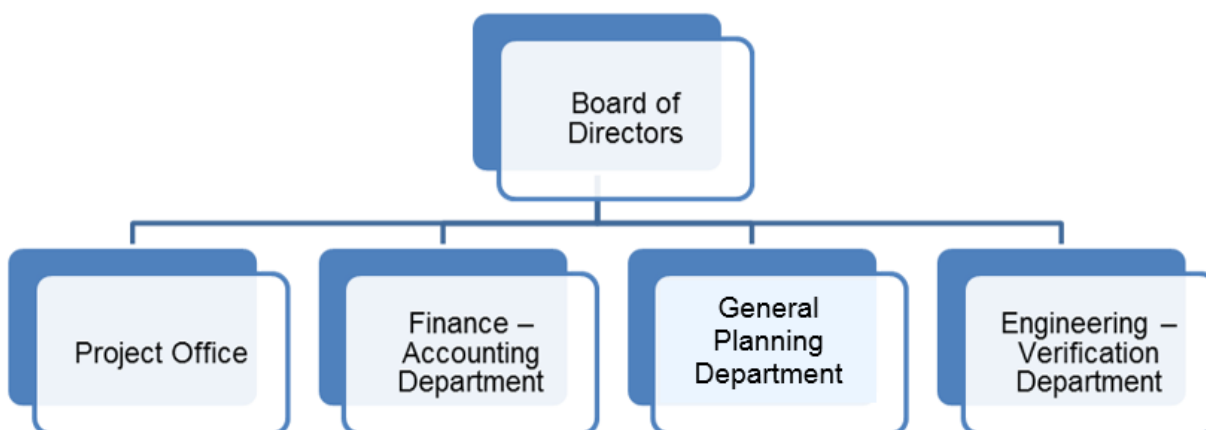
D. Project Management Units Structure

1. Nghe An Project Management Unit

a. PMU Structure

39. The PMU is proposed to be structured in 4 Departments –see figure 2 below.

Figure 2: Proposed PMU Organizational Chart



b. PMU Staffing

40. The indicative PMU staffing is proposed to include a total of 18 positions of which 8 positions are concurrent with existing roles in DPI and PMUs and the remaining 10 positions will be contracted specifically for BIIG2 PMU roles.

Table 6: Indicative PMU Staff

No	Content	Number	Note
1	PMU concurrent staffs	8	- Concurrent staff - The project will pay for concurrent allowance and overtime
2	PMU specialized staffs	10	- Specialized staff - The project will pay monthly wage, allowance and overtime
	Total	18	

c. Staff Positions

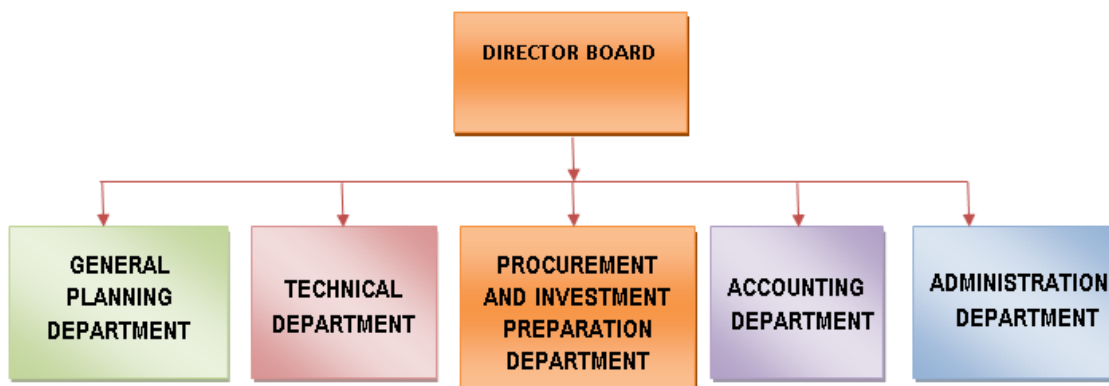
41. The indicative proposed staff positions are presented in Table 7 with a total of 18 positions of which the director and deputy director are identified as concurrent appointments from staff within the DPI. Deputy director will be full-time assignment to the PMU. Director has authority to approve and process approvals and contracts.

Table 7: Indicative Proposed Staffing

Position	Unit	Quantity
Management Board	person	3
PMU Director	person	1
PMU Deputy Director	person	2
Departments	person	15
General Planning Department	person	5
Head of Department	person	1
General planning staff	person	1
Environment staff	person	1
LAR staff	person	1
Gender, socio-economic staff	person	1
Engineering, Procurement Department	person	
Head of Department	person	1
Engineering staff	person	4
Financial and Accounting Department	person	2
Chief accountant	person	1
Accountant	person	1
Project office	person	3
Admin staff	person	2
Translator/interpreter	person	1
Total	person	18

2. Ha Tinh Project Management Unit

a. Indicative PMU Structure



b. PMU Staffing

No	Position	Quantity	Type of employment	Status
I	DIRECTOR BOARD	3		
1	- Director	1	Government staff	Seconded
2	- Vice Director	2	Government staff	Full-time
II	PROCUREMENT AND INVESTMENT PREPARATION DEPARTMENT	5		
1	- Head of Department	1	Government staff	Full-time
2	- Engineering technology and estimation staff	1	Contract	Full-time
3	- Procurement and contract management staff	1	Contract	Full-time
4	- Finance, Economy and project preparation staff	2	Contract	Full-time
III	TECHNICAL DEPARTMENT	7		
1	- Head of Department/Transportation Engineer	1	Government staff	Full-time
2	- Transportation Engineer	2	Contract	Full-time
3	- Irrigation Engineer	2	Contract	Full-time
4	- Civil Engineer	1	Contract	Full-time
5	- Water supply and drainage Engineer	1	Contract	Full-time
IV	GENERAL PLANNING DEPARTMENT	4		
1	- Head of department, In charge of land acquisition	1	Government staff	Full-time
2	- Staff in charge of environment, Social and land acquisition	1	Contract	Full-time
3	- Report Compilation/Planning Staff	1	Contract	Full-time
3	- Staff in charge of appraising/ Monitoring and evaluation	1	Contract	Full-time
V	ACCOUNTING DEPARTMENT	3		
1	- Chief Accountant	1	Government staff	Full-time
2	- General and Operation Accountant	1	Contract	Full-time
3	- Payment Accountant	1	Contract	Full-time
VI	ADMINISTRATION DEPARTMENT	7		
1	- Office Chief	1	Government staff	Full-time
2	- Clerk - treasurer – housekeeper	1	Contract	Full-time
3	- Interpreter	2	Contract	Full-time
4	- Driver	2	Contract	Full-time
5	- Guard	1	Contract	Seasonal Contract
	Total	29		

3. Quang Binh Project Management Unit

a. PMU Structure

42. A PMU will be established as per directive of decree 16 under DPI and reporting to the PPC. The PMU is structured around 4 operation departments. The Project Management Unit

(PMU) of BIIG2 Quang Binh is proposed to build on the existing Project Preparation Board and have additional staff from DPI.

43. The members of the Project Preparation Board have a good understanding of BIIG2 at its preparation stage enabling a smooth transition into implementation. One third of the Project Preparation Board's staff are technical staff with expertise and more than 15 years of working experiences in the field of irrigation, roads-civil infrastructure construction, thus, have a good insight, understand of relevant regulations and procedures in design and construction and the technical staff will be responsible for appraisal and management of subprojects. The staff have good understanding of related regulations of the multilateral donors such as ADB, WB.

44. The organizational staffing of PMU BIIG2 consist of 16 staff based on the proposed organizational structure as follows:

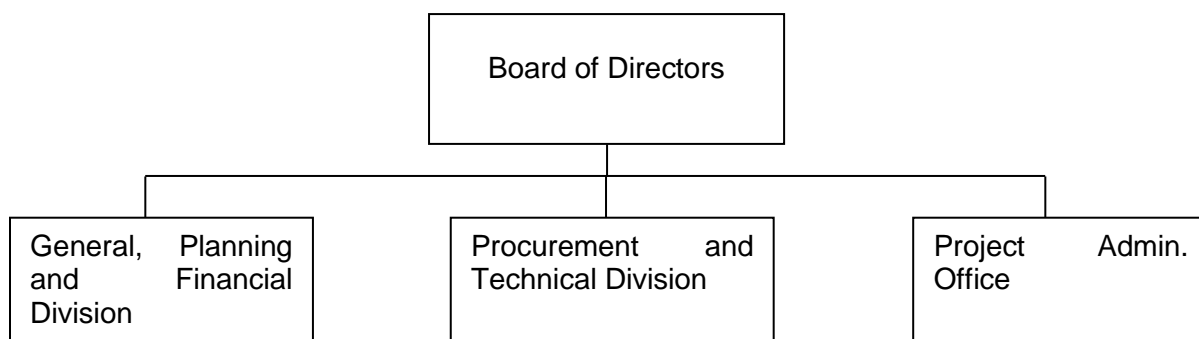
Table 8: Indicative Staff Positions and numbers

Positions	Number
Project Director	1 person
Vice-directors	2 persons
General, Planning and Finance Division	5 persons (incl.: 01 Head of Division; 01 Chief Accountant, 01 Accountant, 01 officer in charge resettlement, 01 M&E cum gender officer)
Procurement and Technical Division	5 persons
Project Admin. Office	3 persons (incl.: 01 admin. Officer and 02 interpreters)

45. The organizational structure of PMU of BIIG2 Quang Binh is proposed based on full-time and part-time working basis as follows:

Table 9: Staffing Summary

No.	Structure of PMU of BIIG2 Quang Binh	Unit	Full-time or part-time employment	Quantity (person)
1	Part-time staff	Person	50%	8
2	Full-time staff	Person	100%	8
	Total			16

Figure 3: Quang Binh PMU structure**b. Proposed Staffing**

46. The organizational structure of PMU of BIIG2 Quang Binh is proposed based on full-time and part-time working basis as presented below:

Table 10: Indicative PMU Staffing

No.	Position	Quantity
A	Board of directors	3
1	Director	1
2	Deputy Director	2
B	Department position	13
B.1	General, planning and Finance Division	6
1	Manager	1
2	Chief accountant	1
3	Accountant	1
4	Officer in charge resettlement	1
5	M & E cum gender officer	1
6	General planning officer	1
B.1	Procurement and technical division	5
1	Manager	1
2	Officers	4
B.2	Project Admin. Division	3
1	Admin. Officer	2
2	Interpreter	1
	Total	16

4. Quang Tri Project Management Unit**a. Proposed staffing**

47. The BIIG2 Project in Quang Tri shall be organized following the model of the Greater Mekong Sub-Region Corridor Towns Development Project (referred to as GMS Project). Accordingly, the staffs having involved in the PPTA for BIIG2 Quang Tri and the GMS Project shall be recruited and contracted to continue working for the BIIG2 Quang Tri with the following justifications: (i) Eligibility: In line with Clause 37 under Decree No.16/2016/NĐ-CP dated 16/3/2016 of the Government on management and use of official development assistance (ODA) and preferential loans of foreign donors; (ii) The staffs are experienced, familiar with the regulations on management and use of ODA by the Government of Vietnam and the regulations of the ADB; (iii) cost savings in training off human resources with effective using of capacity and

experience of staffs; (iv) They have established working relationships with central ministries, agencies and local departments and sectors, thus contributing to speeding up the implementation of the project; (v) The GMS project is scheduled to end its activities by 2018, and this is also the time when the Loan Agreement of the BIIG2 Project will take effect. Therefore, the recruitment and contracting with the staffs of the GMS project to for BIIG2 is suitable.

48. Contracted staffs of BIIG2 Quang Tri, will be contracted on a seasonal basis to ensure progress of the project. The expected organizational structure of the Quang Tri BIIG2 project is as follows:

Table 11: Indicative Proposed Staffing Positions

Position	Number
Project Director	1
Deputy Project Director	1
Project Office	5
Coordinator and translator	2
Planning department	3
Technical department	5
Procurement	5
Accounting Department	2
Land acquisition and Resettlement	3
Environment-Gender-Training Department	2
Total	29

49. Expected structure of part-time staffs and contracted staffs of BIIG2 Quang Tri is as follows:

Table 12: Indicative PMU Staffing

	Structure of PMU staffing	Unit	Quantity
1	Staffs working part time for the PMU	person	8
2	Contracted full time staffs working for the PMU	person	17
3	Seasonal contracted staffs, not full time	person	4
	Total		29

50. Based on work volume and progress of the project, the PD for BIIG2 Quang Tri shall contract with qualified and experienced manpower to work in suitable points of time to implement the project activities.

b. Procurement Staff

Table 13: Indicative Procurement Staff

No	Professional qualifications	Working type	Position
1	Civil Engineer; Master in Economics	Part-time	Head
2	Master in Economics	Part-time	Staff
3	Civil Engineer; Master in Urban Planning	Full time	Staff
4	Bachelor of Economics; Master in Linguistics and Foreign cultures	Full time	Staff
5	Engineer in Construction economics & Project management	Full time	Staff

c. Project Coordination Unit

51. The Coordination Unit will be managed by an overall coordinator with 2 support staff for five years with the appointment and formation of the unit seen as an advance action required to ensure early start up for work planning and project administration systems. A minimum of 1 staff position will have English capability for writing and reporting of Project reports and communication.

5. Loan Implementation Consultants

52. The loan implementation consultant (LIC)⁵ for each PMU will include procurement, financial and safeguard support. The LIC will be funded through counterpart funds. All detailed designs, construction will be funded through an additional contract using counterpart funds.

Table 14: Indicative Loan Implementation Consultants

Position	Person Month	Comment
A. Infrastructure Engineer	40	Advance action required
B. Procurement Specialist	36	Advance action
C. Financial Accountant – Senior	60	Donor experience
D. Safeguards – Social	10	Donor experience
E. Safeguard – Environment	24	4 person-month per year
F. Gender Specialist	6	Donor experience

Source(s): Asian Development Bank estimates

⁵ LIC composition may vary province by province depending on province's justified actual need

IV. COSTS AND FINANCING

53. The project is estimated to cost \$ 203.5 million (Table 15).

Table 15: Summary Cost Estimates
(\$ million)

Item	Amount ^a
A. Base Cost^b	
1. Transport Infrastructure Improved	133.1
2. Productive Infrastructure for Business Development Improved	32.3
4. Decentralized Public Asset Management Processes Established	2.0
5. Project Management	6.4
Subtotal (A)	173.8
B. Contingencies^c	25.5
C. Financial Charges During Implementation^d	4.2
Total (A+B+C)	203.5

^a Includes taxes and duties of \$16.4 million to be financed by the government.

^b In Q1 2017 prices, exchange rate as of 10 March 2017.

^c Physical contingencies calculated at 10.0% for civil works and equipment. Price contingencies calculated at an average of 1.5% on foreign exchange costs and 5.0% on local currency costs; includes provision for potential exchange rate fluctuation under the assumption of a purchasing power parity exchange rate.

^d Interest during construction has been calculated at a rate of 2.0% per year for the concessional OCR loan and at the 5-year (2018–2023) US dollar fixed swap rate plus an effective contractual spread of 0.5% and a maturity premium of 0.10% for the regular OCR loan. Commitment charges for the regular OCR loans are 0.15% per year to be charged on the undisbursed loan amount.

Source: Asian Development Bank estimates.

54. The government has requested (i) a concessional loan of \$97,000,000 from ADB's concessional ordinary capital resources; and (ii) a regular loan of \$52,000,000 from ADB's ordinary capital resources to help finance the project.

55. The ADB loans will finance infrastructure works, construction supervision, and independent audit. The government shall (i) make portions of the proceeds of the concessional and regular loan available to the NCPs through budget allocation, and (ii) relend the balance of the proceeds of the loans to the NCPs under respective onlending agreements, all upon terms and conditions satisfactory to ADB.

56. The government will fund \$54,521,310 to assist implementation, including detailed design, project management, land acquisition and resettlement costs, loan implementation consulting services, and taxes and duties.

57. The summary financing plan is in Table 16.

Table 16: Summary Financing Plan

Source	Amount (\$ million)	Share of Total (%)
Asian Development Bank		
Ordinary capital resources (regular loan)	52.0	25
Ordinary capital resources (concessional loan)	97.0	48
Government	54.5	27
Total	203.5	100

Source: Asian Development Bank estimates

A. Cost Estimates Preparation and Revisions

58. The cost estimates were prepared by the PPTA consultants based on the estimated bill of quantities for the representative subprojects, and applying provincial cost norms. Other costs were derived from field and institutional consultations during the PPTA.

B. Key Assumptions

59. The following key assumptions underpin the cost estimates and financing plan:

- (i) Exchange rate: D22,500 = \$1 (as of 15 March 2017)
- (ii) Price contingencies over the implementation period are applied as follows:

Table 17: Price Escalation estimates

Item	2018	2019	2020	2021	2022	Average
Foreign rate of price inflation	1.5%	1.5%	1.5%	1.5%	1.5%	1.5%
Domestic rate of price inflation	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%

Source(s): PPTA Final Report based on ADB VRM Guidance

60. A summary of the project resources by financier is in Table 18 excluded VAT to be financed by Government.

Table 18: Summary Financing Plan by Financier

Component	Financier	
	ADB	Government
Output 1		
Roads Bridges Associated Works		
Detailed Engineering Design		
Construction Supervision Consultants		
Land Acquisition		
Output 2		
Infrastructure		
Detailed Engineering Design		
Construction Supervision		
Land Acquisition		
Output 3		
PAM Support		
Project Management		
Project Management Unit staff and operating		
Vehicles		
Project LIC		
Audit of Project Financial Accounts		

ADB = Asian Development Bank, LIC = loan implementation consultant

C. Detailed Cost Estimate by Expenditure Category

Table 19: Detailed Costs by Expenditure Category – Overall

Basic Infrastructure for Inclusive Growth in the North Central Provinces Sector Project Expenditure Accounts Project Cost Summary	(Local Million)			(US\$ '000)			% Total Base Costs
	Local	Foreign	Total	Local	Foreign	Total	
I. Investment Costs							
A. Civil Works							
Roads	1,687,283	723,121	2,410,405	72,460	31,054	103,514	60
Other Works	477,217	204,522	681,739	20,475	8,775	29,251	17
Subtotal Civil Works	2,164,501	927,643	3,092,144	92,935	39,829	132,764	76
B. Vehicles	1,575	-	1,575	68	-	68	-
C. Land Acquisition and Compensation	334,890	-	334,890	14,503	-	14,503	8
D. Subproject - Other costs	269,217	-	269,217	11,642	-	11,642	7
E. Road Safety Awareness	4,866	2,085	6,951	211	90	301	-
F. Consulting Services							
Loan Implementation Consultants	32,125	-	32,125	1,378	-	1,378	1
Detailed Design	79,359	-	79,359	3,418	-	3,418	2
Construction Supervision	52,855	9,017	61,872	2,268	387	2,655	2
ADB_Independent Audit	3,326	1,425	4,751	143	61	204	-
Subtotal Consulting Services	167,665	10,443	178,107	7,207	448	7,655	4
G. Asset Management Systems	38,863	6,195	45,058	1,725	275	2,000	1
H. Gender Action Plan	3,830	-	3,830	164	-	164	-
I. Environmental Action Plan	10,611	-	10,611	455	-	455	-
J. Project Management							
Staff Costs	53,464	-	53,464	2,294	-	2,294	1
Operating Costs	40,148	1,030	41,178	1,724	44	1,768	1
Other _equipment	5,530	147	5,677	237	6	244	-
Subtotal roject Management	99,142	1,177	100,319	4,255	51	4,305	2
Total BASELINE COSTS	3,095,159	947,544	4,042,703	133,164	40,693	173,857	100
Physical Contingencies	230,088	91,772	321,861	9,872	3,938	13,810	8
Price Contingencies	709,826	254,607	964,433	8,582	3,068	11,650	7
Total PROJECT COSTS	4,035,074	1,293,923	5,328,997	151,618	47,698	199,317	115
Interest During Implementation	-	106,928	106,928	-	4,009	4,009	2
Commitment Charges	-	5,407	5,407	-	196	196	-
Total Costs to be Financed	4,035,074	1,406,258	5,441,332	151,618	51,903	203,521	117

Source(s): Asian Development Bank estimates

Table 20: Detailed Costs by Expenditure Category – Nghe An

Basic Infrastructure for Inclusive Growth in the North Central Provinces Sector Project Expenditure Accounts Project Cost Summary Nghe An PPC	(Local Million)			(US\$ '000)			% Total Base Costs
	Local	Foreign	Total	Local	Foreign	Total	
I. Investment Costs							
A. Civil Works							
Roads	410,868	176,086	586,954	17,629	7,555	25,184	55
Other Works	165,318	70,851	236,169	7,093	3,040	10,133	22
Subtotal Civil Works	576,186	246,937	823,123	24,722	10,595	35,317	77
B. Vehicles	1,575	-	1,575	68	-	68	-
C. Land Acquisition and Compensation	93,733	-	93,733	4,156	-	4,156	9
D. Subproject - Other costs	63,820	-	63,820	2,806	-	2,806	6
E. Road Safety Awareness	1,231	528	1,759	53	23	75	-
F. Consulting Services							
Loan Implementation Consultants	8,696	-	8,696	373	-	373	1
Detailed Design	13,534	-	13,534	594	-	594	1
Construction Supervision	13,355	2,357	15,712	573	101	674	1
ADB_Independent Audit	827	354	1,181	35	15	51	-
Subtotal Consulting Services	36,412	2,711	39,123	1,575	116	1,692	4
G. Asset Management Systems	9,571	1,689	11,260	425	75	500	1
H. Gender Action Plan	849	-	849	36	-	36	-
I. Environmental Action Plan	2,801	-	2,801	120	-	120	-
J. Project Management							
Staff Costs	14,837	-	14,837	637	-	637	1
Operating Costs	10,366	-	10,366	445	-	445	1
Other _equipment	1,216	-	1,216	52	-	52	-
Subtotal roject Management	26,419	-	26,419	1,134	-	1,134	2
Total BASELINE COSTS	812,599	251,865	1,064,463	35,094	10,809	45,903	100
Physical Contingencies	63,270	24,982	88,252	2,715	1,072	3,787	8
Price Contingencies	175,867	69,493	245,360	2,120	837	2,957	6
Total PROJECT COSTS	1,051,735	346,340	1,398,075	39,929	12,718	52,647	115
Interest During Implementation	-	28,393	28,393	-	1,061	1,061	2
Commitment Charges	-	1,610	1,610	-	58	58	-
Total Costs to be Financed	1,051,735	376,343	1,428,079	39,929	13,837	53,766	117

Source(s): Asian Development Bank estimates

Table 21: Detailed Costs by Expenditure Category – Ha Tinh

Basic Infrastructure for Inclusive Growth in the North Central Provinces Sector Project Expenditure Accounts Project Cost Summary Ha Tinh PPC	(Local Million)			(US\$ '000)			% Total Base Costs
	Local	Foreign	Total	Local	Foreign	Total	
I. Investment Costs							
A. Civil Works							
Roads	478,174	204,932	683,106	20,516	8,793	29,309	56
Other Works	161,445	69,191	230,635	6,927	2,969	9,896	19
Subtotal Civil Works	639,619	274,122	913,741	27,443	11,761	39,205	74
C. Land Acquisition and Compensation	125,338	-	125,338	5,378	-	5,378	10
D. Subproject - Other costs	86,264	-	86,264	3,701	-	3,701	7
E. Road Safety Awareness	1,231	528	1,759	53	23	75	-
F. Consulting Services							
Loan Implementation Consultants	8,868	-	8,868	380	-	380	1
Detailed Design	30,336	-	30,336	1,302	-	1,302	2
Construction Supervision	16,476	2,907	19,383	707	125	832	2
ADB_Independent Audit	827	354	1,181	35	15	51	-
Subtotal Consulting Services	56,506	3,262	59,768	2,424	140	2,564	5
G. Asset Management Systems	10,139	1,127	11,266	450	50	500	1
H. Gender Action Plan	1,182	-	1,182	51	-	51	-
I. Environmental Action Plan	2,859	-	2,859	123	-	123	-
J. Project Management							
Staff Costs	11,457	-	11,457	492	-	492	1
Operating Costs	10,751	566	11,316	461	24	486	1
Other _equipment	1,227	65	1,292	53	3	55	-
Subtotal roject Management	23,434	630	24,065	1,005	27	1,033	2
Total BASELINE COSTS	946,572	279,669	1,226,241	40,628	12,001	52,629	100
Physical Contingencies	70,136	27,819	97,955	3,009	1,194	4,203	8
Price Contingencies	225,016	77,336	302,352	2,724	931	3,656	7
Total PROJECT COSTS	1,241,724	384,823	1,626,547	46,362	14,126	60,488	115
Interest During Implementation	-	32,297	32,297	-	1,205	1,205	2
Commitment Charges	-	2,081	2,081	-	75	75	-
Total Costs to be Financed	1,241,724	419,201	1,660,926	46,362	15,406	61,768	117

Source(s): Asian Development Bank estimates

Table 22: Detailed Costs by Expenditure Category – Quang Binh

Basic Infrastructure for Inclusive Growth in the North Central Provinces Sector Project Expenditure Accounts Project Cost Summary Quang Binh PPC	(Local Million)			(US\$ '000)			% Total Base Costs
	Local	Foreign	Total	Local	Foreign	Total	
I. Investment Costs							
A. Civil Works							
Roads	379,900	162,814	542,715	16,300	6,986	23,286	63
Other Works	80,630	34,556	115,185	3,459	1,483	4,942	13
Subtotal Civil Works	460,530	197,370	657,900	19,759	8,468	28,228	76
C. Land Acquisition and Compensation	66,067	-	66,067	2,835	-	2,835	8
D. Subproject - Other costs	59,359	-	59,359	2,547	-	2,547	7
E. Road Safety Awareness	1,231	528	1,759	53	23	75	-
F. Consulting Services							
Loan Implementation Consultants	6,912	-	6,912	297	-	297	1
Detailed Design	17,480	-	17,480	750	-	750	2
Construction Supervision	12,570	1,908	14,478	539	82	621	2
ADB_Independent Audit	845	362	1,208	36	16	52	-
Subtotal Consulting Services	37,807	2,270	40,077	1,622	97	1,720	5
G. Asset Management Systems	9,576	1,690	11,266	425	75	500	1
H. Gender Action Plan	1,016	-	1,016	44	-	44	-
I. Environmental Action Plan	2,812	-	2,812	121	-	121	-
J. Project Management							
Staff Costs	9,526	-	9,526	409	-	409	1
Operating Costs	10,213	-	10,213	439	-	439	1
Other _equipment	1,516	-	1,516	65	-	65	-
Subtotal roject Management	21,255	-	21,255	913	-	913	2
Total BASELINE COSTS	659,653	201,858	861,511	28,318	8,663	36,982	100
Physical Contingencies	46,887	19,737	66,624	2,012	847	2,859	8
Price Contingencies	159,074	54,788	213,862	1,924	660	2,585	7
Total PROJECT COSTS	865,614	276,383	1,141,997	32,254	10,171	42,425	115
Interest During Implementation	-	22,296	22,296	-	835	835	2
Commitment Charges	-	780	780	-	28	28	-
Total Costs to be Financed	865,614	299,459	1,165,073	32,254	11,033	43,288	117

Source(s): Asian Development Bank estimates

Table 23: Detailed Costs by Expenditure Category – Quang Tri

Basic Infrastructure for Inclusive Growth in the North Central Provinces Sector Project Expenditure Accounts Project Cost Summary Quang Tri PPC	(Local Million)			(US\$ '000)			% Total Base Costs
	Local	Foreign	Total	Local	Foreign	Total	
I. Investment Costs							
A. Civil Works							
Roads	418,341	179,289	597,630	18,015	7,721	25,735	67
Other Works	69,825	29,925	99,750	2,996	1,284	4,280	11
Subtotal Civil Works	488,166	209,214	697,380	21,010	9,004	30,015	78
C. Land Acquisition and Compensation	49,752	-	49,752	2,135	-	2,135	6
D. Subproject - Other costs	59,773	-	59,773	2,588	-	2,588	7
E. Road Safety Awareness	1,173	503	1,675	52	22	74	-
F. Consulting Services							
Loan Implementation Consultants	7,649	-	7,649	328	-	328	1
Detailed Design	18,010	-	18,010	773	-	773	2
Construction Supervision	10,454	1,845	12,299	449	79	528	1
ADB_Independent Audit	827	354	1,181	35	15	51	-
Subtotal Consulting Services	36,940	2,199	39,139	1,585	94	1,679	4
G. Asset Management Systems	9,576	1,690	11,266	425	75	500	1
H. Gender Action Plan	783	-	783	34	-	34	-
I. Environmental Action Plan	2,139	-	2,139	92	-	92	-
J. Project Management							
Staff Costs	17,645	-	17,645	757	-	757	2
Operating Costs	8,818	464	9,282	378	20	398	1
Other _equipment	1,571	83	1,654	67	4	71	-
Subtotal roject Management	28,034	547	28,581	1,203	23	1,226	3
Total BASELINE COSTS	676,336	214,152	890,488	29,123	9,220	38,343	100
Physical Contingencies	49,796	19,234	69,030	2,137	825	2,962	8
Price Contingencies	149,869	52,990	202,859	1,814	639	2,452	6
Total PROJECT COSTS	876,000	286,377	1,162,378	33,073	10,684	43,757	114
Interest During Implementation	-	23,942	23,942	-	908	908	2
Commitment Charges	-	936	936	-	34	34	-
Total Costs to be Financed	876,000	311,255	1,187,255	33,073	11,626	44,699	117

Source(s): Asian Development Bank estimates

D. Allocation and Withdrawal of Loan Proceeds

Table 24: Concessional Ordinary Lending

No.	Item	Total Amount Allocated for ADB Financing (\$)		Percentage and Basis for Withdrawal from the Loan Account
		Category	Subcategory	
1	Project cost*	94,500,798		100 percent of total expenditure claimed***
1A	for Nghe An Province**		23,639,949	100 percent of total expenditure claimed***
1B	for Ha Tinh Province**		23,624,433	100 percent of total expenditure claimed***
1C	for Quang Binh Province**		23,633,171	100 percent of total expenditure claimed***
1D	for Quang Tri Province**		23,603,245	100 percent of total expenditure claimed***
2	Interest Charges	2,499,202		100 percent of total amount due
	Total	97,000,000		

* This loan will be front-loaded until fully utilized, and then the withdrawal of the ordinary operations loan will commence.

** Subject to the condition for withdrawal described in paragraph 6, Schedule 3 of the loan agreement (ordinary operations [concessional]).

*** Exclusive of taxes and duties imposed within the territory of the Borrower.

Table 25: Ordinary Capital Resources

No.	Item	Total Amount Allocated for ADB Financing (\$)		Percentage and Basis for Withdrawal from the Loan Account
		Category	Subcategory	
1	Project cost*	50,294,420		100 percent of total expenditure claimed***
1A	for Nghe An Province**		14,990,434	100 percent of total expenditure claimed***
1B	for Ha Tinh Province**		19,345,254	100 percent of total expenditure claimed***
1C	for Quang Binh Province**		7,254,032	100 percent of total expenditure claimed***
1D	for Quang Tri Province**		8,704,700	100 percent of total expenditure claimed***
2	Interest and Commitment Charges	1,705,580		100 percent of total amount due
	Total	52,000,000		

* For categories 1A to 1D, the allocated amount will be withdrawn after the corresponding categories under the COL loan is fully withdrawn.

** Subject to the condition for withdrawal described in paragraph 6, Schedule 2 of the Loan Agreement (Ordinary Operations)

*** Exclusive of taxes and duties imposed within the territory of the Borrower.

E. Detailed Cost Estimates by Financier

Table 26: Expenditure Category by Financier – Overall

Expenditure Accounts by Financiers (US\$ '000)	ADB_COL		OCR_ADB		Govt		Total	
	Amount	%	Amount	%	Amount	%	Amount	%
I. Investment Costs								
A. Civil Works								
Roads	72,698	60	37,807	31	10,929	9	121,434	60
Other Works	19,839	58	11,488	33	3,098	9	34,425	17
Subtotal Civil Works	92,537	59	49,295	32	14,027	9	155,860	77
B. Vehicles	-	-	-	-	76	100	76	-
C. Land Acquisition and Compensation	-	-	-	-	14,923	100	14,923	7
D. Subproject - Other costs	-	-	-	-	12,383	100	12,383	6
E. Road Safety Awareness	-	-	-	-	327	100	327	0
F. Consulting Services								
Loan Implementation Consultants	-	-	-	-	1,446	100	1,446	1
Detailed Design	-	-	-	-	3,647	100	3,647	2
Construction Supevision	1,769	58	999	33	274	9	3,041	2
ADB_Independent Audit	195	91	-	-	19	9	215	0
Subtotal Consulting Services	1,964	24	999	12	5,387	65	8,350	4
G. Asset Management Systems	-	-	-	-	2,000	100	2,000	1
H. Gender Action Plan	-	-	-	-	181	100	181	0
I. Environmental Action Plan	-	-	-	-	503	100	503	0
J. Project Management								
Staff Costs	-	-	-	-	2,446	100	2,446	1
Operating Costs	-	-	-	-	2,002	100	2,002	1
Other _equipment	-	-	-	-	267	100	267	0
Subtotal roject Management	-	-	-	-	4,715	100	4,715	2
Total PROJECT COSTS	94,501	47	50,294	25	54,521	27	199,317	98
Interest During Implementation	2,499	62	1,510	38	-	-	4,009	2
Commitment Charges	-	-	196	100	-	-	196	0
Total Disbursement	97,000	48	52,000	26	54,521	27	203,521	100

Source(s): Asian Development Bank estimates

Table 27: Expenditure Category by Financier – Nghe An

Expenditure Accounts by Financiers								
Nghe An PPC (US\$ '000)								
	ADB_COL		OCR_ADB		Nghe An PPC		Total	
	Amount	%	Amount	%	Amount	%	Amount	%
I. Investment Costs								
A. Civil Works								
Roads	14,995	51	11,970	40	2,667	9	29,633	55
Other Works	8,172	68	2,723	23	1,078	9	11,973	22
Subtotal Civil Works	23,167	56	14,694	35	3,744	9	41,605	77
B. Vehicles	-	-	-	-	76	100	76	0
C. Land Acquisition and Compensation	-	-	-	-	4,175	100	4,175	8
D. Subproject - Other costs	-	-	-	-	2,922	100	2,922	5
E. Road Safety Awareness	-	-	-	-	87	100	87	0
F. Consulting Services								
Loan Implementation Consultants	-	-	-	-	391	100	391	1
Detailed Design	-	-	-	-	623	100	623	1
Construction Supervision	424	54	297	38	71	9	792	2
ADB_Independent Audit	49	91	-	-	5	9	53	0
Subtotal Consulting Services	473	25	297	16	1,090	59	1,859	4
G. Asset Management Systems	-	-	-	-	500	100	500	1
H. Gender Action Plan	-	-	-	-	39	100	39	0
I. Environmental Action Plan	-	-	-	-	128	100	128	0
J. Project Management								
Staff Costs	-	-	-	-	681	100	681	1
Operating Costs	-	-	-	-	516	100	516	1
Other_equipment	-	-	-	-	59	100	59	0
Subtotal roject Management	-	-	-	-	1,255	100	1,255	2
Total PROJECT COSTS	23,640	45	14,990	29	14,016	27	52,647	98
Interest During Implementation	610	58	451	43	-	-	1,061	2
Commitment Charges	-	-	58	100	-	-	58	0
Total Disbursement	24,250	45	15,500	29	14,016	26	53,766	100

Source(s): Asian Development Bank estimates

Table 28: Expenditure Category by Financier – Ha Tinh

Expenditure Accounts by Financiers								
Ha Tinh PPC (US\$ '000)								
	ADB_COL		OCR_ADB		Ha Tinh PPC		Total	
	Amount	%	Amount	%	Amount	%	Amount	%
I. Investment Costs								
A. Civil Works								
Roads	16,661	48	14,853	43	3,117	9	34,631	56
Other Works	6,353	55	4,163	36	1,040	9	11,556	19
Subtotal Civil Works	23,014	50	19,016	41	4,157	9	46,187	75
C. Land Acquisition and Compensation	-	-	-	-	5,584	100	5,584	9
D. Subproject - Other costs	-	-	-	-	3,950	100	3,950	6
E. Road Safety Awareness	-	-	-	-	86	100	86	0
F. Consulting Services								
Loan Implementation Consultants	-	-	-	-	399	100	399	1
Detailed Design	-	-	-	-	1,405	100	1,405	2
Construction Supervision	562	57	329	34	88	9	979	2
ADB_Independent Audit	49	91	-	-	5	9	53	0
Subtotal Consulting Services	610	22	329	12	1,897	67	2,837	5
G. Asset Management Systems	-	-	-	-	500	100	500	1
H. Gender Action Plan	-	-	-	-	59	100	59	0
I. Environmental Action Plan	-	-	-	-	142	100	142	0
J. Project Management								
Staff Costs	-	-	-	-	518	100	518	1
Operating Costs	-	-	-	-	563	100	563	1
Other _equipment	-	-	-	-	62	100	62	0
Subtotal roject Management	-	-	-	-	1,143	100	1,143	2
Total PROJECT COSTS	23,624	39	19,345	32	17,518	29	60,488	98
Interest During Implementation	626	52	579	48	-	-	1,205	2
Commitment Charges	-	-	75	100	-	-	75	0
Total Disbursement	24,250	39	20,000	32	17,518	28	61,768	100

Source(s): Asian Development Bank estimates

Table 29: Expenditure Category by Financier – Quang Binh

Expenditure Accounts by Financiers		ADB_COL		OCR_ADB		Quang Binh PPC		Total	
Quang Binh PPC (US\$ '000)		Amount	%	Amount	%	Amount	%	Amount	%
I. Investment Costs									
A. Civil Works									
Roads		17,819	65	7,104	26	2,465	9	27,388	63
Other Works		5,314	91	-	-	526	9	5,839	14
Subtotal Civil Works		23,133	70	7,104	21	2,991	9	33,228	77
C. Land Acquisition and Compensation		-	-	-	-	2,946	100	2,946	7
D. Subproject - Other costs		-	-	-	-	2,734	100	2,734	6
E. Road Safety Awareness		-	-	-	-	79	100	79	0
F. Consulting Services									
Loan Implementation Consultants		-	-	-	-	311	100	311	1
Detailed Design		-	-	-	-	780	100	780	2
Construction Supervision		450	68	150	23	59	9	660	2
ADB_Independent Audit		50	91	-	-	5	9	55	0
Subtotal Consulting Services		500	28	150	8	1,156	64	1,806	4
G. Asset Management Systems		-	-	-	-	500	100	500	1
H. Gender Action Plan		-	-	-	-	46	100	46	0
I. Environmental Action Plan		-	-	-	-	127	100	127	0
J. Project Management									
Staff Costs		-	-	-	-	431	100	431	1
Operating Costs		-	-	-	-	461	100	461	1
Other _equipment		-	-	-	-	67	100	67	0
Subtotal roject Management		-	-	-	-	959	100	959	2
Total PROJECT COSTS		23,633	56	7,254	17	11,538	27	42,425	98
Interest During Implementation		617	74	218	26	-	-	835	2
Commitment Charges		-	-	28	100	-	-	28	0
Total Disbursement		24,250	56	7,500	17	11,538	27	43,288	100

Source(s): Asian Development Bank estimates

Table 30: Expenditure Category by Financier – Quang Tri

Expenditure Accounts by Financiers								
Quang Tri PPC (US\$ '000)								
	ADB_COL		OCR_ADB		Quang Tri PPC		Total	
	Amount	%	Amount	%	Amount	%	Amount	%
I. Investment Costs								
A. Civil Works								
Roads	23,222	78	3,880	13	2,680	9	29,782	67
Other Works	-	-	4,602	91	455	9	5,057	11
Subtotal Civil Works	23,222	67	8,481	24	3,136	9	34,839	78
C. Land Acquisition and Compensation	-	-	-	-	2,218	100	2,218	5
D. Subproject - Other costs	-	-	-	-	2,777	100	2,777	6
E. Road Safety Awareness	-	-	-	-	74	100	74	0
F. Consulting Services								
Loan Implementation Consultants	-	-	-	-	345	100	345	1
Detailed Design	-	-	-	-	838	100	838	2
Construction Supervision	332	54	223	37	55	9	611	1
ADB_Independent Audit	49	91	-	-	5	9	53	0
Subtotal Consulting Services	381	21	223	12	1,243	67	1,848	4
G. Asset Management Systems	-	-	-	-	500	100	500	1
H. Gender Action Plan	-	-	-	-	36	100	36	0
I. Environmental Action Plan	-	-	-	-	106	100	106	0
J. Project Management								
Staff Costs	-	-	-	-	816	100	816	2
Operating Costs	-	-	-	-	462	100	462	1
Other _equipment	-	-	-	-	80	100	80	0
Subtotal roject Management	-	-	-	-	1,358	100	1,358	3
Total PROJECT COSTS	23,603	54	8,705	20	11,449	26	43,757	98
Interest During Implementation	647	71	261	29	-	-	908	2
Commitment Charges	-	-	34	100	-	-	34	0
Total Disbursement	24,250	54	9,000	20	11,449	26	44,699	100

Source(s): Asian Development Bank estimates

F. Detailed Cost Estimates by Outputs and/or Components

Table 31: Cost Estimate by Output – Overall

Basic Infrastructure for Inclusive Growth in the North Central Provinces Sector Project Expenditure Accounts by Components - Totals Including Contingencies (US\$ '000)		Output 1: Transport Infrastructure Improved	Share of Category (%)	Output 2: Infrastructure for Business Development Improved	Share of Category (%)	Output 3: Decentralized Public Asset Management Processes Established	Share of Category (%)	Project Management	Share of Category (%)	Total
I. Investment Costs										
A. Civil Works										
Roads	121,434	100%	-	-	-	-	-	-	-	121,434
Other Works	-	-	34,425	100%	-	-	-	-	-	34,425
Subtotal Civil Works	121,434	78%	34,425	22%	-	-	-	-	-	155,860
B. Vehicles										
	-	-	-	-	-	-	76	100%	-	76
C. Land Acquisition and Compensation										
	14,901	100%	22	0%	-	-	-	-	-	14,923
D. Subproject - Other costs										
	10,467	85%	1,915	15%	-	-	-	-	-	12,383
E. Road Safety Awareness										
	327	100%	-	-	-	-	-	-	-	327
F. Consulting Services										
Loan Implementation Consultants	-	-	-	-	-	-	1,446	100%	-	1,446
Detailed Design	2,724	75%	924	25%	-	-	-	-	-	3,647
Construction Supervision	2,469	81%	573	19%	-	-	-	-	-	3,041
ADB_Independent Audit	-	-	-	-	-	-	215	100%	-	215
Subtotal Consulting Services	5,192	62%	1,496	18%	-	-	1,661	20%	-	8,350
G. Asset Management Systems										
	-	-	-	-	2,000	100%	-	-	-	2,000
H. Gender Action Plan										
	40	22%	22	12%	-	-	119	66%	-	181
I. Environmental Action Plan										
	72	14%	11	2%	-	-	421	84%	-	503
J. Project Management										
Staff Costs	-	-	-	-	-	-	2,446	100%	-	2,446
Operating Costs	-	-	-	-	-	-	2,002	100%	-	2,002
Other _equipment	-	-	-	-	-	-	267	100%	-	267
Subtotal roject Management	-	-	-	-	-	-	4,715	100%	-	4,715
Total PROJECT COSTS	152,433	76%	37,891	19%	2,000	1%	6,992	4%	-	199,317
Interest During Implementation	-	-	-	-	-	-	-	-	-	4,009
Commitment Charges	-	-	-	-	-	-	-	-	-	196
Total Disbursement	-	-	-	-	-	-	-	-	-	203,521

Source(s): Asian Development Bank estimates

Table 32: Cost Estimate by Output – Nghe An

Basic Infrastructure for Inclusive Growth in the North Central Provinces Sector Project Expenditure Accounts by Components - Totals Including Contingencies Nghe An PPC (US\$ '000)		Output 1: Transport Infrastructure Improved	Share of Category (%)	Output 2: Infrastructure for Business Development Improved	Share of Category (%)	Output 3: Decentralized Public Asset Management Processes Established	Share of Category (%)	Project Management	Share of Category (%)	Total
I. Investment Costs										
A. Civil Works										
Roads	29,633	100%	-	-	-	-	-	-	-	29,633
Other Works	-	-	11,973	100%	-	-	-	-	-	11,973
Subtotal Civil Works	29,633	71%	11,973	29%	-	-	-	-	-	41,605
B. Vehicles										
	-	-	-	-	-	-	76	100%	-	76
C. Land Acquisition and Compensation										
	4,175	100%	-	-	-	-	-	-	-	4,175
D. Subproject - Other costs										
	2,709	93%	213	7%	-	-	-	-	-	2,922
E. Road Safety Awareness										
	87	100%	-	-	-	-	-	-	-	87
F. Consulting Services										
Loan Implementation Consultants	-	-	-	-	-	-	391	100%	-	391
Detailed Design	576	92%	47	8%	-	-	-	-	-	623
Construction Supervision	583	74%	209	26%	-	-	-	-	-	792
ADB_Independent Audit	-	-	-	-	-	-	53	100%	-	53
Subtotal Consulting Services	1,159	62%	256	14%	-	-	444	24%	-	1,859
G. Asset Management Systems										
	-	-	-	-	500	100%	-	-	-	500
H. Gender Action Plan										
	11	28%	-	-	-	-	28	72%	-	39
I. Environmental Action Plan										
	22	17%	-	-	-	-	106	83%	-	128
J. Project Management										
Staff Costs	-	-	-	-	-	-	681	100%	-	681
Operating Costs	-	-	-	-	-	-	516	100%	-	516
Other _equipment	-	-	-	-	-	-	59	100%	-	59
Subtotal roject Management	-	-	-	-	-	-	1,255	100%	-	1,255
Total PROJECT COSTS	37,796	72%	12,442	24%	500	1%	1,909	4%	-	52,647
Interest During Implementation	-	-	-	-	-	-	-	-	-	1,061
Commitment Charges	-	-	-	-	-	-	-	-	-	58
Total Costs to be Financed	-	-	-	-	-	-	-	-	-	53,766

Source(s): Asian Development Bank estimates

Table 33: Cost Estimate by Output – Ha Tinh

Basic Infrastructure for Inclusive Growth in the North Central Provinces Sector Project		Output 1: Transport Infrastructure Improved		Output 2: Infrastructure for Business Development Improved		Output 3: Decentralized Public Asset Management Processes Established		Project Management	Share of Category	Total
Expenditure Accounts by Components - Totals Including Contingencies Ha Tinh PPC (US\$ '000)		Share of Category (%)	Share of Category (%)	Share of Category (%)	Share of Category (%)	Share of Category (%)	Share of Category (%)	Share of Category (%)	Share of Category (%)	
I. Investment Costs										
A. Civil Works										
Roads	34,631	100%	-	-	-	-	-	-	-	34,631
Other Works	-	-	11,556	100%	-	-	-	-	-	11,556
Subtotal Civil Works	34,631	75%	11,556	25%	-	-	-	-	-	46,187
C. Land Acquisition and Compensation	5,562	100%	22	0%	-	-	-	-	-	5,584
D. Subproject - Other costs	3,015	76%	935	24%	-	-	-	-	-	3,950
E. Road Safety Awareness	86	100%	-	-	-	-	-	-	-	86
F. Consulting Services										
Loan Implementation Consultants	-	-	-	-	-	-	399	100%	-	399
Detailed Design	725	52%	681	48%	-	-	-	-	-	1,405
Construction Supervision	823	84%	156	16%	-	-	-	-	-	979
ADB_Independent Audit	-	-	-	-	-	-	53	100%	-	53
Subtotal Consulting Services	1,548	55%	837	29%	-	-	452	16%	-	2,837
G. Asset Management Systems	-	-	-	-	500	100%	-	-	-	500
H. Gender Action Plan	-	-	22	38%	-	-	37	62%	-	59
I. Environmental Action Plan	-	-	11	7%	-	-	131	93%	-	142
J. Project Management										
Staff Costs	-	-	-	-	-	-	518	100%	-	518
Operating Costs	-	-	-	-	-	-	563	100%	-	563
Other _equipment	-	-	-	-	-	-	62	100%	-	62
Subtotal roject Management	-	-	-	-	-	-	1,143	100%	-	1,143
Total PROJECT COSTS	44,842	74%	13,382	22%	500	1%	1,764	3%	-	60,488
Interest During Implementation	-	-	-	-	-	-	-	-	-	1,205
Commitment Charges	-	-	-	-	-	-	-	-	-	75
Total Costs to be Financed	-	-	-	-	-	-	-	-	-	61,768

Source(s): Asian Development Bank estimates

Table 34: Cost Estimate by Output – Quang Binh

Basic Infrastructure for Inclusive Growth in the North Central Provinces Sector Project Expenditure Accounts by Components - Totals Including Contingencies Quang Binh PPC (US\$ '000)		Output 1: Improved Transport Infrastructure	Share of Category (%)	Output 2: Improved Infrastructure for Business Development	Share of Category (%)	Output 3: Decentralized Public Asset Management Processes Established	Share of Category (%)	Project Management	Share of Category (%)	Total
I. Investment Costs										
A. Civil Works										
Roads	27,388	100%	-	-	-	-	-	-	27,388	
Other Works	-	-	5,839	100%	-	-	-	-	5,839	
Subtotal Civil Works	27,388	82%	5,839	18%	-	-	-	-	33,228	
C. Land Acquisition and Compensation	2,946	100%	-	-	-	-	-	-	2,946	
D. Subproject - Other costs	2,312	85%	422	15%	-	-	-	-	2,734	
E. Road Safety Awareness	79	100%	-	-	-	-	-	-	79	
F. Consulting Services										
Loan Implementation Consultants	-	-	-	-	-	-	311	100%	311	
Detailed Design	668	86%	112	14%	-	-	-	-	780	
Construction Supervision	555	84%	104	16%	-	-	-	-	660	
ADB_Independent Audit	-	-	-	-	-	-	55	100%	55	
Subtotal Consulting Services	1,223	68%	217	12%	-	-	366	20%	1,806	
G. Asset Management Systems	-	-	-	-	500	100%	-	-	500	
H. Gender Action Plan	17	38%	-	-	-	-	29	62%	46	
I. Environmental Action Plan	20	16%	-	-	-	-	107	84%	127	
J. Project Management										
Staff Costs	-	-	-	-	-	-	431	100%	431	
Operating Costs	-	-	-	-	-	-	461	100%	461	
Other _equipment	-	-	-	-	-	-	67	100%	67	
Subtotal roject Management	-	-	-	-	-	-	959	100%	959	
Total PROJECT COSTS	33,987	80%	6,478	15%	500	1%	1,460	3%	42,425	
Interest During Implementation	-	-	-	-	-	-	-	-	835	
Commitment Charges	-	-	-	-	-	-	-	-	28	
Total Costs to be Financed	-	-	-	-	-	-	-	-	43,288	

Source(s): Asian Development Bank estimates

Table 35: Cost Estimate by Output – Quang Tri

Basic Infrastructure for Inclusive Growth in the North Central Provinces		Output 2: Infrastructure for Business		Output 3: Decentralized Public Asset Management		Share of Project Management		Share of Category	Total
Expenditure Accounts by Components - Totals Including Contingencies Quang Tri PPC (US\$ '000)		Output 1: Transport Infrastructure Improved	Share of Category (%)	Share of Category (%)	Share of Category (%)	Share of Category (%)	Share of Category (%)	Share of Category (%)	Total
I. Investment Costs									
A. Civil Works									
Roads	29,782	100%	-	-	-	-	-	-	29,782
Other Works	-	-	5,057	100%	-	-	-	-	5,057
Subtotal Civil Works	29,782	85%	5,057	15%	-	-	-	-	34,839
C. Land Acquisition and Compensation	2,218	100%	-	-	-	-	-	-	2,218
D. Subproject - Other costs	2,431	88%	346	12%	-	-	-	-	2,777
E. Road Safety Awareness	74	100%	-	-	-	-	-	-	74
F. Consulting Services									
Loan Implementation Consultants	-	-	-	-	-	345	100%	-	345
Detailed Design	755	90%	83	10%	-	-	-	-	838
Construction Supervision	507	83%	103	17%	-	-	-	-	611
ADB_Independent Audit	-	-	-	-	-	-	53	100%	53
Subtotal Consulting Services	1,262	68%	187	10%	-	399	22%	-	1,848
G. Asset Management Systems	-	-	-	-	500	100%	-	-	500
H. Gender Action Plan	11	31%	-	-	-	-	25	69%	36
I. Environmental Action Plan	29	27%	-	-	-	-	77	73%	106
J. Project Management									
Staff Costs	-	-	-	-	-	-	816	100%	816
Operating Costs	-	-	-	-	-	-	462	100%	462
Other _equipment	-	-	-	-	-	-	80	100%	80
Subtotal roject Management	-	-	-	-	-	1,358	100%	-	1,358
Total PROJECT COSTS	35,808	82%	5,590	13%	500	1%	1,859	4%	43,757
Interest During Implementation	-	-	-	-	-	-	-	-	908
Commitment Charges	-	-	-	-	-	-	-	-	34
Total Disbursement	-	-	-	-	-	-	-	-	44,699

Source(s): Asian Development Bank estimates

G. Detailed Cost Estimates by Year**Table 36: Cost Estimate by Year – Overall**

Expenditure Accounts by Years (US\$ '000)	Totals Including Contingencies					Total
	2018	2019	2020	2021	2022	
I. Investment Costs						
A. Civil Works						
Roads	-	3,979	21,517	56,212	39,727	121,434
Other Works	-	1,376	6,880	15,077	11,092	34,425
Subtotal Civil Works	-	5,354	28,397	71,290	50,819	155,860
B. Vehicles	76	-	-	-	-	76
C. Land Acquisition and Compensation	2,206	6,066	6,651	-	-	14,923
D. Subproject - Other costs	1,356	3,723	4,494	1,995	816	12,383
E. Road Safety Awareness	-	158	145	24	-	327
F. Consulting Services						
Loan Implementation Consultants	289	383	355	244	176	1,446
Detailed Design	790	1,843	836	127	52	3,647
Construction Supervision	-	161	827	1,196	857	3,041
ADB_Independent Audit	42	42	43	44	44	215
Subtotal Consulting Services	1,121	2,429	2,060	1,610	1,129	8,350
G. Asset Management Systems	-	941	935	124	-	2,000
H. Gender Action Plan	-	52	71	41	16	181
I. Environmental Action Plan	79	121	147	108	48	503
J. Project Management						
Staff Costs	475	482	489	496	504	2,446
Operating Costs	374	379	385	478	387	2,002
Other _equipment	267	-	-	-	-	267
Subtotal roject Management	1,116	861	874	975	890	4,715
Total PROJECT COSTS	5,953	19,704	43,774	76,167	53,718	199,317
Share of Total Project Costs	3%	10%	22%	38%	27%	100%
Interest During Implementation						4,009
Commitment Charges						196
Total Disbursement						203,521

Source(s): Asian Development Bank estimates

Table 37: Cost Estimate by Year – Nghe An

Expenditure Accounts by Years		Totals Including Contingencies					
Nghe An PPC (US\$ '000)		2018	2019	2020	2021	2022	Total
I. Investment Costs							
A. Civil Works							
Roads		-	2,150	4,705	12,921	9,856	29,633
Other Works		-	-	1,174	5,960	4,839	11,973
Subtotal Civil Works		-	2,150	5,880	18,880	14,695	41,605
B. Vehicles		76	-	-	-	-	76
C. Land Acquisition and Compensation		47	95	4,033	-	-	4,175
D. Subproject - Other costs		504	1,562	664	106	86	2,922
E. Road Safety Awareness		-	26	52	9	-	87
F. Consulting Services							
Loan Implementation Consultants		92	104	91	63	40	391
Detailed Design		133	306	142	24	19	623
Construction Supervision		-	20	244	300	229	792
ADB_Independent Audit		10	11	11	11	11	53
Subtotal Consulting Services		235	441	487	398	299	1,859
G. Asset Management Systems		-	282	186	31	-	500
H. Gender Action Plan		-	13	16	11	-	39
I. Environmental Action Plan		26	33	40	29	-	128
J. Project Management							
Staff Costs		132	134	136	138	140	681
Operating Costs		98	100	101	121	95	516
Other _equipment		59	-	-	-	-	59
Subtotal roject Management		289	234	237	259	235	1,255
Total PROJECT COSTS		1,177	4,836	11,595	19,723	15,315	52,647
Share of Total Project Costs		2%	9%	22%	37%	29%	100%
Interest During Implementation							1,061
Commitment Charges							58
Total Costs to be Financed							53,766

Source(s): Asian Development Bank estimates

Table 38: Cost Estimate by Year – Ha Tinh

Expenditure Accounts by Years Ha Tinh PPC (US\$ '000)	Totals Including Contingencies					Total
	2018	2019	2020	2021	2022	
I. Investment Costs						
A. Civil Works						
Roads	-	-	3,397	17,238	13,997	34,631
Other Works	-	1,376	4,637	3,694	1,849	11,556
Subtotal Civil Works	-	1,376	8,034	20,932	15,846	46,187
C. Land Acquisition and Compensation	1,102	3,350	1,131	-	-	5,584
D. Subproject - Other costs	512	1,064	1,651	688	36	3,950
E. Road Safety Awareness	-	86	-	-	-	86
F. Consulting Services						
Loan Implementation Consultants	92	101	93	64	49	399
Detailed Design	317	726	315	35	12	1,405
Construction Supervision	-	46	175	426	333	979
ADB_Independent Audit	10	11	11	11	11	53
Subtotal Consulting Services	419	883	593	536	405	2,837
G. Asset Management Systems	-	283	186	31	-	500
H. Gender Action Plan	-	17	24	13	5	59
I. Environmental Action Plan	28	32	36	31	15	142
J. Project Management						
Staff Costs	101	102	104	105	107	518
Operating Costs	106	108	109	127	113	563
Other _equipment	62	-	-	-	-	62
Subtotal roject Management	269	210	213	232	219	1,143
Total PROJECT COSTS	2,331	7,300	11,868	22,462	16,527	60,488
Share of Total Project Costs	4%	12%	20%	37%	27%	100%
Interest During Implementation						1,205
Commitment Charges						75
Total Costs to be Financed						61,768

Source(s): Asian Development Bank estimates

Table 39: Cost Estimate by Year – Quang Binh

Expenditure Accounts by Years Quang Binh PPC (US\$ '000)	Totals Including Contingencies					Total
	2018	2019	2020	2021	2022	
I. Investment Costs						
A. Civil Works						
Roads	-	1,263	5,903	11,743	8,479	27,388
Other Works	-	-	573	2,907	2,360	5,839
Subtotal Civil Works	-	1,263	6,476	14,650	10,839	33,228
C. Land Acquisition and Compensation	587	1,478	882	-	-	2,946
D. Subproject - Other costs	139	654	673	713	554	2,734
E. Road Safety Awareness	-	23	48	8	-	79
F. Consulting Services						
Loan Implementation Consultants	51	87	88	50	37	311
Detailed Design	169	382	176	40	14	780
Construction Supervision	-	85	247	226	102	660
ADB Independent Audit	11	11	11	11	11	55
Subtotal Consulting Services	231	564	521	327	163	1,806
G. Asset Management Systems	-	283	186	31	-	500
H. Gender Action Plan	-	12	18	9	7	46
I. Environmental Action Plan	21	27	34	24	22	127
J. Project Management						
Staff Costs	84	85	86	87	89	431
Operating Costs	86	87	88	111	90	461
Other equipment	67	-	-	-	-	67
Subtotal Project Management	236	172	174	198	179	959
Total PROJECT COSTS	1,213	4,476	9,011	15,960	11,765	42,425
Share of Total Project Costs	3%	11%	21%	38%	28%	100%
Interest During Implementation						835
Commitment Charges						28
Total Project Disbursement						43,288

Source(s): Asian Development Bank estimates

Table 40: Cost Estimate by Year – Quang Tri

Expenditure Accounts by Years Quang Tri PPC (US\$ '000)	Totals Including Contingencies					
	2018	2019	2020	2021	2022	Total
I. Investment Costs						
A. Civil Works						
Roads	-	565	7,512	14,311	7,395	29,782
Other Works	-	-	496	2,517	2,044	5,057
Subtotal Civil Works	-	565	8,008	16,828	9,438	34,839
C. Land Acquisition and Compensation	470	1,142	605	-	-	2,218
D. Subproject - Other costs	201	443	1,507	487	140	2,777
E. Road Safety Awareness	-	22	45	7	-	74
F. Consulting Services						
Loan Implementation Consultants	54	91	83	67	50	345
Detailed Design	171	429	203	29	7	838
Construction Supervision	-	10	162	244	194	611
ADB_Independent Audit	10	11	11	11	11	53
Subtotal Consulting Services	235	541	459	350	262	1,848
G. Asset Management Systems	-	93	376	31	-	500
H. Gender Action Plan	-	10	14	8	4	36
I. Environmental Action Plan	4	29	38	24	11	106
J. Project Management						
Staff Costs	158	161	163	166	168	816
Operating Costs	84	85	86	119	89	462
Other _equipment	80	-	-	-	-	80
Subtotal roject Management	322	246	249	285	257	1,358
Total PROJECT COSTS	1,232	3,092	11,300	18,021	10,111	43,757
Share of Total Project Cost	3%	7%	26%	41%	23%	100%
Interest During Implementation						908
Commitment Charges						34
Total Disbursement						44,699

Source(s): Asian Development Bank estimates

H. Provincial Forecast Cashflow

Table 41: Nghe An

<u>Nghe An</u>	<u>2018</u>	<u>2019</u>	<u>2020</u>	<u>2021</u>	<u>2022</u>	<u>Total</u>
COL: Loan \$24.25mill						
ADB Net of Tax	9.4	1,984.3	4,062.8	10,028.8	7,554.6	23,640
Interest Charge	0.0	10.1	60.6	173.3	366.0	610
Subtotal COL Cashflow	9	1,994	4,123	10,202	7,921	24,250
Share of COL Loan	0.04%	8%	17%	42%	33%	100%
OCR: Loan \$15.5 mill						
ADB Net of Tax	-	-	1,520	7,435	6,036	14,990
Interest Charge	0	0	12	107	332	451
Charges	3	10	19	18	7	58
Subtotal OCR Cashflow	4	11	1,551	7,560	6,375	15,500
Share of OCR Loan	0.0%	0%	3%	24%	74%	100%
Counterpart Funds: \$14.02mill						
Government Cashflow (incl. Tax)	1,168	2,851	6,013	2,260	1,725	14,016
Share of Government Total Cost	8%	20%	43%	16%	12%	100%
Total Project Cost \$53.77million						
Total Project Cashflow	1,181	4,857	11,687	20,021	16,020	53,770
Share of Total Project Cost	2%	9%	22%	37%	30%	100%

Source(s): Asian Development Bank estimates

Table 42: Ha Tinh

<u>HA Tinh</u>	<u>2018</u>	<u>2019</u>	<u>2020</u>	<u>2021</u>	<u>2022</u>	<u>Total</u>
COL: Loan \$24.25mill						
ADB Net of Tax	9	1,303	5,582	9,816	6,914	23,624
Interest Charge	0	7	54	189	375	626
Subtotal COL Cashflow	9	1,310	5,636	10,005	7,289	24,250
Share of COL Loan	0.04%	5%	23%	41%	30%	100%
OCR: Loan \$20.0 mill						
ADB Net of Tax	-	-	1,897	9,629	7,819	19,345
Interest Charge	0	0	15	136	428	579
Charges	4	13	25	23	9	75
Subtotal OCR Cashflow	5	14	1,938	9,788	8,256	20,000
Share of OCR Loan	0.0%	0%	3%	23%	74%	100%
Counterpart Funds: \$17.52mill						
Government Cashflow (incl. Tax)	2,322	5,997	4,388	3,017	1,794	17,518
Share of Government Total Cost	13%	34%	25%	17%	10%	100%
Total Project Cost \$61.77million						
Total Project Cashflow	2,336	7,321	11,962	22,811	17,339	61,773
Share of Total Project Cost	4%	12%	19%	37%	28%	100%

Source(s): Asian Development Bank estimates

Table 43: Quang Binh

<u>Quang Binh</u>	2018	2019	2020	2021	2022	Total
COL: Loan \$24.25mill						
ADB Net of Tax	9.6	1,236.1	5,401.3	9,951.5	7,034.7	23,633
Interest Charge	0.0	6.4	52.2	184.5	373.7	617
Subtotal COL Cashflow	10	1,242	5,453	10,136	7,408	24,250
Share of COL Loan	0.04%	5%	22%	42%	31%	100%
OCR: Loan \$7.5 mill						
ADB Net of Tax	-	-	726	3,596	2,932	7,254
Interest Charge	0	0	6	51	160	218
Charges	2	5	9	9	3	28
Subtotal OCR Cashflow	2	5	741	3,656	3,096	7,500
Share of OCR Loan	0.0%	0%	3%	24%	74%	100%
Counterpart Funds: \$11.54 mill						
Government Cashflow (incl. Tax)	1,203	3,240	2,884	2,413	1,798	11,538
Share of Government Total Cost	10%	28%	25%	21%	16%	100%
Total Project Cost \$43.29 million						
Total Project Cashflow	1,214	4,487	9,079	16,205	12,302	43,289
Share of Total Project Cost	3%	10%	21%	37%	28%	100%

Source(s): Asian Development Bank estimates

Table 44: Quang Tri

<u>Quang Tri</u>	2018	2019	2020	2021	2022	Total
COL: Loan \$24.25mill						
ADB Net of Tax	9.4	533.5	6,571.0	11,228.7	5,260.6	23,603
Interest Charge	0.0	2.9	43.8	200.1	400.0	647
Subtotal COL Cashflow	9	536	6,615	11,429	5,661	24,250
Share of COL Loan	0.04%	2%	27%	47%	23%	100%
OCR: Loan \$9 mill						
ADB Net of Tax	-	-	873	4,317	3,515	8,705
Interest Charge	0	0	7	62	192	261
Charges	2	6	11	11	4	34
Subtotal OCR Cashflow	2	6	891	4,389	3,712	9,000
Share of OCR Loan	0.0%	0%	3%	24%	74%	100%
Counterpart Funds: \$11.45mill						
Government Cashflow (incl. Tax)	1,223	2,559	3,856	2,476	1,336	11,449
Share of Government Total Cost	11%	22%	34%	22%	12%	100%
Total Project Cost \$44.7million						
Total Project Cashflow	1,234	3,101	11,362	18,293	10,708	44,701
Share of Total Project Cost	3%	7%	25%	41%	24%	100%

Source(s): Asian Development Bank estimates

I. Contract and Disbursement S-Curve

Figure 4: Aggregate Contract and Disbursement S -Curve

	Contract Awards (in USD million)					Disbursements (in USD million)						
	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total		
2018	0.000000	0.000000	0.000000	3.013551	3.013551	0.000000	0.000000	0.000000	0.051580	0.051580		
2019	7.661877	4.645327	4.645327	4.645327	21.597858	1.714911	1.714911	1.714911	1.756374	6.901107		
2020	21.653258	7.553960	7.553960	7.783971	44.545149	7.369108	8.152447	7.369108	8.194531	31.085194		
2021	41.569162	0.000000	21.716914	0.000000	63.286076	14.788461	15.092165	14.788461	14.524880	59.193968		
2022	12.352584	0.000000	0.000000	0.000000	12.352584	10.268012	12.511023	12.268012	12.554380	47.601428		
2023	0.000000	0.000000	0.000000	0.000000	0.000000	3.122717	1.000000	0.044007	0.000000	4.166724		
	Total Contract Awards					144.795218	Total Disbursements					149.000000

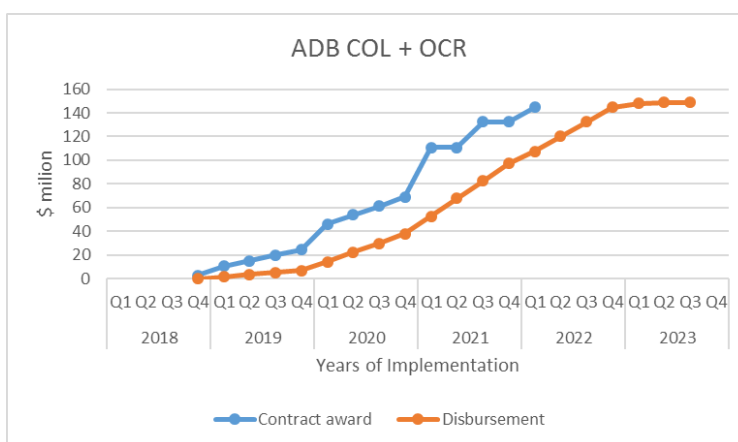


Figure 5: ADB COL Contract and Disbursement S -Curve

	Contract Awards (in USD million)					Disbursements (in USD million)						
	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total		
2018	0.000000	0.000000	0.000000	2.727266	2.727266	0.000000	0.000000	0.000000	0.047410	0.047410		
2019	4.645327	4.645327	4.645327	4.645327	18.581308	1.714911	1.714911	1.714911	1.756374	6.901107		
2020	7.553960	7.553960	7.553960	7.783971	30.445851	5.860833	6.629858	5.860833	6.671942	25.023466		
2021	21.029459	0.000000	21.716914	0.000000	42.746373	9.247087	9.479220	9.247087	9.521937	37.495331		
2022	0.000000	0.000000	0.000000	0.000000	0.000000	6.234913	6.420667	6.234913	6.464024	25.354517		
2023	0.000000	0.000000	0.000000	0.000000	0.000000	1.134162	1.000000	0.044007	0.000000	2.178169		
	Total Contract Awards					94.500798	Total Disbursements					97.000000

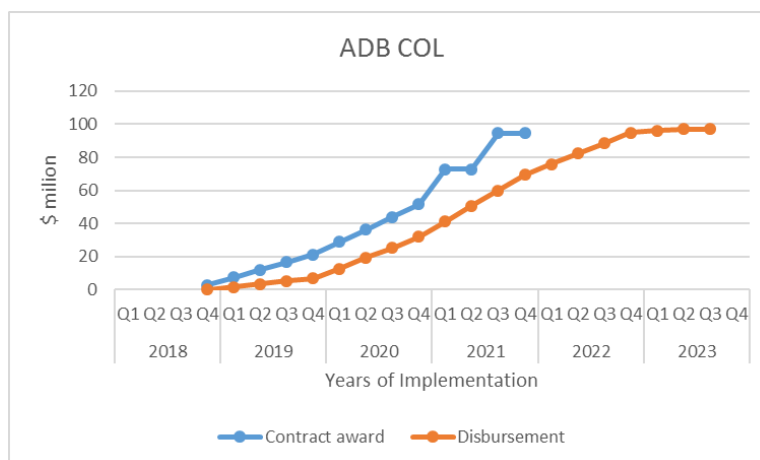
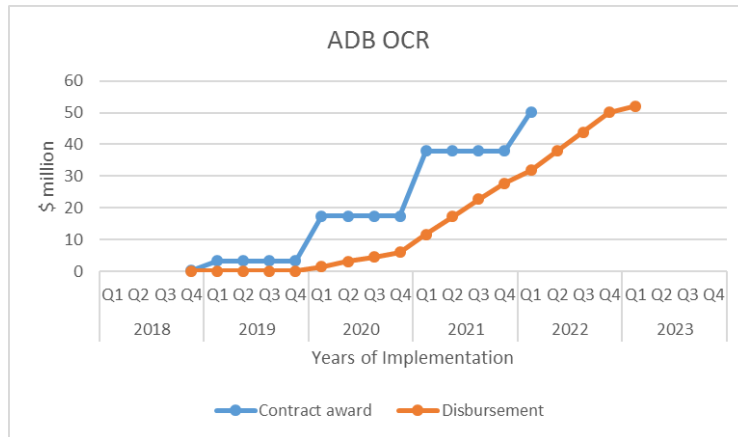


Figure 6: ADB OCR Contract and Disbursement S -Curve

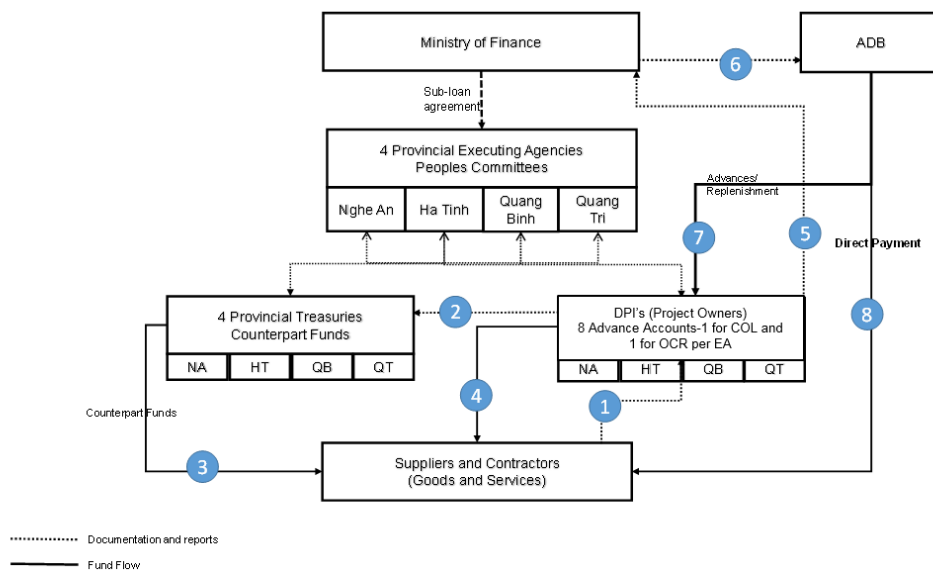
	Contract Awards (in USD million)					Disbursements (in USD million)						
	Q1	Q2	Q3	Q4	Total	Q1	Q2	Q3	Q4	Total		
2018	0.000000	0.000000	0.000000	0.286285	0.286285	0.000000	0.000000	0.000000	0.004170	0.004170		
2019	3.016550	0.000000	0.000000	0.000000	3.016550	0.000000	0.000000	0.000000	0.000000	0.000000		
2020	14.099298	0.000000	0.000000	0.000000	14.099298	1.508275	1.522589	1.508275	1.522589	6.061728		
2021	20.539703	0.000000	0.000000	0.000000	20.539703	5.541374	5.612945	5.541374	5.002943	21.698637		
2022	12.352584	0.000000	0.000000	0.000000	12.352584	4.033099	6.090356	6.033099	6.090356	22.246911		
2023	0.000000	0.000000	0.000000	0.000000	0.000000	1.988555	0.000000	0.000000	0.000000	1.988555		
	Total Contract Awards					50.294420	Total Disbursements					52.000000



J. Fund Flow Diagram

61. There are 8 advance accounts to be established (i.e. two per province) with ADB COL and OCR loan resources being managed in separate advance accounts in each province.

Figure 7: Project Funds Flow Chart



Notes to figure:

- (1) Submission of claims
- (2) Endorsement of claims payable

- (3) Payment of claims from counterpart funds
- (4) Payment of eligible claims for ADB-financed items from advance account
- (5) Submission of withdrawal applications for Advance, Liquidation/Replenishment and Direct Payment
- (6) Endorsement of withdrawal applications for Advance, Liquidation/Replenishment and Direct Payment
- (7) Deposit of Advance and Replenishments to advance accounts
- (8) Direct payments of eligible claims for ADB-financed items

V. FINANCIAL MANAGEMENT

A. Financial Management Assessment

62. The overall financial management assessment (FMA) is presented in the context of ADB's sector modality for the Project. The financial assessment uses the detail of representative subproject feasibility⁶ as well as the proposed financial structure and management of the overall project.

63. The main financial management risks that need to be managed by the EAs, IAs, and PMUs are: (i) implementation risk - lack of familiarity with ADB sector project subproject processing procedures, delayed feasibility and subproject preparation leading to potential eligibility and cost escalation issues, weak understanding and adherence to ADB procurement procedures, unfamiliar and weak skills set relating to financial management and disbursement procedures and requirements leading to prolonged project implementation, project management unit incentives to prolong implementation to maintain the PMU as an institution outside the usual sector structures, (ii) compliance risk - lack of familiarity with ADB financial management requirements, particularly on accounting, reporting and auditing, which may delay project reporting and derail identification of issues on the use of loan proceeds, (iii) financing risk – some EAs have indicated relatively higher levels of counterpart funds without clear implementation cost structures that may delay approvals for counterpart fund amounts and the subsequent transfer of counterpart funds to the PMU, a lack of awareness of the cash flow of counterpart funds which are required proportionately more during the first two years of implementation for project implementation, and (iv) operational risk - inadequate experience in the range of subprojects to be implemented that will impact project progress, an acceptance of lower quality standards as price escalation is experienced in order to maintain optimistic physical targets, limited ability to maintain project assets after project completion.

64. The identified financial management risks to be closely monitored during project implementation are as follows:

Table 45: Financial Management Action Plan

Potential Risk Event	Suggested Action	Target Date for Implementation	Responsibility
Inadequate accounting systems	Assessment of accounting systems and recommendation for implementing/ upgrading of accounting software and operating manuals for timely production of accounts as per national accounting standards with consistent accounting codes shared between all PMU Project Accounts. Assure DPI and PMU accounts are kept separately	1 month before effectiveness.	Quang Tri Coordination PMU/IA

⁶ Under ADB OM (para. 3.), where the outputs of a project can be quantified but not valued, economic efficiency can be assessed in terms of cost-efficiency alone.

Potential Risk Event	Suggested Action	Target Date for Implementation	Responsibility
Inadequate Staffing systems	Confirmation of institutional structures and staffing qualifications and positions and recommendations for institutional and staffing systems as agreed in the PAM.	One month after loan agreement signing	EAs/IAs
Inadequate accounting staff in government agencies	Completion of identification and posting of adequate government staff including at least 3 qualified and experienced financial management and accounting related full time staff in each PMU as per institutional structure agreed with Government in the PAM.	One month after loan effectiveness	EAs/IAs
Non-availability of qualified consultant staff	Completion of recruitment of loan implementation consultant's accounting staff	Upon Loan agreement signing	EAs/IAs
Inadequate internal control systems	Development of an operations manual including control systems and internal audit procedures, if relevant. All PMU accounts to undergo both internal control audit during the life of the Project	One month before loan effectiveness	EAs/IAs
Debt Management Clearances	Each Province to provide confirmation of (i) MOF defined debt ceiling requirement, (ii) the timeline for achieving the debt ceiling, and (iii) a date for MOF clearance	Prior to loan approval	EAs/IAs
Counterpart fund management	Confirmation of project budget management system to manage funds flows for counterpart funds from provincial governments budget to the project with confirmed counterpart funds both in total allocation to the Project and in terms of the quarterly cashflow projection basis	One month before loan signing	EAs/IAs
Weak external control	Recruitment of external auditors whose qualifications, experience and terms of reference are acceptable to ADB in a timely fashion to audit project accounts as agreed in the PAM.	Three months after loan effectiveness	EAs/IAs

Potential Risk Event	Suggested Action	Target Date for Implementation	Responsibility
Lack of experience in ADB funded projects and the required documentation and procedures	Capacity building for staff (enclosed separately below)	Within 12 months of loan effectiveness	EAs/IAs
Commitment to ADB procurement and disbursement systems, procedures and approval systems by all EAs including Quang Tri	Dialogues between ADB and Quang Tri outlining the requirements for all procurement prior to loan negotiation with Quang Tri committing to the required systems.	Prior to loan negotiations	Quang Tri EA

65. It was agreed that the EAs and IAs will build capability by (i) setting up clear institutional arrangements and coordination mechanisms amongst the four provinces; (ii) completing staff deployment in appropriate financial management positions and that all of these position will be assigned full time to PMU roles with a written confirmation that the staff member is no longer allowed to undertake DPI or EA based tasks; (iii) ensuring each PMUs have access to English language support that is capable of interpretation, and translation of technical writing into the standard required for submission documents; (iv) developing methodologies for managing cost escalation risks; (v) the need to monitor the risk of lags in foreign exchange movement that erode forecast currency devaluation under public-private partnership (PPP) cost estimation assumptions resulting financing shortfalls; and (vi) of undertaking more training, particularly on ADB policy and procedures so that the EAs and IAs will have adequate administrative and accounting capacity to prepare and maintain proper SOE records and make them readily available for examination.

B. Risk Analysis

66. The risk assessment considered the staffing, internal control, accounting and reporting policies and procedures, and auditing standards and arrangements of the EA and IAs. The overall financial management risk-rating of the project before considering mitigating measures is high.

1. Inherent Risk

67. Inherent risk is the susceptibility of the project financial management system to factors arising from the environment in which it operates, such as country rules and regulations and project management entities and the political economy of their working environment.

Table 46: Inherent Risk Assessment

Risk type	Risk Assessment	Risk Description	Mitigation Measures
Country-specific	H	Incomplete and unclear fiscal decentralization, debt management and proposed public finance reforms result in a lack of certainty	Counterpart fund requirements are defined by local covenant Debt management agreements to be signed between each EA and the Ministry of Finance and will form the basis of each EA being able to borrow ODA finance prior to approval of

Risk type	Risk Assessment	Risk Description	Mitigation Measures
		and clarity regarding internal controls, reporting, and procurement transparency Financial and procurement skills at provincial level are weak and face a challenge to keep up to date with reforms	Government Investment Plan approval Contracted skills included in loan Implementation Consultancy
Entity-specific	M	Delay project implementation due to lack of familiarity with ADB disbursement procedures and requirements Incentive to delay implementation to extend the life of the PMU and the staffing contracts	Training on ADB financial management requirements, including disbursement, accounting and auditing, foreign exchange and interest rate risk management.
Overall Assessment of Inherent Risk	M		

ADB = Asian Development Bank, CPS = country partnership strategy, IFRS = international financial report system.
Source: Asian Development Bank.

2. Control Risk

68. Control risk is the risk that the project's accounting and internal control framework are inadequate to ensure project funds are used appropriately and efficiently for the purpose intended, and that the use of funds is properly recorded and reported with supporting documentation.

Table 47: Control Risk Assessment

Risk type	Risk Rating	Risk Description/Mitigation Measures
Implementing Agency (DPI and PMUs)	H	Project financial management policies and procedures are in place for DPI budget and financial accounting systems, however the relationship of these to the PMUs remains unproven. Staffing of the PMU financial management team needs to be clearly identified as full time roles with staff only engaged in BIIG activities and with advanced academic and professional experience Each of the project IAs will adopt the accepted accounting principles as specified by the Ministry of Finance. The IA PMUs will set up a separate project accounting system within three months after loan effectiveness and each IAs will submit a copy of these to ADB financial management expert in VRM.

Risk type	Risk Rating	Risk Description/Mitigation Measures
Loan Funds Flow	M	<p>ADB loans are on-lent to each EA. Each EA will repay the portion made available to it through budget allocation whilst the State will repay the portion made available to the EAs under respective on-lending agreements. The EAs will assume the foreign exchange and interest rate variation risks. The concessional loan will have a repayment period of 25 years, including a grace period of 5 years while the ordinary loan will have a repayment period of 25 years, including a grace period of 6 years. Each PMU will open its own advance accounts to manage the loan proceeds in line with the requirements in the Loan Agreement. Timely release of loan proceeds to each province will be required through loan covenant.</p>
Counterpart funds	S	<p>The required quantum of CF required in the first 2 years is significant and if these are delayed or constrained the subproject DED and subsequent works contracts will be delayed resulting in (i) significant price escalation, (ii) reduced availability of financing leading to either fewer subprojects or lower quality works.</p> <p>The necessity for provinces to avoid budget deficits any provincial level deficit will result in delayed availability or release of approved counterpart funds causing additional delays.</p>
Staffing	H	<p>PMU staffing is a mix of existing government civil servants with lifetime employment and adequately qualified and contracted staff positions that are yet to be filled. No province has experience in acting as a loan EA and therefore lack previous experience in financial management, familiarity with ADB loan management policies and procedures/ procedures and training on ADB loan management policies and procedures including procurement, disbursement and repayment policy need to be provided to enhance the professional capacity of relevant staff before implementing the project. Contracted staff and implementation support consultant are included in the design along with DPI and PMU participation in ADB in-country training and awareness programs prior to loan effectiveness</p>
Internal Audit	M	<p>All IAs have internal audit training and undergo an internal audit annual, however these fail to meet international standards. The Project will be included in all internal audit procedures and reporting</p>
External Audit	L	<p>The Project will be using ADB funds finance the contracting and conducting of external audits per international standards for which TOR are provided in the PAM</p>
Reporting and Monitoring	L	<p>Reporting will draw on the financial management systems management information system and the Project accounts with each IA receiving monthly reports, quarterly updates and annual results. Monitoring will be through the individual IA and their reporting to the Provincial EA plus through quarterly reports to ADB, and through the yearly external audit. The consolidation of the four provincial data sets will</p>

Risk type	Risk Rating	Risk Description/Mitigation Measures
		provide an additional control point to ensure data is reconciled and consistent.
Information Systems	M	The EA and IAs will use stand-alone computerized accounting systems which produce financial statements automatically. Further each PMU will have a work planning and budgeting system based on ADBs (VRM) Project administration work books that links to the annual budget, disbursement and physical completion records to form the basis of the PPMS
Overall Risk	H	

ADB = Asian Development Bank, EA = executing agency, IA = implementing agency, MOF = Ministry of Finance,
 Note: Degrees of rating: high, substantial, moderate, and low.
 Source: Asian Development Bank.

69. Addressing the issues raised in the risk evaluation, the level of training and understanding required within the project implementation process was identified as varying by province. The exact extent required is difficult to determine when not all PMUs are in place and the respective staff not engaged. An initial part of capacity building under the project is a Training Needs Assessment (TNA) from which a training plan could be developed. The TNA would be directed at DOF and PMUs as well as for recipient line ministries. The initial training and capacity building plan is presented in Table 48 below and needs to be financed from local counterpart funds under Decree 16 provisions.

Table 48: Capacity Building and Training Summary

Agency	Identified need	Proposed action	Delivered by
Overall	Needs not fully clear	1. Training needs assessment by province to be extended and developed with suggestions below. 2. Overall implementation meeting for all interested parties explaining overall project and individual agencies role within framework.	Government
Provincial DPI	Coordination	1. Regional briefing meeting on structure and operation as well as interface between provinces. 2. Overall procurement training on both ADB and Vietnamese procedures covering preparing ToRs, Expression of Interests and RFP submission to CMS and procedure for award of contracts.	Government National Consultant
Provincial DOF	Coordination	Regional briefing meeting on structure and operation as well as interface between provinces.	Government National Consultant

Agency	Identified need	Proposed action	Delivered by
PMU to be established	Establishment and ongoing operations along with reporting needs.	<ol style="list-style-type: none"> 1. Initial briefing of PMUs generally on their function and broad legal and ADB framework. 2. Detailed training by province on day to day operation of PMU. 3. Training on conducting procurement procedures. 4. Detailed training for accounting staff of PMU on recording, reporting and presentation of accounts within government and ADB requirements. 5. Awareness training on ADB Safeguard and Gender expectations and procedural requirement 	Consultant/ Government
Related Banks	Uneven experience and little or no ADB loan exposure.	Briefing workshop for banks. Since three separate banks to be involved needs decision whether this is a separate exercise or can be combined. Suggested as separate.	DOF central
Project recipients	Possible no earlier experience on ODA procedures	Depending on bidding packages potential contractors need to be made aware of procedures and bidding regulations.	Government/DPI/PMU

C. Fund Flow Mechanism

70. The GOV is the borrower of the ADB loan for financing the Basic Infrastructure for Inclusive Growth in the North Central Provinces Sector Project. On behalf of the borrower, Ministry of Finance (MOF) will relend a portion of the proceeds of the ADB loans⁷ to the four Executing Agencies being Ha Tinh PPC, Nghe An PPC, Quang Binh PPC, and Quang Tri PPC while the balance will be made available to the EAs through budget allocation. The repayment period of the COL loan is 25 years including a grace period of 5 years while the repayment period of the OCR loan is 25 years including a grace period of 6 years. Repayment of on-lent funds will be undertaken within domestic procedures and agreements with the Government of Viet Nam solely responsible for the repayments to ADB.

71. Each Project Management Unit will open two advance accounts to manage the loan proceeds in line with the requirements in the Loan Agreement. No subaccounts are necessary. Reimbursement of expenses will involve each PMU/IA submitting its own withdrawal applications and supporting documentation direct to ADB.

72. Counterpart funding will be the sole responsibility of each Provincial PPC and will be provided through appropriate government procedures.

D. Personnel

73. The financial staff of EA and IAs are a mix of government civil servants seconded to the PMU and individuals contracted to the PMU to ensure the correct experience and range of skills

⁷ Concessional capital resources loan and ordinary capital resources loan

are available during implementation. It is expected that staff will need training to familiarize with ADB project-related disbursement guidelines and procedures, project accounting requirements, project and contract management, financial monitoring and report preparation. Additionally, somebody with English capability will be needed to support the finance teams, especially at the early stage of project implementation and with capacity to provide technical translation to a standard for ADB document submission. Current expertise in English for some provinces while sufficient for oral translation needs further strengthening so that possible delays to procurement and contracting procedures are to be avoided.

74. Key risks relate to the timing of the formation of the final PMUs and the subsequent staffing of these. The PMUs can legally be formed up to 30 days after loan signing with individual staff position filled by this time. Currently, (i) positions within the PMU are proposed only, (ii) positions within the proposed PMU are indicated to be either seconded DPI staff or contracted positions however this may change on the formal establishment of the PMUs, (iii) the individuals to fill positions are unknown and as such the capability of staff is largely unknowable, (iv) the EAs and Project Owners may choose to modify the structures and also the nature of each position resulting in fewer full time contracted positions that are substituted for part time DPI seconded staff. The experience in Viet Nam PMU operation is that without full time staff PMU and project performance is significantly and adversely affected.

E. Disbursement

1. Disbursement Arrangements for ADB Funds

75. The loan proceeds will be disbursed in accordance with ADB's *Loan Disbursement Handbook (2017, as amended from time to time)*, and detailed arrangements agreed upon between the government and ADB. Online training for project staff on disbursement policies and procedures is available.⁸ Project staff is encouraged to avail of this training to help ensure efficient disbursement and fiduciary control.

76. **Advance fund procedure.** 8 advance accounts (2 for each EA) will be established at commercial banks nominated by SBV and acceptable to ADB and maintained by each Project Owner as assigned by each PPC (EA). The Project Owner (IA) will be the DPI who will form a PMU that will in turn establish the Provincial Advance account. The currency of the advance accounts is USD. Each advance account is to be used exclusively for ADB's share of eligible expenditures with COL and OCR loan resources being managed in separate accounts. The Project Owner on behalf of the PPC that established the advance account in its name is accountable and responsible for proper use of advances to the advance account.

77. The total outstanding advance to the advance accounts should not exceed the estimate of ADB's share of expenditures to be paid through the respective advance account for the forthcoming 6 months. The DPI/PMU on behalf of the PPC may request for initial and additional advances to the advance accounts based on an Estimate of Expenditure Sheet setting out the estimated expenditures to be financed through the accounts for the forthcoming 6 months.⁹ Supporting documents should be submitted to ADB or retained by the PPC and their delegated Project Owner (IA) in accordance with ADB's *Loan Disbursement Handbook (2017, as amended from time to time)* when liquidating or replenishing the advance accounts.

⁸ Disbursement eLearning. http://wpqr4.adb.org/disbursement_elearning

⁹ ADB. 2017. *Loan Disbursement Handbook, Appendix 8A*. Manila.

78. **Statement of expenditure procedure.**¹⁰ The SOE procedure is applied for items up to a ceiling of \$100,000 equivalent per individual payment. All supporting documents and records for the expenditures claimed under the SOE should be maintained and made readily available for review by ADB's disbursement and review missions, upon ADB's request for submission of supporting documents on a sampling basis, and for independent audit.

79. Before the submission of the first withdrawal application, the borrower should submit to ADB sufficient evidence of the authority of the person(s) who will sign the withdrawal applications on behalf of the government, together with the authenticated specimen signatures of each authorized person. The minimum value per withdrawal application is set in accordance with ADB's *Loan Disbursement Handbook (2017, as amended from time to time)*. Individual payments below this amount should be paid (i) by the Project Owner being the respective DPI and subsequently claimed to ADB through reimbursement, or (ii) through the advance fund procedure, unless otherwise accepted by ADB.

80. No withdrawals shall be made from the Loan Account for any province until the respective Subsidiary Loan Agreement, in form and substance satisfactory to ADB, has been duly authorized by, and executed and delivered on behalf of, the Borrower (or its authorized government entity) and the concerned Project Province, and is legally binding upon the parties thereto in accordance with its terms.¹¹

F. Accounting Policies and Financial Reporting

81. Each IAs/PMU will adopt accounting methods required by MOF to establish a separate set of project accounts and records by funding source for all expenditures incurred on the project. Subsidiary ledgers will be maintained to facilitate reconciliation of accounts with the general ledger and bank records. All reports and supporting documents on all transactions will be stored and retained on a semi-permanent basis and will be accessible by authorized users, and are available for audit inspection. The IA will prepare individual project financial statements and submit to the EA for monitoring and each EA will submit their accounting records to the ADB via the Project Coordination Unit in Quang Tri for consolidation and reporting.

82. The EAs through the IAs/PMUs will maintain, or cause to be maintained, separate books and records by funding source for all expenditures incurred on the project. Annual project financial statements will be prepared following modified cash-based accounting system in accordance with the government's accounting laws and regulations, specifically Circular No.195/2012/TT-BTC under the Vietnamese Accounting Standards (VAS).

83. Financial reporting follows the recent State Budget Law¹² which covers the responsibilities including the duties of state agencies, revenue sources and spending authority, preparation of budget estimates, and on budgetary execution, along with details on accounting, auditing and disclosure requirements.

G. Budgeting System

84. The financial departments of EA and IAs are responsible for summarizing the preliminary budgets and make an overall annual budget for approval by the Project Owner on behalf of the

¹⁰ SOE forms are available in Appendix 7B, ADB's *Loan Disbursement Handbook (2017, as amended from time to time)*.

¹¹ Disbursement conditions for specific category/subcategory are set out in the Loan Agreement.

¹² State Budget Law Decision No. 224/QD-BTC, dated January 30, 2013.

EA (the respective PPC).

85. Detailed project budgets will be formulated by each PMU under the oversight of the financial management team, with input from the procurement expert, technical staff with input from relevant departments but the accounting staff needs to make sure the costs are incurred within budget. The project budgets will be prepared annually by each IA and their PMU based on the work planning templates provided in the PAM and will include physical and financial targets.

86. Prior to loan effectiveness - a whole of life project work plan will be prepared with a supporting budget by project output, subproject, expenditure items, and disbursement category. This work plan and supporting budget will be continually applied for ongoing planning and reporting by the PMU and monitoring by each IA. Budget monitoring reports will present a comparison between budgeted and actual amounts, and highlight budget variances with each PMU Project Director responsible for identifying and auctioning remedial actions to recover or reschedule activities that are delayed or incomplete. The Project Coordination Unit within the Quang Tri Province PMU will provide the consolidation of planning, budgeting and progress records across all four EAs and report this to ADB.

H. Safeguard of Assets

87. Subsidiary records of fixed assets and stocks are currently considered to be well managed and kept up-to-date and reconciled with control accounts of the IA periodically. The EA and IAs will conduct annual physical inventory of all project assets and all subproject assets will remain on the PMU registry until formally handed over to asset managers on completion with supporting documentation that will be included in the scope of the external audit and in Project progress reports where assets, receiving entity and date of transfer will be recorded. During construction / installation insurance shall be the responsibility of contractors and shall cover worker compensation for losses due to accidents apart from compensation for property.

I. Auditing and Public Disclosure

88. Each of the PPCs through the DPI/PMUs will cause the detailed project financial statements to be audited in accordance with International Standards on Auditing by an independent auditor acceptable to ADB. The audited project financial statements together with the auditor's opinion and management letter will be presented in the English language to ADB within 6 months from the end of the fiscal year by PPCs through the DPI/PMUs.

89. The audit report for the project financial statements will include a management letter and auditor's opinions, which cover (i) whether the project financial statements present an accurate and fair view or are presented fairly, in all material respects, in accordance with the applicable financial reporting standards; (ii) whether the proceeds of the loan were used only for the purpose(s) of the project; and (iii) whether the borrower or executing agency was in compliance with the financial covenants contained in the legal agreements (where applicable).

90. Compliance with financial reporting and auditing requirements will be monitored by review missions and during normal program supervision, and followed up regularly with all concerned, including the external auditor.

91. The government, the PPCs and DPI/PMU's are aware of ADB's approach to delayed submission, and the requirements for satisfactory and acceptable quality of the audited project

financial statements.¹³ ADB reserves the right to require a change in the auditor (in a manner consistent with the constitution of the borrower), or for additional support to be provided to the auditor, if the audits required are not conducted in a manner satisfactory to ADB, or if the audits are substantially delayed. ADB reserves the right to verify the project's financial accounts to confirm that the share of ADB's financing is used in accordance with ADB's policies and procedures.

92. Public disclosure of the audited project financial statements, including the auditor's opinion on the project financial statements, will be guided by ADB's Public Communications Policy 2011.¹⁴ After the review, ADB will disclose the audited project financial statements and the opinion of the auditors on the project financial statements no later than 14 days of ADB's confirmation of their acceptability by posting them on ADB's website. The management letter, additional auditor's opinions, and audited entity financial statements will not be disclosed.¹⁵

J. Reporting and Monitoring

93. The project financial reports will be prepared using existing Public Sector budget accounting software systems and are submitted on a monthly, quarterly and annual basis. The reports will highlight the physical and financial progress of projects being undertaken in comparison with the proposed annual work plan and budgets established prior to end of the previous year. Reports will be produced for each subproject, each IA/EA and for the overall project. During project implementation, financial reports will be prepared and submitted to the DPI and the PPC of each province and to ADB as quarterly progress reports for individual outputs. The financial report will be used for monitoring progress of project implementation and compare actual expenditure with budgeted and programmed allocations. The Project Coordination Unit Quang Tri will consolidate each EA reports into a project level report, however it should be noted to avoid cash flow constraints and delays each EA will submit their financial and procurement approval requests and their financial withdrawal applications direct to ADB with the record of these shared with the coordination unit. As such, the coordination unit will not be involved with the presentation of procurement approvals, or withdrawal applications.

K. Information Systems

94. A computerized accounting system will be used by each PMU for the accounting records, payment financial statement including balance sheet, income statement and cash flow statement. The financial reports are generated by the computer system rather than by manual. The financial data and the operational information have not been inter-connected in the system, and reconciliations are realized by regular manual checks.

¹³ ADB's approach and procedures regarding delayed submission of audited project financial statements:

- (i) When audited project financial statements are not received by the due date, ADB will write to the executing agency advising that (a) the audit documents are overdue; and (b) if they are not received within the next 6 months, requests for new contract awards and disbursement such as new replenishment of advance accounts, processing of new reimbursement, and issuance of new commitment letters will not be processed.
- (ii) When audited project financial statements are not received within 6 months after the due date, ADB will withhold processing of requests for new contract awards and disbursement such as new replenishment of advance accounts, processing of new reimbursement and issuance of new commitment letters. ADB will (a) inform the executing agency of ADB's actions; and (b) advise that the loan may be suspended if the audit documents are not received within the next 6 months.
- (iii) When audited project financial statements are not received within 12 months after the due date, ADB may suspend the loan.

¹⁴ Public Communications Policy: <http://www.adb.org/documents/pcp-2011?ref=site/disclosure/publications>

¹⁵ This type of information would generally fall under public communications policy exceptions to disclosure. ADB. 2011. *Public Communications Policy*. Manila. (Paragraph 97(iv) and/or 97(v)).

95. A key source of information will be the ADB VRM project administration workbooks that provide subproject and overall project level work plans, budgets, cash flow timelines, contract award schedules and disbursement projections. The workbooks will form the basis of a Provincial level PPMS that will interface with the project accounting systems to report physical and financial progress against agreed quarterly reporting indicators.

96. Existing accounting software systems of the EAs and IAs are sufficient for supporting the project information system and for generating project reports required for both external and internal use. In addition, all current staff in the IAs are familiar with these systems, although supplementary training in reporting requirements for the ADB financed project will be provided. Systems and procedures for regular back-ups of all accounting systems and appropriate security measures over backed-up data are in place.

L. Financial Capacity Assessment Results

97. Table 49 below summarizes the assessment results on the financial management capacities. It illustrates that skills in the general financial management practices such as book keeping, statutory reporting, and project budgeting and costing are sufficiently acquired. They are good at the computerized accounting system and payment processing, project budgeting and costing. Internal auditing, project modelling and evaluation, management accounting and reporting need some enhancement at average.

Table 49: Financial Capacity Assessment Summary

Skills Required	Current Level	Comments
Financial accounting (book keeping)	Medium	Staff skills in this area are well possessed.
Entity treasury (debt financing, investment, cash management)	Low	EA debt management systems are being addressed prior to loan effectiveness.
Statutory reporting	Medium	Financial reports are regularly prepared. No obvious problem has been found by the auditor however the standards are lower than required by ADB. But there is limited understanding of the financial reporting requirements for ADB funding.
Computerized accounting	Medium	The accounting system has been fully computerized and connected with the CQTG headquarters.
Management accounting and reporting	Low	The management and operation are comparatively complex and management accounting needs to be improved.
Budgeting	Medium	The budget system is running well.
Project budgeting and costing	Low	Each project has a budget and is renewed every year. Budget control is well in place. Project costing is conducted as a routine work. ADB VRM Project administration work books will be developed for all subproject and consolidated by output and EA prior to loan signing with assistance from PPTA

Skills Required	Current Level	Comments
Financial modelling and project evaluation techniques	Medium	Project costing and evaluations are undertaken by consultants. Cost escalation and unit costs are administratively determined and as such underestimate the escalation and market rates requiring reduced quality or changed scope of works. Cost estimators often do not adjust costs the from time of costing to time of contracting (2 to 3 years) resulting in substantial risk of under financing
Internal control and audit	Low	The internal control is done mainly through the computerized accounting system. The internal audit is annual but does not review transaction records in detail.

Source: Asian Development Bank.

VI. PROCUREMENT AND CONSULTING SERVICES

A. Advance Contracting

98. All advance contracting will be undertaken in conformity with ADB Procurement Guidelines (2015, as amended from time to time) and ADB's Guidelines on the Use of Consultants (2013, as amended from time to time). The issuance of invitations to bid under advance contracting will be subject to ADB approval. The borrower, the four NCP PPC's, and DPI/PMU's have been advised that approval of advance contracting does not commit ADB to finance the project.

99. Advance actions include (i) the ranking of consultants' proposals prior to loan signing; (ii) recruitment of loan implementation consultants, (iii) preparation of detailed design including terms of reference, request for proposals, expression of interest, for DED consulting services; and (iv) formation of a procurement evaluation committee to evaluate proposals; and (v) contract signing after loan signing.

B. Procurement of Goods, Works, and Consulting Services

100. All procurement of goods and works financed by ADB loan proceeds will be undertaken in accordance with ADB's Procurement Guidelines (2015, as amended from time to time). Those contracts procured using National Competitive Bidding (NCB) will follow the national procurement laws, subject to the modifications described in the NCB Annex attached to the Procurement Plan. Procurement of goods will use International Competitive Bidding (ICB) procedures if over \$2 million, NCB if \$2 million or less, shopping if less than \$100,000. Civil works will use ICB procedures if over \$10 million with exceptions,¹⁶ NCB if \$10 million or less, shopping if less than \$100,000.

101. Before the start of any procurement, ADB and the government will review the public procurement laws of the central and state governments to ensure consistency with ADB's Procurement Guidelines (2015, as amended from time to time).

102. All consultants financed by ADB loan proceeds will be recruited in accordance with ADB's Guidelines on the Use of Consultants (2013, as amended from time to time).¹⁷ The terms of reference for all consulting services are detailed in Section D.

103. Construction supervision contracts – one per EA, will comprise national input for road, structures, bridge and water supply engineering inputs. The four packages will be contracted using Quality and Cost-Based Selection (QCBS).

104. Project audit service contracts – one per EA, will be recruited as a single package by Quang Tri PMU on behalf of other three provinces. The package will be contracted using Fixed Budget Selection (FBS).

C. Procurement Plan

105. An 18-month procurement plan indicating threshold and review procedures, goods, works, and consulting service contract packages and national competitive bidding guidelines is in Annex 1.

¹⁶ NCB can be used subject to OSFMD's prior approval

¹⁷ Checklists for actions required to contract consultants by method available in e-Handbook on Project Implementation at: <http://www.adb.org/documents/handbooks/project-implementation/>

D. Consultant's Terms of Reference

106. Detailed terms of reference for all consulting services are in Annex 2. Indicative list of key consultants to be engaged under the project is shown in Table 50.

Table 50: Indicative List of Key Consultants to Be Engaged

No.	Consultants	Fund source
1	Construction Supervision Consultant	ADB
2	Loan Implementation Consultant	CF
3	Audit Consultant	ADB
4	DED Consultant	CF

ADB=Asian Development Bank; CF=counterpart fund

VII. SAFEGUARDS

A. Environment

107. The overall project is classified as **Category B** for environment and all subproject are required to be category B or below. The project has an **environmental assessment and review framework (EARF)**. Initial environment examinations including environmental management plans (EMP) have been prepared for the representative subprojects and will be updated and approved by ADB to reflect any changes in the subproject during DED. These documents will be uploaded onto the ADB website before ADB staff review meeting (SRM).

108. The processing of additional subprojects will include an initial environmental examination during the feasibility stage to be contracted and completed by the EAs and IAs. These will be guided by the EARF and are expected to be completed prior to loan signing and or loan effectiveness. Further the detailed engineering design consultant will also be required to provide environmental safeguard input to the design process. The approved EMP will be integrated in the bidding and civil work contracts. Site EMP in detailing mitigation measure implementation in each construction package will be prepared by respective contractor and submitted to PMU for review. Each Province has committed counterpart funding for the implementation of the environmental safeguards identified for the representative subprojects and indicative budgets for the additional subprojects.

109. Each PMU will have an environmental safeguards staff/focal point who will also be assisted by an environmental safeguards consultant who is part time within the loan implementation consultant team. Further the DED consultants will also be required to provide environmental safeguard input to the design process. The PMU environment safeguards staff will work closely with environment consultants that form part of the successful DED team, and the environmental consultant in the loan implementation consultant team, as well construction supervision consultants for supporting each PMU to assess, monitor and supervise the EMP implementation, and ensure environment compliance in each subproject. Semi-annual environment monitoring report, during construction phase, will be prepared and submitted by PMU to ADB for review and uploading on ADB's website.

B. Involuntary Resettlement

110. The overall project is classified as **Category B** for involuntary resettlement. The developments and improvements under the subprojects will not trigger major resettlement impacts because most of the infrastructure will be improved within existing right of ways (ROWs). An assessment and full census of impacted households along the length of the subproject ROW was conducted, based on the center-line and preliminary designs for the representative roads, and a resettlement framework and resettlement plans were prepared in accordance with national legal requirements and ADB's Safeguard Policy Statement (2009).

111. There were no subprojects with significant involuntary resettlement (IR Cat A) impacts. Primary points of concern will be minor land acquisition and compensation for roadside trees, crops, or small structures that may be affected within the ROW. The PPCs and ADB have agreed on a combined **resettlement and ethnic minorities development framework (REMDF)**. Minor land acquisition, compensation, allowances, operation and administration, surveys, monitoring, and reporting will be financed from government counterpart funds. The internal monitor will ensure that the resettlement process and impacts is evaluated properly and reported to ADB semi-annually through the EAs.

112. Public consultation and information disclosure was undertaken during the preparation of **resettlement and ethnic minorities development plans (REMDP)**, including affected persons and the public associated with the representative subprojects. The consultation and information-sharing process will be continued throughout project implementation. The main features of the resettlement concerns-project impacts, asset valuation, entitlements, and compensation provisions-were disclosed to project-affected people during consultative meetings.

113. The REMDF has been prepared and will be implemented by the PMUs' who have a social and resettlement staff positions for social safeguard. For the processing of subprojects both the FS and detailed designs will be supported by the requirement from REMDP and social safeguard input to the detailed design processes. Additional budgets have been included in the Government counterpart contribution for the implementation of the Gender Action Plan and the requirements of the REMDF.

114. For the representative subprojects (3 road, and 1 water supply) the following has been prepared:

- (i) Engineering preliminary designs established the center lines and right of way for all roads and the alignment of all intakes, pumping and treatment stations and distribution network for the water supply schemes
- (ii) Based on the engineering survey and cadastral data surveys were conducted to enable the quantification of resettlement impacts and baseline data for the draft REMDPs. They include the inventory of losses (IOL) to estimate resettlement impacts and a socioeconomic survey to assess pre-project living standards of affected households as well as likely social impacts resulting from land acquisition on them;
- (iii) Public consultations with stakeholders comprising of government entities, private sector interests and affected households. Meaningful consultations will continue during the updating and implementation of the REMDPs during and on completion of the detailed designs and their approval. The draft and updated REMDPs have been disclosed to affected households and their communities based on the preliminary feasibility design documents;
- (iv) The final REMDPs for all representative subprojects will be disclosed prior to project approval of the detailed designs. The fundamental objective of the project resettlement policy is to replace and compensate lost assets based on the principle of replacement cost. Compensation and various forms of assistance will be provided. Once land acquisition is completed, income restoration measures will be implemented in a way that will ensure that standards of living of the project affected persons are at least restored to their pre-project levels, and that those in the category of vulnerable groups (i.e., poor households.) are assisted to help improve their socioeconomic status;
- (v) The REMDPs will be updated upon loan effectiveness, endorsed by the EAs and submitted to the ADB for review and concurrence. The updated REMDPs will require further detailed studies (including detailed measurement survey and replacement cost survey) and additional consultation. Principal aspects to be updated in the REMDPs are resettlement impacts based on DMS; census of affected people; entitlement matrix; and replacement costs and details of consultations and disclosure; and
- (vi) The PMUs, LAR Board at district level, and/or Center for Land Fund Development, the wards/communes, and relevant mass organizations

(particularly the Vietnam Women's Union (WUs)) will have primary responsibility for the updating and implementation of the REMDPs with the support of the consultant. As such the capacity of these bodies is of critical importance and the project must ensure appropriate capacity building assistance in the form of information, training, and consultation and mentoring.

115. The EAs/IAs and the PMUs will ensure that any involuntary resettlement is carried out in accordance with the agreed REMDPs, ADB's Safeguard Policy Statement (2009), and the Vietnamese laws and regulations on involuntary resettlement. In case of discrepancies between the government's laws, regulations, and procedures, and ADB's Safeguards Policy Statement (2009), ADB' Safeguards Policy Statement will apply.

116. The EAs/IAs and the PMUs will ensure that the REMDPs agreed between the EAs and ADB will be updated following completion of detailed designs based on detailed measurement survey; census of affected people; entitlement matrix; replacement costs and details of consultations and will be submitted to ADB for review and concurrence before awarding bid of civil works.

117. The EA will engage the services of a qualified appraiser to carry out the replacement cost survey for land and non-land assets, and submit the replacement cost survey report to the PPCs and PMUs for review and approval.

118. The PMUs and LAR Board at district level the wards/communes and relevant mass organizations (particularly the WUs) will have primary responsibility for the updating and implementation of the REMDPs with the support of the Loan Implementation Consultant.

119. The EAs/IAS and the PMUs shall ensure that a site possession notice to a civil works contract to commence construction activities for a specific section or subproject is issued only when the resettlement specialist of the PMU has officially confirmed in writing that (i) payment has been fully disbursed to the displaced persons and rehabilitation measures are in place for that specific section as per updated REMDPs agreed between the EAs and ADB; (ii) already compensated APs for that specific section have been cleared the area in a timely manner; and (iii) that the specific section is free from any encumbrances.

120. The EAs shall timely and sufficiently provide counterpart funds for land acquisition, resettlement and monitoring activities specified in the agreed REMDPs, and will meet any unforeseen obligations more than the REMDPs budget estimate to satisfy resettlement objectives.

121. PMUs are responsible for internal monitoring with assistance from the loan implementation consultants. PMUs will submit semi-annual internal monitoring reports to ADB. Final monitoring and evaluation need to be conducted after completion of all land acquisition activities every 6 months to assess (i) achievement of land acquisition objectives; (ii) changes in living standards and livelihoods; (iii) restoration of the economic and social base of the affected people; (iv) effectiveness and sustainability of entitlements; and (v) the need for further support as required. Findings monitoring reports will be submitted to ADB and PMU. External resettlement agency is not required for this project because of insignificant impact on land acquisition.

C. Indigenous peoples

122. ADB's Indigenous People's policy requires that under an ADB loan, the borrower/client will undertake meaningful consultation with affected Indigenous Peoples, herein referred to in the

Vietnamese context as “Ethnic Minorities” to ensure their informed participation in (i) designing, implementing, and monitoring measures to avoid adverse impacts on them or, when avoidance is not possible, to minimize, mitigate, and compensate for such effects; and (ii) tailoring project benefits that accrue to them in a culturally appropriate manner. Consultation will be carried out in a manner commensurate with the impacts on affected communities. The consultation process and its results are documented and reflected in the REMDF.

123. The overall project is classified as Category B for Ethnic Minorities and all representative and additional subprojects must be Category B. Since in many cases ethnic minorities form the overwhelming majority of the population of road subproject areas and since the project is designed to provide positive impacts for these groups, measures to mitigate negative impacts have been incorporated in the subproject REMDPs and the procedures within the REMDF that the PMUs apply in the processing of additional subprojects.

124. Impacts on ethnic minorities in the project areas are overwhelmingly positive since the subprojects will be aimed at the overall economic and social improvement of the total population. The project will not cause physical displacement from traditional or customary lands, nor negatively impact the identity, culture, or customary livelihood system of ethnic minorities. REMDPs will ensure the inclusion of ethnic minorities and their access to project benefits. The REMDP also includes mitigation measures to address impacts on ethnic minorities, an institutional capacity development program, a grievance redress mechanism, and compliance with ADB information disclosure and consultation requirements.

125. Internal monitoring and progress reporting will be the responsibility of the PMUs. At the local level, the CISB will provide support for monitoring on a regular basis.

126. **Prohibited investment activities.** Pursuant to ADB’s Safeguard Policy Statement (2009), ADB funds may not be applied to the activities described on the ADB Prohibited Investment Activities List set forth at Appendix 5 of the Safeguard Policy Statement (2009).

D. Road Safety Dimensions

1. Road Safety Objectives and Strategy

127. The improvements in subproject roads to a smoother riding road quality, may encourage higher speeds, that may in turn increase rate and severity of crashes on these roads. In some rural areas, the paved roads may also change the road environment, as all vulnerable road users feel less safe with increased traffic speeds. For all subprojects, road safety assessments in line with government procedures will be made to minimize rate/severity of crashes over the long-term and to demonstrate good practice road safety interventions to the PMU.

2. Road Safety Action Plan (RSAP)

128. Experts from ADB technical assistance program will provide the following support to improve road safety related to the Output 1 subproject investments:

- (i) will hold training sessions in each of the four NCPs on incorporating road safety measures into subproject DEDs, including how to cost such measures. The trainees will include PMU road staff and local design consultants;
- (ii) upon request will review road subproject DEDs.

129. The PMUs will work with the Provincial and District Road Safety Committees and related entities at the Commune levels to coordinate and implement associated capacity building activities and to raise local awareness of road safety issues due to road improvements in their communities. Implementation of the RSAP will be overseen by the PMUs. Budget for all non-engineering road safety activities will be through counterpart funding.

130. All roads will at a minimum have appropriate traffic calming and control measures at all schools and kindergartens, health clinics and hospitals, market and high intensity traffic areas and administrative centres.

VIII. GENDER AND SOCIAL DIMENSIONS

A. Gender Objectives and Strategy

131. The project is classified as Effective Gender Mainstreaming (EGM). The objective of the GAP is to reduce inequalities between women and men associated with access to benefits and opportunities and social risks such as exposure to disease and road safety. A gender analysis revealed that women have fewer opportunities than men to participate in public decision making, and less access to information, training, and employment, especially during the low agricultural season. The agricultural value chain subprojects and enterprise values subprojects, are likely to enable women to participate and benefit in the improved economic opportunities associated with agriculture value chains and the road connections to markets. The design features of the GAP are (i) promotion of equality of project benefits and opportunity-sharing between men and women; (ii) reduction in gender inequalities and social risks such as HIV/AIDs transmission prevention, human trafficking prevention and road safety; (iii) training of women, including those from ethnic minorities on technical topics, including tourism service deliveries; (iv) increased representation of women in decision-making bodies and (v) collection of sex-disaggregated data for benefit monitoring and evaluation.

132. A Gender Action Plan has been developed that will also be applied at the subproject implementation level and will be the responsibility of the gender focal point in the PMU with support from a gender consultant in the loan implementation consultant team.

B. Budget and Implementation Arrangements

133. The GAP implementation budget is estimated [Financing Table] for operational costs plus the input from the gender LIC consultants. The four Provincial People's Committees (PPCs) will be the EAs and their Departments of Planning and Investment (DPIs) as project owners will be the implementing agencies (IAs) responsible for implementing and monitoring the GAP with support from the safeguards social/gender specialist. The PMUs will (i) assign a gender focal point and (ii) will incorporate GAP monitoring in their quarterly progress reports, (using the ADB GAP Progress Report template) to government and ADB. The PMUs will also assign a gender focal point among PMUs staff to be responsible for GAP implementation, monitoring and reporting to ADB. The IAs will recruit national gender consultant(s) (6 person-month inputs/province) to support PMUs in preparing GAPs for the additional subprojects, implementing and reporting on GAP implementation and capacity building for IAs on Gender mainstreaming.

134. The PMUs will work with the relevant provincial, district and commune agencies (Vietnam Women's Union, Agriculture extension agencies, Committee for Ethnic Minority Affairs and NGOs, etc.) to implement and coordinate training, capacity building, and HIV/AIDs awareness raising and road safety activities.

135. Implementation of GAP will be overseen by each Provincial Steering Committee. Budget for GAP implementation is provided through counterpart funding including training for capacity building and gender activities at subproject level.

Table 51: Gender Action Plan

Strategy	Activities and Targets	Responsibility
Output 1: Transport Infrastructure Improved		
Enhance women's participation in decision making.	<p>T.1.1. In all Community participation consultations during subproject DED preparation women will comprise at least 50% of the participants.</p> <p>A.1.1. Consultation meetings will be held at convenient times and venues for women.</p> <p>A.1.2. Women's groups and unions will be included in the consultation during subproject DED preparation.</p> <p>T.1.2. The subproject community supervision and monitoring committee, will consist of at least one female member.</p> <p>T.1.3. Community supervision and monitoring members, including women, will be trained for subproject monitoring.</p>	PMUs, design consultant, supervision consultant
Economic empowerment for women.	<p>A.1.5. Equal employment opportunities for female and male local people will be a provision included in contractors' contract.</p> <p>A.1.6. PMUs will monitor contractor compliance with gender related labor code items (equal pay for work of a similar value, providing protective gears to workers, prohibit use of child labors, etc.).</p>	PMUs, contractors, construction supervisor
Reduction in gender inequalities and social risks.	<p>A.1.7. Road safety measures: Traffic calming measures provided to all road sections passing schools, markets, medical facilities and administrative centers (2016 baseline 0).</p> <p>T.1.3. 25 training programs, (one for each road subproject) will be provided to vulnerable road users, targeting women and children, with female road users accounting for 50% among participants (2016 baseline 0).</p> <p>A.1.8. All road safety information and communication will be conducted in a gender sensitive manner and use gender inclusive language.</p> <p>A.1.9. Training and information dissemination will be prepared in ethnic languages for ethnic minority women as needed.</p> <p>T.1.4. At least 50% of the communication campaign's facilitators will be women.</p> <p>A.1.10. PMUs and mass organizations will conduct campaigns on traffic regulations and safety measures in 89 beneficiary communes (covering villages and schools through which the subproject roads pass) to raise awareness of road safety during construction and operation.</p> <p>A.1.11. HIV/AIDS prevention awareness raising program will be delivered by the contractors for their workers.</p>	PMUs, design consultant, contractors, local governments
Output 2: Productive infrastructure for business development improved		
Enhance women's access to benefit, participation in decision making,	<p>T.2.1. Two rural water supply schemes will be constructed providing connections to 10,100 households with 58,000 beneficiaries 50% being female receiving access to safe and clean water (2016 baseline 0).</p> <p>A.2.1. Women's groups will be consulted separately during subproject DED. Physical features integrated into designs of productive infrastructure that respond to women's needs as</p>	Contractors/ PMUs

Strategy	Activities and Targets	Responsibility
employment opportunity, and reduce social risks.	<p>expressed by them directly or women's groups in community consultations could include: female washroom and shower facilities; and or safe places for young children to stay while parents work.</p> <p>A.2.2. Physical gender design features in rural water supply schemes include at least female washroom and shower facilities, safe places for their children at public facilities.</p> <p>A.2.3. One dock upgraded to port type 1 standard. It will include washroom facilities dedicated for women's use. (2017 baseline: port type 3 standard).</p> <p>T.2.2 The subproject community supervision and monitoring committee, will consist of at least 35% female membership (default composition: at least 1 female member in the 3-member committee).</p> <p>T.2.3. Community supervision and monitoring members, including all women members trained for subproject community monitoring with at least 35% of trained participants being female.</p> <p>A.2.3.2. PMUs ensure that contractors comply with gender related labor code (such as ensuring equal pay for work of a similar value, providing protective gears to workers, forbid use of child labors, conduct HIV/AIDS awareness program for workers, etc.).</p> <p>A.2.4.3. Small-scale assessment conducted to assess impact of improved productive infrastructure supported by the project on gender relations and in women's lives done by June 2022.</p>	
Capacity building for gender mainstreaming		
	<p>T.4.1. PMU staff to be comprised of at least 20% female.¹⁸</p> <p>A.4.1. GAP briefing to be provided to PMU relevant staff (gender focal point, procurement, resettlement and safeguards, M&E, etc.).</p> <p>A.4.2. Project M&E include sex-disaggregated data collection and analysis for GAP and DMF gender related target.</p> <p>A.4.3. Gender consultant will be recruited to support GAP implementation at the beginning of project implementation.</p> <p>A.4.4. Gender focal point in PMUs will be responsible for ensuring GAP implementation.</p> <p>A.4.5. GAP reporting to ADB included as in the quarterly report.</p> <p>A.4.5. Marketing and technical or impact studies will be conducted taking gender perspective into consideration.</p>	PMUs

A = activity, DED = detailed design, DMF = design monitoring framework, EM = ethnic minority, GAP = gender action plan, M&E = monitoring and evaluation, PMU = project management unit, T = target

¹⁸ Current project preparatory technical assistance PMUs female staff account for between 15%-30% of the PMUs staff.

IX. PERFORMANCE MONITORING, EVALUATION, REPORTING, AND COMMUNICATION

A. Project Design and Monitoring Framework

Impact the Project is aligned with			
Socioeconomic development of Ha Tinh, Nghe An, Quang Binh, and Quang Tri Provinces accelerated (Provincial socioeconomic development plans through 2020 with a vision to 2030, National Target Program on new rural development, and the Master Plan on Socio-Economic Development of the Central Viet Nam's Northern and Coastal Region through 2020) ^a			
Results Chain	Performance Indicators with Targets and Baselines	Data Sources and Reporting Mechanisms	Risks
Outcome Service delivery in NCPs improved	By 2024 a. Average annual PCU increased by 7.7% and movement of goods ton-km increased by 6.3% on improved roads (2016 baselines: 0.71 million PCU and 3.1 ton-km) b. 10,100 households with 50% female beneficiaries, received clean water (2017 baseline: 0) c. 44 communes consisting of 17,600 ha protected from flood and sea level rise (2017 baseline: 0) d. Dock capacity increased to 17,000 tons of aquatic products per year (2017 baseline: 6,800 tons of aquatic products per year) e. Asset management data for provincially owned road and irrigation infrastructure integrated into annual provincial reports and development plans (2017 baseline: 0)	a. PPMS, government and public transport operator statistics b. PPMS, annual provincial public health reports c. PPMS, PPC annual reports d–e. Provincial annual reports and socioeconomic development plans	Premature asset deterioration due to: inadequate O&M, and, or climate change impacts Cost escalation and reduction in overall project scope due to delays caused by counterpart funding not available as required
Outputs 1. Transport infrastructure improved	By 2023 1a. About 214 km of district roads upgraded (2017 baseline: 0) 1b. Traffic-calming measures implemented in all 25 road sections passing schools, markets, medical facilities,	1a–c. PPMS and QPRs	Premature road deterioration due to narrow application of official Vietnamese traffic forecasting system and under-designed roads

Results Chain	Performance Indicators with Targets and Baselines	Data Sources and Reporting Mechanisms	Risks
2. Productive infrastructure for business development improved	<p>and administrative centers (2017 baseline: 0)</p> <p>1c. 25 training programs, one for each road subproject, provided to vulnerable road users on each of the road subprojects, targeting women and children, with female road users accounting for 50% of participants (2017 baseline 0)</p> <p>2a. Two rural domestic water supply schemes consisting of about 403 km of pipelines constructed (2017 baseline: 0)</p> <p>2b. About 27 km of dikes, embankments, and canals constructed (2017 baseline: 0)</p> <p>2c. At least one dock upgraded to port type 1 standard and included washroom facilities dedicated for women's use (2017 baseline: unclassified port type)</p> <p>2d. At least one water reservoir upgraded for irrigation and domestic consumption (2017 baseline: 0)</p>	2a–d. PPMS and QPRs	<p>Water resources for RDWS impacted due to climate change droughts and floods</p> <p>Subproject service standards and scope reduced due to weak financial management including user cost recovery systems</p>
3. Decentralized public asset management processes established	<p>3a. Asset planning system for road infrastructure established and populated in each NCP (2017 baseline: 0)</p> <p>3b. Water supply asset planning with supporting databases for business management reporting for two water supply schemes completed (2017 baseline: 0)</p> <p>3c. Decentralized irrigation infrastructure asset management systems</p>	3a–c. PPMS and QPRs	Weak financial management and procurement systems hamper effective asset management

Results Chain	Performance Indicators with Targets and Baselines	Data Sources and Reporting Mechanisms	Risks
	established in each NCP (2017 baseline: 0)		
<p>Key Activities with Milestones</p> <p>1. Transport infrastructure improved</p> <p>1.1 Prepare feasibility studies for four additional subprojects by March 2018 (PSD)</p> <p>1.2 Award contracts for representative subprojects by March 2019 (PSD)</p> <p>1.3 Award works contracts for additional priority subprojects by December 2019 (PSD)</p> <p>1.4 Prepare additional subproject DED using remaining funds by March 2020 (PSD)</p> <p>1.5 Award works contracts for final additional subprojects by December 2020 (PSD)</p> <p>1.6 Complete all construction by October 2022 (PSD)</p> <p>2. Productive infrastructure for business development improved</p> <p>2.1 Prepare feasibility studies for additional subprojects by March 2018 (PSD)</p> <p>2.2 Award works contracts for representative subprojects by March 2019 (PSD)</p> <p>2.3 Award works contracts for priority additional subprojects by December 2019 (PSD)</p> <p>2.4 Prepare additional subproject DED using remaining funds by March 2020 (PSD)</p> <p>2.5 Award works contracts for final additional subprojects by December 2020 (PSD)</p> <p>2.6 Complete all construction by October 2022 (PSD)</p> <p>2.7 Establish operation and maintenance capability by December 2022 (PSD)</p> <p>3. Decentralized public asset management processes established</p> <p>3.1 Implement road network asset planning systems by December 2022 (GCD)</p> <p>3.2 Implement rural water supply asset planning by December 2022 (GCD)</p> <p>3.3 Extend decentralized irrigation asset management by December 2022 (GCD)</p> <p>Project Management Activities</p> <p>Establish coordinating office and PMUs by January 2018</p> <p>Mobilize loan implementation consultants by March 2018</p> <p>Have PPMS functioning within 90 days of loan signing</p> <p>Inputs</p> <p>ADB ordinary capital resources</p> <p style="padding-left: 20px;">\$97.00 million (concessional loan)</p> <p style="padding-left: 20px;">\$52.00 million (regular loan)</p> <p>Government: \$54.52 million</p> <p>Assumptions for Partner Financing</p> <p>Not Applicable</p>			

ADB = Asian Development Bank, DED = detailed engineering design; GCD = governance and capacity development, ha = hectare, km = kilometer, NCP = north central province, PCU = passenger car unit, PMU = project management unit, PPC = provincial people's committee, PPMS = project performance monitoring system, PSD = private sector development, QPR = quarterly progress report.

^a Prime Minister. 2012. *Decision No.1786/QD-TTG dated 27 November 2012 approving the socio-economic development master plan of Ha Tinh province through 2020, with vision to 2050*. Hanoi; Prime Minister. 2011. *Decision No. 1600/QD-TTg Issuing the List of the National Target Programs—Phase 2016–2020*. Hanoi;

Prime Minister. 2015. *Decision No.620/QD-TTG dated 12 May 2015 approving the socio-economic development master plan of Nghe An province through 2020*. Hanoi;

Prime Minister. 2011. *Decision No.952/QD-TTG dated 23 June 2011 approving the socio-economic development master plan of Quang Binh province through 2020*. Hanoi;

Prime Minister. 2011. *Decision No.321/QD-TTG dated 02 March 2011 approving the socio-economic development master plan of Quang Tri province through 2020*. Hanoi;

Government of Viet Nam. *Official Gazette*. 2013. Decision No. 1114/ QD-TTg of July 9, 2013, Approving the Master Plan on Socio-Economic Development of the Central Viet Nam's Northern and Coastal Region through 2020. Hanoi.

Source: Asian Development Bank.

B. Monitoring

1. Project performance monitoring.

136. Project progress and performance will be based on the indicators and targets shown in the DMF. Five kinds of monitoring will be carried out including: (i) implementation progress monitoring; (ii) safeguard monitoring; (iii) benefit monitoring and evaluation; (iv) GAP monitoring; and (v) loan agreement covenant monitoring.

137. **Implementation progress monitoring** will be one of the main tasks of each PMU that will be supported by each PMU monitoring and evaluation specialist and will be based on the detailed work planning schedules – see Annex 4 for the proposed subproject and project management work planning template and the overall project implementation schedule. Collectively these will be consolidated into a provincial EA and Project wide PPMS.

138. The Provincial PPMS will be managed by the PMU who will maintain it and report updated progress on a quarterly basis. The consolidated project PPMS will be managed by the BIIG2 Coordination Unit attached to the Quang Tri Province.

139. The project performance monitoring system (PPMS) will monitor the progress of activities in the province. To augment information collected during the PPTA and the subproject feasibility studies will provide a baseline dataset for each subproject that will define (i) activities, (ii) the implementation timelines and milestones, (iii) outputs delivery progress, (iv) final output, and (v) contribution of each subproject output to the outcome indicators. The PPMS will not directly assess the contribution to the project impact. PPMS monitoring activities will entail periodic monitoring of the benefits and impacts of a representative number of selected subprojects as reported in quarterly reports. This will be undertaken by each PPC-PMU monitoring and evaluation staff member.

140. Each subproject will have a completion report prepared by the construction supervision consultant that will include details of (i) output completed, (ii) output still in progress, (iii) road user data and forecasts based on traffic counts after road completion and within 6 months of Project completion and the conversion of this data into PCU with a comparative assessment of measured PCU's and the those projected at subproject design and feasibility approval. For Water supply the number of connections, sale of water data will also be compared to design forecasts. The PMU staff will collate this into provincial level reports and the BIIG1 coordination unit will consolidate these into an overall Project Performance data base and reporting system that can be used for post evaluation purposes.

2. Compliance monitoring.

141. The government and EAs have agreed with ADB on certain covenants for the project, which are set forth in the loan agreement including the following:

- (i) The government will ensure that adequate funds are allocated for the periodic maintenance of infrastructure developed under the project through provincial budgets to maintain the infrastructure in functional order; and
- (ii) The government will ensure that a grievance redress mechanism established in RPs/REMDPs for affected people in the participating districts will be implemented effectively and satisfactorily.

142. ADB will monitor compliance with all covenants throughout implementation via regular review missions, quarterly progress reports submitted by the PMUs through the Secretariat, and review of project accounts and procurement procedures.

143. Safeguards monitoring. Safeguards monitoring with associated grievance redress mechanisms will be developed to ensure that the required policies, procedures and plans for: (i) resettlement including land acquisition and compensation; (ii) ethnic minority people specific actions are implemented and achieve their expected outcomes during subproject preparation, implementation and operation; and (iii) EMP plan implementation.

3. Gender and social dimensions monitoring.

144. PMUs will report to ADB regularly. Data will be disaggregated by sex and where sensible¹⁹ ethnic minorities. Routine monitoring by the Project will focus on assessing progress against GAP targets, identifying constraints and developing remedial actions to effectively address these. Monitoring results will be included in at least every second quarterly progress reports, and assessment/evaluations of the GAP will be an essential element of all reviews.

4. Road Safety Monitoring

145. The implementation of the road safety awareness plan and the implementation of the measures will be reported in the detailed design documentation and quarterly progress reports.

C. Evaluation

146. ADB will conduct regular (at least twice per year) reviews throughout implementation of the project to assess implementation performance and achievement of outcomes and objectives, examine financial progress, and identify issues and constraints affecting the project and work out time-bound action plans for their resolution.

147. A midterm review will also be undertaken from 18 months to 24 months from loan effectiveness. This review will include a comprehensive evaluation of project implementation arrangements, detailed evaluation of the scope and implementation process and progress of subprojects, feedback from the PPMS, performance of consultants, and possible reallocation of loan proceeds. During this more significant review, the effectiveness of project management arrangements will be a priority with remedial action will be instituted as required.

148. Within 12 months of physical completion of the project, ADB will conduct a project completion mission to carry out a preliminary assessment of the success of the Project to achieve its physical, and socio-economic developmental objectives, as well as to review compliance with ADB requirements and loan covenants.

D. Reporting

1. Provincial Work Planning and Reporting

149. Reporting will be directly linked to the physical implementation progress of project annual work plans, budgets and forecasts of contract awards and disbursements. Work planning will be

¹⁹ Where Ethnic minorities account for more than 85% of the population the need to disaggregated is significantly reduced

developed by each PMU no later than 45 days prior to the end of the fiscal year with a mid-year update no later than 30 days after mid-year. The work plans will be developed for each individual subproject with the first annual work plan within 45 days of Project start up. Draft work plans will be developed prior to loan signing to enable preparation of advance funds to be planned and approved. A draft structure for subproject physical planning is included in Annex 4 and will be linked into the ADB (Viet Nam Resident Mission PDIP excel work book) after loan negotiations. The individual subproject work plans will be consolidated and linked to the budgets for ADB and Government Funds in separate projections. Both the work plan and projections will be based on a life of project approach with progress reported against these and modifications and adaptation to plans made on an as needed basis but no less than six monthly. The Project Director is solely responsible for ensuring work plans and forecast are developed and maintained on this time line. In addition to the subproject work plan each PMU will also derived a project procurement and contract award schedule. The information for this schedule will be derived from the subproject workplan schedule and will develop a procurement and contract award reporting worksheet that clearly identifies progress against plans and highlights on a quarterly basis any deviation from planned schedule timelines where the deviation exceeds one month and formal PMU statement on the cause and management response to address the delay is required.

150. The PMU Project Director will also ensure that the overall progress of the project implementation and management are clearly scheduled including activities such as Safeguard monitoring reports, compliance reporting, land acquisition and compensation achievement and the achievement of outputs and how these are contributing to the project DMF indicators – see Table 22 below. As such this will require each PMU to establish a Project Performance Management System that disaggregates technical, social and financial data within each subproject and captures (i) baselines data from the feasibility study surveys, (ii) data on technical, safeguards and social from the detailed design stage, (iii) subproject outputs and the effects on the number of beneficiaries, the nature of impacts etc. The different outputs require significantly different data sets that will need to be stored and accessible to the PMU for project completion reporting as well as implementation reporting. An indicative table of contents for the progress report is provided in Annex 5.

2. Project Level Work Planning and Reporting

151. As coordinating **Province the Quang Tri DPI/PMU** will provide ADB with (i) quarterly progress reports in a format consistent with ADB's project performance reporting system; (ii) consolidated annual reports including (a) progress achieved by output as measured through the indicator's performance targets, (b) key implementation issues and solutions, (c) updated procurement plan, and (d) updated implementation plan for the next 12 months; and (iii) a project completion report within 6 months of physical completion of the project. To ensure that projects will continue to be both viable and sustainable, project accounts and the executing agency audited financial statement together with the associated auditor's report, should be adequately reviewed.

152. Each Provincial DPI/PMU will ensure that the required information and milestones are achieved through a Memorandum of Understanding agreed between the four EA's that details the annual timing for the preparation and Provincial approval of:

- (i) Each Provinces annual implementation and work plans presented by subproject, output and for the overall province, including
 - a. supporting annual budgets in the form of financial forecasts that define budget and cashflow requirements by source of funding,

- b. annual projection of contract awards and
 - c. projected disbursements
- (ii) Timing of a joint provincial project performance and planning meeting supported by the BIIG2 co-ordination unit in Quang Tri that presents:
- a. A review of progress and achievement in the past year
 - b. An updated status of subproject preparatory work for submission to ADB and PPC for approvals
 - c. An updated procurement and contracting status
 - d. An updated implementation program for the following year including carry over activities that were not completed
 - e. Revised budget and financial projections by subproject, financial cashflows
 - f. Revised contract award and disbursement projections
 - g. The preparation of a consolidated work plan and financial projection for ADB 8 weeks prior to the end of each Project year, timing of a joint provincial project performance and planning meeting every three month, and planning update meeting within one month of the mid-year point that:
 - i. Review the consolidated quarterly report prepared by the BIIG2 coordination report
 - ii. Identifies outstanding implementation issues and challenges
 - iii. Identifies issues or bottlenecks that need to be addressed within or across the provinces
 - iv. Prepares a report for ADB and the respective PPCs

E. Stakeholder Communication Strategy

1. Consultation

153. The project is designed to improve the welfare of rural inhabitants in the four Project Provinces through a series of investments aimed to improve transport, socio-economic wellbeing and agricultural value chains.

154. Project preparation has been conducted with stakeholder agencies in the government at national, provincial and district levels including MPI, MOF, SBV and Ministry of Natural Resources and Environment (MONRE). Meetings have also been held in the participating provinces with DPI, DOT, DARD, DOIT and DOF officials, focusing on management arrangements and issues. Requirements for ensuring appropriate levels of consultation for subproject preparation and implementation have been reviewed and confirmed. Representative subproject preparation included consultation requirements involving documented evidence of inclusive consultation with all communities in the subproject area and participant information on numbers of women and men by ethnic minority. Subproject socio-economic/gender surveys that identify vulnerable groups to provide a basis for specific consultation and participation mechanisms will be followed during implementation.

155. During implementation, the process of consultation will continue throughout the process for preparing and approving FS for additional subprojects and the follow on DEDs for each subproject. The consultation seeks to provide community groups the opportunity to voice their views on how the subproject is to be designed, implemented and operated. In addition, associated initiatives will be built into the design of each subproject to enhance the inclusiveness of the

project activities from the perspective of social and economic integration of less well-off communities.

2. Participation

156. It is anticipated that the community will be mobilized in several different ways during subproject design, implementation and operation. During subproject design and preparation stages, community participation will consist primarily of their contribution through the consultation process, field survey and focus group discussions and direct consultation. During construction, there will be significant opportunities for active participation, particularly for the poor households who will benefit from the subproject through opportunities to participate in paid employment for unskilled workers and through the linkages to producers to value chain enterprises and markets. This will be encouraged through (i) the bidding documents which will require contractors to investigate the option of local employment whenever possible, and (ii) through the terms of reference for the value chain service provider, the criteria for accessing producer group and enterprise grants.

3. Awareness

157. Information about the project and the subprojects, including the objectives, potential environmental impact, implementation arrangements, resettlement and compensation matters, gender issues, issues of concerns for ethnic minorities will be provided to beneficiaries. Information will be provided through village meetings, pamphlets, and other announcements in both Vietnamese language and the language(s) of the communities whenever appropriate. The community will be fully informed of issues such as their right to participate in the subprojects and to be compensated for any loss of property including productive land and/or assets as well as gender equity and other relevant policies. Separate meetings and discussions will be arranged with the people who are directly affected by land acquisition and/or resettlement issues. The community and particularly the affected households will be provided with detailed guidance and procedures regarding resettlement and compensation.

158. An example of a subproject communication plan is incorporated in the table 52.

Table 52: Example of a Subproject Communication Strategy

Objective	Key Risks Challenges	Stakeholder Group	Messages	Means of Communication	Timeline	Responsibility	Resources
Disseminate information on project design, key impacts anticipated as well as any mitigation measures, to project APs and beneficiaries	Language/Culture Literacy Managing expectations, including that of establishment of farmer groups Reach of information, especially in isolated, remote areas Lack of confidence in local authorities	Subproject APs Community members (men & women in communes/villages) Women headed HH Poor HH, ethnic minority HH	Subproject design, key benefits, implementation arrangements and schedule of infrastructure investment for value chains development Main impacts of subproject (positive and negative) through disclosure Planned mitigation measures, especially for female APs (including compensation rates, entitlements, grievance redress mechanism)	Public information meetings Resettlement committee meetings in affected areas Printed information in language with simply sentences in order to easily understanding for EM and posted in accessible public areas Gender-sensitive IEC campaign, including community-level training and public media campaign Meetings, consultations and other interactions between PMUs/ communities/ farmer groups in the subproject area's service zones	Ongoing prior to implementation of activities Early in each phase of subproject preparation Subproject detailed design Ongoing during civil works Post evaluation after project completion	Primary: PMUs Contractors/ subcontractors for civil works Local authorities at commune-, ward-, city- and district-level (CPCs, and DPCs) VWU Secondary: PPCs DPI DARD	Costs will be covered in part by the RPs, GAPs as well as basic project implementation budgets under PMU Incremental Cost and Construction Supervision Contract Resettlement Specialist WSC/PMU Social Development & Safeguards Specialists Compensation and Resettlement Committees (CRCs) Community Supervision Boards (CSBs)
Deliver information on labor	Language/Culture	Community members as well as outsiders hired	Opportunities for appropriate skills training/upgrading	Public information meetings	Early in each phase of sub project	Primary: PMUs WSCs	Costs will be covered in part by the

Objective	Key Risks Challenges	Stakeholder Group	Messages	Means of Communication	Timeline	Responsibility	Resources
opportunities and good labor practices	Literacy and low levels of awareness	as semi-skilled and skilled construction workers, community mobilizers and IEC campaign facilitators in subproject areas Contractors/ subcontractors for civil works	during period of hire, with quotas reserved for women (GAP) Core labor standards, including no forced labor and child labor Gender parity in work related compensation, i.e., equal pay for equal work, for women and men, and the right to separate living & toilet facilities at work sites Schedule of civil works Labor safety regulations Risks and prevention of HIV/AIDS transmission and Human Trafficking	Printed information in local language(s) and language(s) of migrant workers (on pamphlets and billboards), posted in accessible public areas, especially at or near construction sites IEC campaign for HIV/AIDs and Human Trafficking, including community-level training and public media campaign	preparation Ongoing during civil works and conduct of IEC campaigns	Local authorities at commune-, ward-, city- and district-level VWU CHCs DPI Secondary: PPCs DOLISA	GAPs as well as basic project implementation budgets under PMU Incremental Cost and Construction Supervision Contract PMU Social Development & Safeguards Specialists CSBs Community health workers Health NGOs
Inform Provincial stakeholders about project design and entry points for their participation – community mobilization, and ensuring women’s access to all	Lack of sectoral capacity Relative lack of resources and decision making authority compared to other departments and agencies,	Vietnam Women’s Union (VWU)	Basic project design and anticipated impacts, as they matter to women Disseminate information on improved HH water management, sanitation and hygiene to communities in	Public information meetings IEC campaign (including materials) to raise awareness on links between gender and WASH issues Training materials	From outset of the project	VWU Local authorities at commune-, ward-, city- and district-level CHCs	Costs will be covered by the GAP budget PMU Director PMU Social Development & Safeguards Specialists CSBs Community

Objective	Key Risks Challenges	Stakeholder Group	Messages	Means of Communication	Timeline	Responsibility	Resources
project benefits			collaboration with Community Health Centers.	integrating gender			health workers
Inform network of Community Health Centers in project areas about project design and the role they are expected to play in disseminating information on improved WASH as well as HIV/AIDS causes & prevention	Relative lack of resources and decision making authority compared to other departments and agencies, including WSCs	Community Health Centers (and community health workers), Department of Health	Disseminate information on health benefits of improved water supply, sanitation and hygiene to communities in collaboration with VWC Design and propagate training module about HIV/AIDS	Public information meetings, IEC sanitation and hygiene awareness materials, including community based training and public media campaign HIV/AIDS training module	Early in each phase of sub project preparation Ongoing during civil works and conduct of IEC campaigns	VWU PMUs WSCs Local authorities at commune-, ward-, city- and district-level CHCs	Costs will be covered by the project implementation budget & Safeguards Specialists CSBs Community health workers
Promote community involvement in resettlement and project monitoring	Identifying valid community representatives Newly formed, slow to build up capacity required Functions vaguely defined	Community Supervision Boards (CSBs) Compensation and Resettlement Committees (CRCs)	Information on resettlement areas, affected households, resettlement plan and compensation policies Core labor standards integrating gender concerns and labor safety regulations Special consideration of community members from poor and/or	Meetings between WSCs/PMUs and CSBs and CRCs Public information meetings presided over by CSBs or CRCs Direct interactions between affected HHS and CSBs or CRCs Printed information in local	Early in each phase of sub project preparation Ongoing during civil works and conduct of IEC campaigns	VWU PMUs WSCs Local authorities at commune-, ward-, city- and district-level	Costs will be covered by the GAPs and basic project implementation (social development component) budgets PMU Social Development & Safeguards Specialists CSBs Community health workers

Objective	Key Risks Challenges	Stakeholder Group	Messages	Means of Communication	Timeline	Responsibility	Resources
			women-headed HHs in all aspects of the project Risks and prevention of HIV/AIDS transmission and Human Trafficking	language(s) posted in accessible public areas Gender-sensitive IEC campaign, including community-level training and public media campaign			
Ensure understanding of HIV/AIDS transmission and Human Trafficking risks, and prevention measures for both	Language/Culture Literacy and low levels of awareness	Communities in or near project area construction sites Workers on construction site	Key risks and mitigation measures of HIV/AIDS transmission and Human Trafficking	Public information meetings Printed information in local language(s) and language(s) of migrant workers (on pamphlets and billboards), posted in accessible public areas, especially at or near construction sites IEC campaign for HIV/AIDs and Human Trafficking, including community-level training and public media campaign	Prior to commencement of civil works and throughout civil works	PMUs VWU CHCs Civil works contractors/ subcontractors	Costs will be covered in part by the GAPs as well as basic project implementation budgets PMU Social Development & Safeguards Specialists CSBs Community health workers Local NGOs with a health focus

ADB=Asian Development Bank; PMU=Projects Management Board; Aps=Affected Persons; CSB=Community Supervision Board; CPC=Commune Peoples Committee; CWU=Commune Women's Union; DARD=Department of Agriculture & Rural Development; DOC=Department of Construction; DONRE=Department of Natural Resources & Environment; DOT=Department of Transport; DPI=Department of Plan and Investment DRCs=District Resettlement Committees; GAP=Gender Action Plan; IAs=Implementing Agencies; IPP=Indigenous Peoples Plan; PP=Project Proposal; O & M=Operation & Maintenance; PPC=Provincial People's Committee; RIs=Rural Infrastructure; RP=Resettlement Plan; VWU=Viet Nam Women's Union

Table 53: Consultation and Participation Plan

Topics/Subjects	Stakeholder Group	Why They are Included	Type of Participation		Participation Methods	
				Methods	Responsibility	Time line Cost
REMDP	Women, poor and vulnerable households, ethnic minority groups near project sites.	Representing interests of women and ethnic groups.	Information sharing (M), Collaboration (M)	Separate meetings with ethnic groups in local language and ii) meetings with women organized through VWU. Printed information about infrastructure and training programs available in local and accessible language (or visual depictions) posted in accessible public areas. Designation and provision of materials/toolkit to women's groups and disseminating information about work and training opportunities from the project.		Included in R-EMDP cost
GENDER EQUALITY	Beneficiary communities and villages, poor and vulnerable households and ethnic groups, with 50% representation of women	Direct beneficiaries of project; participants in value chains and water supply schemes to ensure awareness of negative impacts (land acquisitions, resettlement, compensation policy),	Information sharing (M), consultation (M), Collaboration) (M)	Information: Community meetings and dissemination of information brochures on project scope, design elements, participation mechanisms, and entitlements for person affected by		During detail design of infrastructure subprojects and throughout project implementation. Included in GAP budget

Topics/Subjects	Stakeholder Group	Why They are Included	Type of Participation		Participation Methods	
				Methods	Responsibility	Time line Cost
		implementation plan (to reduce inconveniences) and social risk reduction.		involuntary resettlement impacts. Consultation through village meetings and focus group discussions on measures to enhance benefits and mitigate risks. Decisions: Community members determine participation and guidelines for women's groups with support from village leaders and mass organizations to ensure they are inclusive, with representatives of ethnic groups, women and other subgroups		
SOCIAL RISKS	Mass Organizations (e.g. Vietnam Women's Union, etc.)	Representing interests of women and ethnic groups.	Information sharing (High)	Project management and Implementation: Direct consultations and participation in project implementation through collaboration with PMU and representation on provincial steering committee.	Monitoring: Representation on provincial steering committees and district / commune level committees.	During detailed design of subprojects and throughout project implementation. Included in GAP budget

Topics/Subjects	Stakeholder Group	Why They are Included	Type of Participation		Participation Methods	
				Methods	Responsibility	Time line Cost
				Strategic Decision-Making: Contribute to decisions on destination management and GAP and consultation plan implementation.		
Project Design, Implementation, Monitoring	Provincial and District Government	Representatives of government are responsible for project implementation, and representing provincial and district interests.	Partnership (H) (H) (Information sharing) (H)	Approvals: Review and approve annual work plan and budgets, safeguard documents, civil works design, and site management contracts or concessions.	PMU	During detailed design of subprojects and throughout project PMU cost
	Government Departments on National and Subregional Steering Committee.	Setting policy and guidelines and coordination and approvals.	Information Sharing, (H) Collaboration (Medium)	Policy Guidance and Approvals: Semiannual meetings of the national project steering committee provide direction on project implementation matters. Review periodic progress reports and safeguards reports.	PMU	At least two meetings of each committee per year. PMU management cost

X. ANTICORRUPTION POLICY

159. ADB reserves the right to investigate, directly or through its agents, any violations of the Anticorruption Policy relating to the project.²⁰ All contracts financed by ADB shall include provisions specifying the right of ADB to audit and examine the records and accounts of the executing agency and all project contractors, suppliers, consultants, and other service providers. Individuals and/or entities on ADB's anticorruption debarment list are ineligible to participate in ADB-financed activity and may not be awarded any contracts under the project.

160. To support these efforts, relevant provisions are included in the loan agreement and the bidding documents for the project. All contracts financed by ADB shall include provisions specifying the right of ADB to audit and examine the records and accounts of the EAs, as well as all contractors, suppliers, consultants, and other service providers as they relate to the Project. Individuals/ entities on ADB's anticorruption debarment list are ineligible to participate in ADB- financed activity and may not be awarded any contracts under the project.³⁸

161. The project design and implementation arrangements provide for mitigation of corruption risks. Risks associated with project management, including procurement and disbursement, will be mitigated by the engagement of LIC to advise and assist in the procurement of goods and services, and the engagement of other consultants. The overall project will establish and operate a website in which it will disclose implementation progress; bid notifications and their results; and provide grievance redress mechanism against any corrupt practice. References on ADB's Anticorruption Policy can be accessed through the following link: <http://www.adb.org/Integrity/>.

²⁰ Anticorruption Policy: <http://www.adb.org/Documents/Policies/Anticorruption-Integrity/Policies-Strategies.pdf>

XI. ACCOUNTABILITY MECHANISM

162. People who are, or may in the future be, adversely affected by the project may submit complaints to ADB's Accountability Mechanism. The Accountability Mechanism provides an independent forum and process whereby people adversely affected by ADB-assisted projects can voice, and seek a resolution of their problems, as well as report alleged violations of ADB's operational policies and procedures. Before submitting a complaint to the Accountability Mechanism, affected people should make an effort in good faith to solve their problems by working with the concerned ADB operations department. Only after doing that, and if they are still dissatisfied, should they approach the Accountability Mechanism.²¹

²¹ Accountability Mechanism. <http://www.adb.org/Accountability-Mechanism/default.asp>.

XII. RECORD OF CHANGES TO THE PROJECT ADMINISTRATION MANUAL

163. All revisions and/or updates during implementation should be retained in this section to provide a chronological history of changes to implemented arrangements recorded in the PAM, including revision to contract awards and disbursement s-curves.

ANNEX

A. Annex 1: Procurement Plan

Basic Data

Project Name: Basic Infrastructure for Inclusive Growth in the North Central Provinces Sector project	
Project Number: 49026-003	Approval Number:
Country: Socialist Republic of Viet Nam	Executing Agency: Provincial People's Committee of Ha Tinh Provincial People's Committee of Nghe An Provincial People's Committee of Quang Binh Provincial People's Committee of Quang Tri
Project Procurement Classification: B	Implementing Agency: Provincial Department of Planning and Investment of Ha Tinh Provincial Department of Planning and Investment of Nghe An Provincial Department of Planning and Investment of Quang Binh Provincial Department of Planning and Investment of Quang Tri
Project Procurement risk: High	
Project Financing Amount: US\$ 203.5 million ADB Financing: US\$ 149.0 million Co-financing (ADB Administered): Non-ADB Financing: US\$ 54.5 million	Project Closing Date: 30 /09/2023
Date of First Procurement Plan: 31/10/2017	Date of this Procurement Plan: 31/10/2017

A. Methods, Thresholds, Review and 18-Month Procurement Plan

1. Procurement and Consulting Methods and Thresholds

164. Except as the Asian Development Bank (ADB) may otherwise agree, the following process thresholds shall apply to procurement of goods and works.

Procurement of Goods and Works		
Method	Threshold	Comments
International Competitive Bidding (ICB) for Works	\$10,000,000	Prior review for all contracts
International Competitive Bidding for Goods	\$2,000,000 and above	Prior review for all contracts
National Competitive Bidding (NCB) for Works	Beneath that stated for ICB, Works	Prior review for 1 st contract implemented by each IA
National Competitive Bidding for Goods	Beneath that stated for ICB, Goods	Prior review for 1 st contract implemented by each IA
Shopping for Works	Below \$100,000	Prior review for 1 st contract implemented by each IA
Shopping for Goods	Below \$100,000	Prior review for 1 st contract implemented by each IA

Consulting services	
Method	Comments
Quality and Cost Based Selection (QCBS)	Prior review for all contracts
Fixed Budget Selection	Prior review for all contracts

2. Goods and Works Contracts Estimated to Cost \$1 Million or More

165. The following table lists goods and works contracts for which the procurement activity is either ongoing or expected to commence within the next 18 months.

Package Number	General Description	Estimated Value	Procurement Method	Review [Prior / Post/Post (Sampling)]	Bidding Procedure	Advertisement Date (quarter/year)	Comments
Quang Tri Province							
QT01	Upgrade of Cam Lo and Gio Linh district road (Km0-Km23+300) and construction of 04 new bridges: (i) Slab beam bridge at Km11+882.07; (ii) Slab beam bridge at Km17+153.19; (iii) Slab beam bridge at km18 + 347.64; (iv) Bridge at Hieu river at Km21+208.88)	10,000,000	NCB	Prior	1S1E	Q2/2018	Pre-qualification of Bidders: No Domestic Preference Applicable: No Bidding document: Harmonized Standard Bidding Documents for NCB works issued by ADB
QT02	Construction of Hung Vuong Road connecting with East-West Economic Corridor and East-south EZ of Quang Tri province	5,059,000	NCB	Post	1S1E	Q2/2018	Pre-qualification of Bidders: No Domestic Preference Applicable: No Bidding document: Harmonized Standard Bidding Documents for NCB works issued by ADB

Package Number	General Description	Estimated Value	Procurement Method	Review [Prior / Post/Post (Sampling)]	Bidding Procedure	Advertisement Date (quarter/year)	Comments
QT03	Construction of Road connecting Cua Viet port with Eastern communes of Trieu Phong – Hai Lang districts and the center of East-South EZ	6,186,000	NCB	Post	1S1E	Q2/2018	Pre-qualification of Bidders: No Domestic Preference Applicable: No Bidding document: Harmonized Standard Bidding Documents for NCB works issued by ADB
QT04	Construction of Cua Tung – Cua Viet Tourism Service Infrastructure	4,967,000	NCB	Post	1S1E	Q2/2018	Pre-qualification of Bidders: No Domestic Preference Applicable: No Bidding document: Harmonized Standard Bidding Documents for NCB works issued by ADB
QT05	Construction of Khe Van Road (Huong Hiep commune, Dakrong district) to Huong Linh commune, Huong Hoa district, Quang Tri Province	4,825,000	NCB	Post	1S1E	Q3/2018	Pre-qualification of Bidders: No Domestic Preference Applicable: No Bidding document: Harmonized Standard Bidding Documents for NCB works

Package Number	General Description	Estimated Value	Procurement Method	Review [Prior / Post/Post (Sampling)]	Bidding Procedure	Advertisement Date (quarter/year)	Comments
							issued by ADB
QT06	Construction of Inundation prevention system of Thuan-Trach – Trung-Tai, Ba Que, Vinh-Duong-Thanh communes in Trieu Phong and Hai Lang districts	5,246,000	NCB	Post	1S1E	Q3/2018	Pre-qualification of Bidders: No Domestic Preference Applicable: No Bidding document: Harmonized Standard Bidding Documents for NCB works issued by ADB
Quang Binh Province							
QB01	Construction of three tourism road sections with total length of 17.5 km: (i) Bao Ninh - Hai Ninh road (10.6 km); (ii) An-Son Road (3.2 km) and new bridge at 3 + 94.66km; (iii) Ngu Thuy Bac road (3.7 km)	6,488,500	NCB	Prior	1S1E	Q4/2018	Pre-qualification of Bidders: No Domestic Preference Applicable: No Bidding document: Harmonized Standard Bidding Documents for NCB works issued by ADB
QB02	Construction of Road from South Quang Hai Bridge to Lac Giao	5,561,630	NCB	Post	1S1E	Q4/2018	Pre-qualification of Bidders: No Domestic Preference Applicable: No Bidding document: Harmonized Standard Bidding Documents for NCB

Package Number	General Description	Estimated Value	Procurement Method	Review [Prior / Post/Post (Sampling)]	Bidding Procedure	Advertisement Date (quarter/year)	Comments
							works issued by ADB
QB03	Construction of Road connecting from National Highway 1A bypass with Eastern Branch of Ho Chi Minh Road	4,952,653	NCB	Post	1S1E	Q1/2019	Pre-qualification of Bidders: No Domestic Preference Applicable: No Bidding document: Harmonized Standard Bidding Documents for NCB works issued by ADB
QB04	Construction of Dinh Muoi Tourism Road, Quang Binh District	3,579,722	NCB	Post	1S1E	Q1/2019	Pre-qualification of Bidders: No Domestic Preference Applicable: No Bidding document: Harmonized Standard Bidding Documents for NCB works issued by ADB
QB05	Construction of Road from Loc Ninh commune to Tay Bac Industrial Zone in Dong Hoi City	5,061,148	NCB	Post	1S1E	Q1/2019	Pre-qualification of Bidders: No Domestic Preference Applicable: No Bidding document: Harmonized Standard Bidding Documents

Package Number	General Description	Estimated Value	Procurement Method	Review [Prior / Post/Post (Sampling)]	Bidding Procedure	Advertisement Date (quarter/year)	Comments
							for NCB works issued by ADB
QB06	Upgrading irrigation and flood drainage system of Kenh Kia river, Ba Don town area and Quang Trich district	3,691,163	NCB	Post	1S1E	Q4/2018	Pre-qualification of Bidders: No Domestic Preference Applicable: No Bidding document: Harmonized Standard Bidding Documents for NCB works issued by ADB
QB07	Upgrading and expansion of Gianh river fishing port, Bo Trach district	3,918,682	NCB	Post	1S1E	Q1/2019	Pre-qualification of Bidders: No Domestic Preference Applicable: No Bidding document: Harmonized Standard Bidding Documents for NCB works issued by ADB
Ha Tinh Province							
HT01	Construction of two water supply system and auxiliary works for 7 communes in Loc Ha district and 2 communes in Can Loc district: (i) Thach Ha	6,947,200	NCB	Prior	1S1E	Q3/2018	Pre-qualification of Bidders: No Domestic Preference Applicable: No Bidding document: Harmonize

Package Number	General Description	Estimated Value	Procurement Method	Review [Prior / Post/Post (Sampling)]	Bidding Procedure	Advertisement Date (quarter/year)	Comments
	booster station and Network 1 (Southern Network) (ii) Treatment plant at Cu Lay reservoir and Network 2 (Northern Network).						d Standard Bidding Documents for NCB works issued by ADB
Nghe An Provinces							
NA01	Construction of Anh Son district road (DR349) with total length of 8km and 2 new bridges: (i) Dong Dau at 2 + 108.26 km; (ii) Khe San at 5 + 826.03 km	5,195,000	NCB	Prior	1S1E	Q2/2018	Pre-qualification of Bidders: No Domestic Preference Applicable: No Bidding document: Harmonized Standard Bidding Documents for NCB works issued by ADB
NA02	Upgrading Mo River Dyke in Quynh Luu district, Phuc Tho Dyke in Nghi Loc district and Hieu River embankment in Quy Chau District	9,026,000	NCB	Post	1S1E	Q4/2018	Pre-qualification of Bidders: No Domestic Preference Applicable: No Bidding document: Harmonized Standard Bidding Documents for NCB works issued by ADB

3. Consulting Services Contracts Estimated to Cost \$100,000 or More

166. The following table lists consulting services contracts for which the recruitment activity is either ongoing or expected to commence within the next 18 months.

Package Number	General Description	Estimated Value	Recruitment Method	Review (Prior / Post)	Advertisement Date (quarter/year)	Type of Proposal	Comments
Quang Tri Province							
CS01-Audit	Project audit	213,600	FBS	Prior	Q2/2018	BTP	Assignment: National Comments: (i) This includes project audit for Quang Tri, Quang Binh, Ha Tinh and Nghe An; and (ii) Quang Tri will recruit the auditor on behalf of other three provinces.
QTCS	Supervision of Construction works	547,000	QCBS	Prior	Q2 / 2018	STP (70:30)	Assignment: National Comments: Time-based contract
Quang Binh Province							
QBCS	Supervision of Construction works	675,500	QCBS	Prior	Q2 / 2018	STP (70:30)	Assignment: National Comments: Time-based contract
Ha Tinh Province							
HTCS	Supervision of Construction works	792,000	QCBS	Prior	Q2 / 2018	STP (70:30)	Assignment: National Comments: Time-based contract
Nghe An Province							
NACS	Supervision of Construction works	776,000	QCBS	Prior	Q2 / 2018	STP (70:30)	Assignment: National Comments: Time-based contract

4. Goods and Works Contracts Estimated to Cost Less than \$1 Million and Consulting Services Contracts Less than \$100,000 (Smaller Value Contracts)

Goods and Works								
Package Number	General Description	Estimated Value	Number of Contracts	Procurement Method	Review [Prior / Post/Post (Sampling)]	Bidding Procedure	Advertisement Date (quarter/year)	Comments

Consulting Services								
Package Number	General Description	Estimated Value	Number of Contracts	Recruitment Method	Review (Prior / Post)	Advertisement Date (quarter/year)	Type of Proposal	Comments

167. The following table groups smaller-value goods, works and consulting services contracts for which the activity is either ongoing or expected to commence within the next 18 months.

B. Indicative List of Packages Required Under the Project

168. The following table provides an indicative list of goods, works and consulting services contracts over the life of the project, other than those mentioned in previous sections (i.e., those expected beyond the current period).

Goods and Works							
Package Number	General Description	Estimated Value (cumulative)	Estimated Number of Contracts	Procurement Method	Review [Prior / Post/Post (Sampling)]	Bidding Procedure	Comments
Ha Tinh Province – Additional subproject(s)							
	Civil works package(s) for output 1 – road subproject(s)	34,651,300	8	NCB	Post	1S1E	(i) One package for each subproject (ii) Multiple contracts may be considered.
	Civil works package(s) for output 2 – water supply subproject(s)	4,495,000	2	NCB	Post	1S1E	(i) One package for each subproject (ii) Multiple contracts may be considered.
Nghe An Province – Additional subproject(s)							
	Civil works package(s) for output 1 –	24,451,000	5	NCB	Post	1S1E	(i) One package for each subproject

	road subproject(s)						(ii) Multiple contracts may be considered.
	Civil works package(s) for output 2 – water supply subproject(s)	4,546,000	1	NCB	Post	1S1E	(i) One package for each subproject (iii) Multiple contracts may be considered.

Consulting Services						
Package Number	General Description	Estimated Value (USD)	Recruitment Method	Review (Prior/Post)	Type of Proposal	Comments

C. Non-ADB Financing

169. The following table lists goods, works and consulting services contracts over the life of the project, financed by Non-ADB sources.

Goods and Works				
General Description	Estimated Value (cumulative)	Estimated Number of Contracts	Procurement Method	Comments
Pubic Asset Management	2,000,000	8	National Procedures	Advertisement date: Q2/2019 Financed by Government

Consulting Services				
General Description	Estimated Value (cumulative)	Estimated Number of Contracts	Recruitment Method	Comments
Loan Implementation Consultant	2,000,000	4	National Procedures	Advertisement date: Q4/2017 Financed by Government
Road Safety Awareness Training	300,000	12	National Procedures	Advertisement date: Q2/2019 Financed by Government

D. National Competitive Bidding

1. General

170. The procedures to be followed for the procurement of goods, non-consulting services, and works under contracts awarded on the basis of National Competitive Bidding shall be

those set forth in: (a) Law on Procurement No. 43/2013/QH13 dated November 26, 2013 ("Law on Procurement") and (b) Decree No.63/2014/ND-CP dated June 26, 2014 (collectively, "National Procurement Laws"). Whenever any procedure in the National Procurement Laws is inconsistent with the ADB Procurement Guidelines (March 2013, as amended from time to time), the ADB Procurement Guidelines shall prevail, amongst others on the following.

2. Eligibility

171. The eligibility of bidders shall be defined under section I of the ADB Procurement Guidelines; accordingly, no bidder or potential bidder should be declared ineligible for reasons other than those provided in section I of the ADB Procurement Guidelines, as amended from time to time. Conditions of bidders' participation shall be limited to those that are essential to ensure bidders' capability to fulfil the contract in question. Foreign bidders shall be eligible to participate under the same conditions as national bidders. Foreign bidders shall not be asked or required to form joint ventures with, or be subcontractors to, national bidders to submit a bid.

172. A firm declared ineligible by ADB cannot participate in bidding for an ADB-financed contract during the period determined by ADB.

173. A bidder shall not have a conflict of interest, which term shall be defined in accordance with section 1 of ADB Procurement Guidelines.1 Any bidder found to have a conflict of interest shall be ineligible for contract award.

174. Government-owned enterprises in the Borrower's country shall be eligible to participate as a bidder only if they can establish that they are legally and financially autonomous, operate under commercial law and are not dependent agencies of the Borrower or Sub-Borrower. National sanction lists may only be applied with approval of ADB.

3. Preference

175. No preference of any kind shall be given to domestic bidders over foreign bidders or for domestically manufactured goods over foreign manufactured goods. Unless otherwise stated in the applicable financing agreement, preferences among domestic bidders set forth in Article 14(3) of the Law on Procurement shall not be applied.

4. Bidding Procedure

176. Single stage-single envelope shall be the default bidding procedure and application of other bidding procedures shall require ADB's prior approval.

5. Time for Bid Preparation

177. The time allowed for the preparation and submission of bids for large and/or complex packages shall not be less than thirty (30) days from the date of the invitation to bid or the date of availability of the bidding documents, whichever is later.

6. Standard bidding documents

178. The Borrower's standard bidding documents, acceptable to ADB, shall be used. Bidders shall be allowed to submit bids by hand or by mail/ courier.

7. Bid Opening and Evaluation

- (i) Bids shall be opened in public, immediately after the deadline for submission of bids, regardless of the number of bids received.
- (ii) Except with prior approval of ADB, merit points shall not be used in bid evaluation.
- (iii) No price adjustments shall be made for evaluation purposes in accordance with Article 117(6) of Decree 63 when unit rates offered by the bidder are determined to be abnormally low.
- (iv) Bidders shall be given commercially reasonable time period to respond to clarification requests.
- (v) Bidders shall not be eliminated from detailed evaluation on the basis of minor, non-substantial deviations³.
- (vi) Except with the prior approval of ADB, negotiations contemplated under paragraphs 7 and 8 of Article 117 of Decree No. 63/2014/ND-CP shall not take place with any bidder prior to contract award.
- (vii) A bidder shall not be required, as a condition for award of contract, to undertake obligations not specified in the bidding documents or otherwise to modify the bid as originally submitted.

8. Rejection of All Bids and Rebidding

- (i) No bid shall be rejected on the basis of a comparison with the Procuring Entity's estimate or budget ceiling without ADB's prior concurrence.
- (ii) All bids shall not be rejected and new bids solicited without ADB's prior approval.

9. Publication of the Award of Contract and Debriefing.

- (i) For contracts subject to prior review, within 2 weeks of receiving ADB's "No—objection to the recommendation of contract award, the borrower shall publish in the Government Public Procurement Gazette, or well-known and freely-accessible website the results of the bid evaluation, identifying the bid and lot numbers, and providing information on: i) name of each bidder who submitted a bid; ii) bid prices as read out at bid opening; iii) name and evaluated prices of each bid that was evaluated; iv) name of bidders whose bids were rejected and the reasons for their rejection; and v) name of the winning bidder, and the price it offered, as well as the duration and summary scope of the contract awarded.
- (ii) For contracts subject to post review, the procuring entity shall publish the bid evaluation results no later than the date of contract award.
- (iii) In the publication of the bid evaluation results, the Borrower shall specify that any bidder who wishes to ascertain the grounds on which its bid was not selected, may request an explanation from the Borrower. The Borrower shall promptly provide an explanation of why such bid was not selected, either in writing and/or in a debriefing meeting, at the option of the Borrower. The requesting bidder shall bear all the costs of attending such a debriefing.

10. Contract Administration

179. The Contract Agreement, as such term is defined in the relevant bidding document, shall be applied without any modification during implementation except as otherwise agreed by ADB.

11. Fraud and Corruption

180. A provision shall be included in all bidding documents for NCB works and goods contracts financed by ADB stating that ADB will sanction a party or its related parties, including declaring ineligible, either indefinitely or for a stated period of time, to participate in ADB-financed, administered or supported activities if it at any time determines that the party

has, directly or indirectly through an agent, engaged in integrity violations as defined under ADB's Integrity Principles and Guidelines, including corrupt, fraudulent, collusive, or coercive practices in competing for, or in executing, an ADB-financed, administered or supported contract.

12. Right to Inspect/ Audit

181. Each bidding document and contract financed by ADB shall include a provision requiring bidders, contractors, agents (whether declared or not), sub-contractors, sub-consultants, service providers, or suppliers and any personnel thereof, to permit ADB to inspect all accounts, records and other documents relating to any prequalification process, bid submission, and contract performance (in the case of award), and to have them audited by auditors appointed by ADB.

B. Annex 2: Consultant's Draft Terms of Reference

1. Loan Implementation Consultant

a. Infrastructure Engineer (40 person months per province) – team leader

182. The Infrastructure Engineer position may be divided into two positions one for roads (20 PM) and one for water supply (20 PM), of which one of the engineers will be the team leader. The infrastructure engineer will provide implementation support and coordinate the other specialists' inputs under the project. The position requires infrastructure engineer qualification and experience to provide technical input to the PMU decision making regarding the approvals for procurement, contracting, and supervision of works contracts. The specialist will report to the Project Director and the Deputy Directors and will be based in the Project Management Unit (PMU) and will provide leadership of the LIC team and ensure the day to day management of the LIC responds to work plans agreed by the PMU.

183. The Infrastructure Engineer will hold a tertiary qualification, preferably with a post graduate degree in transport, civil and agricultural engineering. The specialist will be familiar with working in multinational donor projects.

184. They will have a minimum of 10 years' experience in rural infrastructure development that must include road and water supply construction. Ideally the candidate will have experience both within the project provinces and in Team Leadership.

185. Duties of the specialist include to act as the LIC Team Leader in its management and technical duties including:

- (i) Support project quality assurance regime for the road and water supply subprojects;
- (ii) Provide a technical review of proposed road and water supply designs in subproject investment reports and investment studies prepared by consultants in participating provinces;
- (iii) Support the provincial roads and water supply specialists in briefing consulting engineers engaged to prepare subproject investment reports and investment studies on the proposed changes and explain the reasons for these changes;
- (iv) Prepare construction supervision quality control guidelines to be followed by the provincial consultants appointed to carry out this task. This shall specifically address the quality control of materials and the construction processes;
- (v) Provide technical review for all road and water supply subproject investment reports and investment studies and provide recommendations;
- (vi) Assist the PMU in the scheduling and planning of project implementation;
- (vii) Provide technical support and input to procurement, contracting, disbursement and liquidation of expenditures following ADB procedures;
- (viii) Assist in the design, planning and supervision of the monitoring of implementation safeguards and benefits;
- (ix) Ensure that baseline surveys and quarterly reports are carried out to obtain the necessary information to measure and report implementation performance.
- (x) Ensure that appropriate levels of community participation are undertaken in the detailed design activities;
- (xi) Supervise the training consultants and ensure that the training program is properly prepared and implemented;
- (xii) Ensure that the safeguard studies are undertaken for each of the subprojects and assist in preparing RPs/REMDPs for new sub-projects and updating REMDPs to submit to ADB for review and approval before implementation;
- (xiii) Assist the PMU by reviewing and overseeing the input of the construction supervision consultants as and when required;

- (xiv) Bring safeguard issues identified by other consultants, SOs or the monitoring teams to the attention of the PMU, accompanied by recommendations for action;
- (xv) Assist the PMU to develop the information for their preparation of the project completion report.

b. Social Safeguard Specialist (10 pm per province):

186. The safeguard requirements of ADB seek to ensure the poor and other disadvantaged groups within the target area access project benefits. This will require specialist expertise in identifying affected groups characteristics and needs and accommodating these needs wherever feasible. Given the large proportion of ethnic minorities among the target population, measures will need to be taken to ensure these groups benefit from project interventions. The specialists will support project initiatives in community development including gender and indigenous peoples' activities.

187. The specialist will assist the PMUs in developing and implementing initiatives to assure that benefits are shared by all disadvantaged groups including the ethnic minorities. In addition, there is scope to develop other associated initiatives that will target women, the poor and ethnic groups that require further definition during preparation of subprojects for funding under the proposed Project. The specialist will have tertiary qualifications from a recognized institution with preferably 10 years of experience in related fields on internationally funded projects.

188. The specialist needs to work closely with the respective PMU and other stakeholders to ensure implementation of the project social safeguards will comply with ADB safeguard policy statement 2009 and relevant regulations of the government. Duties of the specialists will include the following:

- (i) Review the Poverty and Social Assessment, REMDP's, REMDF and the PAM to ascertain the nature and extent of interventions considered appropriate under the project;
- (ii) Review/ascertain changes or updates to ADB and Government policies on ethnic minorities and resettlement as set out in the PAM;
- (iii) Prepare and deliver workshops on social safeguards to ensure sound understanding of the principles and operational requirements for PMU staff and other relevant stakeholders;
- (iv) Assist the PMU and related agencies in preparation, update, implementation and monitoring of REMDPs to ensure that all provisions and requirements from all approved subproject REMDPs are undertaken and ensure they are appropriately monitored by the project performance monitoring systems (PPMS);
- (v) In coordination with the Commune Supervision Boards (CSB) monitor (government funded and includes at least one woman) all subprojects to determine if serious negative impacts on ethnic minorities, women or other disadvantaged groups are occurring and make recommendations to the PMU to ameliorate/mitigate these;
- (vi) In coordination with the CSB monitor community involvement in subproject implementation and bring issues or problems to the attention of the PMUs;
- (vii) In coordination with the CSB document the community participation process and make recommendations for changes in processes and procedures for the balance of the project to strengthen the understanding and skills of government staff in this critical area;
- (viii) Assist the PMUs in development of performance frameworks and quarterly activity schedules for the Community Development Officers; and
- (ix) Other relevant duties and responsibilities as required.

c. Gender Specialist (6 person months per province)

189. The specialist will have academic training in social sciences and the role of gender in development. The specialist will need experience in gender mainstreaming with respect to rural communities in Viet Nam that include ethnic minorities. Prior knowledge and experience with Effective Gender Mainstreaming strategies and lessons in ODA projects is highly desirable. The specialist will be required to:

- (i) Support PPMU to implement GAP (including provide technical inputs for gender related training, briefing to stakeholders, workshop, materials development, gender provision in bidding documents, etc.
- (ii) Develop and deliver training and mentoring of each PMU's gender focal point in monitoring and reporting on GAP implementation
- (iii) Review PMUs workplan and schedules and suggest options for strengthening the gender mainstreaming activities as defined in the GAP
- (iv) Support PPMUs to implement GAP implementation recommendations by ADB mission.

d. Environment Safeguard Specialist (24 person months per province)

190. While the pre-screened subprojects are expected to have minimal long term environmental impacts, there are possibly short-term concerns for which mitigation strategies need to be designed and implemented. Expertise is needed to ensure that the subprojects have well developed and executable environmental management plans (EMP) with appropriate mitigation measures based on the environmental assessment and review framework prepared. They will develop mechanisms to ensure that mitigating measures are observed and will establish reporting formats to monitor the performance of contractors during the construction phase when environmental impacts are most likely.

191. The specialists will have appropriate tertiary qualifications in environmental science or natural resource management from a recognized institution and will have more than 10 years of experience working in the field of environmental management for internationally funded development projects. Training skills would also be an advantage to the international and national specialists. The specialists will be based in PMU and will be required to visit subproject sites for monitoring purposes and training as required while being responsible to the LIC team leader.

The specialist needs to work closely with the respective PMU and other stakeholders to the project will comply with ADB safeguard policy statement 2009 and relevant regulations of the government. Detail duties of the specialists will include the following:

- (i) Review the environmental recommendations of the PPTA Final Report and the formats for environmental examinations contained therein;
- (ii) Assist with the screening of subprojects, completing REA checklists for candidate subprojects;
- (iii) Brief the staff of the PMUs in participating provinces on environmental procedures and requirements for subproject preparation;
- (iv) Visit each subproject during the subproject preparation to ensure environmental safeguards are being properly conducted providing advice and support for IEE preparation;
- (v) Assist the PMUs with the internal review of the initial environmental examinations and associated environmental management plans prepared for each subproject and assist with updating the draft IEEs in response to comments received;

- (vi) Assist the PMUs to ensure that EMP is adequately integrated in bidding document and civil contract; Assist PMU in establishment and operation of environment management system described in EMP;
- (vii) Undertake regular supervision of the contractor's environmental performance and assist PMU to carry out subproject environment sampling for surface/ground water quality, dust and noise as required in the EMP, and prepare semiannual monitoring report for submission to ADB and government environment authority and;
- (viii) Assist in the preparation and implementation of training activities with regard to the environmental aspects of the Project.

e. Financial and Accounting Specialist (60 person months per Province):

192. The Specialist shall have tertiary qualifications in accounting or similar discipline, or its equivalent - CPA qualifications is preferred. The specialist shall have extensive experience (minimum 10 years) in designing and implementing accounting systems or similar projects in Viet Nam. The specialist must have good working knowledge of English, and work experience with any donor-funded project a distinct advantage.

193. The specialist will advise and assist PMU on overall accounting functions and activities of the Project and ensure that a separate set of accounts is kept for the project. The specialist will perform the following tasks:

- (i) Develop a suitable project accounting system, chart of accounts, and procure and adapt any necessary software to ensure an effective and efficient project accounting, monitoring and reporting system to project executing and implementing agency managers and ADB. The system will be capable of producing routine reports by which the Project's financial and physical progress can be monitored and evaluated;
- (ii) Ensure that financial transactions are, in all cases, recorded in project accounts accurately and on a timely basis and in accordance with ADB and the government requirements and agreed financial policies and procedures for the Project;
- (iii) Ensure that Project expenditures on contract payments are made in accordance with the terms and conditions of the respective contracts and are adequately certified by duly authorized officials in relation to works completed and/or goods or services provided;
- (iv) Ensure that adequate internal control is established and maintained in terms of separation of responsibilities for processing and authorizing payments and in the management and accounting for project expenditures and assets;
- (v) Ensure that all financial records are retained for audit purposes and for review by ADB and the government until at least one year following Project completion;
- (vi) Ensure that Project financial transactions are recorded in the accounts in accordance with the government regulations and ADB requirements and that records are reconciled periodically, at least on a monthly basis;
- (vii) Ensure that the advance account and Sub-Accounts to be established for the Project in local commercial banks are administered in accordance with ADB requirements;
- (viii) Ensure that withdrawal requests for reimbursements from ADB are prepared and submitted to the government and to ADB on a timely basis and in accordance with ADB procedures to replenish the advance account. Ensure that Statements of Expenditures (SOEs) supporting withdrawal requests accurately reflect qualifying project expenditures and that underlying documents that verify these expenditures are retained and available for review as required;

- (ix) Periodically, but at least quarterly, reconcile project records with ADB records relating to disbursements from ADB's Loan for all Project components. Project records and bank statements should be reconciled more frequently, at least monthly;
- (x) Ensure timely preparation and distribution of integrated quarterly financial management and project management reports and annual project financial reports and statements required by ADB, under the provisions of the Loan Agreement, as well as by the government. Provide any special financial reports that may be required from time to time on specific aspects of project's financial progress or position as may be requested by ADB and/or the government;
- (xi) Ensure that annual Project budgets are consistent with agreed program activity levels and expenditures and that budgetary allocations for the Project are available to meet projected cash flow requirements for contract payments, pending reimbursement by ADB, and for administrative expenditures of PMU and implementing units;
- (xii) Ensure that Project assets and inventories are safeguarded and revalued and verified periodically in accordance with the requirements of ADB and government of Viet Nam and to support annual Project financial audits;
- (xiii) Liaise effectively with auditors to ensure effective annual audits in accordance with ADB's requirements;
- (xiv) Conduct on-the-job training on project accounting and through classroom presentations;
- (xv) Prepare progress reports for inclusion in the monthly, quarterly and annual progress reports to be prepared by PMU; and
- (xvi) Supervise the implementation of the financial management action plan.

2. Construction Supervision Consultants

a. Objective

194. The primary objectives of the consulting services are to:

- (i) Function as the Engineer in administering the civil works contract (the Contract) in accordance with the International Federation of Consulting Engineers (FIDIC) conditions of contract;
- (ii) Design Consultants Contractors;
- (iii) Review and advise four NCP DPIs/PMUs (the Employer) on approval of the construction methods and construction implemented by the Construction Contractors;
- (iv) Ensure that the permanent and temporary works have been designed and are constructed in accordance with the provisions of the Contracts and in accordance with the Vietnamese Design and Construction Standards; and
- (v) Advise the Employer on all matters concerning implementation of the Contracts including quality control, work progress, implementation issues, and arbitration or litigation etc.

b. Scope of Work

i. Civil Works Contract Administration

195. Design review. DEDs have been prepared through a firm of consultants. The design review includes, but is not limited to, the following:

- (i) Establish the schedule, methods and procedures for the review of detailed engineering design and construction drawings of the civil works provided by the Employer.
- (ii) Review the detailed design and construction drawings in accordance with the design standards, criteria and conceptual design provided in the Contract.
- (iii) Ensure that the Technical Specifications in the Bid Documents and the provisions of Vietnamese Design and Construction Standards have been duly accounted for in the DED and construction drawings.

ii. Contract Administration

196. The construction works will be executed under the International Federation of Consulting Engineers (FIDIC) Conditions of Contract for Works of Civil Engineering Construction.

Accordingly, four NCP DPis/PMUs will be the Employer and the consultant will function as the Engineer.

197. The consultant will administer the civil works contracts and ensure that the road and water supply subprojects are constructed in accordance with the provision of the civil works contracts. The consultant will be required to nominate an engineer's representative who will be a full-time resident in the project area. The responsibility of the Engineer includes, but is not limited to, the following tasks:

- (i) Give the order to commence the works;
- (ii) Review and approve contracts proposed personnel for positions nominated in the Contract;
- (iii) Inspect and approve all material sources identified by the Contractor;
- (iv) Review and approve the Contractor's implementation schedule, and supervise the progress of construction works. The Consultant will keep the Employer informed of any delay or potential delays in the work schedule of the Contract, and will take all necessary actions to prevent potential delays;
- (v) Review, approve and monitor the construction plan to minimize disruption to vehicular traffic and water supply and agricultural activities during construction, and to ensure that construction activities do not endanger safety of the public;
- (vi) Regularly monitor and inspect the contractor's quality control and assurance program to ensure that quality of the finished works meet the contract standards and specifications. This includes regular checking of the materials testing program;
- (vii) Advise and assist the Employer with respect to arbitration or litigation relating to the works, whenever required;
- (viii) Monitor progress of the construction works through computer-aided project management techniques;
- (ix) Convene regular site meetings with the Contractor to discuss issues and problems affecting the progress, and brief the Employer;
- (x) Coordinate with the relevant local government authorities/agencies so as to minimize disruption to the works program, as required by the Contractor;
- (xi) Review the contractor's insurance cover to ensure that the contractor has provided all the insurance required by the contract and such insurance are maintained throughout the contract period;
- (xii) Prepare any required variation orders requested by the Employer and review any variation order proposed by the contractor and provide their advice to the Employer in accordance with the contract;

- (xiii) Review all claims submitted by the Contractor and provide advice to the Employer of the validity of the claim, the effect of such claim on the construction schedule and the cost of the project;
- (xiv) Review and comment on the monthly progress reports submitted by the contractor detailing the work undertaken during the previous month, the progress of the work against the approved schedule, the problems and difficulties encountered by the contractor and other issues requested by the Employer;
- (xv) Issue completion certificate after satisfactory completion of the works in accordance with the contract provisions;
- (xvi) Supervise updating of the Resettlement Plan, if necessary, and develop poverty monitoring impact monitoring systems;
- (xvii) Review and advise the Employer whether the construction methods as proposed by the contractor for carrying out the works are satisfactory, with particular references to the technical requirements of sound environmental standards on the basis of ADB's Safeguards Policy Statement (2009), inspection of contractor's construction equipment, safety of the works, property, personnel, and general public;
- (xviii) Assess and check the laboratory and field tests carried out by the contractor, and independent tests.
- (xix) Issue orders to the Contractor to remove or improve any works that are not in accordance with the drawings and/or specifications;
- (xx) Maintain records of all testing work, including cross-referencing of items of work to which each test refers and location from which any samples were obtained for testing.
- (xxi) At the completion of the contract, verify the contractor's "as-built drawings" as a true record of the works as constructed;
- (xxii) Measure the completed works and keep detailed records, including the measurement books;
- (xxiii) Prepare quarterly cash flow projections for the Employer in an acceptable format, in which cash flow should identify budget estimates for all outstanding works;
- (xxiv) Supervise the maintenance of records for all plant, labor and materials used in the construction of the works;
- (xxv) Supervise the process of interim and final payments to the Contractor (interim monthly payment shall be based on interim payment certificate processed by the Consultant following claims filed by the Contractor);
- (xxvi) The Consultant will be responsible for checking and monitoring the performance requirements in the Contract and ensuring the criteria and limits are met;
- (xxvii) Maintain a day-to-day diary, which shall record all events pertaining to the administration of the contract, request forms, and order given to the contractor, and any other information which may at a later date be of assistance in resolving queries which may arise connecting execution of the works;
- (xxviii) Supervise the implementation of training programs of four NCP DPIs/PMUs staff at the site on project management including quality assurance and contract administration.

198. In addition, or as an expansion of the activities and responsibilities required of the engineer under the civil works contracts, the consultant will:

- (i) Ensure that the construction methods proposed by the contractor for carrying out the works are satisfactory, with particular references to the technical requirements of sound environmental standards on the basis of the ADB's Safeguards Policy Statement (2009);

- (ii) inspection of contractor's construction equipment; safety of the works, property, personnel, and general public; and the recommendations of the Environmental Management Plan (EMP);
- (iii) Supervise the implementation of the environmental monitoring plan and annual report of implementing this plan as part of project implementation report.
- (iv) Supervise the provision of environmental management seminars for contractors and four NCP DPIs/PMUs staff;
- (v) Supervise of resettlement plans as per ADB's Safeguards Policy Statement (2009);
- (vi) Monitor the Construction Contractors to ensure that no child labor is used for the execution of the civil works contracts as required by the civil works contracts;
- (vii) Monitor the implementation of the health and safety program at camp site including the information and education campaign on sexually-transmitted diseases and HIV/AIDS (human immunodeficiency virus/acquired immunodeficiency syndrome) as required by the civil works contracts; and
- (viii) Supervise the implementation of training programs for four NCP DPIs/PMUs staff at site on project management including quality assurance, contract administration, and water treatment system maintenance.

iii. Actions Requiring Specific Approval of the Employer

199. The consultant will be required to obtain prior approval of the employer in the following matters as specified in the civil works contracts:

- (i) Recommending the subletting of any part of the works;
- (ii) Certifying additional cost;
- (iii) Determining an extension of time;
- (iv) Issuing a variation having financial implications; and
- (v) Fixing rates or prices.

iv. Project Performance Monitoring/Benefit Monitoring and Evaluation

200. The consultant will help the Employer establish a system for project performance monitoring in accordance with the project framework. The consultant will:

- (i) Identify, on the basis of the project framework developed during project processing, performance indicators to be monitored during the implementation of the Project;
- (ii) Advise on the establishment of systems for collecting data and statistics for such monitoring;
- (iii) Advise on the carrying out a baseline survey on performance indicators including on poverty, socioeconomic survey, gender development, employment– generation amongst others to Project Affected Persons, and other social and economic development activities;
- (iv) Advise on collection of required data and undertake other relevant surveys before construction and immediately after completion of the Project; and
- (v) Incorporate findings and supporting data in the project completion report, in accordance with a schedule and terms of reference to be mutually agreed by four NCP DPIs/PMUs and ADB.

c. Reporting and Deliverables:

201. CSCF will produce the following reports in English:

- (i) Monthly reports on progress of all construction work;
- (ii) A draft subproject completion report to be submitted to each PMU within two months of the completion of subproject construction; and
- (iii) Submit a final subproject completion report within one month of receipt of comments from PMU.

d. Resources

202. The consulting services will be contracted using QCBS a STP using a service and lump sum contract in Vietnamese language a by each PMU. The PMU will enter into procurement within 3 months of loan signing. The required inputs for each PMU are:

Quang Tri Province

No.	Expertise	Quantity	Person months
1	Road CS Engineer	4x30	120
2	Bridge CS Engineer	3x22	66
3	Irrigation CS Engineer	2x12	24
4	Unallocated (M&E)	1	24
Total		10	234

Quang Binh Province

No.	Expertise	Quantity	Person months
1	Road CS Engineer	4x30	120
2	Bridge CS Engineer	2x22	44
3	Irrigation CS Engineer	2x12	24
4	Unallocated (M&E)	1	24
Total		9	212

Ha Tinh Province

No.	Expertise	Quantity	Person months
1	Road CS Engineer	6x30	180
2	Bridge CS Engineer	3x22	66
3	Water Supply CS Engineer	1x20	20
4	Irrigation/Productive Engineer	1x20	20
5	Electrical Engineer	1	24
6	Unallocated (M&E)	1	24
Total		12	334

Nghe An Province

No.	Expertise	Quantity	Person months
1	Road CS Engineer	4x30	120
2	Bridge CS Engineer	2x22	44
3	Irrigation/Dyke CS Engineer	2x12	24
4	Unallocated (M&E)	1	24
Total		9	212

e. Qualification Requirements

i. Team Leader/Construction Supervision Engineer

- (i) Professional standard: Qualified Transport / Water Resources Engineer or similar field holding a current Construction Supervision Practice Certificate

- (ii) Work experience: at least 12 years, including at least 8 years of project management.
- (iii) Extensive experience in a wide range of civil engineering activities and experience with ODA Funders (ADB, WB and other Funders)
- (iv) At least 5 years engaged in supervision of detailed design or construction of projects (with Construction Supervision Practice Certificate).
- (v) English ability: Fluent oral and written English.
- (vi) Good health.

ii. Deputy Team Leader: Design Supervision/ Construction Supervision engineer

- (i) Professional standard: Qualified Transport / Water Resources Engineer or similar field holding a current Construction Supervision Practice Certificate
- (ii) Work experience: at least 10 years.
- (iii) Extensive experience in a wide range of civil engineering activities and experience with ODA Funders (ADB, WB and other Funders)
- (iv) At least 5 years of experience in detailed design appraisal or in construction supervision (with Construction Supervision Practice Certificate) for water resources projects.
- (v) English ability: Good standard of oral and written English.
- (vi) Good health.

iii. Road/Bridge Design Engineers

- (i) Professional standard: Qualified road/bridge Engineer or similar field holding a current Construction Supervision Practice Certificate
- (ii) Work experience: at least 10 years.
- (iii) Extensive experience in a wide range of civil engineering activities and experience with ODA Funders (ADB, WB and other Funders)
- (iv) At least 5 years of experience in construction supervision (with Certificate) for roads/bridges projects
- (v) English ability: Good standard of oral and written English.
- (vi) Good health.

iv. Water Supply Design Engineer

- (i) Professional standard: Qualified Water Resources Engineer or similar field holding a current Construction Supervision Practice Certificate
- (ii) Work experience: at least 10 years.
- (iii) Extensive experience in a wide range of civil engineering activities and experience with ODA Funders (ADB, WB and other Funders).
- (iv) At least 10 years of experience in detailed design and at least 5 years of experience in design document appraisal (with construction supervision certificate) for water resources projects
- (v) English ability: Good standard of oral and written English.
- (vi) Good health.

v. Electrical Engineer

- (i) Professional standard: Qualified Electrical Engineer or similar field holding a current Construction Supervision Practice Certificate
- (ii) Work experience: at least 5 years.
- (iii) Extensive experience in a wide range of civil engineering activities and experience with ODA Funders (ADB, WB and other Funders)

- (iv) At least 5 years of experience in electrical works supervision of water supply works or related infrastructures (with construction supervision certificate).
- (v) English ability: Good standard of oral and written English.
- (vi) Good health.

vi. Monitoring Expert

- (i) Professional standard: Qualified agriculturalist with agricultural engineering background
- (ii) Work experience: at least 10 years.
- (iii) Extensive experience in a wide range of monitoring of output and outcomes with experience with ODA Funders (ADB, WB and other Funders)
- (iv) At least 10 years of experience in detailed design and at least 5 years of experience in design document monitoring for supervising producer and value chain impacts
- (v) Experience working with private sector service provider in agricultural value chains
- (vi) English ability: Good standard of oral and written English.
- (vii) Good health.

vii. Social Safeguard Specialist (Resettlement and Ethnic Minority)

- (i) Professional standard: Tertiary qualifications in sociology, anthropology or similar field
- (ii) Work experience: at least 10 years in implementation of resettlement for ODA projects.
- (iii) Extensive experience in a wide range of civil engineering activities and experience with ODA Funders (ADB, WB and other Funders)
- (iv) At least 5 years of experience in supervision of social aspects of construction.
- (v) English ability: Good standard of oral and written English.
- (vi) Good health.

viii. Social/Gender Specialist

- (i) At least 8 year experience in implementing, monitoring and reporting on Gender main streaming plans of development projects (preferable with infrastructure related project and international donors funded projects)
- (ii) Having proven skills and experience on gender related training design and delivery.
- (iii) Being familiar with Vietnamese government gender related laws and policies.

ix. Environment Expert

- (i) Professional standard: Environment science and technology expert or similar field
- (ii) Work experience: at least 10 years.
- (iii) Extensive experience in a wide range of civil engineering activities and experience with ODA Funders (ADB, WB and other Funders)
- (iv) At least 5 years of experience in supervision of environment aspects of construction.
- (v) English ability: Good standard of oral and written English.
- (vi) Good health.

3. Independent Auditor Terms of Reference

203. A description of the project will be provided with a focus on: (i) the purpose for which the funds are intended, which is consistent with broad project objectives and budget, (ii) a description of the executing and implementing agencies, (iii) loan amount and project cost (by ADB, co-financier(s), and government counterpart), (iv) accounting and financial management practices, financial reporting periods to be audited (whether it is the first or last audit), and (v) other relevant information that should be brought to the attention of the auditors.

204. Management's responsibility for preparing project financial statements: The management is responsible for preparing and fairly presenting the project financial statements, and for maintaining sufficient internal controls to ensure that the financial statements are free from material misstatement, whether due to fraud or error. In addition, management is responsible for ensuring that funds were used only for the purpose(s) of the project, for compliance with financial covenants (where applicable), and for ensuring that effective internal controls, including over the procurement process, are maintained. In this regard, management must:

- (i) Prepare and sign the Project Financial Statements. (**Annex C1**).
- (ii) Prepare and sign a Statement of Compliance. (**Annex C2**)

a. Objectives

205. The objectives of the audit of the project financial statements is to enable the auditor to (i) express an independent and objective opinion as to whether the project financial statements present fairly, in all material respects, or give a true and fair view of the project's financial position, its financial performance and cash flows, and (ii) provide a reasonable assurance opinion over certain specific representations made in the Statement of Compliance. (Refer to Annex C2).

i. Auditing Standards

206. The audit is required to be conducted in accordance with the Standards promulgated by the International Auditing and Assurance Standards Board (IAASB), including: (i) International Standards on Auditing (ISA); and (ii) International Standards on Assurance Engagements (ISAE). These standards require that the auditor comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the project financial statements are free from material misstatement.

207. An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the project financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the project financial statements whether due to fraud or error. In making those risk assessments, the auditor considers the internal control relevant to the entity's preparation and fair presentation of the project financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control.

208. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the project financial statements. The auditor also note the impact on APFS arising from any material deviations from the agreed accounting standards and comment on any accounting policy changes during a financial year or from one year to another.

209. In complying with ISA, the auditor will pay attention to the following standards:

- (i) ISA 800: Special Considerations – Audits of Financial Statements Prepared in Accordance with Special Purpose Frameworks. Where the audit report has been issued under ISA 800, it shall include the mandatory Emphasis of Matter paragraph alerting users of the audit report that the project financial statements are prepared in accordance with a special purpose framework and that, as a result, the project financial statements may not be suitable for another purpose. The auditor shall include this paragraph under an appropriate heading;

- (ii) ISA 240: The Auditor's Responsibilities Relating to Fraud in an Audit of Financial Statements;
- (iii) ISA 250: Consideration of Laws and Regulations in an Audit of Financial Statements.
- (iv) ISA 260: Communication with Those Charged with Governance;
- (v) ISA 265: Communicating Deficiencies in Internal Control to Those Charged with Governance and Management; and ISA 330: The Auditor's Responses to Assessed Risks.

ii. Audit Deliverables

- (i) The auditor must verify that the project financial statements have been prepared under modified-cash basis accounting in accordance with the ADB's reporting requirements as detailed in Annex C1. An auditor's opinion providing reasonable assurance over the project financial statements.
- (ii) The auditor will provide a reasonable assurance opinion following ISAE 3000 "Assurance Engagements other than Audits or Reviews of Historical Financial Information" for the following assertions by Management in the Statement of Compliance (see Annex C2) that:
 - a. the proceeds of the loan were used only for the purpose(s) of the project; and
 - b. the borrower or executing agency was in compliance with the financial covenants of the loan agreement(s), where applicable.

210. The auditor needs to outline the degree of compliance for each of the financial covenants in the loan agreement.

211. Where reasonable assurance has been provided using ISAE 3000 (on the use of loan proceeds and compliance with financial covenants), the assurance report must contain, among others:

- (i) A title that clearly indicates the report is an independent assurance report;
- (ii) An addressee;
- (iii) An identification and description of the subject matter information and, when appropriate, the subject matter;
- (iv) Identification of the criteria;
- (v) A statement that the engagement was performed in accordance with ISAE;
- (vi) A summary of the work performed; and
- (vii) The auditors' conclusion.

212. Management letter: The auditor will provide a management letter containing, at a minimum, the following:

- (i) Any weaknesses in the accounting and internal control systems that were identified during the audit, including any irregularity in the use of the advance fund and statement of expenditures (SOE) procedures (where applicable);
- (ii) Any identified internal control weaknesses related to the procurement process such as, over the bidding, evaluation and contract management domains;
- (iii) Recommendations to rectify identified weaknesses;
- (iv) Management's comments on the audit recommendations along with the timeframe for implementation;
- (v) The status of significant matters raised in previous management letters;
- (vi) Any other matters that the auditor considers should be brought to the attention of the project's management; and
- (vii) Details of any ineligible expenditure identified during the audit. Expenditure is

considered ineligible if it refers to (i) expenditures incurred for purposes other than the ones intended under the legal agreement(s); (ii) expenditures not allowed under the terms of the legal/financing agreements; and (iii) expenditures incurred in violation of applicable government regulations. If the auditor reports any ineligible expenditure in the management letter, the details of the findings should include the funding source to which the observation relates.

iii. Specific Considerations

213. The auditor will, during the course of the audit, pay particular attention to the following:

- (i) The use of external funds in accordance with the relevant legal and financing agreements;
- (ii) The provision of counterpart funds in accordance with the relevant agreements and their use only for the purposes intended;
- (iii) The maintenance of proper books and records;
- (iv) The existence of project fixed assets and internal control related thereto;
- (v) Project's accounting policies, and confirm the extent to which the agreed project accounting policies have been applied. In particular, the impact on the APFS arising from any material deviations from the agreed accounting standards. Comments on any accounting policy changes, either during a financial year, or from one year to another;
- (vi) On the advance fund procedure (where applicable), audit procedures are planned and performed to ensure (a) the advance account (and any sub-accounts) has been managed in accordance with ADB's Loan Disbursement Handbook (2017, as amended from time to time), (b) the cash balance of the advance account (and any sub-accounts) is supported by evidence, (c) the expenditures paid from the advance account (and any sub-accounts) comply with the approved project purpose and cost categories stipulated in the loan agreement, and (d) the amount of expenditures paid from the advance account (and any sub-accounts) comply with disbursement percentage stipulated in the loan agreement;
- (vii) On the SOE procedure (where applicable), audit procedures are planned and performed to ensure that (a) the SOEs have been prepared in accordance with ADB's Loan Disbursement Handbook (2017, as amended from time to time), (b) the individual payments for expenditures stated in the SOE are supported by evidence, (c) the expenditures stated in the SOEs comply with the approved project purpose and cost categories stipulated in loan agreement,
- (viii) (d) the amount of expenditures stated in the SOEs comply with disbursement percentages stipulated in the loan agreement, (e) adequate supporting documentation has been maintained to authenticate claims stated in the SOE for reimbursement of eligible expenditures incurred and liquidation of advances provided to the advance account; and
- (ix) Any weakness in internal controls. Review and evaluate the system of internal controls in effect, including internal audit procedures, to determine the degree of reliance that may be placed upon them and to determine the extent of testing of actual transactions needed to assure the auditor of the accuracy of the accounting records

214. **Audit Deliverables:** All reports must be presented in the English language within 06 months following the end of the fiscal year. The Auditor's reports on the projects financial statements should be prepared in 08 hard copies.

215. **Public disclosure:** Public disclosure of the project financial statements, including the auditor's opinion on the audited project financial statements, will be guided by ADB's Public Communications Policy 2011. After review, ADB will disclose the audited project financial

statements and the opinion of the auditor on the audited project financial statements no later than 14 calendar days of ADB's confirmation of their acceptability by posting them on ADB's website. The management letter and the additional auditor's opinions will not be disclosed.

216. **Qualifications of Audit Firm:** The following are the requirements on the qualification of auditing firms for auditing ADB funded projects in Viet Nam. It must be authorized to practice in Viet Nam and be capable of applying established procedures and reliable methodology in conformity with ISA and ISAE. The detailed requirements on the qualification of auditing company are:

- (i) Be a legal entity with business license granted by the competent authority, as requested by Vietnamese law; having business registration or set up business in the fields relevant to the requirements of the TORs;
- (ii) Must be impartial and independent from all aspects of management or financial interests in the EA/IA being audited. In particular, the auditor should be independent of the control of the entity;
- (iii) Be included in the most updated list of authorized auditing companies and auditors which is approved by Ministry of Finance and published on website: www.mof.gov.vn;
- (iv) Have adequate staff, with appropriate professional qualifications and suitable experience in finance/financial management in ODA funded projects or the government projects/ programs, including experience in auditing the Enterprise Financial system (EFS) comparable in nature, size and complexity to the entity whose audit they are to undertake;
- (v) Notify and get written endorsement of the executing agency every time an engagement team member is substituted; and
- (vi) Subcontracting of audit services is not permitted

217. The following are the requirements on the qualification of Individual auditor for each proposed position in the audit: The auditor must be authorized to practice in the country and be capable of applying the agreed auditing standards. The auditor should have appropriate professional qualifications and suitable experience, including experience in auditing the accounts of projects or entities comparable in nature, size and complexity to the project or entity whose audit they are to undertake. To this end, the auditor is required to provide curriculum vitae (CV) of the personnel who will provide the opinions and reports, together with the CVs of managers, supervisors and key personnel likely to be involved in the audit work. These CVs should include details of audits carried out by these staff, including ongoing assignments.

218. The auditor will be impartial and independent from any aspects of management or financial interest in the entity or project under audit. In particular, the auditor should be independent of the control of the entity. The auditor should not, during the period covered by the audit, be employed by, or serve as director for, or have any financial or close business relationship with the entity. The auditor should not have any close personal relationships with any senior participant in the management of the entity. The auditor must disclose any issues or relationships that might compromise their independence.

b. Outline TOR of each position

v. Audit Engagement Partner (X national expert):

219. Holding the highest responsibility for the audit engagement, the Partner will be responsible for:

- (i) Provide directives for the whole audit team from the planning, implementation of the

- audit and issuing audit opinions.
- (ii) Take responsibility for the overall quality of the audit. Assure the audit is carried out in compliance with the Firm's quality standards and procedures and with the requirements of clients.
- (iii) Developing an understanding of client's business and becoming a "functional expert" in the area.

Minimum Qualifications:

- (i) A university graduate (preferably with a post-graduate degree) in accounting, auditing, finance, or related fields;
- (ii) Holder of the Audit practitioner certificate granted by the Vietnamese MoF and, preferably, an internationally recognized professional certificate to practice audit or accounting, such as ACCA, CPA Australia, etc.;
- (iii) Professional experience for 15 years or above working in financial, advisory or audit services, with 08 years or more providing audit services since being granted with Vietnamese or international auditor certificate, of which at least 04 years in directing auditing teams;
- (iv) Experience as Audit Director or Partner for at least 03 audit contracts for projects funded by ADB, the World Bank, or large international donors;
- (v) Experience working for a Big4 or large regional accounting firm is a plus; and
- (vi) Fluent English is compulsory.

ii. Audit Manager (X national expert):

The Manager will be responsible for:

- (i) Receive the instructional directives from Partner and give detailed guidance to all team members;
- (ii) Monitor the audit fieldwork of engagement team, reviews staff work and ensure that it meet professional standards and the internal audit department's guidelines;
- (iii) Take responsibility for the quality of the audit before submitting to the engagement partner;
- (iv) To be the contact point with project management regarding key issues identified, audit adjustments; and
- (v) Monitor the progress of the audit and monitor the adherence to the committed deadline

Minimum Qualifications:

- (i) A university graduate (preferably with a post-graduate degree) in accounting, auditing, finance, or related fields;
- (ii) Holder of the Audit practitioner certificate granted by the Vietnamese MoF and/or an internationally recognized professional certificate to practice audit or accounting, such as ACCA, CPA Australia, etc.;
- (iii) At least 10 years of experience providing audit services, of which 05 years or more in managing the audit team;
- (iv) Audit experience for projects funded by ADB, the World Bank, or large international donors in Vietnam would be an advantage;
- (v) Experience working for a Big4 or large regional accounting firm is a plus; and
- (vi) Fluent English is compulsory.

iii. Senior Auditors (X national experts):

The Senior Auditors will be responsible for:

- (i) Follow the instructions from Engagement Partner and Manager;
- (ii) Keep the Partner and Manager updated on the key issues or audit adjustments on a regular basis;
- (iii) Being responsible for the audit quality of the whole team in front of Manager;
- (iv) Being responsible for the compliance with auditing firm quality standards and procedures and with the requirements of this TOR.

Minimum Qualifications:

- (i) A university graduate in accounting, auditing, finance, or related fields;
- (ii) Preferably holder of the Audit practitioner certificate granted by the Vietnamese MoF and/or an internationally recognized professional certificate to practice audit or accounting, such as ACCA, CPA Australia, etc.;
- (iii) At least 05 years of experience in providing audit services;
- (iv) Audit experience for projects funded by ADB, the World Bank, or large international donors in Vietnam would be an advantage; and
- (v) English proficiency is preferable.

iv. Junior Auditors (X national experts):

The Junior Auditors will be responsible for:

- (i) Implement audit procedures, audit assigned sections in the agencies, be responsible for the data and issues related to the audit engagement;
- (ii) Support the preparation of the audit report; draft the minutes of audit; report to the Audit Seniors regarding the issues related to the audit.

Minimum Qualifications:

- (i) A university graduate in accounting, auditing, finance, or related fields;
- (ii) Preferably holder of the Audit practitioner certificate granted by the Vietnamese MoF and/or an internationally recognized professional certificate to practice audit or accounting, such as ACCA, CPA Australia, etc.;
- (iii) At least 02 years of experience working in providing audit services;
- (iv) Audit experience for projects funded by ADB, the World Bank, or large international donors in Vietnam would be an advantage; and
- (v) English proficiency is preferable.

220. **Locations to be audited:** The audit fieldwork shall be carried out in the PMUs. Since the Project is implemented in provinces and districts, the auditors may have to travel to those provinces to do audit and randomly choose the locations to be visited.

221. **Phasing of the Audit:** The TORs must specify when the report will be submitted in draft and in final format.

222. Although the auditing firm will be contracted for the mentioned audit phases (maximum three years per contract), it must submit the financial proposal in US\$ in a format indicating the amount for each financial year independently:

- (i) If performance is not satisfactory in one year then the client will not be bound for subsequent year's audits; and
- (ii) If the performance is satisfactory, the auditor may participate in bidding process for the next fiscal years, but the total assignment should be up to 6 years for one project.
- (iii) The audited phases need to cover the period from loan effective date to the end of 04 months grace period (if any) succeeding the loan closing date.

c. Available information to be provided to the auditor

- (i) The auditor should have full and complete access, at all reasonable times, to all records and documents including books of account, legal agreements, bank records, invoices and any other information associated with the project and deemed necessary by the auditor. The auditor will also obtain confirmation of amounts disbursed and outstanding at ADB. The Auditor shall have the right of access to banks and depositories, consultants, contractors and other persons or firms engaged by the project. In case access has been restricted, the auditor must note this in the management letter;
- (ii) The auditor will be provided with full cooperation by all employees of the entity and the project implementing units, whose activities involve, or might be reflected in, the annual project financial statements. The auditor will be assured rights of access to banks and depositories, consultants, contractors, and other person or firms hired by the employer; and
- (iii) ADB can request access to the auditors unedited audit working papers. If necessary, the auditing company can be requested, free of charge, to participate in a wrap-up session for the Ministry of Finance (MOF), the EA/IAs and ADB to share common findings across projects being audited and provide recommendations for addressing bottlenecks in preparation for the next audit.

d. Reporting relationships

- (i) The audit services will be contracted by PMU, and the Auditor shall report to: the Project Director and Chief Accountant.

223. The Auditor should maintain and file the work papers and provide them to the Government and/or ADB when requested.

C. Annex 3: Long List of Subprojects

Component 1: Transport connection infrastructure					
Description	Quang Tri	Quang Binh	Ha Tinh	Nghe An	Total
Name Representative	Constructing and Upgrading Gio Linh – Cam Lo Inter-district Road of Quang Tri Province (23.3km)	Improving and Upgrading Tourism road connecting Dong Hoi City and Southern areas of Quang Binh Province (17.5km)	-	Upgrading district road DH349 from Dinh Son to Star fruit tree (Cay Khe) T-junction, Anh Son district, Ngha An province (8.00071km)	3
Name Additional	(ii) Hung Vuong Road connecting with East – West Economic Corridor and East – South EZ of Quang Tri province (4.72km); (iii) Road connecting Cua Viet port with Eastern communes of Trieu Phong – Hai Lang districts and the center of East-South EZ (36.030km) (iv) Cua Tung – Cua Viet Tourism Service Infrastructures (15.946km); (v) Khe Van Road (Huong Hiep commune, Dakrong district) to Huong Linh commune,	(ii) Road from Southern Quang Hai bridge to Lac Giao (iii) Road from National Highway 1A bypass to Eastern branch of Ho Chi Minh road (iv) Road from Loc Ninh to Tay Bac Dong Hoi industrial zone (v) Construction of Dinh Muoi travel road, Quang Ninh district	(i) Upgrading An Vien - My Thanh route of Nghi Xuan district (8km); (ii) Can Loc - Huong Khe inter-district road (14.2km) (iii) District road 6 Huong Khe district (8km) (iv) Ky Dong - Ky Trung inter-commune road (3.81km) (v) Construction of main road of Hong Linh town (phase 1) (4.071km) (vi) The western boundary road of Le Van Thiem Secondary School, Ha Tinh City (1.1km)	(ii) Road for transportation and development of material areas, Nghia Dan District, Nghe An Province (11.85km) (iii) Road from Van Dien commune to Nam Nghia commune, Nam Đán district and Arterial road from NH46 to Hung My commune center, Hung Nguyen district, PR 8B (9.678 km) (iv) Road connecting PR 533, Thanh Chuong district with Ho Chi Minh road and western districts of	22

Component 1: Transport connection infrastructure					
Description	Quang Tri	Quang Binh	Ha Tinh	Nghe An	Total
	Huong Hoa district, Quang Tri province (11.820km)		(vii) Upgrading inter-district road, Can Loc - Loc Ha (11.95km) (viii) Son Le - Son An - Son Tien inter-commune road, Huong Son district (10.1km)	Nghe An province (9.994km) (v) Vertical axle road No. V of Cua Lo town (5.795km) (vi) Construction of horizontal urban road N7 and road of two head roads of Hieu River 2 of Thai Hoa Town (1.82km)	
Total Number	5	5	8	6	25
Length Representative (km)	23.3	17.5	-	8.00071	47.701
Length Additional (km)	68.52	21.3	61.231	44.035	211.29
Total Length (km)	91.82	38.8	61.231	52.0357	259
No. of Beneficiaries - Representative	9,000	40,217		9,302	58,519
No. of Beneficiaries – Additional	45,734	424,196	148,246	241,651	859,827
Total Beneficiaries	54,734	464,413	148,246	250,953	918,346

Production development infrastructure Subproject Details

Output 2: Production development infrastructure					
	Quang Tri	Quang Binh	Ha Tinh	Nghe An	Total
Number of representative subproject	-	-	1	-	1
Costs (US\$) of representative subproject			7,730,000		
Number of additional subproject	1	2	2	2	7
Total Number of Subprojects	1	2	3	2	8
<u>A: Representative Subprojects</u>					
Representative Subproject	-	-		-	
Project Daily Water Capacity (m ³ per day)	-	-	9,500	-	9,500
Number of beneficiary households supplied	-	-	(15,572 HHs)	-	15,572
Total beneficiary Population supplied	-	-	60,414	-	60,414
<u>B: Additional Subprojects</u>					
	Quang Tri	Quang Binh	Ha Tinh	Nghe An	Total
Name	Inundation prevention system of Thuan-Trach-Trung-Tai, Ba-Que-Vinh-Duong-Thành communes in Trieu Phong and Hai Lang District.	(i) Upgrading of irrigation and flood drainage system of Kenh Kia river, Ba Don town and Quang Trach district (ii) Upgrading and expansion of Song Gianh fishing port, Bo Trach district	(ii) Construction of infrastructure for aquaculture development in 3 communes of Thach Long, Mai Phu and Ho Do (iii) Infrastructure for growing fruit trees in Loc	(i) Construction and upgrading Mør river dyke Quynh Luu district, Phuc Tho dyke Nghi Loc district and Hieu river embankment Quy Chau district (ii) Reinforced canals,	

Output 2: Production development infrastructure					
	Quang Tri	Quang Binh	Ha Tinh	Nghe An	Total
			Yen commune, Huong Khe district:	ditches and rural roads in Yen Thanh district	
Sector (outputs)	<ul style="list-style-type: none"> - Rehabilitate North main canal, T2B Canal, T3B Canal, T10B Sub-Canal and the works on the Canal. The total length of Canal is L = 12,539.65m. - Rehabilitate the Inundation Prevention System: Co Ha, Cuu Vinh Dinh section 1, Cuu Vinh Dinh section 2, Tan Vinh Dinh section 1, Tan Vinh Dinh section 2 with total length is L=17.506,5km - Construct newly 03 bridges with the design load of HL93: Dong Quan Bridgel Don Que Bridge and Dien Khanh Bridge. 	<ul style="list-style-type: none"> (i) - Strengthening, reinforcing the dike and embankment with the length of about 8km. - Upgrade the drainage canal system: 2.6km. - To build and upgrade the main irrigation canals with a total length of 3.2km - Construction of irrigation and drainage system: including 04 irrigation pumping stations; 9 sewer regulation; 26 sewers (ii) - Rehabilitation and upgrading to ensure the achievement of grade I port according to the approved planning in Decision No.176/QĐ-TTg dated 	<ul style="list-style-type: none"> (ii) Sub project including: Irrigation system and service road for production: + Irrigation system: constructing of 1 canal with L=1.3 m length total; + Service road for production: construction of 04 road with L=2.29 m length total; (iii) - To build and upgrade three rural roads, a lake without water and two power systems: + Transport infrastructure: To build three new rural roads of grade A of 9.173m long and 6.5m for line 1 and 6m for line 2, line 3, Bsmooth = 3.5m, width = 2x1.5m, Cement 	<ul style="list-style-type: none"> (i) I. Phuc Tho dyke - Building dyke, starting point at K0+00 in Dung Quyet road, nearby Rao Dung culvert, ending point at K1+715.0 in Hai Quan fencing wall. - Rescue road in combination with construction road and access road II. Mo river dyke - Upgrading Mo river dyke from K2+200 to K7+684,9 (length of 5,484.9m), starting point from Quynh Minh bridge to ending point in boundary between Quynh Bang and Quynh Lien communes; This route is located in Quynh Minh, Quynh Luong and 	

Output 2: Production infrastructure	2: Production	development			
	Quang Tri	Quang Binh	Ha Tinh	Nghe An	Total
		<p>12/11/2015 of the Government. Include items:</p> <ul style="list-style-type: none"> - Upgrade the boat landing. - Dredge the water in front of the wharf. - Construction of surface water drainage and wastewater collection system - Upgrade the power system. - Building a new water supply system - Repair other auxiliary items 	<p>road surface; + Irrigation Infrastructure: Upgrade a reservoir of 50,000m³, including: a 247m long earth dam, a 30m concrete dam floodplain, a 30m-long concrete dam sewer, a 908m long + Electricity infrastructure to renovate 02 transformer stations of 180kVA, 4.5km of medium voltage line 35KV, 4km of low voltage line of 0.4kV</p>	<p>Quynh Bang communes.</p> <ul style="list-style-type: none"> - Along the dyke, reconstruction and newly-building of 21 drainage culverts over the dyke. <p>III. Hieu river embankment Building around 2Km embankment , along lower Hieu river starting point at near-by Ke Bon bridge.</p> <p>(ii) I. Dyke system</p> <ol style="list-style-type: none"> 1. Category and grade of works: Class IV irrigation structures. 2. Irrigation: Irrigation assurance frequency: P=75%. 3. Design speed: V=15km/h. 4. Total length of canal: 23.2km. <p>II. Road system:</p> <ol style="list-style-type: none"> 1. Category and grade of works: Grade A and B rural road. 2. Total length of road: 10 	

Output 2: Production infrastructure	Quang Tri	Quang Binh	Ha Tinh	Nghe An	Total
				routes with total length of 16,931km 3. Design speed: 30Km/h for Grade A rural road and 20km/h for Grade B rural road. 4. Grade A rural road: Roadbase's width of 6.5m; Pavement's width of 3.5m; Sidewalk of 2x1.5m=3m; Grade B rural road: Roadbase's width of 5m, pavement's width of 3.5m, sidewalk's width of 2x0.75=1.5m 5. Pavement structure: Bituminous ballast	
No. of Beneficiaries	40,053	(i) 36,786 (ii) 80,388	(ii)19,910 (iii) 6,000	(i) 52,800 (ii) 446,280	682,217
Costs (US\$)	6,489,518	(i)4,770,000 (ii)4,860,000	(ii)3,012,000 (iii) 1,876,000	(i) 7,864,753 (ii) 3,297,534	32,169,805
Output 2: Summary					
Number of subprojects	1	2	3	2	8
Total Costs	6,489,518	9,630,000	12,618,000	11,162,287	39,899,805
Total Beneficiaries	40,053	117,174	85,414	499,080	742,631

D. Annex 4: Proposed Subproject Planning Template

Prov:	Cost Estimates (VND mil.)			Implementation Status	Detailed Implementation Plan			Progress Report Status Update - Q** - 20**		
	Total	ADB Loan	C. Fund		Task	Deadline	Project Management Service Standard	Achieved	Delayed	Action
Subproject:								Yes/No	Revised date	
Output 1:										
Rehabilitation and upgrade of the road connecting from the center of Pac Nam district, Bac Kan province with Son Lo, Bao Lac district, Cao Bang province										
Feasibility Reports for Additional Subproject FS					Preliminary design prepared by Provincial Consultant		before loan signing			
					Land Acquisition surveys completed					
					Subproject REMDP prepared					
					Environmental Examination and IEE /EIA prepared					
					Social and Poverty Assesments and Gender Action Plan prepared with baseline data					
					Subproject Financial and Economic assesment					
					FS report prepared by Provincial Consultant					
Feasibility Reports for Representative / and Additional Subprojects				Prepared during PPTA	FS updated by provincial consultant		14 days			
					FS endorsed by PMU/PPC submitted to ADB		14 days			
					Implementation plan submitted to PMU by consultant		7 days			
					Implementation plan reviewed by PMU		5 days			
					Implementation plan revised and resubmitted to PMU		7 days			
					Implementation plan Approved by PMU submitted PPC		30 days			
Detailed Engineering Design					ToR for Detailed Design Prepared		PPSFF			
					DED TOR Approved		30 days			
					Bidding documents prepared submitted to DPI		14 days			
					Bidding document approved by DPI		5 days			
					Advertisement in newspapers		3 days			
					Proposal submitted to PMU by firms		3 weeks			
					Technical proposal evaluated by PMU		10 days			
					Technical evaluation approved by DPI		3 days			
					Financial Proposals public opening by PMU		2 days			
					Financial Proposals evaluated by PMU		5 days			
					Financial Evaluation results approved by DPI		3 days			
					Contract signing PMU - consultants		7 days			
					Advance Payment (20% completed by PMU)		7 days			
					Technical Design completed by consultant		90 days			
					Technical design appraised by independent consultant		30 days			
					Technical edsign revied and commented by LIC		14 days			
					Design revisions by consultant		14 days			
					Revised design endorsed by PMU/LIC		14 days			
				Technical design appraised by DPI		3 month				
				Technical design approved by PPC		14 days				
				Payment up to 90-% of contract value		7 days				
				Last paymentof 10% to consultant by PMU						
Land Acquisition and Resettlement					Contract signed between PMU and CLD					
					Inventory completed by CLD		30 days			
					Compensation plan prepared by CLD		30 days			
					Compensation plan publiced by CLD		30 days			
					Compensation plan approved by CPC		30 days			
					REMDP updated by LIC		14 days			
					Updated REMDP submitted by CPMU to ADB		7 days			
					Comment of ADB for updated REMDP provided to PMU		7 days			
					REMDP finalized LIC & resubmitted by PMU to ADB		7 days			
					Updated REMDP approved by ADB		7 days			
					Compensation delivered by CLD and PMU		3 weeks			
					LIC checked and submitted report to ADB		30 days			
				Last payment (10%) done by PMU to inventory consultant		30 days				

Prov:	Cost Estimates (VND mil.)			Implementation Status	Detailed Implementation Plan			Progress Report Status Update - Q** - 20**		
	Total	ADB Loan	C. Fund		Task	Deadline	Project Management Service Standard	Implementation Vs Planning		
Subproject:								Achieved	Delayed	Action
Output 1:								Yes/No	Revised date	
Rehabilitation and upgrade of the road connecting from the center of Pac Nam district, Bac Kan province with Son Lo, Bao Lac district, Cao Bang province										
Construction supervision consultant (across all subprojects) Procurement starts within 1 month of Loan Signing					Procurement based on draft BD's prepared by PPTA					
					BDs revised updated submit by PMU to DPI		7 days			
					BDs approved by DPI		10 days			
					BD/ToR forwarded to ADB for CMS uploading (STP)		7 days			
					CMS uploading by ADB		3 days			
					Proposals submitted by consulting firms forwarded to PMU		21 days			
					Technical proposals evaluated by PMU		3 weeks			
					Technical evaluation results approved by PMU/DPI		10 days			
					Financial proposals opened publicly by PMU		5 days			
					Financial proposals evaluated by PMU		7 days			
					Financial evaluation results approved by DPI		7 days			
					Contract signed between PMU and consultants		10 days			
					Advance payment (20% of contract) done by PMU		30 days			
					Second payment (20% of contract) done by PMU		1 year			
					Third payment (20% of contract) done by PMU		1 year			
					Fourth payment (20% of contract) done by PMU		1 year			
					Contract expired		60 days			
					Last payment (20% of contract) done by PMU		300 days			
Civil works					Bidding documents prepared by DED consultant					
					Bidding documents submitted by PMU to DPI		7 days			
					Bidding documents submitted by DPI to ADB		2 weeks			
					Bidding documents commented by ADB		2 weeks			
					Revised bidding documents submitted by DPI to ADB		7 days			
					Final bidding documents approved by ADB		7 days			
					Bidding documents approved by DPI/PPC		5 days			
					Advertisement placed on ADB website/newspapers		10 days			
					Bid opening ceremony organized by PMU		30 days			
					Bid evaluation completed by PMU		45 days			
					BER submitted by PMU to DPI		7 days			
					BER submitted by CPMU to ADB		30 days			
					BER reviewed and commented by ADB		2 weeks			
					BER revised by PMU and resubmitted by DPI to ADB		30 days			
					Revised BER approved by ADB		7 days			
					BER approved by DPI		10 days			
					Contract signed by PMU and contractor		10 days			
					Advance payment (20% of contract) done by PMU		30 days			
				Second payment (20% of contract) done by PPMU		90 days				
				Third payment (20% of contract) done by PPMU		120 days				
				Fourth payment (10% of contract) done by PPMU		120 days				
				Civil works completed by the contractor						
				Quality of civil works checked by consultant		30 days				
				Civil works handed over to the end user		31 days				
				Fifth payment (15% of contract) done by PPMU		31 days				
				Warranty payment (5% of contract) done by PPMU		365 days				

Prov:	Cost Estimates (VND mil.)			Implementation Status	Detailed Implementation Plan			Progress Report Status Update - Q** - 20**		
	Subproject:	Total	ADB Loan		C. Fund	Task	Deadline	Project Management Service Standard	Implementation Vs Planning	
Achieved				Delayed					Action	
Output 1:								Yes/No	Revised date	
Rehabilitation and upgrade of the road connecting from the center of Pac Nam district, Bac Kan province with Son Lo, Bao Lac district, Cao Bang province										
Subproject planning and implementation activities					FS appraisal fees					
					Last payment done for TOR & cost estimates for FS					
					Last payment done for FS monitoring survey					
					Appraisal fee for feasibility of investment					
					Last payment done for preparation of EIA					
					TOR & cost estimates for technical design					
					RFP preparation					
					Detailed design monitoring survey					
					Appraisal consultant of detailed design & cost estimates					
					Appraisal fees for detailed design & cost estimates					
					BD preparation & assessment & appraisal fees					
					Last payment done for English translation fee					
					Evaluation results appraisal fees					
					Monitoring and assessment fee for investment					
					Quality of civil works checked by consultant					
				Document file fee						
				Others						
Subproject audit			0	Not yet due.	Subproject audit completed					
Subproject liquidation			0	Not yet due.	Subproject liquidation completed					
Subtotal	0	0	0		Subproject Completion Date					

E. Annex 5: Indicative Progress Report – Table of Contents

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F. Annex 6: GAP Monitoring Table

Project/Loan number: yyyy

Project title: xxxxxxx

Date of report or cut-off date of report:

Gender strategy	Target/action	Progress to - date	Issues/ recommendations.
Output 1			
	A1.1. T1.1. ...		
Output 2			
	A2.1 T2.1. T2.2. ...		
Output 3			
	A3.1 ...		

G. Annex 7: Guidelines for Incorporating Climate Change Risk in the Detailed Engineering Design of Road Subprojects

ABBREVIATIONS

ADB	:	Asian Development Bank
amsl	:	Above mean sea level
BIIG	:	Basic Infrastructure for Inclusive Growth
CC	:	Climate Change
CCA	:	Climate change adaptation
cm	:	Centimeter
CMIP	:	Coupled Model Intercomparison Project
CO ₂	:	Carbon Dioxide
CRVA	:	Climate Risk and Vulnerability Assessment
CSIRO	:	Commonwealth Scientific and Industrial Research Organisation
DED	:	Detailed design and engineering
dia	:	Diameter
DPI	:	Department of Planning and Investment
EA	:	Executing Agency
EARF	:	Environmental Assessment and Review Framework
EVA	:	Extreme Value Analysis
GCM	:	Global Climate Model
GEV	:	Generalized Extreme Value probability distribution
GHG	:	Greenhouse gas
IMHEN	:	Institute of Meteorology, Hydrology and Environment of Vietnam
IPCC	:	Inter-Governmental Panel on Climate Change
m	:	Meter
mm	:	Millimeter
m ³ /sec	:	Cubic Meters Per Second
MoNRE	:	Ministry of Natural Resources and Environment
MoST	:	Ministry of Science and Technology
NTP	:	National Target Program to Respond to Climate Change
PDF	:	Probability Distribution Function
PPC	:	Provincial People's Committee
PPMU	:	Provincial Project Management Unit
PPTA	:	Project Preparation Technical Assistance
PRECIS	:	Providing Regional Climates for Impacts Studies (climate model)
RCM	:	Regional Climate Model
RCP	:	Representative Concentration Pathway
SLR	:	Sea Level Rise
SRES	:	IPCC Special Report on Emission Scenarios
TCVN	:	Vietnam National Design Standard
W/m ²	:	Watts per square meter
WMO	:	World Meteorological Organization

SUMMARY

224. The Basic Infrastructure for Inclusive Growth Projects will be implemented in eight provinces in the north-eastern and north-central sub-regions of Vietnam (BIIG-1 and BIIG-2, respectively).²² They are to be executed by each Provincial People's Committee (PPC) as Executing Agency, with their respective Departments of Investment and Planning (DPI) designated as project owners. The expected outcome is improved subregional competitiveness through increased productivity, services delivery, and movement of goods and people.

225. Using ADB's sector project modality, representative subprojects from the range of different types of infrastructure were selected during project preparation to establish the feasibility of proposed investments using a preliminary design and cost estimate. The feasibility test includes an assessment of climate risk and vulnerability of the representative subprojects.

226. The climate risk assessment identified the roads and bridges as vulnerable infrastructure elements due to increased flood risk. The assessment recommends that detailed engineering designs incorporate increased flooding risk due to climate change. The following report describes an approach for including climate change in the detailed design of roads and associated structures.

227. These guidelines serve two purposes. First, they provide background understanding on the rationale for re-assessing design flood levels to consider climate change impacts based on climate modeling projections. Second, described here are steps to guide DED practitioners in adjusting design flood levels.

228. Government road design standards specify the estimation of design flood levels based on a frequency of occurrence (return period). These are set according to the road category and type of structure, both of which reflect local site conditions and forecast traffic volumes. The estimated design flood level then determines the road embankment elevations, road drainage provisions, and vertical clearance of bridge decks.

229. The following guidelines do not change the existing national standards. The objective, rather, is to provide a cost-effective option to adjust design flood levels using existing design frequencies and hydrological formulas— by *moving historical climate records in setting input parameters to the formulas and models to using projected climate records inclusive of climate change*. Scientific climate change projections need to be factored into the design process.

230. Climate modeling data for the RCP 8.5 scenario is used for deriving the climate change projections.²³ This scenario represents the most conservative²⁴ assumptions on limiting future global greenhouse gas emissions. RCP scenarios diverge in their projected atmospheric CO₂ concentrations beginning about 2040s. For the proposed BIIG-1 and BIIG-2 infrastructure design economic life is up to the mid 2030's, for which projected climate change should be consistent across RCP scenarios. However, a review of projected data found some inconsistency in the RCP 4.5 scenario data relative to the other scenarios. Taking this

²² BIIG-1 covers four North-Eastern provinces of Bac Kan, Cao Bang, Ha Giang and Lang Son; BIIG-2 covers four North-Central provinces of Ha Tinh, Nghe An, Quang Binh, and Quang Tri.

²³ Representative Concentration Pathways (RCPs) reflect the degree to which GHG emissions are actively mitigated, stabilized or increased. The four RCP scenarios are identified by their total "radiative forcing", which is the difference between solar energy absorbed by the Earth and the energy radiated back to space. It is measured in watts per square meter (W/m²) projected in year 2100 relative to 1750.

²⁴ Conservative in the sense that this scenario assumes there may not be much success in curtailing global greenhouse gas emissions over the coming decades.

inconsistency into account, and considering the risk mitigation objective of the guidelines, the RCP 8.5 climate change projections were applied.

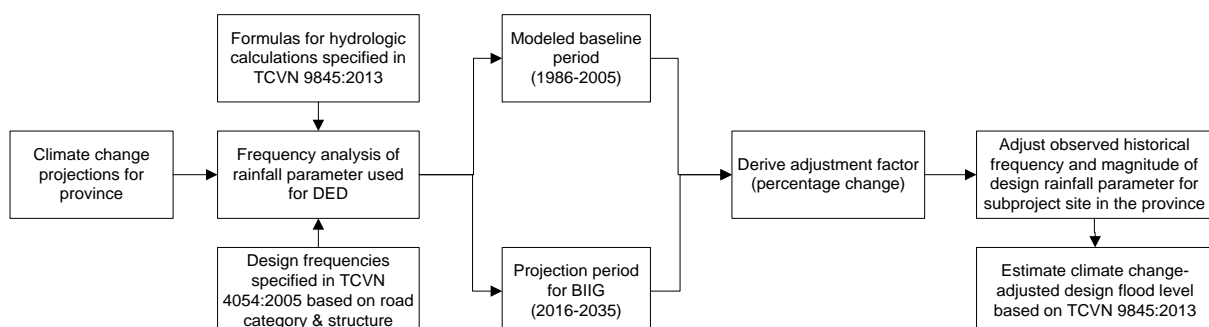
231. Projections indicate that future rainfall intensities are likely to increase. In the BIIG provinces, model-derived projections indicate significant increases in extreme rainfall especially for BIIG1 provinces. The risk of relying on unadjusted historical rainfall for design purposes is that the structures would likely be under-designed and vulnerable to frequent disruption and damage during operation. Managing this risk is now a priority in the Government's transport sector policy framework.

232. Design rainfall adjustments presented in part one of these guidelines are for road component structures with design frequencies set at a return period of 25 years or less. For larger structures with design frequencies involving 50 or 100-year return periods (e.g., large bridges), adjustments are necessary though this may require different estimation approaches involving more complex hydrodynamic modelling solutions. An approach for dealing with such structures will be added as Part 2 of these guidelines for inclusion in the BIIG1 and 2 Project Administration Manual.

233. The two most important sets of national standards relevant to the engineering design of roads and bridges are TCVN 4054:2005 and TCVN 9845:2013. The former applies to the design of roads and highways in general, including new construction and rehabilitation of existing roads. Its scope also includes both urban roads and rural roads. The most important aspect of this standard is that it specifies the design frequency (return period) to be used in estimating design flood levels, depending on the road classification and the type of component structure.

234. TCVN 9845:2013, on the other hand, specifies procedures and formulas for hydrologic calculations used to determine the level of road embankments, drainage specifications and clearance of bridges above the design flood level. The formulas are based on the one-day maximum rainfall intensity. After the design frequency for a structure has been determined with reference to TCVN 4054:2005, the hydrologic calculations based on that frequency are done with reference to formulas specified in TCVN 9845:2013.

235. These guidelines develop, for the required design frequency levels up to P4 specified in the national standard, estimates of daily maximum rainfall for the historical baseline and for the period to 2035 that uses climate change projections. This data is then applied to generate the expected flood levels and design requirements. Steps for carrying out such adjustment are described in the guidelines. The framework is shown below.



236. Statistical modeling using extreme value analysis was applied to derive design rainfall adjustment factors for each BIIG province. The frequency analysis used the Generalized Extreme Value (GEV) probability distribution function, which showed the best fit to the data for the BIIG provinces.

237. Following the method above, annual one-day maximum rainfall data were extracted from the climate model baseline²⁵ simulation and the climate projection for each province. The *one-day maximum rainfall* estimated at various frequency levels (using the fitted probability distribution) were compared between the two periods. For any given design frequency, rainfall values corresponding to the modeled baseline and the projection period were then used to calculate *percentage changes* (adjustment factors). The results then used to adjust the actual *historical* rainfall values derived from observation data applicable to a specific subproject site. Adjustment factors derived for each province are provided in the guidelines.

238. To illustrate use of the guidelines, adjusted extreme daily rainfalls were applied to three representative subprojects to assess the extent of modification required—that is, to compare with the unadjusted conventional design using only historical rainfall data. The cases were selected to represent the range of road categories and terrain among the BIIG subprojects. The impact on the design of using one-day maximum rainfall adjusted for climate change are summarized below:

- An increase of 0.81 to 0.87 meter in water elevation at 5 small bridge locations for the Dinh Son – Anh Son mountain road in Nghe An province. The dimensions of 6 of the 25 culvert locations were increased based on the adjusted design flows. For example, at a stream located at Km2+759 the flow increased from 5.17 to 7.37 m³/sec, with the dimensions of the proposed slab culvert increasing from 150 x 150 cm to 200 x 200 cm.
- For the Bao Ninh – Hai Ninh coastal road in Quang Binh province, the P4 design flows at two culvert sections increase by around 34% after adjusting the P4 value derived from historical record. The flood water elevations increased by 0.5 to 0.6 meter, requiring both an increase of culvert size and a need to raise the height of the road embankment.

239. For the Boc Bo - Bang Thanh - Son Lo Road in Bac Kan province, the design flood flow at 4 small bridge locations increased by 36% to 119%. Flood water elevations at P4 frequency increased by 0.2 to 2.26 meters after adjustment.

²⁵ The term “baseline climate” is used to refer to the modeling simulation of the past climate, while the term “historical climate” is used to refer to the real climate as observed in the past by monitoring stations.

I. INTRODUCTION

A. Background

240. The two Basic Infrastructure for Inclusive Growth (BIIG) Sector Projects include BIIG-1 in four north-eastern provinces (Bac Kan, Cao Bang, Ha Giang and Lang Son) and BIIG-2 in four north-central provinces (Ha Tinh, Nghe An, Quang Binh and Quang Tri). The Projects' Executing Agency will be the Provincial People's Committee with their Departments of Investment and Planning (DPI) designated Project Owners.

241. The projects' expected outcome is to enhance opportunities for inclusive economic growth through improved transport infrastructure (roads and bridges), improved services (water supply, agricultural productivity), and professionally managed provincial infrastructure. Using ADB's sector project modality, representative subprojects were used to assess each Project's feasibility during project preparation. A climate risk and vulnerability assessment (CRVA) examined the likely effects of climate change on the representative subprojects based on their preliminary engineering designs.²⁶ Findings identify roads and their structures such as bridges to be the most vulnerable due to projected increased intensity of rainfall leading to increased flood water levels.

242. Climate change is not explicitly included in Vietnam's engineering design standards for roads and bridges. The standards include hydrologic calculations of the design flood levels that are then used to inform the design. The existing standards provide engineering formulas wherein rainfall intensity is a key input that can potentially be adjusted for climate change impacts on flood levels. The following guidelines provide an approach and estimates for adjusting the design rainfall intensity at various frequencies or return periods corresponding to the road classification and type of structure.

243. Design flood levels, determined from hydrologic calculations based on peak rainfall, are used for the technical specifications of road component structures including drainage and bridges. The one-day maximum rainfall is used as a key determinant of flood levels for a specified frequency of occurrence (i.e., equivalent to return period). The frequency of occurrence is specified in Government regulation TCVN 4054:2005 for differing categories of roads and for differing bridges sizes. The design flood levels are then used to determine road level/elevation, road drainage provisions, and vertical clearance of bridge decks above the floodwater level. Currently historical daily maximum rainfall data is applied to estimate the design flood levels for each frequency or return period specified.

244. Overall, climate change scenarios future extreme rainfall events are projected to increase in magnitude for any specified frequency or return-period.²⁷ Reliance on historical rainfall and past flood events will therefore increasingly underestimate future flood levels. The risk of using solely historical data for engineering design purposes to estimate flood levels is that the resultant structures may be increasingly vulnerable to recurrent damage or the increased potential for some structures to fail.

245. These guidelines provide a method for reducing these risks by applying climate change-adjusted rainfall projections within the hydrological formulas used to estimate future (frequency-based) peak flows and flood levels. The underlying set of design standards do not

²⁶ The CRVA was framed to answer: (i) what climate parameters are critical to infrastructure performance and durability? (ii) how are these critical climate parameters projected to change over the project life? (iii) are existing/similar assets already being affected by increasing climate variability and extremes? (iv) what non-climate factors aggravate or mitigate climate change impacts (v) how vulnerable is the infrastructure? (vi) what measures should be incorporated in the detailed design of the subproject?

²⁷ An equivalent statement is that the frequency or return period will be shorter for any given extreme rainfall magnitude.

require change the guidelines simply adjust the required input data to maximum daily rainfall expected by mid-century.

B. Purpose and scope of guidelines

246. The following report serves two purposes. The first part provides the rationale for adjusting design flood estimates based on climate modeling projections produced by MoNRE.²⁸ The second part describe steps that DED practitioners can apply to adjust design flood levels for climate change based on design frequencies and hydrological formulas specified in existing national standards.

247. Annex A presents the climate modeling for Viet Nam, and Annex B summarizes the projections for Vietnam. Annex C presents formulas specified for estimating the design flood. Annex D gives details on the extreme value analysis method used to derive rainfall adjustment factors. Annex F gives results of recalculating the engineering specifications of road component structures using climate change-adjusted rainfall applied to 3 case study subprojects. Annex G gives an overview of hydrological modeling, which is suited to designing structures requiring more extreme design frequencies (e.g., P1).

248. The guidelines apply current government standards which stipulate the design frequencies, depending on the road category and type of component structure,²⁹ for hydrological parameters (flood volume, water level and water velocity) used to determine the road embankment level, drainage system provisions, bridge clearances and structural supports, and allowable overflow depths on spillway crossings.

249. The objective of the guidelines is to provide a cost-effective means for adjusting design flood levels using existing design frequencies and hydrological formulas using forward projections rather than solely relying on historical climate records.

250. The scope of the design rainfall adjustment factors recommended in these guidelines is for road structures with design frequency levels set at a return period of 25 years or less (P4 to P10). For larger structures with design frequencies involving return periods of 50 years (P2) or 100 years (P1), such as large bridges, adjustments are necessary though this may require different estimation approaches involving more complex hydrodynamic modeling solutions or comparative analysis using similar watersheds.³⁰

II. Projected climate change in BIIG-1 and BIIG-2 provinces

A. Climate change modeling approach

251. The following section describes the climate change modeling studies used to obtain climate change projections at province level. Additional technical details are provided in Annex A. The rainfall adjustment factors provided in these guidelines are derived from analysis of model-generated climate change projections.

252. Global climate change models (GCMs) use greenhouse gas emission scenarios to project climate change in the medium to long term. These scenarios define alternative greenhouse gas (GHG) emission levels with typically four CO₂ atmospheric concentration

²⁸ For brevity, only a summary of climate change projections is presented in the guidelines. Details are found in the CRVA report for each sub-region.

²⁹ The notation Px (e.g., P4) refers to an extreme weather event with x% probability of being equaled or exceeded in any one year. The corresponding return period or recurrence interval is the reciprocal of the exceedance probability.

³⁰ A future addition to the guidelines is planned to include adjustment for medium and large bridges, including use of appropriate hydro-dynamic models. An overview of such models is given in Annex G.

trajectories reported for climate change policy known as Representative Concentration Pathways (RCPs). The projections from RCPs are then used as inputs to GCMs in generating climate change projections. GCMs simulate the processes and feedback loops between components of the climate system at global scale. GCMs typically model at low spatial resolutions (more than 200 km) due to computing requirements.³¹

253. The differing climate research institutions that develop and run these climate models use differing assumptions of the global climate system, resulting in differing climate projections for the same RCP scenario between models. The extent of agreement of the projected direction and magnitude of climate change across multiple models is considered indicative of the “robustness of projections”.

254. Global climate models continue to be improved and increasingly are capable of producing higher resolution projections³². Currently existing GCM outputs remain unreliable at sub-regional levels or below. Locations with rugged topography and elevation differences that strongly influence climate, as in the case of BIIG-1 north-eastern provinces, limit the direct use of existing GCM outputs. To increase the reliability of climate change impact assessments at sub-regional or provincial scale, higher-resolution climate change projections are needed to transform GCM output into local or regional projections.

255. Downscaling or “regionalization” produces higher-resolution climate projections derived from low-resolution GCM outputs at a *scale* of 50 km or less. Such downscaling provides a more precise representation of the effects of local geographic features, such as mountain topographies – increasing their applicability and reliability for local planning.

256. *Dynamical* and *statistical* downscaling methods are used. In dynamical downscaling, a regional climate model (e.g., PRECIS³³) is run for a delineated sub-region in which the boundary conditions are derived from a parent GCM. In statistical downscaling, analysis is based on statistical properties of the historical climate at observation stations that are correlated with gridded coarse-scale GCM baseline projections. (Refer to Appendix A for additional explanation on downscaling methods).

B. Viet Nam Climate Change Projections

257. Outputs from five regional climate models have been used by MoNRE’s Institute of Meteorology, Hydrology and Environment (IMHEN) to develop downscaled climate change projections for Vietnam.³⁴ Each of the five regional climate models used input data from the output of one or more low resolution or “parent” GCMs. Among the five regional climate models studied by MoNRE,³⁵ the output of the PRECIS regional climate model is considered the most reliable and was run using data from the CNRM-CM5, GFDL-CM3 and HadGEM2-ES GCM

³¹ A primer on how climate models work, based on expert consensus, is available at the website of the US National Research Council's Board on Atmospheric Sciences and Climate: <http://nas-sites.org/climate-change/climate-modeling>. For a more technical description, refer to Chapter 9 of the IPCC’s Assessment Report No. 5 (2013): Evaluation of Climate Models.

³² Improvements in climate modelling are heavily reliant on the computing power provided by supercomputers, such as the Earth Simulator in Japan.

³³ PRECIS was developed at the UK Met Office Hadley Centre with the purpose of enabling users in developing countries to easily produce detailed climate projections for any chosen region of the world.

³⁴ Ministry of Environment and Natural Resources. Climate Change and Sea Level Rise Scenarios for Vietnam. Hanoi, 2016. The summary report is in English; the full report in Vietnamese. Details of MoNRE’s 2016 climate change database and how it was set up are described in Annex A, which also provides a guide on interpreting the scenarios and modeling outputs.

³⁵ Referring to page 39 of the MoNRE climate change full report indicated that the results of rainfall calculations show differences between the models for climatic regions of Vietnam, and that the PRECIS model gave results that were judged more reliable compared with the other models.

models. The regional climate models produced three sets of high-resolution climate projections under each particular regional climate model.

258. For these guidelines, the output from the three GCMs downscaled using PRECIS are used to generate forecasts of future daily maximum rainfall at various frequencies under climate change conditions. These projections relative to the current baseline climate conditions are used to develop the adjustment factors.

259. MoNRE's database on downscaled climate projections for Viet Nam used two of the four RCP CO₂ concentration scenarios, namely: RCP 4.5 representing a CO₂ concentration pathway based on moderate levels of GHG emissions mitigation, and RCP 8.5 which represents the pathway without effective mitigation of future GHG emissions resulting in strong warming by the end of century.

260. In terms of projected atmospheric CO₂ concentrations, the RCP 4.5 and 8.5 scenarios differ little up to 2040. Thereafter, their projections diverge as emission levels under RCP 4.5 assumptions stabilize, emission levels under RCP 8.5 continue to increase. Given that the purpose is to mitigate risk of climate change by ensuring that infrastructure engineering design is resilient, these guidelines apply climate projections derived from RCP 8.5.

261. Data for each of the BIIG-1 and BIIG-2 provinces from the downscaled model projections for the annual maximum daily rainfall covering the (i) baseline (1986 to 2005), (ii) early century (2016 to 2035), and (iii) mid-century (2046 to 2065). These were used in the climate risk and vulnerability assessments up to mid-century for the two BIIG projects.

262. The need for climate change risk adjustment is demonstrated for the BIIG1 and 2 project provinces with the projected daily maximum rainfall compared to the current baselines rainfall levels – see Table 54. The annual daily maximum rainfall within the average of three PRECIS-downscaled GCMs³⁶ under the RCP 8.5 scenario to increase in all provinces with more intense wet season rainfall.

Table 54. Projected change in extreme rainfall in BIIG-1 and BIIG-2 provinces (%)

Province	Annual max 1-day rainfall		
	Baseline 1986-2005 (mm)	2016-35 (% of baseline)	2046-65 (% of baseline)
Bac Kan	101	+47	+58
Cao Bang	92	+41	+58
Ha Giang	151	0	+17
Lang Son	102	+77	+65
Nghe An	215	+29	+35
Ha Tinh	288	+23	+18
Quang Binh	207	+21	+26
Quang Tri	194	+38	+44

*zero means no change.

263. For these guidelines, the applicable period of analysis corresponds the economic life of BIIG-1 and BIIG-2 road infrastructure subprojects, which is up to the mid-2030's. Specifically, one-day maximum rainfall adjustment factors are derived to adjust baseline maximum one day rainfall for input to the design rainfall intensity in the TCVN-specified hydrological formulas for estimating design flood levels.

³⁶ A modeling run refers to a downscaling application of PRECIS to a global climate model. In this study, PRECIS was used to downscale 3 GCMs: CNRM-CM5, GFDL-CM3 and HadGEM2-ES. The tabulated values are the average from the three modeling runs.

264. The considerable differences between provinces for projected change in rainfall intensity support the recommendations from a recent hydrological study (Doan Thi Noi, 2016³⁷) that question the use of the 18 climate sub-regions³⁸ specified in TCVN 9845:2013. The use of a limited number of climate sub-regions results removes the significant variance between provinces leading to design bias.

III. Vietnam engineering design standards

A. Government-mandated engineering standards

265. The transport sector Climate Change Action Plan for the period 2016 to 2020, prepared by the Ministry of Transport (MoT, 2015) aims to continually assess the impact of climate change on the country's transportation system; identify suitable adaptation measures for transport construction works; and mobilize international resources to support the application the solutions to mitigate and adapt to climate change. In support of this plan, the MoT has issued supporting decisions to clarify objectives and pave the way for climate change impacts be addressed through improved road standards and specifications.³⁹ To date, no road-specific engineering design guidelines for climate change resilience have been issued.

266. In Vietnam, the Ministry of Science and Technology (MoST) is responsible for reviewing and approving national standards for application in various sectors. There are also sector-specific national standards, referred to as branch standards, such as those issued by MoT for the design of roads and bridges. Development of national standards is carried out by committees and working groups composed of technical experts and standards developers. After undergoing a series of draft preparation and review by stakeholders, the Ministry of Science and Technology exercises final authority to approve and issue the standard.

267. The two national standards relevant to the engineering design of roads and bridges are TCVN 4054:2005⁴⁰ and TCVN 9845:2013. The former applies to the design of roads and highways, including new construction and rehabilitation of existing roads. Its scope includes both urban and rural roads. Roads are categorized into classes based on expected traffic volumes.⁴¹ The standard specifies the design frequency (or return period) to be used in estimating design flood levels, depending on the classification of the road and the type of structures associated with it – see Table 2.

268. TCVN 9845:2013, specifies procedures and formulas for hydrologic calculations, which for roads are used to determine road embankment elevations, road drainage specifications and clearance of bridges above the design flood level. TCVN 9845:2013 is a consolidation of previous ministerial branch standards dealing with hydrologic calculations for water-based infrastructure, including those previously issued by the MoT pertaining to roads and bridges (e.g., 22 TCN 272-05 for bridges).

³⁷ Doan Thi Noi, 2016, English summary of PHD thesis titled "Research on rainfall - runoff changes and propose Scientific methodology to compute designed flood for transportation infrastructure in the northeast mountainous region of Viet Nam". Water Resources University, Hanoi Viet Nam.

³⁸ There are 18 climate subregions covering Viet Nam, as defined by MoNRE.

³⁹ MoT Decision No. 1456 / QD-BGTVT of 11 May 2016 clarified that the specific objective is to integrate the implementation of measures to improve resilience to climate change in transport investment projects, which is to be pursued in parallel with expanding the country's transport infrastructure.

⁴⁰ The coding of a national standard consists of three fields: the first field shows the letter code indicating the type of standard (for example, national standards are assigned the code TCVN). The second field contains a number that identifies the standard in the order of issuances, and the last field indicates the year when the standard was approved.

⁴¹ The previous version of TCVN 4054 (2005) was issued in 1998. This standard was developed by a Technical Subcommittee on Highway Transportation Works based on MoT's recommendations. The standard was approved by the General Department of Standard, Metrology and Quality Control of the MoST, which officially issued it.

269. A key parameter specified under TCVN 4054:2005 is the frequency of the one-day maximum rainfall, where Px represents the probability “x” with which an event is equaled or exceeded in any one year, and is equal to the reciprocal of the return period in years. The specified Px frequency level determines the magnitude of the design rainfall, which is used to determine the design flood level calculated using hydrologic formulas as provided in TCVN 9845:2013. The Px frequency levels are set according to the road category and type of component structure – see Table 55.

270. The guidelines use a projected maximum daily rainfall level for the required Px frequency specified in the national standard. The procedure for such adjustment is explained in Section IV below.

271. After the Px frequency for a structure has been determined with reference to TCVN 4054:2005, the hydrologic calculations based on that Px frequency use formulas specified in TCVN 9845:2013. To illustrate, under TCVN 9845:2013, the design water discharge at any given road location, e.g., a small bridge, is estimated using the formula below, in which the parameter X_{np} represents the one-day maximum rainfall amount at the Px frequency specified for the type of structure and classification of road.

$$Q_p = A_p \cdot \phi \cdot X_{np} \cdot F \cdot \delta_1 (m^3 / s)$$

272. Definitions of the other parameters in the formula above, including other hydrologic formulas that depend on the Px parameter, are shown in Appendix C. These formulas were applied to three representative BIIG subprojects (details shown in Appendix F) as case studies to demonstrate the effect of adjusting the design rainfall intensity for projected climate change. The guidelines use a projected maximum daily rainfall level for the required Px frequency specified in the national standard. The procedure for such adjustment is explained in Section IV below.

Table 55. TCVN 4054:2005 design frequencies (Px values) applied to different road categories and component structures

Component structure	Road category*		
	Expressway	1 and 2	3, 4 and 5**
Embankment and protection works	The design frequency is based on the calculated frequency for the associated/adjacent bridge or culvert		
Medium and large bridges ⁴²	P1	P1	P1
Small bridges and culvert crossings	P1	P2	P4
Intercepting and lateral (side) ditches	P4	P4	P4

*The road category is defined in terms of use and traffic forecast for the specific road section – lower category numbers (category 1 and 2) have higher traffic forecasts.

**The frequencies apply for both mountain roads and roads located on flat areas, i.e., “plain roads”.

273. Under certain conditions the Px design frequencies in Table 55 can be adjusted. These conditions are identified as: (i) technical difficulties in complying with the standard, the calculated frequencies may be relaxed (e.g., from P4 to P5) subject to approval by relevant authorities, although these are not identified, and (ii) if, during field investigation or surveying,

⁴² Large bridges are those with drainage aperture (or opening) exceeding 100 meters. Medium bridges are those with aperture between 25 to 100 meters. And small bridges are those with less than 25 meters aperture.

historic maximum flood water levels are found to be higher than the flood levels calculated through frequency analysis, the historic flood water is to be used, especially for designing large bridges. No opportunity is provided to adjust the design frequencies for financial budget or cost constraints.

274. Further adjustment is available for category 5 roads only. For category 5 the road elevation may allow the road to be overtopped. This applies to crossings⁴³ over a wide and flat river bed with shallow depth, over waterways where water is not fast-flowing, and at localized depressions. Such “submersible” road sections can be combined with culverts (usually box-type) to allow water to pass underneath and reduce water depth over the crossing. The maximum permissible water depth above the top of submersible road sections are specified in terms of expected water velocity at the crossing and the type of vehicle – see Table 56.

Table 56. Allowable maximum depths for submersible crossings within Category V roads (meters)

Water velocity in meters per second	Allowable maximum depth above the submersible road section		
	Cars	Chained vehicles	Non-motorized vehicles
Less than 1.5	0.5	0.7	0.4
Between 1.5 to 2.0	0.4	0.6	0.3
More than 2.0	0.3	0.5	0.2

B. Climate resilient planning and design challenges

275. Design engineers in Vietnam are aware of climate change issues, but they find it difficult to incorporate climate change effects for a variety of reasons: a lack of measured flow and flood level data for the vast majority of rivers, difficulty in accessing projections data on daily maximum rainfall or flood levels, the additional costs incurred by local design consultants that are not reflected in the detailed design cost norms followed in the sector, and the perceived uncertainty surrounding the considerable range of projections derived from different climate change models and scenarios.

276. The future magnitude of rainfall change remains uncertain,⁴⁴ however, the direction of change (that of increasing rainfall intensity) appears unequivocal. While available climate models do not reliably predict rainfall extremes at local (site-level) scale, the scientific basis for intensifying extremes is well-established and there is consensus among climate models for increased rainfall intensity.

277. The guidelines provide an affordable procedure to incorporate climate risk into the design of site-specific infrastructure. The guidelines are presented in two Parts. Part One presents the recommended approach for small structures or roads categories 3, 4, and 5 the require P4 and P10 frequency for estimation of flood levels. Part Two provides guidelines for structures requiring P1 and P2 frequency levels in the estimation of flood and flow rates.

⁴³ Also referred to as “spillway” crossings in the subproject feasibility studies.

⁴⁴ Change in rainfall intensity, in particular, cannot be predicted with precision and accuracy at sub-regional scale, but always within a range of uncertainty.

IV. Frequency analysis for adjusting the design rainfall

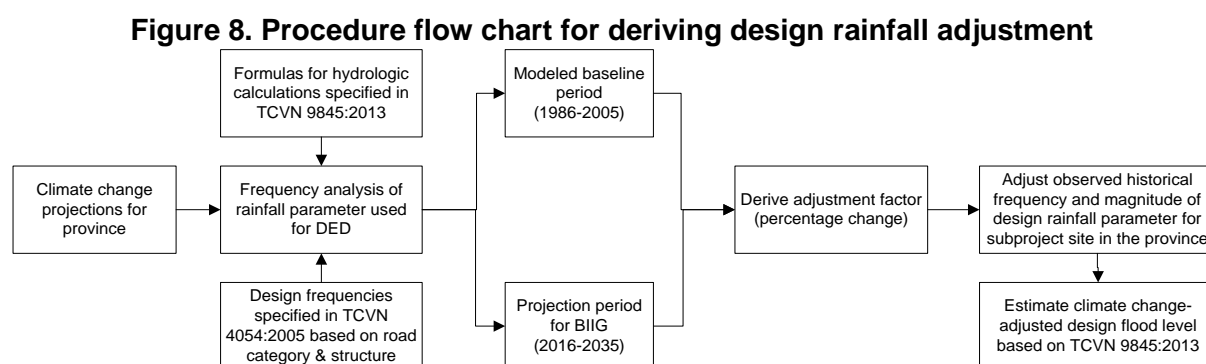
A. Extreme value analysis method

278. Extreme value analysis (EVA) provides a method for the analysis of rare events that lie in the tails of probability distributions. EVA estimates the probability of events that are more extreme than may have previously been observed. The following section presents the use of this analysis to estimate projected daily maximum rainfall adjustments for a P4 rainfall intensity that is applied in the TCVN engineering design formulas to estimate design flood levels for basic structures (road embankments, drainage system, spillway-crossings, and small bridges) associated with road categories 3, 4 and 5.

279. Rainfall intensity-frequency-duration (IFD) relationships are currently derived from historical rainfall records and assume future rainfall will mirror the *statistical* characteristics of the historical rainfall record. Climate modeling projections invalidate this assumption with climate change suggesting historical rainfall IFD relationships are likely to be increasingly unreliable predictors of future flood levels.

280. As explained in Annex D, extreme value analysis used a *Generalized Extreme Value* (GEV) probability distribution function that provided the best fit to data according to statistical tests using the BIIG datasets. Annex D also explains the underlying theory and procedure for fitting statistical models based on extreme value analysis. For these guidelines, the analysis used modeled rainfall data—specifically, the climate models and climate change scenario explained above.

281. The random variable used for the extreme value analysis was the annual one-day maximum rainfall data extracted from the climate model baseline⁴⁵ simulation (1986-2005) and the climate projection for 2016-2035 based on RCP8.5. Daily maximum rainfall at a range of frequency levels derived from the GEV probability distribution function were compared between the two periods. For a given Px frequency level, values corresponding to the maximum daily rainfall in the modeled baseline period and in the projected period were used to calculate percentage adjustments. The percentage adjustments are used to adjust values derived from conventional frequency analysis of historical rainfall data for the site – see Figure 8. The steps are further explained below, and results for each province are tabulated and charted in Appendix E.



⁴⁵ In these guidelines, the term “baseline climate” is used to refer to the modeling simulation of the past climate, while the term “historical climate” is used to refer to the real climate as observed in the past by monitoring stations. A climate model’s predictive ability is fine-tuned by adjusting its baseline simulation so that it matches the historical climate as much as possible.

B. Note on Interpreting frequency probability and return periods

282. The P_x notation used in the TCVN standards represents the probability of an event being equaled or exceeded in any one year. The theoretical return period is the reciprocal of that probability. For example, a 25-year event has a $1/25=0.04$ or 4% chance of being equaled or exceeded in any year, denoted by P_4 .

283. A 25-year event does not mean that it will happen regularly every 25 years, or only once in 25 years. Even though the term "return period" connotes a fixed interval, it is not. In any given 25-year period, a P_4 or 25-year event may occur once, twice, more, or not at all, and each outcome has a probability that can be computed.⁴⁶

284. Ten or more years of data are ideally required to perform a frequency analysis for determining return periods that can be supported statistically. A longer time series increases the reliability of the frequency analysis and provides more confidence in the results. The extreme value (frequency) analysis for developing these guidelines used a 20-year time series for each time block.

C. Proposed climate risk adjustment factor

285. Percentage adjustments recommended in these guidelines are applied to the Basic Infrastructure for Inclusive Growth Sector Project (I) and (ii) provinces. Annex E presents the estimated change between the baseline and projected future one-day maximum rainfall under RCP 8.5. Each province-level assessment is presented in one graph comparing five datasets - one for the baseline, one for of the three PRECIS model simulations projecting rainfall, and one being the average across the three projections. The proposed adjustment factor is the percentage change (increase) between the baseline and the average of the three modeling projections.

286.

⁴⁶ The probability P that one or more events occurring during any period (n) will exceed a given threshold can be expressed, using the binomial distribution, as $P = 1 - (1 - 1/T)^n$, where T is the threshold return period (e.g. 50-yr), and n is the number of years for the period being examined. Using this equation, there is approximately a 63% chance of one or more 100-year events occurring in any 100-year period. Using the equation, we can also calculate that the probability of a 100-year flood occurring during a 25-year period (say, the project life) is 22%.

Table 5757 (BIIG-1) and

Table 5858 (BIIG-2) present the percentage adjustment factors for one-day maximum rainfall across a range of Px frequency levels.⁴⁷ A feature of the datasets is significant differences in the level of adjustment between provinces highlighting the importance of downscaling climate change projections for a province rather than the 18 climatic zones used in the TCVN standard.

287. In summary, P4 frequency specified in TCVN 4054:2005 for the type of structure is used in the TCVN 9845:2013 hydrological formulas using one-day maximum rainfall as parameter to determine the design flood level, which is in turn used to design the road embankments, assess drainage system requirements, and estimate vertical clearances above the design flood level for small bridges.⁴⁸ The recommended adjustments are in terms of the percentage increases to be applied to the P4 rainfall amounts derived from actual/historical rainfall data for the site.

⁴⁷ Note that these values are derived from climate model data which use grid point values that are assumed to represent area averages. They should not be expected to closely match station-based climate data collected at specific sites (point values). However, their statistical properties (mean, variance) are expected to be similar.

⁴⁸ Note that the setting of the spillway top elevations for submersible crossings over shallow streams is based on P10 design frequency.

Table 57. Computed percentage increase relative to baseline 1-day maximum rainfall (BIIG-1)

Exceedance frequency	Return period, yrs	Province			
		Bac Kan	Cao Bang	Ha Giang	Lang Son
P20	5	51%	42%	4%	29%
P10	10	56%	49%	12%	39%
P5	20	61%	58%	22%	49%
P4	25	62%	61%	26%	52%
P2	50	67%	74%	39%	62%
P1	100	72%	91%	54%	72%

Table 58. Computed percentage increase relative to baseline 1-day maximum rainfall (BIIG-2)

Exceedance frequency	Return period, yrs	Province			
		Ha Tinh	Nghe An	Quang Binh	Quang Tri
P20	5	24%	34%	2%	24%
P10	10	27%	35%	9%	39%
P5	20	32%	37%	21%	58%
P4	25	34%	38%	26%	65%
P2	50	40%	42%	47%	91%
P1	100	48%	49%	78%	122%

288. Beyond P4, that is, for very low frequency events (P1 and P2) used for designing medium to large bridges, the computed percentage adjustments shown in Tables 57 and 58 may be unreliable. The sites of medium to large bridges typically involve relatively large drainage basin areas for which the relationship between P_x rainfall and P_x flood level may be weak.⁴⁹

V. Steps for adjusting design of structures requiring P4 to P10 frequency

A. Applying the guidelines

289. A step-wise implementation of the guidelines is presented below for adjusting the historically derived rainfall data for input to hydrological formulas specified in TCVN 9845:2013, specifically for structures that are required to be designed with P4 rainfall frequency.

- Determine from TCVN 4054:2005 the applicable P_x design frequency level for the road category and component structure being designed—specifically, identify those components requiring a P4 (or higher, e.g., P10) design frequency.
- From the subproject site's historical record of rainfall, assemble a time series of 1-day maximum rainfall (in mm/day) for a minimum of 10-years. In general, the return period being projected should not be more than about two times the length or duration of the time series data.
- Complete a data quality and verification check of the historical rainfall data to identify gaps and outliers. The data set needs to be fully populated if the fitted probability distribution function is to be robust. The sensitive nature of the distribution to the completeness of the time series often requires decisions regarding the inclusion or non-inclusion of outliers.⁵⁰

⁴⁹ There is also no significant correlation found between the time series pairs of annual maximum rainfall and maximum river flow/level in the historical data for large (gauged) basins in the BIIG provinces. Incongruent correlations of maximum rainfall and runoff can be expected where the basin is large, as earlier explained. In any case, P1 and P2 design flows/levels that apply to bridges that traverse rivers draining large basins are not customarily determined using empirical rainfall-runoff formulas, unlike for small basins in which the use of empirical formulas to relate (P4) peak rainfall to peak flow is applicable.

⁵⁰ Another approach is to calculate the P4 values with and without the outliers to assess the differences.

- Check for any “jumps”, or “outliers” outside gradual shifts in data values that may be caused by (non-climate) factors like station relocation, and changes in instrumentation or observation practices.⁵¹
- Calculate the Px daily maximum rainfall by conducting an extreme value frequency analysis⁵² of the historical data—that is, calculate the value corresponding to the required Px frequency level which serves as the historical reference value (that is, based on the existing climate) and which needs to be adjusted for climate change impact.
- Calculate the adjustment factor being the percentage increase in daily maximum rainfall for a given rainfall frequency as the change between the projected time period (specified as the economic life of the infrastructure) and the baseline data set.
- Adjust the historical reference value above using the percentage adjustment factor for the province in which the planned subproject is located (

⁵¹ This test is for so-called “stationarity” or time homogeneity. A non-stationary process has a variable variance and a mean that does not return to a long-run mean over time, whereas a stationary process reverts around a constant long-term mean and has a constant variance independent of time. Such changes are easy to identify by plotting the time series data and using an Excel built-in function to detect trend, if any.

⁵² Refer to Annex D, Section B, for the extreme value frequency analysis procedure using the Generalized Extreme Value probability distribution function and the equations used to estimate parameters.

- Table 57 and
- Table 58). To adjust the baseline value, simply add the adjustment factor (as percent increase in decimal) from the tables.
Adjusted design rainfall = (Historical reference value) x (1 + adjustment factor⁵³)
- Use the adjusted one-day maximum rainfall (corresponding the specified Px frequency level) as input to the hydrological formula in TCVN 9845:2013 to estimate the climate change-adjusted design flood level.
- Use the adjusted design flood level in the setting the technical specifications for the structure being designed.

B. An application of the guidelines to selected BIIG-1 and BIIG-2 subprojects

290. As a case study to highlight the impact of the P4 adjustment the estimated adjustment factor was applied to three BIIG1 and 2 representative road subprojects. These roads are all under categories 4 and 5. Adjustment factors for the one-day maximum rainfall parameter were applied in the hydrologic formulas specified in TCVN 9845:2013 to assess the impact on the engineering specifications for the road embankments, drainage systems and small bridges that are subject to P4 design frequency, as specified in TCVN 4054:2005. Adjustments to the P1 and P2 structures (medium and large bridges) were not calculated.

291. The case-subprojects are summarized in Table 5959.

Table 59. Subprojects selected to demonstrate effect of adjusting P4 design rainfall

Subproject	Features
Construction and upgrading of Boc Bo - Bang Thanh - Son Lo Road <i>Bac Kan</i>	Twenty-one km of existing rural road will be upgraded to <i>category 5 mountain road</i> meeting TCVN 4054-05 standards: 6.5 m road base width, 3.5 m surface width, and 1 m hard shoulder each side. Pavement is 3.5 cm <i>asphalt</i> , with 15 cm base and 18 cm sub-base. The road cuts through the slopes of hills with interweaving rock and soil formations. Six small slab bridges (6 m long) are to be upgraded, and 2 new medium-size bridges (33 m and 48 m) are to be constructed along the route. The P4 adjustment factor for this subproject was an increase of 62% above the historical baseline value of the one-day maximum rainfall (Table 57).
Dinh Son – Anh Son mountain road <i>Nghe An</i>	The existing 8-km asphalt road is badly degraded due to traffic volume and the axle weight of trucks. The traffic forecast indicates the need for a higher category IV road design and the project owner has agreed to apply this during the DED. The route passes through some densely populated sections, agricultural fields and flat lands. There are 3 existing bridges plus a causeway that will be replaced with a bridge. Longitudinal and cross gradients are not high, and the existing subgrade has been assessed as suitable. Surfacing will be with asphalt concrete. The P4 adjustment factor for this subproject was an increase of 38% above the historical baseline value of the one-day maximum rainfall (Table 58).
Bao Ninh – Hai Ninh coastal road <i>Quang Binh</i>	The existing coastal road is unpaved. The road is to be improved to support tourism access. Upgrading to category 5 plain road involves widening to 7.5 m, adding 2 layers of base (14 cm) and sub-base (16 cm), and surfacing with 7 cm of asphalt concrete. When finished, the 10.6 km road will have a road-top elevation ranging from 4.1 to 9.9 m above mean sea level. A new 600-m section will provide a commune bypass is to be constructed at the southern end of the alignment. Two spillway-culvert crossings will be replaced. Twenty-eight new culverts are proposed in addition to the 15 existing culverts. The P4 adjustment factor for this subproject was an increase of 26% above the historical baseline value of the one-day maximum rainfall (Table 58).

⁵³ Use the decimal value of the percentage increases shown in Tables 4 and 5.

292. The detailed results of applying the climate change-adjusted P4 design rainfall to the cases above are presented in Appendix F. The following case summaries highlight the important changes that result from the climate change-adjusted P4 one-day maximum rainfall parameter.

293. For the Boc Bo - Bang Thanh - Son Lo Road in Bac Kan Province, the design flood flow at four small bridge locations was increased by 36% to 119%. Flood water elevations at P4 frequency increased by 0.20 to 2.26 meters after adjustment, which will require raising the elevation of the road embankment at the corresponding sections. The changes in key design parameters of the four small bridges are shown in Table 60.

Table 60. Calculated changes to design parameters of small bridges in Bac Kan subproject

Site of small bridge	At P4 using historical rainfall data				At P4 under RCP 8.5 scenario			
	Q _P (m ³ /s)	H _P (m)	V _P (m/s)	L _o (m)	Q _P (m ³ /s)	H _P (m)	V _P (m/s)	L _o (m)
Khuoi Linh	39.5	64.0	1.91	7.9	53.7	64.2	2.22	8.6
Na Vai	111.2	92.1	0.44	31.6	224.0	93.9	0.73	31.3
Khuoi Man	75.6	148.0	1.17	23.4	165.5	149.1	1.67	24.9
Ban Man	75.7	144.6	1.18	23.8	163.1	146.9	1.17	24.6

Q_p is the peak flow rate; H_p is the peak water elevation; V_p is the peak water velocity; and L_o is the design aperture which is the sum of the internal widths between the bridge piers.

294. The recalculation of P4 flood water levels at five flood prone sections along the Dinh Son – Anh Son mountain road in Nghe An province resulted in an increase of 0.81 to 0.87 meter in water elevations. The results for the sections examined are shown in Table 61. At the small bridge location in Dong Dau (Km2+108.26), the calculated peak flow increased from 89 m³/s to 102 m³/s. Calculated floodwater level there at P4 frequency increased from 16.1 m using historical data to 16.9 m under RCP 8.5 climate change scenario. The corresponding design aperture of the bridge increased from 10.0 m to 12.3 m.

Table 61. Calculated changes in flood levels at flood prone sections in Nghe An road subproject

Flood-prone section (chainage)	Investigated location	Recorded highest flood levels (m)			P4 flood level based on historical rainfall data (m)	Adjusted P4 flood level under RCP 8.5 scenario (m)
		1988	1978	2011	H _p	H _p
Km2+020 - Km2+250	Km2+108.26	16.8	16.7	16.6	16.1	16.9
Km2+460 - Km2+904	Km2+759.40	16.9	16.7	16.7	16.1	16.9
Km4+123 - Km4+258	Km4+220.16	17.1	16.9	16.6	16.3	17.1

Flood-prone section (chainage)	Investigated location	Recorded highest flood levels (m)			P4 flood level based on historical rainfall data (m)	Adjusted P4 flood level under RCP 8.5 scenario (m)
		1988	1978	2011	H _p	H _p
Km6+742 - Km6+877	Km6+800	17.3	17.1	16.6	16.5	17.3
Km7+80 - Km7+340	Km7+110	17.3	17.1	16.6	16.5	17.4

295. At the Nghe An road subproject, the dimensions of the culverts at 25 locations were recalculated with results showing an increase in required culvert sizes at 6 of the 25 locations. For example, the calculated design flows at a stream located at Km2+759 increased from 5.17 to 7.37 m³/sec, resulting in sizing up the dimensions of the slab culvert from 150 x 150 cm to 200 x 200 cm.

296. For the Bao Ninh – Hai Ninh coastal road, the P4 design flows at two culvert sections increased by around 34% after applying the P4 climate change adjustment. The flood water elevations increased by 0.5 to 0.6 meter, which imply a need to correspondingly raise the level of the road embankment to provide adequate freeboard. The flow velocities at these two culvert locations increased by around 10%, indicating need to strengthen the culvert aprons and wing walls.

VI. Additional DED guidelines for climate resilience

297. As discussed above, preliminary engineering specifications for the road subprojects (and associated bridges), which were assessed to be the most vulnerable to climate change impact and which account for 75 to 80% of the project investment cost, need to be re-assessed during DED to check for robustness to higher design floods, based on hydro-climate projections derived from modeling. This adjustment is deemed as the most important climate resilience measure for the project.

298. Other road structure vulnerabilities were identified in the climate risk and vulnerability assessments done earlier for BIIG-1 and BIIG-2 which examined representative subprojects to identify specific concerns and corresponding response measures.

299. The most important of these concerns were found to be: (i) culvert placements and their fortification against increased water flows, (ii) road foundation strength and provisions to prevent water ingress and consequent structural deformation that would eventually extend to the surface pavement, (iii) slope stabilization for cut sections and road embankment sides, and (iv) provision of proper end-outfalls for lateral ditches. These concerns are related directly or indirectly to a critical climate change indicator identified in the CRVA—that of significantly increased future rainfall intensity as projected by models.

300. Another critical climate change indicator identified in the CRVA is increased heat wave duration. Climate modeling projections indicate longer durations of very hot weather (above 35oC), which is likely to have an impact on the required operating stiffness of flexible/asphalt pavements, and consequently their durability and resistance to deformation.

301. A list of other road component structures found vulnerable to climate change impact, including recommended measures to be taken during DED is provided in Table 62.

Table 62. Vulnerability and resilience measures for other road component structures

Item exposed and vulnerable to CC risk	Nature of CC risk/hazard	Reference to existing standards, and assessment of adequacy	Measures that can be taken during DED
Culvert placements	Increased water flow rates and water velocities associated with projected intensification of rainfall	Standards provide for various engineering safeguards in constructing culverts. These safeguards are adequate if the flow volumes and velocities are adjusted for higher rainfall intensities	Additional fortification of culvert sections in contact with fast flowing water, such as stronger foundations, extended aprons, and wider wing walls
Road foundations	Increased risk of water seepage into the road structure due to intensification of rainfall and flooding; exposure of the sub-grade to high water levels for extended periods	Structural requirements are provided in the standards for designing road embankments under different soil and geologic conditions. These are adequate if the design flood levels are properly adjusted for climate change	Embankment specifications depend on the estimated length of consecutive days to which the structure is exposed to high water level. This is likely to increase with climate change and should be accounted for during the DED
Cut slopes (related to new road alignments, or due to widening of existing roads for upgrading to a higher category)	Increased rainfall intensities will lead to increased risk of soil erosion and soil saturation resulting to potential slumping of scoured slopes, especially those	Engineering standards for cult slopes are set mainly according to the geology of the area and the depth of the required cuts to attain design grade. Consider also increased rainfall intensities and	The slope angles mandated in the standards (based on depth of cut and geology) can be maintained if slope protection measures are applied. These include various armoring solutions

Item exposed and vulnerable to CC risk	Nature of CC risk/hazard	Reference to existing standards, and assessment of adequacy	Measures that can be taken during DED
	located on non-cohesive soils	their impact of slope stability.	(e.g., retaining walls) in combination with bio-engineering measures where soil conditions allow
Drainage ditches	Increased rainfall intensities would result in higher flows, impounding water in ditches without proper outlets; water may penetrate through cracks and saturate the road foundation	The standards do not specifically address measures to prevent ditches from merely impounding water, and should be addressed during DED	Ditch designs should be checked during DED for proper provision of discharge outlets at their ends to prevent the ditches from merely impounding drainage water that may penetrate through cracks and saturate the road foundation
Asphalt pavements	Heat wave duration is projected to increase, which can adversely affect stiffness of asphalt	Specifications on flexible pavements are specified in branch standard 22TCN 211 (and as referenced by TCVN 4054:2005). However, specifications date back to 1993 and may need to be updated.	The DED should re-assess the sensitivity of the asphalt pavements, particularly the loss of stiffness caused by temperatures projected to be higher than those recorded in the past, and for longer periods.

302. The existing standard—in particular TCVN 4054:2005 and the technical branch standards referenced there—already specify measures for road construction that address the concerns above. These measures have been applied in the preliminary engineering design of representative subprojects. However, those preliminary designs were carried out without detailed information on the projected changes in critical climate parameters, notably the intensity of rainfall which is a key input to the engineering formulas used in designing structures. As such, the preliminary designs need to be adjusted, as illustrated in the three subproject cases described above. Also, the engineering safety measures specified in the standard that are relevant to climate resilience are only generally described; they would need to be elaborated or enhanced during the detailed engineering design work itself.

303. Items that need to be addressed more closely during the DED to incorporate climate change risk, with reference to the existing standard and to the critical climate parameters that need to be adjusted in applying the engineering guidelines and formulas, are explained below.

304. Culvert placements. Strengthened culvert foundations are important in view of increased water volumes and velocities associated with intensified future rainfall projected by climate models (see, for example, Table 61 on the Bac Kan subproject case). Fortification of culvert sections in contact with fast-flowing water will be important, particularly their foundation, aprons and wing walls. TCVN 4054:2005 specifies various engineering safeguards for constructing culverts (e.g., provision of drop water structures or chutes below the culverts at steep locations; see Section 9), which are adequate as long as the calculated water flow volumes and water velocities are adjusted for higher rainfall intensities. Design enhancement options include extended culvert aprons with anchor toes to prevent scouring and weakening of the culvert bedding and the area surrounding the culvert placement.

305. The existing TCVN requirements for culverts specify minimum size at 0.75 m diameter. However, it is recommended that the DED examine feasibility of increasing the culvert sizes to at least 1 meter in flood-prone sections with high silt and debris loads, not just to discharge water more quickly but to also facilitate cleaning and removal of soil deposits and debris.

306. Road foundations. The structural requirements and engineering safeguard measures identified in TCVN 4054:2005 (plus the referenced branch standards in 22TCN 171 and 22TCN 262) for designing road embankments under different soil and geologic conditions are adequate as long as the design flood water levels are properly adjusted for climate change.⁵⁴ The standard also provides for measures to stabilize sections with high embankment slopes for protection from scouring. Runoff calculations to estimate erosion rates, and for assessing slope stability, should take into account increased rainfall intensities (in addition to soil characteristics and other parameters). For critical slopes identified, additional measures to be considered during DED may involve reinforcing critical sections, supporting with retaining structures or landslide guard walls, and reforming cut areas with surface soil layer and vegetation cover.

307. Soil types suitable as subgrade fill for road embankments, including the minimum clearance between the subgrade level and the surrounding standing water level (or water table) are specified in Table 22 of TCVN 4054:2005. The specifications depend on the estimated length of consecutive days to which the structure is exposed to high water level, which is likely to increase with climate change and should be accounted for during the DED.

308. Slope stabilization. The standard provides various structural measures for stabilizing embankment slopes and road-cut to protect from erosion and risk of collapse (refer also to 22TCN 262). Additional or complementary measures to reduce infiltration, enhance slope drainage and integrity, including the use of plants should be considered during the DED. Appropriate measures that been field tested and evaluated for effectiveness should be applied.⁵⁵

309. Lateral ditches. These should be checked during DED for proper provision of discharge outlets at their ends to prevent the ditches from concentrating runoff water that may penetrate through cracks and saturate the road foundation, which leads to weakening and reflected deformation and cracks on the road surface.⁵⁶ Section 9.1 of TCVN 4054:2005 on planning of road drainage facilities does not specifically address such measure, and this should be brought to the attention of the DED teams.

310. Asphalt pavements. Specifications on flexible pavements are specified in branch standard 22TCN 211 which dates back to 1993 (and as referenced by TCVN 4054:2005). The DED should re-assess the sensitivity of the asphalt stiffness to temperatures projected to be higher than those recorded in the past. Potential problems that should be examined during DED include migration of liquid asphalt under prolonged hot weather. Heat wave duration, as indicated by the number of consecutive days with temperature exceeding 35°C, is projected by climate models to increase.

311. The quality of asphalt material used in road construction and maintenance is an important resilience measure. The detailed engineering design of flexible pavements should incorporate developments in asphalt technology to check for modified binders that improve the performance of asphalt under increasingly hot weather.

⁵⁴ As specified in TCVN 4054:2005 (Section 7.3.2), the design elevation of the pavement edge of road sections running along riverbanks, approaches to small bridges, culverts, and flooded fields must be at least 0.50m higher than the flood water level at the design frequency specified for the type of structure.

⁵⁵ International Centre for Environmental Management (ICEM). *Natural solutions to erosion control in Viet Nam: Case studies from the Northern mountainous region*. ADB CDTA on Promoting Climate Resilient Rural Infrastructure in Northern Viet Nam, May 2017. Four demonstration sites in Northern Vietnam provinces were set up in this study: two sites on riverside slope management (in Son La and Bac Kan); and two roadside slope management (in Son La and Thai Nguyen).

⁵⁶ Traffic loading is the most important factor influencing pavement performance, and the effect is compounded if the foundation becomes saturated because it then loses its ability to adequately support traffic loads, leading to premature pavement failure.

312. Branch standard 22TCN 334:2005 (as referenced by TCVN 4054:2005) provides technical specifications for construction of macadam foundations in highway pavement structures. For asphalt roads, the DED should further check measures for proper base and sub-base compaction and moisture conditions during road construction. The quality of gravel materials including thickness of the layers to ensure durable performance should be checked and, if necessary, adjusted for projected increased exposure to surrounding water or high water tables (in addition to traffic loads).

313. Concrete pavements. Based on follow-on geological survey work during DED, concrete pavement should be considered in low-lying areas where the road structure is vulnerable to water penetration due to more frequent flooding associated with changing rainfall regimes.

314. Coastal structures. The river port infrastructure subproject in BIIG-2 should be checked for adequate clearance of vital components (e.g., the port's generators) above water level that will likely be higher than levels indicated in frequency analysis of past data on maximum tide and surge levels.

315. Irrigation water use efficiency. For the irrigation subprojects, resilience to future water scarcity requires thinking beyond new water supply measures. DED should combine water supply measures with provisions for increased efficiency in water use. Numerous technical innovations and management measures are available that can improve the efficiency of water use for irrigated agriculture (e.g., lining of canals to reduce seepage, irrigation scheduling to prevent farmers from over-irrigating, and improved rice planting and irrigation methods through use of the system of rice intensification or SRI⁵⁷, among others).

316. Shifting to high-value crops—such as safe vegetables, herbs and spices--that are less water-intensive than traditional rice farming, which is already planned to be promoted under the subproject, should also be considered as a climate resilience measure in the design of cropping systems for agricultural development subprojects.

317. Water supply catchments should be provided with adequate natural vegetation cover to protect from projected future increase in both rainfall intensity and erosivity. Measures to reduce stream erosion—such as through bio-engineering measures that use combinations of live plants and inert structures, and also through construction of check dams and sediment basins—should be considered in the DED to prevent reservoirs from prematurely filling with sediment.

⁵⁷ SRI is based on four management principles that interact with each other: (i) early, quick and healthy plant establishment; (ii) reduced plant density; (iii) improved soil conditions through enrichment with organic matter; and (iv) reduced and controlled water application.

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APPENDIX A: CLIMATE MODELING

A. Climate change modeling

318. Assessing exposure to climate change hazards depends on predicting the direction and magnitude of climate change. Climate change projections are based on plausible scenarios for possible future greenhouse gas emissions as driven by population, technology and socio-economic factors. Several climate groups develop models as a means of informing climate change policy options and providing information on risks arising from climate change. Each model uses different assumptions both in terms of the scope of the underlying physics, datasets, and relationships of variables, and as a result often generate differing projections. This reflects the inherent uncertainty that prevails in both knowledge of climate variables and in the pathways through which Greenhouse Gas (GHG) emission levels will be defined. Such uncertainty positions climate change model outputs as possible scenarios, as opposed to definitive predictors of future climate.⁵⁸

319. The increasing importance of climate change has led to significant advances in scientific understanding resulting in increased complexity of climate modeling techniques to reduce or understand future climate projections. The challenge, however, is that climate projections are mostly globally defined, reflecting the global circulation models that underpin climate science -- yet the actions required to mitigate GHG emissions and adapt to climate change impacts are mostly local. The scale differences between these remain a significant challenge increasing the uncertainty of local level information.

320. Managing uncertainty is a priority in the ongoing development of climate change science. Models are selected that reflect a study region's dominant climate features, especially for climate parameters that are expected to have the most impact. Assessing uncertainty involves characterizing the range of probable outcomes examined either through multiple runs of the same model under different initial conditions, or through using multiple models i.e., an ensemble of models. An ensemble enables produces multiple projections that can be used to develop a probability distribution that in turn can be used to quantify the likelihood of climate change outcomes.⁵⁹

321. When the projection from several models are combined, the resultant average has often been found to be a better correlate of actual observations, than for the output of any individual model as it includes "more information". Nonetheless, climate model projections are all driven by assumptions and need to be interpreted with caution considering the underlying uncertainty.⁶⁰

⁵⁸ IPCC (2013). Climate Change the Physical Science Basis. Working Group No. 1, Contribution to the Fifth Assessment Report. Intergovernmental Panel on Climate Change. Cambridge University Press.

⁵⁹ Likelihood levels in terms of *percentiles* are derived from climate change projections that draw from multiple models, that is, the multiple model results are aggregated using percentile ranking. The 10th percentile value, for example, means that 90% of the models predict values equal to or higher than that percentile value. At the other end, the 90th percentile value means that 10% of the models predict values equal to or higher than that value. Hence, one can say that there is an 80% likelihood that the actual value falls between the 10th and 90th percentile values.

⁶⁰ A primer on how climate models work and how projections are interpreted is available at the website of the US National Research Council's Board on Atmospheric Sciences and Climate: <http://nas-sites.org/climate-change/climatemodeling>. For a more technical description, refer to Chapter 9 of the IPCC's Assessment Report No. 5 (2013): Evaluation of Climate Models.

B. Greenhouse Gas Emission Scenarios

322. Future GHG emissions and CO₂ concentration scenarios used in climate change modeling are defined by the Inter-Governmental Panel of Climate Change (IPCC). After 2007, the IPCC produced so-called “Representative Concentration Pathways” (RCPs) scenarios to provide flexibility in exploring the influence of policy choices, specifically regarding cuts in greenhouse gas emissions. The RCPs are identified by their total *radiative forcing*, measured in watts per square meter (W/m²) in 2100 relative to 1750.⁶¹ Essentially, the RCP’s describe the degree to which GHG emissions are actively mitigated, stabilized or increased and the resultant atmospheric CO₂ concentrations.⁶²

323. The four RCP scenarios span the range of plausible radiative forcing values, from 2.6 to 8.5 W/m². One scenario (RCP2.6) leads to a very low forcing level, two medium stabilization scenarios (RCP4.5 and RCP6) and one high emission scenario (RCP8.5).⁶³ Note that the RCPs were independently developed by different climate modeling groups that used different mathematical representations of the climate system and are, strictly speaking, not directly comparable.

324. In the latest IPCC (fifth) Assessment Report (2013), the RCP scenarios were used to generate projections to reflect the likely outcomes of differing global policy choices for mitigating GHG emissions. Table 63 shows the associated radiative forcing of each scenario, the projected atmospheric CO₂ concentration, and the corresponding representative climate policy.

Table 63. Latest Scenarios Used in the IPCC Fifth Assessment Report (2013)

RCP Scenarios	Radiative Forcing (W/m ²)	Projected CO ₂ atmospheric concentration by 2100	Representative Climate Policy
RCP 2.6	2.6	421	Mitigation
RCP 4.5	4.5	538	Stabilization
RCP 6.0	6.0	670	Stabilization
RCP 8.5	8.0	936	Business as usual

Source: IPCC (2013)

RCP = representative concentration pathway, CO₂ = carbon dioxide, W = watts, m² = square meter

325. Note that there is no preferred single climate change scenario for use in climate change impact studies. The IPCC does not give recommendations on which RCP scenario is more likely to materialize, and there are no weightings applied to the RCPs. Hence, no conclusions are made in climate change studies about the most probable future scenario outcome. Rather, a range of scenarios representing high and low CO₂ concentration levels (sometimes described as pessimistic and optimistic scenarios) are included in climate change simulations to test the “robustness” of adaptation measures.

⁶¹ Radiative forcing is the additional energy taken up by the climate system due to enhanced greenhouse effect. It measures the difference in the balance of energy that enters the atmosphere and the amount that is returned to space (compared to the pre-industrial baseline).

⁶² The word “representative” signifies that each RCP represents a larger set of scenarios compatible with the range of emission scenarios found in the scientific literature. The term “concentration pathway” means that these RCPs are not fully integrated scenarios yet, but instead are internally consistent sets of emission trajectories and corresponding radiative forcing. The results are used in subsequent phases of modeling to explore impact of socio-economic and policy choices. The use of the word “concentration” also means that CO₂ concentrations are used as the primary product of the RCPs, which serve as input to more fully integrated climate models. Unlike the previous generation of scenarios—the SRES scenarios--no fixed sets of assumptions relating to population growth, economic development, or technology are associated with any RCP.

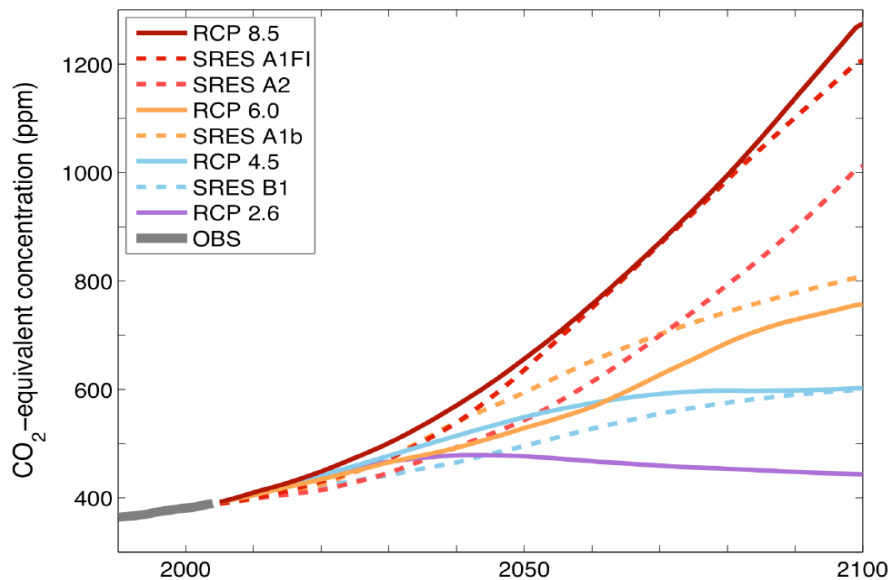
⁶³ Note, by way of perspective, that the global net effect of human activities since 1750 has been estimated as being equivalent to a radiative forcing of 0.6 to 2.4 W/m².

326. Within the context of climate risk to infrastructure, and specifically rural roads and water supply schemes, the economic life of proposed infrastructure is relatively short reflecting the category of road, and the expected traffic forecast and as well as expected traffic growth. Most BIIG-1 and BIIG-2 road infrastructure has an economic life of 12 to 15 years. Thus, the relevant projections are up to mid-2030s.

327. Up to the mid-2030s, the climate change risk to the road infrastructure are expected to be relatively consistent across all four RCP scenarios, since up to about the mid-2030s all RCP scenarios have relatively similar projected atmospheric CO₂ concentrations – see Figure 1.

328. By mid-century (*circa* 2050) the 4 RCP scenarios indicate increasing divergence in atmospheric CO₂ concentrations and the commensurate divergence in climate projections. This is explained by the fact that prior to 2040, projected changes in global climate are largely driven by the warming that is already “in the pipeline”, that is, the atmospheric concentrations faced is already largely known based on past emissions of greenhouse gases and as such the uncertainty introduced from future GHG atmospheric concentration is limited. In contrast, warming after mid-century is strongly dependent on the future levels of GHG emissions that will be determined by still uncertain global policy actions.

Figure 9. Projected CO₂ concentration under various RCPs



Source: IPCC (2013); also showed are projections from the earlier set of SRES scenarios.

329. In terms of atmospheric CO₂ concentrations, the two RCP scenarios of interest (RCP 4.5 which represents moderate warming trajectory, and RCP 8.5 which represents strong warming) do not actually differ much up to about 2040s. But thereafter, CO₂ concentration levels under RCP 4.5 peak and stabilize, whereas RCP 8.5 keeps rising. Since we're only projecting up to 2030s for BIIG planning, the two scenarios are relatively similar in terms of GHG emissions. As such the choice of RCP will have little impact and, after a data quality review, the RCP 8.5 scenario was considered more reliable.

330. For purposes of deriving adjustment factors for extreme rainfall to guide the detailed engineering design of BIIG infrastructure subprojects (at P4 frequency), it is recommended that RCP 8.5 associated with a higher projected atmospheric GHG concentration by 2030s be adopted. This RCP represents the most conservative outlook on global management of GHG

emissions.⁶⁴ Nevertheless, for the profiling of climate change in the eight project provinces presented in Appendix B, projections derived from both RCP 4.5 and RCP 8.5 scenarios are provided.

C. Regional downscaling methods

331. Global Climate Models produce projections at very large scale with coarse projections that are informative in the terms of overall global risk but provide limited information at lower levels of aggregation such as national, provincial or local level. With the need to mitigate climate change risk, increasingly local-level actions are required. To inform such programs it is necessary to provide projections at lower scales by “downscaling” from global model projections. Downscaling is used to take information generated at larger scales and to use this to make local projections.

The **National Center for Atmospheric Research** (USA) defines two main approaches to downscaling of climate information as dynamical and statistical.

Dynamical downscaling requires running high-resolution climate models on a regional sub-domain, using observational data or lower-resolution climate model output as a boundary condition. These models use physical principles to reproduce local climates, but are computationally intensive.

Statistical downscaling is a two-step process consisting of i) the development of statistical relationships between local climate variables (e.g., surface air temperature and precipitation) and large-scale predictors (e.g., pressure fields), and ii) the application of such relationships to the output of global climate model experiments to simulate local climate characteristics in the future.

Source: <https://gisclimatechange.ucar.edu>

332. In dynamical downscaling high-resolution simulation models extrapolate from the GCM to regional or local levels. A regional climate model (e.g., PRECIS) is applied to a delineated area in which the boundary conditions are generated or “driven” by a parent GCM. Dynamical downscaling is based on physical laws with the advantage of being able to produce a large variety of climate variables. The disadvantage of this method is computational complexity, which limits the number of GCMs that can be downscaled.

333. Statistical downscaling, on the other hand, uses statistical methods to define the relationships between data at the larger scale and then use these relationships to transform GCM outputs to local scale. Since it is not dependent on specifying complex physical relationships, statistical downscaling is not as computationally demanding.⁶⁵ However, it can only generate a smaller set of climate variables.

334. Downscaled climate projections are adjusted to match the statistical properties of the observed climate—a process known as “bias correction.” This correction is done so that the climate simulation for the historical period statistically matches the actual observations. The correction factor derived is then applied to the future projections from the climate model.⁶⁶

⁶⁴ “Conservative” regarding what can be done to reduce global GHG emissions, still faced with difficulties to effectively address the threat (e.g., US pullout from the Paris climate accord).

⁶⁵ Several statistical approaches can be used for downscaling including limited area modelling, stochastic modelling, pattern based weather approaches and regression analysis. The least computationally demanding of these, regression is generally preferred.

⁶⁶ The climate modeling cells used by MoNRE to represent the provinces were selected to overlap with the locations of Class-1 hydrometeorological stations; this enables bias-correction to be done on the baseline modeling data with reference to historical observations.

D. Viet Nam Climate Change Database⁶⁷

335. Regional Climate Models were used by MoNRE's Institute of Meteorology, Hydrology and Environment, with support from CSIRO/AusAid, to produce high-resolution projections of climate change for Vietnam using *nine* GCMs from the latest set of global models endorsed by the IPCC, namely: NorESM1-M, CNRM-CM5, GFDL-CM3, HadGEM2-ES, ACCESS1-0, MPI-ESM-LR, NCARSST, HadGEM2-SST and GFDL-SST.

336. Dynamical downscaling of the nine GCMs using *five* Regional Climate Models, namely: (i) the AGCM/MRI model from Japan Meteorological Agency (JMA), (ii) the PRECIS model from the UK Met Office, (iii) the CCAM model from CSIRO - Australia, (iv) the RegCM model from ICTP – Italy, and (v) the cIWRf model from Santander Meteorology Group – Spain provides provincial level forecasts. There were 16 computational cases (model-runs) in total. Statistical methods were applied for bias-correction of the model baseline outputs with reference to observed data. See Table 64.

Table 64. Models Used in MoNRE's Climate Change Database

Regional Climate Model	Resolution and Area coverage	Modeling Organization	Parent GCM
cIWRf	30 km, 3.5-27oN and 97.5-116oE	NCAR, NCEP, FSL, AFWA	NorESM1-M
PRECIS	25 km, 6.5-25oN and 99.5-115oE	Hadley - UK	CNRM-CM5 GFDL-CM3 HadGEM2-ES
CCAM	10 km, 5-30oN and 98-115oE	CSIRO, Australia	ACCESS1-0 CCSM4 CNRM-CM5 GFDL-CM3 MPI-ESM-LR NorESM1-M
RegCM	20 km, 6.5-30oN and 99.5-119.5oE	Abdus Salam International Centre for Theoretical Physics (ICTP), Italy	ACCESS1-0 NorESM1-M
AGCM/MRI	20 km covering entire globe	JMA, Japan	NCAR-SST HadGEM2-SST GFDL-SST SST ensembles

337. Of the five Regional Climate Models applied by MoNRE to downscale various GCMs, PRECIS was noted to be the most reliable according to the Ministry's 2016 Report on Climate Change and Sea Level Rise Scenarios for Vietnam (page 39, full report in Vietnamese).

⁶⁷ Ministry of Environment and Natural Resources. Climate Change and Sea Level Rise Scenarios for Vietnam. Hanoi, 2016 (in Vietnamese; a summary version for Policy Makers is available in English).

338. In deriving the climate change adjustment factors for extreme rainfall based on the TCVN/TCN-specified frequencies, only data from the downscaling of three GCMs using PRECIS were used, namely: CNRM-CM5, GFDL-CM3 and HadGEM2-ES (as shown in Table 10).

APPENDIX B: PROJECTED CLIMATE CHANGE IN PROJECT PROVINCES⁶⁸

A. Increase in temperature

339. According to MoNRE, average annual temperatures throughout the country increased by 0.62°C from 1958 to 2014, at an average of approximately 0.1°C per decade. Extreme temperatures are projected to increase in all climate zones. The number of hot days (maximum temperatures exceeding 35°C) show increasing trends in most of the country.

340. Under Scenario RCP 8.5 the projected average temperature increase in BIIG-1 provinces is 1.1°C and 2.2°C, for early and mid-century, respectively. For BIIG-2, the corresponding average increase is 0.9°C and 1.9°C, respectively.

341. Although changes in average temperature increases are modest, the projected change in extreme temperatures is more significant. Heat wave occurrence, (defined as number of consecutive days with maximum temperatures exceeding 35°C), is projected to increase across all the BIIG provinces. For temperature, changes projected from 8 downscaled GCMs using data obtained from MoNRE are summarized in Table 65.⁶⁹

Table 65. Projected change in heat wave duration (number of consecutive days with $T_{\max} > 35^{\circ}\text{C}$)

Province	Baseline number of days	RCP 4.5		RCP 8.5	
		2016-2035	2046-2065	2016-2035	2046-2065
Bac Kan	4	7	15	11	20
Cao Bang	6	9	16	12	20
Ha Giang	5	7	14	10	19
Lang Son	1	2	7	3	10
Ha Tinh	13	37	114	62	145
Nghe An	12	42	128	67	155
Quang Binh	17	28	97	47	122
Quang Tri	18	33	88	46	113

B. Increase in rainfall intensity

342. Across Viet Nam rainfall is projected to increase. Under RCP 4.5, by early century, annual rainfall is projected to increase by 5 to 10% relative to 1986-2005. By mid-century, rainfall would increase 5 to 15% overall. Under RCP 8.5, the projected increase is of roughly the same magnitude. Projected change in 1-day and 5-day maximum rainfall are higher than annual changes, increasing by 10 to 70% relative to 1986-2005.

343. For BIIG-1 provinces, observations from inland stations during 1961 to 2010 indicate a slight decreasing trend in annual rainfall. In BIIG-2 corresponding station observations show almost no change in annual rainfall. But future rainfall is generally projected to increase in all project provinces. In terms of percentage change relative to reference period (1986-2005), mean values derived from climate modeling are shown in Table 66.⁷⁰

⁶⁸ Additional information on climate change projections for BIIG-1 and BIIG-2 are provided in the Climate Risk and Vulnerability Assessment report for each subregion.

⁶⁹ The eight GCMs were: CCAM-CCSM4, CCAM-CNRM-CM5, CCAM-GFDL-CM3, CCAM-NorESM1-M, cIWRF-NorESM1-M, PRECIS-CNRM-CM5, PRECIS-GFDL-CM3, PRECIS-HadGEM2-ES. Three *regional climate models* were used to downscale these eight GCMs: CCAM, cIWRF and PRECIS. CCAM was used on 4 GCMs; cIWRF was used on 1 GCM; and PRECIS was used on 3 GCMs.

⁷⁰ The ranges of projections with reference to 10% and 90% percentile values (i.e., 80% confidence interval) are shown in the CRVA reports for BIIG-1 and BIIG-2.

Table 66. Projected change in annual rainfall (%)

Province	Baseline (mm)	RCP 4.5		RCP 8.5	
		2016-35	2046-65	2016-35	2046-65
Bac Kan	1,492	+17.4	+18.3	+6.6	+15.4
Cao Bang	1,678	+14.2	+16.0	+3.8	+12.8
Ha Giang	2,459	+5.8	+7.8	-3.3	+4.0
Lang Son	1,498	+18.7	+18.7	+10.5	+17.9
Nghe An	2,035	+10.2	+16.8	+16.6	+21.6
Ha Tinh	2,720	+11.3	+16.3	+12.9	+14.1
Quang Binh	2,425	+10.1	+12.6	+10.8	+14.1
Quang Tri	2,178	+11.4	+16.6	+16.5	+16.8

Note: A plus sign means increase as a percentage of baseline; negative means decrease. Baselines were derived from the average of 3 climate models.

344. Extreme rainfall events are projected to increase more in both sub-regions. Most additional annual rainfall will be as more intense precipitation during the wet season, and during occurrences of typhoons predicted to become stronger. Percentage changes in the extreme rainfall based on the average of three modeling runs using the regional climate model PRECIS,⁷¹ are shown in Table 67. For the maximum one-day rainfall and the maximum five-day rainfall.

Table 67. Projected change in extreme rainfall in BIIG-1 and BIIG-2 provinces (%)

Province	Annual maximum one-day rainfall					Annual maximum five-day rainfall				
	Baseline (mm)	RCP 4.5		RCP 8.5		Baseline (mm)	RCP 4.5		RCP 8.5	
		2016-35	2046-65	2016-35	2046-65		2016-35	2046-65	2016-35	2046-65
Bac Kan	101	+82	+52	+47	+58	223	+83	+46	+40	+58
Cao Bang	92	+70	+54	+41	+58	211	+66	+46	+32	+46
Ha Giang	151	+10	+25	0	+17	359	+8	+21	-4	+15
Lang Son	102	+42	+44	+77	+65	197	+92	+52	+69	+69
Nghe An	215	+23	+34	+29	+35	455	+26	+40	+30	+34
Ha Tinh	288	+27	+38	+23	+18	649	+27	+41	+26	+19
Quang Binh	207	+31	+35	+21	+26	481	+25	+35	+21	+24
Quang Tri	194	+42	+45	+38	+44	480	+35	+45	+31	+40

*Colored values for RCP 4.5 appear incongruent for BIIG-1; the projected mid-century values are lower than for early-century, even as the projected annual rainfall is projected to increase as shown in Table 12. Modeled baseline values refer to period 1986-2005, averaged from 3 climate models.

C. Sea level rise

345. Sea levels at coastal monitoring stations of Vietnam rose by about 2.45 mm/yr during the period 1960-2014. From 1993 to 2014, the rate of SLR had increased to 3.34 mm/yr. The largest increase in average sea level was found along the central coast at 4 mm/yr. Under RCP 4.5, the average sea level rise for coastal areas nationally is projected to be about 22 cm by mid-century while under RCP 8.5, the projected average SLR is 25 cm.⁷²

⁷¹ Of the 5 regional climate models used by MoNRE to downscale various global climate models, PRECIS was noted to be the most reliable according to the Ministry's 2016 Report on Climate Change and Sea Level Rise Scenarios for Vietnam (page 39, full report in Vietnamese). In this PPTA study, data from the PRECIS downscaling of 3 GCMs were used: CNRM-CM5, GFDL-CM3 and HadGEM2-ES. The tabulated values are the average from the 3 downscaled GCMs. Among these GCMs, MoNRE informants indicated that CNRM-CM5 was the most "stable" (i.e., the variability of the projections is not too wide compared to the other 2 GCMs). This GCM was used to set the baseline for the extreme value frequency analysis of maximum one-day rainfall projections shown in Annex E.

⁷² With 80% of models predicting in the range of 14 to 32 cm and 17 to 35 cm, respectively.

346. The coastal zone of the BIIG-2 provinces is covered by two sea level monitoring regions from Hon Dau near Hai Phong in the north to Deo Hai Van near Danang to the south. The average values of sea level rise projections from multiple models are shown in Table 68.

Table 68. Sea level rise projections for BIIG-2 coastal zone (cm)

Scenario	Coastal region	2030	2050	2080	2100
RCP 4.5	Hon Dau - Deo Ngang	13	22	39	53
	Deo Ngang - Deo Hai Van	13	22	40	53
RCP 8.5	Hon Dau - Deo Ngang	13	25	50	72
	Deo Ngang - Deo Hai Van	13	25	50	72

Note: Deo Ngang is at the border of Ha Tinh and Quang Binh.

347. Storm surge is a rise in sea level due to the impact of typhoons or tropical depressions. In the coastal area between Nghe An and Ha Tinh, the observed highest storm surge was 400 cm. MoNRE has estimated that the highest storm surge in this coastal stretch is likely to be 450 cm. Between Quang Binh and Hue, the highest observed storm surge was 300 cm, and MoNRE's estimate of the highest possible surge that can occur along this coast is 350 cm.

APPENDIX C: HYDROLOGICAL COMPUTATION FORMULAS

348. For traffic structures, the calculation of flood characteristics is specified in legacy documents and guidance documents over the past years. For example, the standard on “calculation of design hydrological characteristics” - QP.TL. C-6-77 has been applied since 1977. In 1996 the calculation of flood characteristics was improved based on the branch standard 22-TCN 220-1995. Currently, these legacy regulations and standards has been consolidated in a national standard, TCVN 9845:2013.

349. Specifications for the design flood frequency to be used for various transportation works are stipulated in TCVN 4054:2005 and TCVN 5729:2012. However, TCVN 5729:2012 applies only to expressway projects. TCVN 4054:2005 is the most relevant to the road classifications under BIIG-1 and BIIG-2. For hydraulic calculations related to bridge works, the MoT branch standard 22TCN 272:2005 is still applied, even as the specifications there have been incorporated in the more recent national standard, TCVN 9845:2013.

350. To calculate the flood characteristics, various parameters are used including the watershed area, watershed morphology, characteristics of soils and rocks, vegetation cover in the watershed, and the rainfall intensity corresponding to a frequency or return period specified for the structure’s design flood level (as specified in TCVN 4054:2005).

351. In brief, the calculation of the flood characteristics for traffic structures is conducted as follows: based on TCVN 4050-2005, determine which flood frequency is applicable for the category of road and the type of component structure. Then apply the formula to estimate the design flood level, as specified in TCVN 9845:2013. Use the one-day maximum rainfall corresponding to the design flood frequency specified for the structure.

352. TCVN 9845:2013 specifies the methodology for calculating flood flow characteristics caused by heavy rain for small structures on rivers that are not impacted by the tide and not associated with mud/rock flows. According to this standard, the calculation of the design flood peak for a given watershed can be based on one of the following formulas:

- For a watershed with area smaller than 100 km², it is possible to use the “Limited Strength” formula.
- For a watershed with area exceeding 100 km², it is possible to use the “Discount” formula.
- In addition to using the formulas above for medium and large watersheds, it is advised to compare the calculated results with other methods such as modeling of the river section and other approaches (Section 5.1 TCVN 9845-2013, Page 10).

Limited Strength Formula

$$Q_{P\%} = A_{P\%} \cdot \phi \cdot H_{P\%} \cdot F \cdot \delta$$

353. where (the dot symbol means multiply):

- i. P% - Design frequency (Section 10, TCVN 4054:2005 and Section 9, TCVN 5729:2012)
- ii. H_{P%} - **Maximum one-day rainfall** corresponding to design frequency P% of the representative station of the watershed, in millimeters. The rainfall data of the station must be updated up to the time of calculation (details are in Appendix B of TCVN 9845:2013).
- iii. Q_{P%} - Flood peak discharge corresponding to design frequency in m³/s;
- iv. F – Watershed area in km²;

- v. ϕ - Flood flow coefficient, depends on the type of soils in the watershed structure, design daily rainfall ($H_{P\%}$) and watershed area (F) (see Table A.1, Appendix A, TCVN 9845-2013);

354. Flow discharge coefficient ϕ in the formula is defined by the formula based on daily rainfall, watershed area and the soil/sediment type. The latter, particularly sand content, is determined through sampling.

355. $AP\%$ - Relative modular of maximum flow corresponding to the design frequency (Table A.3, Appendix A, TCVN 9845-2013) depending on the rain location, hydrological, and topographical features of the river bed ϕ_s (defined by formula 10), the concentration time of the flow on the slope τ_{sd} . Note that τ_{sd} is defined according to Section 5.2.2.1 of the regulation.

356. δ - The factor at the level that reduce slightly the flood discharge by the ponds, lakes, swamplands in the area, defined according to Table 6, TCVN 9845:2013.

Discount formula

357. As specified for the watershed with the area of more than 100 km², the flood frequency can be calculated by the discount formula, as follow:

$$Q_p = q_{100} \left(\frac{100}{F} \right)^n \lambda_p \cdot F \cdot \delta \quad (m^3 / s)$$

Where:

q_{100} – Flood peak module corresponding to frequency of 10% converted to 100km² watershed, see Table A.5, Appendix A, TCVN 9845:2013 according to the station near the construction site; units in m³/s/km².

$\left(\frac{100}{F} \right)^n$ - Discount coefficient for the flood peak module by the area, n is referred to Table A.5,

Appendix A, under TCVN 9845:2013.

F – Watershed area in km²;

λ_p – Frequency conversion coefficient, with reference to Table A.5, Appendix A, TCVN 9845:2013;

δ - a factor to consider the regulating effects of ponds, lakes and swamps.

358. In case the selected watershed has different survey data, to calculate the flood peak frequency, the following formula can be used:

$$Q_p = q_{ptt} \left(\frac{F_a}{F} \right)^n \frac{\delta}{\delta_a} F$$

where:

q_{ptt} – Flood peak module of the similar watershed by practical measurements, m³/s/km²;

F_a, δ_a – area and regulating coefficient of the similar watershed.

359. The similar watershed, beside above requirements, need to have daily rainfall corresponding to design frequency not much different from this rainfall in the study area.

360. In addition, TCVN 9845:2013 also specify the tasks and calculation contents of other parameters such as design water level, discharge distribution, and flow velocity in rivers and streams, and design aperture. These calculations indirectly relate to the maximum daily rainfall via design flood peak discharge.

APPENDIX D: STATISTICAL MODELING USING EXTREME VALUE ANALYSIS

A. Extreme Value Theory

361. Changes in extreme events is assessed using extreme value theory to calculate extreme quantiles (depicted by the cumulative distribution function) for different periods, both past and future. Specifically, the theory is used to estimate the intensity and frequency of rare events that lie far in the tails of the probability distribution. The most common approach involves fitting a statistical model to the annual extreme values in the time series data.

362. The application of this classic theory assumes that the time series being analyzed is “stationary”, that is, the statistical parameters (mean and variance) are constant for the time series.⁷³ In using projected climate data that cover several periods (e.g., baseline, early century, mid-century) it is assumed that the time series is stationary within any one period. As such the periods being assessed need to be sufficiently spaced to provide detectable changes in statistical parameters across periods. For the purpose of climate change impacts the MoNRE databases use a baseline time series covering 1986-2005; early-century period of 2016-2035; and mid-century of 2046-2065.

363. Extreme value analysis (EVA) requires putting together a sample of extreme values obtained by selecting the maximum value observed in each time block (e.g., year or season). Statistical tests confirm that the Generalized Extreme Value (GEV) distribution is appropriate for block maximum values.⁷⁴

364. This analysis procedure can be applied to both modeled climate data and actual historical data on selected climate parameters, in this case one-day maximum rainfall.

365. Theoretically, although very long period return values can be calculated from the fitted probability distribution (say, for 100-year return period), the confidence that can be placed in the results is low if the length of the return period is substantially greater than the period covered by the sample of extremes (in our case, 20 years). Estimating return levels for very long return periods is prone to large sampling errors and potentially large biases due to uncertainty about of the actual shape of the tails of the probability distribution. Generally, confidence in return levels decreases rapidly when the period is more than about two times the length of the time series data.⁷⁵

366. Statistical extreme value analysis comes with uncertainty—in this case, associated with the estimation of the statistical model parameters.⁷⁶ Thus, on top of the climate modeling uncertainty described earlier, statistical modeling of extreme events derived from the climate modeling results creates an additional layer of uncertainty.

B. Fitting of Probability Distribution

367. Identifying the best-fitted probability distribution to an extreme value time series involves applying goodness-of-fit tests. These tests measure the compatibility of the time

⁷³ It also assumes that the statistical parameters are “homogenous” or unchanging over the area of interest.

⁷⁴ Another method using “peaks over threshold” (POT) values to assemble data on exceedances above a specified threshold. For this method, a generalized Pareto distribution is generally found to be the best-fitting statistical distribution function.

⁷⁵ World Meteorological Organization. *Guidelines on Analysis of extremes in a changing climate in support of informed decisions for adaptation*. WMO Climate Data and Monitoring WCDMP-No. 72, 2009.

⁷⁶ Uncertainty may be related to the statistical techniques, but depend particularly on the sample series length for extremes analysis. The fitted probability distribution is also very sensitive to inclusion or exclusion of outlier values.

series with the theoretical probability distribution function, i.e., to test if a sample of data came from a population with a specific probability distribution.

368. To construct the statistical model for the one-day maximum rainfall, we fitted 10 probability distributions to samples of time series derived from the climate modeling data on one-day annual maximum rainfalls. The Kolmogorov-Smirnov and Anderson-Darling tests were used along with the chi-square test at 0.01 level of significance to identify the best-fitting probability distribution.⁷⁷ The candidate distributions were ranked from (highest) 1 to 10 based on lowest t-statistic value. The probability distribution with consistent high ranking using the Kolmogorov-Smirnov test was selected.

369. The Generalized Extreme Value distribution represents the best fit to data. The goodness-of-fit test served to validate the recommended statistical model in the literature on extreme value analysis. Then we applied this model to calculate exceedance probabilities and corresponding return periods.

370. The GEV distribution is a three-parameter model with the following probability distribution function, where $z=(x-\mu)/\sigma$, and k , σ , μ are the shape, scale and location parameters, respectively. The scale must be positive ($\sigma>0$), whereas the shape and location can take on any real value.

$$f(x) = \begin{cases} \frac{1}{\sigma} \exp(-(1+kz)^{-1/k}) (1+kz)^{-1-1/k} & k \neq 0 \\ \frac{1}{\sigma} \exp(-z - \exp(-z)) & k = 0 \end{cases}$$

371. The range of definition of the GEV probability distribution depends on the value of the shape parameter k :

$$\begin{aligned} 1 + k \frac{(x - \mu)}{\sigma} > 0 & \quad \text{for } k \neq 0 \\ -\infty < x < +\infty & \quad \text{for } k = 0 \end{aligned}$$

372. The parameters of the GEV probability distribution function are estimated from the time series (e.g., a 20-year record of annual maximum daily rainfall).⁷⁸ Estimated GEV parameters are applied to generate, first, the probability density function using the formula above—and from it, the cumulative distribution function. The cumulative distribution function is then used to calculate the annual exceedance probabilities and corresponding return periods.⁷⁹ The latter refers to the probability that an event is equaled or exceeded in any single year. The return period is the reciprocal of the exceedance probability.

373. After estimating the parameters of the GEV probability distribution, the probabilistic model was used to compare the return period of baseline and future extreme rainfall.

374. Theoretically, although very long period return values can be calculated from the fitted probability distribution (say, for 100-year return period), the confidence that can be placed in the results is low if the length of the return period is substantially greater than the period

⁷⁷ The Anderson-Darling test is just a modification of the Kolmogorov-Smirnov (K-S) test. It gives more weight to the distribution tails than does the K-S test. We placed more weight on the result of the K-S test in selecting the best-fitting distribution.

⁷⁸ Open source statistical modeling packages are available to automate fitting of probability distribution functions, such as the programming language R (www.r-project.org). Commercial packages are also available, such as EasyFit (www.mathwave.com), which can be linked to MS Excel.

⁷⁹ The exceedance probability is 1 minus the cumulative probability at any given point (x) in the distribution.

covered by the sample of extremes (in our case, 20 years). Estimating return levels for very long return periods is prone to large sampling errors and potentially large biases due to uncertainty about of the actual shape of the tails of the probability distribution. Generally, confidence in return levels decreases rapidly when the period is more than about two times the length of the time series data.⁸⁰

375. As with climate modeling uncertainty, statistical extreme value analysis comes with uncertainty—in this case, associated with the estimation of the statistical model parameters.⁸¹ Thus, on top of the climate modeling uncertainty described earlier, statistical modeling of extreme events derived from the climate modeling results creates an additional layer of uncertainty. It is important to recognize this propagation of uncertainty throughout the modeling process in interpreting findings.

376. Identifying the best-fitted probability distribution to an extreme value time series involves applying goodness-of-fit tests. These tests measure the compatibility of the time series with the theoretical probability distribution function, i.e., to test if a sample of data came from a population with a specific probability distribution.

377. To construct the statistical model for the one-day maximum rainfall, we fitted 10 probability distributions to samples of time series derived from the climate modeling data on one-day annual maximum rainfalls. The Kolmogorov-Smirnov and Anderson-Darling tests were used at 0.01 level of significance to identify the best-fitting probability distribution.⁸² The candidate distributions were ranked from (highest) 1 to 10 based on lowest t-statistic value. The probability distribution with consistent high ranking using the Kolmogorov-Smirnov test was selected. A sample goodness-of-fit test results for a time series data set (baseline CNRM model run for Bac Kan) is shown below.

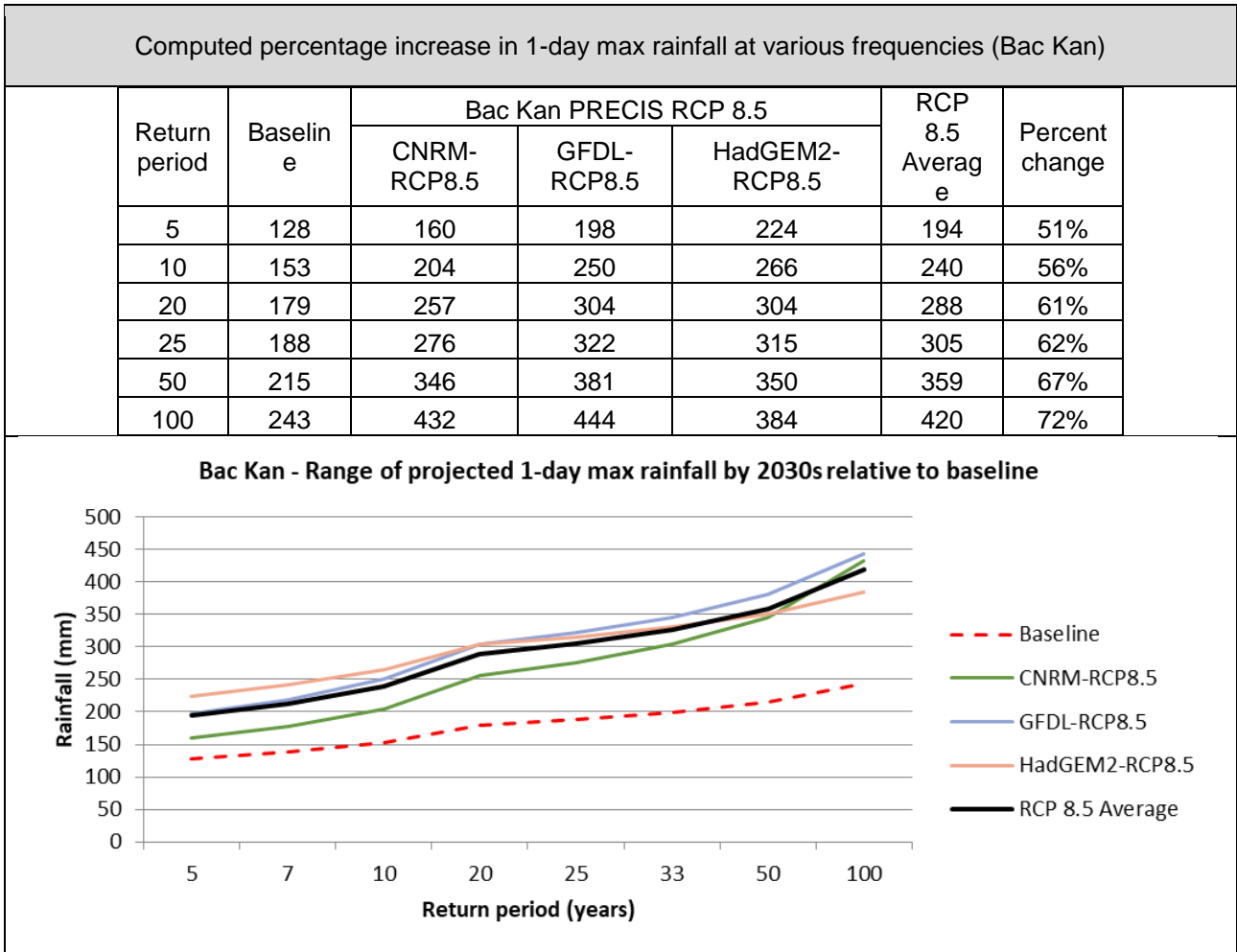
Distribution	Kolmogorov Smirnov		Anderson Darling	
	Statistic	Rank	Statistic	Rank
Frechet	0.21117	10	0.97013	10
Frechet (3P)	0.10664	7	0.25044	6
Gen. Extreme Value	0.07925	1	0.15528	1
Gumbel Max	0.10733	8	0.34885	9
Log-Pearson 3	0.09056	4	0.18677	4
Lognormal	0.11972	9	0.32719	8
Lognormal (3P)	0.08024	2	0.18456	3
Wakeby	0.09038	3	0.15668	2
Weibull	0.10601	6	0.23953	5
Weibull (3P)	0.10207	5	0.26229	7

⁸⁰ World Meteorological Organization. *Guidelines on Analysis of extremes in a changing climate in support of informed decisions for adaptation*. WMO Climate Data and Monitoring WCDMP-No. 72, 2009.

⁸¹ Uncertainty may be related to the statistical techniques, but depend particularly on the sample series length for extremes analysis. The fitted probability distribution is also very sensitive to inclusion or exclusion of outlier values.

⁸² The Anderson-Darling test is just a modification of the Kolmogorov-Smirnov (K-S) test. It gives more weight to the distribution tails than does the K-S test. We placed more weight on the result of the K-S test in selecting the best-fitting distribution.

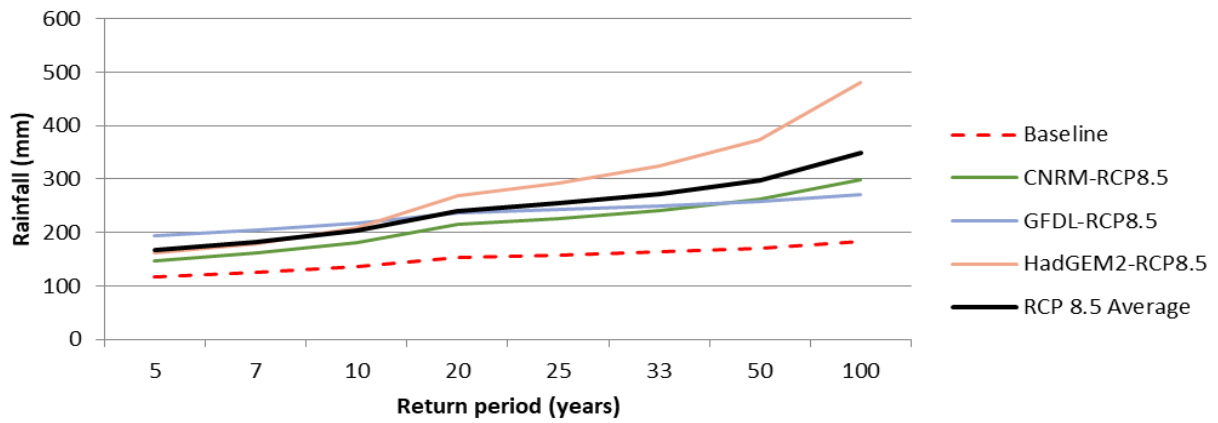
APPENDIX E: FREQUENCY ANALYSIS TABLES AND CHARTS



Computed percentage increase in 1-day max rainfall at various frequencies (Cao Bang)

Return period	Baseline	Cao Bang PRECIS RCP 8.5			RCP 8.5 Average	Percent change
		CNRM-RCP8.5	GFDL-RCP8.5	HadGEM2-RCP8.5		
5	118	148	194	161	167	42%
10	137	182	218	209	203	49%
20	153	216	237	269	241	58%
25	157	227	243	292	254	61%
50	171	262	258	375	298	74%
100	183	298	270	480	350	91%

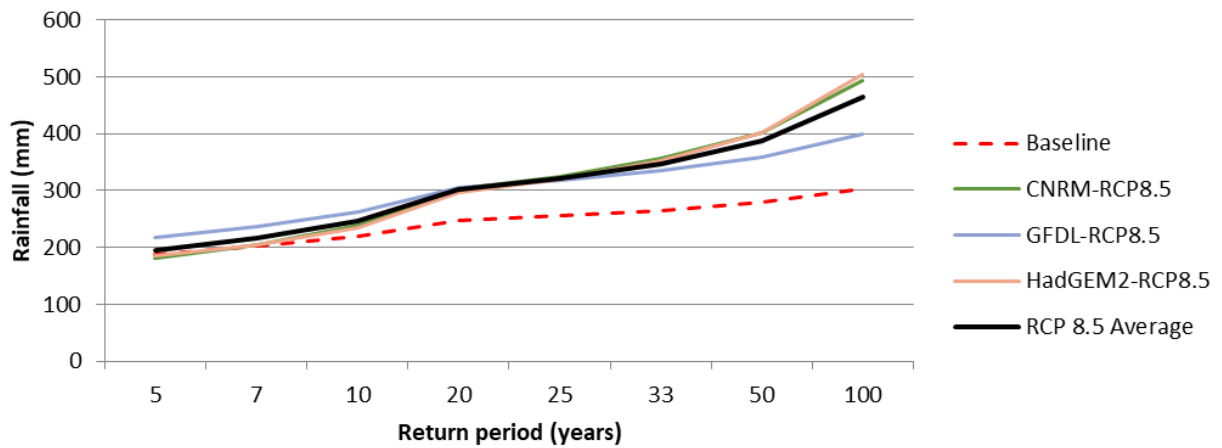
Cao Bang - Range of projected 1-day max rainfall by 2030s relative to baseline



Computed percentage increase in 1-day max rainfall at various frequencies (Ha Giang)

Return period	Baseline	Ha Giang PRECIS RCP 8.5			RCP 8.5 Average	Percent change
		CNRM-RCP8.5	GFDL-RCP8.5	HadGEM2-RCP8.5		
5	188	182	218	185	195	4%
10	219	238	262	235	245	12%
20	247	302	305	297	301	22%
25	255	325	318	320	321	26%
50	280	402	359	402	388	39%
100	302	493	400	504	465	54%

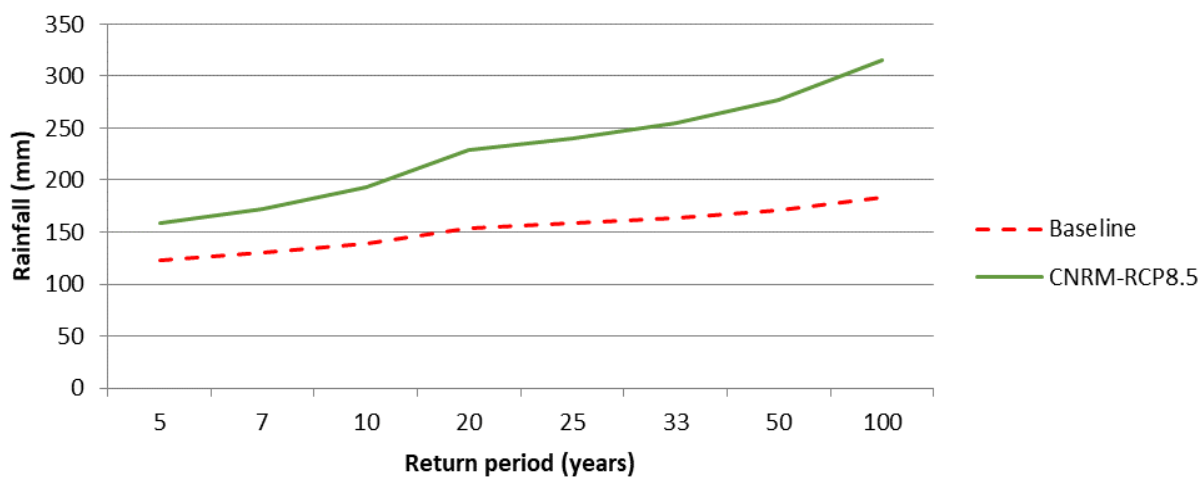
Ha Giang - Range of projected 1-day max rainfall by 2030s relative to baseline



Computed percentage increase in 1-day max rainfall at various frequencies (Lang Son)
We recommend using only the projection from the CNRM model⁸³

Return period	Baseline	Lang Son PRECIS RCP 8.5			Percent change
		CNRM-RCP8.5			
5	123	158			29%
10	139	193			39%
20	154	229			49%
25	158	240			52%
50	171	277			62%
100	183	315			72%

Lang Son - Range of projected 1-day max rainfall by 2030s relative to baseline

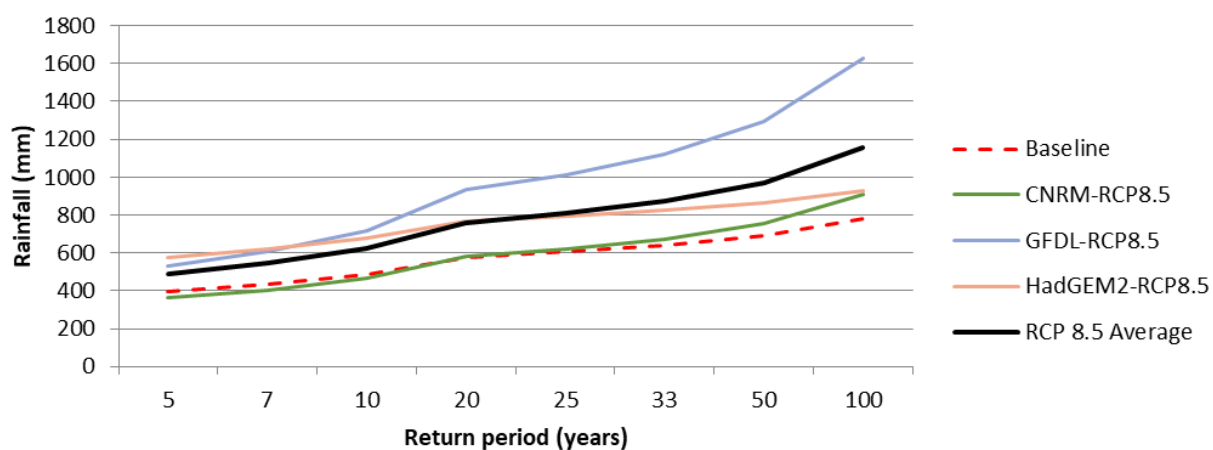


⁸³ The projections from the two other models, GFDL-RCP8.5 and HadGEM2-RCP8.5 appear too high and incomparable with the projection for the adjacent provinces.

Computed percentage increase in 1-day max rainfall at various frequencies (Ha Tinh)

Return period	Baseline	Ha Tinh PRECIS RCP 8.5			RCP 8.5 Average	Percent change
		CNRM-RCP8.5	GFDL-RCP8.5	HadGEM2-RCP8.5		
5	396	362	531	576	490	24%
10	488	465	717	682	621	27%
20	577	580	935	769	761	32%
25	605	620	1014	794	809	34%
50	692	756	1291	865	971	40%
100	778	912	1625	925	1154	48%

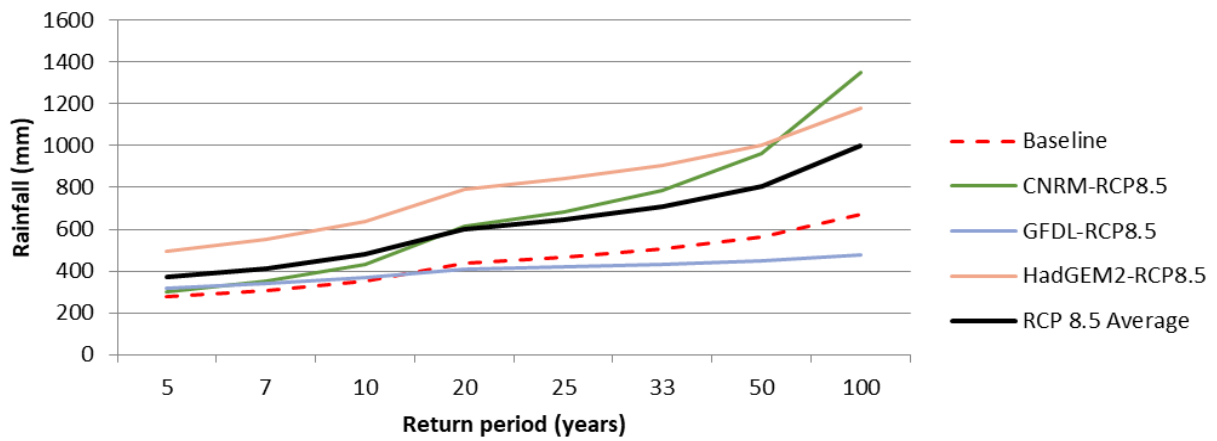
Ha Tinh - Range of projected 1-day max rainfall by 2030s relative to baseline



Computed percentage increase in 1-day max rainfall at various frequencies (Nghe An)

Return period	Baseline	Nghe An PRECIS RCP 8.5			RCP 8.5 Average	Percent change
		CNRM-RCP8.5	GFDL-RCP8.5	HadGEM2-RCP8.5		
5	276	302	320	492	371	34%
10	355	433	368	638	479	35%
20	439	613	407	789	603	37%
25	468	684	418	840	647	38%
50	565	961	449	1003	805	42%
100	672	1349	476	1178	1001	49%

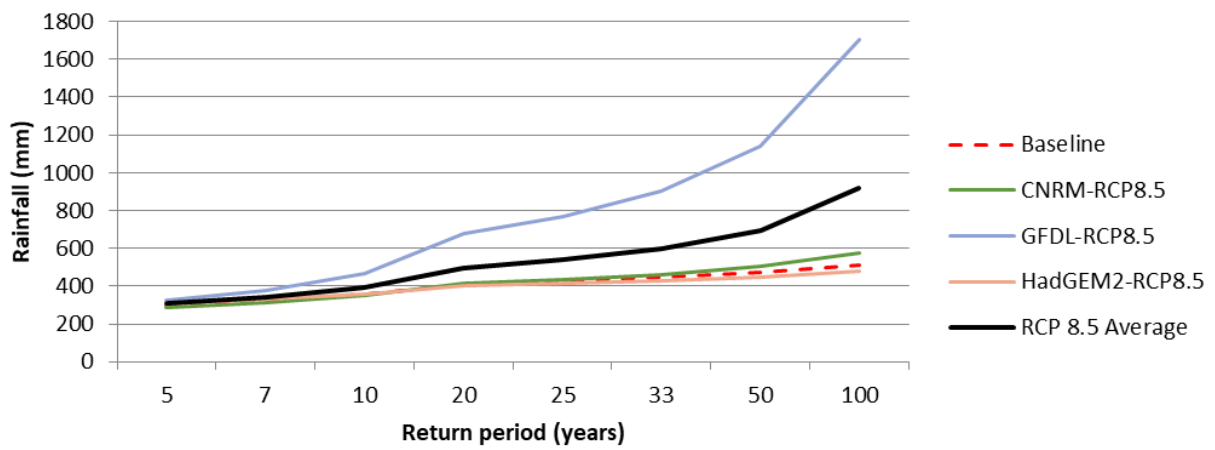
Nghe An - Range of projected 1-day max rainfall by 2030s relative to baseline



Computed percentage increase in 1-day max rainfall at various frequencies (Quang Binh)

Return period	Baseline	Quang Binh PRECIS RCP 8.5			RCP 8.5 Average	Percent change
		CNRM-RCP8.5	GFDL-RCP8.5	HadGEM2-RCP8.5		
5	302	288	324	309	307	2%
10	360	350	467	358	392	9%
20	412	414	681	400	498	21%
25	427	435	771	413	539	26%
50	473	503	1140	447	697	47%
100	515	576	1702	478	918	78%

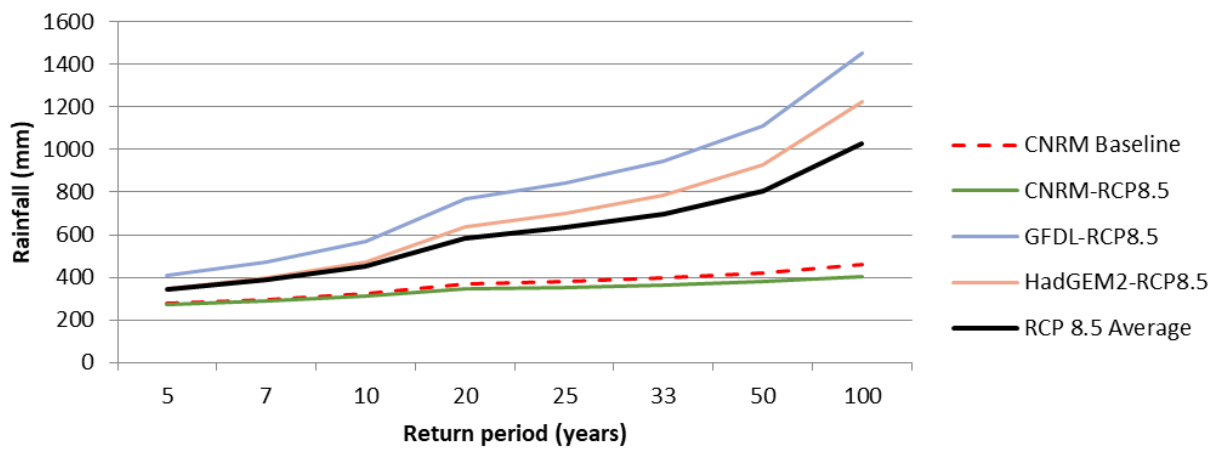
Quang Binh - Range of projected 1-day max rainfall by 2030s relative to baseline



Computed percentage increase in 1-day max rainfall at various frequencies (Quang Tri)

Return period	Baseline	Quang Tri PRECIS RCP 8.5			RCP 8.5 Average	Percent change
		CNRM-RCP8.5	GFDL-RCP8.5	HadGEM2-RCP8.5		
5	278	274	411	346	344	24%
10	325	312	571	474	452	39%
20	369	344	770	636	583	58%
25	382	353	844	698	632	65%
50	423	381	1112	926	806	91%
100	462	405	1452	1223	1027	122%

Quang Tri - Range of projected 1-day max rainfall by 2030s relative to baseline



APPENDIX F: RECALCULATION OF BIIG1AND 2 SUBPROJECT DESIGNS

A. Basis for engineering formulas and computations

378. The case study road subprojects were all designed in accordance with design frequencies for component structures as specified in TCVN 4054:2005. Hydrological calculations for the preliminary engineering design of the representative road subproject in Nghe An were based on formulas specified in national standard TCVN 9845:2013. Calculations for the subprojects in Bac Kan and Quang Binh were computed based on formulas specified in MoT branch standard 22TCN220:1995, which has been incorporated in TCVN 9845:2013.

379. Technical references used included: (i) Computation of Design Hydrological Characteristics (QP.TL.C-6-77) and (ii) Hydrographical and Hydraulic Computation for Road and Bridge handbook published by the Ministry of Transportation in 2006.

B. Projected change in magnitude of 1-day maximum rainfall due to climate change

Exceedance frequency	Return period, years	Province		
		Bac Kan	Nghe An	Quang Binh
P20	5	51%	34%	2%
P10	10	56%	35%	9%
P5	20	61%	37%	21%
P4	25	62%	38%	26%
P2	50	67%	42%	47%
P1	100	72%	49%	78%

C. Design frequencies applied to subproject components

Province	P%	Component
Bac Kan	P4	Small bridges
Nghe An	P4	Culvert, small bridge
Quang Binh	P4	Culvert, small bridge

D. Calculated changes in 1-day maximum rainfall

Bac Kan	1-day maximum rainfall (mm/day)	
	Following historic data at P4	Following RCP 8.5 scenario at P4
Bản Mạn	157	254
Nà Lại	157	254
Nà Vài	197	319
Khuổi Mạn	157	254

Nghe An	1-day maximum rainfall (mm/day)	
	Following historic data at P4	Following RCP 8.5 scenario at P4
Dinh Son to Cay Khe road, Anh Son district	438	604

Quang Binh	1-day maximum rainfall (mm/day)	
	Following historic data at P4	Following RCP 8.5 scenario at P4
Section 1of Bảo Ninh – Hải Ninh coastal road	338	425

E. Calculated change in design of drainage and small bridges

1. Nghe An: *Dinh Son - Thanh Son mountain road*

Computation of water levels under historic and CC scenario for flood-prone sections (caused by overflows of the Con River)

No.	Flood-prone sections	Investigated location	Highest flood level (m)			Historic flood level for design corresponding to P4 (m)	Average increase following RCP 8.5 scenario flood level for design corresponding to P4 (m)	Max. increase following RCP 8.5 scenario flood level for design corresponding to P4 (m)	Notes
			Year 1988	Year 1978	Year 2011	H ₄	H ₄	H ₄	
1	Km2+020 - Km2+250	Km2+108.26(Dong Dau bridge)	16.84	16.69	16.6	16.08	16.95	17.36	Cluster of water levels at small bridge
2	Km2+460 - Km2+904	Km2+759.40	16.90	16.75	16.66	16.14	16.95	17.32	Cluster of water levels at culvert of big span
3	Km4+123 - Km4+258	Km4+220.16	17.05	16.90	16.65	16.29	17.15	17.93	Cluster of water levels at culvert of big span
5	Km6+742 - Km6+877	Km6+800	17.27	17.09	16.63	16.51	17.35	18.15	Cluster of water levels at culvert of big span
6	Km7+80 - Km7+340	Km7+110	17.29	17.11	16.64	16.53	17.37	18.17	Cluster of water levels for alignment

Computation results for 25 culverts (note: dia = diameter in cm)

No.	Station	Computed following the actual Max. 1day rainfall of P4 (438mm/day)		Computed following the 1day max. rainfall of P4 of RPC 8.5 scenario (average. change 38% = 604.44 mm/day)		Computed following the 1day max. rainfall of P4 of RPC 8.5 scenario (max. Change 79% = 784 mm/day)	
		Q ₄ (m ³ /s)	Span of colvert designed at basic step (cm)	Q ₄ (m ³ /s)	Span of colvert designed at basic step (cm)	Q ₄ (m ³ /s)	Span of colvert designed at basic step (cm)
1	Km0+5.20	Structure	dia100, maintain the old culvert	Structure	dia100, maintain the old culvert	Structure	B=70 maintain the old culvert
2	Km0+249.38	Structure	dia150, maintain the old culvert	Structure	dia150, maintain the old culvert	Structure	dia75; 70 maintain the old culvert
3	Km1+201.94	1.26	dia150, maintain the old culvert	1.79	dia150, maintain the old culvert	8.02	Slab culvert L=200; H=250; l _{um} new culvert
4	Km1+310.46	1.15	dia150, maintain the old culvert	1.59	dia150, maintain the old culvert	3.46	2dia150; make new culvert
5	Km1+379.99	1.08	dia150, maintain the old culvert	1.49	dia150, maintain the old culvert	Structure	dia75; culvert with new design.
6	Km1+440.74	0.96	Slab culvert L=100; H=100 maintain the old culvert	1.35	Slab culvert L=100; H=100; maintain the old culvert	Structure	dia75; maintain the old culvert

No.	Station	Computed following the actual Max. 1day rainfall of P4 (438mm/day)		Computed following the 1day max. rainfall of P4 of RPC 8.5 scenario (average. change 38% = 604.44 mm/day)		Computed following the 1day max. rainfall of P4 of RPC 8.5 scenario (max. Change 79% = 784 mm/day)	
		Q ₄ (m ³ /s)	Span of culvert designed at basic step (cm)	Q ₄ (m ³ /s)	Span of culvert designed at basic step (cm)	Q ₄ (m ³ /s)	Span of culvert designed at basic step (cm)
7	Km2+759.40	5.17	Slab culvert L=150; H=150; maintain the old culvert	7.37	Slab culvert L=200; H=200; lưm cèng mii	Structure	dia75; maintain the old culvert
8	Km3+20.01	Structure	B=80, maintain the old culvert	Structure	B=80, maintain the old culvert	66.87	Make new culvert, box BxH=3x(3x3)
9	Km3+297.11	Structure	B=80, maintain the old culvert	Structure	B=80, maintain the old culvert	Structure	dia75; maintain the old culvert
10	Km3+615.93	Structure	B=70, maintain the old culvert	Structure	B=70, maintain the old culvert	2.45	Make new culvert dia150
11	Km3+815.85	1.19	dia100; maintain the old culvert	1.74	dia150; Constructing new culvert	2.07	Make new culvert dia150
12	Km3+924.35	Structure	B=70, maintain the old culvert	Structure	B=70, maintain the old culvert	1.36	dia75; maintain the old culvert
13	Km4+30.81	Structure	dia75; maintain the old culvert	Structure	dia75; maintain the old culvert	23.85	Slab culvert L=400; H=300
14	Km4+220.16	4.25	2dia150; maintain the old culvert	6.09	2dia150; maintain the old culvert	Structure	B=100, maintain the old culvert

No.	Station	Computed following the actual Max. 1day rainfall of P4 (438mm/day)		Computed following the 1day max. rainfall of P4 of RPC 8.5 scenario (average. change 38% = 604.44 mm/day)		Computed following the 1day max. rainfall of P4 of RPC 8.5 scenario (max. Change 79% = 784 mm/day)	
		Q ₄ (m ³ /s)	Span of culvert designed at basic step (cm)	Q ₄ (m ³ /s)	Span of culvert designed at basic step (cm)	Q ₄ (m ³ /s)	Span of culvert designed at basic step (cm)
15	Km4+370.57	1.88	dia150; maintain the old culvert	2.63	dia150; maintain the old culvert	Structure	B=70, maintain the old culvert
16	Km4+628.71	Structure	dia75; design new culvert	Structure	dia75; design new culvert	Structure	dia75; maintain the old culvert
17	Km4+883.13	Structure	dia75; maintain the old culvert	Structure	dia75; maintain the old culvert	8.02	Slab culvert L=200; H=250; make new culvert
18	Km5+21.03	Structure	dia75; maintain the old culvert	Structure	dia75; maintain the old culvert	3.46	2dia150; make new culvert
19	Km6+223.28	35.67	Slab culvert L=400; H=450; maintain the old culvert	50.29	Constructing new culvert, box BxH=3x(3x2.5)	Structure	dia75; culvert with new design
20	Km6+582.49	Structure	dia75; maintain the old culvert	Structure	dia75; maintain the old culvert	Structure	dia75; remain old culvert
21	Km6+795.11	1.17	dia100; maintain the old culvert	1.81	Constructing new culvert - dia150	Structure	dia75; remain old culvert
22	Km7+184.05	1.16	dia100; maintain the old culvert	1.60	Constructing new culvert - dia150	66.87	Make new culvert, box BxH=3x(3x3)

No.	Station	Computed following the actual Max. 1day rainfall of P4 (438mm/day)		Computed following the 1day max. rainfall of P4 of RPC 8.5 scenario (average. change 38% = 604.44 mm/day)		Computed following the 1day max. rainfall of P4 of RPC 8.5 scenario (max. Change 79% = 784 mm/day)	
		Q ₄ (m ³ /s)	Span of culvert designed at basic step (cm)	Q ₄ (m ³ /s)	Span of culvert designed at basic step (cm)	Q ₄ (m ³ /s)	Span of culvert designed at basic step (cm)
23	Km7+345.74	0.67	dia75; maintain the old culvert	1.01	dia75; maintain the old culvert	Structure	dia75; maintain the old culvert
24	Km7+600.94	12.25	Slab culvert L=300; H=200	17.62	Slab culvert L=300; H=300	2.45	Make new culvert dia150
25	Km7+977.82	Structure	B=100, maintain the old culvert	Structure	B=100, maintain the old culvert	2.07	Make new culvert dia150

Computation results for small bridges

Name of brige	F (Km ²)	Q ₄ (m ³ /s)	H ₁₉₈₈ (m)	H ₄ (m)	V ₄ (m/s)	L ₀ (m)	Remark
Dong Dau bridge Km2+108.26 (small bridge)	1.158	89	16.84	16.08	1.88	10	Old bridge is submerged by flood and affected by flood of Con downriver. Recomending to construct a new bridge with sequence circuit: L = 1x12 (m).
Computed results following the 1day max. rainfall at P4 of RCP 8.5 scenario (average. change 38% = 604.44 mm/day)							
Name of brige	F (Km ²)	Q ₄ (m ³ /s)	H ₁₉₈₈ (m)	H ₄ (m)	V ₄ (m/s)	L ₀ (m)	Remark
Dong Dau bridge Km2+108.26 (small bridge)	1.158	102.36	16.84	16.95	1.66	12.3	Old bridge is submerged by flood and affected by flood of Con downriver. Recomending to construct a new bridge with sequence circuit: L = 1x15 (m)
Computed results following the 1day max. rainfall at P4 of RCP 8.5 scenario (max. change 79% = 784 mm/day)							
Name of brige	F (Km ²)	Q ₄ (m ³ /s)	H ₁₉₈₈ (m)	H ₄ (m)	V ₄ (m/s)	L ₀ (m)	Remark
Dong Dau bridge Km2+108.26 (small bridge)	1.158	132.5	16.84	17.36	1.75	13	Old bridge is submerged by flood and affected by flood of Con downriver. Recomending to construct a new bridge with sequence circuit: L = 1x15 (m)

2. Quang Binh: Section 1 of the Bao Ninh – Hai Ninh plain road

Item	At P4 of historical rainfall data			At P4 of CC RCP 8.5 scenario		
	Q _P (m ³ /s)	H _P (m)	V _P (m/s)	Q _P (m ³ /s)	H _P (m)	V _P (m/s)
Culvert C1	22.56	2.74	3.95	30.263	3.32	4.39
Culvert C2	16.378	2.45	3.77	21.889	2.97	4.14

3. Bac Kan: Boc Bo - Bang Thanh - Son Lo mountain road

Site of bridge	At P4 of historical rainfall data				At P4 of CC RCP 8.5 scenario			
	Q _P (m ³ /s)	H _P (m)	V _P (m/s)	L _o (m)	Q _P (m ³ /s)	H _P (m)	V _P (m/s)	L _o (m)
Khuoi Linh	39.52	64.02	1.91	7.9	53.75	64.22	2.22	8.58
Na Vai	111.19	92.14	0.44	31.65	224.01	93.90	0.73	31.29
Khuoi Man	75.63	148.04	1.17	23.38	165.49	149.15	1.67	24.91
Ban Man	75.67	144.62	1.18	23.82	163.06	146.88	1.17	24.62

Where:

Q_p – Design flow at construction site (m³/s) at frequency P%; Q_p corresponds with H_p

H_p – Design water level (m) at frequency P%

V_p – Streamflow velocity at frequency P%

L_p – Drainage aperture/opening at frequency P%

APPENDIX G: APPROACH USING HYDRO-DYNAMIC MODELING

380. For structural components that require P1 and P2 estimates, such as for medium to large bridges, combined application of climate change modeling and hydrological modeling is a suitable approach.

381. Projections of daily rainfall and relevant atmospheric conditions (e.g., temperature, relative humidity) obtained from regional/downscaled climate models can be used as climatic time series inputs to hydrologic models to assess future change in flood levels. That is, hydrologic modeling results can be compared between simulations using baseline/historical rainfall data and that using projected climate data.

382. Hydrologic models are available, such as the Soil and Water Assessment Tool (SWAT) and Hydrologic Engineering Center - Hydrologic Modeling System (HEC-HMS). These are designed to simulate the complete hydrologic processes of watershed systems. Data input are grouped into five categories: topography, land use, soil, land use management and climate.

383. Essentially, a hydrologic model is first calibrated for the subject basin using historical data. Then climatic input data (representing a range of modeling results) are fed to the calibrated model to assess effects on future river flows (in particular, peak flows used for designing structures) and other hydrologic parameters if relevant to the engineering design (e.g., sediment discharge). The climate input data, in gridded format, can be obtained from MoNRE.⁸⁴

384. Basin-scale hydrologic modeling requires gridded daily precipitation, maximum and minimum temperatures, and wind magnitude as input to simulate similarly gridded daily “state variables” such as runoff. Resulting gridded runoffs are then hydraulically routed to the basin outlet or a specified location (e.g., bridge site). Use of multiple climate modeling outputs to feed the hydrologic model allows the assessment of uncertainty around, say, a mean or median projection, providing quantitative information for risk-based decision making.

385. Impacts of potential climate change on streamflow can be evaluated by comparing simulations using the rainfall data derived from GCMs (e.g., covering 2016-2035, applicable to the operating life of BIIG-1 and BIIG-2 infrastructure subprojects).⁸⁵ The streamflow projections are then compared with the baseline runs of the model (using both observed historical rainfall data and baseline data generated by models) to assess the significance of change.

386. An advantage of using integrated models (e.g., SWAT and HEC-HMS) for climate impact analysis of streamflow is that these models can also be used to examine climate change effects on other factors of change, such as land use change. Changes in vegetation cover and basin alterations due to population growth or development activities (e.g., establishment of tree plantations) can then be considered in projecting future streamflow.

387. A common problem with the use of regional climate modeling outputs directly in hydrological impact studies is that the simulated rainfall often exhibits biases.⁸⁶ Bias correction is

⁸⁴ Climate modeling data, at daily scale, can also be downloaded from existing data distribution centers, such as the one maintained by the World Climate Research Program (WCRP) for the CMIP3 and CMIP5 generation of global climate models (http://cmip-pcmdi.llnl.gov/cmip5/data_portal.html).

⁸⁵ If there is an adequate number of rainfall time series inputs, the streamflow projections can be presented as percentile values to bound the range of uncertainty.

⁸⁶ Modeling biases can arise from the internal physics used in the model or from the errors in lateral boundary conditions.

often required to bring model-simulated baseline rainfall in line with the historical observations. Such bias correction has been applied to the entire time series of rainfall in MoNRE's climate change database.

388. Essentially, for the design of bridges (specifically, to determine the design vertical clearance from the P1 or P2 flood), the modeling sequence and steps are:

- First, set up a basin-scale hydrological model and calibrate/validate it using observed hydro-meteorological data.
- Second, use results from a high-resolution climate model (e.g., downscaled for the basin from a global climate model to determine climate projections for the basin over the analysis period (e.g., reference historical period versus operating period of planned infrastructure, say, up to 2030s). Outputs generated from the climate model (e.g. temperature, precipitation) are used as input to the hydrological model.
- Third, use a hydraulic routing model to convert projected basin runoff (flow volumes) generated by the hydrologic model to flooding depth at various points in the river network. For example, the Hydrologic Engineering Center – River Analysis System (HEC-RAS, which is often used in conjunction with HEC-HMS) is a computer program for modeling water flowing through open channels and computing water surface profiles. HEC-RAS is particularly applicable for bridge and culvert design and analysis, embankment design, as well as river modification studies.⁸⁷

389. An example of this approach is reported for a recent study that investigated possible impacts of climate change on future floods in the VuGia -ThuBon river basin in central Vietnam using a multi-model climate ensemble.⁸⁸ An ensemble of regional climate projections derived from different combinations of global and regional climate models in combination with different greenhouse gas emission scenarios were used.⁸⁹

390. Climate data were used as input to a basin water balance model (WaSIM-ETH) to reproduce discharge data at Nong Son station. Annual maximum discharges were extracted from the modeled daily series for the reference period (1980-1999) and future periods (2011-30, 2031-50, and 2080-99) for use in subsequent extreme value frequency analyses. To derive flood frequency curves for the four time periods, the Generalized Extreme Value probability distribution was fitted to the data.

391. Adjusted return periods were calculated based on the delta change method. In this method, the observed extreme values were adjusted using the derived values from the hydrological simulations, which in turn were fed by future climate projections.

392. The study calculated, on average, an increase for the P1 (or 100-year return period) flood magnitude of 4%, 65%, and 94% for 2011-30, 2031-50, and 2080-99, respectively, relative to the

⁸⁷ If water allocation, say for water supply or irrigation development, is the purpose of the analysis, an alternative third model could be a water accounting model (e.g., WEAP, which stands for Water Evaluation and Planning system). Such models can be used to assess the impacts of climate change on water resource availability and water balance in the basin. Results of the hydrological modeling (i.e., projections in river flow), in conjunction with projected water demands, are used as input to the water accounting model. The model calculates a mass balance of flow sequentially down a river system, making allowance for abstractions and inflows. It can be used to simulate alternative scenarios comprising different development and management options.

⁸⁸ Patrick Laux, Thanh Dang, Harald Kunstmann. Expected climate change impacts on extreme flows in Vietnam: The limits of bias correction techniques. *Geophysical Research Abstracts* Vol. 18, EGU2016-8130, 2016.

⁸⁹ In this study, the emission scenarios were based on the 2007 SRES scenarios, which are explained in Annex A.

baseline. However, there was a large spread in the simulated peak flood magnitudes derived from the different models. Nevertheless, there was agreement among the models towards increased future peak flows. Due to the obtained large spread of simulated peak flood magnitudes, the investigators stressed the need for combined climate and hydrological simulations. They also noted that wide spread in model-projected flood magnitudes remains a crucial problem for decision makers in applying climate change impact assessments, as demonstrated in this case.

393. In another case involving the Mekong Delta Connectivity Project,⁹⁰ a climate risk and vulnerability assessment was by carried out and findings reported in 2015. The project involves proposed construction of two large bridges in the Mekong Delta (across the Han River and the Tien River) that would be linked by a 24-km connecting road and 26 small bridges. Thirteen structural components of the project were examined for climate risk and vulnerability--including bridges, road embankments and road drainage structures.

394. For this Mekong delta infrastructure project, the most critical climate change impact—as in the case also of BIIG-1 and BIIG-2--was found to be the likely changes in design flood elevations. The climate risk assessment used rainfall projections from 6 GCMs that were run under two SRES scenarios (A1B and B2), which were used as input to a hydraulic model for the Mekong delta. Modeling results showed that, over a 100-year period, the increase in water level at P1 frequency on the floodplain induced by climate change would reach 0.6 m, while the increase in flood water level at the Cao Lanh bridge site across the Tien River was estimated to reach 0.7 m. Based on these findings, the ICEM study recommended that the design height of the road embankments, including the approach embankments to the bridges, be raised by 0.6 m.

⁹⁰ International Center for Environmental Management (ICEM). Climate Risk and Vulnerability Assessment of the Central Mekong Delta Connectivity Project, February 2015.