SFG1603 REV

SOCIALIST REPUBLIC OF VIETNAM

VINH PHUC FLOOD RISK AND WATER MANAGEMENT PROJECT

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT

(Draft Version)

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DEVELOPMENT RESEARCH AND CONSULTANCY CENTRE (DRCC)

February 26, 2016

ABBREVIATIONs

ADB	Asian Development Bank
BD/CD	Bidding and contract documents
BTNMT	Ministry of Natural Resources and Environment
CPCs	Commune People's Committees
CSC	Construction Supervision Consultant
DARD	Department of Agriculture and Rural Development
DONRE	Department of Natural Resources and Environment
DPI	Department of Planning and Investment
DRCC	Development Research and Consultancy Centre
EA	Environmental Assessment
ECOP	Environmental Codes of Practice
EHS	Environmental, Health, and Safety
EIA	Environmental Impact Assessment
EM	Ethnic Minority
EMDP	Ethnic Minority Development Plan
EMPF	Ethnic Minority Policy Framework
EMP	Environmental Management Plan
ES	Executive Summary
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Framework
ESMP	Environmental and Social Management Plan
EPC	Environmental Protection Commitment
ESU	Environmental and Social Unit
FS	Feasibility Study
FDI	Foreign direct investment
GoV	Government of Vietnam
GIIP	Good International Industry Practice
HH	Household
IEC	Information-Education-Communication
IEMC	Independent Environmental Monitoring Consultant
IMC	Independent Monitoring Consultant
IPs	industrial parks

M&E	Monitoring and Evaluation
MPI	Ministry of Planning and Investment
NH	National Highway
NGOs	non-governmental organizations
O&M	Operation and maintenance
PCR	Physical Cultural Resources
PMO	Project Management Office
PMU	Provincial Management Unit
PPC	Provincial People's Committee
PPE	Personal Protective Equipment
PS	Pumping station
PSC	Provincial Steering Committee
QCVN	Technical regulations
RAP	Resettlement Action Plan
RESA	Regional Environmental and Social Assessment
RPF	Resettlement Policy Framework
SA	Social Assessment
SEMP	Site-specific Environment Management Plan
SMF	Social Management Framework
TCVN	Vietnam standards
TSS	Total suspended solid
TOR	Terms of Reference
TT	Circular
VBSK	Vertical Brick Shaft Kiln
VECs	Valuable Ecological Components
VPFRWMP	Vinh Phuc Flood Risk and Water Management Project
WB	World Bank
WHO	World Health Organization
WWTP	Wastewater Treatment Plant

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1. PROJECT ORIGIN

Next to Ha Noi, Vinh Phuc is 60km away from the capital city to the Northwest and located in a key economic region surrounding with key economic centers of the Red River Delta, Ha Noi Capital and Northern Vietnam. Given the geographic advantages, Vinh Phuc shows its significant economic growth in recent years and becomes one of the main industrial centers of the Red River Delta with a great FDI attraction. In particular, the FDI capital of 150 projects up to December 2012 is approximately 2.5 billion USD and the annual investment capital for the province ranging from 200 to 350 million USD at present. With a half of the province GDP is from foreign direct investment activities, Vinh Phuc also plays an important part in national budget contributing. The public debt level is not significant during the period 2006 - 2011 and the average loans of Vinh Phuc only accounts for 1% of the revenues.

Despite of the rapid economic growth, Vinh Phuc is facing challenges including regular floods, regional water pollution, lack of technical infrastructure and limited institutional capacity. As a consequence, the difficulties prevent Vinh Phuc from higher socio-economic development. Significantly, the Phan River basin, which takes two thirds of the province area and more than 80% of local population, is often affected by the floods. Having almost all of the FDI activities, the area has been damaged by floods in terms of agricultural and industrial manufacturing, people daily life, technical infrastructure as well as regional environment in both rural and urban areas. The initial estimated loss by floods in the period 2006-2013 is 150 million USD and the damage of the agricultural production accounts for 30% in total. Moreover, water pollution from wastewater and solid wastes in river basins of Phan River, Ca Lo River, Pho Day River and local lakes is very severe, affecting directly to people health, living environment and visual scenery of the areas. Therefore, better oversight, flood control and environment improvements in the area are measures for sustainable economic development of Vinh Phuc.

In recent years, Vinh Phuc has received the support capital not only from the government but also from other international organizations such as JICA, ADB for investment in wastewater treatment works and environmental landscape improvement. The issues on floods and water pollution, however, are not adequately addressed. In the situation, the province has implemented many measures, especially the Vinh Phuc Flood Risk and Water Management Project in coordination with the World Bank, aiming to water treatment and regional flood settlement.

The project is invested by a fresh new loan of World Bank and approved by the Prime Minister. The project proposes 03 components: Component 1- Flood Risk Management; Component 2- Water Management; Component 3- Implementation Supporting and Institutional Strengthening

The project is approved by the Prime Minister in a list of the World Bank 220-million USD investment project. The aim of the project is to control flood risk, decrease the number of floods in the areas of Phan River and Ca Lo River, and improve flood drainage and water storage system to cool the pollution in Phan River, Ca Lo River. It also signaled its intention in improving infrastructure in order to develop industrial centers, attract investment support, rehabilitating ecological environment and establishing regulating lakes, matching the flood drainage plan, the province traffic plan as well as the Vinh Phuc general plan on urban construction up to 2030 and with vision to 2050.

2. OBJECTIVES AND SCOPES OF THE PROJECT

2.1. Objectives of the Project

2.1.1. Overall Objectives

The development target of the project has been released to provide a sustainable environment for the long-term socioeconomic development in Vinh Phuc, focus on flood control in the central basin of the province and prevent the rapid degradation of the surface water quality.

The project development target is implemented through:

I. Construction and development supporting on technical infrastructure, economic infrastructure and social infrastructure in order to control floods and rehabilitate rivers;

II. Improving the water quality in the basin areas of Phan River and Ca Lo River by dredging, observing the forecast of water environment quality and wastewater along the Phan and Ca Lo River banks, fully solving some hot spots causing water pollution condition in Vac Lake, Dieu Lake and Phan River basin.

III. Establishing water monitoring and water quality management system, controlling flood and having emergency responses;

IV. Developing institutions and training staffs for certain departments in general and water department in particular, aiming to a simultaneous management on river basins as well as other aspects related to water.

2.1.2. Specific objectives

- ✓ Controlling flood risks, decreasing the flood amount in the Phan and Ca Lo River basins;
- ✓ Improving the flood drainage capacity, storing water and developing river conditioning in Phan and Ca Lo River, meeting water usage demand of households in the region communes;
- ✓ Rehabilitating ecological environment and establishing regulating retention lakes, matching the Vinh Phuc general plan on urban construction up to 2030 and in the vision of 2050;
- ✓ Implementing step by step the overall measure plan in the river basin areas of Phan River and Ca Lo River in Vinh Phuc province;
- ✓ Upgrading the regional infrastructure in rivers, canals to drain off the water when raining, avoiding inundation; gaining confidence from organizations for FDI support in infrastructure investment in the connection area of the route Ha Noi- Lao Cai, focusing on obtaining development investment in industrial zones of Binh Xuyen, Ba Thien and Tam Duong as well as the ICD inland port.

2.2. Scopes and Location of Project

As the irrigation development plan up to 2020 and orientations up to 2030, there are totally 03 locations of flood drainage in Vinh Phuc province:

- ✓ Location 1: the basin of Lo - Pho Day River has 445.82 km^2 of the drainage area, the water drainage has natural direction to Lo and Pho Day River.
- ✓ Location 2: the basin of Phan -Ca Lo River has 710 km^2 of the drainage area which accounts for 60% of the natural area in Vinh Phuc. The water drainage now has natural direction to Cau River (through Phuc Loc Phuong gate) after flowing through Phan - Ca Lo River.
- ✓ Location 3: The area of Yen Lac and Vinh Tuong (outside the Red River dyke) has 39.74 km^2 of the drainage area and the natural drainage direction to Red River.

A

Figure 1. Map of drainage area division in Vinh Phuc

The scope of VPFRWMP project is within the natural land of Vinh Phuc (Location 2 in drainage area division in Vinh Phuc), including land area of 7 districts - towns - cities namely Tam Dao, Tam Duong, Vinh Tuong, Yen Lac, Binh Xuyen, Phuc Yen Town and Vinh Yen City.

- ✓ The project area border has 710 km^2 of the natural land area with Tam Dao mountain range in the North - Northeast; Pho Day River in the West; Red River dyke in the South; Ca Lo Cut River in the East - Southeast.
- ✓ Located in Ha Noi Capital area, the Northern key economic region is along the Lao Cai - Ha Noi – Hai Phong – Quang Ninh economic corridor; the project center - Vinh Yen city has 50 km away from Ha Noi center and 25 km away from the Noi Bai international airport.

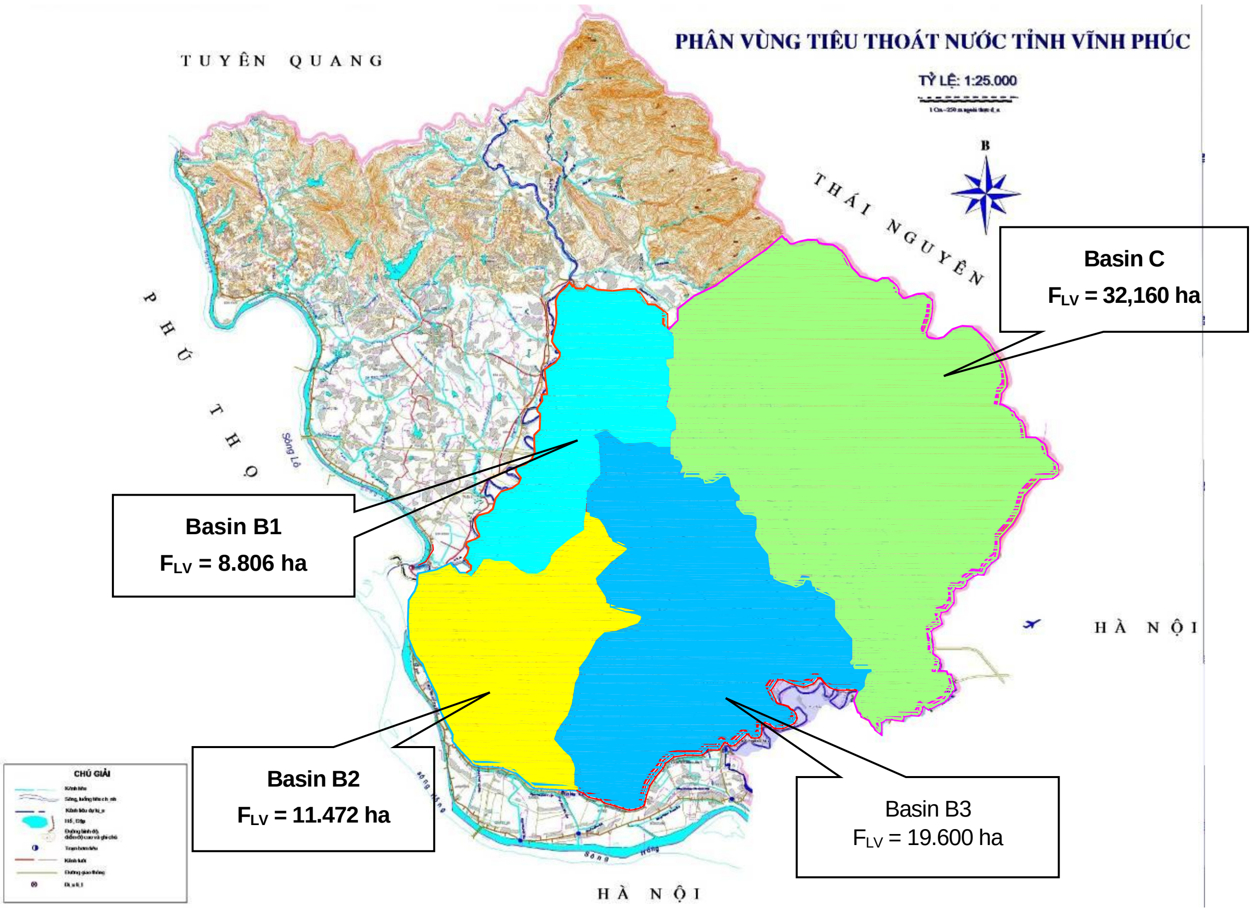

Figure 2. Map of the project basin area division

3. APPROACHES AND METHODS FOR ENVIRONMENTAL AND SOCIAL IMPACTS ASSESSMENT

3.1. Environmental and Social Approaches

3.1.1. Environmental Approach

The project is supported by WB and the Government of the Socialist Republic of Vietnam. The environmental and social impact assessment of the project is ordered to implement and to be match with the policy and requirement of WB and the government, according to experiences from the projects supported by WB and the projects implemented by Vietnam government

ESIA report is prepared based on terms of reference (TOR) of the project with national standards and technical regulations (QCVN) as well as Vietnam standards (TCVN) defined by Vietnam government

Moreover, project content, scope and technical implementation are studied thoroughly in the ESIA project towards every component as well as overall project. Thus fieldwork conducted in and around the project scope is implemented for selection and assessment environmental and social issues rising when the project is implemented.

The evaluation process for the ESIA project is conducted based on a combined analysis of economy, finance, institutions, society and technology, ensuring the environmental and social issues are involved in selecting the project, locations and decisions related to technological measures, etc. The project impacts are divided into direct and indirect ways, cumulative impacts as well as medium-term and long-term impacts. It is also necessary to clarify potential impacts may happen during the construction period, unavoidable and unconverted impacts.

At the same time, conducting and proposing policies and appropriate measures for each component are required to manage and reduce to the minimum environmental and social impacts

Besides, two consultation meetings are held in order to prepare for the ESIA project as other consultations are also conducted in the project preparation process.

3.1.2. Social Approach

This social assessment (SA) was conducted alongside the environmental assessments of the project, on the basis of the feasibility study. Its main purpose was two-fold. First, it examined the potential subproject's positive and adverse impacts of planned project interventions. Second, its findings informed the definition of measures for addressing impacts and proposing community activities to be undertaken, relevant to reach the project's development goal. In doing so, the SA gathered the relevant information on the project's area concerning, demography, economic profile, public services provision and concerns and suggestions of the affected. For the unavoidable identified adverse impacts, and as per the local norms and the Bank's OP 4.12 consultation with stakeholders, local people, governmental agencies, and others pertinent, were carried out to ensure affected peoples will be appropriately compensated for, and supported, in a manner that their socio-economic activities will be promptly and fully restored at least to the pre-project level, and that their livelihoods will not be worsen off. As part of the SA where ethnic minority (EM) peoples are present in the subproject area, and once confirmed by the EM screening (as per Bank's OP 4.10), consultation were carried out in a free, prior, and informed manner, to confirm if there is broad community support from affected EM peoples for the subproject implementation. EM screening was conducted as per Bank's OP 4.10, and with the scope and coverage of the social assessment vis-à-vis the environmental assessment (OP 4.01). A gender analysis was also carried out as part of the SA to understand underlying gender dimensions (from project impact perspective) to enable gender mainstreaming to promote gender equality, and enhance further the development effectiveness of the subproject, and the project as a whole. Based on the magnitude of the potential project impacts, a gender action plan, and gender monitoring plan were prepared as well as a Community Health Action Plan, and Participation Plan and Stakeholder Communication Strategy

3.2. Environmental and Social Assessment Methods

3.2.1. Environmental method

1. *Fieldwork survey method*: survey on actual state of natural resources. It includes studying and selecting locations, data, monitoring methods as well as taking samples of soil, deposit, water surface, ground-water and atmosphere within the project area.
2. *Sociology survey and community consultation method*: The method allow evaluating participants and community involvement in the project implementation. To consult communities, the advisory group held consultations and covered all the areas which have construction implementation. All the people components such as direct or indirect affected people; management agencies; project contributors; other related organizations and individuals, etc. are ensured to attend at the consultations. The consultations are held in two times:
    - ✓ The first time: clarifying the project impact scope, introducing the Project, evaluating preliminarily environmental impacts caused by the project activities, collecting comments on mitigation measures; analyzing undefined environmental factors in the project areas.
    - ✓ The second time: finishing the ESIA report including reporting and discussing ESIA results, collecting feedbacks and unifying environmental assessment results of the project.
    - ✓ In the consultation process, it concludes warning negative environmental impacts that might happen in project implementation and proposing measures to these impacts. Authorities together with people in affected areas shall make contributive comments on mentioned environmental issues and mitigation measures to implement.
3. *Statistical method*: collecting and analyzing meteorological, hydrological and environmental data in years in project areas.
4. *Inheritance method*: learning from related research results.
5. *Expert method*: the advisory group worked and held meetings and workshops with participation of environmental experts, sociological experts, etc. in order to propose

mitigation measures to negative impacts of the project.

6. *Collecting, analyzing and project conducting method*: Analyzing, collecting project impacts on natural component of the project environment and socioeconomic factors.
7. *Rapid appraisal method*: is a method implemented based on emission factors and. This rapid appraisal method is highly effective in identifying volume size, pollution level of emission from equipment and truck usage; volume size, water pollution level from wastewater amount of workers during the period of project implementation; pollution volume size of constructions in the project. Thus, the method anticipates these volume sizes for pollution rising locations to clarify capacity of environmental impacts causing pollution.
8. *Comparing method*: Evaluating impacts by comparing results of measurement, analysis, calculation and anticipation the pollution level from project activities with Vietnam standards conducted by the Ministry of Environment and Natural Resources in terms of soil, water, noise, air quality as well as criterions of the Ministry of Health and the Ministry of Construction.
9. *Matrix method:* the matrix table is created by comparing each project activities with every index and environmental components to evaluate causes and consequences. The method is highly effective in identifying project impacts as well as proposing measures to information and impact summary. Being an easy-to-use method which requiring not many environmental indexes, the matrix method shows its benefits when displaying relationships between development and environment through applying many activities based on an element.
10. *Modelling method:* In order to reach objectives of the flood risk and water management project, the model method is necessary to anticipate flood development and inundation possibility. Thanks to the national and international quality, the models MIKE11 HD and AD are applied with the results considered as fundamental for impact assessment of flood management level and impacts on river ecosystem before and after the project construction.
11. *Observing, sampling and environment analyzing method*: Based on project activities as well as surveys the current situation in the project areas, the report started to observe, take samples to analyze current environment situation in the regions, thus proposing mitigation measures as well as environment management plan during the project implementation. The selected samples of environment components conclude:
    - ✓ Soil, water surface, groundwater quality monitoring is implemented according to the below processed/regulations:
    - ✓ *Air monitoring:* Circular no 28/2011/TT-BTNMT provides regulations on technical process of air and noise quality observing.
    - ✓ *Water surface and deposit monitoring:* Circular no 29/2011/TT-BTNMT provides regulations on technical process of water surface environment observing.
    - ✓ *Groundwater environment monitoring:* Circular no 30/2011/TT-BTNMT provides regulations on technical process of groundwater environment observing.

- ✓ *Soil monitoring:* Circular no 33/2011/TT-BTNMT provides regulations on technical process of soil observing.

The taken samples then preserved and delivered to VILAS standard laboratory to analyze significant environmental index. The analyzing methods are applied under Vietnam conducted criterions and standards.

3.2.2. Social assessment method

Screening of ethnic minorities:

The purpose of screening for EM peoples was to determine their presence, as per the OP 4.10 in the project area. Once confirming the presence of EMs, the OP 4.10 was triggered and an EMPF was prepared to guide the preparation of the EMDP, for subprojects in the preparation and implementation phases.

Data collection and survey processing

Regarding the process for the elaboration of the SA, the method included data gathering and analysis of secondary information, and primary qualitative and quantitative information. The latter included defining a survey approach/ frame and methodology to determine the appropriated sample size, and data collection technique/ method. Two main survey techniques selected, included the following: (i) through templates/ forms applied among authorities of the project wards/communes; (ii) a stratified sampling survey among the households' on their socio-economic information.

Collection of Secondary Data

Sources of information and project-related data collected included by the Vinh Phuc ODA PMU, and from other local socio-economic analysis as the Vinh Phuc Statistic Yearbook, the Socio-economic Reports of the province/district/communes, and the poverty analysis regarding ethnic groups.

Quantitative Research

A socioeconomic survey was conducted to document the profile of the people in the project area, involving affected households and beneficiaries (or both). The socio-economic survey was carried out within a period between August 10th and 28th. The sample size included 965 households consulted through a questionnaire, which covered 21 wards of 7 the districts of Vinh Phuc province. The table below shows the number of households that participated in the mentioned surveyed:

- ✓ *Local authorities*: Representatives of departments and sectors in the project area's districts, and wards/communes.
- ✓ *Households*: Beneficiaries, vulnerable households, ethnic minority households, households at risk of being affected by the project, sampling households with different living standards.

Table 1. Surveyed households at the project's basins

Basins	**District/city**	**No. of surveyed HHs**		**Total**
		Beneficiary HH	***Affected HH***	
C	2	53	108	161
B3	3	90	178	268
B2	2	90	179	269
B1	2	57	112	169
Component 2	4	40	58	98
Total		330	635	965

Source: Socio-economic survey, August 2015.

Qualitative research

It was conducted through in-depth interviews and with a sample size is 246 key informants. These include a) leaders, and group/chiefs of villages; b) leaders of the Ward/commune People's Committee; c) agriculture extension officials; d) heads of medical stations; e) Women's Union, f) households located in the project area; and g) affected and beneficiaries' households. Local people's opinions and wishes were collected to address potential conflicts and define actions to mitigate or provide remedies to impacts of the project.

In addition, 21 focused group discussion included 172 people and community meetings with 392 people. These consisted of representatives from social unions of villages/hamlets and vulnerable households, ethnic minority households, household-headed women. The group discussions was focused on household's living conditions, occupation, accessibility to public service infrastructures, health care, traffic, climate change, related matters.

Public Consultations

Developing and implementing an effective public participation plan to involve all interested and affected stakeholders is vital for the project. Public participation techniques for collecting information about public response to proposed project investments, throughout the implementation and monitoring are required. During the project's preparation phase, 21 public consultations in 21 wards/communes were carried involving the participation of the following stakeholders:

- ✓ Local authorities, representatives from 21 communes
- ✓ Mass organizations, including Fatherland Front (21 persons), Women's Union (25 persons), Youth Union (21 persons), Farmers' Union (28 persons), Veterans' Union (21 persons) of 21 selected wards/ communes. Households that included households with potential land to be acquired, beneficiary households (965 HH, in which 330 beneficiary households and 635 affected households), vulnerable affected such as, households with the disabled members (20 households), ethnic minority households (35 households).

Issues discussed during public consultation included: (i) introduction of the project and its components; (ii) overview of local socio-economic situation of project ward/communes; (iii) assessment status of infrastructure of residential areas, including electricity, roads, schools and health stations; (iv) gathering of demands (suggestions and concerns)) for investment in construction and renovation of the local infrastructure; and (v) screening and assessment of potential impacts that may occur during the project's construction phase (partial and temporary flooding in nearby area, limited access to fishing revenue) on socio-economic, and cultural practices of people in the project area. (The detailed information on Information Disclosure, Consultation and Participation is presented in Chapter 8 of this document)

4. ESIA REPORT PREPARATION INSTITUTLON

Project Name: Vinh Phuc Flood Risk and Water Management Project

Project Category: A

Donor: World Bank (WB)

Line Agency: Vinh Phuc Provincial People's Committee

Agency proposing the Project: Vinh Phuc ODA Project Management Unit

Address: Nguyen Trai, Dong Da Ward, Vinh Yen City, Vinh Phuc Province

Tel. No.: (0211).3860.858; Fax: (0211).3860.858;

Project Management Agency: Vinh Phuc ODA Project Management Unit

Consulting Agency: Development Research and Consultancy Centre (DRCC)

Address: Floor 15, No. 1 Lieu Giai Street, Ba Dinh District, Ha Noi

Representative: Mr. Nguyen Hong Quang. Position: Director

List of people participating in the preparation of ESIA for the Project is shown in the table below:

Table 2. List of people participating in the Project ESIA preparation

No.	Name of Expert	Qualification	Position
1	Nguyen Thi Loan	Assoc. Prof. Dr. in Environment	Team Leader
2	Tran Thien Cuong	Dr. in Soil, Water, and Environmental Science	Environmental Specialist
3	Tran Minh	MSc. in Environment	Environmental Specialist
4	Pham Hong Hiep	MSc. in Environmental Technology	Environmental Technology Specialist
5	Nguyen Xuan Huan	MSc. in Environmental Science	Environmental Chemistry Model Specialist

6	Nguyen Thi Thuc	MSc. in Environment	Environmental Specialist
7	Hoang Duc Thang	MSc. in Environmental Technology	Supporting staff in environmental monitoring and sampling
8	Dinh Manh Cuong	MSc. in Environment	Supporting staff in environmental monitoring and sampling
9	Nguyen Tien Dan	MSc. in Environmental Chemistry	Supporting staff in environmental monitoring and sampling
10	Pham Tien Dung	MSc. in Construction	Construction Specialist
11	Hoang Hoa Quan	MSc. Ecology	Ecology Specialist
12	Bui Quang Binh	Dr. in Earth Science	GIS Specialist
13	Khuc Thi Thanh Van	Dr. in Sociology	Social/Resettlement Specialist

CHAPTER 1. PROJECT DESCRIPTION

1.1. PROJECT OVERVIEW

1.1.1. Project Components

The Vinh Phuc Flood Risk and Water Management Project is proposed to be implemented in Vinh Yen City, Phuc Yen Town, and districts of Yen Lac, Binh Xuyen, Vinh Tuong, and Tam Duong. The Project consists of three components:

- ✓ Component 1: Flood Risk Management
- ✓ Component 2: Water Environment Management
- ✓ Component 3: Project Implementation Support and Institutional Strengthening

<u>Component 1- Flood Risk Management</u>

(a) Vinh Phuc Province is located in the transition zone between the mountainous region and North Delta of Red River. The north has Tam Dao Mountain range with El. 1,592 m Dao Tru mountain peak. The Lo River runs from east to west along the boundary of mountain and plain and Red River runs north to south along the west provincial boarder. The terrain of Vinh Phuc Province is high at its northwest and runs gradually down to the lowland southeastward. The project area, the economic center of the project, is of 720 km^2 of Phan River Basin, and has mountains and hilly area on its north, with the elevation from El. 300.0 m to 700.0 m, and flood plain, with the elevation varying from El. 10.0 m to 12.0 m, at center and south part of the basin.

(b) The project area covers the entire Phan River Basin, with a catchment area of 398.5 km^2, and upper reaches of Ca Lo River, about 13 km with a catchment area of 311.2 km^2. The area has very complex hydrological and hydraulic conditions. Phan River originates from Tam Dao and serves as the main canal, with width ranging from 20.0 m to 50.0 m and river bed elevation from 9.6 m to 3.0 m, running 64.5 km from north to south and then to east, to discharge the water, collected from number of creeks/rivers and ponds/lakes, into the Ca Lo River and then about 110 km to the sea. To better understand the topographic and hydrological features of the project area, Phan River Basin, referred as Basin B, is divided into three sub-basins, i.e. B1 as the northern, B2 the as southwestern, B3 as the center, and discharge the water into the upper reaches of Ca Lo River referred as Basin C.

(c) The rain in the project area is unevenly distributed in both the space and time. According to the meteorology records from 1962 to 2010, the annual mean precipitation varies 1,575 mm at Vinh Yen Station in its center and south to 2,439 mm in the north mountainous area at Tam Dao Station. About 70% to 85% of the rainfall at the center and south part occurs in June, July and August but in mountainous area sets in one month later. The heavy rainfalls brought by Northeast monsoons usually covers the entire project area and last for 3 to 5 days during the rainy seasons.

(d) As the heavy rain occurs in the project area usually at the same time as that in the Ca Lo River Basin, the water downstream in Ca Lo River forces the water level in Phan River too high for natural drainage, which results in waterlogging or inundation up to 2.5 m in some places that last 10 to 20 days. These waterlogging and flooding affect agriculture, transports, industry and livelihoods in the province. There are existing flood infrastructures, including five small and medium capacity pumping stations as well as sluice gates, but most of these infrastructures date back to the French period and are barely functioning or out of operation. Besides outdated infrastructure, there is not enough pumping capacity and retention capacity, rivers and drains are silted, and there are not enough regulating structures to manage flood waters.

(e) A commonly used numerical hydrodynamic model was used to conduct the flood risk assessment and verify the design scenarios. The model was properly calibrated and validated based on the data available. The August 2013 flood event has been used to develop the model and validation of the model was carried out through the review by a technical team from a reputational international consulting firm. A 2D model is used to prepare the flood risk map that helps to determine the area of flood damages. The model results confirmed the key causes of the floods and waterlogging in the project area, i.e. quick runoff generation from mountainous and hilly areas in the north, lower discharge capacity of Phan River, and gentle hydraulic profile along Phan River due to the higher water level at its conjunction with the Ca Lo River. Alternative analysis with various design scenarios against the storms of different return periods was carried out to determine the design scenarios. Based on such an analysis, it was determined to invest the structural measures protect the project area from being flooded caused by storm with 10 years return period and non-structural measures to reduce the damages caused by the storm with the probability over 10%. The model was used to verify the design scenarios to ensure the adequacy of the design of structures.

(f) As determined by the assessment and analysis, the proposed strategy on the flood risk management is to create retention storage in three sub-basins of Phan River to better regulate the peak floods, which will also serve as the water reservoirs during the non-flood season, to build one pumping station in each sub-basin to pump out the excessive flood water out of the basin, and to dredge key sections of Phan River to increase its discharging capacity. Based on this strategy, the project proposed to support: i) dredging of three existing lakes to increase their retention capacity that will help to store the peak of the runoff generated in the basin; ii) construction of three pump stations, with the total capacity of 145 m^3/s, to divert the excessive runoff to Pho Day River from the upstream and Red River from the middle reaches of Phan River; iii) dredging of key sections and renovation of some cross river structures to improve the discharging capacity of Phan River; and iv) construction of two sluice gate structures at the conjunctions with the Ca Lo River to prevent the floods entering into Phan River Basin when necessary. The non-structural measures, including a pre-warning system and flood emergence response plan, are proposed to be developed to reduce the damages and losses of lives when the storm over 10 year recurrence occurs.

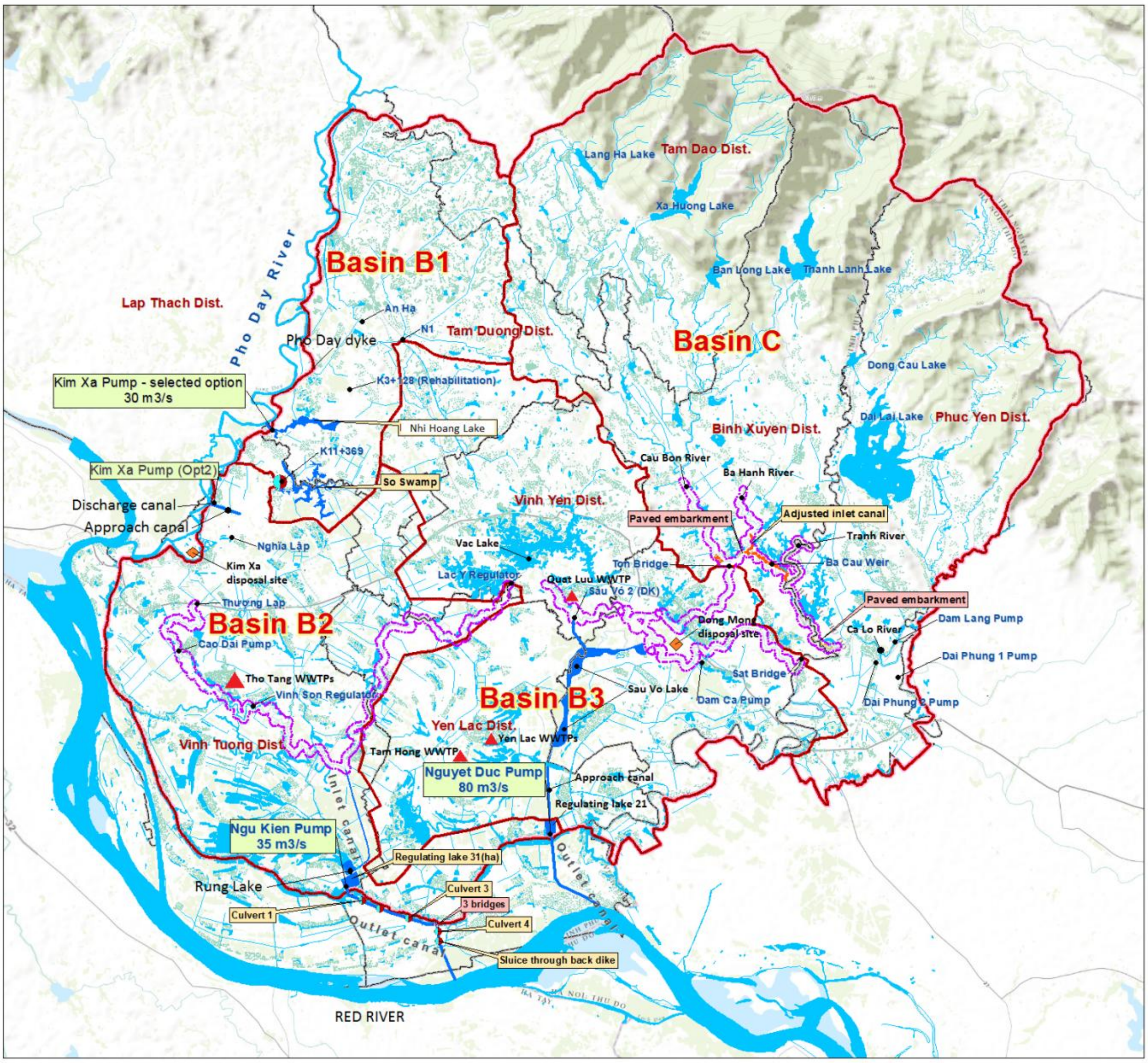

Figure 3. Layout of the basins and project investments

The activities proposed to be undertaken by sub-basin are given below:

1. ***Sub-basin B1***: Dredging the Nhi Hoang Lake to serve as a retention lake, with the storage of 750,000 m^3, and construction of a 3.8 ha Kim Xa dumping site to receive the dredged materials from the lake; construction of Kim Xa Pump Station, with the design capacity of 30 m^3/s, two concrete culverts at K3+128 and K13+300, excavation of a 313.0 m long discharging canal; 18.65 m long approaching canal and improving 10 -chamber control gate at K11+369 to separate irrigation basin area.

Figure 4. Layout of Sub-basin B1

2. ***Sub-basin B2***: Dredging of a retention lake with the storage of 1.35 millionm^3, construction of Ngu Kien Pump Station, with the design capacity of 35 m^3/s, and excavation of a 3.96 km of approaching canal, with eight basic bridges across the canal, and a 3.83 km of discharging canal with a culvert at Dyke Ta Hong, dredging key sections along 11.5 km of Phan River,

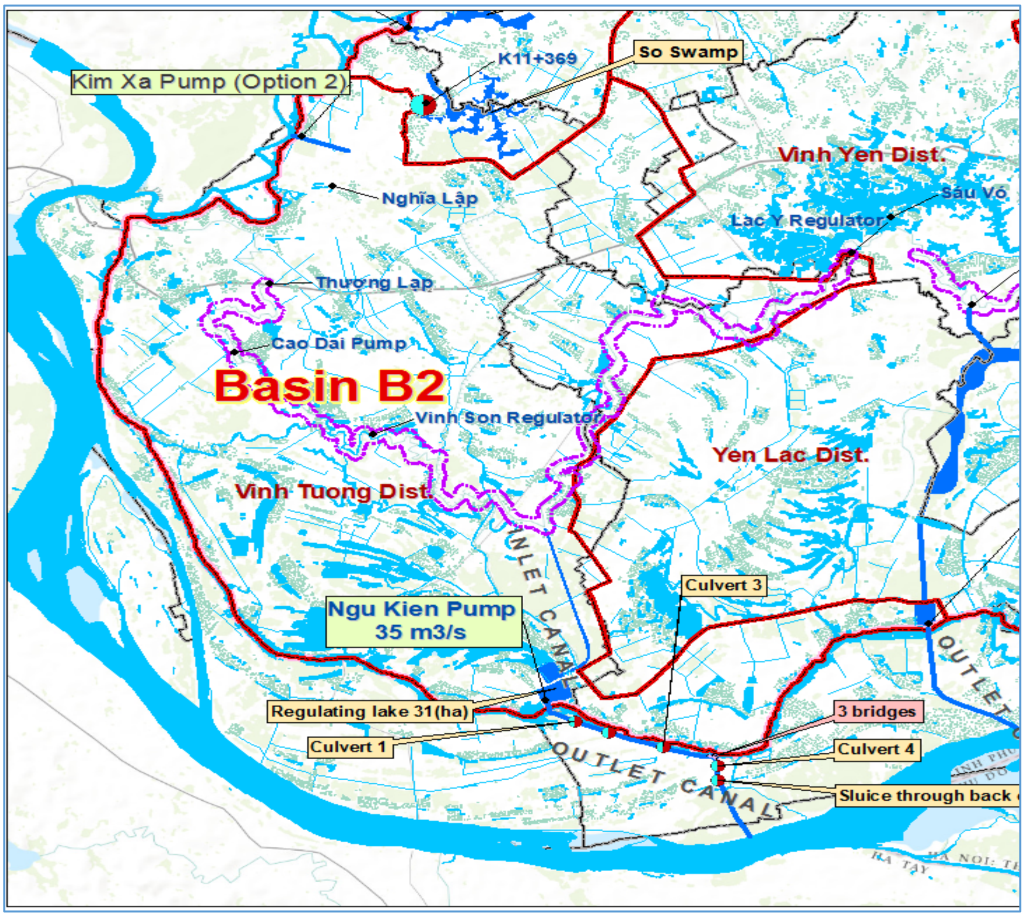

Figure 5. Layout of sub-basin B2

3. ***Sub-basin B3***: (i) Construction of Nguyet Duc pumping station with capacity of 80 m^3/s, excavation of 7.71 km approaching canal, a regulating pond with the storage of 1.62 million m^3, and 3.15 km of discharging canal, with associated sluice gates and other structures; dredging 176.5 ha of Sau Vo Lake, with a storage of 4.0 million m^3 and key section of 3.4 km of Phan River, construction of 5.7 km service road with the width of 10.5 m; and construction of a 54.31 ha Dong Mong disposal site to receive the dredged materials from the projects.

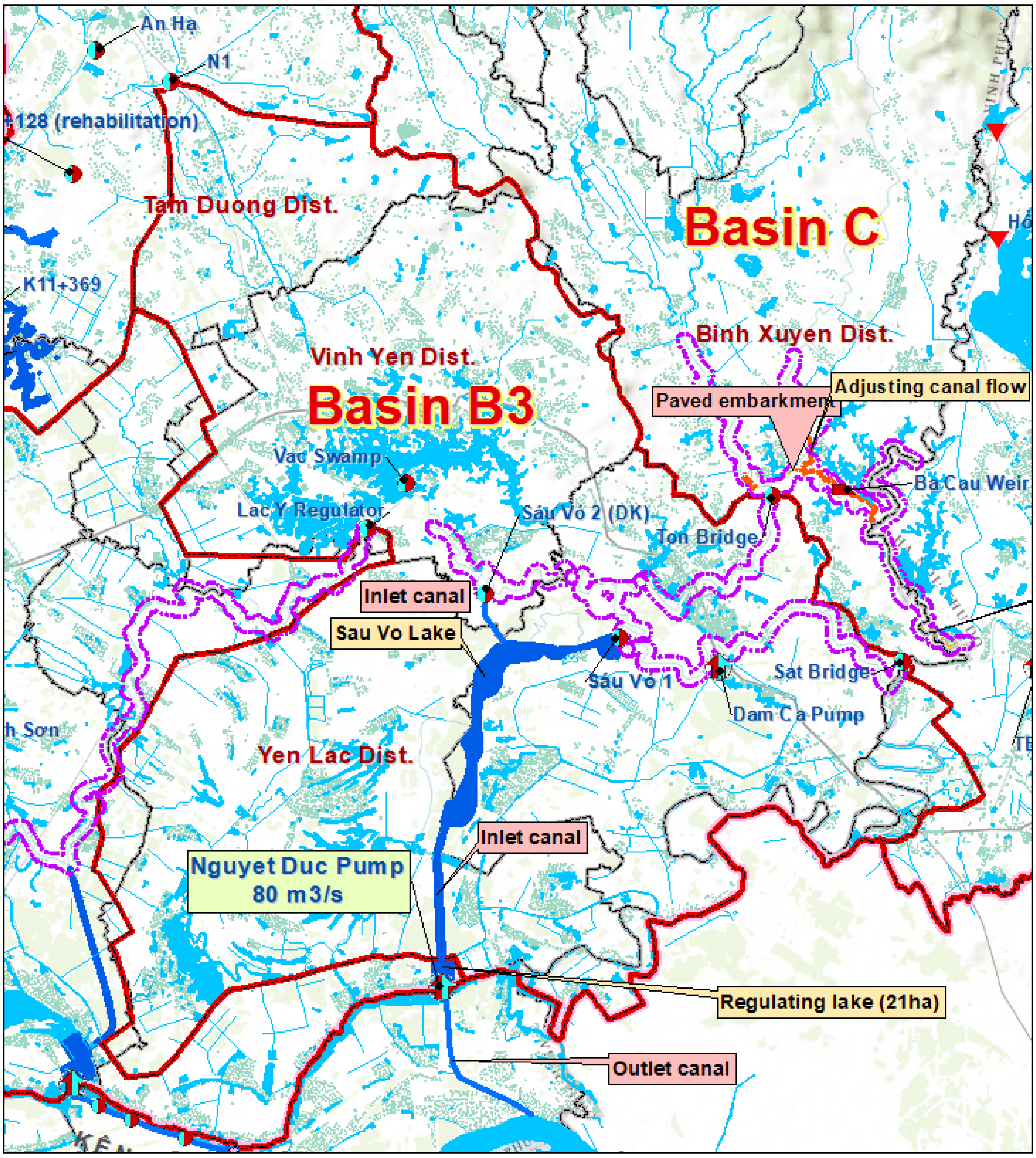

Figure 6. Layout of Sub-basin B3

4. **Basin C**: Dredging of total 21.38 km of four rivers, i.e. Cau Bon River, Tranh River, Ba Hanh River, and Noi River, and construction of two sluice gate structures at Ton Bridge and Sat Bridge.

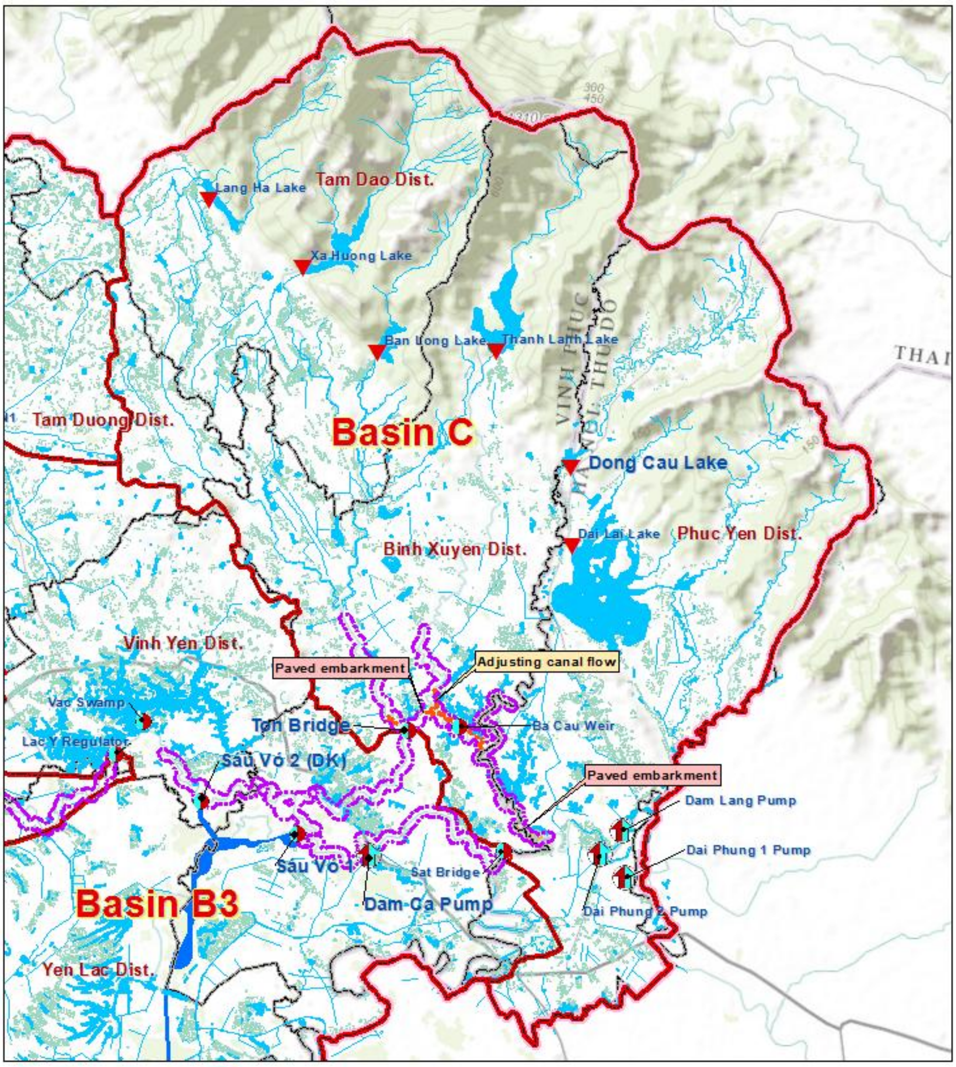

Figure 7. Layout of Basin C

<u>Component 2- Water Environmental Management</u>

1. The water quality monitoring data from the provincial Department of Natural Resources and Environment (DONRE) and additional sampling work conducted by the consultant during project preparation suggest that water pollution happens mostly with high concentration of BOD5 and coliform in the section between Thuong Lac and Lac Y control gates of Phan River. The main sources of the pollution are from the domestic wastewater discharges from the towns and villages in Phan River basin. Wastewater generated from industrial parks are treated before discharge. Four towns and 33 villages were identified based on the selection criteria of (i) the size of population; (ii) the distance to Phan River; and (iii) the availability of piped water supply system that is developed under either the Government’s program or the ongoing the World Bank financed program for results (PforR) for rural water supply and sanitation. The total population in these towns and villages is about 150,000. The proposed interventions through the project include rehabilitation and construction of sewerage network, household connections and wastewater treatment facilities.

2. The wastewater generated from the towns and villages is mostly domestic and partly from the livestock farming activities. The majority of the households in these towns and villages use septic tanks to primarily treat the wastewater prior to discharge to the drain network, mainly in the form of open canals along the roads. The drain network is combined system that conveys both storm water and wastewater. Under the project, these open drains will be rehabilitated and upgraded with proper covering. In addition, the network will be extended by constructing new primary, secondary and tertiary sewers to provide service to the 4,300 unconnected households in the towns and villages. To separate wastewater from combined drain before its discharge to the environment, interceptors with combined sewer overflow (SCO) chambers will be constructed. Intercepted wastewater will be transferred to wastewater treatment facilities either by gravity or through relay pumping stations. In total, about 20 relay pumping stations with more than 5km of pressurized pipeline.

3. Wastewater treatment facilities are simple and of low costs advanced septic tanks equipped with trash removal unit at influent and an additional wet land at effluent. The similar wastewater treatment facilities are widely used in Vinh Phuc province and the country and demonstrate their simplicity and efficiency. The proposed treatment facilities can treat the influent wastewater with BOD^5 level varied from 120mg/l to 150mg/l to the level requested by the Government’s effluent standards as 50mg/l without using energy and with less volume of sludge generated. There are 38 wastewater treatment facilities are provisioned to be constructed with capacity varied from 300 m^3/day to 2,500 m^3/day, from which five facilities are for three towns (Yen Lac, Tam Hong and Vinh Tuong) and 33 facilities are for 33 rural villages. One town namely Huong Canh only needs to build sewer and collection systems as there is an existing Quat Luu wastewater treatment plant which was constructed to treat wastewater for Vinh Yen City and Huong Canh town with initial capacity of 5,000 m^3/day.

4. Separate operation and maintenance (O&M) arrangements are proposed for towns and villages. While the town’s and commune’s governments (Peoples Committees) remains the owners of the assets created from investments, O&M service in the towns can be implemented through service contracts signed between the respective asset owners and selected service providers. The O&M service for rural villages can be implemented by concerned communities under the guidance from asset owners. For the towns, the existing water supply utilities can be selected for providing wastewater service given the similarities of these services and common customers. The service charge for wastewater service will be implemented by the provincial government as a surcharge on top of the water bill and will be collected by the service providers. For the rural villages, a small wastewater fee which will be decided by local commune governments can be added to the existing fee of solid waste management or water bill where available.

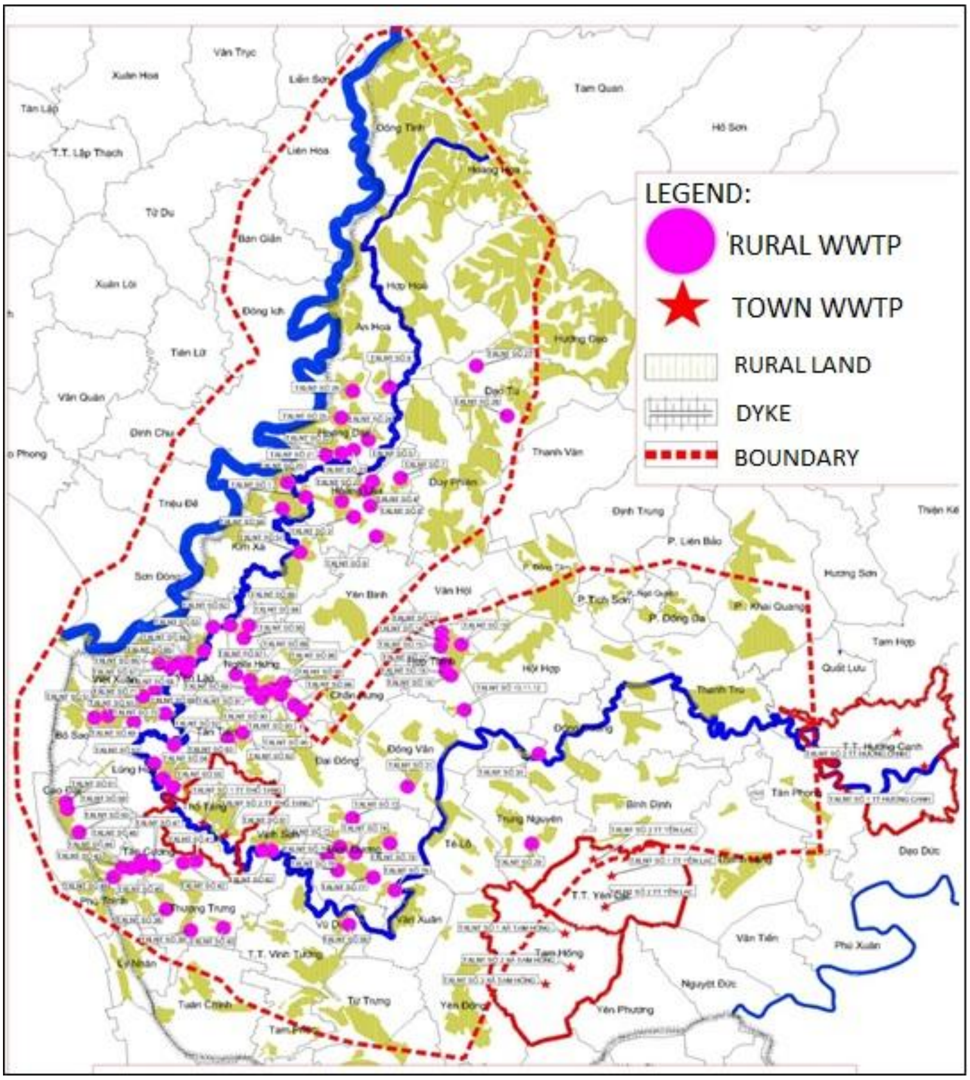

Figure 8. Locations of proposed wastewater treatment facilities of the Project Component 2

<u>Component 3- Project Implementation Support and Technical Assistance</u>

1. Project implementation support is to ensure the project is implemented properly. For that purpose, the capacity of the project implementing unit (PMO) needs to be strengthened and several consultancies need to be employed. PMO's capacity building includes (i) providing office equipment, hardware, software and transportation; and (ii) providing training courses/study tours on project management to PMO's staff. The consulting services needed include (i) consultant for preparation of detailed engineering design and bidding document preparation for the remained works; (ii) consultant for construction supervision; (iii) consultant for safeguard compliance monitoring; (iv) consultant for auditing the project financial statements; (v) consultant for project progress monitoring and reporting; and (vi) other consultancies.

2. The technical assistance is focusing on strength the capacity of the province in the field of integrated water resources management and flood risk control. This includes establishment of flood early warning system for the province and other related water resource. In addition, institutional strengthening and capacity building activities will be

carried out for the O&M services. For the water quality monitoring, the government (DONRE) has committed building the water quality monitoring system as part of the government's overall environmental monitoring program in Vinh Phuc. The Bank was furnished the letters from the Vinh Phuc PPC (Letters No. 2273, 2974 and 2494) regarding the from approving the list of proposed monitoring stations which will be financed from the Government budget, which includes The letter No. 2494 from Vinh Phuc PPC approving the budget for construction of some monitoring stations in 2015 including 2 station for surface water monitoring.

3. The flood early warning system includes a number of hydromet stations constructed in Phan River's basin that transfer information to the local department of agriculture and rural development (DARD) for storage and processing. Given the capacity of the DARD, processing collected information is desired to be performed by special agency at central level based on contractual agreement. The forecasts generated from the data processing are transferred back to provincial committee for preventing floods and disasters, for which DARD is a standing member. The committee, based on received forecasts and working protocol can make decisions on how the province may react on that event. The project will support the province in (i) providing necessary equipment for water monitoring and hydromet systems; (ii) setting up the institutional arrangement that will be strengthened by varied consultancies; and (iii) drafting working protocol for water resource management and flood prevention. The assets created from the projects will be transferred to O&M entities. The existing Lien Son irrigation management company will be responsible for O&M of flood control assets such as pumping stations, canals, lakes and gates. The assessment of the company's capacity shows that some areas of that company will need to be strengthened. It includes (i) asset management strategy; (ii) O&M equipment; (iii) resources management; and (iv) labor skills. For the wastewater collection and treatment system in the towns, the capacity of town's government on managing these system will need to be strengthened. That includes improving the technical skills and business knowledge regardless the town's government will be responsible for O&M or outsource the service. All capacity building activities can be supported under the project through a number of trainings, consulting services and procuring of equipment needed.

1.1.2. Detailed Description on Project Investments

Table 3. Detailed List of Project Investments and Locations

No.	Investments	Location
Component I- Flood Risk Management		
1.1	***Sub-basin B1 - Kim Xa pumping station basin area of 8,806 ha (Figure 1.2)***	
	Dredging Nhi Hoang retention lake with storage area of 750,000 m^3 on an area of 38.5 ha to the depth of 1.8-2.0 m	- Hoang Dan, Hoang Lau communes - Tam Duong District
	Construction of Kim Xa pumping station of 30 m^3/s**.** Main works include: - 6 pumps at Km13+300 on the right dyke of Pho Day River - A substation for the pumping station, with two 4000KVA-35/6 transformers and one 100kVA-35/0.4 transformer. - The two-storey management house in a floor area of 250 m^2	Hoang Dan Commune Tam Duong District
	Construction and rehabilitation of two concrete culverts at K3+128 and K13+300 (*as control gates from Phan River to Nhi Hoang retention lake*)	
	- Excavation of a discharging canal of 355 m long and 3.5 m wide; from pumping station through Pho Day dyke culvert to Pho Day River. The discharging canal include: - section 1 is from pumping station through dyke concrete culvert, 42 m long, concrete culvert; - Associated two-chamber culvert through dyke Pho Day, connecting with section 1 and section 2 of discharging canal - section 2 is soil canal, 313 m long, located outside the dyke,	
	- Construction of a soil approaching canal from Nhi Hoang Lake to the pumping station, 18.65 m long; 42 m wide	
	Rehabilitating a 10-chamber control gate at Km11+369 of Phan River (this is a control culvert from Phan River and So lake)	Kim Xa Commune Vinh Tuong District
	Construction of Kim Xa disposal site with a total area 3.8 ha and storage capacity of 64,000 m^3, to the elevation of 11.0-11.5 m	
1.2	***Sub-basin B2 - Ngu Kien pumping station 11,472 ha (Fig 1.3)***	
	Construction of Ngu Kien pumping station, designed capacity of 35 m^3/s. - 07 pumps in the pump house - 1 two-storey management house with the total floor area of 250 m^2 and - 1 substation with two 4000KVA-35/6 transformers and one 100kVA-35/0.4 transformer.	Ngu Kien Commune Vinh Tuong District
	Dredging the Rung retention lake in front of the pumping station with the storage of 1.35 mil m^3 and the area of 30.9 ha, to the depth of 3.8-4.2 m.	
	Construction of a reinforced discharging canal with 3-chamber culverts through Red River dykes with the length of 3.83 km and width bed of 16 m, bed elevation +9.6 m, top elevation +15.4 m.	Communes of Ngu Kien, Dai Tu and Lien Chau Vinh Tuong and Yen Lac

No.	Investments	Location
		Districts
2	Dredging key sections along Phan River from Thuong Lap Bridge to Lac Y Bridge, with the length of 11.5 km, to the depth of 0.5-1.5 m. Embankment of some critical parts of about 3 km in length.	- Tho Tang, Tan Tien, Cao Dai, Thuong Trung, Vinh Son, Binh Duong, Vu Di Communes - Vinh Tuong District
	Excavation of an approaching soil canal from Phan River to Rung retention lake with the length of 3.96 km, width of 35.5 m; with eight basic bridges across the canal.	Vu Di, Yen Dong Communes Yen Lac District
		Tu Trung, Ngu Kien Communes Vinh Tuong District
1.3	***Sub-basin B3 - Nguyet Duc pumping station of 19,600 ha* (Fig 1.4)**	
	Dredging Phan River section from Vac Lake discharging canal to Sau Vo sluice gate with the length of 3.4 km, to the depth of 1.5-2.0 m, with 0.5 km embankment and paved slope.	Yen Phuong Commune Vinh Yen City, Yen Lac,Binh Xuyen Districts
	- Rehabilitating 7.71 km approaching soil canal from Phan River to Sau Vo retention lake. The approaching canal include 03 successive existing canals of 5 km long (Sau Vo2, Dong May 2, Vuon Song) and a newly constructed canal of 2.7 km long connecting Vuon Song canal with the regulation lake in front of the pumping station; - Rehabilitating associated Sau Vo 2 sluice gate, (control gate from Phan River to approaching canal)	Communes of Dong Cuong, Binh Dinh, Tan Phong, Thanh Lang, Yen Lac Town, Nguyet Duc, Yen Phuong Binh Xuyen and Yen Lac Districts
	Dredging Sau Vo retention lake in area of 176.5 ha to the average depth of 1.5-3 m; with the storage of 4 million m^3.	Dong Cuong, Binh Dinh, Tan Phong, Thanh Lang, Yen Lac Town Binh Xuyen, Yen Lac Districts
	Construction of 5.7 km asphalt service road with the width of 17.5 m; which is across the Sau Vo lake.	
	Construction of a new regulating pond of 1.62 million m^3 in front of the pumping station with the area of 21ha, to the depth of 5-7m.	Nguyet Duc, Yen Phuong Communes Yen Lac District
	Construction of Nguyet Duc pumping station with capacity of 80 m^3/s, pumping water from regulation lake through the main dyke to the discharging canal. - 08 pumps in the pump house. - 01 two-storey management house with the total floor area of 203 m^2 and - 1 substation with two 10,000KVA-35/6 transformers and one 320 kVA-35/0.4 transformer	
	- Construction of 3.15 km discharging canal from the pumping station to Red River, 8-15m wide. Type of canal: reinforced with M200 concrete. - Construction of associated 5-chamber sluice gates through the primary and secondary dykes of the Red River.	Trung Kien, Trung Ha, Hong Phuong Communes Yen Lac District

No.	Investments	Location
	Construction of Dong Mong disposal site of 54.31 ha, elevation +8.5-8.8 m; with the storage capacity of 1.62 million m^3	Huong Canh Commune Binh Xuyen District
1.4	***Basin C: Tam Dao, Binh Xuyen, Phuc Yen (Flv= 32,160 ha)* (Fig 1.5)**	
	- Dredging and rehabilitation of total 21.38 km of four rivers in Binh Xuyen district, i.e. Cau Bon River, Tranh River, Ba Hanh, and Noi River +Cau Bon River: 7.67 km long; design bottom width from 20 m to 25 m with slope factor of 1.5; + Tranh River: 5.504 km long; design bottom width from 15 m to 25 m with slope factor of 1.5; + Ba Hanh River: 7.5 km long; bottom width from 15 m to 30 m with slope factor of 1.5; + Noi River: 0.78 km; bottom width of 25 m with slope factor of 1.5; - Adjustment of alignment of some winding sections of Tranh River (0.27 km) and Cau Bon River (0.5 km). - Embankment of some key sections of on Ba Hanh river with total length of 1.4 km	Communes of Huong Son Ba Hien, Thien Ke, Huong Canh, Son Loi, Tam Hop Binh Xuyen Districts Communes of Tien Chau, Nam Viem Phuc Yen Town
	Construction of two sluice gates structures at Ton Bridge and Sat Bridge: - Ton Bridge sluice gate structure on Cau Bon River, main includes: (i) a three-chamber sluice gate (total size 3x6mx8m), (ii) concrete access road of 1.16 km long and 5m wide; and (iii) management house with an area S=400 m^2 - Sat Bridge sluice gate structure on Ca Lo river, main investments: (i) a three-chamber sluice gate (with the size3x6mx10m); (ii) concrete access road of 0.23 km long and 5m wide; (iii) management house with an area of S=400 m^2; and (iv) embankment of some sections at the river bank of the sluice gates i.e. 103 m upstream both river banks and of 410 m down stream at the left bank of Ca Lo river.	Tam Hop, Son Loi Communes Binh Xuyen District Tien Chau Phuc Yen Town Son Loi Binh Xuyen District
Component II- Water Environmental Management		
2.1	***Construction of wastewater collection and 05 treatment facilities at 4 towns***	
	- Construction of wastewater collection system: sewer network 1.7 km, 03 pumping station, 03 CSOs - Construction of 02 WWTPs at Nam Cuong Hamlet (1120 m^3/d) and Phuong Vien Hamlet (1969 m^3/d)	Tho Tang Town
	- Construction of wastewater collection system: 6.95 km sewer network, 04 pumping station, 04 CSOs - 01 WWTP with the capacity : 2,157 m^3/d	Tam Hong Town
	- Construction of wastewater collection system: 6.26 km sewer network, 06 pumping station, 03 CSOs, - 02 WWTPs in Dong Hai Hamlet with capacity of 780 m^3/d anf 01 station in Roc Ben lake with capacity of 1258 m^3/d	Yen Lac Town
	- Construction of wastewater treatment collection system: 8.6 km sewer network and 07 pumping station, 05 CSOs to transport wastewater from Huong Canh town to Quat Luu treatment station in the old center of Vinh Yen City	Huong Canh Town
2.2	***Construction of 33 small-scale wastewater collection and treatment plants with capacity range of 50-280 m^3/day, 9.33 km sewe network, 33 CSOs, 66 manholes***	

No.	Investments	Location
	28 WWTPs in Vinh Tuong District	
	Dong Hamlet, 162 m^3/day Trung Hamlet, 62 m^3/day	Lung Hoa
	Nam Hamlet, 85 m^3/day	Lung Hoa 1
	Nam Hamlet, 108 m^3/day	Lung Hoa 2
	Phu Yen 1 Hamlet, 101 m^3/day Phu Yen 2 Hamlet, 124 m^3/day Phu Yen 3 Hamlet, 116 m^3/day Hac Dinh Hamlet, 39 m^3/day Doan Cheo Hamlet, 39 m^3/day Doi Me Hamlet, 70 m^3/day	Yen Lap
	Hoi Chu Hamlet, 39 m^3/day	Yen Lap 1
	Hoi Chu Hamlet, 85 m^3/day	Yen Lap 2
	Hamlet 5, 104 m^3/day	Vinh Son 1
	Hamlet 5, 44 m^3/day	Vinh Son 2
	Lac Trung Hamlet, 118 m^3/day Hoa Phu Hamlet, 80 m^3/day Ha Tri Hamlet, 68 m^3/day Hoa Da Hamlet, 58 m^3/day Ngoc Dong Hamlet, 39 m^3/day Tu Ky Hamlet, 124 m^3/day Yen Thinh Hamlet, 85 m^3/day Phong Doanh Hamlet, 124 m^3/day	Binh Duong
	Vu Di Hamlet, 97 m^3/day	Vu Di
	Moi Hamlet, 116 m^3/day	Tan Tien 1
	Moi Hamlet, 116 m^3/day	Tan Tien 2
	Nghia Lap Hamlet, 39 m^3/day Cho Hamlet, 62 m^3/day Dinh Hamlet, 57 m^3/day	Nghia Hung
	3 WWTPs in Yen Lac District	
	Vuon Den field in Yen Lac Hamlet, 230 m^3/day Vat Cach Hamlet, 72 m^3/day Dich Dong Hamlet, 68 m^3/day	Dong Van Dong Cuong
	2 WWTPs in Tam Duong District	
	Doan Ket Hamlet, 59 m^3/day Hamlets of Moi, Doai, Hoc and Ngoi, 150 m^3/day	Hoang Lau Hoang Dan

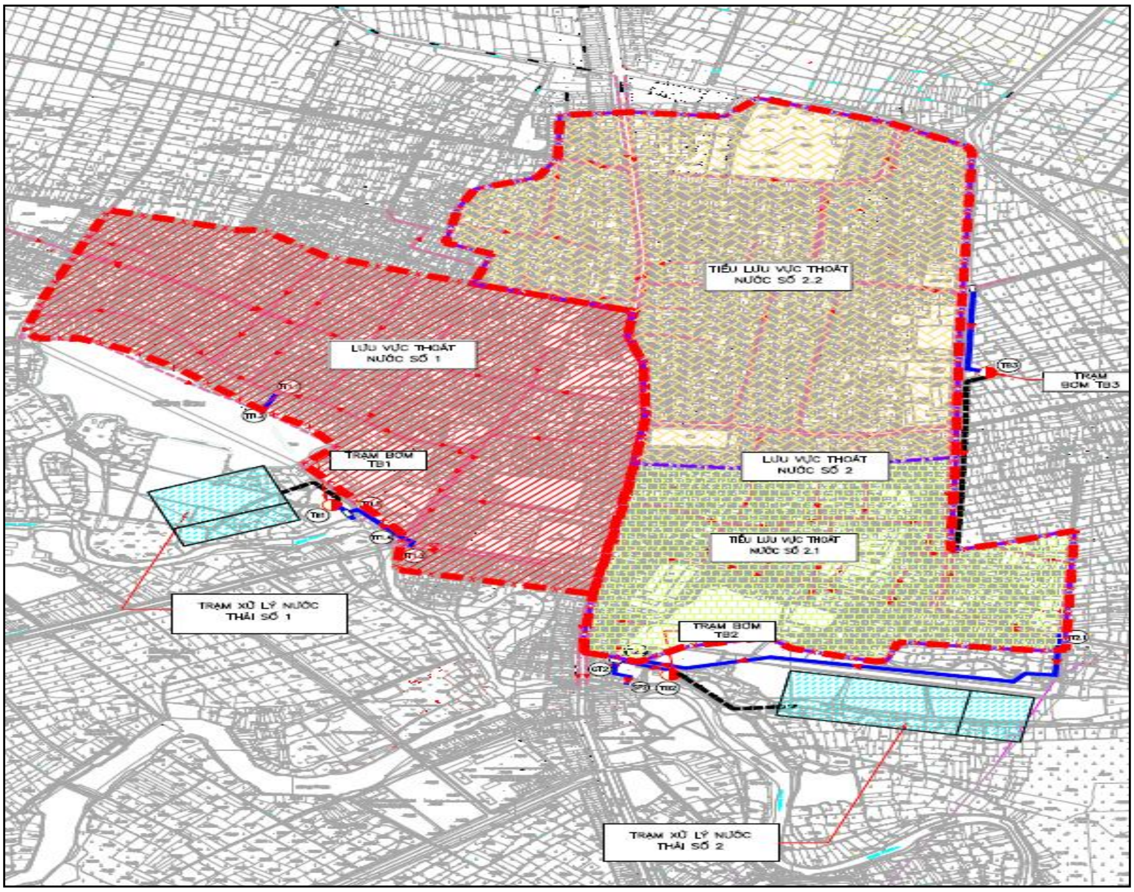

Figure 9. The WTTP facilities in Tho Tang Town

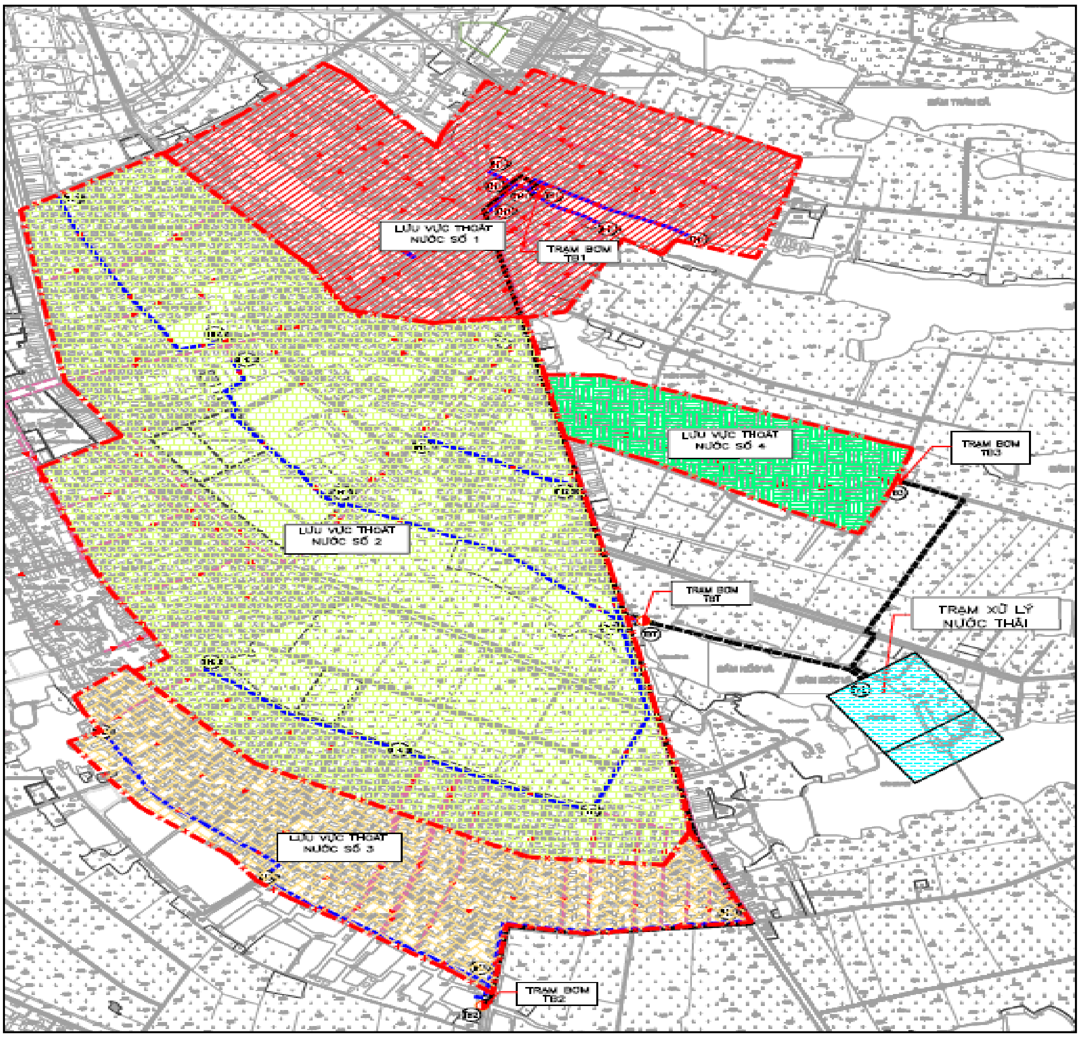

Figure 10. WWTP and pumping stations in Tam Hong Town

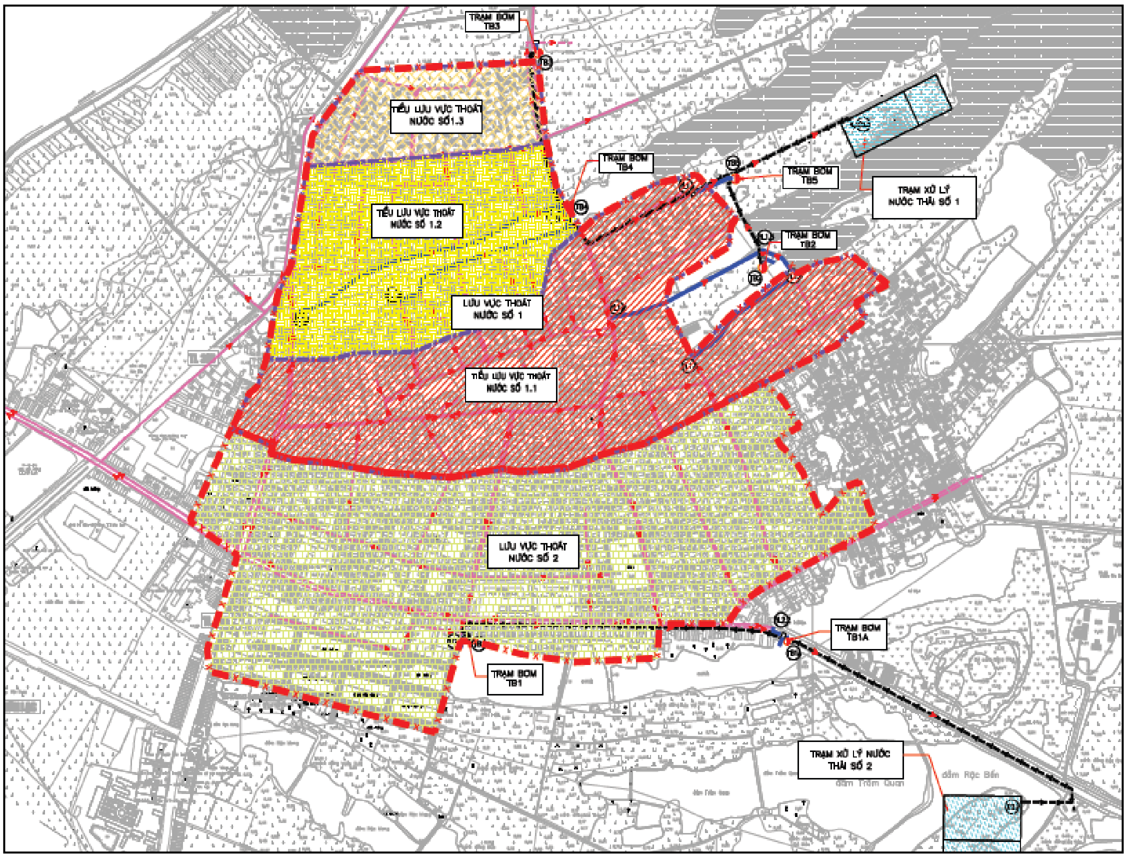

Figure 11. WWTP and Pumping facilities in Yen Lac Town

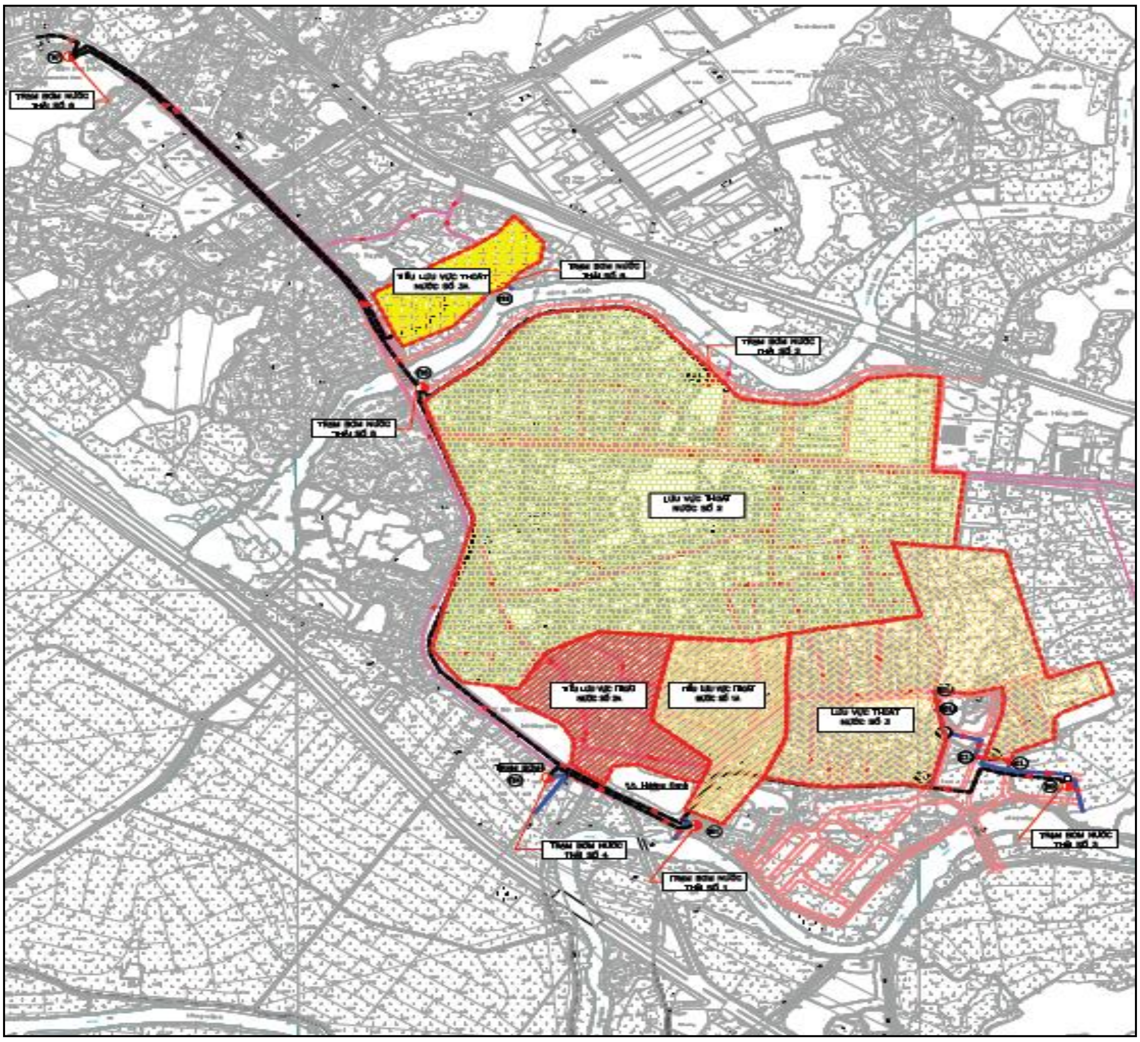

Figure 12. WWTP and pumping stations in Huong Canh Town

1.1.3. Construction Methods and Technology Options

1.1.3.1. Component 1- Flood Risk Management

a. Construction of pumping stations, canals, and on-canal-structures.

Based on the 1:500 scale canal and pumping station plan, topographical conditions, and field study, the construction works are proposed as follows: approaching canal, suction tank, pump house, discharge tank, dyke sluice, substation, management house and the access road with the cross section of about 12m and the length of about 6km.

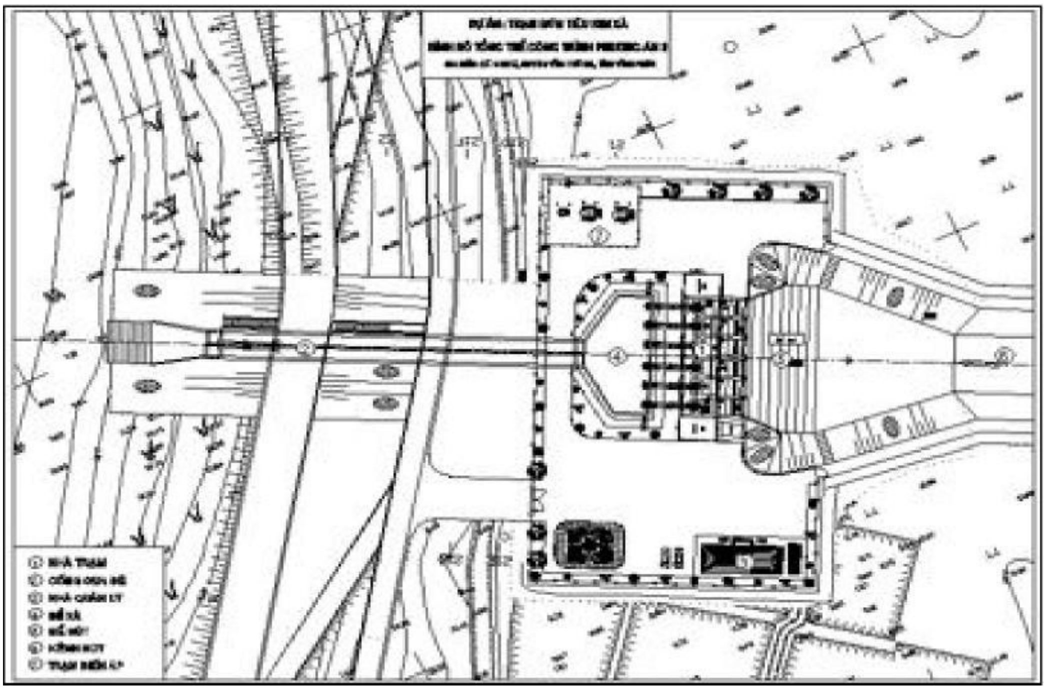

Figure 13. Typical pumping arrangement site for Ngu Kien pumping station

- Kim Xa, Ngu Kien, and Nguyet Duc drainage pumping stations are designed for the drainage purposes of three basins with the flow capacities of Qtk = 30 m^3/s, 35 m^3/s and 80 m^3/s. The structure is reinforced concrete. The pumping house has reinforced concrete structure covered with brick.

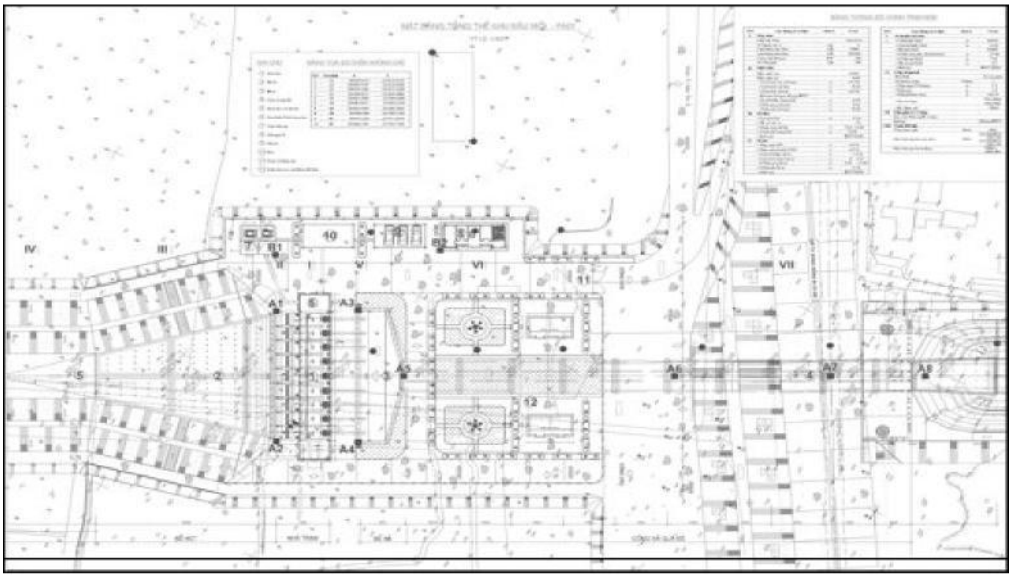

Figure 14. Pumping station area

- ✓ Construction of outlet sluices through the left bank of Pho Day River and left bank of Red River: As for the sluices at Kim Xa and Ngu Kien pumping stations, five-gate sluices are arranged with the aperture Lx(WxH) = 5x(2,5x3,2) and at Nguyet Duc pumping station, eight-gate underground sluices are arranged with the same aperture.

- ✓ Reinforced concrete structure, operation valve to the river side. Connecting to the sluice is the absorption basin.
- ✓ Construction of approaching canal to the pump station from Phan River and discharging canal to Red River. The width is from 30m-80m while the length of the approaching canal is 1,100m-7,500m.
- ✓ Construction of 35kV power line: substations are installed for Kim Xa and Ngu Kien pumping stations, each including: two transformers of 2500kVA-35(22)/0.4kV, one transformer of 150kVA-35(22)/0.4kV, and 01 transformer of 100kVA-35(22)/0.4kV.
- ✓ The substation for Nguyet Duc pumping station is designed to house four transformers of 2500kVA-35(22)/0.4kV, one transformer of 200kVA-35(22)/0.4kV, and one transformer of 100kVA-35(22)/0.4kV.

Example of typical pump:

- ✓ Pump with concrete volute chamber: used for flooding absorption, low investment, small footprint, simple operation, and low management cost.
- ✓ Construction features: Precast concretes can be used to assemble by blocks.

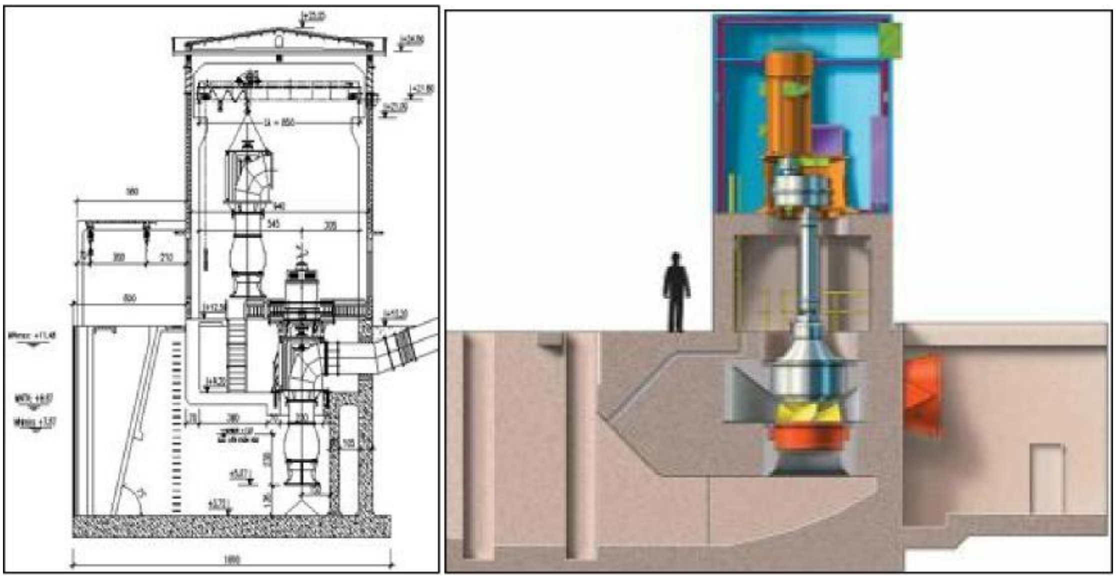

Figure 15. Typical pump station structure

** Construction process:*

Based on the volume and work items, the construction process within two years is estimated as follows:

- ✓ Construction year 1: construction of plant, inlet tank, discharge tank, and management house.
  - From October 2016 to November 2018: excavating foundation of the inlet tank and preparing the site for the worker camp area at the elevation +11.20m, and embanking the upstream coffer of the field.
  - From November 2016 to December 2016: excavating the foundation of

discharge tank; concrete piling construction for the discharge tank.

- The coffer shall enclose the whole area of the pumping station to prevent flooding in the field with the flood frequency P=10%. The elevation of the coffer is +9.50m; the width of the coffer surface B=4.0m, upstream slope m=1.5m, downstream slope m=1.5m. After the embankment of the coffer, drainage of water from the foundation pit is needed and then excavating the foundation until it reaches the elevation of the foundation bottom for pile driving. After the pile driving, second phase of foundation excavation is carried out until it reaches the design elevation. Outdoor drainage system made of straw wattle and bamboo piles around the foundation pit to drain construction water, storm-water and water seeping into the pit. After the completion of the drainage system, pouring concrete of the pump station foundation and building the station up to the elevation of +11.40m. Construction of approaching canal; canal paving; construction of discharge tank.
- Rainy season: Continue the construction of the upper part of the pumping station and discharge tank until the design elevation.

✓ Construction year 2:

- Dry season: From October until the end of April
- Embankment of coffer: embankment of coffer in combination with the construction of bypass road to build the dyke sluice. The elevation of the coffer is +9.8m, the width of the coffer surface is B=4.00m; the surface is covered with a 16cm-thick-aggregate layer; the upstream and downstream slopes of the coffer is m=1.5m.
- Construction of dyke sluice.
- Finishing construction of the pump station, including the installation of equipment. The construction must be completed by May 30.
- Rainy season: Construction of the management house and its fencing wall.

✓ Construction year 3

- Dry season: From October until the end of April: construction and completing all of the remaining work items such as painting, approaching canal, planting grass, etc.
- Rainy season: Complete all of the work items. Check and hand over the project and put into operation.

** Drainage of water from the foundation pits*

In general, the drainage of water from the foundation pits is not complicated since the permeability coefficient is rather small; the entire foundation pit of the pump station is on the third soil layer. However, in order to keep the foundation pit completely dry when it rains, after excavating the foundation pit to the design elevation, an outdoor drainage system should be built to drain storm-water and water seepage during the construction process.

** Excavation and spoil transportation*

The construction of pumping station does not generate considerable earthwork volume. In order to accelerate the construction progress and reduce the cost, the construction method is primarily machine based and manual works are minimized. Specifically:

- ✓ Excavation: Using 1.3 m^3 excavators and transporting excavated soil to the disposal site by the 10T-12T dump trucks; leveling the site with contractors 110CV. During the excavation process, the contractors should arrange soil storage area to ensure the quality of backfill soil. Lower quality soil will be used to cover the ground or transported to the disposal site.
- ✓ Backfilling soil: Due to the relatively large volume of excavated soil, a part of good quality soil can be salvaged for embankment in order to reduce the cost, accelerate the construction progress, reduce the disposal site area as well as the amount of soil exploited from the borrow pits. Excavating backfill soil by the 1.3 m^3 excavators; transporting to the filling area by 10T-12T dump trucks; leveling the site with contractors 110CV and 9T compactor. For such the area where large compactors cannot and must not be used on as the outlet, manual compaction with portable compactors is carried out.

** Concrete and reinforced concrete work*

The project has quite large volume of concrete work. Concrete construction work must be done in the condition of dry pit to ensure the quality of the work. In addition, the works have relatively complex structures and construction activities will be carried out in narrow foundation pits, which require appropriate construction solutions from the construction unit to accelerate the construction progress because the concrete work plays a decisive role in the progress of the construction works. The concrete construction solution is proposed as follows: mixing by 500-liter-mobile mixers; mixed concrete is then poured manually or through curb and gutter into the forms. As for the pump station, 10T-15T cranes can be used to pour concrete and compaction by needle vibrator or vibratory plate compactor depending on the structure of the work. Maintenance is carried out by watering the concrete directly.

** Pile driving*

The principles and requirements for construction and checking-and-handing-over should comply with the Vietnamese Construction Standard VN286:2003.

The works are constructed within the dyke area. Therefore, in order to ensure the safety of the dyke sections near the construction works, it is important to pay special attention to the concrete pile driving. It is proposed to use the pressing-in method. As the foundations of the pumping stations are located on the third soil layer, which is hard-plastic, therefore, the pile driving is possible.

b. Dredging works

** Design and construction solutions of lakes and rivers:*

- ✓ Bottom elevation of the dredged lake:

- The water level for aquatic life, landscape, and tourism of the lake must be 2m at the minimum.
- The water level of the lake before rain with the option 2.2 is +5.5, the bottom elevation is proposed at +3.5.

✓ Dredging slope: 1:2.5: A part of the dredged spoil of the lake and talus is transported to the disposal site and a part is reused for embankment and rehabilitation of the lake.

✓ Dredging solutions

For the first 18 months of project implementation, the main work include:…

Below is the summarization on the dredging solutions for the investments under the first 18 months of the project.

- Flow diversion technique: When dredging lake, flow diversion for construction activities is necessary. For this method, the sections along the existing Dong May, Vuon Song, and Sau Vo canals will be dredged first to form a new drainage axis for flow diversion. Other areas will be dredged to become tributary canals and flow into the above mentioned canals. The diversion time will be in dry season, from October until the end of April.
- Water withdrawal of the foundation pits: the measures include the treatment of water seeping into the coffer body and foundation and drainage of water from the pits. In order to handle water seepage into the coffer body and foundation, the following measure can be applied: arranging surrounding water-collecting ditches which will drain to a collection pit at a place that is favorable for pumping and drainage of pumped water. Then using centrifugal pump with suitable capacity to pump water from the foundation pit.

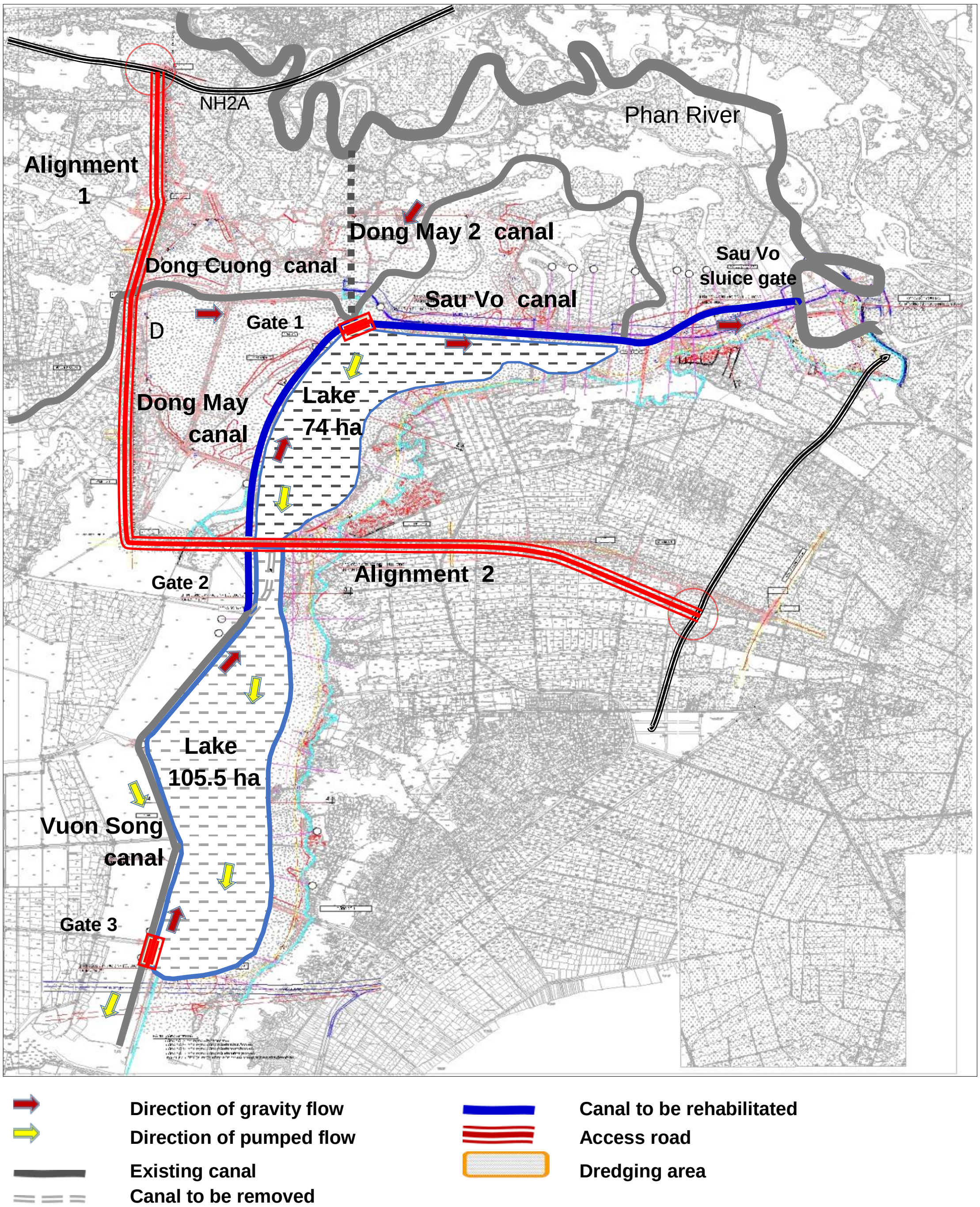

Figure 16. Typical plan for Sau Vo Lake Area

<u> Construction of headwork</u>*

✓ Foundation excavation method

- Mechanical excavation; for the protection layer, excavation by hand.
  - One 0,8 m^3 excavator with the capacity of 350 m^3/shift.
  - One 5-7T dump truck to serve the excavator. The truck transports excavated soil to the disposal site.

- ✓ Reinforced concrete construction
  - Concrete piles are precast at the pile casting area planned in accordance with the overall construction site plan. When excavating the foundation to the design elevation, using self-propelled pile driver combined with specialized equipment to move the pile to the design elevation.
  - The principles and requirements for construction and handover must comply with the Construction Standard VN286:2003.
- ✓ Concrete placement method
  - The height of the form is less than 4m. The construction solution is to use mobile concrete mixer with the capacity of 250 liters to 500 liters to mix concrete mortar. Using curbs and gutters to pour concrete into the forms and then using vibratory plate compactor or needle vibrator to compact the concrete.
- ✓ Brick construction
  - Using mortar mixer machine with capacity of 80 liters.
  - Gather and build the bricks; ensure technical conditions and standards.
- ✓ Backfilling
  - Motorized transportation of soil from the borrow pits. Manual and motorized combination method is used for leveling and compacting soil. Using jumping jack compactor MRT60S for compaction. For the compaction at the sluice gate, the work must be closely supervised and checked to ensure its quality.
- ✓ Equipment installation
  - The installation of mechanical equipment is carried out by machinery and by hand.
  - Hydro-mechanical equipment such as pump, valve gate, sewer grate, pump pipeline, etc. are installed as follows:
    - Check the machines/equipment before installation
    - Comprehensively check the components to be installed
    - Check the operation of the pump such as: ensure that hand crank, bearings, and plain bearings are working normally (are not jammed, rusty dirt) and fully lubricated.
    - Solve the problems caused by the transportation and storage process. If there is doubt or need to handle the important parts such as silver copper, bearings, impellers, etc., it is necessary to notify the manufacturer for solutions.
    - Install the machine/equipment
    - The machine/equipment is installed in the following sequence: pump motors - piping.
    - When installing, the following requirements must be met:
      - o The pump is working smoothly, there is no unusual noise.

- The cover is balanced, easy to open and close.

- Production and installation of other mechanical equipment:
  - Using welding electrode E40 or other types equivalent to steel welds CT38
  - The welds must be mature, are not cracked, and ensure bearing
  - Using welds D10, continuous welds
  - When producing, ensure geometrical dimensions
  - Cleaning rusty on the metal surface before painting
  - The mechanical equipment is manufactured and installed in compliance with the QPTL-E-3-80.
  - Protect the surface of mechanical equipment after making of galvanized coating.

Installation of valve gate and sewer grate

Sluice gate valve, sewer grate and other accessories are installed by 3T-5T chain hoist; and then manually adjust to suit the design position.

* *Installation of precast structure*

Precast concrete structure is casted at the material area. After meeting standards, the structures will be installed. They are transported and installed manually.

c. Construction solutions for disposal sites

<u> Elevation of the disposal site</u>*

As the disposal sites are located by Pho Day River and Red River, it is important to raise the elevation of the disposal sites to the maximum extent possible (specifically access roads) to minimize the impacts of flooding from the rivers and at the same time increase the containing capacity of the disposal sites. This must be balanced against the construction cost by raising the disposal sites. The road elevation must be higher than the soil level as soil will be discharged from the unloading area by gravity method.

The final design elevation has been studied based on these criteria to ensure that the disposal sites are in connection with the surrounding structures. The elevations of the disposal sites are proposed to increase as follows:

- ✓ Kim Xa disposal site to the maximum elevation +11.0 m – +11.5 m, the direction of the slope is westward to Pho Day River and also horizontal to ensure the maximum drainage of surface water.
- ✓ Dong Mong disposal site to the maximum elevation +8.5 m - + 8.8 m. The site will store about 1.62 mil m^3 of dredged material from the project.

With such elevations, the disposal site area, upon completion, will be beneficial for most of the time of the year, except for the peak time of the rainy season when the river water level rises. Soil will be filled about 50 cm lower than the road elevation.

** Access roads*

All of the main access roads are designed to use excavated soil from the disposal sites. In order to build this backfilling foundation, generally, it is necessary to excavate suitable soil and transport to the required locations, and then spread with bulldozer and compact using roller. The maximum spreading distance by roller is 50-75 m. In some cases, especially for the wetland pond area, the use of excavating equipment and transport by dump truck is needed. The pumping out of water will be carried out, the temporarily wet soil will be kept to dry enough to be used for backfilling. At the selected area, the existing topsoil will have to be removed before carrying out the backfilling activities.

To minimize the exceeded cost due to backfilling, the slope of the embankment is designed at 1:1.5. The table calculating the stability in Appendix 1 confirms that this is appropriate slope for the earthwork selected within the disposal site area on the condition that a distance of 6m at the slope foot must be maintained.

The temporary road surface consists of a 20cm-thick-aggregate layer on top of the compacted soil layer K=0.9. This structure ensures that the road can withstand large tonnage from soil-transporting-trucks and still remain easy flow when it rains. The roads are designed as temporary roads only for the purposes of transporting excavated soil. Hence, these roads maybe damaged and subsided during transport process and will be maintained regularly during the process.

The roads are generally designed with the roadbed width of 5.0m. This parameter is very convenient for one-way traffic, and to avoid another truck at the unloading area (disposal grounds). The network of access roads are generally interconnected, including different routes leading to the unloading areas so that the disposal sites can be controlled and managed to handle a large number of trucks going to the disposal sites.

** Unloading areas*

Unloading areas will be arranged about 75m to 100m away from the disposal site. These areas are arranged with enough slopes to allow sludge flowing to the lower area of the disposal sites. The trucks are only operating on the roads and prepared unloading areas. There is no traffic activity in the area where soil has just been disposed, except for the leveling by the bulldozers after a period of time when the moisture content has been reduced to the acceptable level. The maximum leveling distance by bulldozer is about 100m.

** Drainage works*

On the entire disposal sites, in general, water will be drained in the horizontal direction of the disposal site to the area near the rivers or existing drainage canals. The sluices are of great importance in collecting water after river water level rises which causes flooding of the disposal sites in the rainy season.

The construction of the disposal sites shall more or less cause impacts on the drainage system; therefore, it is necessary to provide some mitigation measures. The lakes and ponds to the west of the disposal sites will be maintained. As the existing sluices run under the main road, the drainage system of the disposal sites and westward system can drain following the current flow.

1.1.3.2. Component 2- Construction of wastewater treatment plants (WWTPs)

a. Construction solutions for the wastwater collection and treatment facilities are as follows:

Building connections from combined sewers to the WWTPs

The existing centralized sewer systems should be connected and convey wastewater and storm water to the proposed WWTPs or to the separator chambers to separate storm water. Wastewater will be transported to the booster pumping stations or directly to the WWTPs (if possible). Depending on the specific locations, the size and type of sewers will be calculated and selected suitably to the actual conditions to ensure drainage as required. Sewers/ditches are built using materials available in the locality.

Construction of storm water separator chambers

By constructing stormwater separator chambers, stormwater will be separated towards the receivers and flows by gravity in rainy season while the D300-size sewage drains will convey wastewater to the WWTPs.

The separator chambers are equipped with rubbish filters at the inflow and a gate in front of the effluent sewers to prevent rainwater into the WWTPs in heavy rains. The chamber bed has a siltation hole to reduce the risk of sand entering the WWTPs.

Construction of booster pumping stations

Downstream of the separators there will be booster pump stations, depending on the network of pumping stations to be located in the submerged chambers of the green campus or public lands. The booster pumping stations will enable the WWTPs to raise their elevation and can operate even when the effluent water level rises. The pumping station chamber will be made of reinforced concrete and pumps are to be immersed in the chamber, therefore no impact on the architecture landscape in the zones.

Construction of pressure pipelines

The pressure pipelines will be connected from the pump stations to the WWTPs using HDPE heat solder joints. At the crossings, the pipelines will be strengthened using steel pipe protectors. The pressure pipelines are disposed at the existing roads or planned roads to facilitate the operation management and upgrade/rehabilitation (if needed) in the future.

Construction of connector manholes

The connector manholes will be built at the junctions of the old and the new lines, at the shifting points, and at the intersections.

The connector manholes will be built of brick or concrete depending on the geographical location and geological conditions of the ground, the station width will be equal to the outer diameter of the biggest sewers/drains plus 0.2 m on 2 sides (making a total increase of 0.4 m), the station bottom is at 0.3m lower than the sewer bottom as minimum.

Construction of connection for particular households

In order to enhance performance of the WWTPs and reduce wastewater infiltration to groundwater, it is proposed to build the connection for the households who are unaffordable to connect to the common systems. The connection work includes a combined collection and connector for the household wastewater sources. An uPVC D150 size sewer will connect the station with the outside common drains.

Provision of covers to some open canals

In order to ensure sanitation criteria, to prevent bad odor and overflow of solid waste into the common sewer system, it is proposed to provide covers for the open sewers.

Construction of WWTP

The WWTP will be constructed based on the selected design and alternative. The treatment lagoons will be built by concrete or brick depending on the local geological conditions in each area. The plantation filter is covered with a clay layer at the bottom and surround. The local filtration materials will be plants suitable with local soil and climate.

b. Technical solutions for wastewater treatment

For this component, low cost and environment-friendly technology will be selected based on the size and location of the facilities. The wastewater treatment technology by natural biology with the capacity less than 1,000 m^3 a day is applied for the plants/facilities as shown in the figure below:

Septic tank combined with plantation filters;

Anaerobic tank combined with aerobic lagoon and plantation filters.

These technologies will be flexibly applied for each specific case, depending on the location of each WWTP.

ANAEROBIC TANK AEROBIC LAGOON PLANTATION FILTER

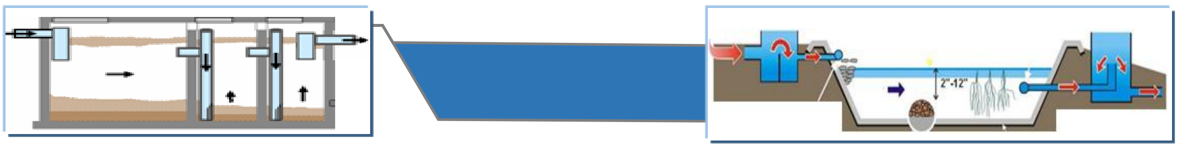

Figure 17. Anaerobic tank combined with aerobic lagoon and plantation filters.

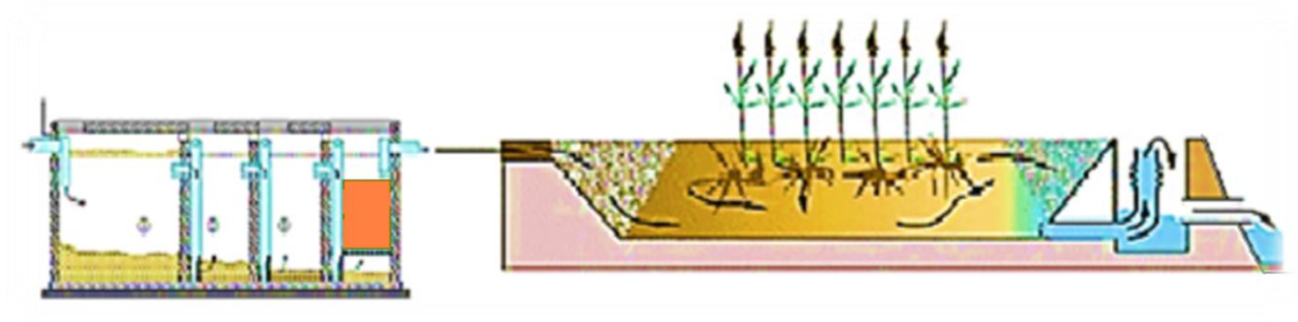

Figure 18. Septic tank combined with plantation filter

** Auxiliary structures*

The work items are spread throughout the project area. To facilitate the construction activities, the work site is expected to be located in a convenient area next to the roads. The construction sites are classified into the following zones:

Administrative zone consists of house of the construction steering unit, house and office of the staff.

- ✓ Residential area of the workers and their families
- ✓ The auxiliary workshops
- ✓ The mechanical area comprising vehicle gathering area and houses of the mechanical workers
- ✓ Occupied area of the site.

1.1.4. List of Machinery and Equipment

Equipment includes pumps and other associated equipment supplied by the pump manufacturer, equipment such as crane, chain hoist, valve, etc. provided by the manufacturers by order. List of the equipment and machinery expected for the construction activities is presented in the table below:

Table 4. List of machinery and equipment of the project

No.	***Equipment***	***Component1***				***Component2***	
		B1	B2	B3	C	Town	Rural
1	110 CV bulldozer	2	2	2	1	1	2
2	0.45 m^3 Excavator	2	3	3	1	1	2
3	8T disposal truck	5	10	10	2	2	4
4	9T Compactor	2	3	3	1	na	na
5	Jumping Jack Compactor	3	5	5	1	1	3

No.	Equipment	Component1				Component2	
		B1	B2	B3	C	Town	Rural
6	Tracked crane (0.7÷1.1)m^2	2	4	4	1	na	na
7	Iron bending machine 5 KW	2	4	4	1	1	2
8	Iron cutting machine	2	4	4	1	1	2
9	5T crane boom	1	1	1	1	na	na
10	50 KW welding machine	2	2	2	1	1	2
11	50 KW welding transformer	2	2	2	1	1	2
12	Concrete mixer 750L	4	4	4	1	1	2
13	Fixed concrete batching plant 30 m^3/h	2	2	2	1	1	3
14	Cement silos	2	2	2	1	1	2
15	Trucks for transportation of cement	2	2	2	1	1	2
16	Materials conveyor	2	2	2	1	1	2
17	110 CV bulldozer	1	1	1	1	1	3
18	Truck for transportation and mixing of concrete	2	3	3	1	1	3
19	Concrete pumping machine	2	2	2	1	1	3
20	1.5kW Needle vibrator	15	15	15	3	3	7
21	1.5kW vibrator plate compactor	10	10	10	2	2	5
22	Concrete jack hammer	10	10	10	2	2	5
23	f 32 mm concrete drilling machine	2	2	2	1	1	2
24	Concrete strength tester	2	2	2	1	1	2
25	Car pump	2	2	2	1	1	2
26	320 KVA Generators	2	2	2	1	1	2

Source: Feasibility Study Report-VPFRWMP

1.1.5. Construction Materials and Disposal Sites

Based on the progress of construction and installation, the supply of technical materials must ensure proper and full components, building materials structure, and technical equipment so that the construction activities are not interrupted. The volume of materials estimated for the project components is shown in the table below.

Table 5. Estimated amount of materials of the project

No.	Materials	Unit	Component 1				Component 2	
			Sub-basin B1	Sub-basin B2	Sub-basin B3	Basin C	Town	Rural
1	Different types of rocks, stones	m^3	48,844	46,494	105,219	17,306	5,192	9,345
2	Different types of sand	m^3	21,624	17,824	63,940	69.74	20,923	37,661
3	Steel wire	kg	54,710	65,652	60,181	32,826		
4	Nail	kg	9,866	11,840	10,853	5,920		
5	Wood plank	m^3	698	837	767	418		
6	Welding rod	kg	14,046	16,856	15,451	8428	100	180
7	Different types of steel	kg	227,921	273,505	8401	136,752	41,025	73,846
8	Cement PC30	kg	2,612,312	1,801,028	4,364,804	1,080,616	3,241,851	5,835,331

Source: Integrated Feasibility Study Report-VPFRWMP

Supply of construction materials

Steel and cement are provided by material suppliers in Vinh Yen City and all district centers in the project area. Bricks are available as locally manufactured in the province of Vinh Phuc by Tam Dao and Hop Thinh companies, for example.

Sand and gravel are exploited from permitted companies in Vinh Phuc province in an average distance of 20km from construction sites. A list of sand and gravel suppliers are permitted Vinh Province and presented in the table below.

All of the materials shall be tested in terms of physical properties in accordance with the current regulations. If the materials compositions do not meet the standard, the contractor shall change the materials sources. Demands for material and technical supplies are associated with the construction progress.

The material supply will take into account the depreciation due to transport and unloading.

Table 6. List of quarry sand and gravel in the province of Vinh Phuc

No	Company name	Material	Location of extraction
1	Dai Viet Mineral JSC.	Sand and gravel	Hai Luu and Bach Luu Commune Song Lo District
2	Hoa Phat Mining JSC.	Sand, gravel	Don Nhan commune, Song Lo District.
3	Tu Hai JSC	sand	Red River at Vinh Ninh commune, Vinh Tuong District
4	An Viem Ltd.	black sand	Red River at Ha Trung Commune, Yen Lac District

No	Company name	Material	Location of extraction
		Sand, gravel	Lo River at Hai Luu Commune, Song Lo District.
5	Huu Bich Vinh Phuc JSC	sand	Red River at Vinh Ninh, Vinh Tuong District.
6	Phong Chau Construction JSC	sand	Red River at Vinh Thinh Commune, Vinh Tuong District
7	Sang Son One member Ltd.	sand	Red River at Vinh Ninh, Vinh Tuong district.
8	Yellow Sand Branch Co.	Sand, gravel	An Tuong and Vinh Thinh Commune, Vinh Tuong District
9	VCI Investment Corporation	Sand, gravel	Red River at Cao Dai Commune, Vinh Tuong District.
10	Vinh Phuc Transportation and Construction Ltd.	Sand, gravel	Lo River at Communes of Don Nhan, Yen Thach and Phuong Khoan, Song Lo District
11	AVA Indochina Mineral Corporation	Sand, gravel	Lo River at Cao Phong commune, Don Nhan commune, Song Lo District.

Regarding backfilling soil, according to the design, soil of class 2 excavated from the components of the project can be reused for backfilling demands in all components. If the demand for soil arises during actual construction, it will be met from the borrow pits in the districts of Tam Dao, Tam Duong and Lap Thach of Vinh Phuc province. The average distance from the building to the land mine is about 20 km.

Table 7. Summary of materials planned for the project

Material	Backfilling soil, sand, gravel		Rock	Cement	Steel
	Extraction of sand and gravel	***Borrow pits (optional)***			
Location	Lo River and Red River, Vinh Phuc	Minh Quang (Tam Duong Dist.) Thanh Van (Tam Duong Dist.), Hop Hoa, Dong Tinh, Huong Dao (Lap Thach Dist.)	Minh Quang Quarry Tam Dao District, Vinh Phuc	In Vinh Yen City and district centers	In Vinh Yen City and district centers
Distance from construction sites (km)	20	20	10	3-5	3-5
Capacity (m^3)	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient
Supply License	Obtained	Obtained by supplier	Obtained	Obtained	Obtained

Material	Backfilling soil, sand, gravel		Rock	Cement	Steel
	Extraction of sand and gravel	***Borrow pits (optional)***			
	by supplier		by supplier	by supplier	by supplier

A list of potential sources of quarry and construction materials (sand extraction points) in Vinh Phuc for the project is presented in Table 7.

These quarries are operational since 2008 with permission by Vinh Phuc PPC. Their supplies are not only for infrastructure projects in Vinh Phuc but also Ha Noi and Phu Tho Province. The VPFRWM project does not involve large scale extraction of sand and gravel, therefore, does not require opening of any new quarry. None of those quarries is an exclusive source for the project.

b. Power and fuel supply

The national power grid is easily accessible in the whole project area. Mobile diesel generators are also prepared for use where needed. The low-voltage power system has been distributed to the project area for construction and operation of facilities.

Oil and gas for the operation of machinery in the construction sites are supplied by local petroleum companies. Since the distribution network is available, the fuel supply for the project is quite convenient.

c. Water supply for construction and domestic uses

Water sources for work execution will mainly come from rivers/streams available nearby. For construction areas that are afar from the water sources or the water quality is unqualified, water tank trucks shall be used for transferring water to construction sites.

For domestic purpose, depending on conditions of given sites, water can be supplied from centralized water supply schemes where available and dug and drilled wells at the construction sites. Where water schemes are not available for domestic use, water from wells will be purified through an on-site simple filter system and/or clean water in tanks is supplied.

d. Domestic solid waste treatment

The total amount of domestic waste is about 548 kg/d at maximal. The solid waste generated at the project sites in Vinh Yen and Phuc Yen town will be collected by Vinh Phuc URENCO and disposed at Ngoc Thanh landfill (6 km distance from basin C) and Khai Quang landfill (03 km distance from basin B3).

The domestic waste generated at construction site in the rural area will be collected and transported, treated at legitimate local landfill managed by local environmental sanitation groups or coops

Hazardous waste will be collected and stored temporarily in storehouses at sites, then transported by specialized units through a contractual service. At present Green Industrial Environment Company in Phuc Yen town is capable of handling part of the waste and the remaining will be handled by URENCO 10 Company in Hanoi.

d. Disposal of excavated marials

The amount of excavated materials from project activities is summarized in the table below:

Table 8. Dredged sludge volume of each subcomponent and basin

No	**Work**	**Dredged organic sludge (m^3)**	**Excavated soil**	**Volume to be disposed**	**Volume for back filling**	**Volume to be transported out of construction sites**	**Remaining volume**
	Basin B	***1,105,508***	***6,139,122***	***1,423,680***	***1,635,023***	***5,609,607***	***4,605,484***
A	*Sub-basin B1*	*63,665*	*451,500*	-	*89,274*	*425,891*	*463,611*
I	Pumping station	20059	70382	48271	58271	32,170	12,111
II	Lake dredging	43606	381118	31003	31003	393,721	236,970
B	*Sub-basin B2*	*167,810*	*2,372,977*	*590,647*	*694,373*	*1,846,414*	*1,678,604*
I	Pumping station		808,713	386,718	38,321	770,392	770,392
II	Approaching canals and on-canal structures	9,147	550,028	139,845	28,717	530,458	521,311
III	Discharging canals and on-canal structures	106,795	574,027	12,215	574,027	106,795	-
IV	Dredging Phan River from Thuong Lac to Lac Y	51,869	433,459	51,869	50,590	434,738	382,869
V	Vinh Son regulation gate	-	2,670	-	930	1,740	1,740
VI	Lac Y regulation gate	-	4,080	-	1,788	2,292	2,292
C	*Sub-basin B3*	*874,033*	*3,314,645*	*753,758*	*851,376*	*3,337,302*	*2,463,269*
I	Pumping station	5,634	74,762	5,633	21,146	59,250	53,616
II	Approaching canals and on-canal structures	-	783,240	5,633	385,441	397,799	397,799
III	Discharging canals and on-canal structures	89,016	145,382	-	444,789	-210,391	-299,407
IV	Regulating lake in front of PS	-	591,166	-	-	591,166	591,166
V	Dredging Phan River section from Lac Y - Thinh Ky	36,892	119,414	-	-	156,306	119,414

No	Work	Dredged organic sludge (m^3)	Excavated soil	Volume to be disposed	Volume for back filling	Volume to be transported out of construction sites	Remaining volume
VI	Dredging Sau Vo Lake	690,263	1,576,726	690,263	-	2,266,989	1,576,726
VII	Assess Road of Sau Vo lake	52,228	23,955	52,228	-	76,183	23,955
D	*Sub-basin C*	*379,852*	*813,684*	*201,046*	*65,524*	*1,085,349*	*748,160*
I	Cau Bon River	135,121	199,464	135,121	65,524	269,061	133,940
II	Tranh River	42,664					-
III	Ba Hanh River	181,380,8	478,077,8	181,380,8	-	659,458,6	478,077,8
IV	Noi River	2,487,5	74,844,6	-72,357,1	-	77,332,2	74,844,6
V	Ton Bridge gate	15,859,0	22,421,0	-6,562,0	-	38,280,0	22,421,0
VI	Sat Bridge gate	2,340,0	38,877,0	-36,537,0	-	41,217,0	38,877,0
E	**Total**	**1,393,426**	**7,203,666**	1,575,455	**1,776,895**	6,820,233	5,244,778

Source: Integrated Feasibility Study Report-VPFRWMP

About 8.4 mil cubic meters of excavated materials will be generated from the project activities including 1.49 mil m^3 dredged sludge and 6.95 mil m^3 excavated soil. The testing showed that the dredged sludge is not hazardous, however, they have high content of organic substances and thus will be disposed at Dong Mong (1.62 mil m^3) and Kim Xa (0.06 mil m^3) disposal sites, which are constructed under the project.

The amount of excavated soil is 6.9 mil m^3. They have all analyzed meters within the permissible limits for agriculture or commercial purpose. Part of the excavated soil, 1.7 mil m^3 will be used back filling and the remaining 5.2 m^3 will be used sold to brick manufacturers using Vertical Shaft Brick Kiln (VSBK) technology or be levelling as necessary.

Some information on the technical details on Kim Xa and Dong Mong disposal sites are presented below.

Kim Xa disposal site

Kim Xa disposal site is located outside the left bank of Pho Day River within the administrative boundary of Kim Xa Commune, Vinh Tuong District. Kim Xa disposal site is bounded by Pho Day River to the North, the East and the South, and by left bank of Pho Day River to the West. The site lies by River bank, the distance from river is 85 m and 1000m from the dyke. Kim Xa site with an area of 3.8ha has been approved by the Vinh Phuc Provincial People's Committee (PPC).

Its storage capacity is 64,000 m^3. Based on its natural conditions, the site is used for storing waste soil and dredged sludge, without hazardous soil, from excavation works in the project.

The site will be returned to the local authority after the completion of project.

Dong Mong Disposal site

Dong Mong disposal site is located within the administrative boundary of Huong Canh Town in Binh Xuyen District. According to the planning, Dong Mong disposal site consists of two slots at both sides of Huong Canh- Tan Phong road. The disposal site area is 54.31 ha and of agricultural land without any house or structure built thereon.

The disposal site has the average elevation of about +5.8m; the lowest elevation is +4.6 m (pond area) while the highest is +6.7m (field bund). The main drainage direction is toward Canh River. Since this is gravity drainage, flooding always occurs when it rains and the water level of Canh River rises.

The site has a storage capacity of 1,629,300 m^3 and is divided into 13 small slots, of which one slot is paved with HDPE material for hazardous sludge. This dedicated slot is able to store about 80,000 m^3.

The dredged sludge that does not cause bad odor and not contain pollutants beyond the allowable limits shall be collected, transported and gathered at the disposal sites whose locations were identified by the Project. Dredged sludge is generated during the dredging of retention lakes, rivers, and canals; dredging and disposal of weak foundations of pumping stations, service roads, and other auxiliary structures. A part of the sludge volume that meets the physical standards will be used for the embankment and leveling of other components. The rest shall be transported to the disposal site.

After completing the project, the Project Owner will return the site to the local authority for building a new administrative center of Binh Xuyen District.

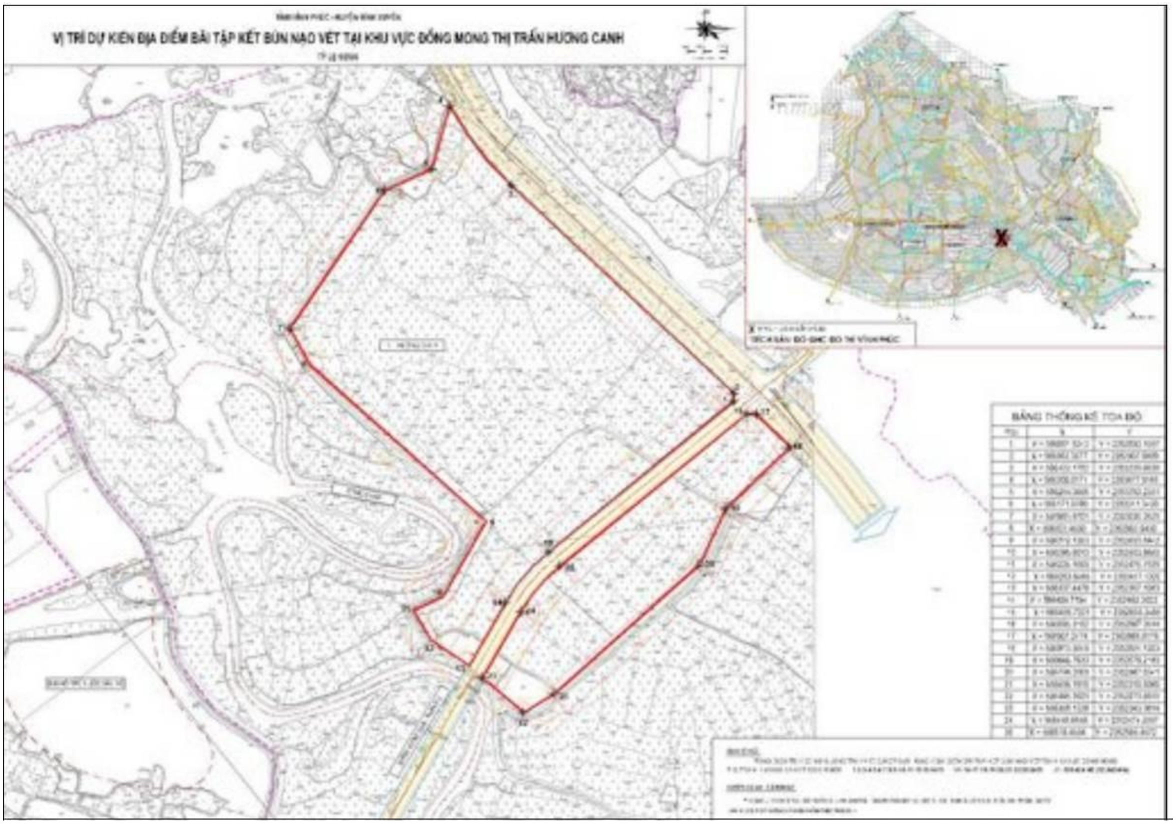

Figure 19. Proposed location of Dong Mong disposal site

Dredged sludge volume

The scope of implementation of the Project Component 1 is divided into four basins; therefore, the scope of the project is quite large and far from each other. Hence, the generated sludge in each basin is expected to be gathered at the respective disposal sites in order to ensure the balance in terms of sludge volume and reasonable transportation distance from the construction site to the disposal site.

1.2. PROJECT MANAGEMENT, PERSONNEL, BUDGET AND IMPLEMENTATION PROGRESS

1.2.1. Project Management and Personnel

Project organization

Project Name: Vinh Phuc Flood Risk and Water Management Project

Project Category: A

Donor: World Bank (WB)

Line Agency: Vinh Phuc Provincial People's Committee

Agency proposing the Project: Vinh Phuc ODA Project Management Unit

Address: Nguyen Trai, Dong Da Ward, Vinh Yen City, Vinh Phuc Province

Tel. No.: (0211).3860.858; Fax: (0211).3860.858;

Project Management Agency: Vinh Phuc ODA Project Management Unit

Address: Nguyen Trai, Dong Da Ward, Vinh Yen City, Vinh Phuc Province

Tel. No.: (0211).3860.858; Fax: (0211).3860.858;

Management and personnel of the project implementation

For a sustainable and effective project management and implementation, the arrangements for the project management and implementation as well as personnel are as follows:

** The Government of Vietnam (GoV) and World Bank (WB)*

The Government of Vietnam and the Donor shall manage, monitor and supervise the implementation process of the Project through the following tasks: Monitoring and supervising the management and implementation arrangements of the project; supporting the project implementation; supporting ODA disbursement; solving issues that are beyond the jurisdiction of the line agency; providing professional guidance for management and implementation arrangements, and monitoring and evaluation of the project.

** Vinh Phuc Provincial People's Committee (PPC)*

As a line agency, the PPC is responsible for making decisions related to the organizational structure of the project management and implementation; approving the overall plan of the project implementation; appraising and approving the annual budget allocation of the project; implementing bidding in accordance with the current laws and regulations on bidding; organizing monitoring and evaluation of the implementation progress to ensure that the project implementation meets its schedule, quality and objectives set forth; taking responsibility for the loss, waste, corruption and violation in ODA management and use under its jurisdiction; performing other duties and authorities as stipulated by law and the international treaties on ODA of the project; coordinating with the Ministry of Planning and Investment to implement monitoring and evaluation of the programs and projects at national level; implementing reporting regime under the current regulations and guidelines of the Ministry of Planning and Investment; responding to the recommendations of the project owner outlined in the implementation progress reports and project evaluation reports in an adequate and timely manner; coordinating with the donor and other relevant agencies to carry out unscheduled monitoring, if necessary; organizing to carry out the impact assessment of the projects under its jurisdiction according to the annual impact assessment schedule of the Ministry of Planning and Investment; sharing information through project monitoring and evaluation system at governing body level to ensure the transparency and community supervision; being responsible for directing and organizing the implementation of land acquisition and compensation of the project; ensuring adequate counterpart funding according to the schedule agreed with the donor and allocating budget to repay the donor.

** Project Steering Committee*

Vinh Phuc PPC has established the Steering Committee of Vinh Phuc Province to attract ODA and other preferential loans from donors (Decision No. 3246/QD-UBND dated November 7 2014), on behalf of the PPC, responsible for the project activities.

The Project Steering Committee is headed by the Chairman of the PPC and 02 Deputy Directors are the Deputy Chairmen of the PPC; the standing member is Director of the DPI; and the other members are leaders of the departments of Agriculture and Rural Development, Construction, Finance, Communications and Transport, Health, Natural Resources and Environment, Labor, Invalids and Social Affairs, IPA, and JBIC, the Provincial State Treasury, and the Director of the PMU, and leaders of the districts and towns.

Responsibility: Advise the PPC with regards to the project arrangements and implementation; advise the PPC to solve issues related to the project implementation process under the responsibility of the PPC; support the PPC in approving the counterpart funding to ensure timely provision for the Project; monitor and evaluate the project implementation process in compliance with the procedures of the Government and commitments with the donor.

** Vinh Phuc ODA Project Management Office (PMO)*

As consented by the Donor, the PMO was established by the Vinh Phuc PPC and thus has overall responsibility for the project. The PMO comprises the Director of the Project Management Unit, who is at the same time the Deputy Director of the Department of Planning and Investment; Assisted the Director are two Deputy Directors of the Project Management Unit and other departments (including administration, accounting and financial management, procurement, environmental and social safeguards, operation and maintenance) as well as technical divisions (project divisions). The PMO has mobilized experienced staff from the existing Provincial PMU and technical staff from other departments of Agriculture and Rural Development, Natural Resources and Environment, Construction, and Transportation. This area highly qualified and experienced staff in implementing ODA projects. The number of dedicated staff is about 17 persons. The Board is assigned as owner managing the ODA projects funded by other financial institutions in the area of Vinh Phuc Province.

During the preparatory phase, the PPC assigned the ODA Management Board- the existing Department of Planning and Investment to prepare the project, build the detailed outline, organize the preparation for the Feasibility Study Report, and organize negotiations on the projects using ODA from the WB. These are the basis for establishing the PMO.

Responsibility of the PMO: As the representative agency, the PMO is responsible for implementing and complying with the laws and regulations on functions and duties of the project owner; making decision to establish and organize the project management and implementation apparatus; Signing contracts as stipulated by laws.

- Prepare overall plan and annual detailed plan for the project implementation, perform preparatory and implementation activities of the project including procurement, contract management, disbursement, financial and property management of the project, monitoring and evaluation of the project implementation, commissioning and handover of the project outputs after completion; complete the audit work and handover the project properties; prepare project completion report and balance-sheet report. Preparatory and implementing activities of other ODA-funded projects in the province area.
- Organize the appraisal and approval of technical design, total cost estimates and cost estimates of the project components; Negotiate, sign, and supervise the contract performance and handle the breach of contract; Recommend to the governing body in terms of mechanism and policies to ensure the project implementation in line with the international commitments;
- Organize the establishment and operation of monitoring and evaluation system (M&E) at the project-owner-level and arrange necessary resources for this task; designate unit responsible for regularly conducting M&E of the project;
- Organize the M&E according to the schedule approved in the project document; timely handle difficulties and problems under its jurisdiction and the recommendations outlined in the evaluation reports.
- In the ultra vires case, the PMU should submit to the governing body for handling measures. The PMU also realizes the reporting regime pursuant to the prevailing regulations and guidelines of the Ministry of Planning and Investment (MPI);
- Hire consultants to carry out evaluation on the basis of the monitoring and evaluation (M&E) plan outlined in the project document; and share information through the M&E systems of the project to ensure transparency and enlist the community supervision.
- Perform the task to exchange and coordinate with the donor, report the work progress, propose solutions to the problems, and transfer technique, technology and human resources after the project comes into operation.
- Perform other duties as prescribed in the role of project owner and project management unit as well as other tasks assigned by the line agency and donor.

1.2.2. Cost and Implementation Schedule

Project Financing

The estimated total project cost is USD220 million with USD150 million proposed to be financed by an IBRD loan. The estimated government counterpart funding is US$70 million to cover the costs of resettlement, portion of construction, project overhead, front-end fee and interest during construction.

Table 9. Project Cost and Financing by Component [To be revised]

No	Project cost items	Construction costs after taxes (USD)	WB loan (USD)	Counterpart fund (USD)
A	Phase 1: 30% of the project value	37,298,344	33,568,510	3,729,834
I	Construction costs	35,815,151	32,233,636	3,581,515
II	Equipment costs	1,483,193	1,334,873	148,319
B	Phase 2: 70% of the project value	83,170,962	74,853,866	8,317,096
I	Construction costs	54,721,080	49,248,972	5,472,108
II	Equipment costs	28,449,882	25,604,894	2,844,988
III	Total of construction and equipment costs	120,469,306	108,422,376	12,046,931
IV	Component 3	14,545,450	13,090,905	1,454,545
	Total costs of Components 1, 2 and 3	135,014,756	121,513,281	13,501,476
V	Project management costs	1,500,390	-	1,500,390
VI	Construction consulting fees	3,959,644	805,714	3,153,930
VII	Other costs	7,389,126	3,485,355	3,903,772
VIII	Costs for compensation, support and resettlement	31,553,246	-	31,553,246
IX	Contingencies	26,185,302	18,216,107	7,969,195
	Quantity contingencies for additional work load	17,941,716	12,580,435	5,361,281
	Inflation contingencies for cost escalation	8,243,586	5,635,672	2,607,913
	Interest cost	13,640,475	5,979,984	7,660,491
	Total investment costs	219,242,940	150,000,440	69,242,500

Project preparation cost: Vinh Phuc PPC has committed to use its provincial budget to prepare PDO, FS, basic design and other supporting reports.

<u>Project Implementation Schedule</u>

The project shall be implemented from 2015 to 2021 (six years).

1.3. PROJECT AREA OF INFLUENCE

In the process of assessing the environmental and social impacts of a project, it is very important to take into account scoping of the project influence area. The investment in of the project "Vinh Phuc Flood Risk and Water Resources Management" aims to ensure flood control for the center basin of the province and prevent the rapid degradation of surface water quality, especially for Phan River-Ca Lo River basin. The investment will be implemented through building a system of infrastructure such as pumping stations and drainage; dredging and rehabilitating Phan River and the river system in Binh Xuyen (Cau Bon River, Tranh River, Ba Hanh River and Noi River); building and rehabilitating some regulating gates on the rivers; dredging and rehabilitating lakes (Sau Vo, Rung and Nhi Hoang). To improve water quality, the project will also build domestic wastewater treatment plants for residential areas in 4 towns and 33 wastewater treatment plants scattering in rural residential areas along Phan River.

Therefore, the influence area of the project does not limit to the project boundary, including Basin B and C, but extend outside the basin. Hydraulic calculation results show the influence scope as follows:

- ✓ Kim Xa Pumping Station: Pumping water to Pho Day River will affect approximately 5 km downstream from the discharged point.
- ✓ Ngu Kien Pumping Station: Pumping water to Red River will affect about 3 km downstream from the discharge point.
- ✓ Nguyet Duc Pumping Station: Pumping water to Red River will affect about 3 km downstream from the discharge point.
- ✓ Downstream of 3 BinhXuyen rivers: As water draining from 3 rivers in Binh Xuyen to Ca Lo River and Cau River, the influence zone will include two communes Van Yen and Tu Lap in Me Linh District of Hanoi, positively impacted

In summary, the influence area covers the city ofVinh Yen, Phuc Yen Town, five districts of Vinh Phuc Province (Tam Duong, Tam Dao, Yen Lac, Binh Xuyen, VinhTuong) and Me Linh district of Hanoi. Specifically:

- ✓ Tam Duong District: 5/12 communes (Thanh Van, Kim Long, Dao Tu, DuyPhien, Van Hoi);
- ✓ Yen Lac District: 12/17 communes and towns (Bin hDinh, Yen Lac Town, Yen Dong, Nguyet Duc, Van Tien, Tam Hong, part of Dong Cuong, Trung Nguyen, Te Lo, Dai Tu, Yen Phuong, Lien Chau);
- ✓ Vinh Yen City: 9/9 wards and communes (wards Lien Bao, Dong Da, Ngo Quyen, Tich Son, Khai Quang, Thanh Tru, Dinh Trung Commune, part of Dong Tam and Hoi Hop);
- ✓ Binh Xuyen District: 8/13 communes and towns (Quat Luu, Phu Xuan, Huong Canh town, Thanh Lang; part of Tan Phong, Tam Hop, Son Loi, Dao Duc);
- ✓ VinhTuong District: 3/29 communes (part of Van Xuan, Ngu Kien, Tu Trung town);
- ✓ Phuc Yen Town: 3/10 wards and commune (part of Ward Trung Trac and Trung Nhi and TienChau commune);
- ✓ Me Linh District of Hanoi: 2 communes (Van Yen and Tu Lap).

Also due to the local terrain, a major part of the plain of Vinh Phuc lies in low land where is frequently flooded. In particular, high-risk areas is located in Phan River Basin (the Project area), including the city of Vinh Yen and most operating FDI firms. Flooding has caused serious impact Vinh Yen city, industrial parks, and plants causing extensive damage to agricultural production activities of people; damage to infrastructure in both rural and urban; disruptions to production in many industrial areas, causing long-term environmental and social consequences after flooding; negatively impacting some indicators of human development; group of low-income residents. Therefore, the project implementation will have positive impact on people lives and business prospect in Vinh Phuc.

For other projects that have been deployed and are going to be implemented within the project area, impact assessment will consider the following:

a) Improving Investment Environment in Vinh Phuc Province Project

The project was implemented with funds from JICA. Waste water collection system and a treatment plant have been constructed in Quat Luu commune, Binh Xuyen district with an initial capacity 4000 m^3/day-night (serving 04 wards in Vinh Yen City: Lien Bao, Khai Quang, Dong Da, and Ngo Quyen). These are the points where Component 2 of the Project does not cover.

Relationship with the Project: In Component 2 of the Project, a domestic wastewater collection system for Huong Canh Town will be installed. The collected wastewater from Huong Canh town will be conveyed and treated by Quat Luu WWTP.

b) Project title: Lung Hoa Commune WWTP, VinhTuong District

Capital source: VinhPhuc provincial budget for environmental protection

Construction period: 2013, operation: since 2014

Capacity: 350 m^3/day-night

Domestic wastewater in Lung Hoa commune residential area will be collected and treated in the WWTP to ensure QCVN 08/2008 Standard B and discharged into the lagoon in Lung Hoa village, then flows into Phan River.

Relationship with the Project: Lung Hoa Commune borders Phan River. In the past, wastewater in communal residential areas were not treated but discharged directly into the nearby ponds and lakes, and eventually into Phan River. Since the project is implemented, all wastewater is treated against QCVN 08/2008 standard B and then is discharged into the lagoon in Lung Hoa, then into Phan River. This has contributed to improving environmental quality for Phan River basin.

c) Urban Development Category 2 Project -Vinh Yen Green City

Funding: ADB (105.8 million USD)

Project Progress: Being in the stage of investment preparation

Construction period: 2016-2020

Urban Development Category 2 Project -Vinh Yen Green City is included in the urban development program Category II - Green City funded by ADB. The project includes 08 sub-projects, in which a sub-project is to dredge Vac Lake and a 2 km long river section connecting Vac Lake with Phan River.

Relationship with the Project:

Overall Vac Lake will work to reduce flood from northern area of Vinh Yen to Phan River. This contributes to reduction of flood drainage for ADB project in Vac Lake and Vinh Yen City. The proposed pumping stations under the WB's funded project VPFRWMP will work actively to drain and control the highest water level in Vac Lake through lowering the flood level in Phan River, towards no flooding in Vinh Yen downtown and neighboring area.

d) Project Title: Te Lo village WWTP, Yen Lac District

Capital source: Vinh Phuc provincial budget for environmental protection

Construction period: 2012 (not yet operational)

Relationship with the Project:

Te Lo Village is a craft village for collecting scrap and waste situated adjacent to Phan River. Wastewater from the village is considered contaminated with high organic matter and heavy metals. The entire amount of wastewater from this village is still being discharged directly into Phan River basin without treatment, reducing river water quality. Te Lo WWTP project when in operation will contribute to improving the water quality of Phan River, while reducing investment costs for the project VPFRWMP in Component 2. Treated wastewater will meet QCVN 08/2008 Standard B before discharging into Phan River.

CHAPTER 2.
POLICY AND LEGAL FRAMEWORK, INSTITUTIONS

2.1. TECHNICAL BASIS

1. Decision No. 1336/QD-TTg dated 22/09/2008 of the Prime Minister on Drainage planning of 3 key economic regions of North, Central and South regions up to 2020.
2. Decision No. 1554/QD-TTg, dated 217/10/2012 of the Prime Minister on Irrigation Planning for Red River delta during 2012 to 2020 and orientations for 2050 in the context of climate change, sea level rise.
3. Decision No. 113 /QD-TTg dated 20/01/2012 on the overall socio-economic development planning of Vinh Phuc province until 2020.
4. Decision No. 2258/QD-Committee on 20/9/2012 on Regional construction planning of Vinh Phuc Province by 2030 and vision to 2050.
5. Decision No. 1717/QD-CT dated 04/7/2013 of People's Committee of Vinh Phuc province on Irrigation Development Planning of Vinh Phuc province by 2020 and orientations to 2030.
6. Decision No. 3879/QD-UBND dated 29/12/2014 of People's Committee of Vinh Phuc province on Urban drainage planning of Vinh Phuc province by 2030 and vision to 2050.
7. Overall drainage plan of Phan and Ca Lo River basins of Vinh Phuc Province by 2020.

2.2. LAWS, DECREES, CIRCULARS, AND REGULATIONS/STANDARDS OF VIETNAM

2.2.1. Environmental Legal

The preparation of the ESIA report is based on the laws and regulations of Vietnam on environmental protection, soil and water resources, and Vietnamese standards of air, surface water and groundwater quality, etc., as well as the legal documents of the project and documents collected from the stakeholders. Specifically:

On environmental protection:

1. Law on Environmental Protection by the National Assembly of the Socialist Republic of Vietnam ratified on 23/06/2014 and signed and published by the President on 1/1/2015.
2. Decree No. 18/2015/NĐ-CP signed on 14/02/2015 by the Government providing environmental protection planning, strategic environmental assessment, environmental impact assessment and environmental protection plan;
3. Circular No. 27/2015/TT-BTNMT dated 29/05/2015 by the Ministry of Natural Resources and Environment on strategic environmental assessment, environmental impact assessment and environmental protection plan;

As legal basis for preparation of the project ESIA and EMP.

Regarding land resources

1. Land Law 2013, which has been effective since July 1, 2014.
2. Decree 43/2014/NĐ-CP detailing some articles of 2013 Land Law.
3. Decree No. 42/2012/ND-CP dated May 11, 2012 by the Government on management and use of rice cultivation land.

As legal basis for management, use and protection of land in the project area.

Regarding water resources

1. Law No. 17/2012/QH13 on water resources ratified by the National Assembly of the Socialist Republic of Vietnam on 21/6/2012;
2. Decree No. 201/2013/NĐ-CP detailing regulations on implementation of some articles of water resources law;
3. Decree No. 120/2008/ND-CP dated 01/12/2008 by the Government on river basin management;
4. Decree No. 80/2014/ND-CP dated 06/08/2014 by the Government on drainage and wastewater treatment;

As basis for management, use and protection of surface water and river basis in construction of project works.

2.2.2. Social Legal Basis

Regarding compensation and resettlement

The legal framework with respect to land acquisition, compensation and resettlement is based on the Constitution of the Socialist Republic of Vietnam (2013), and the Land Law 2013 (revised), and other relevant decrees/guidelines. The principal legal documents applied for the RPF include the followings:

1. Constitution of Vietnam 2013.
2. The Land Law 2013, which has been effective since July 1, 2014.
3. Decree No.43/2014/ND-CP guiding in detail some articles of Land Law 2013.
4. Decree No.44/2014/ND-CP providing methods for land pricing; adjustment to land price brackets, land price lists; specific land pricing and land price consultancy activities.
5. Decree No. 47/2014/ND-CP providing compensation, support, resettlement when land is recovered by the State.
6. Decree No. 38/2013/ND-CP of 23 April 2013, on management and use of official development assistance (ODA) and concessional loans of donors.
7. Circular No. 36/2014 / TT-BTNMT dated 30 June 2014, regulating method of valuation of land; construction, land price adjustment; specific land valuation and land valuation advisory.
8. Circular No. 37/2014/TT-BTNMT dated 30 June 2014, regulating compensation, assistance and resettlement when the State acquires land.
9. Decision No. 1956/2009/QD-TTg, dated November 17 2009, by the Prime Minister approving the Master Plan on vocational training for rural labors by 2020.
10. Decision No. 52/2012/QD-TTg, dated November 16 2012, on the support policies on employment and vocational training to farmers whose agricultural land has been recovered by the State.

11. Other regulations or administrative decisions related to resettlement plan to be issued by Vinh Phuc Province People's Committee in relation to the Land Law 2014, and its relevant decrees and circulars: Decision No. 35/2014/QD-UBND of the Vinh Phuc PPC dated 15 August 2014 on issuing regulations on compensation and resettlement assistance when the State acquires land in Vinh Phuc Province and Decision No. 61/2014/QD-UBND dated December 31 2014 by Vinh Phuc PPC on land prices in Vinh Phuc Province for the 2015-2019 period.

As legal basis for acquisition and use conversion for each land type and compensation for AHs in the project area.

Table 10. Legal documents relating to ethnic minority

2013	Joint Circular No. 05/2013-TTLT-CEM-ARD-MPI-TC-XD dated on November 18, 2013 guideline of program 135 on support infrastructure investment, production development for extremely difficult communes, border communes, particularly difficult villages
2012	Decision No. 54/2012-QD-TTg of the Prime Minister dated on December 04, 2012 on promulgation of lending policy for development for particularly difficult ethnic minorities in period 2012-2015
2012	Decree No. 84/2012/ND-CP of the Government dated on December 10, 2012 on functions, tasks, powers and organizational structure of the Committee for Ethnic Minorities.
2012	Joint Circular No. 01/2012/TTLT-BTP-CEM date on January 17, 1012 of the Ministry of Justice and the Committee for Ethnic Minorities on guideline and legal assistance for ethnic minorities.
2010	Decree No.82/2010/ND-CP of government, dated 20 July 2010 on teaching and learning of ethnic minority languages in schools.
2009	Decision No 102/2009/QD-TTg dated on August 07, 2009 of the Prime Minister on directly policy assistance for the poor in difficult area.
2008	Resolution No.30a/2008/NQ-CP of government, dated 27 Dec. 2008 on support program for rapid and sustainable poverty reduction for 61 poorest districts.
2007	Circular No.06 dated 20-September-2007 of the Committee for Ethnic Minorities Affair guidance on the assistance for services, improved livelihood of people, technical assistance for improving the knowledge on the laws according the decision 112/2007/QD-TTg
2007	Decision No. 05/2007/QD-UBDT dated 06-September-2007 of the Committee for Ethnic Minorities Affair on its acceptance for three regions of ethnic minorities and mountainous areas based on development status
2007	Decision No.01/2007/QD-UBDT dated 31-May-2007 of the Committee for Ethnic Minorities Affair on the recognition of communes, districts in the mountainous areas.
2007	Decision No.06/2007/QD-UBDT dated 12-January-2007 of the Committee for Ethnic Minorities Affair on the strategy of media for the program 135-phase 2

2.2.3. Project Related Documents

1. Decision No. 1682/QD-TTg dated 30th Sept. 2015 of the Prime Minister on approving the list of the VPFRMWP funded by WB.
2. Official Letter No. 7401/UBND-KT4 dated 5th Dec. 2014of Vinh Phuc PPC tasked to prepare the project and deploy the content of ODA's World Bank and ADB mobilization preparation project;
3. Official Letter No. 8559/BKH-KTDN on 13th Nov. 2014 by the Ministry of Planning and Investment issued preparing the ADB and WB loan projects in Vinh Phuc province.
4. Official Letter No. 5925/UBND-KT1 dated 17th Oct. 2013 of Vinh Phuc PPC issued the ODA mobilizing and preferential loans for investment in infrastructure development in Vinh Phuc province.
5. Decision 636/QD-UBND dated 05th March 2014 of the Chairman of PPC established the Official Development Assistance (ODA) PMU.

2.2.4. Vietnamese Environmental Standards and Technical Regulations

The current Vietnam National Standards (TCVN) and Technical Regulations (QCVN) on the Environments are the national standards established by MONRE and they are to be applied for all agencies, enterprises and projects carried out in Vietnam.

1. QCVN 05:2013/BTNMT - National Technical Regulations on ambient air quality;
2. QCVN 08:2008/BTNMT - National Technical Regulations on surface water quality;
3. QCVN 09:2008/BTNMT - National Technical Regulations on groundwater quality;
4. QCVN 14:2008/BTNMT - National Technical Regulations on domestic wastewater;
5. QCVN 39/2011/BTNMT- National Technical Regulation on water quality for irrigated agriculture;
6. QCVN 26:2010/BTNMT - National Technical Regulations on noise;
7. QCVN 27:2010/BTNMT - National Technical Regulations on vibration;
8. QCVN 07: 2009/BTNMT - National Technical Regulations on the thresholds of hazardous waste;
9. QCVN 03: 2008/BTNMT - National Technical Regulations on permissible limits of heavy metals in soil;
10. QCVN 15: 2008/BTNMT - National Technical Regulations on chemical residues in soil and plant protection;
11. QCVN 43:2012/BTNMT - National Technical Regulation on sediment quality.

2.2.5. Other relevant documents and reports

1. Statistical Yearbook of Vinh Phuc Province in 2014.
2. Feasibility Study Report - VPFRWMP.
3. Social Assessment Report- VPFRWMP.
4. Report on the environmental status of Vinh Phuc Province from 2012 to 2014 by Vinh Phuc Provincial Department of Natural Resources and Environment.

5. Integrated Report on Survey and Assessment of Biodiversity Status and Action Plan on Biodiversity by 2015 with orientation to 2020 of Vinh Phuc Province.
6. Socioeconomic development reports in 2014 and first nine months of 2015 by the communes and districts in the project area.

2.3. Safeguards Policies and Guidelines of the World Bank

The project must also comply with the safeguard policies of the World Bank, triggered by Project activities, and described below. The ESIA will also apply WBG Environmental, Health, and Safety Guidelines known as the "EHS Guidelines". The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP)1.

Safeguard policies triggered for the project:

- **OP/BP 4.01- Environmental Assessment:**

The Project is classified as a category A due to the potentially significant environmental and social impacts associated with the Project investments and activities. A full ESIA including an Environment Management Plan (ESMP) has been prepared for the Project.

Social Assessments have been conducted for the Project. Social impacts were also considered in the ESIA.

- **OP/BP 4.04 – Natural Habitats:**

The policy is triggered as the project will impact the aquatic environment of rivers the Phan, Red, Pho Day, Ca Lo, Binh Xuyen System and lakes i.e. Sau Vo, Rung, Nhi Hoang in the project area of influence. The ESIA has assessed project impacts on natural habitats for which provision of appropriate conservation and mitigation measures would be required.

- **Physical Cultural Resources OP/BP 4.11**

The policies are triggered as the project involves large excavation activities. As such, chance find procedures will be incorporated into ESMPs, and added to construction contracts.

- **Safety of Dams OP/BP 4.37**

The project will not involve any dam construction or rehabilitation or works on related reservoirs. However, there are two dams designed for irrigation and flood control purposes, namely Thanh Lanh and Xa Huong, respectively upstream of Tranh and Cau Bon River, which are used to meet the irrigation demand of Basin B during the dry season. Full Dam Safety reports have been prepared accordingly, and the mitigation actions proposed are incorporated into the ESIA.

- **Projects on International Waterways OP/BP 7.50**

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1 *http://www.ifc.org/wps/wcm/connect/554e8d80488658e4b76af76a6515bb18/Final%2B-%2BGeneral%2BEHS%2BGuidelines.pdf?MOD=AJPERES*

Component 1 of the Project, Flood Risk Management, includes the construction of three pumping stations in Basin B, with a total capacity of 145 cubic meters per second (m^3/s). Two of these pumping stations - Ngu Kien and Nguyet Duc - will discharge water to the Red River. As such, OP 7.50 is triggered, and the riparian state concerned - China - will be notified of the Project activities.

- **OP/BP 4.12 Involuntary Resettlement**

Involuntary resettlement may cause severe long-term hardship, impoverishment, and environmental damage unless appropriate measures are carefully planned and carried out. The Bank's Resettlement Policy OP 4.12, includes safeguards to address and mitigate the economic, social, and environmental risks arising from involuntary resettlement. The WB's involuntary resettlement policy objectives are the following:

- ✓ Physical displacement, economic and physical adverse impacts should be avoided where feasible or, if not possible, minimized by examining all available design alternatives, technology, site selection. Where avoidance is not possible, impacts shall be mitigated.
- ✓ Where resettlement cannot be avoided, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the people affected by a project to share in benefits.
- ✓ Affected Persons should be meaningful consulted and should have opportunities to participate in planning and implementing resettlement programs.
- ✓ Affected Persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-project levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

Following the OP 4.12 and to address the impacts of the project, the objectives of the policy have been applied to all the components. The resettlement planning has involved screening, identifying key issues to prepare the instruments required for the subcomponents: RPF, EMDF, and 3 Raps for the first year of project implementation.

- **OP/BP 4.10 Indigenous Peoples**

The OP 4.10 aims at avoid potentially adverse effects on indigenous people and increase activities to bring about projects benefits taking into account their cultural demands and needs. The Bank requires indigenous peoples, (here refer as Ethnic Minorities), to be fully informed and able to freely participate in projects. The project has to be widely supported by the affected EMs. Besides, the project is to be designed to ensure that the EMs are not affected by adverse impacts of the development process, mitigation measure to be defined if required and that the EM peoples to receive socio-economic benefits that should be culturally appropriate to them. The Policy defines that EM are identified in varying degrees of the following characteristics:

- ✓ Self-identification as members of a distinct indigenous cultural group and recognition of this identity by others;

- ✓ Collective attachment to geographically distinct habitats or ancestral territories in the project area and to the natural resources in these habitats and territories;
- ✓ Customary cultural, economic, social, or political institutions that are separate from those of the dominant society and culture; and
- ✓ Speak an indigenous language, often different from the official language of the country or region.

The OP 4.10 requires the borrower to conduct free, prior and informed consultations with potentially affected EM peoples and to establish a pattern of broad community support for the project and its objectives. The primary objectives of OP 4.10 are to ensure:

- ✓ that such groups are afforded meaningful opportunities to participate in planning project activities that affects them;
- ✓ that opportunities to provide such groups with culturally appropriate benefits are considered; and
- ✓ that any project impact that adversely affect them are avoided or otherwise minimized and mitigated.

In this project the policy objectives are addressed, so as to ensure that EM groups in the subproject areas will receive long term benefits through flooding management, and that negative impacts (temporary and permanent) on EMs communities in the subproject area (and adjacent areas) during the project implementation and construction process are mitigated and compensated.

CHAPTER 3. NATURAL, ENVIRONMENTAL AND SOCIO-ECONOMIC CONDITIONS

3.1. THE CURRENT STATUS OF NATURAL CONDITIONS

3.1.1. Geographical Location and Geological Conditions

3.1.1.1. Geographical location:

Vinh Phuc Province has the total natural area of 1,231 km^2, located in the Red River Delta belonging to the Northern midland and mountainous region, with co-ordinates from 21^O 08’ to 21^0 34$^’$ North latitude (Dao Tru Commune, Tam Dao District); from 105^0 09’ (Bach Luu Commune, Song Lo District) to 105^{o}47’ East longitude (Ngoc Thanh Commune, Phuc Yen Town).

Vinh Phuc is bounded by Thai Nguyen and Tuyen Quang provinces to the North; by Ha Noi City to the South and East; and by Phu Tho Province to the West. It is divided into nine district - level administrative units, namely Vinh Yen City, Phuc Yen Town, and seven districts (Tam Duong, Tam Dao, Binh Xuyen, Vinh Tuong, Yen Lac, Song Lo and Lap Thach).

The project area of the VPFRWMP components is spread over 66 communes belonging to seven district-level administrative units of the province, including Vinh Yen City, Phuc Yen Town, and five districts (Tam Duong, Tam Dao, Binh Xuyen, Vinh Tuong, and Yen Lac). The total project area is 710 km^2, representing 57% of the total area of the province. The project area is bounded by Thai Nguyen and Tuyen Quang provinces to the North, by Lap Thach District to the West, and by Ha Noi to the South and East. Therefore, the project area has the common natural and socioeconomic characteristics of the entire Vinh Phuc Province.

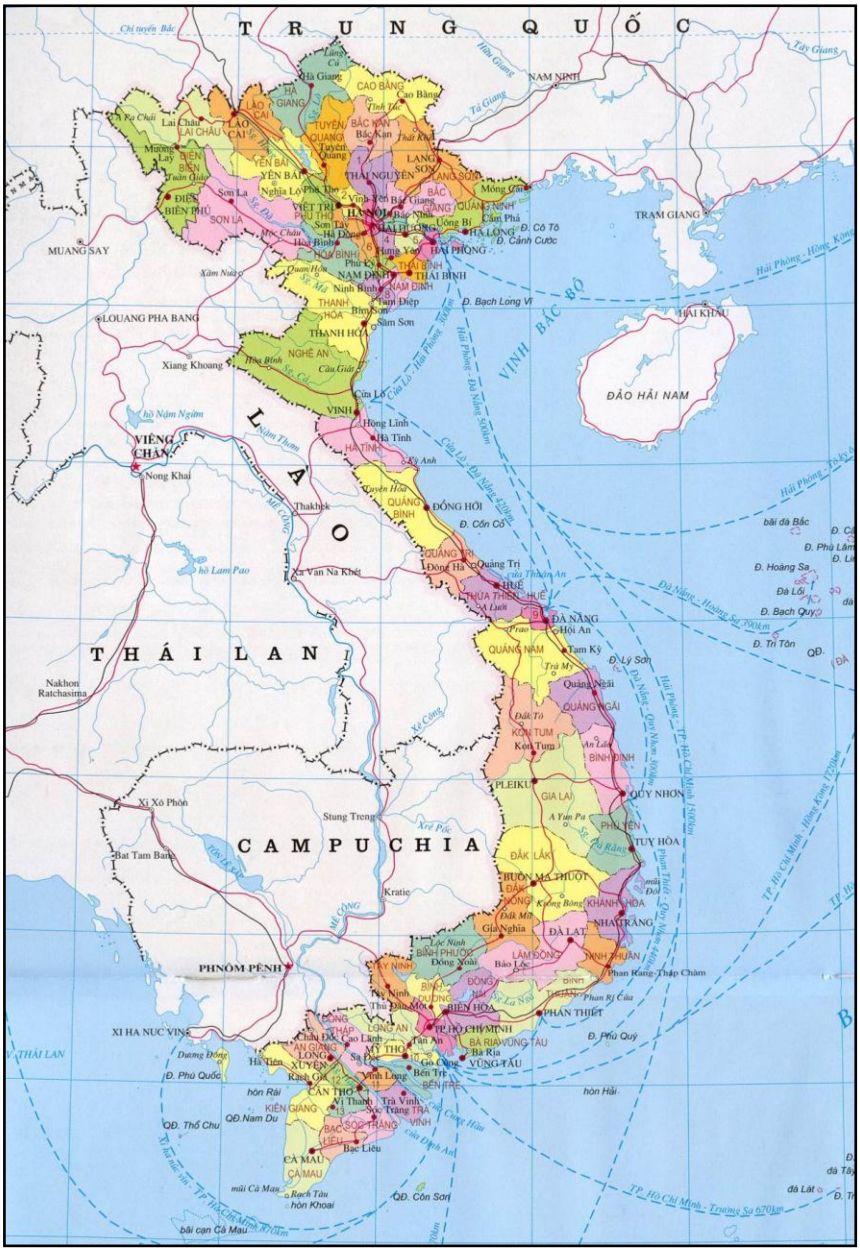


Figure 20. Vinh Phuc Province in the administrative map of Vietnam

3.1.1.2. Topographical features

Vinh Phuc is located in the transitional area between the mountainous region and Northern delta. The North of the province has Tam Dao mountain range with Dao Tru peak at 1,592 m high. The West and North of the province are surrounded by two large rivers, which are Red River and Lo River, creating gradual lowering topography from the Northwest to the Southeast. Vinh Phuc is divided into three distinct ecological regions as follows:

1. Mountainous region:

According to its formation origin and height, mountainous topography is divided into three types:

- ✓ Alpine topography: Tam Dao mountain range in Vinh Phuc starts from Dao Tru Commune (Tam Dao District) with the total length more than 30 km, from the Northwest to Southeast, with several peaks above 1,000 m.
- ✓ Low mountain topography: With an area of tens of square kilometers, the representative of this type of topography is Sang Mountain in two communes, Dong Que and Lang Cong (Lo River).
- ✓ Residual mountain topography: This is an axis of the Northwest-Southeast anticline located in Vinh Yen City and Binh Xuyen District.

2. Hilly topography:

With the elevation from 20 m to 200 m and the following forms:

- ✓ Eroded and corroded hill: due to the cleavage and corrosion process by water on the ground at the mountainous areas where the positive structure is weakly elevated.
- ✓ Cumulative hill: is formed by accumulation and corrosion process, distributed at the large stream outlets at the foot of Tam Dao Mountain such as Dao Tru, Tam Quan, Hop Chau, Minh Quang (Tam Dao District), and Trung My (Binh Xuyen District).
- ✓ Eroded cumulative hill: is formed from cumulative hill but is eroded. This type of hill is common along Lo River. The hill is bowl-shaped or prolonged and composed of sandstone and gravel.

3. Plain topography:

Representing 40% of the province's total area, the terrain has relatively flat surface; based on the absolute altitude and formation conditions, Vinh Phuc plain can be divided into three types:

- ✓ Delta: is a type of landform that forms from the deposition of sediment carried by the large estuaries. Vinh Phuc delta is developed from the deposition of Lo River, Red River, Pho Day River and smaller rivers and streams from Tam Dao mountain range.
- ✓ Plain in front of the mountain: is built by the long-term destruction of the mountainous region due to erosion and corrosion process of surface water. Compared to the river delta, this type of plain is less fertile.
- ✓ Valleys and floodplain: the river valleys in Vinh Phuc have negative structure, with the length several times larger than the width. This type of landform is mainly formed by the corrosion of flow.

Due to its spreading area, the project area has all three types of terrains with the slope direction from Northwest to Southeast. Most of the Northern area is mountainous and hilly terrain (Tam Duong, Tam Dao, and Binh Xuyen districts) at predominant elevation of 300 m to 700 m while the Southern and Southeastern areas are lowlands at common elevation of +10.0 m to +12.0 m (Vinh Tuong, Yen Lac, Binh Xuyen, and Vinh Yen) and the low-lying areas adjacent to the Red River dyke at elevation of 5.0 m to 8.0 m.

3.1.1.3. Geological and soil features

Although the territory area is not large, the stratigraphic structure of Vinh Phuc Province is rather complex with many different origins. The richness of the stratigraphic layers will largely decide the quality of soil and availability of different minerals. However this also means that the area of land types as well as minerals reserves is also limited.

The project area has two main major soil groups, which are alluvial soil and mountainous and hilly soil.

a. Alluvial soil

Alluvial soil group in Vinh Phuc, which is deposited by two river systems, the Red River and Lo River, can be divided into the following types:

1. Annually deposited alluvial soil:
    - ✓ Alluvial soil which is deposited annually by the Red River is characterized by neutrality and alkaline. Its area is about 6,167 ha, accounting for 4.89% of the natural area, mainly distributed in the communes along the dyke in Vinh Tuong, Yen Lac, Lap Thach, and Song Lo districts. This is good soil that is suitable for most types of agricultural crops, especially short-term and high-yielding crops.
    - ✓ Alluvial soil which is deposited annually by Lo River is characterized by light brown, neutral, less acid, porous, nutritious, and suitable to rain-fed crops and short-term industrial crops. Its area is about 3,920 ha and mainly distributed in Song Lo and Lap Thach districts.
2. Alluvial land which is not deposited annually: often has light brown color and is neutral, mainly distributed in the lowland areas. This is heavy mechanical composition soil with the pH level from 5.0 to 5.5.
3. Exhausted soil on old alluvium: has an aggregate area of about 6,400 ha, representing 15.49% of the natural area. This type of soil is distributed in most of the districts in the province, particularly in the sloping and wavy terrain with poor nutrition and discrete surface. The main mechanical compositions are sand and silt sand. This type of soil is suitable for agricultural crops but produces low yield.
4. Non-exhausted sloping soil on the mountains and hills: has an aggregate area of 11,230 ha, is primarily distributed in Lap Thach, Song Lo, Binh Xuyen, and Tam Duong districts. This type of soil is often formed along the low mountains and hills, creating small and narrow terraced fields.
5. Windy sandy soil: covers an area of about 300 ha, and is mainly distributed in Dinh Trung (Vinh Yen City) and scattered in some communes of Tam Duong. This soil is formed due to the impacts of sloping soil along mountains and hills; the mechanical compositions are sand and silty sand.
6. Alluvial soil in mountainous area: has about 1,208 ha and is primarily distributed in Lap Thach, Song Lo, and Tam Duong districts, along the streams to create long and narrow fields with high pH level, light mechanical compositions, and high water holding capacity (WHC). In general, this area is suitable for intensive farming.
7. Soft muddy soil: is mainly distributed in Song Lo and Lap Thach districts with an aggregate area of about 900 ha. This soil can be grown to two rice crops per year;

however, it is necessary to pay due attention to irrigation for de-acidification and groundwater prevention.

b. Mountainous and hilly soil

Mountainous and hilly soil of the province accounts for one third of the total natural area, comprising the following main types:

- ✓ Ferralitic soil changed due to wet-rice cultivation: with an aggregate area of about 4,850 ha, primarily in the North of Tam Duong, Binh Xuyen, Lap Thach, and Song Lo districts.
- ✓ Brown-yellowish Ferralitic soil on old alluvium: covers an area of about 2,300 ha, mainly distributed in Lap Thach, Song Lo, Vinh Yen, and Phuc Yen. It is characterized by acidity, porous structure, and light - to - medium mechanical compositions. It is suitable for growing rain-fed crops, short-term industrial crops, and forestry crops.
- ✓ Red-yellowish Ferralitic soil on mica schist: accounts for 2.1% of the total natural area and is mainly distributed in the North of Tam Duong and Binh Xuyen districts and scattered in some areas in Lap Thach District. This soil is suitable for agroforestry production, particularly industrial crops.
- ✓ Yellow or red Ferralitic soil in clay schist: has a total area of about 9,120 ha and is mainly distributed in Lap Thach and Song Lo districts and scattered in Tam Duong, Binh Xuyen, and Phuc Yen. This type of forest land produces high yield; particularly, in the sloping area under 200 m, it is suitable for growing fruit trees, industrial crops and other types of specialties.
- ✓ Red-yellowish or grey-yellowish Ferralitic soil on acid magmatic rocks: covers an area of 1,900 ha and is mainly distributed in Tam Dao, Lap Thach, Song Lo, and a part of Phuc Yen Town. It is characterized by acidity and thin topsoil, which is suitable for forestry development.
- ✓ Red-yellowish or grey-yellowish Ferralitic soil on quartzite sandstone: has an aggregate area of about 16,830 ha and is mainly distributed in Phuc Yen, Lap Thach, Song Lo, Tam Duong, and Binh Xuyen. This is skeletal soil (with rock outcrop) that needs forestation development.
- ✓ Ferralitic soil on mountains: covers a total area of about 10,000 ha at an elevation from 150 m to 500 m, mainly distributed in Lap Thach, Song Lo, and Tam Dao districts. Many areas have become barren hills and mountains; it is necessary to develop a forest restoration plan.
- ✓ Humus Ferralitic soil on mountains: accounts for a small area on Tam Dao mountain range at an elevation of more than 500 m. Apart from forestry purpose, it can be used to cultivate seedlings, grow herbal plants, cold-climate trees, and winter vegetables.
- ✓ Strongly eroded Ferralitic skeletal soil (with rock outcrop): has an aggregate area of about 410 ha, distributed along the National Highway (NH) No.2 from Phuc Yen to Vinh Yen. It is mostly sloping land strips.

3.1.2. Climate and Weather Conditions

The project area is located in the tropical monsoon climate region with two distinctive seasons: the rainy season starts from May to October while the dry season lasts from October until the end of April

3.1.2.1. Temperature

According to the data over the years of Tam Dao and Vinh Yen meteorological stations, the average temperature is 23^0C, with the highest at 41.1^0C and the lowest at 0.0^0C.

Table 11. Average monthly temperatures, maximum and minimum temperatures (^{0}C)

TT	Station/ Period	Fact-ors	Month												Year
			I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
1	Tam Dao (1962÷2011)	T^oC	11.2	12.4	15.4	18.9	21.6	23.0	23.1	22.8	21.6	19.2	16.0	12.7	18.2
		T_{max}	26.2	29	30.7	32.1	33.4	33	31.8	32.4	30.8	29	27.3	24.7	33.4
		T_{min}	0.9	0.0	0.5	7.0	9.5	15.8	18	17.7	11.6	10.4	5.1	1.0	0.0
2	Vinh Yen (1961÷2011)	T^oC	16.6	17.9	20.4	24.2	27.5	29.1	29.2	28.6	27.6	25.1	21.6	18.2	23.8
		T_{max}	31.4	35.2	36.3	37.9	41.1	40.2	39.5	38.1	36.7	37	33.9	31.5	41.1
		T_{min}	11.2	12.4	15.4	18.9	21.6	23.0	23.1	22.8	21.6	19.2	16.0	12.7	18.2

Source: Vinh Phuc Province Statistical Year Book, 2014

3.1.2.2. Humidity:

The average humidity over the years ranges from 81% to 87%. Particularly, in the mountainous area with dense trees and rains, the humidity is much higher. The area with high humidity in the province is Tam Dao mountainous area with 87.8% while the area with lower humidity is Vinh Yen with 81.7%.

Table 12. Average monthly humidity (%)

Station	Period	Month												Year
		I	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*	*X*	*XI*	*XII*	
Tam Dao	1962÷2011	89.2	91.8	91.4	91.4	88.6	88.2	89.4	89.2	86.2	82.8	81.7	83.5	87.8
Vinh Yen	1961÷2011	80.9	82.8	84.4	84.5	81.2	81.0	81.7	83.9	81.9	80.7	79.2	78.6	81.7

Source: Vinh Phuc Province Statistical Year Book, 2014

3.1.2.3. Wind speed:

Annually, there are two main monsoon seasons, the Northeast monsoon and Southeast monsoon. Northeast monsoon prevails from October to March of the following year and often accompanied with hoarfrost, which affects agricultural production. The Southeast wind lasts from April to September, carrying steam and causing heavy showers.

The annual and monthly average wind speed in the province varies greatly according to terrains and altitudes. For example, the average wind speed in the plain area of Vinh Yen is 1.6 m/s, while in Tam Dao mountainous area, the speed increases to 3 m/s.

Table 13. Averageannual and monthly wind speed (m/s)

Station	**Period**	**Month**												**Year**
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Tam Dao	1962÷ 2011	3.1	3.1	3.1	3.0	3.1	2.5	2.8	2.2	2.9	3.4	3.3	3.1	3.0
Vinh Yen	1961÷ 2011	1.5	1.8	1.8	2.0	2.0	1.7	1.7	1.4	1.2	1.2	1.2	1.3	1.6

Source: Vinh Phuc Province Statistical Year Book, 2014

3.1.2.4. Evaporation:

The average evaporation in the province ranges from 540 mm to 1,000 mm, depending on the location, terrain, temperature, and number of sunny hours. The higher the altitude, the smaller the evaporated amount. Specifically, in Tam Dao, the evaporated amount is 541 mm while in lower areas, the evaporated amount is higher; for example, the evaporated amount in Vinh Yen is approximately 1,000 mm.

Table 14. Annual and monthly evaporation (mm)

Station	**Period**	**Month**												**Year**
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Tam Dao	1962÷ 2011	35.1	24.2	27.8	31.9	52.5	48.4	45.8	41.9	53.7	67.5	60.4	52.0	541.4
Vinh Yen	1961÷ 2011	70.2	63.5	67.8	76.4	111.3	104.8	101.9	80.0	79.4	86.5	79.4	78.6	999.8

Source: Vinh Phuc Province Statistical Year Book, 2014

3.1.2.4. Rainfall:

In the project area, rainfall is unevenly distributed in space and time. Rainfall mainly concentrates from June to September (accounting for 75% to 85% of the annual rainfall). In spatial terms, rainfall is usually higher in the mountains than in the plains and midlands. The average annual rainfall at the Vinh Yen station, which represents the plains and midlands, is 1,574.8 mm while the average rainfall at Tam Dao station, which represents the mountains, is 2,439.4 mm.

Inundation usually occurs in plain areas in June, July and August (70%); and in mountainous areas in July, August and September. Most heavy rains happen in August, which usually last in 2-3 days, with a large proportion of rain falling on the second day. 32% of the total heavy rains have most of rain falling on the first day, and 45% on the middle of the rain, and 23% on the last day.

The intensity of rainstorm is high, which can reach 86 mm/hour at Vinh Yen station and 108 mm/hour at Tam Dao station. The number of rainy days with intensity of 50-100 mm is about 6-18 days per year on average; and the number of rainy days with intensity of more than 100 mm is 2-5 days per year, mostly occurring in July and August (accounting for 50% of the number of rainy days with the same intensity in the whole year).

Table 15. Hourly maximum rainfall over years in the project area

Feature	**Vinh Yen**		**Tam Dao**	
	X(mm)	Occurrence time	X(mm)	Occurrence time
1hmax	86,3	0h 23/VII/2012	108,5	1h 8/IX/2006
24hmax	361,9	31/X/2008	397,8	3/X/1978
48hmax	459,6	31/X÷1/XI/2008	433,5	2÷3/X/1978
72hmax	500,5	31/X÷2/XI/2008	451,5	30/X÷2/XI/2008
120hmax	525	30/X÷4/XI/2008	620,1	20÷24/VII/1980

Source: Integrated Feasibility Study Report of VPFRWMP

Maximum rainfalls usually last for 3 to 5 days, and over a large area, covering the entire project area. Particularly, rains created by storms or Northeast monsoon wind last for 2-3 days continuously and cause significant floods in the Red River basin in general and the project area in particular. One-day maximum rainfall reaches 300 mm to 330 mm, three-day maximum rainfall is from 450 mm to 550 mm while five-day maximum rainfall reaches 500 mm to 680 mm.

Table 16.Total maximum rainfalls over repeated cycles in the project area

Station	Feature	Xtb	Cv	Cs	X(mm)					
					100 years	*50 years*	*33 years*	*20 years*	*10 years*	*5 years*
Tam Dao	1 day max	190	0.33	0.37	351	329	316	298	271	241
	3 day max	273	0.30	0.38	487	458	440	416	381	340
	5 day max	319	0.29	1.05	605	558	531	495	444	389
	7 day max	350	0.29	0.85	647	601	574	537	485	429
Vinh Yen	1 day max	126	0.45	1.56	320	285	264	238	202	165
	3 day max	175	0.43	1.90	446	393	363	325	273	222
	5 day max	207	0.42	1.69	504	448	416	375	320	263
	7 day max	235	0.39	1.45	540	486	453	413	357	298
Phuc Yen	1 day max	136	0.43	2.26	353	308	282	251	209	168
	3 day max	191	0.45	3.43	548	461	413	355	284	221
	5 day max	216	0.41	3.10	574	490	444	387	316	252
	7 day max	238	0.38	2.65	591	514	470	416	347	282
Dong Anh	1 day max	130	0.43	2.07	335	294	270	241	201	163
	3 day max	189	0.44	2.05	493	433	398	354	296	239
	5 day max	219	0.42	1.81	540	478	443	398	338	277
	7 day max	250	0.39	1.49	572	514	480	437	377	316

Source: Integrated Feasibility Study Report of VPFRWMP

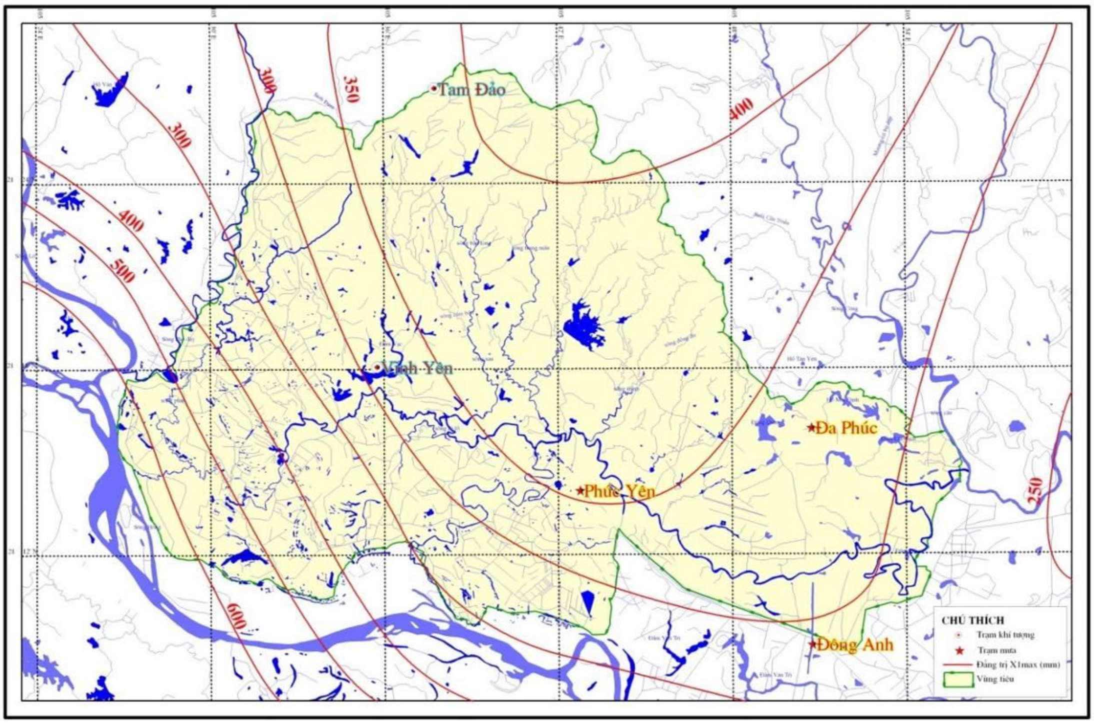


Figure 21. Map of isohyetal lines for 1-day maximum rains in the project area

3.1.2.5. Impacts of climate change in the project area

Vietnam is among the countries most affected by global climate change. According to the scenarios of climate change and sea level rise for Vietnam, issued by the Ministry of Natural Resources and Environment in 2012, the climatic conditions of Vinh Phuc Province will undergo some changes, specifically:

The summer rainfall will increase, relative to the 1980-1999 period, according to the medium emission scenario B2, as follows: rainfalls will increase by 2.3% in 2020, by 3.4% in 2030, by 6.2% in 2050, and by 11.8% by the end of the 21^{st} century.

Changes in annual mean temperature relative to the 1980-1999 period, according to the medium emission scenario B2 (Appendix 4), are as follows: by 2020, annual mean temperature will increase by 0.4^oC, 0.6^oC by 2030, 1.1^oC by 2050, and by 2.1^oC by the end of the 21^{st} century.

3.1.3. Hydrological Conditions of River system in the project area

a. Red River:

In the middle land of the Red River system, the flow regime of the river system in the project area is affected by the Red River, Pho Day, and Cau River. The river network in the area is dense (on average of 0.7 km/km^2), with typical features of rivers in Northern Vietnam. The aforementioned rivers area the water sources and receiving points of the project area. The Red River-Thai Binh River system

The Red River section, after confluence of Da-Thao and Lo rivers, flows through the southern boundary of the project area is about 41 km long. Pho Day River, a left tributary of Lo River, has downstream in Vinh Phuc Province and forms a natural border between Lap Thach District and the project area. In the flood season, water level in the Red River and Pho Day River is usually at 2 m to 4 m higher than that in the fields in the project area. Therefore, gravity drainage from the project area to the Red River and Pho Day River is difficult. Cau River is the biggest tributary in the upstream of Thai Binh river system. Cau River receives discharges from the project area via the Ca Lo River at Phuc Loc Phuong gate. In the flood season when the project area has heavy rain causing flooding, flooding also appears in Cau River. The water level at Phuc Loc Phuong gate rises, causing flooding in Ca Lo River unable to drain.

b. Phan River-Ca Lo River system:

Phan River originates from the Western side of Tam Dao mountainous range, at $150^0 40'$ longitude and $21^0 28'$ latitude, running through Tam Duong, Vinh Tuong, Vinh Yen City, and Yen Lac and confluencing with Ca Lo River at Huong Canh. The length of Phan River from An Ha three-gate sluice in An Hoa Commune, Tam Duong District to the intersection is 64.5 km. The area of the river basin is 347.5 km^2. The basin slope varies from 2.5‰ to 5.3‰. The river flows in different directions and has large meanders with the winding level at 2.7. According to the river topographic survey, the river can be divided into four sections, with the flow changes from Northeast to Southwest (24.4 km), to Northwest to Southeast (15.9 km), and to Southwest-Northeast-Southeast (25.3 km). The elevation of the riverbed varies from +9.60 m ~ +5.00 m ~ +3.00 m. The cross section varies from 20.0 m ~

30.0 m to 50.0 m.

The Phan River from An Ha three-chamber sluice gate to the intersection with Ca Lo Cut River is 73 km long, running across 4 districts, has an area of 395 km^2. The entire Phan River Basin is included within Vinh Phuc province, with an area of 398.5 km^2 (also called Basin B in the WB's report).

Ca Lo River is located downstream of Binh Xuyen river net work and Phan river (see Fig 23 below). Water from the Binh Xuyen river network (basin C) and Phan river (Basin B) flow to Ca Lo River then to Cau River. In the past, Ca Lo River used to be a tributary connecting the Red River to the Cau River. After the gates at the 23-chamber sluice gate to the Red River was ruined (about 100 years), Ca Lo River no longer connects to the Red River. The reach of Ca Lo River from the 23-chamber sluice gate to Thinh Ky is now called the Ca Lo Cut (shortened Ca Lo) River, which receives flows and stores irrigation water for the riparian areas in the southeast part of the project area.

The Ca Lo River section from Thinh Ky to Phuc Loc Phuong is 67km long with an aggregate area of 320.8 km^2, for which 13 km long runs within the Vinh Phuc Province with an area of 311.2 km^2 (from Ca Lo Cut intersection to Xuan Phuong Bridge) (denoted as Basin C in the WB Report). The river originates from the Western side of Tam Dao mountainous range and runs through three districts. To the upstream area are the regulation lakes such as Xa Huong, Lang Ha, Ban Long, Lap Dinh, Thanh Lanh, and Dai Lai and other rivers including Cau Bon, Tranh, Ba Hanh, Dong Do, Ca Lo, and Ca Lo Cut.

Phan-Ca Lo River basin is one of the three flooding diversion areas for Vinh Phuc and has the largest catchment area, accounting for 80% of the drainage catchment of the province, and contains all the rainfalls in an area of 715.8 km^2, representing nearly two third of the natural area of Vinh Phuc Province. This is a collection and drainage area across seven districts in the province, which is the study area of the Project.

In addition, Phan and Ca Lo Rivers also receive water from rivers and streams originated from the Western edge of the Tam Dao range, including Cau Bon, Tranh, Ba Hanh (in Binh Xuyen District), Dong Do (Ha Noi), and Ca Lo Cut rivers. There are lakes in the upstream of these rivers and streams such as Xa Huong, Lang Ha, Ban Long, Lap Dinh, Thanh Lanh, and Dai Lai, etc.

Figure 22. Main river network in the project area

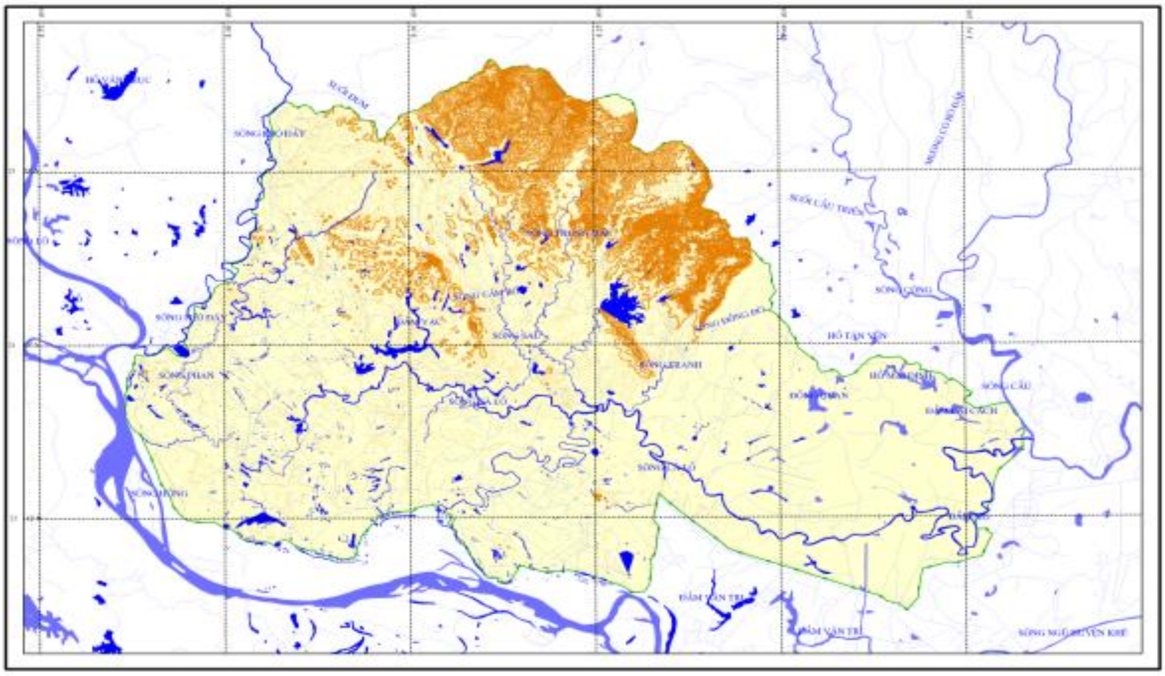


Figure 23. Natural geographical map of Phan-Ca Lo River basin

c. Small tributaries of Phan-Ca Lo Rivers:

- ✓ **Ca Lo Cut:** with the total length of about 25 km; this is a tributary of the Red River, originating from Trung Ha and then confluencing with Ca Lo at Dai Loi Hamlet, Nam Viem Commune. The river is terminated at Van Yen 23-chamber sluice gate.
- ✓ **Cau Bon River:** originated at the elevation of 800 m of Tam Dao Mountain Range. The river is about 22 km long and flows from North to South to Ham Rong Bridge in Tam Hop Commune, then the river changes the direction to Northeast-Southwest to

Tien Huong, Huong Canh Town in Binh Xuyen District, and confluences with Ca Lo River. At Ham Rong Bridge, a branch of Cau Bo River connects to Tranh River at Tranh Bridge and then confluences with Ba Hanh River. The area of Cau Bon basin is 118.7 km^2.

- ✓ **Tranh River*:*** in Binh Xuyen District, originating from Tam Dao Mountain Range at the elevation of 275 m. The river is 21 km long and flows from North to South to Tranh Bridge. A river branch to the West of Tranh River connects to Cau Bon River and other branch flows eastwards to confluence with Ba Hanh River and then to Ca Lo River at Nam Viem. The basin area is 53.43 km^2.
- ✓ **Ba Hanh River*:*** in Binh Xuyen District and Phuc Yen Town. The river is 23.5 km long and the basin area is 80.42 km^2.

Table 17.Summary of river features in the project area

No.	**River**	**Area (km^2)**	**Length (km)**	**Slope (‰)**	**Meandering coefficient**	**From**	**To**
1	Phan	347.5	64.5	0.05÷0.15	>2.5	Three chamber sluice gate	Huong Canh
2	Ca Lo (VP)	72.3	21.7	0.07÷0.25	2.0	-Huong Canh...	Xuan Phuong Bridge
3	Ca Lo Cut		25.12	0.06	>2.0	- Tien Chau …	Nguyet Duc
4	Ton Bridge	135.5	21.0	>0.25	<1.5	Tributary river of Ca Lo	
5	Ba Hanh	94.4	19.5	>0.25	<1.5	Tributary river of Ca Lo	
6	Dong Do	82.9	25.0	>0.25	<1.5	Tributary river of Ca Lo	
7	Ben Tre	72.4*	12.0	0.40	>1.0	- An Hoa, Tam Duong…Vac Lake	

Source: Feasibility Study Report of VPFRWMP

The drainage in the project area is entirely gravity drainage, which depends largely on the water level of Phan and Cau rivers. All of the water in the project area is drained to Vac Lake via Ca Lo River and then to Cau River.

The flow in Phan River is mainly formed due to rainwater and return flow during the irrigation process of Lien Son system. The flow and water level in the dry season are low; however, when there is heavy rain in the basin area, the water level rises quickly and reaches the level (+12 ÷ +13) in the upstream and the middle while it reaches the level (+8.5 ÷ +9.0) in the downstream. In typical flood years such as 1980, the water level at the upstream (Thuy Yen) reached the (+14.30) level, (+12.26) level in Cho Vang, (+10.60) level in Cao Dai, (+9.30) level at Lac Y sluice gate (near Vac Lake mouth) and at (+9.10) level in Huong Canh. With these historic water levels, up to 70% of the cultivation area was inundated and unable to gravity drain. On the other hand, the river was deposited at many sections, affecting the flooding drainage capacity.

3.1.4. Infrastructure Conditions

3.1.4.1. Current status of transportation

Vinh Phuc's transportation network is quite developed with three categories: roads, railways, waterways. The transport system in the province area is distributed reasonably with high traffic density.

- ✓ *Roads*: The urban and rural transports have been upgraded and are supporting trading and economic exchanges within province. The total length of provincial roads is 297.55km; including 103.5km urban roads; in district roads 426km,in district roads; 3.136km in communal roads.
- ✓ *Railway transport:* In the province area, the Ha Noi- Lao Cai railway runs through five (out of nine) administrative units, namely Phuc Yen Town, Binh Xuyen District, Vinh Yen City, Tam Duong District, and Vinh Tuong District with the total length of 35km and five stations, of which the two main stations are Phuc Yen and Vinh Yen. This railway connects the Hanoi Metropolitan via Vinh Phuc, to the midland and mountainous Northern provinces and China.
- ✓ *Waterways*: The province has two major rivers (grade II) which are under the central management: the Red River (30km), and the Lo River (34km). These two rivers are navegated by vehicles with the maximum tonnage of 300 tons. The two local rivers Ca Lo (27km) and Pho Day (32km) which are navigable only during the rainy season serve the vehicles with the maximum tonnage of 50 tons. The province has two ports, namely Vinh Thinh in the Red River, and Nhu Thuy in the Lo River.
- ✓ *In the project area, the current status of transportation is shown in the socioeconomic survey results as follows:* According to the survey results on access roads in the project area, 70.5% of households surveyed said they access through concrete roads; for 8.6% of the households asphalt roads; 7.5% said that the access roads to their houses are earth ones, and 13.5% stated that access roads are made of stones, gravel and bricks. Basins B1 and Component 2, have the highest proportion of earth roads in the project area (21.3% and 8.2% respectively). Most of the communes in the project area have participated in new rural road programs. 100% of roads in the communes that finished the transportation criterion under the program have been asphalted or concreted such as Yen Lap, Kim Xa, Hoang Lau communes in basin B1, Thuong Trung and Tho Tang communes in basin B2.

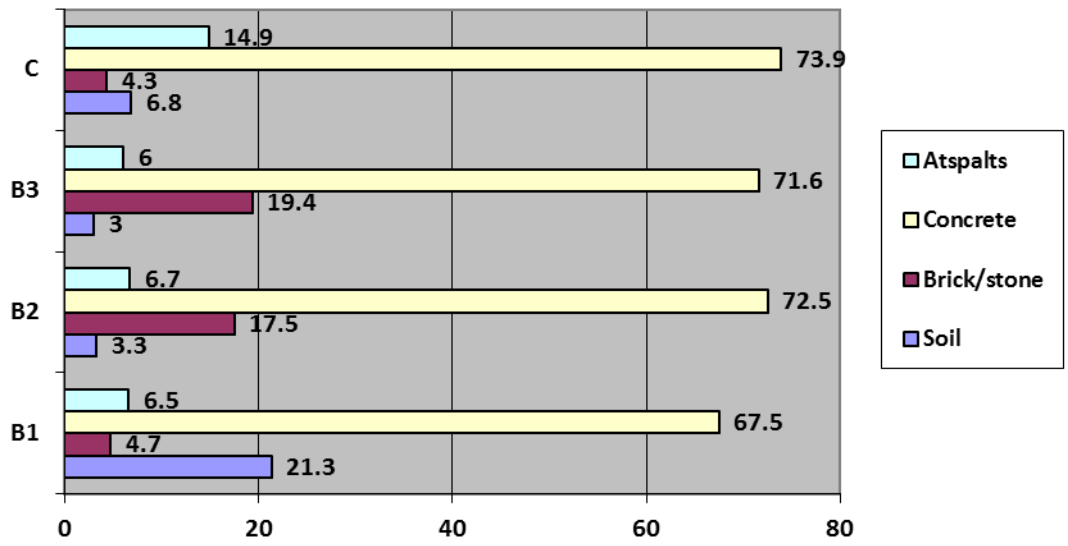


Figure 24. Access roads to households' houses in the project area

Evaluating the survey results on alley roads where the households live showed that: in general, a relatively high proportion (59.1%) of alley roads are in good conditions, as they also confirm for the alley roads in the project basins: B1 (65.1%), Component 2 (63.3%), B2 (59.9%), which are concrete roads. The people surveyed provided the following qualification for their alleys roads:

Table 18. Quality of roads and alleys where the surveyed households live (%)

Quality	**Unit**	**Surveyed basins/sub-basins**					**Total (%)**
		C	**B3**	**B2**	**B1**	**Component 2**	
Good in general	%	55.3	55.2	59.9	65.1	63.3	59.1
Narrow	%	13.7	16.4	17.1	19.5	13.3	16.4
Low road surface	%	29.8	30.6	20.1	25.4	34.7	27.0
Often flooded	%	28.6	19.0	17.5	22.5	24.5	21.3
Rough and difficult to travel	%	12.4	22.4	20.4	26.6	23.5	21.0
Without lighting system	%	85.1	50.4	43.9	59.2	76.5	58.5

(Source: Socioeconomic Survey, 08/2015, N= 965)

The survey result also showed that, when asked about the quality of roads use for accessing local houses, the 21.3% stated that the road is often flooded in the rainy season as well as stagnant by domestic waste due to unavailability of drainage system by the road.

16.4% said the road is narrow; 27% thought the road surface is low; 21% said it is rough and difficult to travel on; 58.5% stated that the road does not have a lighting system. The lighting systems are only installed at main street roads of communes and villages.

3.1.4.2. Water supply status

Recently, Vinh Phuc has been provided with domestic water supply plants namely, the Vinh Yen water supply plant with the capacity of 16,000 m^3 per day and night with 17 drilled wells; the Phuc Yen water supply plant with the capacity of 12,000 m^3 per day and night with five drilled wells, of which, the capacity for industrial production purpose is 3,174 m^3 per day and night. In addition to the above plants, there are small-scale water supply projects in Tam Dao Town (capacity of 5,000 m^3 per day-night), Yen Lac, Lap Thach and Vinh Tuong Town with a capacity of 3,000 m^3 per day-night.

The survey result showed that the water source used mostly by households in the project area is water in drilled wells (accounting for 80.3%), the proportion of households using tap water accounted for only 12.9%. In addition, households using water from dug wells are 6.1%, and only a small proportion of households use rainwater for daily activities. Specific information about water sources used by households is as follows:

Table 19. Coverage of water sources in the project area (%)

Water sources	**Surveyed basins/sub-basins**					**Entire area**
	C	***B3***	***B2***	***B1***	***Component 2***	
Tap water with separate water meters	1.9	9.0	23	0	23.5	11.6
Tap water with shared water meters	0	0.7	4.1	0	0	1.3
Drilled well water	84.5	86.9	72.1	85.2	69.4	80.3
Dug well water	12.4	3.4	0.4	13.6	6.1	6.1
Rainwater	1.2	0	0	0	1.0	0.3
Other sources	0	0	0.4	1.2	0	0.3
Total number of HHs	161	268	269	169	98	965

(Source: Socioeconomic Survey, 08/2015, N= 965)

Currently the water supply plants in Vinh Phuc province provide clean water for households living in Vinh Yen city, communes of Lap Thach, Tam Duong, Yen Lac, Tam Dao districts and some industrial parks located in the province. The project basins entail 7 districts/city but mostly concentrated in the rural communes, so the people have not accessed to tap water, only households in Tho Tang, Ngu Kien (basin B2), Huong Canh (basin B3), Yen Lac (under Component 2) are using tap water. Some households drill wells themselves to obtain water for their daily use. Water from drilled wells is used for drinking, bathing and washing purposes. There are also some households using combined water sources such as rainwater and purchased bottled water to ensure for their use.

When self-assessing the quality of water used by households, 66.3% of them thought that the water they are using is clear and clean; 20.3% of households stated their water is clear but smelly; 8.2% supposed that their water is not clear, colored and smelly.

3.1.4.3. Power supply status

Vinh Phuc is among the provinces located in the region with favorable conditions of power supply from the national power grid. The integrated transmission and distribution system is planned and invested to ensure sufficient supply of power for the development demands of the industrial zones in the province.

The survey result showed that in all the project basins, the people accessed to the national power grid, 97.4% of households used electricity with a separate meter; only 2.6% of households used shared electricity with their neighbor. According to the survey data on power quality in residential areas, only 11.1% stated that power is weak or very weak; 32.2% said that the power is strong enough for their demand and 56.7% said it is normal and acceptable. Overall, no differences in power supply quality are observed between the project basins.

3.1.4.4. Drainage status

a. Current status of drainage facilities

The river, lake, and basin systems in the project area play an important role in storing water for irrigation and drainage when it rains to prevent flooding in the project area. The irrigation and drainage system comprises the followings:

Main drainage axis

Currently, the drainage of the project area entirely depends on the Phan- Ca Lo river system. The only drainage direction is to Cau River at Phuc Loc Phuong. The total length of Phan-Ca Lo River from An Ha three-chamber sluice gate to Phuc Loc Phuong is about 140 km (120km of phan River and 20km of Ca Lo River), while the length of the river in the project area is 64.5 km, with large meandering rate of K $\approx$ 1.8. The width of the river changed from 7m to 15m (at An Ha) and extending toward the downstream from 30m to 50m (the section from the downstream of Lac Y regulator to Huong Canh Bridge is 80m to 100m). Phan River receives sewage of the entire basin B, water flow rate on the Phan River in the rainy season is around (30 - 80) m^3/s, to the downstream - the Ca Lo River, also receives extra water from the Binh Xuyen River system (basin C).

a) Phan- Ca Lo river system is a natural river system and subject to certain impacts in the development process of the project area. According to the survey results on the entire route, there are 102 civil bridges, aqueducts, and sluices etc., in which 76 works are on the Phan River.

Table 20. Total number of works on the major river systems

No.	**River/Reach**	**Total**	**Number of works on the mainstream**	**Number of sluices, major drainage and tributaries**
*	**Total**	**230**	**102**	**128**
1	Phan River	184	76	108
	An Ha- Nghia Lap	*57*	*17*	*40*
	Nghia Lap to Lac Y	*106*	*44*	*62*
	Lac Y to Huong Canh	*21*	*15*	*6*
2	Ca Lo River (Vinh Phuc)	10	6	4
3	Ca Lo Cut River	18	6	12
4	Bnh Xuyen river system	18	14	4
	Cau Bon River	*10*	*6*	*4*
	Chanh River	*5*	*5*	
	Ba Hanh River	*3*	*3*	

Source: Report on Hydraulic Model, Vinh Phuc ODA-PMU, 2015

Through development phases, socioeconomic and infrastructure conditions of the province have undergone several changes. As a result, the existing facilities no longer meet the demands for drainage, causing flooding in several areas in the province.

b) In the total of over 86km of the main drainage system of Phan- Ca Lo Rivers in the project area, only 29km has embankment, including 23km of the Ca Lo river dyke and 6km of Sau Vo dyke on Phan River. The existing dykes are mainly located in the downstream area. In the upstream area of the Phan River to Vinh Yen, there is no completed dyke or embankment system. During heavy rains, the water level in Phan River rises and freely overflows into the low-lying areas, causing flooding. When the water level is low, in many parts, the drainage process is very slow due to inefficiency of the drainage system.

c) Along Phan River, in the densely population areas, encroachment into the river has narrowed down Phan river drainage sections. This issue often occurs in Huong Bridge (Tho Tang), Phan river section from Vinh Son to Vu Di Bridge, etc.

Canal and infield drainage system:

According to the survey data in the entire project area, there are 128 joining points of the drainage flow, drainage culverts of all types from the target area to the mainstream river. The drainage flows are mainly formed by natural drainage channels combined with earthworks and expansion during the process of production development and formation of residential areas and urban centers.

Basic characteristics of the channels and flows are small cross sections. Some sections have been occupied for aquaculture purpose and many local projects tasked to regulate water level for irrigation have been built in various forms, causing bottlenecks and impeding the flow when it rains. The ability to collect water on the mainstream, Phan River, is significantly affected; thereby causing local flooding in the areas when there is heavy rain.

Lake, pond, and swamp system

On the upstream tributaries (basin C) to the West of Tam Dao range, a number of lakes have been developed for regulating water supplies during the dry season and partially regulating flood in the rainy season. Currently, there are six lakes with the capacity of 2.6 million to 25.4 million cubic meters, namely Xa Huong, Lang Ha, Dai Lai, Thanh Lanh, Ban Long and Dinh Lap. However, these lakes have no regulatory capacity for flood control; therefore, the control of flood in the downstream area in heavy rains is limited.

In the downstream area, along Phan River, there are natural lakes such as So Lake with the water surface area above 80 ha (Sub-basin B1), which is currently exploited by local people for aquaculture purpose. The lake is divided into several lots; the regulation capacity is thus reduced and limited while the drainage facilities are not guaranteed. Therefore, flooding water overflows on roads and residential areas when it rains. In the sub-basin B2, there are several lakes and swamps, including Thuong Trung, Tuan Chinh, and Vu Di, etc.; however, the largest is Rung Lake in Ngu Kien, Tu Trung, and Tam Phuc communes with an area of over 120 ha.

In the sub-basin B3, Vac Lake has an area of about 180 ha while Sau Vo Lake has a total area of nearly 1,000 ha. After the construction of Thinh Ky three-chamber sluice gate, Ca Lo Cut River has become natural swamp with an area of 100ha. There are also hundreds of small ponds and swamps in the area.

The total water surface area of the project area is over 5000 ha, of which over 3000 ha is used for aqua farming. The total project surface area of all the lakes under project financing during dry season is 410 ha, i.e. Sau Vo 250 ha, Rung 140 ha, Nhi Hoang 20 ha.

The project plans to finance dreding operation for three lakes, including Sau Vo Lake (176.5 ha of total 295 ha), Rung Lake (30.9 of total 150 ha), and Nhi Hoang Lake (from 22.5 ha total area to an area of 38.5 ha). Of the total water surface area, it is estimated that 180 ha (44%) are currently used by 132 households for aquaculture purpose.

The current aqua-farming is mainly extensive and spontaneous, local people have built their own embankments and cells, thereby, reducing the regulation capacity of the ponds and swamps and significantly affecting the drainage capacity.

Drainage pumping station system

The project area currently has 12 drainage pumping stations of different types. However, the pumping stations were built for local drainage (leading to flooding situation in other areas), and the system is not synchronous (headwork and collecting channel system are not completed) and designed with low assurance level, mainly for agricultural use but not for residential area use. The survey of the actual operation of the pumping stations in the project area shows that in the big floods since 2006, the pumping stations are almost inactive due to unclosed embankment system. The water level in Phan River rises and overflows into the drainage area of the pumping stations, making the drainage pumping ineffective.

b. Survey results of people's assessment of drainage conditions

During the study, the surveyors also combined in-depth interviews and field observation to have the most general assessment on the current situation of water drainage in residential areas. The survey result is recorded as follows:

Table 21. Current status of drainage system in the project area

Drainage status	**Unit**	**Surveyed basins/sub-basins**					**Entire project area**
		C	**B3**	**B2**	**B1**	**Compo-nent 2**	
Drained to combined sewers	%	54.7	62.3	72.9	56.2	55.1	62.2%
Self-absorbed into the ground	%	13.7	10.4	3.7	15.4	8.2	9.7%
Directly drained to rivers/ ponds/ lakes	%	28.6	27.2	23.4	28.4	36.7	27.6%
Others	%	3.1	0	0	0	0	0.5%
Total	No. of HHs	161	268	269	169	98	965

(Source: Socioeconomic Survey, 08/2015, N= 965)

The survey result showed that the sewer system in the project basins is very poor, and only 62.2% of households responded that their waste water is drained into the combined sewer system of the locality. Among them, basin B2 has the most complete sewer system (72.9% of households drained their sewerage into the combined sewer), while the drainage systems in basins C and Component 2 are incomplete and the sewer lines existed mostly on the main roads of villages and hamlets. In the project basins, 27.6% of households directly discharged their waste water into rivers, streams and lakes. These are mainly households living next to Ba Hanh River, Tranh River, Canh River (in basin C), Phan River and households near Sau Vo Lake, Rung Lake. As a result, waste water will pollute the habitat, affecting the households and causing potential outbreak of diseases.

When exploring drainage condition in the project basins, the survey also showed that only 27.3% of the households stated that water drained well in all conditions, up to 57.5% of the households stated that the drainage was poor when it rained heavily; 8.6% reported poor drainage occurred in a light rain and 8.5% responded that the drainage was poor even without rain.

Table 22.Drainage quality in the project basins

Assessment	**Unit**	**Surveyed basins/sub-basins**					**Entire project area**
		C	B3	B2	B1	Component 2	
Drained well in all conditions	%	29.2	24.3	27.8	31.4	23.5	27.3
Drained poorly in heavy rain	%	59.6	57.5	56.1	45.0	61.2	55.6
Drained poorly in	%	7.5	8.2	9.3	7.7	11.2	8.6%

light rain							
Drained poorly under no rain	%	3.7	10.1	6.7	16.0	4.1	8.5
Total	Number	161	268	269	169	98	965

(Source: Socioeconomic Survey, 08/2015, N= 965)

3.1.4.5. Flooding status in the project area

According to annual reports and measured data of Lien Son, Tam Dao, and Phuc Yen IDMCs, flooding situation in the 1990-2014 period in the project are described as follows:

- ✓ Phan - Ca Lo river basin was affected by inundation in 20 out of 25 years, with 1 to 3 times of waterlogging per year;
- ✓ When heavy rains fall, the Phan river level rises, impeding the drainage from the areas. The high water level in Phan River often lasts for several days; particularly, at Sau Vo, the flood level of over 8.0m during November 2009 lasted for 15 days from November 2 to November 17; the flood in August 2013 lasted for 12 days; the flood in July 2007 lasted for 10 days, and the flood in August 2006 lasted for 8 days, etc.
- ✓ The scope of flooded areas includes urban areas of Vinh Yen City and Phuc Yen Town, the industrial zones, especially in Binh Xuyen District, and particularly the low-lying fields and aqua-farming area in the project area. The flooding level at some areas is from 1.8m to 2.5m, inundation in these areas often lasts from 10 to 20 days.

a. Inundated agricultural area:

Winter-spring crop: inundation often occurs at the end of the cropping season when paddy blossoms and fills the grains (25 April to 25 May). In the most severe year, about 3,000ha to 3,500ha were inundated, of which 1,200ha to 1,300 ha were fully lost. In average years, about 1,500ha to 1,700ha were inundated, of which 300ha to 700 ha were fully lost. In the least affected year, about 1,000ha to 1,200ha were inundated, of which 200ha to 500 ha were fully lost. In particular, the inundated areas extended to 15,000ha in October 2008.

Summer-autumn crop: inundation is frequent in July and August, mostly from mid-July to 20 August every year. Therefore, the sowing areas in the summer-autumn crop are about 5,000 ha to 7,000 ha less than those in the winter-spring crop. In 2006, from August 16 to 19, rainfall over 300mm caused inundation on over 11,000 ha of rice, crops, and aquaculture, leading to severe losses for agricultural production in the area. On average, the inundation-affected area is about 8,000ha to 8,500ha.

b. Frequently-flooded areas:

Kim Xa basin (B1): On average, the annually flooded agricultural and residential area due to heavy rains is about 500ha, mostly in the downstream of Vang Bridge to An Ha three-gate sluice. This is low-lying area where the So and Nhi Hoang lakes are located. It is usually grown to only one crop per year.

Ngu Kien basin (B2): The frequently-flooded area is more than 2,000ha, mostly in the drainage area of Cao Dai pumping station, the areas along Phan River in Tho Tang Town, and the areas in the drainage catchment to Nam Yen Lac canal.

Nguyet Duc basin (B3): The frequently-flooded area is over 1,500ha, of which: (i) The low-lying area in the drainage basin of the Sau Vo sluice is mostly affected with more than 1,000 ha of agricultural land is flooded annually. (ii) Vinh Yen City and its neighboring area have about 180ha of frequently-flooded area. Particularly, several residential areas in the city center are usually flooded from 0.2m to 0.5m in heavy rains. Some suburban residential areas including Dam Coi, Quan Tien, Vinh Quang (Thanh Tru), and Lac Y (Dong Tam) are isolated when the flood water in Phan River is high.

Binh Xuyen system (C): The frequently-flooded area is about 1,000 ha. Of which: (i) Cao Minh and Nam Viem communes (in the drainage basin of Dam Lang pumping station) in Phuc Yen Town have a total area of over 300 ha subject to frequent flooding. (ii) Binh Xuyen District: Son Loi Commune has about 200ha subject to frequent flooding. In the area, Binh Xuyen industrial zones and clusters are also affected by annual flooding. The low-lying areas in Ba Hien, Thien Ke, and Tam Hop communes have a total of 300ha that are frequently flooded.

c. People’s assessment of flooding situationin the project area

The survey on flooding situations in the project basins showed that 71.6% of the households responded that flooding occurred in the locality, specifically in basin C (77%), basin B3 (67.5%), basin B2 (71%), basin B1 (76.3%). Component 2 of the project is deployed in the communes of Hop Chau, Ho Son, and Quang Minh under Tam Dao district, which are located in the upstream area of 3 rivers in Binh Xuyen, which suffered less floods than other basins.

Table 23. Flooding situation in the project basins

Flooding situation	**Unit**	**Surveyed basins/sub-basins**					**Total**
		C	B3	B2	B1	Component 2	
Yes	Percent (%)	77.0	67.5	71.0	76.3	67.3	71.6
No	Percent (%)	23.0	32.5	29	23.7	32.7	28.4
Total	No. of HHs	161	268	269	169	98	965

(Source: Socioeconomic Survey, 08/2015, N= 965)

In the project basins, flooding took place frequently during the rainy season. The survey on the time of the floods showed that floods did not take place from January to April. From June onwards, floods tended to appear increasingly, becoming common in July and August (33% - 60.8%) and the most frequent in September (80.8%). Floods occurrence decreased in October, November and December. It can be seen that July, August and September are the months when the households suffer from floods the most. Land area flooded in the basins was mostly agricultural land, so at that time the people could not cultivate in low-lying areas but they were just able to cultivate one spring crop.

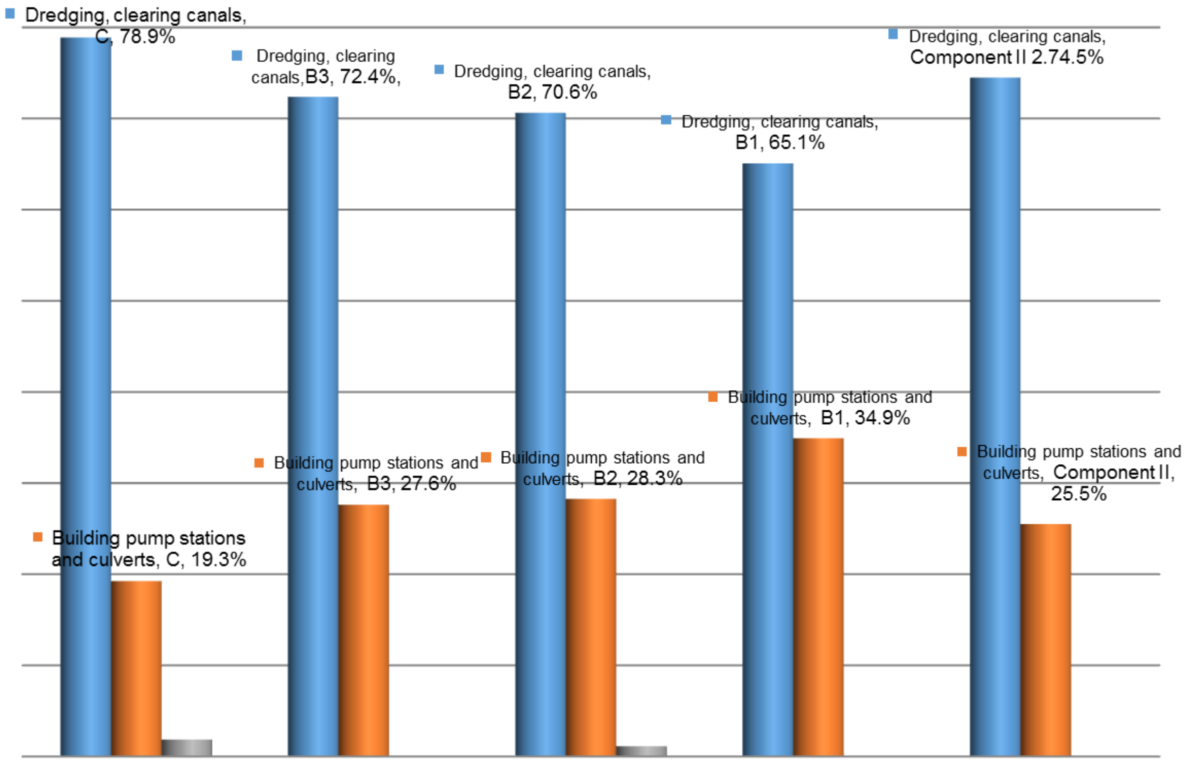


Figure 25. Suggestions of local communities for resolving flooding in the project basins

4.1.4.6. Solid waste collection and treatment

According to the survey results, the solid waste collection and treatment activities in Vinh Phuc are not integrated in fully manner and investments are required. Some urban areas built wastewater collection drains. The facilities are usually small-scale, scattered and local. Even in the larger urban areas such as Vinh Yen City and Phuc Yen Town, to date, there is no wastewater collection and treatment plant. Wastewater is treated locally in the septic tanks of individual households and then discharged directly into the storm-water and wastewater drainage system.

With regards to domestic waste, the province has developed the waste treatment facilities into fertilizer's production. These facilities are located in Thanh Lang Town, Dai Dong Commune, Dong Cuong Commune, and Lap Thach Town. They have been completed and come into operation. The treatment capacity of each facility is 10 tons of organic waste per month.

According to the statistical results, the percent of treated domestic waste in the urban area is 65%, while the percent of treated waste in the rural area is 52%. For industrial and solid wastes, industrial waste treatment is under the responsibility of the enterprises. A large amount of this type of waste is reused as materials and fuels for other sectors while a part is treated simply by burning or burying.

In the project area, the survey result showed that:

- ✓ 85.4% of households stated that wastes are collected daily.

- ✓ In the project basins, the proportions of waste collection on daily basis in Basin C and Component 2 are lowest (72.7% and 72.4%respectively). Most of wards/communes in Basins B1, B2 and B3 satisfied with environmental criteria under the New Rural Development Program; therefore the daily waste collection is performed quite well with the respective proportions at Basin B1, B2 and B3 of 85.2%, 95.2% and 88.1%
- ✓ The fee for waste collection is different in each basin. Each household would pay from 10-20 thousand dong per month on average.
- ✓ In general, households currently using daily waste collection service evaluated the service as "not good" due to several reasons; for example, the collecting staff does not collect wastes at the specified time or schedule.

Table 24. Waste collection status in the project area

Status	**Unit**	**Surveyed basins/sub-basins**					**Entire project area**
		C	**B3**	**B2**	**B1**	**Component 2**	
Yes	Rate (%)	72.7	88.1	95.2	85.2	72.4	85.4
No	Rate (%)	27.3	11.9	4.8	14.8	27.6	14.6
Total	No. of persons	161	268	269	169	98	965

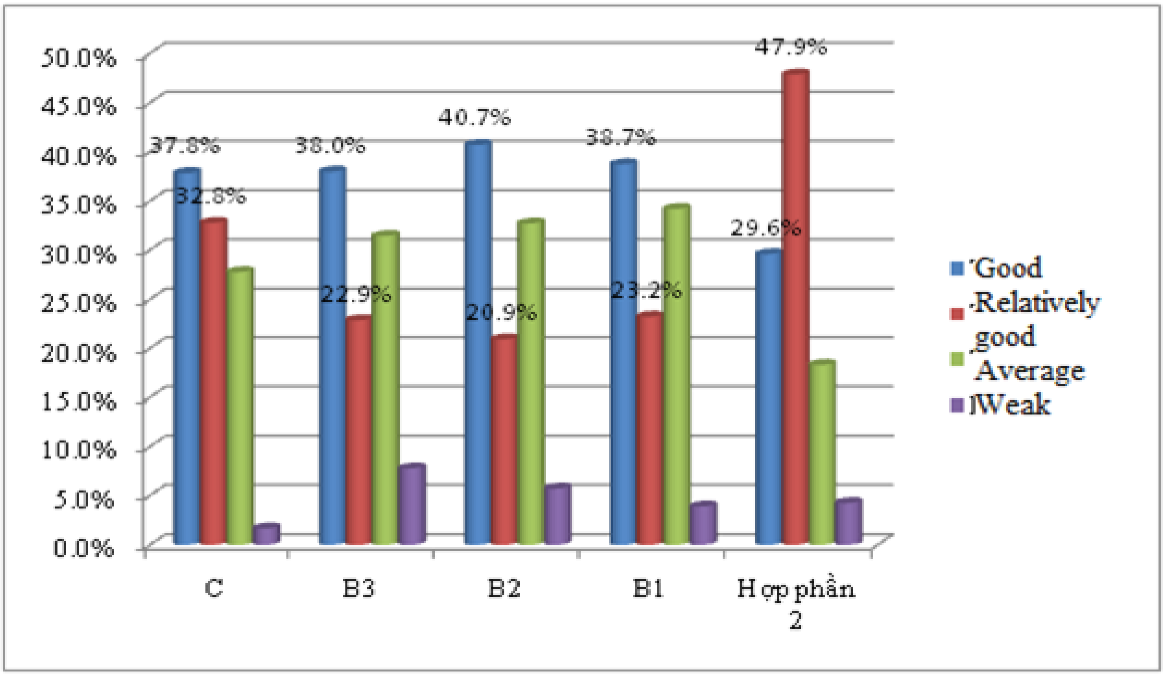


Figure 26.Quality of waste collection services in the project area

(Source: Socioeconomic Survey, 08/2015, N= 965)

In the 4 project basins, about 14.6% of the surveyed households stated that waste is not collected daily. However, in fact, street households are often served by waste collection teams on daily basis, but waste collection for households in alleys encounters many difficulties because the alley roads are undeveloped. Therefore, the households have to find ways to treat their household wastes on their own. The method of burning and burying (53.6%) is most popular. It is generally followed by dumping out to gardens/dug holes (8.3%). Households living near Phan River, Binh Xuyen 3-river system mostly discharge waste directly into these sources (15.5%).

In-depth interviews and group discussions confirmed that waste collection is only good for street households of villages/hamlets. For lanes/alleys remote the main streets, waste is not collected but discharged into river, causing congestion and environmental pollution. Thus, waste can be seen as one of factors causing environmental pollution and affecting the people's health and lives when the waste is not collected properly and at the right place and time.

Environmental pollution

The result showed that 52.1% of households stated that the environment is polluted. Of which, in Basin B1 the 56.8% of the households surveyed confirmed any sources of pollution, followed by Basin B3, 55.2% and Basin C, 42.2%. Especially, in the project basins, 40.6% of households stated that their living environment is severely polluted. The pollution level in the project basins is different, of which the highest pollution level is in Basins B3 and B2 (43.2% and 43.5%, respectively) and it is followed by Basin C, 29.4%. According to these results, in the project basins, environmental pollution is a serious problem and this situation may increase in coming years unless the mitigation measures for environmental pollution are taken.

When exploring the causes of pollution, there were different opinions. Many people stated that polluted living environment is caused by wastewater, garbage and flooding, etc. Of which flooding in rainy season is one of main causes of environmental pollution, accounting for 64.6%. It is followed by stagnant wastewater (41.6%) and uncollected waste (17.9%).

Table 25. Environmental pollution situation

Pollution situation	**Unit**	**Surveyed basins/sub-basins**					**Entire project area**
		C	**B3**	**B2**	**B1**	**Component 2**	
Severe pollution	Rate (%)	29.4	43.2	43.5	41.7	37.7	40.6
Less pollution	Rate (%)	70.6	56.8	56.5	58.3	62.3	59.4
Total	No. of persons	68	148	138	96	53	503

(Source: Socioeconomic Survey, 08/2015, N= 965)

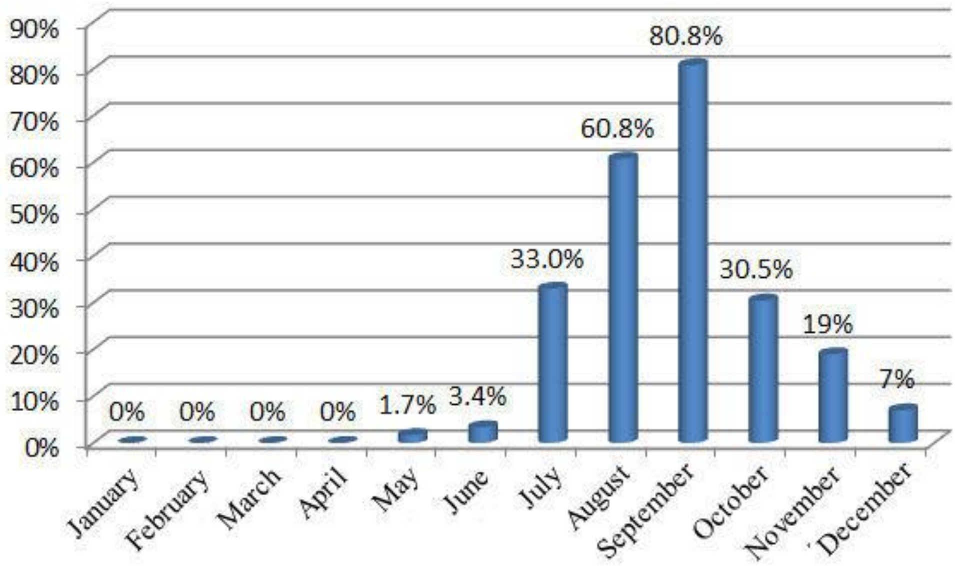


Figure 27.Flooding time in a year

Other reasons for flooding

When exploring the cause of flooding in the project basins, beside the heavy rain reason, another reason also mentioned by the local authorities and people was that the local ditches and canals did not meet the requirement for drainage during the rainy season. Specifically:

- ✓ In basin C, the riverbed of three rivers in Binh Xuyen, namely Ba Hanh, Tranh and Canh, is currently narrowed and accumulated with sediment, especially sections passing the communes of Son Loi, Ba Hien, Thien Ke. As a result, the water drained slowly in the rainy season.
- ✓ Phan River is large and runs through most of the project basins. It plays a very important role in flood relief for the 3 river system in Binh Xuyen as well as B3 and B2 basins. However, this river is now narrowed and accumulated; the riverbed is shallow and contains sediments. As a result, the water drained slowly in the rainy season.
- ✓ B1 basin and eight-gate outfall in Yen Lap commune play an important role in drainage for the entire agricultural area of Yen Lap, Kim Xa, Nghia Hung communes and some communes along Phan River. However, this eight-gate culvert is now degraded, thus does not satisfy the drainage requirement in the rainy season.
- ✓ When collecting ideas of the households on their desire for construction of a drainage system in the project area, 81.7% of households participants stated that the construction should be done immediately; 14.2% expressed that it should be done if conditions permit, only 4.1% stated that construction of the drainage system is not necessary. Accordingly, the desire to renovate the drainage system is not a single group request, but it is a general and shared idea of people in the project basins.
- ✓ With an insight into the suggestions from the community in resolving the flooding situation at the locality, the survey results showed that 71.9% of households stated

that it is required to dredge canals/ ditches and clear stream while 27.5% of households stated that it is required to flood drainage build pumping stations and dam embankments. In the project basins, Basin C has densest rivers, therefore, up to 78.9% of households proposed the method of dredging canals and clearing stream. Measures to resolve flooding in the project basins as proposed by local communities are presented in the table below:

Table 26. Methods for resolving flooding in the project basins

Methods for resolving flooding in the locality	**Unit**	**Surveyed basins/sub-basins**					**Total**
		C	**B3**	**B2**	**B1**	**Component 2**	
Dredging canals, ditches and clearing stream	Rate (%)	78.9	72.4	70.6	65.1	74.5	71.9
Building flood drainage pumping stations and dam embankment	Rate (%)	19.3	27.6	28.3	34.9	25.5	27.5
Other methods	Rate (%)	1.9	0.0	1.1	0.0	0.0	0.6
Total	No. of persons	161	268	269	169	98	965

(Source: Socioeconomic Survey, 08/2015, N= 965)

It can be said that resolving of flooding at the project basins is essential for people living in 7 districts/cities, among others, because it will allow the people to cultivate 2 or 3 seasons per year instead of only one season in low-lying land, thereby improving their living conditions and income of households.

3.2. CURRENT STATUS OF NATURAL ENVIRONMENTAL COMPOSITIONS

In order to assess the current environmental status in the project area, Vinh Phuc ODA PMU has coordinated with the consulting agency to conduct survey, monitoring, and sampling in the project area. Specifically, a total 241 samples were taken, including 62 air samples (31 locations x 2 times (morning and afternoon) = 62 samples); 59 surface water samples; 15 wastewater samples; 25 groundwater samples; 20 soil samples around the dredging area; 31 sediment samples of dredged soil; and 29 surface sediment samples equally distributed among project components. Locations, size, and structure of samples are summarized in the table and map of sampling locations is presented in this report appendix.

The sampling was conducted in August and September 2015.

The process of sampling and preserving samples is done in accordance with the prevailing regulations in the Vietnamese Environmental Standards.

The analysis of environmental monitoring results is based on the current standards and technical regulations of Vietnam, with comparison and reference to the annual monitoring results of the Vinh Phuc Provincial DONRE in order to have accurate evaluations of the quality of baseline environment in the project area.

3.2.1. Surface Water Quality

The surface water environment in the study area is mainly affected by the agricultural production, industrial production, livestock husbandry, and aquaculture activities. In addition, domestic wastewater from the residential areas along Phan River is among key factors affecting the surface water quality in the project area. As stated above, the sampling was conducted in August and September, which was the rainy season of the Northern region; therefore, the concentrations of pollutants in the water were diluted. At other times of the year, the concentrations might be higher.

59 surface water samples were taken, monitored and analyzed, coded from SW1 to SW59 (Appendix 3.1), in the project area. Specifically, 10 surface water samples were taken at the locations of proposed WWTPs; pumping stations (03 samples); lakes to be dredged (10 samples); disposal sites (7 samples); Phan River (26 samples); Yen Lap control gate (01 sample), canal connecting Rung Lake-Phan River (02 samples), and three rivers in Binh Xuyen (Tranh, Ba Hanh, and Cau Bon Rivers) (3 samples). The map of sampling locations is presented in the Appendix 3.4.

The monitoring indicators including pH, DO, TSS, BOD_5, COD, NH_4^+, NO_2^-, NO_3^-,PO_4^{3-}, which are the basic indicators to assess the current status of water environment quality in chemical aspects such as self-cleaning ability, organic contamination level, and mineral contamination level, etc. The analysis results are then referred to the National Technical Regulation QCVN 08:2008/BTNMT on surface water quality, B1 level. The current status of surface water quality in the project area is as follows:

In terms of pH level, the measured pH values range from 6.5 to 7.1, which are within the permissible limits (5.5 to 9.0). This is the range to ensure living environment of the aquatic species.

In terms of dissolved oxygen (DO), 57 out of 59 samples meet the permissible standard, which is not less than 4 mg/l. The highest values were measured in Phan River for the samples coded SW41, SW42, and SW43 in the area of Ton Bridge control gate (Basin C) and near Sau Vo (Sub-basin B3). The highest value is 6.48mg/l (sample SW43 in Phan River, 700 m from Ton Bridge Control Gate to the downstream), which is 1.615 times higher than the standard.

With regards to biochemical oxygen demand (BOD_5), 33 out of 59 samples, accounting for 56% of the total samples, have relatively high BOD5 values, which are 1.01 to 2.82 times higher than the permissible standard.

In Phan River, 12 out of 26 samples exceed the standard value, of which the highest value is measured at Huong Bridge across Phan River in Sub-basin B2 (sample coded SW17), which is 28.13 mg/l, 1,88 times higher than the permissible standard. In Sub-basin B1, three out of eight samples exceed the standard value; those comprise SW1 taken at Kim Xa pumping station area, SW7 at Kim Xa disposal site, and SW8 along the dyke of Pho Day River. In Sub-basin B2, 10 out of 22 samples exceed the standard value, including all of the samples that have highest values taken from Phan River, particularly at the locations SW17 and SW20. For Sub-basin B3, 16 out of 16 samples exceed the standard value; those are mostly in Phan River, from Lac Y to Sat Bridge, and in three towns, namely Yen Lac, Tam Hong, and Huong Canh. The exceeding level of the samples taken at Phan River is rather small with the highest value at 18.24 mg/l (sample coded SW40), which is 1.2 times higher than the permissible standard. All of three towns in Sub-basin B3 have 100% of the samples (eight samples) exceeding the permissible standard. These also comprise the highest values among the total 59 samples. Of which, the highest is measured at Tam Hong Town (B3) at 42.34 mg/l (sample coded SW59 taken from the pond planned to build WWTP in Lam Xuyen hamlet). In Basin C, all of three samples have the values slightly exceeding the permissible standard; of which, the highest is from Ba Hanh River in Ba Hien Commune (SW44) with the value of 16.71 mg/l, which is 1.1 times higher than the standard.

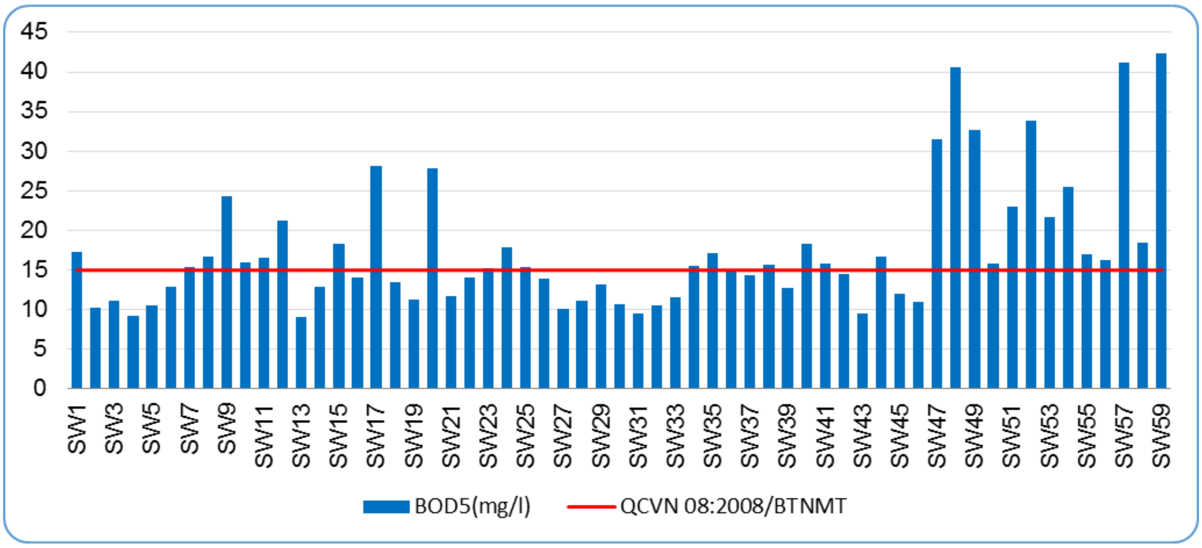


Figure 28. BOD_5 contents in the surface water in the project area

In terms of chemical oxygen demand (COD), 21 out of 59 samples, representing 35.6%, have COD values higher than the permissible standard. Specifically, by basin area, Sub-basin B1 has one out of eight samples, Sub-basin B2 has eight out of 22 samples, Sub-basin B3 has 11 out of 26 samples, and basin C has one out of three samples. However, the exceeding range of the majority of the samples is from 1.01 to 1.88 times higher than the standard. Particularly, only one sample measured at Tam Hong Town reached 132.9 mg/l, which is 4.43 times higher than the permissible standard (sample coded SW57 taken at the pond planned for WWTP in Lung Thuong Hamlet, Tam Hong Town-B3)

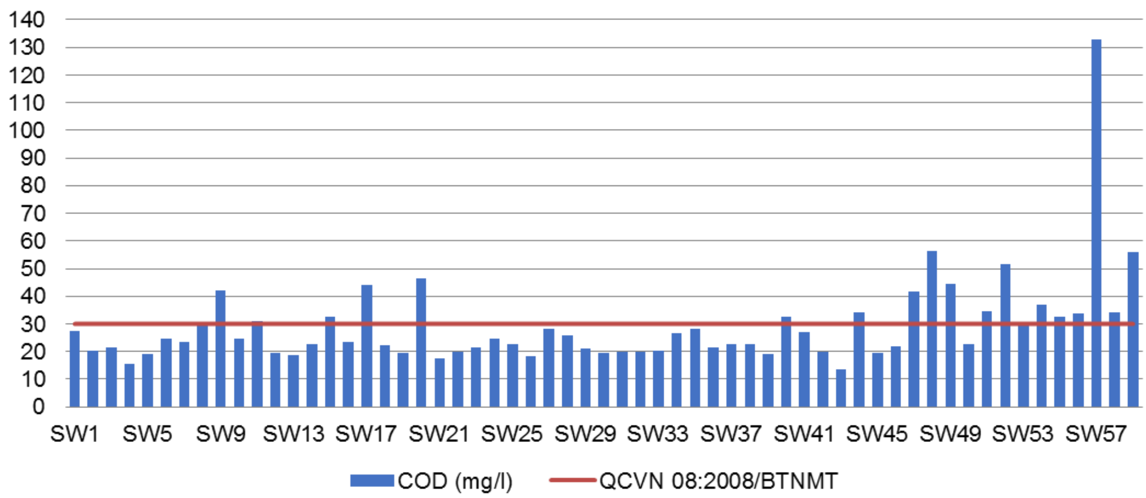


Figure 29. COD contents in the project area

For total suspended solid (TSS) contents, 57 out of 59 analyzed samples have TSS contents from 1.08 to 4.28 times higher than the permissible standard, which indicates that the surface water in the project area has relatively high turbidity. The highest values are measured at Tam Hong Town (Sub-basin B3), Dong Mong disposal site (basin C) and Phan River, the section from Thuong Lap to Lac Y (Sub-basin B2). Nhi Hoang Lake(Sub-basin B1) and Sau Vo Lake (Sub-basin B3) are the areas with lowest TSS contents in the project area.

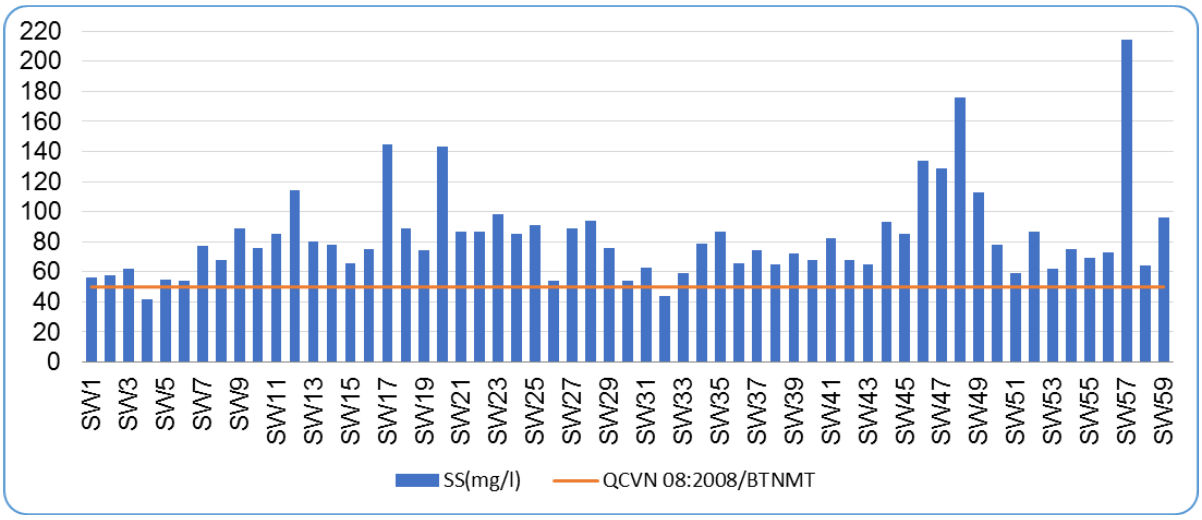


Figure 30. TSS contents in the project area

For water bodies having dredging activities in the project, the analysis results showed that:

+ Nhi Hoang Lake: with 4 samples analyzed, TSS ranging from 42-62 mg/l, with 3 samples higher than QCVN08: 2008/BTNM, B1 column (50 mg/l) from 1.12 to 1.14 times.

+ Rung Lake: With 2 water samples analyzed, turbidity is higher than allowable level 1.7 and 1.52 times.

+ Sau Vo Lake: With 4 samples analyzed, TSS ranging from 44 - 63mg/l and 3 samples are higher than allowable level.

- Phan River: With 15 water samples analyzed along the river from Thuong Lap Bridge to Sat Bridge, all samples have higher levels of TSS than QCVN08:2008/BTNMT, B1 column from 1.08 to 2.28 times.

+ Binh Xuyen Rivers: with 8 samples analyzed, TSS levels ranging between 72 - 134mg/l, 1.3 - 2.68 times higher than permissible level.

With regards to indicators including NH_4^+, NO_2^-, $PO_4^{3-}$and oil/grease, there is a larger number of the samples that have higher values than the permissible standards. Specifically, for NH_4^+,17 out of 59 samples; for NO_2^-,13 out of 59 samples; for PO_4^{3-} 8 samples, and for oil/grease, 31/59 samples have contents higher than standards.

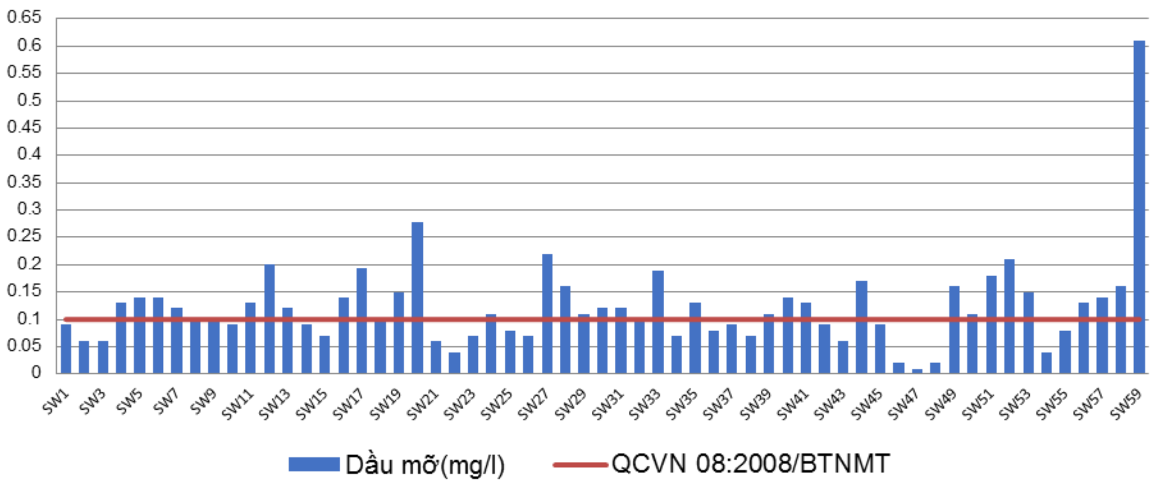


Figure 31. Oil and grease contents in the surface water in the project area

In terms of Coliform indicator, 34/59 samples show higher values than the permissible standard, most of which are in Phan River (from Thuong Lap to Lac Y and Lac Y to Sat Bridge). The highest value is measured at Huong Bridge area (sample coded SW17) across Phan River (B2), which is 31600 MPN/100ml, 4.21 times higher than the permissible standard.

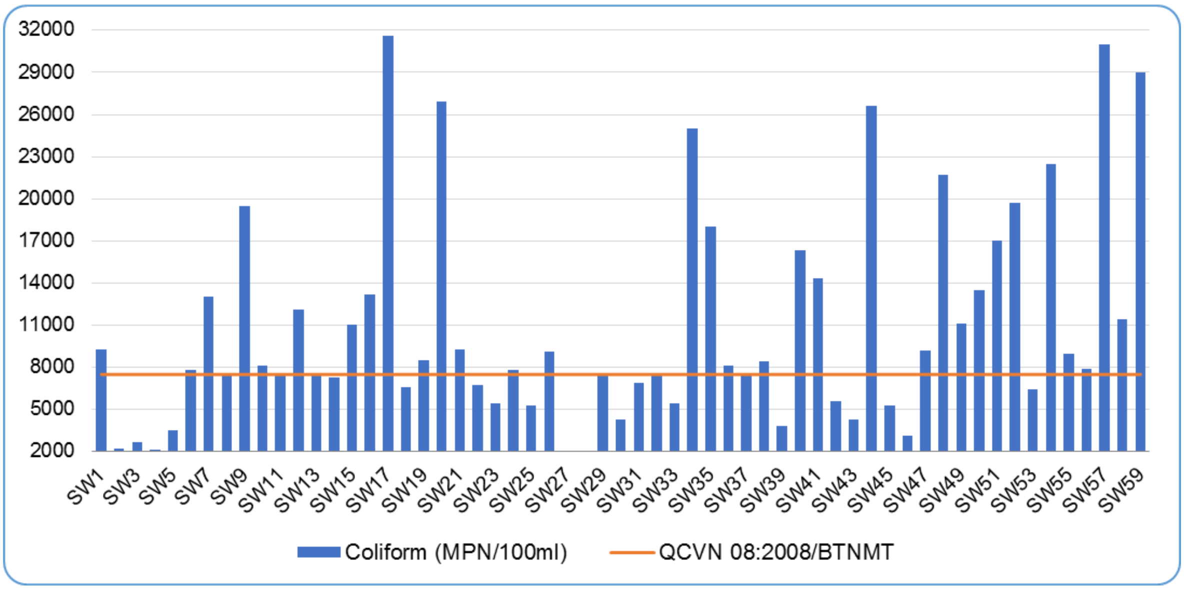


Figure 32. Coliform contents in surface water in the project area

Conclusion:

All parameters, particularly BOD, NH_4^{+}, and coliform, indicate that the surface water in the project area shows signs of contamination of organic matters. In addition, there are COD in Basin B3 at position in the Component 2 (Tam Hong town, Yen Lac district and Huong Canh town).. This result is consistent with the annual surface water quality monitoring results of Vinh Phuc Province as the monitoring results show that most of the water bodies in the area including Phan River, Ca Lo, Pho Day, and lakes such as Rung and Vac, have been contaminated with organic matters such as SS, NH_4^+, oil and grease, and Coliform. Among the water bodies belonging to the project components, samples taken from Phan River usually have the highest concentrations of DO (SW43), BOD, COD, TSS, (SW 17, SW20 - B2), and Coliform (SW17 - B2).

It is also noted that the water quality in the town areas under the Component 2 of the Project has greater sign of pollution than in other areas when most of the pollutant parameters have higher values than permissible standards. Typically, the sample SW57 in Lung Thuong Hamlet in Tam Hong Town (B3) has 10 out of 11 parameters higher than the standards. It can be explained that the samples of the Component 2 are mainly stagnant ponds containing domestic wastewater from the residential areas which are unable to circulate; therefore, organic matters accumulated in these ponds are higher than in the rivers under the Component 1. This also shows that the surface water in the ponds and lakes in the towns under Component 2 has been contaminated due to domestic wastewater and waste from the densely populated areas as well as from the greater trading and services activities than other areas. The results also confirm the project investments (Component 2) in this area are reasonable.

3.2.2. Underground Water Quality

The groundwater quality in the project area is assessed by sampling and analyzing 24 groundwater samples coded from GW1 to GW25. Specifically, 10 samples were taken at the locations in front of and behind five proposed WWTPs or hierarchy pumping stations; 03 samples at the locations of the drainage pumping stations; 03 samples at three lakes to be dredged; 05 samples at the disposal sites; and 04 samples at the locations of the proposed wastewater treatment facilities in the rural residential areas. The details of sampling locations are presented in the Appendix 3.2 of this report. All of the groundwater samples are mainly taken from the drilled wells of the households located in or close to the areas where the project components are located. Map of the sampling locations and results of groundwater quality analysis are summarized in the Appendix 3.6 and 4.4 of this report.

The results of groundwater quality analysis at the Appendix 4.4 show that the groundwater has good quality and meets the domestic water supply standards for the residential areas. In fact, groundwater is used by the majority of the households in the project area. Accordingly, most of the groundwater samples have pH, TS, hardness, DO, NH_4^+, NO_3^-, SO_4^{2-}, As, Mn, Fe, Cl^- and Coliform concentrations lower than the permissible limits as stipulated in the National Technical Regulation QCVN 09:2008/BTNMT.

Referring to this National Technical Regulation, only four out of 25 groundwater samples, namely GW7 at Nguyet Duc pumping station (B1), GW15 at Yen Lac Town (B3), GW18 and GW19 at Tho Tang Town (B2), have $NH4^+$concentrations higher than the permissible standards. These are 1.25, 1.01, 1.31, and 1.75 times higher than the standards respectively.

Three out of 25 groundwater samples at Nhi Hoang Lake in Hoang Lau Commune (GW2-B1), Huong Canh Town (GW10-B3), and Yen Lac Town (GW15-B3) are contaminated with pathogenic microorganisms with the respective Coliform concentrations at 4, 7, and 6 MPN/100ml, which are 1.33, 2.33, and 2 times higher than the permissible standard in the Technical Regulation QCVN 09:2008/BTNMT.

3.2.3. Wastewater Quality

The Component 2- Water Environment Management of the Project will support the construction of wastewater collection and treatment system in the towns including Huong Canh, Yen Lac, Tam Hong, and Tho Tang, as well as at 33 locations scattered in the villages/hamlets/rural residential areas along Phan River. Therefore, the monitoring and analysis of domestic wastewater quality of these towns and rural residential areas are necessary and will serve as the basis to suggest appropriate treatment technologies to improve the quality of water environment in the area.

The locations of the wastewater sampling are described in the Appendix 3.2 of this report. Accordingly, 15 wastewater samples were taken at Huong Canh Town (B3-2 samples), Yen Lac Town (B3-2 samples), Tam Hong Town (B3-3 samples), and Tho Tang Town (B2-2 samples) and in five communes in Sub-basin B1, namely Lung Hoa, Cao Dai, Binh Duong, Yen Lap, and Hoang Lau (1 sample in each commune). The indicators for analyzing wastewater samples include the following 18 indicators: pH, H_2S, TSS, COD, BOD_5, NO_2, NO_3, Cu, Pb, Fe, Cd, Mn, SO_4^{2-}, Cr (VI), As, Hg, E.coli, and Coliform.

The monitoring and analysis results show that wastewater is contaminated with organic matters and microorganisms when 100% of the samples have TSS, BOD_5 and Colifom concentrations higher than the permissible standards as stipulated in the Technical Regulation QCVN 14:2008/BTNMT (Column B). Of which, the highest TSS concentration is 408.7 mg/l, which is 4.1 times higher than the standard (WW2 sample, Huong Canh, B3); the highest BOD_5concentration is measured at 146 mg/l, which is 2.92 times higher than the standard (sample coded WW7, Tho Tang Town, B2); and the highest Coliform concentration is 5.35 times higher than the permissible limit (sample coded WW2, Huong Canh Town, B3).

3.2.4. Air Quality

To evaluate the quality of ambient air in the project area, the locations of the air quality monitoring are identified based on proposed work items classified by components and basin B (including three sub-basins, which are Kim Xa, Ngu Kien, and Nguyet Duc) as well as basin C. Accordingly, 31 locations (Appendix 3.2 and 3.3) were identified including pumping stations (3 locations), WWTPs (10 locations), lakes to be dredged (6 locations), disposal sites (3 locations), and Phan River (9 locations). At each location, monitoring was conducted in two different times, in the morning and in the afternoon, with the average monitoring duration of one hour. The results of ambient air quality monitoring and analysis are presented in the Appendix 4.1 of this report.

The results show that at all surveyed locations, the quality of ambient air is quite good with the concentrations of CO, NO_2, SO_2 and HC much lower than the limits as stipulated in the Technical Regulations QCVN 05:2013/BTNMT and QCVN 06:2009/BTNMT. None of the samples shows sign of contamination with these toxic substances.

According to the Technical Regulation QCVN 26:2010/BTNMT on noise, for the common areas, from 6 AM to 9 PM, the limit is 70 dBA. In comparison with the noise standard, all of the measured locations have noise levels lower than the limit. The highest noise level is measured at 63.1 dBA. With regards to temperature, humidity as well as wind speed, there is currently no national technical regulation on these parameters. However, from the analysis results, it is notable that at the monitoring time, the temperature in the project area was relatively high, ranging from 26.1 to 31.7^{0}C with high humidity level (on average 72%) and weak wind speed.

Compared with the 2014 monitoring results by Vinh Phuc DONRE, there are small differences when four out of 18 monitoring locations in rainy season have suspended dust concentrations from 1 to 1.5 times higher than the permissible standards. These comprise the following locations: KK14 in Dong Hamlet, Khai Quang Ward, Vinh Yen City, KK15 in Ngoc Thanh Commune, Phuc Yen Town, KK17 in Tao Phu, Tam Hong Commune, Yen Lac District, and KK18 in Thuong Hamlet, Tuan Chinh Commune, Vinh Tuong District. The main reason for suspended dust contamination is due to emissions generated from transportation activities.

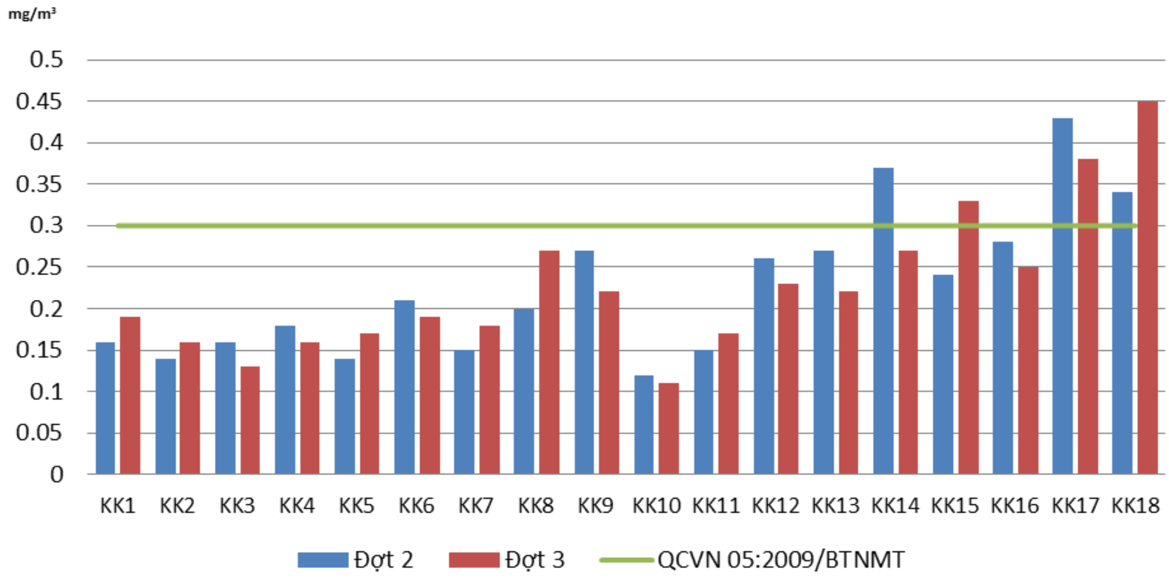


Figure 33. Suspended dust monitoring in the project area

The analysis and comparison results above can be used to assess that the ambient air quality in the project area is not polluted, ensuring safety for people living nearby as well as the workers when the project is implemented.

3.2.5. Current Status of Soil Quality Surrounding the Construction Sites

The civil works of the Project will involve excavation, leveling, and transportation, which will cause certain impacts on the soil quality in the project area. 20 soil samples were taken and coded from S1 to S20 in the project area in order to assess the quality of soil environment surrounding the project construction sites, which will serve as the basis to evaluate the impacts caused by construction activities on the soil environment quality, if any.

Soil samples were taken using mixed method and by depth levels from 0 cm to 35 cm. The number of soil samples corresponding to each work item/component of the project are as follows: 10 samples at the locations of proposed WWTPs, 3 samples at the locations of the pumping stations, 3 samples at the areas near Sau Vo, Rung, So, and Nhi Hoang lakes, and 4 samples at the disposal sites. The sampling locations are presented in more details in the Appendix 3.2 and 3.7.

The parameters analyzed to assess the soil quality in the project area include heavy metals parameters (Cd, As, Zn, Hg, Cr(VI), Fe, Pb, Cu) and plant protection chemicals/pesticides in the form of organic chlorines (DDT and DDD). The results of soil quality analysis are summarized in the **Table 27**. The results are compared and referred to the National Technical Regulation QCVN 03:2008/BTNMT on permissible limits of heavy metals in soil and Regulation QCVN 04:2008/BTNMT on pesticide residuals in soil.

Table 27. Analysis results of soil quality around the construction sites

Work items/ Components	**Sample codes**	**Basin/ Sub-basins**	**Cd** *(mg/kg)*	**As** *(mg/kg)*	**Zn** *(mg/kg)*	**Hg** *(mg/kg)*	**Cr(VI)** *(mg/kg)*	**Fe** *(mg/kg)*	**Pb** *(mg/kg)*	**Cu** *(mg/kg)*	**DDT** *(µg/kg)*	**DDD** *(µg/kg)*
QCVN 03:2008/BTNMT	Agricultural land		*2.000*	*12.000*	*200.000*	-	-	-	*70.000*	*50.000*	-	-
	Residential soil		*5.000*	*12.000*	*200.000*	-	-	-	*120.000*	*70.000*	-	-
QCVN 04:2008/BTNMT			-	-	-	-	-	-	-	-	*0.010*	*0.010*
Kim Xa pumping station	S1	B1	0.932	4.913	93.122	0.093	1.360	79.150	39.129	43.182	0.006	0.009
Nhi Hoang and So Lakes	S2		0.019	3.621	67.204	0.006	0.452	102.114	28.193	36.799	0.002	0.004
Kim Xa disposal site	S3		0.193	5.122	76.134	0.106	0.740	83.019	37.019	37.303	KPH	0.002
Ngu Kien pumping station	S4	B2	0.070	3.259	88.215	0.077	0.416	76.750	19.085	25.139	KPH	KPH
Rung Lake	S5		0.275	3.976	114.023	0.032	1.282	81.973	27.139	31.687	0.001	0.002
Vinh Ninh	S6		0.419	2.980	65.349	0.138	1.049	117.036	41.018	70.191	0.002	0.005
Nguyet Duc pumping station	S7	B3	0.172	4.102	124.741	0.124	1.095	142.015	36.200	54.035	0.003	0.004
Sau Vo Lake	S8		0.130	3.618	91.070	0.006	0.570	84.064	27.034	38.313	KPH	0.002
Dong Mong	S9		0.088	3.136	109.339	0.004	0.913	70.159	32.910	61.097	KPH	<0.001
	S10		0.104	2.918	93.018	0.002	0.788	81.037	18.377	49.302	KPH	<0.001
Huong Canh Town	S11		0.215	3.727	147.215	0.093	1.068	152.971	29.184	33.176	0.001	0.004
	S12		0.338	4.105	68.901	0.028	2.619	63.797	36.076	84.418	KPH	0.003
Yen Lac Town	S13		1.206	6.197	133.111	0.273	2.533	96.015	41.030	113.019	0.013	0.019

Work items/ Components	**Sample codes**	**Basin/ Sub-basins**	**Cd** ***(mg/kg)***	**As** ***(mg/kg)***	**Zn** ***(mg/kg)***	**Hg** ***(mg/kg)***	**Cr(VI)** ***(mg/kg)***	**Fe** ***(mg/kg)***	**Pb** ***(mg/kg)***	**Cu** ***(mg/kg)***	**DDT** ***(µg/kg)***	**DDD** ***(µg/kg)***
QCVN 03:2008/BTNMT	Agricultural land		*2.000*	*12.000*	*200.000*	-	-	-	*70.000*	*50.000*	-	-
	Residential soil		*5.000*	*12.000*	*200.000*	-	-	-	*120.000*	*70.000*	-	-
	S14		0.893	4.323	60.272	0.078	1.832	75.833	30.712	68.035	0.006	0.009
	S15		1.017	5.138	77.860	0.272	2.109	109.191	37.098	72.136	0.007	0.012
Tho Tang Town	S16	B2	0.750	5.918	122.017	0.160	2.761	127.013	39.728	80.972	0.004	0.006
	S17		0.372	3.182	65.793	0.098	1.974	85.202	40.781	71.031	0.002	0.007
Tam Hong Town	S18	B3	0.306	4.070	98.175	0.071	1.937	104.351	39.600	80.323	KPH	0.003
	S19		0.391	3.018	139.026	0.137	2.860	68.930	35.111	45.090	0.002	0.005
	S20		0.272	3.799	67.137	0.141	1.329	77.994	29.096	77.203	KPH	0.004

Compared with the standards as stipulated in the Technical Regulation QCVN 03:2008/BTNMT, the monitoring results show that the concentrations of Pb, Zn, As, and Cd in all of the 20 samples are lower than the permissible limits. Except for Cu concentration which is rather high as eight out of 20 samples have higher concentrations than the permissible standards for residential soil and 11 out of 20 samples have higher concentrations for agricultural soil, mainly in Yen Lac, Tam Hong, Huong Canh (B3), and Tho Tang (B3) towns. As these areas are used for intensive farming of rain-fed crops, the use of chemical fertilizers and pesticides is quite high. The highest value is measured at 113.02 mg/kg in Huong Canh Town (S13 - B3), which is 2.26 times higher than the standard for agricultural land and 1.61 times higher than the standard for residential land.

Ngu Kien pumping station, Kim Xa disposal site, Sau Vo Lake, Dong Mong, Huong Canh, and Tam Hong towns are the areas with the lowest pesticide residuals (DDT and DDD). Most of the soil samples in these areas are not contaminated or contain a small amount less than 0.001 μg/kg. Yen Lac Town is the only area where two out of four samples (S13 and S15-B3) have higher concentrations than the permissible limits. However, the concentrations are not much higher, from 1.2 to 1.9 times higher than the permissible standards.

3.2.6. Current Status of Dredged Materials

The Project requires dredging of sediments in Phan River, Binh Xuyen river network, Rung Lake, Sau Vo Lake, and Nhi Hoang Lake. In addition, at the construction areas of the proposed pumping stations and WWTPs, the construction process also requires the removal of surface sediments (sludge) and underlying soil layers. These materials after being dredged will be transported to Kim Xa, and Dong Mong disposal sites. Therefore, in order to assess the impacts of these dredged materials on the environment during the process of dredging and disposing into the respective disposal sites, the analysis and evaluation of the materials quality are necessary. Two types of sediment samples were taken in the area, which are surface sludge (removal of organic sludge layer) and dredged soil (sediments to be removed to a certain depth that requires dredging). The specific analysis results are as follows:

a. Regarding dredged soil

The construction of WWTPs, disposal sites and dredging of lakes and Phan River will produce a large volume of sludge and spoil (sediments); therefore, 31 samples, coded from SE1 to SE31 (Table 28), are proposed for analyzing to assess the contamination levels, which will serve as the basis for the reuse of this amount of sediments for agricultural and site leveling purposes or for safe and suitable treatment/disposal plans. The sediment samples were taken from surface layer to the depth required for dredging (about 0.5 m to 1 m); except for the disposal sites where samples need to be taken to a depth of 2 m.

Table 28. Analysis results of dredged soil quality in the project area

Work items/ Components	**Basin/ Sub-basins**	**Sample codes**	**pH_{KCl}**	**Cd** (mg/kg)	**As** (mg/kg)	**Zn** (mg/kg)	**Cr(VI)** (mg/kg)	**Hg** (mg/kg)	**Fe** (mg/kg)	**Pb** (mg/kg)	**Cu** (mg/kg)	**DDT** (µg/kg)	**DDD** (µg/kg)
QCVN 43:2012/BTNMT on sediment quality			-	3.5	17.0	315	-	0.5	-	91.300	197.0	4.8	8.5
QCVN 03:2008/BTNMT for agricultural land			-	2	12	200	-	-	-	70	50	-	-
QCCVN 07: 2009/BTNMT on hazardous waste thresholds			-	10	40	5000	100	4	-	300	-	20	20
Dredging of Nhi Hoang Lake	B1	SE1	6.2	0.632	0.938	41.124	0.530	0.013	45.12	23.732	20.813	0.013	0.097
Kim Xa disposal site		SE2	7.1	0.581	0.823	65.780	0.512	KPH	47.92	16.648	16.703	0.007	0.130
Rung Lake	B2	SE3	6.8	0.971	1.695	112.306	0.871	0.036	39.18	21.140	39.714	0.015	0.002
(Thuong Lap to Lac Y)		SE4	6.5	1.173	2.872	189.671	0.623	0.012	50.71	34.201	49.731	0.201	1.103
		SE5	6.3	1.039	3.134	164.920	0.876	0.005	57.13	31.092	38.672	0.098	0.791
		SE6	5.9	3.792	5.738	339.861	6.280	0.320	123.59	94.180	216.710	0.019	0.064
		SE7	6.2	0.891	4.108	98.410	1.210	0.017	99.34	42.870	58.182	0.047	0.219
		SE8	6.8	0.773	3.612	60.723	0.931	0.004	49.72	37.833	39.019	0.094	0.763
Sau Vo Lake	B3	SE10	6.4	0.730	1.893	110.731	0.484	0.008	44.18	28.092	37.164	0.043	0.142
(Lac Y to)		SE11	6.3	0.762	2.075	83.621	0.780	0.019	51.09	31.074	50.137	0.091	0.350
		SE12	6.7	1.004	2.717	176.109	0.656	0.006	64.12	36.009	61.370	0.073	0.192
		SE13	6.5	1.670	3.903	188.370	1.038	0.005	73.77	42.086	78.190	0.296	0.893
		SE14	6.4	0.739	1.658	63.514	0.323	KPH	50.12	39.072	39.120	KHP	KHP
Dong Mong		SE15	6.6	0.635	1.012	76.094	0.642	0.002	47.91	27.081	41.018	0.061	0.007
River network in Binh Xuyen	C	SE16	6.1	0.713	1.930	98.103	0.397	0.001	49.36	30.132	36.153	KHP	0.003
		SE17	6.2	0.865	2.076	76.327	0.471	KPH	39.33	34.709	29.313	KHP	0.017
		SE18	6.0	0.808	2.137	85.656	0.532	0.002	42.19	30.028	40.181	KPH	0.024
		SE19	6.1	0.679	2.043	79.137	0.519	0.001	53.20	36.134	36.904	0.033	0.163
		SE20	6.2	0.832	2.136	88.101	0.477	0.003	37.31	37.090	28.173	KHP	0.009
		SE21	6.2	0.796	2.202	96.610	0.391	0.001	56.19	29.086	20.119	KHP	0.015
Huong Canh Town	B3	SE22	6.4	2.014	2.178	193.181	0.833	0.103	102.09	57.012	93.671	0.011	0.004
		SE23	6.8	1.022	1.013	89.402	0.631	0.005	47.96	39.140	45.217	KPH	0.001
Yen Lac Town		SE24	6.3	1.860	1.139	134.185	1.272	0.009	63.12	63.038	46.138	2.012	1.017

Work items/ Components	Basin/ Sub-basins	Sample codes	pH_{KCl}	Cd (mg/kg)	As (mg/kg)	Zn (mg/kg)	Cr(VI) (mg/kg)	Hg (mg/kg)	Fe (mg/kg)	Pb (mg/kg)	Cu (mg/kg)	DDT (µg/kg)	DDD (µg/kg)
QCVN 43:2012/BTNMT on sediment quality			-	3.5	17.0	315	-	0.5	-	91.300	197.0	4.8	8.5
QCVN 03:2008/BTNMT for agricultural land			-	2	12	200	-	-	-	70	50	-	-
QCCVN 07: 2009/BTNMT on hazardous waste thresholds			-	10	40	5000	100	4	-	300	-	20	20
		SE25	6.5	1.734	2.018	172.193	1.685	0.012	67.94	59.179	49.615	1.793	1.008
		SE26	6.2	0.912	1.913	146.182	0.724	KPH	50.59	32.190	32.188	0.214	0.072
Tho Tang Town	B2	SE27	7.0	1.401	0.876	111.792	0.973	0.006	51.73	41.033	40.011	0.022	0.108
		SE28	6.7	0.930	1.068	132.079	0.555	0.004	42.66	36.198	29.136	0.018	0.097
Tam Hong Town	B3	SE29	6.7	2.351	2.091	188.515	0.923	0.003	71.18	51.010	79.112	0.090	0.272
		SE30	6.2	0.913	2.134	129.916	0.461	KPH	63.03	34.030	23.108	KPH	KPH
		SE31	5.8	1.038	1.785	176.510	0.730	0.004	49.18	29.185	30.902	KHP	0.004

The number of soil sampling locations in the project area is as follows: 10 samples were taken at the locations of proposed WWTPs; 3 samples at the locations of lake dredging; 3 samples at the proposed disposal sites; 9 samples at Phan River area; and 6 samples at Binh Xuyen river system area. The locations of sediment sampling are described in more details in the Appendix 3.2 and 4.6 of this report. The analysis parameters to assess the quality of sediments in the project area include the following 11 parameters: pH_{KCl}, some heavy metals (Cd, As, Zn, Hg, Cr (VI), Fe, Pb, and Cu) and pesticides (DDT and DDD).

The analysis results of dredged soil samples are compared with the standards stipulated in the National Technical Regulations QCVN 43:2012/BTNMT on sediment quality, QCVN 03:2008/BTNMT on permissible limits of heavy metals in soil, and QCVN 07: 2009/BTNMT on hazardous waste thresholds.

Referred to the National Technical Regulation QCVN 07: 2009/BTNMT on hazardous waste thresholds, the analysis results show that all of the parameters of the samples are within the permissible limits.

When compared with the National Technical Regulation QCVN 43:2012/BTNMT on sediment quality, in general, most of the parameters of all 31 samples meet the standards. However, only one sample, which is SE6 at Gia Bang Bridge across Phan River (B2), has four parameters that have concentrations slightly higher than the permissible limits. These are Cd, Zn, Pb and Cu, which are 1.08 times, 1.09 times, 1.03 times, and 1.1 times higher than the standards, respectively.

Compared to the National Technical Regulation QCVN 03:2008/BTNMT on permissible limits of heavy metals in soil, 24 out of 31 samples meet the standards while 07 samples exceed the permissible limits. Specifically, five samples in Phan River (B2, B3); one sample in Huong Canh Town(B3), and one sample in Tam Hong Town (B3) have Cd, Cu, Zn, and Pb concentrations higher than the permissible limits. Of five samples from Phan River, the most notable is sample coded SE6 (B2) at Gia Bang Bridge, of which Cd, Zn, Pb and Cu concentrations are 1.9, 1.09, 1.35, and 4.33 times higher than limits respectively. In Lung Thuong Hamlet, Tam Hong Town, the sample SE29 (B3) has Cd, Zn and Cu concentrations which are 1.18, 1.09, and 1.58 times higher than permissible limits.

However, when being compared to the permissible limits for commercial land, all seven samples are still within the limits. Therefore, dredged soil from these areas will not be disposed at Kim Xa (B1) site which can be used for agricultural production purposes when being handed over to the local authorities. Instead, this amount of dredged soil will be gathered at Dong Mong disposal site (B3) which will be developed into a district administrative center when the project is completed.

b. Concerning surface sludge sediment

The analysis results of the surface sludge sediment samples in the project area are presented in the 3.19. The sampling locations are presented in more details in the Appendix 3.2 and 3.6. The results are compared with the permissible limits as stipulated in the (i) National Technical Regulation QCVN 07: 2009/BTNMT on hazardous waste thresholds; (ii) National Technical Regulation QCVN 43:2012/BTNMT on sediment quality; and (iii) National Technical Regulation QCVN 03:2008/BTNMT on permissible limits of heavy metals in soil.

Table 29. Analysis results of surface sludge sediments in the project area

Work items/Components	Basin/ Sub-basin	Sample codes	pH	Cd	As	Zn	Cr(VI)	Hg	Fe	Pb	Cu	DDT	DDD
				mg/kg	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*µg/kg*	*µg/kg*
QCVN 43:2012/BTNMT on sediment quality				3.5	17.0	315	-	0.5	-	91.300	197.0	4.8	8.5
QCVN 03:2008/BTNMT on permissible limits of heavy metals in soil (for agriculture)				2	12	200	-	-	-	70	50	-	-
QCCVN 07: 2009/BTNMT on hazardous waste thresholds				10	40	5000	100	4	-	300	-	20	20
Phan River	B2	MS1	6.38	1.894	4.913	149.186	1.274	0.035	116.93	48.172	47.518	0.639	1.240
		MS2	6.42	1.419	2.103	114.356	1.505	0.069	173.91	36.103	34.219	0.533	1.206
		MS3	5.96	2.391	4.133	152.380	2.471	0.214	334.18	56.750	63.632	0.044	0.515
		MS4	6.37	1.135	2.096	139.838	1.012	0.039	95.75	51.030	32.172	0.063	0.818
		MS5	6.43	0.943	2.351	103.912	1.353	0.011	174.17	50.242	36.205	0.441	1.033
		MS6	6.07	0.922	2.375	167.403	1.036	0.021	109.18	43.155	41.253	0.175	0.809
		MS7	5.49	3.381	8.018	238.730	7.120	0.392	516.44	116.781	207.360	0.473	1.237
		MS8	6.20	1.849	4.094	137.580	2.630	0.108	213.39	58.210	65.402	0.172	1.316
		MS9	6.32	1.373	3.723	76.805	1.024	0.018	88.29	54.133	45.873	0.139	0.740
	B3	MS10	6.01	1.368	2.209	72.191	1.242	0.021	73.98	49.028	33.188	0.098	0.805
		MS11	6.18	0.739	2.915	71.044	1.552	0.018	186.22	58.402	46.793	0.715	1.227
		MS12	6.27	1.066	2.868	94.932	1.731	0.015	99.82	43.806	41.013	0.111	0.573
		MS13	5.59	1.718	3.016	195.710	1.933	0.207	145.87	61.034	57.019	0.083	0.499
Dong Mong	B3	MS14	6.42	0.853	2.913	89.515	0.787	0.016	55.73	33.268	43.175	0.092	0.138
Three rivers in Binh Xuyen	C	MS15	5.74	0.726	3.077	135.122	1.089	0.009	110.73	35.194	41.019	0.055	0.094
		MS16	6.23	0.958	2.121	98.073	0.997	0.005	97.81	41.034	30.812	0.117	0.842

Work items/Components	Basin/ Sub-basin	Sample codes	pH	Cd	As	Zn	Cr(VI)	Hg	Fe	Pb	Cu	DDT	DDD
				mg/kg	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*µg/kg*	*µg/kg*
		MS17	5.94	0.943	2.783	84.772	1.202	0.009	103.18	37.391	32.056	0.040	0.058
		MS18	5.78	0.891	2.196	98.398	1.139	0.010	145.93	38.170	37.134	0.078	0.760
		MS19	6.07	0.932	2.399	89.691	0.970	0.017	91.82	43.038	29.093	0.037	0.108
		MS20	6.19	0.888	3.760	114.085	0.786	0.007	131.09	47.333	34.765	0.072	0.186
Huong Canh WWTP	B3	MS21	5.57	2.277	2.767	206.123	1.306	0.191	158.79	65.177	59.038	0.134	0.558
		MS22	6.53	1.769	1.850	93.575	1.019	0.082	133.08	42.016	47.780	0.001	0.003
Yen Lac WWTP		MS23	6.11	2.154	4.039	137.618	1.848	0.142	158.39	62.124	47.014	0.919	1.589
		MS24	6.27	1.268	2.165	99.444	1.207	0.006	103.97	37.098	39.174	0.313	0.695
Tam Hong WWTP		MS25	5.44	2.665	3.778	218.116	1.633	0.118	193.16	65.792	58.360	0.083	0.336
		MS26	6.08	1.279	2.610	145.901	1.203	0.019	133.08	57.140	28.176	0.079	0.105
		MS27	5.77	1.274	2.185	178.919	1.417	0.013	120.19	31.319	33.982	0.043	0.090
Tho Tang WWTP	B2	MS28	6.19	1.661	2.943	185.937	1.534	0.022	172.93	41.034	42.208	0.076	0.449
		MS29	6.25	1.490	2.137	173.330	1.297	0.019	148.01	39.192	34.760	0.103	0.746

The analysis results show that, compared to the quality of sediment soil, the accumulation of substances, particularly heavy metals, does not differ much among samples.

Compared to the National Technical Regulation QCVN 07: 2009/BTNMT on hazardous waste thresholds, all of the parameters of the sediment samples are within the permissible limits.

Compared to the National Technical Regulation QCVN 43:2012/BTNMT on sediment quality, 28 out of 29 samples meet the standards, except for only one sample at Phan River (MS7-B2) that has Pb and Cu concentrations 1.27 times and 1.05 times higher than the permissible limits.

Referred to the National Technical Regulation QCVN 03:2008/BTNMT on permissible limits of heavy metals in soil, the analysis results show that 22 out of 29 samples meet standards (for agricultural land) in terms of all parameters. Seven samples have heavy metals concentrations slightly higher than the permissible limits. These comprise four sludge samples of Phan River (MS3, MS7, MS8 - B2, and MS13 - B3) and thee samples from Huong Canh WWTP (MS21, B3), Yen Lac WWTP (MS 23, B3), and Tam Hong WWTP (MS25, B3). Specifically, for 4 samples of Phan River, the Cd concentration of MS3 is 1.2 times higher than permissible limit; the concentrations of Cd, Zn, Pb, and Cu of MS7 are 1.7, 1.2, 1.7, and 1.3 times higher than permissible limits; and the Cu concentrations of MS8 and MS13 are 1.3 times and 1.1 times higher than the limits. In Huong Canh Town, the concentrations of Cd and Cu of the sample coded MS21 are 1.1 and 1.2 times higher than the permissible limits. In Yen Lac, Cd concentration of the MS23 is 1.1 times higher, while in Tam Hong, the concentrations of Cd, ZN, and Cu of the MS25 are 1.3, 1.1, and 1.2 times higher than the limits.

Among these 7 samples above, six of them meet the standards applied for commercial land, except for the sample MS7 of which the Cu concentration is higher than the permissible limit for commercial land. Therefore, the dredged material from this area will be gathered at a separate cell in Dong Mong disposal site with appropriate design, particularly with waterproof HDPE membrane.

3.3. BIOLOGICAL AND ECOLOGICAL CONDITIONS

The Project will involve rehabilitation and dredging of Phan River and three river network in Binh Xuyen (Basin C), construction of pumping stations, regulating lakes, inlet and discharging canals, and WWTPs in the residential areas along Phan River in five districts, one town, and Vinh Yen City. Therefore, biological impacts caused by the project implementation process are of great importance.

In order to assess the current status of biological resources in the project area, apart from field investigations, surveys, and assessments conducted in the area, the report is also prepared with reference to several documents and secondary data on biological resources survey and assessment in Vinh Phuc Province, with focus on aquatic and terrestrial ecosystems along the rivers and lakes subject to rehabilitation such as Phan, Ba Hanh, Tranh, Cau Bon, Ca Lo, Pho Day, and Red River (section passing through Vinh Phuc), Rung Lake, Sau Vo, So, and Nhi Hoang, and the areas where the proposed drainage pumping stations (Kim Xa, Ngu Kien, and Nguyet Duc) and WWTPs in four towns (Tho

Tang, Yen Lac, Tam Hong, and Huong Canh) are located.

3.3.1. Summary on ecological and biological conditions at the project area

3.3.1.1. Ecosystem Status

The survey results indicated the presence of terrestrial and aquatic ecosystems in the project area.

a. Terrestrial Ecosystem

The terrestrial ecosystem consists of the agricultural ecosystem, rural residential area, and small-and-medium urban area ecosystem. These types of ecosystems are artificial, composed of poor and unsustainable species without dominant species. The number of compositions of species always subject to change according to use purposes and economic conditions of the people.

According to the Report on “Survey on the current status of biodiversity and biodiversity action plan to 2015 with orientation to 2020 of Vinh Phuc Province”, Vinh Phuc is located in the transition area between the hilly and midland region and Red River Delta region. Therefore, the terrain is gradually lower from Northwest to Southeast and divided into three ecological regions: the delta region, midland, and mountainous region.

a. Mountainous ecosystem

Mainly distributed in the area of Tam Dao National Park, this ecosystem is far from the project area and thus will be less affected by the project implementation process.

b. Midland ecosystem

After the mountainous ecosystem, the midland stretches from Northwest to Southeast. This area has a total natural area of about 24,900 ha, accounting for most of the areas of Tam Duong and Binh Xuyen districts (15 communes) and Vinh Yen City (6 wards and comments), and a part of Lap Thach District (11 communes) as well as Phuc Yen Town. The hilly land fund of the area can be used for industrial and urban development, growing fruit trees, industrial crops combined with large-scale livestock husbandry. In the region, there is a number of large lakes such as Dai Lai, Xa Huong, Van Truc, Lieu Son, and Vac, which supply water for production activities, environmental rehabilitation, and tourism development. This ecosystem is characterized by the mixture between the habitats of mountainous ecosystem and delta ecosystem. These are high and low hills with large or small valleys in between. These valleys are in the wetlands (wet-rice growing fields or natural/artificial swamps, lakes, and ponds).

c. Delta ecosystem

The delta region has an aggregate area of 47,000 ha, comprising both old and new alluvial sub-regions, mainly distributed in Vinh Tuong, Yen Lac, Tam Duong, Binh Xuyen districts, and Vinh Yen City with the area of 46,800 ha. This region has plain topography, which is favorable for infrastructure and urban area development as well as for agricultural production. This area has a large number of natural and man-made swamps, lakes, and ponds of great importance to humans as well as other species.

b. Aquatic Ecosystem

Is the ecosystem in the rivers, canals, lakes and ponds (still water). This ecosystem can be divided into three distinctive regions:

- ✓ Region 1: consists of major rivers (Red River, Phan, Ca Lo, Pho Day, Ba Hanh, Tranh, and Cau Bon, etc.) and water canals derived from Tam Dao mountain range flowing down to the river basins. The ecosystem of this region is characterized by the dominance of terrigenous aquatic species. The water nature in this region is strongly influenced by the hydrological regime in the area and particularly the impacts of human activities along the basin such as the discharge of wastewater and waste into the flow. Therefore, the number and compositions of the species in this region also undergo changes. This region is considered an area with high biodiversity in comparison with other aquatic ecosystems in the province.
- ✓ Region 2: is composed of infield low-lying areas with small irrigation canals which were formed to serve the irrigation purpose in farming activities. Water in this region is generally rated as contaminated; the flow circulation is poor and often receives wastewater from agricultural production as well as wastewater from surrounding residential areas and industrial zones. The number of compositions of species in this region is considered poor and unsustainable; the aquatic species are mainly small ones (including fish).
- ✓ Region 3: comprise static water bodies such as lakes, swamps and ponds. These water bodies are often located in the residential areas. The survey results show that, within the project area, the major lakes and swamps include Sau Vo, Dai Lai, Xa Huong, Van Truc, Lieu Son, Vac, Rung, So, and Nhi Hoang, etc. These are water supply sources for production activities and environmental rehabilitation in the area. The survey results show that most of these water bodies are being used for aquaculture. The water quality in these water bodies, in general, is quite stable compared to other water bodies. The aquatic species in these lakes, swamps and ponds are also considered poor, mainly farmed aquatic species.

3.3.1.2. Biological conditions in the Project Area

According to the Report on “Survey on the current status of biodiversity and biodiversity action plan to 2015 with orientation to 2020 of Vinh Phuc Province”, Vinh Phuc has several rare species that need preserving. However, the sources of biodiversity conservation in Vinh Phuc are only limited within Tam Dao National Park. Tam Dao National Park is home to nearly 1,282 plant species, 102 reptile species, 57 amphibian species, 60 mammal species, and over 243 species of birds (VNPPAA, 2001). In addition, the area has the highest density of insects in Vietnam (Birdlife International, 2004). In which, more than 120 species are endangered. There are species of great importance and in the list of global endangered species, including Vietnamese salamander (Paramesotriton deloustali) (Birdlife International, 2004).

Also according to the above mentioned report and field surveys conducted in the entire project area, there is no ecologically sensitive zones, natural reserves, or national parks in the project area. There is also no rare and endangered species as in the Red List of Threatened Species of both Vietnam and the world.

In terms of species diversity, the above biodiversity report shows that the project area has abundant species. Details are as follows:

a. Flora:

The flora of Vinh Phuc comprises 1,568 species, genera and families belonging to six divisions of vascular plants (excluding Moss). The divisions that have the most important roles in the plant biodiversity value of Vinh Phuc include:

- ✓ Angiosperm (*Angiospermae*) representing nearly 90% of species, 90.4% of genus and 81.4% of families.
- ✓ Fern (*polypodiophyta*) representing 7.71% of species, 7.1% of genera; and 12.3% of families.
- ✓ Gymnosperm (*Gynmospermae*) representing 1.21% of species, 1.6% of genera; and 4.1% of families.
- ✓ Lycopodiophyta representing1.08% of species, 0.5% of genera; and 1.0% of families.

The remaining two divisions have insignificant roles with less than 0.65 in all aspects.

With regards to freshwater aquatic flora, the recognized aquatic communities comprise submerged and floating plants in the rivers and lakes, particularly water hyacinth *(Eichhornia* crassipes), pistia (*Pistia stratiotes*), giant water fern (*Salvinia cuculata*), *Salvinia natans*, lotus (*Nelumbo nucifera*), water-lily (*Nymphaea pubescens*), water primrose (*Ludwigia hyssopifolia*), *Ludwigia adnascens*, *Utricuaria aurea,*and common hornwort (*Hydrilla verticilata*), etc.

In hilly areas, there are some perennial trees such as plant association of *Camellia sinensis.*

The communities of annual terrestrial crops include maize (*Zeamays*), sweet potato (*Ipomoea bataas*), potato (Solanum *tuberosum)*, cassava (*Manihot esculenta)*, and other short-term rain-fed crops and the wetrice association (*Oryza sativa*)

The plants surrounding residential areas include Bead-tree *Melia azedarach*, Orange *Citrus sinensis*, Lime *Citrus aurantium*, Longan *Dimocarpus longan*, Papaya *Carica papaya*, Banana *Musa paradisiaca, ….*

Secondary and low shrubs without timber trees and dominant species: hill guava (*Rhodomyrtus tomentosa*), *Melastoma candidum*, *Cratoxylon prunifolium, Randia spinosa,* andsiamweed *(Chromolaena odorata*) etc.

b. Fauna

Avifauna:

In midland ecosystem: The composition structure of the avifauna is characterized as intermediary between the mountainous avifauna and plain avifauna. Here appears the avifauna of the delta ecosystem with the presence of Gavia (*Podicipediformes*), Crane (*Ciconiiformes*), Geese (*Anseriformes*), whose life is associated to the aquatic environment. Their food are aquatic species and they nest and live in the areas with waters. The avifauna of this ecosystem also shares some elements of the forest avifauna such as Cuckoo (*Cuculiformes*), Kingfisher (*Coraciiiformes*), and Passerin (*Passeriformes*).

For delta ecosystem: with regards to the composition structure of the avifauna in the delta region, of the total 10 orders, six of them are associated with aquatic environment and residential area environment. These comprise *Gruiformes*, *Ciconiiformes*, *Anseriformes*, *Gruiformes*, *Charadriformes*, and *Coraciiiformes*.

Reptiles:

Reptiles (*Reptilia*) comprise of two orders, of which, the scaled reptiles (*Squamata*) are more various with 13 families (representing 86.6% of the families), 42 genera (representing 93.3% of genera), 51 species (representing 92.7% of the species). The Testudinata is less various with two families (accounting for 13.3% of the families), 6.6% of the genera, and 4 species (7.3% of the species).

In terms of families, Colubridae is the largest with 21 genera and 28 species (accounting for more than half of the species in the area), followed by two families, which are *Scincidae* and*Elapidae* with three genera and four species; *Agamida*e and*Viperida*e with three genera and three species; *Emydidae* with two genera and three species; *Gekkonida*e with two genera and two species. The remaining, accounting for 53.3% of the families, only has one genus and one species.

Among 45 genera of reptiles in Vinh Phuc Province, eight genera, accounting for 17.7%, have only one species each. One genus, *Oligodon,* has three species while eight genera have two species, which are *Eutropi*s, *Calamaria*, *Dinodon*, *Lycodon*, *Enhydris*, *Ptyas*, *Bungarus*, and *Cuora*.

Amphibians:

The amphibians comprise of three orders with the largest one is Anura comprising seven families, accounting for 77.7% of the families, 21 genera, representing 91.3% of the genera and 32 species, representing 94.1% of the species. The remaining orders include Caudata and Gymnophiona, each has one family (11.1%), one genus (4.3%), and one species (2.9%).

In terms of families, the largest one is Ranidae family with four genera and eight species, followed by the Dicroglosidae with 5 genera and 6 species, Rhacophoridae with three genera and five species, Microhylidae with two genera and five species. Among 9 families, Vinh Phuc has two families, representing 22.2% that have only one genus and one species.

In terms of genus, in Vinh Phuc Province, the largest genus is Hylarana that has 5 species. One genus, Mycrohyla, has four species; four genera, which are *Occidozyga*, *Hyla*, *Theloderma*, and Polypedates, have two species each.

1. *Mountainous region:*

There are overlaps in the distribution of amphibians as many species are living in all three or two ecosystems. However, most of them are living in the mountainous areas with 30 out of 34 species. Many species are typical in this area and only found at the elevation of 600m to 800m and above of Tam Dao Mountain Range such as Chinese Gliding Frog (*Rh. Dennysi*), Vietnamese mossy frog (*theloderma*), *L. kuhli,* spiny frog *(Q. verrucospinosa*), Mau Son frog (*H. maosonensis*), Fea's horned frog (*B. feae*), *O.andersori*, and particularly the Tam Dao salamander (P. deloustali). Although the species in the mountainous area is diverse, the number of individuals is poor; many species have only a few individuals even during the breeding season such as Fea's horned frog (*B. feae*),*O.andersori*, Vietnamese mossy frog (*theloderma*), etc.

2. *Midland region:*

Midlands are transitional areas with the average elevation of 15 m to 20 m. Therefore, some species in mountainous and plain regions can be found here (19 species representing 55.8% of the total species). The species that are widely distributed include Asian grass frog (*F. limnocharis*), Günther's Amoy frog (*H. guentheri*), Asian common toad (*D. melanostictus*), Common tree frog (*P. leucomystax*) as well as several representatives of the Hylidae family, Dicroglossidae family, Ranidae family, and Microhylidae family, etc. are present in this ecosystem.

3. *Delta region:*

Contrary to the mountainous region, the number of species in the delta region is poorer (13 species accounting for 38.2% of the total species) but are usually widely distributed, living near people with a large number of individuals, especially during breeding seasons such as Asian grass frog (*F. limnocharis*), Günther's Amoy frog (*H. guentheri*), Chinese edible frog (*H.rugulosus*), Asian common toad (*D. melanostictus*), Common tree frog (P. *leucomystax*), and ornamented pygmy frog (*M.* fissipes). This region has relatively flat topography with the elevation from 8 m to 12 m, which is favorable for agricultural production. The area has several residential areas, therefore these amphibians are mainly living in the areas near water without much disturbances such as rice fields, along rivers, ponds, lakes, and swamps.

c. Biodiversity of fish and aquatic organisms

There are many lakes in Phan River basin. Natural lakes include Vac Lake (Vinh Yen City), Rung Lake, Xanh Lake, Quang Cu Lake, Ngu Kien, Sau Vo, Rung Lake (Vinh Tuong District), Tam Hong, Coc Lam (Yen Lac District), Nhi Hoang, So; human-made lakes include Xa Huong (Binh Xuyen District) and Lang Ha, (Tam Duong District).

All the lakes under project financing Sau Vo, Rung, Nhi Hoang lake are natural lakes.

According to the report on rehabilitation and protection of ecological landscape of Phan River basin, common fish and aquatic species found in Phan River basin are freshwater living including, for example, track eel *(Monopterus albus),* pufferfish (*P. cochinchinensis*), yellowhead catfish (*P. fulvidraco*), O. salsburyi,ray-finned fish (*O. gerlachi*), goldfish (*C. auratus*), carp (*C. carpio*), R. giurinus, O. bidens, and dwarf snakehead (*C. gachua, Koi fish*, snakehead fish, catfish, black carp, grass carp, Mrigal carp, tilapia fish, Crucian fish, Carassioides cantonensis, flag-tail fish,Chinese barb P. semifasciolatus,humpback fish, common sawbelly (*H. leucisculus*), R. giurinusand Japanese rice fish, migan and rohu carp fish and Chinese silver carp.

Other common aquatic species are mussels (Corbicula) and helix snail (Angulyagra), Chinese mystery snail (Sinotaia) and several species under Thiaridae family (Melanoides tuberculatus, Tarebia granifera) and shell-fish under Amblemidae family (Oxynaia) and Unionidae (Sinanodonta, Critaria, Pletholophus, Lanceolaria...)

No migratory fish are found in the project area, including rivers such as Phan River and Ca Lo River.In Binh Xuyen rivers including Tranh River, Ba Hanh River and Noi River, there are several fish specifies such as creek chub, carp, Amur catfish, Gold barb, Mosquitofish, Tire track eel, common sawbelly, H. pluriradiatus, and Climbing perch

Regarding aquatic plant, there are 135 aquatic plants found long Phan River basin under 5 divisions: Cyanobacteriophyta, Bacillariophyta, Chrysophyta, Euglenophyta, Chlorophyta.

Regarding zooplankton, there are 23 species under phylum of Arthropoda and 14 species of Nemathelminthes phylum.

In short, the biodiversity in these rivers is assessed as poor with dominant freshwater species and no migratory fish nor catadromous/anadromous species are found in the project area

Details are described in section 3.3.2.

3.3.2 Detailed description on biological and ecological conditions at project area

a) Phan River and Ca Lo River

Phan River originates from Tam Dao, flowing through districts of Tam Duong, Vinh Tuong, Vinh Yen City, Yen Lac before entering Ca Lo River in Huong Canh District and then flowing through Me Linh District (Hanoi) to Cau River.

The total area of the Phan river basin in the project area Phan is 398.8 km2 area with a total length from 3 chamber gate An Ha to the intersection with Ca Lo Cut River of about 73 km. The average width of the river is from 10 m - 30 m, with an average depth of 1.5 m - 3.5 m.

The survey results along the river basin showed Phan river is serving as main drainage work for the region and a system of large irrigation supplying water for about 8000 ha of farming land.

Regarding aquaculture, the survey showed no aquaculture activities in the river; there are only 8 households fishing on the river during off-season period.

The river water quality is now increasingly degraded and polluted by waste water from residential areas, agricultural areas, some craft villages and service business (Te Lo, Tho Tang, Huong Canh ...).

Phan River section in Hoang Thach Bridge and Tho Tang town

The survey on biodiversity of Phan River basin found 10 fish species including sharpbelly (H. leucisculus), ray-finned fish (O. gerlachi), O. salsburiyi, pipefish (S. argentatus), (H.medius), (O. bidens), carp (C. carpio), goldfish(C. auratus), Chinese barb (P. semifasciolatus), and yellowhead catfish (P. fulvidraco). In addition, there are fish kept in the farming ponds in the area and then sold at Thien Ke market, which are Rohu (L. rohita), Mrigal carp (C. mrigala), Silver carp (H. molitrix), Grass carp (C. idella), and Mozambique tilapia O. mossambicus).

Regarding aquatic plant, there are 173 aquatic plants found long Phan River basin under 6 divisions: Cyanobacteriophyta, Bacillariophyta, Dinophyta, Chrysophyta, Euglenophyta, Chlorophyta.

Regarding zooplankton, there are 23 species under phylum of Arthropoda and 14 species of Nemathelminthes phylum.

In short, the biodiversity in Phan River is assessed as poor with dominant freshwater species.

According to the information provided from Vinh Phuc DONRE and Department of Agriculture, there is no endangered and rare fish species in the Phan River section at the project area. No migratory fish or catadromous/anadromous species is detected and recorded in the project area.

b) Ca Lo River

Ca Lo River is located downstream of Binh Xuyen river net work and Phan river (see Fig 23 above). Water from the Binh Xuyen river network (basin C) and Phan river (Basin B) flow to Ca Lo River then to Cau River. The section of Ca Lo River from the 23 chamber gate to Thinh Ky Bridge is called Ca Lo Cut River which receives drainage water and supplies irrigation for the riverside area in South Eastern part of the project area;

Ca Lo River (downstream Phan River) near Kha Do Bridge

Ca Lo River section from Thinh Ky to Phuc Loc Phuong gate is 67 km long with area of 320,8 km2, in which the area in Vinh Phuc Province is about 13 km long, with area of 311,2 km2, aveage river width of 20 m and depth of 1.7 m.

There are no aquafarming activities in the river and about 22 households are fishing there during off-season period.

Common fish found in the river include pipefish (S. argentatus), creek chub (S. atromaculatus), (M.kachekensis), (H.medius), carp (C. carpio), “Cháo” (O. bidens), (O. uncirostrix phodayensis), yellowhead catfish (P. fulvidraco), Amur catfish (S. asotus), Gold barb (P. semifasciolatus), Mosquitofish (S. affinis), Tire track eel (M. armatus), (S. nigrippinnis), (A. tonkinensis), common sawbelly (H. leucisculus), (R. giurinus), H. pluriradiatus, and Climbing perch (A. testudineus). Two types of farmed fish that are also in the river including Rohu (L. rohita) and Mrigal carp (C.mrigala). At Ninh Lai market, apart from river fish, several types of fish are kept at the aqua-farming and then sold at the market. These include carp (C. carpio), Silver carp (H. molitrix), Bighead carp (A.nobilis), Grass carp (C. idella), Mozambique tilapia (O. mossambicus), Rohu (L. rohita), Mrigal carp (C. mrigala). As such, Ninh Lai has 27 species of fish, of which 21 species are living in this river section.

According to the 2004 Vinh Phuc biodiversity report, zooplankton found include 16 species under the following families *Cyclopidae, Sididae, Macrothricidae, Daphniidae, Chydoridae, Philodinidae, Asplanchnidae, Brachionidae, Trichocercidae, Filiniidae, Conochiloides, Lecanidae*

Phytoplankton in the area comprise about 38 species under such families as *Cyanobacteriophyta, Chroococcales, Bacillariophyta, Euglenophyta, Chlorophyta*

According to the information provided from Vinh Phuc DONRE and Department of Agriculture, there is no endangered and rare fish species in the Phan River section at the project area. No migratory fish nor catadromous/anadromous species is detected and recorded in the project area of influence.

c) Red River

Red River drains water from 3 pumping stations of the project, in which directly from Nguyet Duc and Ngu Kien pumping stations and indirectly from Kim Xa pumping station via Pho Day River.

Red River is recognized as an international waterway with total length of 1,149 km originating from China, running through Vietnam before entering East Sea. The section in Vietnam is 510 km long. In the project area, the river travels through districts of Vinh Tuong and Yen Lac with total length of 41km and downstream area in Melinh District of Hanoi. The river section has an average width of about 1.5 km and depth of 5.0m. The field survey along the river section from Viet Tri (Phu Tho Province) to districts of Vinh Tuong and Yen Lac (Vinh Phuc Province) and Me Linh District (Hanoi) recorded no aquafarming activities while about 50 households live on fishing. This is also the only river in Vinh Phuc having waterway transportation of about 20 trips a day.

Red River near Ngu Kien and Nguyet Duc pumping stations

About Biodiversity of fish and aquatic organisms in the Red River section running through Yen Lac, Vinh Tuong, Lap Thach, and Song Lo districts. According to the biodiversity on the existing condition of Red River (2010),   at the Red River confluence area with Da, Thao, Lo River - which is about 20 km upstream of the project area at Ngu Kien pumpingstation. There are 91 species of fish belonging to 11 orders, 26 families, and 75 genera. Of which, carp (Cyprinus carpio) is the largest with 53 species, representing 52.8%, followed by Silurus asotus with 13 species (or 14.3%), and Perciformes (12 species accounting to 13.2%). Among 91 recognized species, 12 species belong to six families and four genera in the 2007 List of Threatened Species of Vietnam, including two species (Japanese eel Anguilla japonica, Cyprinus multitaentiata) in the Extinct (EW) category, one species (Luciobrama macrocephalus) in the Critically Endangered (CR) category, three species (Clupanodon thrissa, Tenualosa, Channa argus) in the Endangered (EN) category, and 6 species (Semilabeo notabilis, Bangana lemassoni,Luciocyprinus langsoni, Ochetobius elongatus, Bagarius yarrelli, Hemibagrus guttatus) in the Vulnerable (VU) category.

Plankton and Benthos: Analysis of 6 samples surveyed in the Red River section going by Ngu Kien PS and Nguyet Duc PS shows that:

- The composition of species is not abundant and no species is listed in the Vietnam Red Book. 15 species belonging to 8 families, 5 orders of 4 algae phyla (Bacillariophyta, Chlorophyta, Cyanobacteria and Euglenophyta). Among them, Bacillariophyta is the most dominant with 9 species in 4 families. Apart from larvae and one unidentified species of crustacean subclass (Ostracoda), there are 10 species of zooplankton, belonging to 4 families and 3 orders of 2 crustacean subclass in arthropod class. In which the family with highest number of species (6) under Cyclopidae, Copepoda subclass. There are 5 benthic species of 2 families of snails and shrimp. No rare benthic species record in the Vietnam Red Book.

- Low biomass: phytoplankton density of about 1276 cells/liter; zooplankton 7 cells/m2; and the density of the bottom - 7 cells/ m2.

According to the information provided from Vinh Phuc DONRE and Department of Agriculture, there is no endangered and rare fish species in the Red River section at the project area. No migratory fish nor catadromous/anadromous species is detected and recorded in the project area of influence.

d) Binh Xuyen Rivers

Cau Bon River: Originating from Tam Dao Mountain with total length of about 22km, running towards Huong Canh Town, Binh Xuyen District and entering Ca Lo River. The Cau Bon River basin is 118.7 km2.

Tranh River: Orginating from Tam Dao Mountain with total length of 21 km running to Tranh Bridge from North to South. The western tributary connects with Cau Bon River while the eastern part connects with Ba Hanh River before entering Ca Lo River in Nam Viem. The basin area is 53.43 km2.

Ba Hanh River: in Binh Xuyen District and Phuc Yen Town with total length of 23.5 km and basin area of 80.42 km2.

The average width and depth of the rivers are about 16m and 1.6m, respectively. They runs through several residential areas in communes of Son Loi, Huong Son, Thien Ke, Ba Hien, Tam Hop and Huong Canh Town. No aquafarming activities are recorded and there are about 7 households living on river fishing.

Ba Hanh River in Basin C

Cau Bon River in Basin C

Tranh River in Basin C

Common fish found in the rivers include creek chub (S. atromaculatus), (M.kachekensis), (H.medius), carp (C. carpio), (O. uncirostrix phodayensis), yellowhead catfish (P. fulvidraco), Amur catfish (S. asotus), Gold barb (P. semifasciolatus), Mosquitofish (S. affinis), Tire track eel (M. armatus), (S. nigrippinnis), (A. tonkinensis), common sawbelly (H. leucisculus), (R. giurinus), H. pluriradiatus, and Climbing perch (A. testudineus). Two types of farmed fish that are also in the river including Rohu (L. rohita) and Mrigal carp (C.mrigala).

Regarding aquatic plant, there are 135 aquatic plants found long Phan River basin under 5 divisions: Cyanobacteriophyta, Bacillariophyta, Chrysophyta, Euglenophyta, Chlorophyta.

Regarding zooplankton, there are 23 species under phylum of Arthropoda and 14 species of Nemathelminthes phylum. No rare benthic species record in the Vietnam Red Book.

In short, the biodiversity in these rivers is assessed as poor with dominant freshwater species and no migratory species, endangered and rare fish species in the Red River section at the project area of influence.

e) Pho Day River

Pho Day River section running through Thien Ke Commune and Ninh Lai Commune in Son Duong District, Tuyen Quang Province has both upstream fish and midstream fish as well as fish escaping from low-lying fields, lakes and ponds due to floods.

The Pho Day river section of 2km upstream from the discharge of Kim Xa PS and 5km downstream crossing by Kim Xa disposal site has the average of 150m in dry season and depth of about 2.5 - 3.0m. No household is fishing in this river section.

According to Vinh Phuc biodiversity report, in the Pho Day river section in Tam Duong District, there are 09 species of fish, including: *O. salsburiyi*,pipefish (*S. argentatus*), goldfish(*C. auratus*), Chinese barb (*P. semifasciolatus*), ray-finned fish (*O. gerlachi*), (*H.medius*), (*O. bidens*), carp (*C. carpio*), yellowhead catfish (*P. fulvidraco*), Mrigal carp (*C. mrigala*), Silver carp (*H. molitrix*), Grass carp (*C. idella*), and Mozambique tilapia *O. mossambicus*).

Regarding phytoplankton, there are 8 families of 5 different orders: Coscinodiscaseae, Fragilariaceae, Naviculaceae, Nitzschiaceae, Scenedesmaceae, Desmidisceae, Oscillatoriaceae, Euglenaceae. Of which, Chlorophyta and Euglenophyta are dominant.

As for zooplankton and zoobenthos, there are 4 zooplankton families including Cyclopidae, Diaptomidae, Daphniidae, Chydoridae. 2 groups of zoobenthos of snail *Gastropoda* and shrimp *Decapoda-Macrura*.

According to the information provided from Vinh Phuc DONRE and Department of Agriculture, there is no endangered and rare fish species in the Red River section at the project area. No migratory fish nor catadromous/anadromous species is detected and recorded in the project area of influence.

e) Sau Vo Lake

The lake has a total area of 295 ha with average depth of 1.8m. In dry season, the area shrinks to about 250 ha. The area being dredged and rehabilitated under the project financing has a total area of 176.5 ha, of which 21 ha is currently being used for aquaculture by 12 housholds every season (both dry and rainy) under the contract with town people committee renewed annually; and a lakeside area of 45 ha which is used for farming in dry season by 258 households.

Sau Vo lake in sub-Basin B3

The survey found that the fish farmed by local households include barb, tilapia, grass carp and common carp. Other aquatic species are shrimp, crab, goby fish etc.

According to the 2010 Vinh Phuc Biodiversity report, plankton found in Sau Vo Lake include Cyanobacteria under 6 orders, 12 families, 33 genera of 4 phyla: Cyanobacteriophyta, Chlorophyta, Euglenophyta and Bacillariophyta.

Cholorophyta has the highest number of species of 64, in which Scenedesmus genus has the highest species and subspecies, followed by Pediastrum genus with 11 species and subspecies. These two genera are commonly found in all sampling sites. Bacillariophyta has 6 species.

According to the information provided from Vinh Phuc DONRE and Department of Agriculture, there is no endangered and rare fish species in the Red River section at the project area. No migratory fish nor catadromous/anadromous species is detected and recorded in the project area of influence

f) Nhi Hoang Lake

Nhi Hoang Lake has an area of 22.5 ha with average depth of 1.8 m. In dry season, the area of the lake is 20 ha at an depth of average 1.6 m, there are about 35 households fish-farming in contract basis of barb, tilapia, grass carp and common carp. The lake is surrounded by permanent agricultural land.

View of Nhi Hoang Lake

Under the VPFRM, the Nhi Hoang lake will be dredged and rehabilitated to an area about of 38.5 ha, to the depth of 1.8 to 2.0 m, with the capacity of 750,000 m3.

According to the 2010 Vinh Phuc Biodiversity report, plankton found in So Lake and Nhi Hoang Lake include Cyanobacteria under 8 orders, 16 families, 37 genera of 4 phyla: Cyanobacteriophyta, Chlorophyta, Euglenophyta and Bacillariophyta. Cholorophyta has the highest number of species of 57 and Bacillariophyta has 7 species.

Both lakes are currently fish farmed on annual contract basis (and 35 households in Nhi Hoang Lake, 20 ha). Fish raised include barb, tilapia, grass carp and common carp. Other aquatic species are shrimp, crab, goby fish etc. No endemic or migratory species are found in these lakes.

g) Rung Lake

Rung Lake has an total area of 150 ha (surface area of about 140ha) with average depth of 1.5 m. During the dry season, the lake area is 140 ha. The lake is currently fish farmed on contractual basis by 85 households, 139 ha. This lake is currently divided into several small ponds for aquafarming purpose.

The lake is surrounded by residential areas of communes of Tu Trung, Ngu Kien and Vu Di and farming areas.

B2, Rung Lake, S: 120 ha, contains about six interconnected small lakes divided by rural roads.

This whole lake contain about 06 interconnected lakes divided by rural roads. Under the project, part of the Rung lake (in Ngu Kien commune,in front of Ngu Kien pumping station, area of 45 ha) will be rehabilitated to an area of 30.9 ha, storage 1.35 mil m3, to the depth from 3.8-9.2.

There are also different types of carp fish, Koi fish, snakehead fish, catfish, black carp, grass carp, Mrigal carp, tilapia fish, Crucian fish, Carassioides cantonensis, flag-tail fish, Chinese barb P. semifasciolatus, humpback fish, common sawbelly (H. leucisculus), R. giurinusand Japanese rice fish. Recently, other Indian carp fish have been kept in the lake such as migan and rohu carp fish and Chinese silver carp.

- Phytoplankton: there are 7 families under 4 orders including: Coscinodiscaseae, Fragilariaceae, Naviculaceae, Nitzschiaceae, Scenedesmaceae, Desmidisceae, Oscillatoriaceae.

- Zooplankton and zoobenthos: there are 3 zooplankton orders consisting of Cyclopoida, Calanoida, Cladocera. Zoobenthos includes 2 groups of snail *Gastropoda* and shrimp *Decapoda-Macrura.*

According to the information provided from Vinh Phuc DONRE and Department of Agriculture, there is no endangered and rare fish species in the Red River section at the project area. No migratory fish nor catadromous/anadromous species is detected and recorded in the project area of influence.

3.4. SOCIO-ECONOMIC AND CULTURAL FEATURES

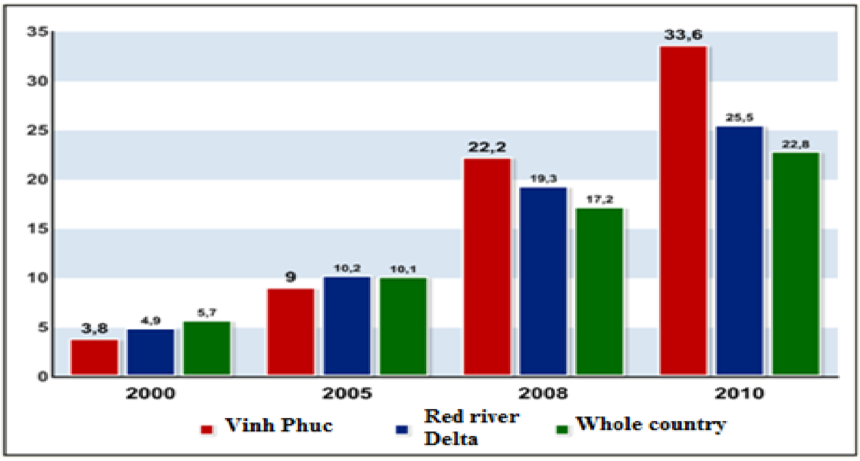
3.4.1. Economic Features

3.4.1.1. Economic Growth Rate

At the 10th session of 9th National Assembly, the "re-structuring" of Vinh Phuc province was passed by the Resolution dated 26 November 1996. Since then, the GDP of the province increases steadily, with an average growth rate for the period 1998-2000 of 18.12%, due mainly to the increasing development of industrial parks, especially from foreign investment areas (FDI).

Growth rate: the growth rate always ranks high in the Red River Delta and the Northern Key Economic regions. In the period 2006-2010, the growth rate of Vinh Phuc province reached 15.6% per year while the growth rate of whole country in the same period, reached 6.9-7% per year. Vinh Phuc province has the highest growth rate in the Northern Region, followed by Quang Ninh, 13.3%, Bac Ninh, 15.2%, Hai Duong 11%, Hung Yen 14.1% and Hai Phong 13.2%, per year.

Regarding GDP per capita: Along with the rapid growth of the economy, GDP per capita in the province is also increasing rapidly. The average growth rate is 26% per year and expected by 2020 to reach VND 28.5 million/person, equivalent to US$ 1,550-1,600, higher than the national average rate (reached $ 1,220 / person by 2010). AGDP growth ranked into the forth position in the Northern key economic zone, followed by Ha Noi, Hai Phong (1.800-1.900 US$/person) and Quang Ninh (1,757 US$/person).



Unit: Million dong, Current Price

Figure 34. GDP per capita in Vinh Phuc Province compared with the Country and the Red River Delta (Unit: Million dong)

Source: Department of Local and Territorial Economy - MPI, 2009

3.4.1.2. Economic Restructuring in the Province

In the period 2001-2005, the economic structure of Vinh Phuc province has changed rapidly: the proportion of industry and construction in GDP increased from 40.68% in 2000 to 62.1% in 2015.

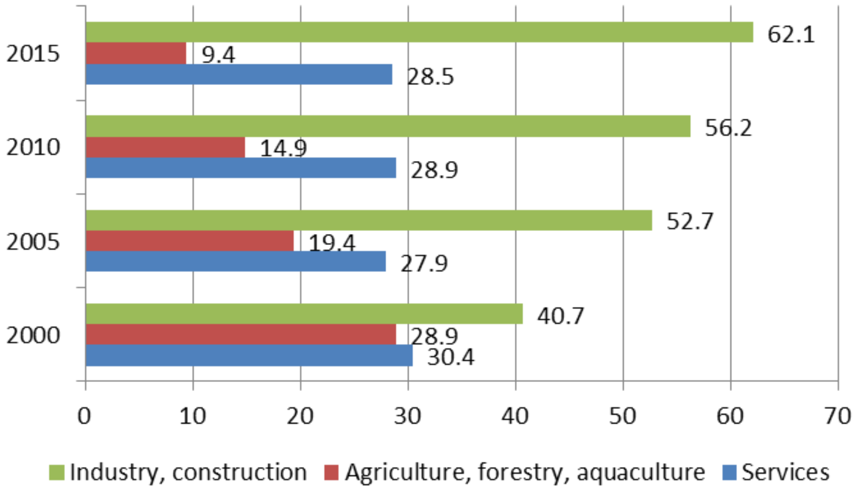


Figure 35. Chart of Economic Structure of Vinh Phuc Province

Industry and Construction: Industrial production in the Vinh Phuc province undergoes a steady development, enterprises have been actively expanding markets; some new enterprises are contributing to the increase in production value of the whole industry. The index of industrial production (IIP) in the province increased by 10.60% over 200/2015. In the first eight months of 2015, the industrial production index increased by 4.56%. In particular, the mining sector increased by 22.45%; processing and manufacturing sectors increased by 4.54%; production and distribution sectors of electricity, gas, hot water, steam and air conditioners increased by 14.51%; water supply sector, waste management and treatment sector deceased by 2.29% compared to the first eight months of 2014.

Agriculture, Forestry and Aquaculture. The structure of this sector also changed and a reduction from 14.9% in 2010 to 9.4% in 2015 is registered.

3.4.2. Social Economic Context

Population and Labor

In the Vinh Phuc province, income and livelihoods in recent years has gradually improved. According to the General Statistics Office of Vietnam Living Standards (2014), areas in the the Vinh Phuc province with growth rate of per capita income is high. In the period 2001 - 2005, per capita income increased at an average rate of 13.8% / year versus 6.05% in the country, during the same period. The poverty rate in the province has decreased from 18.3% (according to the new national standards) in 2005 to 6% in 2010 and about 3% in 2014.

The SA's socio-economic survey in 21 communes/wards in 04 project basins was carried out among 965 surveyed households, in which 330 were beneficiary households and 635 affected households. The average number of inhabitants per household registered was 3.9 persons. The ratio of questionnaire sampling in each basin, was different, according to each circumstance and context

Table 30. Surveyed households in the project basins

Basins	**Town/District**	**Ward/commune**	**Surveyed household**		**Total**
			Beneficiary households	*Affected household*	
C	Binh Xuyen	Tam Hop	20	46	66
		Son Loi	18	32	50
	Phuc Yen	Nam Viem	15	30	45
	Total		53	108	161
B3	Yen Lac	Binh Dinh	12	24	36
		Nguyet Duc	22	44	66
		Yen Phuong	12	24	36
	Binh Xuyen	Huong Canh	10	18	28
		Tan Phong	12	31	43
	Vinh Yen	Thanh Tru	19	40	59
	Total		90	178	268
B2	Vinh Tuong	Thuong Trung	14	30	44
		Van Xuan	18	35	53
		Vinh Ninh	19	39	58
		Ngu Kien	20	40	60
		Tu Trung	10	20	30
		Tho Tang	9	15	24
	Total		90	179	269
B1	Tam Dương	Hoang Dan	20	36	56
		Hoang Lau	14	26	40
	Vinh Tuong	Kim Xa	17	37	54
		Yen Lap	6	13	19
	Total		57	112	169

Basins	Town/District	Ward/commune	Surveyed household		Total
			Beneficiary households	*Affected household*	
Component 2	Tam Dảo	Hop Chau	12	16	28
	Binh Xuyen	Huong Canh	11	18	29
	Yen Lac	Yen Lac	10	13	23
	Vinh Tuong	Tho Tang	7	11	18
	Total		40	58	98
Total surveyed households			330	635	965

(Source: Socio-economic survey, 08/2015

3.4.2.1. Population in the project area

a. Population

Vinh Phuc has a total natural area of 1,237.52 km^2, with a population of 1,041,936 people located in 9 administrative units (General Department of Statistics on Living Standards 2014). The project area consists of 7 districts, namely Vinh Yen City, Phuc Yen city and 5 districts, i.e. Tam Duong, Tam Dao, Binh Xuyen, Vinh Tuong and Yen Lap with a total area of 740.99 km^2, representing 69.6 % of the whole province. The total population of 706,131 people all over the project area, accounting for 76.77% of the provincial population, population density is 957 people/km^2.

In the project area, Binh Xuyen district has the largest population with 255,728 people distributed into 39,011 households, followed by Vinh Yen, Phuc Yen, Tam Duong, Vinh Tuong and Yen Lac. Vinh Yen city and Yen Lac district have highest population density of 2,000 and 1,397 persons/km^2 respectively, followed by Vinh Tuong. And the lowest population density district is Tam Dao with 307 people/km^2. Household size on average is from 3.5-4 person/household.

Table 31. Population And Population Density In The Project Area

Items	**Whole province**	**Binh Xuyen**	**Vinh Tuong**	**Yen Lac**	**Phuc Yen**	**Vinh Yen**	**Tam Dao**	**Tam Duong**
Area *(km^2)*	123752,31	14847,31	14401,55	10767,4	12013,05	5081,27	23478,31	10821,44
Density	842	766	1357	1397	803	2000	307	911
Population	1,041,936	255,728	119,158	91,000	134,630	164,940	116,110	126,069
- Male	512,384	56,333	96,044	74,146	46,425	49,815	35,580	64,330
- Female	529,552	57,436	99,359	76,223	50,034	51,829	36,429	50,454
Urban population	242,921	35,906	20,509	14,216	58,617	85,980	745	10,245
No. of HHs	250,729	39,011	24,191	19,256	12,472	37,628	24,587	26,885

Source: Vinh Phuc Statistical Yearbook, 2014

b. *Ethnic Minority Groups*

The survey's results showed that, San Diu, Cao Lan ethnic minority households located in the Tam Dao district and Binh Xuyen (under Component 2 and basin C of the projec). Out of total 965 people surveyed, 3.4% were San Diu and Cao Lan people. The profile of the EM people is summarized as follows:

- ✓ *Occupation and Income*. EM people working on production of agriculture, forestry, husbandry and fisheries is about 85.4% of the total with an average income of around VND 1.05 million per capita per month.
- ✓ *Access to Public Facilities*. All of the surveyed EM have access to the national power grid, while clean water supply is a critical issue, most EMs use water from drilled well, dug well and also rain water for daily activities.
- ✓ *Flooding*. As per the EMs surveyed of 71.6% of surveyed households responded that flooding seriously occurred in the locality, especially in the rainy season.

Screening and confirmation of EMs

During the SA preparation, EMs presence was identified in the project area. According to their views, the project will support reducing flooding during raining seasons, enabling to improve the agricultural productivity in the project area where the San Diu, Cao Lan EMs reside.

Consultations with the Committee for EM Affairs, confirmed current investments supporting EM in the province at the project area, such as poverty reduction program (135 Program as stipulated in Decision 551/QD-TTg dated 4/4/2013), micro-credit for production development to the poor EM, for period 2012-2015 (as mentioned in Decision 54/2012/QD-TTg dated 4/12/2012), and water supply provision (as mentioned in the Decision 1592/QD-TTg dated 12/10/2009) investments.

In the project area defined for Component 2 at Hop Chau commune (Tam Dao district) basin C, have EM residing, registering the highest proportion of ethnic groups participating in the survey. There are also some cases of EM peoples in other basins and according to the survey mainly ethnic women, whom married with local male (Kinh). Specific information on ethnic groups collected by the surveyed project's basins is as follows:

Table 32. Ethnic Group of respondents in the Basin in Tam Dao

		Basins surveyed					**Total**
		C	**B3**	**B2**	**B1**	**Component 2**	
Ethnic group	Kinh	96.9	98.9	100	100	74.5	96.6
	San Diu	3.1	1,1	0	0.0	25.5	3.4
Total		161	268	269	169	98	965

(Source: Socio-economic survey, 08/2015

As result of screening and consultations with local people it was confirmed the presence of indigenous peoples, (here) or EM communities - as per Bank's OP 4.10 definition, the project required to prepare an EMPF, to provide guidance as to how an EMDP subproject should be prepared, to ensure that (i) affected EM peoples receive culturally appropriate social and economic benefits; and (ii) when there are potential adverse effects on EM, the impact are identified, avoided, minimized, mitigated, or compensated and (iii) free prior and informed consultations are carried out. The SA followed the guidance and principles of the OP 4.10 when carrying out the survey and consultations.

c*. Education and Health in the project area*

According to statistics from the province, education levels in Vinh Phuc are relatively high. The proportion of graduated of primary and secondary is over 99%, of high school is over 95% in the 2008-2009 school year. The number of students awarded in provincial excellent exams rose and the province sent students to national and international excellent exams. Number of students passing the university and college entrance exam in 2008 was 0.67/100 inhabitants, quite high as compared to the whole country.

According to the survey result, out of 965 people interviewed, the people having secondary school level accounted for the highest proportion of 40.7%; followed by high school level people accounted for 37.9%. People with college/university or vocational level accounted for 9.4% and 4.5% of respondents surveyed were illiterate. Specific educational level of respondents in each project basin is shown in the following table:

Table 33. Educational level of survey respondents

Content		**Basins surveyed**					**Total**
		C	B3	B2	B1	Comp 2	
Illiterate/ never attended school	Rate (%)	4	4.5	5.9	1.8	6.1	4.5
Primary school	Rate (%)	3	10.4	9.7	1.8	7.1	7.2
Secondary school	Rate (%)	41	37.7	42.8	49.7	27.6	40.7
High school	Rate (%)	43	36.6	32.0	36.1	53.1	37.9
College/University/Vocational school	Rate (%)	8	10.8	9.7	10.7	5.1	9.4
Post university	Rate (%)	1	0	0	0	1	0.3
Total	Quantity	161	268	269	169	98	965

(Source: Socio-economic survey, 08/2015)

Overall, the educational level of the people in the project area is relatively high. The survey and group discussions with the local people in the project area showed ability of the community to participate and provide comments to the project.

Health

The lack of clean water, frequent inundation in the project basins, uncollected garbage in residential areas, have become the causes of diseases, threatening human health. Common diseases are diarrhea, cold, fever, dengue fever, hand-foot-mouth disease, pinkeye, catching hundreds of people in project area every year. The main cause is still parasite, disease-borne insect growing in contaminated water, transmitting to humans through eating and daily activities. The survey result showed that 46.2% of the households responded that there have been people suffering from disease in their family in the last two months. Following the details on diseases the households had in the last 2 months.

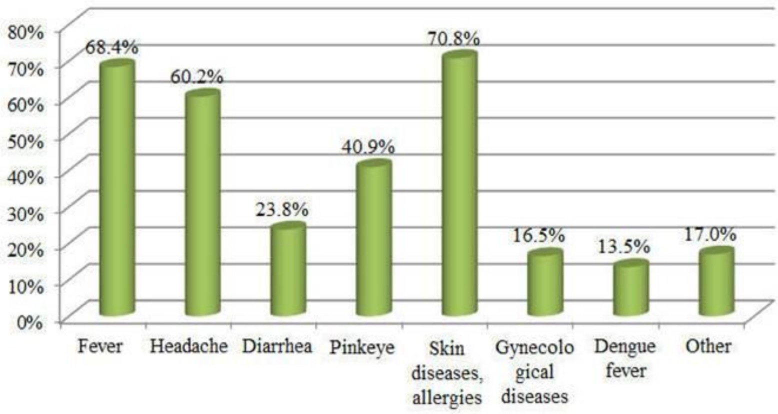


Figure 36. Diseases Caught By Families' Members In The Past 2 Months

In the project area, allergic and skin diseases are the most common ones caught by 70.8% of the households, followed by fever and headache - two common diseases in the community with relatively high proportion of households suffering from (68.4% and 60.2% respectively), diseases related to pinkeye (40.9%), diarrhea (23.8%)... The project basins are flooded annually, so the proportion of people suffering from diseases related to water are higher than that in non-flooded areas, especially for diseases like allergies or skin diseases.

The households surveyed said that these diseases are primarily caused by water pollution and flooding in the rainy season (66.8%), followed by unhygienic foods (23%), cramped shelter (7.2%), and unclean private hygiene (8.1%).

Generally, all communes/wards in the project basins have qualified health centers as that meet the national standard for communal healthcare for the period 2011 - 2020. Health stations of communes and wards are built solidly, provided with equipment and physicians who are well developed in terms of both quantity and quality. The commune/ward health stations are considered the initial healthcare facility for the residents. However, the people do not come to the stations for health check and treatment very often. The stations are often used for examining common diseases and for immunization, regular checkups for children and provision of medicines to policy people and the insured persons. When having a disease, the people often go more prestigious facilities hospitals, polyclinics, rather than to health centers.

In the project basins, disease prevention activities have been conducted fairly well, the information has been widely delivered to the residents. The survey result showed that 82.7% of the households responded that their locality organized disease prevention propaganda activities to the people. The propaganda activities conducted by the locality were for preventing diseases related to respiratory, skin diseases (76.7%), HIV/AIDS (76.5%), sexually transmitted diseases (63.1%) and family planning dissemination (72.5%). Among the project basins, there were no significant differences in the disease prevention propaganda to the people. These are frequently flooded areas, so the prevention propaganda of diseases related to water such as respiratory diseases, skin diseases is often held widely by the local authorities, so that the people can actively prevent the diseases.

Table 34. Health propaganda/ communication in localities

Propaganda campaign		**Basins surveyed**					**Total**
		C	B3	B2	B1	Comp 2	
Sexually transmitted diseases	Quantity	75	148	206	130	50	609
	Rate (%)	46.6%	55.2%	76.6%	76.9%	51.0%	63.1%
Respiratory-related diseases, skin diseases	Quantity	116	192	216	137	79	740
	Rate (%)	72.0%	71.6%	80.3%	81.1%	80.6%	76.7%
HIV/AIDS	Quantity	105	194	225	143	71	738
	Rate (%)	65.2%	72.4%	83.6%	84.6%	72.4%	76.5%
Family planning	Quantity	111	182	225	125	57	700
	Rate (%)	68.9%	67.9%	83.6%	74.0%	58.2%	72.5%

(Source: Socio-economic survey, 08/2015, N= 965)

d. Labour, Occupation and Income

According to survey data of the General Department of Statistics on Living Standards, Vinh Phuc income per capita growth rate is high when compared with the rest of the country. In the period 2001-2005, income per capita grew at the average of 13.8%/year compared to 6.05% of the country during the same period. The poverty rate in the province has decreased from 18.3% (according to the new national standards) in 2005 to 6% in 2010.

The survey result showed that out of 965 households interviewed, farming households took the highest proportion (60.3%); followed by those in trade/service/processing of agricultural products (8.9%), public servants accounted for 9.7% and those in other industries accounted for a small percentage. The occupation proportion of participants surveyed in each project basin is shown in details in the table below:

Table 35. Occupation of respondents

Content		**Basins surveyed**					**Total**
		C	B3	B2	B1	Comp 2	
Public servant	Rate (%)	11.8	8.2	9.7	13	5.1	9.7
Other cadre in locality	Rate (%)	1.2	5.2	3.3	3.0	5.1	3.6
Retired	Rate (%)	6.8	6.7	6.7	4.7	7.1	6.4
Business owner/Contractor	Rate (%)	1.2	2.2	2.6	0.0	1.0	1.7

Content		Basins surveyed					Total
		C	B3	B2	B1	Comp 2	
Farmer	Rate (%)	67.7	57.1	60.6	60.9	55.1	60.3
Worker	Rate (%)	5.0	2.6	4.5	7.1	6.1	4.7
Craftsman	Rate (%)	0	1.9	0	0	1.0	0.6
Trade/service/agricultural processing man	Rate (%)	2.5	7.1	10.4	10.7	17.3	8.9
Public security/Soldier	Rate (%)	0	0.7	0.7	0	1.0	0.5
Hired/unstable job	Rate (%)	1.2	7.5	1.1	0.6	1.0	2.8
Other	Rate (%)	2.5	0.7	0.4	0	0	0.7
Total	Quantity	161	268	269	169	98	965

(Source: Socio-economic survey, 08/2015)

According to survey results, in the project basins, the proportion of households engaged in agriculture was the highest. Their main source of income was mainly from agricultural activities, which decided greatly on the stability and living standards of the households.

e. Income and Expenditure

In the project area, as said above, the proportion of households engaged in agriculture is relatively high and the main households' source of income. There are food crops (such as rice, corn.) and some farm products (such as soybeans, beans, peanuts.). Currently, as flooding s occurs regularly, there are one spring crop (on the lowlands) and 2-3 crops on uplands ground. As a result, most of the households have average income of 4.45 million dong/household/month (or VND 1.14 million per capita per month). Specifically, 42.9% of the households earned from 1 to 3 million dong a month; 35.9% had an income of 3-5 million dong per month; 17.9% had more than 5 million dong per month. These households having an income of more than 5 million dong per month mainly do trade business or government public servants, who live in the center of communes and towns such as: Huong Canh, Tu Trung, Yen Lac. However, 3.3% of the households have an income of less than 1 million dong per month. These are poor and vulnerable households.

Table 36. Income Range of Households In Project Basins

Income range	**Basins Surveyed**					**Total**
	C	***B3***	***B2***	***B1***	***Comp 2***	
Less than 1 million dong per month (%)	3.7	3.0	3.3	3.0	4.1	3.3
1 - 3 million dong per month (%)	46.6	42.5	33.5	51.5	49.0	42.9
3 - 5 million dong per month (%)	35.4	36.6	37.9	33.7	32.6	35.9
More than 5 million dong per month (%)	14.3	17.9	25.3	11.8	14.3	17.9
Total (Households)	161	268	269	169	98	965

(Source: Socio-economic survey, 08/2015, N= 965)

The survey result showed that 67.4% of the households interviewed said that their household income was relatively stable. This rate is relatively high in comparison with the proportion (32.6%) of the households stated their income was unstable. There is not much difference in this stability among the project basins, in particular: 72% of the households in basin C said that their household income was stable, 69.7% in basin B3, 73.2% in basin B2; 67% in basin B1 and 66.5% in Component 2 stated as such.

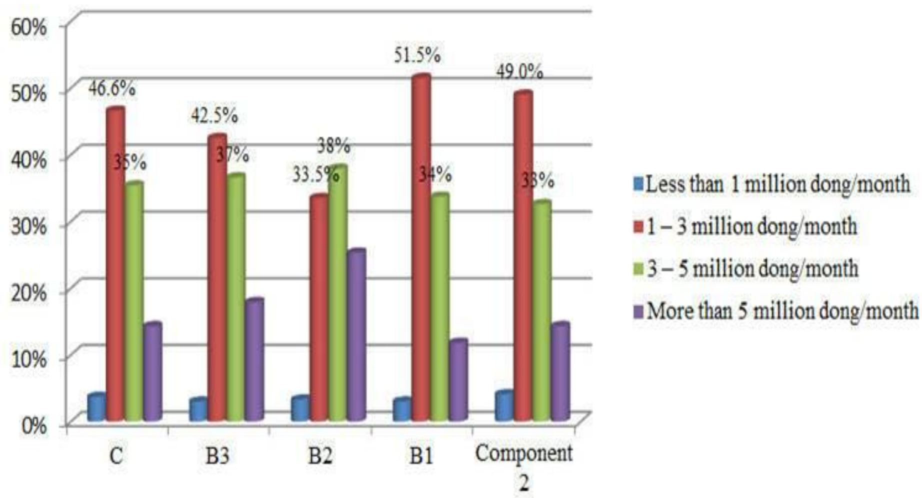


Figure 37. Income range of households in Project Basins

When the surveyed were asked about their average expenditure amount per month and distribution of expenditure by detailed categories were as follows: expense for food, health care, and children's studying. Generally, well-off households often spent more than poor/medium ones and well-off households' expenses for education, health care, electricity, water, travel, supporting others were higher than that of poor/medium households.

Living conditions of poor households in urban areas are highly vulnerable due to their limited income sources. Therefore, in the course of implementing the project poor and vulnerable households need to be addressed appropriately as in the event of temporary/ permanent impacts as a result of the project.

3.4.2.2. Scenic and cultural beliefs and sensitive receptors

Vinh Phuc is a province of many well-known natural landscapes such as: Tam Dao National Forest, Ban Long waterfall, Bo Lac lake, Dai Lai lake, Vac pond, Lang Ha lake; and many folk festivals and historical, cultural sites with spiritual value such as Tay Thien scenic, Binh Son tower, Tran Nguyen Han temple, Dong Dau relic, Hai Ba Trung temple, etc.

Table 37. The historic and archaeological culture places in the province

No.	Administrative unit	National level	Provincial level	Total
1	Vinh Yen city	03	04	06
2	Phuc Yen town	06	03	09
3	Binh Xuyen district	12	06	18
5	Tam Duong district	02	02	04

No.	Administrative unit	National level	Provincial level	Total
6	Tam Dao district	04	07	11
7	Vinh Tuong district	20	10	30
8	Yen Lac district	11	03	14
	Total	58	35	92

(*) Source: Survey of tourism resources in 2007 in Vinh Phuc province

The relics are ranked equally distributed in the districts. It is notable that most of the monuments ratings belong to the type of historical and cultural high value service to develop cultural tourism in the province. A typical number of monuments in the region include: Coi Pogoda (Hop Thinh, Tam Duong); Dong Dau archaeological (Yen Lac Town, Vinh Tuong); Tich Son Pogoda national relic, Ba Temple (Vinh Yen City); Bao An Pogoda (Phuc Yen town); Linh Bao Pogoda Cultural and historical monuments (Tan Cuong, Vinh Tuong); Cultural and historical monuments include: the Kinh Phuc Pogoda (Huong Canh town, Binh Xuyen); and the Bich Tri Temple (Tam Hop town, Tam Duong).

Historically, Vinh Phuc inhabitants organize festivals namely: (i) Religious festival: usually popular beliefs on worshiping gods (village tutelary, Mother Goddess) as the Mau Lam Festival of Vinh Yen with famous Mo dance; the Son Dong village festival in Lap Thach commune; and the one in Tho Tang. (ii) Historic festivals: associated with the commemoration of historical figures include: Ha Loi Temple Festival (Hai Ba Trung temple); Tay Thien, Tam Dao festival and Bach Tru festivals.

In the project area, there are no such historical or cultural sites affected by construction activites. In addition, there are several graveards that will be relocated at Dong Mong disposal site. As the cemetery area was being flooded during the survey period; therefore, it was impossible to observe. According to Project Affected People (Aps), many graves had been buried and several of which was unidentified.

2. During the detailed measuresment survey (DMS) process during implementation period, these impacts will be identified and compensated for land, displacement and reburial of graves. These compensation costs are mentioned in the policy framework prepared for the project and with the compensation and assistance principles established in this RAP, particularly the entitlement matrix in the Appendix 1.

The screening of environmental sensitive receptors (schools, clinics, temples, churches, graveyards, military compounds, state offices etc.) was made and it confirmed that transport activities may have certain impacts to some sites in regards of dust, noise and limited access and nuisance. Those potential sites are located along the transport routes and detailed in the below table.

Table 38 List of sensitive receptors along the transport routes by Project Sub-basins

No	Sub-basin	Transport routes	Receptors	Distance to route
1	B1	From PS to Kim Xa disposal site using Pho Day dyke Road 309 from Nhi Hoang Lake to Pho Day dyke to Kim Xa disposal	None	N/a
2	B2	Road 303 from PS, approach and discharge canals to Dong Mong disposal site	Dong Dau archeological site	120m
		Road 304 from PS, approach and discharge canals to Dong Mong disposal site	Tu Trung primary school Tu Trung secondary school, Tu Trung market Tu Trung Commune, Vinh Tuong District Yen Dong secondary school, Yen Dong Commune, Yen Lac District	50m 50m 70m 50m
		Yen Lac Road to Dong Mong disposal site	Yen Lac secondary school and Yen Lac high school, Yen Lac Town, Yen Lac District Kim Duong Pagoda, Tam Hong Commune, Yen Lac District	50m 30m
		Road from Thanh Lang Town, Tan Phong Commune, Binh Xuyen District to Dong Mong disposal site	Tan Phong communal clinic Tan Phong primary school	75m 30m

CHAPTER 4. ANALYSIS OF ALTERNATIVES

The development of "Vinh Phuc Flood Risk and Water Management Project" is fully consistent with the *"*National *Strategy on Natural Disasters* Prevention *and Mitigation up to 2020"* approved by the Government in Decision no.172/2007/QD-TTg dated 16/11/2007 and the *Urban Construction Masterplan for Vinh Phucup to 2030 with vision to 2050* and*Urban drainage planning of Vinh Phuc up to 2030 with vision to 2050*.

During the impact assessment of the project, the analysis of alternatives is an important stage in the assessment. The main objective of the analysis of alternatives is to identify location/design/technology applicable for a particular project component in order to minimize adverse impacts and maximize positive impacts. The analysis of alternatives is conducted for each component of the project, specially the component 1 in dredging, upgrading irrigation works for flood management and component 2 in researching to select locations, measures and technology for water pollution treatment and minimization for Phan River basin. The results of analyses are presented below.

4.1. THE 'NO PROJECT' ALTERNATIVE

The system of Phan River - Ca Lo River (the Project area) is the largest drainage basin of Vinh Phuc province accounting for nearly 60% of natural areas and 80% of the provincial population. The drainage catchment of the project area include the city of Vinh Yen (grade II urban area), Phuc Yen Town (grade III urban area) and most of the FDI enterprises of the province. The project area contributes a large budget revenue of about 26.5 trillion VND in 2014. Currently the project area has become an industrial hub of Red River Delta and is one important point to attract foreign direct investment (FDI) in the country. In case that the project is not implemented, the existing difficulties and obstacles will exaggerate and hamper socio-economic development of Vinh Phuc Province. These obstacles include:

i) Severely reduced capacity for flood risk control

Due to the natural terrain, most part of delta area in Vinh Phuc are low-lying land which is prone to regular floods. Especially, those areas having high risk are located in the basin of Phan River (the Project area). Flood has caused serious impacts on farming activities in rural areas as well as the production of FDI businesses at the industrial zones and factories, etc. The preliminary estimate on damage of floods from 2006 to 2013 is around 150 million USD including losses in agricultural production with about 30% of total harvested value; damage to infrastructure in both rural and urban areas; traffic interruption in Vinh Yen City; production interruption in many industrial zones causing long-term environmental - social consequences after flood; negative impacts on some human development indicators. The group of low income residents living in agricultural areas is most vulnerable to flooding situations.

Some recent research on the flow regime in downstream areas of Red River- Thai Binh River suggested an increasing rate of flood diversion from Red River via Duong River to Cau River downstream. The current rate is approximately 40%, nearly 1.5 times higher than that before the construction of Hoa Binh reservoir, tends to rise. In the future, along with the forecast of greater global sea level rise, the flood regime in Cau River is likely to cause more adverse impact on flood drainage capacity of the project area.

Therefore the process of climate change is detrimental to the project. In the future, increasing rainfall trends with limited drainage capacity of the project area that largely depends on the water level in Cau River will worsen flooding situation in the project area.

ii) Degraded regional water environment

Phan River in the province regularly receives a large volume of wastewater from production, animal husbandry and domestic activities along both sides of the river basin. It is noticeable that Phan River is flowing through Vinh Tuong and Yen Lac districts where a majority of most developed handicraft and animal husbandry villages of Vinh Phuc province locate such as Ly Nhan, Bich Chu, Tho Tang (Vinh Tuong), Te Lo, Dong Van, Minh Tan (Yen Lac), etc. The manufacturing and animal husbandry activities discharge a large volume of untreated wastewater and solid wastes with diverse pollutants into the basin. With the surging trend of urbanization, industrialization of Vinh Phuc, the number of discharging sources will also increase. If not well controlled, the quality of the water environment will also be at serious risk of degradation. Through the actual survey, the main sources of wastes discharged into Phan River include:

** Solid wastes:*

Almost communes located along Phan River have daily waste collection team for each hamlet. However, collected wastes are usually discharged at uncontrolled places without planning. Wastes are generally gathered at the rear of villages, in the middle of fields or near the bank of Phan River; for example, in Son Tang hamlet, Vinh Son commune, Huong Bridge dumpsite - Tho Tang town, daily dumpsite near Thuong Lap Bridge, etc.

In addition, in some communes like Dong Van (Yen Lac), Te Lo (Yen Lac), Vu Di (Vinh Tuong), etc., there are businesses of garment, scrap collection, disassembling used mechanical equipment, etc. Though a small part of wastes of these industry villages is reused, most is discharged directly along the bank of Phan River.

The fact that domestic and industrial wastes are not properly collected and treated has been causing direct impacts on Phan River such as obstruction of flow, aesthetic damage, water pollution which many affect the health of people living in the region.

** Wastewater*

The surveyalong the basin of Phan River shows that wastewater from households and small production facilities in the residential area are directly discharged into culverts of the residential area, then drained to the basin of Phan River, especially in small towns like Tho Tang, Yen Lac, Huong Canh, Vinh Yen City and some residential areas in the communes along the basin of Phan River. The domestic wastewater contain a high organic and decomposable content that will reduce the quality of water in Phan River (highly increased content of organic substances, reduction of dissolved oxygen, increased pathogenous microorganism, etc.).

- ✓ In addition to domestic wastewater, the basin of Phan River also industrial waste water from industrial zones and clusters, craft villages, animal farms and waste water from other agricultural cultivation areas.
- ✓ Regarding wastewater from industrial parks and clusters, the survey shows that many industrial facilities such as Binh Xuyen IP, Ba Hien IP, Ba Thien industrial cluster, etc are discharging into Phan River. Nevertheless, they have concentrated wastewater treatment systems where wastewater is collected and treated before being discharged.
- ✓ Wastewater from craft villages: In the concerned area of the project, there are currently 12 craft villages in operation (7 carpentry villages; 01 pottery village; 01 cotton and fiber cloth village; 01 plastic recycling village; 01 waterway transportation mechanical village; 01 silk village). The wastewater from these villages also contribute to the pollution of Phan River.
- ✓ Wastewater from animal husbandry: Animal husbandry activities are common in the project area. Although there is no concentrated animal husbandry farm, most of families in rural areas raise poultry and livestock. The scale of animal husbandry is small and individual, spreading all over the river basin, and even on the surface water of the river. The wastewater from household animal husbandry is also discharged into the common drainage network of villages and communes, therefore, the waste water in culverts mixed with the daily waste water at the end of the discharge source.

Wastewater from agricultural cultivation areas: The agricultural cultivation itself does not generate wastewater. However, the runoff rainwater from agricultural cultivation areas is regarded as water contaminant as local people use chemical fertilizers and pesticides during the cultivation process. The wastewater from these areas usually contains residual pesticides and high content of organic substances. However, this source of waste water disperses and spreads all over the locality so it is very difficult for collection and treatment.

iii) Obstructing the realization of industrial and urban planning in Vinh Phuc Province

According to the spatial planning of Vinh Phuc, the project are will be built into large urban areas, while Vinh Phuc City is of grade I, serving as "nuclear", which aims to develop Vinh Phuc province into a centrally affiliate city during the decade of 2020s. The project area will serve as an integrated economic area with potential for industrial development, services, ecological agriculture and an important transport hub of the northern region and the country.

In the absence of the proposed project, the development of residential areas, urban and industrial areas with associated ground clearance is likely to reduce the area of existing lowlands that in turn shrink capacity to regulate regional water flow. The maximum flooding level will likely lead to greater flooding for the project area.

In short, in the near future along with the process of socio-economic development and adverse fluctuations of climate change, if there is no effective solution through the implementation of the project, the flooding and water pollution of the project will become worse. This will have substantial impact in sustaining higher growth and realizing medium and long term development plans of Vinh Phuc Province.

4.2. THE 'WITH PROJECT' ALTERNATIVE

Vinh Phuc flood risk and water management project includes 3 components: Component 1- Flood risk management; Component 2- Water environmental management; Component 3- Project implementation support and Institutional strengthening. The component 3 is supportive for establishment of institutional measures in project management. Therefore, the report only focuses on analyzing Component 1 and Component 2. The analysis results are presented below.

4.2.1. Component 1 - Flood Risk Management

In this component, the project has many investments in 4 different basins and sub-basins. For some investments, different alternatives are proposed and consulted with relevant authorities and local community. From that, best options are selected in terms of location, and design. Particularly:

Thedrainage plan for Basin B is designed on the existing natural conditions (drainage by gravity, flooding level, etc.). The flooding scenarios are established on the basis of hydraulic modelling analysings to stimulate and evaluate the existing flooding conditions in the project area without pump station corresponding to the rain frequency and designed water level of repetitive floods (1 year, 2 years, 3 years, 5 years, 10 years, 15 years, 20 years, and 25 years). From that, drainage basins are delineated and designed; and locations of drainage investments are proposed and selected.

4.2.1.1. Kim Xa sub-basin (B1):

a) Alternatives for the location of Kim Xa pumping station

The drainage in Kim Xa sub-basin is carried out to actively drain flood water and reduce flooded area in the basin itself and to reduce drainage pressure for Ngu Kien sub-basin (B2) and Nguyet Duc sub-basin (B3) in the downstream of Phan river.

Based on the determination of suitable drainage pumping range for the basin, with criteria of maximum 5 rainy days and drainage in 7 days, the project has set up drainage scenarios. There are two alternatives for on the location for the Kim Xa pumping stations. The alternatives analyses based on investment cost, social and environmental impacts aspects of the location of Kim Xa pumping station is presented in the Table below.

Table 39. Analysis of alternatives for location Kim Xa pumping station

	Option 1 ***(selected option)***	***Option 2***
Site description	Pumping station at K13+300 on left dyke of Pho Day River in Hoang Dan Commune, Tam Duong District	Pumping station at K17+430 on left dyke of Pho Day River in Kim Xa Commune, Vinh Tuong District
Design solutions relevant to the	- Constructing 01 pump station with capacity of 30 m^3/s	- Constructing 01 pump station with capacity of 35 m^3/s

	Option 1 ***(selected option)***	***Option 2***
locations	- Rehabilitating culvert at K3+128 to ensure drainage flow of 56.3 m^3/s - Dredging Nhi Hoang Lake to elevation +9.00m - Replacing 10 valves at regulation gate K11+369 to delineate drainage basins - Approaching canal: connecting end point of Nhi Hoang Lake, 22.75m long, trapezoidal section, slope factor = 1.5, canal bed width = 42.0m, bed elevation +7.0m. Paved with stone M100. - Discharging canal: crossing with the dyke over alluvial land to Pho Day River, 313m long, bed width 10m, bed elevation +10.2m, slope factor = 2.0. Clay paved.	- Rehabilitating culvert at K3+128 to ensure drainage flow of 56.3m^3/s - Dredging Nhi Hoang Lake to elevation +9.00m - Upgrading Nghia Lap 8 valve gate from gravity drainage gate to regulation gate to delineate drainage basins - Approaching canal: connecting Pho Day River to the pumping station, 1.1km long, trapezoidal section, slope factor = 1.5, bed elevation +6.26m. Clay paved. - Discharging canal: draining to Pho Day. A 10m long wall of M200 concrete is built to ensure safety as the gate is placed at the riverbank.
Drainage efficiency	Part of the area relies on gravity based drainage As approaching canal is placed near Nhi Hoang lake, leakage along the canal is small thusthe efficiency for the regulation lake is higher.	All area will be pumped for drainage Efficiency of the regulation lake is lower as it is wholly dependent on the function of the pumping station.
Investment cost	11,221,210 USD	12,295,753 USD
Social impact	The acquired land area for construction work is 188,255 m^2 and 20 HHs will be affected. The acquired area is mainly aquaculture ponds in Kim Xa Commune.	The acquired land area for construction work is 225,055 m^2 and 20 HHs will be affected. The acquired area is mainly 2 crop rice fields
Environmental impact	As construction location is quite distant from the main road, therefore during construction period, there will be higher impacts on surrounding community as thetransportation of dredged material and construction materials has to use routes passing through residential areas	As construction location is near the main road lower impacts of transportation of dredged material and construction materials on surrounding community are expected.
Conclusion	Compared to option 1, the option 2 cause higher environmental impact to local community during construction period; however, these impacts could be mitigated by applying good construction practices. On the other hand, the option 1 is better as it causes less land acquisition, lower investment cost and higher drainage efficiency of the regulation lake. In considered all	

	Option 1 *(selected option)*	*Option 2*
	aspects, the option 1 is selected.	

b) Alternatives analyses on the design of Kim Xa disposal site

Table 40. Analysis of alternatives to design of Kim Xa disposal site

	- **Option 1**	- **Option 2(selected option)**
Design	Embankment and dredged material will be disposed to the elevation +17.0; and construction of routes for transporting vehicles of dredged material. Total area: 10.3 ha	No embankment, dredged material is disposed into the lowlying part to the average elevation +11m. Total area: 3.8 ha
Storage capacity	618,000 m^3 Can store 100 % of total volume of dredged Lmaterial from sub-basin B1	64000 m^3 Can store 12.4 % of total volume of dredged materials from material from sub-basin B1. The rest will be disposed to Dong Mong disposal site in B3,
Investment and operation cost	Lower	Higher as about 88% of the sludge should be disposed at sub-basin B3, which results in higher cost for transportation of dredged material
Social impact	The acquired land area of10.3ha and 56 HHs affected on their single crop of vegetable cultivation	The acquired land area of3.8 ha and no HH affected. It is the low land unsuitable for culvation and managed by Kim Xa Communal People's Committee
Environmental impact	- As the capacity is higher, thus the environmental impacts regarding dust, emission and ordor are higher - The elevation of the site is higher than the floodplain, during the flooding season, the whole site could be submerged into Pho Day Riverand thus hamper the drainage capacity of Pho Day river.The environmental impacts are huge. This optionis assessed as infeasible.	As the capacity is lower, thus the environmental impacts regarding dust, emission and ordor are lower. - The dredged material are disposed at the low lying part of the site, and not higher than the floodplain of Pho Day river, and thus will not affect the drainage capacity of Pho Day river during rainy season
Conclusion	Compared to the 2nd option, option 1 has more storage cacacity needed for the disposal of dredged material from sub-basin B1, thus it will save the cost	

	- **Option 1**	- **Option 2(selected option)**
	for transportation and disposal of dredged material in this B1 sub-basin. However, Option 1 is not selected as it causes huge environmental impact regarding the drainage capacity of Pho Day river during the flooding season. Option 2 is selected in consideration of all aspects, especially it ensures the drainage capacity of Pho Day river during operation.	

4.2.1.2. Ngu Kien sub-basin (B2)

a) Alternatives analysis for the locations of Ngu Kien pumping station

In case that the pumping station capacity of 35 m^3/s is selected, four options for location are presented in correspondence with K13+200, K17+000, K16+850 and K17+100. The impact assessment regarding social, environmental and cost aspects for each option is described in the below table.

Table 41. Alternative analysis of location for Ngu Kien pumping station

	Option 1	**Option 2**	**Option 3**	**Option 4**
Location	K13+200	K17+000	K16+850	K17+000
Investment cost	8,656,920 USD	8,591,137 USD	8,634,079 USD	8,588,396 USD
Social impact	The acquired land area is 32 ha with 03 households (HHs) relocated	The acquired land area is 32 ha with no households to be relocated	The acquired land area is 32 ha without relocation	The acquired land area is 32 ha with 02 HHs relocated
Environmental impact	Higher risk of subsidence and erosion due to complicated geographical and topographical conditions. It requires supplementary survey on local geography and hydrology.	Lower risk of subsidence and erosion due to stable geographical conditions. The site is far from residential area and lesser environmental and health impacts on local community are expected.	Cam Vuc Lake can be used as regulating lake in front of the pumping station. However, the risk of subsidence and erosion will be very high due to unstable geographical of the site. It is also close to neighborhoods and creates higher impacts	No geographical data is available and risk of subsidence and erosion is not assessed. It requires supplementary survey on local geography and hydrology. The site is close to neighborhoods and creates higher impacts

	Option 1	Option 2	Option 3	Option 4
Conclusion	Alternative 2 is expected to incur the least environmental impacts. Regarding the social aspect, while the total area of land acquisition is the same in 04 options, the number of households to be relocated in this option 2 is lowest. As a result, this option 2 is selected			

Alternatives analysis for the alignments of approachingand dischargingcanals of Ngu Kien pumping station

With the above selected location, 3 alternatives to alignments of inlet and discharging canals for Ngu Kien station are proposed. Against which aspects of scale, investment cost, social and environmental impacts are analysed in the following table.

Table 42. Alternatives analyses for alignment of discharging and approaching canals of Ngu Kien pumping station

Alternatives	**Option 1**	**Option 2 (selected)**	**Option 3**
Technical	- Approaching canal: 6.1 km long; - Discharging canal: 3.1 km, - The approaching and discharging canals traverse the residential area and agricultural land	- Approaching canal: 5.9 km long - Discharging canal, 3.8 km long - The approaching and discharging canals only traverse the agricultural land	- Approaching canal: 3.9 km long - Discharging canal: 5.7 km long - The approaching and discharging canals only traverse theaquaculture pond and small part of residential land.
Investment cost	5.66 US$ mil.	7.06 US$ mil.	5.88 US$ mil.
Social aspect	42.96 ha is acquired for approaching canal and discharging canal (agriculture land). 75 HHs are affected	44.42 ha is acquired for approaching canal and discharging canal (agriculture land). 42 HHs are affected	40.52ha is acquired for approaching canal and discharging canal (pond and farming land managed by the commune). No HH is affected.
Environmental aspect	Highest environmental impacts during construction period are highest as the canals pass through residential area.	Lowest environmental impacts during construction period as the canal alignments traverse the vacant and residential land.	Low environmental impacts during construction period as the the canal alignments traverse the residential land and small area of residential land

Alternatives	Option 1	Option 2 (selected)	Option 3
Conclusion	While Option 2 has the highest investment cost, it incurs lowest environmental and social impacts, including the lowest number of affected HHs. Therefore, Option 2 is selected.		

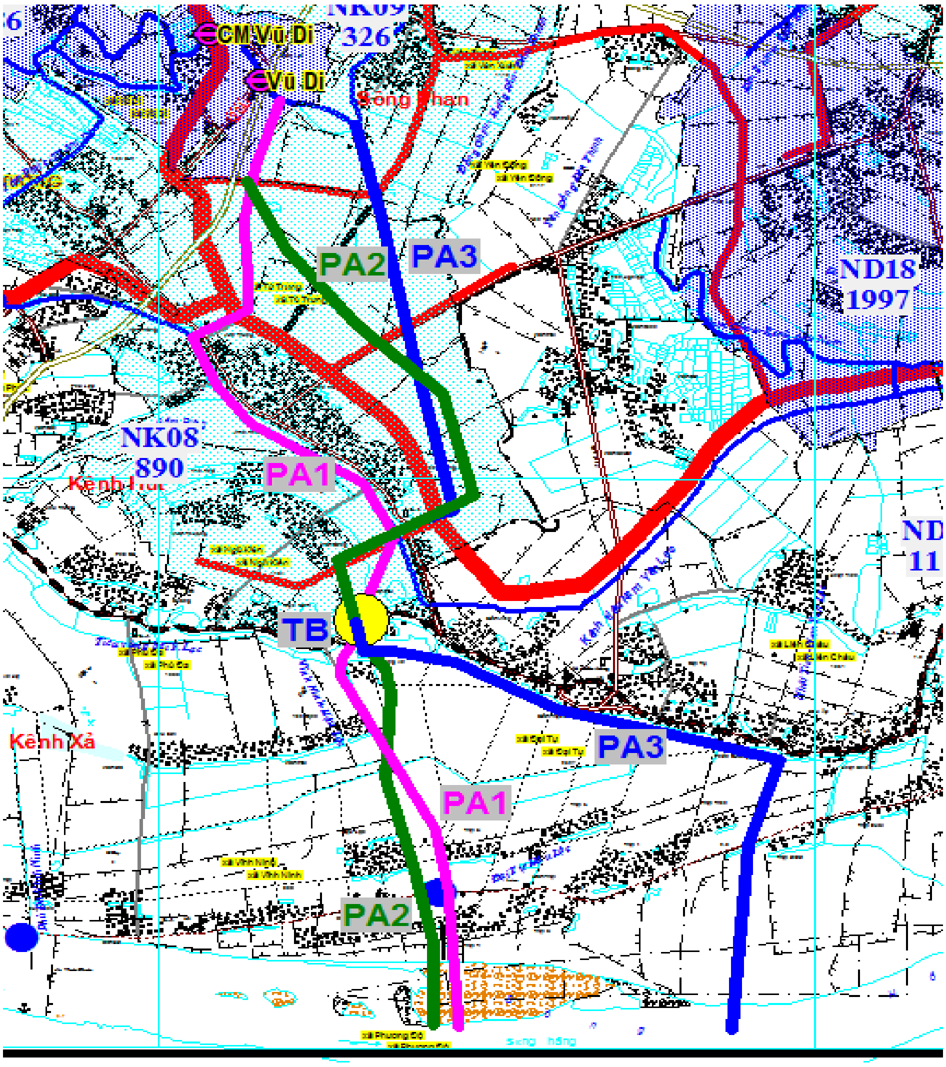


Figure 38. Alternatives to approaching and discharging canals of Ngu Kien pump station

b) Alternatives to the construction of Vinh Ninh disposal site

Vinh Ninh site is planned in the alluvial land in Vinh Ninh commune, Vinh Tuong district. The flood control dyke system of Red river includes the primary dyke with the height of 18.5 m; and the secondary dyke outside the primary dyke and next to the river at the height of 15.8 m.

To dispose the dredged material at sub-basin B2, the feasibility studies consultant proposed to construct one disposal site (namely Vinh Ninh) located outside the secondary dyke of

Red River, on the river floodplain, with the capacity of either 11.6 ha. The disposal site is embanked to the elevation of about +15.5, divided into different cells and routs along the cells will be constructed to transport the excavated materials.

As the elevation of the disposal site is approximately similar to the secondry dyke, the site will act as an obstruction to the flow of the Red River and thus serioulsly affecting the flood drainage capacity of Red River. There is no other alternative on location proposed for the disposal site at sub-basin B2. Thus, it is determined that, no disposal site will be constructed in sub-basin B2. Instead of that, the excavated material will be disposed at Dong Mong disposal site at sub-basin B3.

4.2.1.3. Sub-basin B3 (Nguyet Duc):

The hydraulic modelling shows that with pump flow of Q = 80 m^3/s in Nguyet Duc pump station and combination with operational Ngu Kien and Kim Xa pump stations the entire Basin B area will be pumped up in 7 days.

a) Alternatives analysis for the location and design of Nguyet Duc pumping station

There will be two alternatives for the location of station as well as inlet and discharging canals. The alternative analysis is presented in the following table.

Table 43. Alternative analysis for location and design of Nguyet Duc pumping station

	Option 1 **(Selected)**	**Option 2**
Location	Km26+930 on the right dyke of Red River in Yen Phuong Commune The investments are located within the boundary of Vinh Phuc province	Km 30+110 m on the right dyke of Red River in Nguyet Duc Commune (at the 23 valve gate). The investments are lcoated in both Hanoi and Vinh Phuc province.
Scale of main investments	- Regulation lake in front of puming station needs to be constructed. - Approaching canal: 7.71 km long; connecting the Sau Vo lake and the regulations lake in front of the pumping station. The approaching canal include 03 successively sections: Dong May 2 canal of 1.58 km long; Vuon Song Canal of 2.16 km long; and a newly constructed canal (2.71 km). - Discharging canal: 3.15 km long, traversing the alluvial land and an existing drainage canal to Red River via the back dyke in Trung Kien	- Regulation lake does not need to be constructed. - Approaching: 30 km long, using Ca Lo Cut River as approaching canal and the regulating lake for the pumping station. - Discharging canal: 6.2km long, using the existing drainage to downstream of the 23-door sluice gate. It requires dredging this canal

	Option 1 (Selected)	**Option 2**
	commune, Yen Lac district.	to facilitate discharge into Red River.
Flooding control capacity	- Better than option 2 as the approaching and discharging canals are shorter	- Flooding control capacity is lower than option 1
Investment	40.9 US$ mil.	41.7 US$ mil.
Social impact	The acquired land areais 100.3 ha and 11 HHs will be relocated. Land acquisition is less complicated as the site is situated only in the area of Vinh Phuc province.	The acquired land area for the pumping station 70.0 ha and 70 HHs will be relocated. Thus, land acquisition is more complicated as the site is situated in 2 districts of two different provinces.
Environmental impacts	The amount of dust and emissions generated during construction will be greater due to larger volume of dredged material (for building regulating lake in front of the pump station with an area of 21ha). The affected mainly include residential community in Yen Lac district, Vinh Phuc province residing along the approaching canal and around the pump station.	The amount of dust and emissions generated during construction will be lesser (by utilizing Ca Lo Cut as regulating lake). However, due to longer canal length (30km) impacts are expected greater. The affected mainly include residential community in Yen Lac District, Vinh Phuc and in Me Linh District of Hanoi residing along the approaching canal and around the pump station.

Compared to option 1, option 2 requires more land acquisition and will cause less environmental impacts during the construction period. However, option 1 is more advantagesous as the land acquisition process will be less complicated, the flood control capacity is higher, and the construction cost and the number of affected households are lower. Therefore, option 1 is selected in consideration of all aspects.

4.2.1.4. Basin C:

The Binh Xuyen river system including Cau Bon River, Tranh River, Ba Hanh River and Noi River is the only natural drainage flow in the project area. These rivers flow in the winding terrain with many bendsrequiring adjustment in alignment.

During the rehabilitation, there are two bending sections will be adjusted to enhance the flood capacityi.e. 0.5 km of Cau Bon River and 0.27 km of Tranh River. The alternative analysis is described following.

Table 44. Alternative analysis for Basin C

	Option 1	**Option 2** **(Selected)**
Scale of Work	- Dredging all 04 rivers in C basin no adjustment on the alignment of the rivers. Total length of the rehabiliatated rivers is 22.6 km, including: Cau Bon River: 7.9 km, Tranh River: 6.4 km Ba Hanh River:7.5 km Noi River:0.8 km	- Dredging all 04 rivers in C basin with adjustment on some winding section in 0.5 km of Cau Bon and 0.27 km of Tranh river Total length of the rehabiliatated rivers is 21.76 km, including: Cau Bon River: 7.67 km, Tranh River: 5.88 km Ba Hanh River: 7.5 km Noi River: 0.8 km
Drainage and flood control capacity	Unsatisfactory with 5 day rain frequency	Satisfactory with 5 day rain frequency
Technical	- Less difficult	More difficult as it requires comprehensive hydraulic analysis to ensure drainage capacity and prevent soil erosion at the river bank.
Investment	7. 88 US$ mil.	8.84 US$ mil.
Social impact	17.7 ha of acquired land area and 90 affected HHs	18.6 ha of acquired land area and 100 affected HHs
Environmental impact	Lower volume of earthworks and least environmental impact during construction	Larger volume of earthworks and medium environmental impact during construction
Conclusion	The option 2 require higher investmentcosts, technically more difficult, and cause higher environmental and social impact. However, these impacts could be mitigated via appropriate design and measures. Option 1 is selected as it ensures the drainage capacity in the extreme condition.	

4.2.2. Component 2- Water Resource Management

4.2.2.1 Alternatives analyses to the types ofo drainage system

Table 45. Analysis of alternatives for type of drainage system for towns and rural areas

	Option 1	**Option 2**	**Option 3 (Selected)**
Type of the collection system	- using existing combined drainage systemwhich has no interceptor	- construction of new separated system	- using existing combined drainage system. In addition, construct interceptor to separate wastewater from the combined network to the treatment station during dry season.
Economics	Not requiring extra investment	Large invesment	Medium investment
Planning and Management	Consistentwith the existing drainage system inrural area. - management is simple	Only suitable with the new residential areas and new urban areas. Management of more complicated as the system contains two separate rainy and waste water networks	Consistent with the residential area under improvement. Management is relatively complicated
Environmental aspect	-Wastewater is not collected and treated causing serious pollution to the environment. - If the wastewater are collected for treatment, the capacity of the treatment system will be high and treatment efficiency is low.	- Environmental sanitation is best compared to other options as the wastewater is collected and treated throughly.	- Environmental sanitation is relatively good as wastewater are colleted and treated(during dry season or at low rainfall level) or being diluted with storm water (during the rainy season).
Social impact	Lowest level of land acquisition as it based on the existing drainage network	land acquisition is highest to contruct both rain and wastewater network	Medium level of land acquisition for the construction of the interceptor.

	Option 1	Option 2	Option 3 (Selected)
Conclusion	Among the three analysed option, option 2 bring about highest positive impact on environment. However, the cost is highest and it is not consistent with the planning. Option 1 does not bring about good environment sanitation. Option 3 is selected in consideration of all aspects, i.e. the efficiency of wastewater treatment and collection are relatively good, the cost is acceptable and it is consistent with the planning.		

4.2.2.2. Alternatives to wastewater treatment technology

Based on projection of population, estimate of water consumption and average wastewater volumes in the rural areas and towns, scale of wastewater treatment facilities is recommended as follows:

- ✓ In towns: A total of 5 treatment plants of which 3 stations having a capacity of 1.000 m^3/day-night or less and 2 stations with a capacity greater than 1,000 m^3/day (1300 and 1700 m^3/day);
- ✓ In rural area: 33 facilities with capacity range of 50-280 m^3/day-night.

Based on the criteria of wastewater input quality and standard wastewater after treatment, 3 different treatment technologies are proposed to choose from. The alternative analysis is shown in the following table:

Table 46. Comparing alternatives for waste water treatment of Component II

	Option 1	Option 2 (Selected)	Option 3
Technology	Wastewater treatment using biological ponds	Septic tank combined with with plant filtration	Wastewater treatment using biological filtration tank.
Treatment process	Wastewater - Trash trap - Anaerobic pond - Facultative pond- aerobic pond	Wastewater→ trash trap → Septic tank → Plant filtration → Recipient sources	Wastewater - Trash trap - Primary sedimentation tank - biofilter tank - secondary sedimentation tank - Disinfection
Economics	- Low investment costs - Simple design and construction - Simple management andoperation. - Very low cost management and operation.	- Low initial investment costs - Simple design and construction. - Simple management andoperation. - Very low cost management and	- High investment costs - Complex design and construction - Complex operating procedures are, requiring high skilled operators. - High O&M costs

	Option 1	**Option 2 (Selected)**	**Option 3**
		operation.	
Treatment efficiency	- Treatment efficiency is lowest -Treatment of SS, BOD is guaranteed. - Treatment of N and P is more difficult, only by water microorganism and thus require long time.	- Treatment efficiency is relatively high. -Treatment of SS, BOD is guaranteed. - Treatment of N and P is more efficient via the biosynthesis by plant.	Highest efficiency as it include disinfection step.
Environmental impact	- Generated sludge amount is not high - Causing bad odor, discomfort (especially in summer) or contaminating algae, causing eutrophication and contamination of water sources - Causing a source of concentrated pollution if not well protected, managed and maintained, or when overloaded,toxic shock.	- Generated sludge amount is not high - Odor and emissions (CH_4, H_2S, CO...) from the processing system is low and it does not require large isolation distance to residential areas.	-Requiring treatment of generated sludge. - Odor and emissions (CH_4, H_2S, CO...) from the processing tank, especially anaerobic treatment tank are high,which requires large isolation distances to residential areas.
Social impact	Require highest level of land acquisition	land acquisition is relatively high	Land acquisition is lowest
Conclusion	Through analysis of three alternatives shows that the 2nd alternative is the most efficient in terms of technical, economical and suitable to the conditions of the towns and rural neighborhoods in the project area. The social and environmental impacts are acceptable and controllable. Therefore, Alternative 2 is selected.		

CHAPTER 5.
ENVIRONMENTAL AND SOCIAL IMPACTS ASSESSMENT

5.1. ENVIRONMENTAL IMPACTS ASSESSMENT

5.1.1. Potential Positive Impacts

According to the Vinh Phuc Provincial Urban Development Plan until 2030 and vision to 2050, the province is divided into 3 zones: (1) Urban, industrial and service zone; (2) Agro-forestry and aquacultural development zone; and (3) natural preserve and tourism development zone. Among them, the urban, industrial and service zone includes the entire Vinh Yen city, a part of Phuc Yen town and a part of Binh Xuyen, Tam Duong, Yen Lac and Vinh Tuong Districts. This zone creates a sustainable prime, based on an urban construction, combining economic development and social life improvement and environmental protection. This zone meets the criteria of urban category 1, playing an important role in the whole country and Northern key economic zone.

Therefore, the project area is being zoned and in the future, the core center urban (Vinh Yen city) will become Hanoi capital's satellite urban. The project implementation is appropriate with Vinh Phuc Provincial Urban Development Plan until 2030 and vision to 2050. When the project is implemented, it will bring positive impacts on environment aspect as follows:

- ✓ Step by step implementing Master Plan on drainage solution on Ca Lo River and Phan River downstream of Vinh Phuc Province
- ✓ Controlling flooding risks, participating in cutting, decreasing and controlling flood on Ca Lo River and Phan River downstream
- ✓ Improving capacity of flood discharge and controlling for Phan and Ca Lo Rivers, serving water using demand of communes alongside this river system;
- ✓ Controlling flooding risks for 5.000 ÷ 7.000 ha agricultural land in Basin B and C that contributes to reduced crop loss and improved yields without expanding farming land area and number of crops.
- ✓ Upgrading infrastructure at rivers and water discharge canals when there are heavy rains which cause flood. Building trust in attracting FDI in exploiting infrastructure near the area connecting with Hanoi – Lao Cai Highway. Focusing on attracting investment for developing industrial areas in the province, such as Binh Xuyen, Ba Thien, Tam Duong and inland container port (ICD).
- ✓ Improving people's lives, creating jobs for thousands of labours on spot, limiting social problems, stabilizing social safety and orders via socio-economic development.
- ✓ Ensuring safety for the construction works in the project area.
- ✓ Improving ecological environment via improving existing rivers and reservoirs such as Phan, Tranh, Ba Hanh, Cau Bon and Noi Rivers. Improving reservoirs such as Rung, Sau Vo and Nhi Hoang Lakes, contributing to creating green space, promoting tourism development in Vinh Yen city

5.1.2. Potential Negative Impacts on Basin-wide Project Area

5.1.2.1. Types and Scale of Impacts

Based on the analysis of baseline data, field visits, and discussion with key officials and stakeholders, the potential negative impacts on the physical, biological, and socio-economic environment caused by the project have been identified. Table 46 summarizes the potential impacts by the project components. The levels of impacts are assigned as follows: None (N) -no impact; Low (L) - Small works with minor impacts, localized, reversible, temporary; Medium (M) -Small /medium scale works with moderate impacts of which most are reversible, reducible and manageable, localized, temporary; High (H) -Medium scale works or large scale works with significant impacts (socially and/or environmentally) of which some are irreversible and require compensation. The residual impacts of the project, after implementation of mitigation measures discussed in Chapter 6, are mostly negligible.

In general, the project activities to be carried out under Component 2- Water Environmental Management, and will involve small and/or medium scale civil works, for which most of the potential negative impacts are reversible, temporary, and localized, and could be mitigated through the application of good engineering and construction management practices and with close supervision and monitoring of contractor performance and consultation with local communities.

The investments under the project component 1 are of larger scale, and will their impacts are not reversible of temporary. Notwithstanding their scale, however, their impacts can similarly be mitigated by the application of good engineering and construction management practices and with close supervision and monitoring of contractor performance.

Detailed assessment on negative environmental impacts in section 5.1.2. The social impacts are discussed in details in section 5.2 below.

Table 47. Summary of project environmental and social impacts

Stages	Physical environment			Biological environment		Social environment				Others		Remarks
	Air, noise, vibration	*Land, water*	*Solid waste, sludge*	*Forest, natural habitats*	*Aquatic life*	*Land acquisition, resettlement*	*Indigenous people*	*Physical cultural resource*	*Livelihoods, community disturbances*	*Flood/ transport/ security*	*Off-site impacts*	
Component 1: Flood Risk Management												
Sub-basin B1- Kim Xa: (i) Dredging Nhi Hoang retention lake with storage area of 750,000 m^3 on an area of 38.5 ha (ii) Construction of Kim Xa pumping station of 30 m^3/s; (ii) Construction and rehabilitation of two concrete culverts at K3+128 and K13+300; (iii) Excavation of a discharging canal of 355 m, include section 1 is from pumping station through dyke concrete culvert, 42 m long, concrete culvert and section 2 is soil canal, 313 m long, located outside the dyke; Construction of a soil approaching canal from Nhi Hoang Lake to the pumping station, 18.65 m long; (iv) Rehabilitating a 10-chamber control gate; (v) Construction of Kim Xa disposal site with a total area 3.8 ha and storage capacity of 64,000 m^3, to the elevation of 11.0-11.5 m; - Permanent land acquisition area: 767 affected households; temporary land acquisition of 66,900 m^2 with 20 affected households; estimated 35 households are temporarily impacts from aquaculture - The pumping station site is near the residential area in Hoang Lau Commune., about 50-100 m distant												
Pre-construction	c	L	M	N	L	H	N	N	M	L	L	- Impacts from small or medium scale constructions can be mitigated by ECOPs (see note (2) below this table) -Specific activities including UXO clearance, local inundation, need for borrow from outside, disturbance to resident (small road for transportation of excavated marials), water ecology, excavated and dredged materials, erosion of sludge disposal site
Construction	M	M	H	L	M	M	N	N	M	H	M	
Operation	L	L	L	N	L	N	N	N	N	L	N	- Ensure adequate O&M; livelihood restoration; erosion and sedimentation in the retention lakes, canals, and Phan river.
Sub-basin B2 - Ngu Kien: (i) Construction of Ngu Kien pumping station, designed capacity of 35 m^3/s; (ii) Dredging the Rung retention lake in front of the pumping station with the storage of 1.35 mil m^3 and the area of 30.9 ha; (iii) Construction of a reinforced discharging canal with 3-chamber culverts through Red River dykes with the length of 3.83 km; (iv) Dredging key sections along Phan River from Thuong Lap Bridge to Lac Y Bridge, with the length of 11.5 km; (v) Excavation of an approaching soil canal from Phan River to Rung retention lake with the length of 3.96 km and (vi) permanent land acquisition area:1,526,000 m^2,												

<table>
<tr><th rowspan="2">Stages</th><th colspan="3">Physical environment</th><th colspan="2">Biological environment</th><th colspan="4">Social environment</th><th colspan="2">Others</th><th rowspan="2">Remarks</th></tr>
<tr><th>Air, noise vibration</th><th>Land, water</th><th>Solid waste, sludge</th><th>Forest, natural habitats</th><th>Aquatic life</th><th>Land acquisition, resettlement</th><th>Indigenous people</th><th>Physical cultural resource</th><th>Livelihoods, community disturbances</th><th>Flood/ transport/ security</th><th>Off-site impacts</th></tr>
<tr><td colspan="13">- Permanent land acquisition area: 1,365 affected households; temporary land acquisition area 148,200 m^2, 15 affected households; estimated 85 households are temporarily impacts from aquaculture

- Sensitive areas include Dong Dau archaeological area (Yen Lac Town), Tu Trung primary school and Tu Trung secondary school, Tu Trung market (in Tu Trung Commune), Yen Dong secondary school (Yen Dong Commune) along the transportation route of the provincial road 304.</td></tr>
<tr><td>Pre-construction</td><td>L</td><td>L</td><td>M</td><td>N</td><td>L</td><td>H</td><td>N</td><td>N</td><td>M</td><td>L</td><td>L</td><td rowspan="2">- Impacts from small or medium scope constructions can be mitigated by ECOPs (see note (2) below this table)
- Specific activities including UXO clearance, local inundation, need for borrow from outside, disturbance to resident (small road for transportation of excavated marials), water ecology, excavated and dredged materials, erosion of sludge disposal site;</td></tr>
<tr><td>Construction</td><td>M</td><td>M</td><td>H</td><td>L</td><td>M</td><td>M</td><td>N</td><td>N</td><td>M</td><td>H</td><td>M</td></tr>
<tr><td>Operation</td><td>L</td><td>L</td><td>L</td><td>N</td><td>L</td><td>N</td><td>N</td><td>N</td><td>N</td><td>L</td><td>N</td><td>- Ensure adequate O&M; livelihood restoration; erosion and sedimentation in the retention lakes, canals, and Phan river.</td></tr>
<tr><td colspan="13">Sub-basin B3- Nguyet Duc Basin: (i) Dredging Phan River section from Vac Lake discharging canal to Sau Vo sluice gate with the length of 3.4 km; (ii) Rehabilitating 7.71 km approaching soil canal from Phan River to Sau Vo retention lake and Rehabilitating associated Sau Vo 2 sluice gate (iii) Dredging Sau Vo retention lake in area of 176.5 ha; Construction of 5.7 km asphalt service road (iv) Construction of a new regulating pond of 1.62 million m^3 in front of the pumping station with the area of 21ha; Construction of Nguyet Duc pumping station with capacity of 80 m^3/s; (v) Construction of 3.15 km discharging canal from the pumping station to Red River and Construction of associated 5-chamber sluice gates through the primary and secondary dykes of the Red River.; Construction of Dong Mong disposal site of 54.31 ha with the storage capacity of 1.62 million m^3; permanent land acquisition area:3,436,520 m^2,
- Permanent land acquisition area: 3,333 affected households; temporary land acquisition area 30,000 m^2 and no affected household; estimated 12 households are temporarily impacts from aquaculture in Sau Vo lake; 08 household being temporarily impact from fishing during offseason in Phan river (both B2, B3)

- Sensitive areas include: Yen Lac Secondary School and Yen Lac High School (Yen Lac Town), Kim Duong Pagoda (Tam Hong Commune), health station of Tan Phong Commune, Tan Phong Primary School (in Thanh Lang Town and Tan Phong Commune).</td></tr>
</table>

Stages	Physical environment			Biological environment		Social environment				Others		Remarks
	Air, noise, vibration	*Land, water*	*Solid waste, sludge*	*Forest, natural habitats*	*Aquatic life*	*Land acquisition, resettlement*	*Indigenous people*	*Physical cultural resource*	*Livelihoods, community disturbances*	*Flood/ transport/ security*	*Off-site impacts*	
Pre-construction	L	L	M	N	L	H	N	N	M	L	L	- Impacts from medium scale constructions can be mitigated by ECOPs (see note (2) below this table) -Specific activities including UXO clearance, local inundation, need for borrow from outside, disturbance to resident (small road for transportation of excavated marials), water ecology, excavated and dredged materials, erosion of sludge disposal site.
Construction	M	M	H	L	M	M	N	N	M	H	M	
Operation	L	L	L	N	L	N	N	N	N	L	N	- Ensure adequate O&M; livelihood restoration; erosion and sedimentation in the retention lakes, canals, and Phan river.
Basin C - (i) Dredging and rehabilitation of total 21.38 km of four rivers in Binh Xuyen district: Cau Bon River with length of 7.67km, Tranh River 5.054 km; Ba Hanh River 7.507km; and Noi River: 0.782km; (ii) Adjustment of alignment of some winding sections of Tranh River (0.27 km) and Cau Bon River (0.5 km). Embankment of some key sections of on Ba Hanh river with total length of 1.4 km (iii) Construction of two sluice gates structures at Ton Bridge and Sat Bridge and Permanently land acquisition area: 72,279 m^2, - Permanent land acquisition area: 398 affected households; temporary land acquisition area 15,000 m^2 with 20 affected households; 07 household being temporarily impact from fishing during offseason in Phan river (both B2, B3) - Sensitive areas include: residential area of Huong Canh Town with relatively high density of population and traffic.												
Pre-construction	L	L	L	N	L	H	N	N	L	L	L	- Impacts from medium scale constructions can be mitigated by ECOPs (see note (2) below this table) -Specific activities including UXO clearance, local inundation, need for borrow from outside, disturbance to resident (small road for transportation of excavated marials), water ecology, excavated and dredged materials, risk on river bank erosion and embankment subsidence.
Construction	M	M	M	L	M	M	N	N	M	H	M	
Operation	L	L	L	N	L	N	N	N	N	L	N	- Ensure adequate O&M; livelihood restoration;

Stages	Physical environment			Biological environment		Social environment				Others		Remarks
	Air, noise vibration	*Land, water*	*Solid waste, sludge*	*Forest, natural habitats*	*Aquatic life*	*Land acquisition, resettlement*	*Indigenous people*	*Physical cultural resource*	*Livelihoods, community disturbances*	*Flood/ transport/ security*	*Off-site impacts*	
												risk on river bank erosion and embankment subsidence.
Component 2- Water Environmental Management												
Scheme 1- Construction of wastewater collection and 05 treatment facilities at 4 towns: (i) Tho Tang: Construction of wastewater collection system: sewer network 1.7 km, 03 pumping station, 03 CSOs and Construction of 02 WWTPs at Nam Cuong Hamlet (1120 m^3/d) and Phuong Vien Hamlet (1969 m^3/d); (ii) Tam Hong: Construction of wastewater collection system: 6.95 km sewer network, 04 pumping station, 04 CSOs; 01 WWTP with the capacity : 2,157 m^3/d (iii) Yen Lac: Construction of wastewater collection system: 6.26 km sewer network, 06 pumping station, 03 CSOs, and 02 WWTPs in Dong Hai Hamlet with capacity of 780 m^3/d anf 01 station in Roc Ben lake with capacity of 1258 m^3/d (iv) Huong Canh: Construction of wastewater treatment collection system: 8.6 km sewer network and 07 pumping station, 05 CSOs to transport wastewater from Huong Canh town to Quat Luu treatment station in the old center of Vinh Yen City Permanently land acquisition area:9.2 ha, 35 affected households; temporary land acquisition area 0.92 ha with 25 affected households. - Sensitive areas include: residential areas in Dong Village (Yen Lac Town), Man De Village (Tam Hong Commune), and Tho Trang Town with high density of population; therefore, due attention should be given to the transportation of materials. Permanently land acquisition area:9.2 ha , 35 affected households; temporary land acquisition area 0.92 ha with 25 affected households.												
Pre-construction	L	L	L	N	L	H	N	N	L	L	L	- Small scale impacts, can be mitigated by ECOPs - Site-specfic impacts include UXO, soil erosion, and disposal of excavated materials.
Construction	L	M	M	N	L	L	N	N	M	M	M	
Operation	L	L	M	N	L	N	N	N	N	L	L	- Ensure adequate O&M; management of generated sludge from operation of the wastewater treatment facilities
Scheme 2- Construction of 33 small-scale wastewater collection and treatment plants with capacity range of 50-280 m^3/day, 9.33 km sewer network, 33 CSOs, 66 manholes of Vinh Tuong, Yen Lac and Tam Duong. - Permanent land acquisition area: 5.83 ha, 81 affected households; temporary land acquisition 0.583 m^2 10 affected households.												
Pre-construction	L	L	L	N	N	N	N	N	M	L	L	- Small scale impacts, can be mitigated by ECOPs - Site-specfic impacts include UXO, soil erosion, and disposal of excavated materials.
Construction	M	M	M	L	L	L	N	N	M	M	M	
Operation	L	L	L	N	L	N	N	N	N	L	L	- Ensure adequate O&M; management of

Stages	Physical environment			Biological environment		Social environment				Others		Remarks
	Air, noise vibration	*Land, water*	*Solid waste, sludge*	*Forest, natural habitats*	*Aquatic life*	*Land acquisition, resettlement*	*Indigenous people*	*Physical cultural resource*	*Livelihoods, community disturbances*	*Flood/ transport/ security*	*Off-site impacts*	
												generated sludge from operation of the wastewater treatment facilities.

Notes:

(1) Following criteria are used to assess degree of impacts: No (N) -no impact; Low (L) - small, site-specific, temporary impacts which are adjustable; Medium (M) -small works in towns/sensitive areas; medium work with moderate impacts which most of them can be reversible, minimized and managed, site-specific and temporary. High (H) - medium scale works in small towns/sensitive areas; large scale works with significant impacts (environmental and social) which many of them cannot be reversible and needs compensation; both M and H need supervision and implementation of mitigation measures as well as safeguards sanctions.

(2) Small and medium scale works with site-specific and temporary impacts that can be mitigated by application of advanced construction methods and sound management. It also needs strict supervision and community consultation.

Severely affected households: those households who loss over 20% of their land (or equal to 10% or more of productive land).

Displaced people (DP): those who are affected by involuntary land acquisition that results to:

- Relocation or loss of shelter
- Loss of assets or access to assets;
- Loss of income sources or means of livelihood, regardless of displacement or not; and
- Restricted legal access to parks or protected areas, causing adverse impact on their livelihoods.

Vulnerable group: Those are affected differently by the project’s adverse impacts and/or having difficulty in access to the benefits of the project and compensation, including livelihood restoration and compensation for assets, when compared with the rest of APs. Vulnerable people include people, regardless of gender, ethnicity, age, physical or mental disability, disadvantaged economic or social status, may be more severely affected by relocation in terms of economic or material regards compared to others and who may be more limited than other in capacity to claim compensation or resettlement assistance and related development benefits.

5.1.2.2. Impacts on Physical Cultural Resources (PCRs) and other sensitive receptors

PCR includes archaeological, paleontological, architecturally significant, and religious sites including graveyards, burial sites, and sites of unique natural value. Initial indications are that no observed physical or cultural resources will be affected by the project. Nevertheless, the Contractor is responsible for familiarizing themselves with the following “Chance Finds Procedures”, in case culturally valuable materials are uncovered during excavation.

In the project area, there are no such historical or cultural sites directly affected by construction activites. In addition, there are several graveyards that will be relocated at Dong Mong disposal site. As the cemetery area was being flooded during the survey period; therefore, it was impossible to observe. According to Project Affected People (Aps), many graves had been buried and several of which was unidentified.

During the DMS process, these impacts will be identified and compensated for land, displacement and reburial of graves. These compensation costs are mentioned in the policy framework prepared for the project and with the compensation and assistance principles established in this RAP, particularly the entitlement matrix in the Appendix 1 of RAP.

A list of sensitive receptors that are likely to be impacted by mostly transportation activites of dredged material to disposal sites is presented in Table 38. They include several schools, 01 market, 01 clinic house and 01 pagoda in a distance of 30-70m to the routes. If the transport is not properly organized and scheduled, these sensitive sites will be exposed to noise, dust, limited assess and nuisance, This impact is temporary and occur during construction period

5.1.2.3. Potential Impacts on Regional Landscape and Ecosystems

a. Impacts on regional landscape

As the project intervetions is carried out spreading over a large area of the provincemany construction works, the impacts on regional landscape are inevitable, especially in dredging works in Phan River, Binh Xuyen river system and lakes of Rung, Nhi Hoang and Sau Vo as well as from construction activities of discharging canals, pumping stations, and residential wastewater collection and treatment facilities. Landscape impacts are considered both positive and negative.

Negative impacts on landscape occur primarily during construction phase from earthworks, building activities, operations of construction machinery and transportation vehicles and subsequent generation of dust and emissions. However, these negative impacts are assessed as site-specific and short-term in the construction phase (details of impact assesment are presented below).

Positive impacts are expected during the operation phase of the works through rehabilited rivers of Phan, Tranh, Ba Hanh, Cau Bon and Noi and lakes of Rung, Sau Vo and Nhi Hoang. This will contribute to improved greenery and tourism development of Vinh Yen City.

b. Impacts on ecosystems and biodiversity

Within the project area there is no environmentally sensitive areas such as national parks, natural and biological reserves, biosphere reserves as well as no species in the red book. Therefore, the implementation of the project will have no impact on them.

During the project pre-construction stage, project activities mainly involve land acquisition and site preparation for construction in Basin B and Basin C. Therefore, the degree of impacts on the environment in general and on ecosystems in the area during this phase are assessed as not significant. Impacts on ecosystems are mainly on terrestrial ecosystem (along the riversides of Phan River and three-river network in Binh Xuyen) and aquatic ecosystems of the rivers and lakes to be dredged, improved, and built within the scope of land acquisition of the Project.

Terrestrial ecosystem

Land acquisition for construction of subprojects will have direct impacts on terrestrial ecosystem along Phan, Cau Bon, Tranh and Ba Hanh River basins. It also affects location where head works are built like pumping stations, approaching and discharged canals, dredged lakes (Rung, Nhi Hoang, Sau Vo).

Survey results show that plant and vegetation in the affected scope include agriculture plants (rice, sweet potato, etc.), fruit trees (longan, grapefruit, sapodilla etc.), timber trees (china-tree, bamboo, eucalyptus, etc.). Other shrubs could be cut down during land acquisition, like Senna Alata, Phyllanthus urinaria, Colocasia esculenta, Pistia stratiotes, Medecine of the King's Palace, basket plant, Cyperaceae, and weed.

The cutting down of the above plants also affect life of some animals, insects, bird, etc. However, number of species and quantity affected are small, mainly like frog, snake, and invertebrates living along the rivers and on the bank of the dredged lakes.

Aquatic ecosystem:

The entire project survey shows that the aquatic ecosystems include Phan River basin, 3 rivers of Binh Xuyen network in basin C, and lakes like So, Nhi Hoang, Rung, Sau Vo, discharging canals, irrigation system and ponds for fish raising after bidding managed by commune's people committees.

Species in the aquatic ecosystem mainly are fresh water fishes raised by local people, like black and red grass carps, tilapia, tench, etc., and some shellfishes like shrimp, snails, blood cockle, etc., and some aqua krills.

In addition, some aqua plants are also found in these aquatic ecosystem along Phan River basin and 3 rivers network in Binh Xuyen like water spinach (planted by local people), Eichhornia crassipes, Golden Shower, weed, etc. None of these species is listed as rare and endangered in the national and world red books.

All of these underwater species in the project area will be directly affected during the preparation and construction stages, which are unavoidable. However, given the scale and current situation of project area and the proposed construction methods these impacts are not serious and concentrated within the land acquisition area in Binh Xuyen, Yen Lac, Vinh Tuong districts and Vinh Yen city. These are temporary during the construction and they will be stable after operation.

5.1.2.4. Potential Impacts on Hydrology

a. Impacts on hydrology of Pho Day River of flood control investments in Kim Xa sub-basin (B1)

Kim Xa pumping station

This pumping station (PS) is designed for drainage pumping for 7.94 ha of sub-basin B1 (Kim Xa) with a capacity of 30 m^3/s. Water from Kim Xa basin will be pumped to Pho Day River through the discharging canal.

The average flow of Pho Day River in the flood season is 721 m^3/s and the river width at the discharge position is 800 m, the calculation results showed that, with the discharge volume of the PS of 30 m^3/s, river flow would increase by 4.2% and water level at the discharge position increase by about 1.3 cm.Scope of impacts extend only about 5 km downstream from the discharge location.During the operation of Kim Xa pumping station, the total flow of Pho Day river at this section will be 751 m^3/s, lower than the drainage capacity of Pho Day River of 833 m^3/s. Therefore, it is assessed that the impact by the water discharging from the Kim Xa PS to hydrological regime of Pho Day River is considered as negligible.

Discharging canal of Kim Xa pumping station

For the discharge canal of this PS (this area does not have the secondary dyke), as designed, water will be pumped from the PS to the culvert through Pho Day dyke then to discharging canal outside the Pho Day dyke. The discharging canal is made of soil with the bottom elevation of 9.5 mand top elevation of 10.2 m. The elevation of the floodplain surrounding the discharging canal is also 10.2. As the top elevation of the canal is similar to the elevation of the surrounding flood plain, thus the canal does not form an obstruction to the flow of Pho Day River, and consequently does not affect the hydrology of Pho Day River.

Impact of formation of Kim Xa disposal site on the flood drainage on Pho Day River

The 3.8 ha Kim Xa disposal site is planned in the floodplain outsie the dyke eft embankment of Pho Day River in Kim Xa commune, Vinh Tuong district,

Excavated material will be disposed at in the low part (the level of the natural lowest position is + 9.5m with an area of about 3.8ha) while level of the left embankment of Pho Day River is+20m, plain length from the riverbed about 85m; from the riverbed to the embankment base (the longest section) is 1000m.

This design showed that, the level of filled dump will be higher than the average level of the plain of 6.0m and lower than the left embankment level of Pho Day River from 1.9 - 2.2m.

Therefore, the formation of the disposal site would obstruct the flood drainage of Pho Day River when flood level rising higher than the average level of the plain. Following the recommendation by ESIA consultant the disposal site was redesigned to ensure the level of the disposal site should not exceed the existing natural average level of the area (+11.0m).

b. Impacts on hydrology of Red River of flood control investments in Ngu Kien sub-basin (B2)

Ngu Kien Pumping station (B2)

This PS is designed with a capacity of 35 m^3/s, ensuring the drainage for 12.34 ha of sub-basin B2. The PS discharging canal is located in Ngu Kien commune, Vinh Tuong district. Water will be pumped from the PS to through primary and secondary dykes of Red River the discharging canal.

Calculation results showed that, when water flow of the Red River in the flood season reaches 8,000 m^3/s and the average river width at discharge position is 2200 m, the maximum discharge flow of the PS is 35 m^3/s (accounting for only 0.43 % of river flow), water level at the discharge position will increase by 0.12 cm and scope of impact extends only about 1km downstream. During the operation of Ngu Kien pumping station at maximum capacity of 35 m^3/s, the total flow of Red River is 8,035 m^3/s, much lower than the drainage capacity of Red River of 18,000 m^3/s. Thus it is assessed that the impacts by water discharging from the Ngu Kien PS to hydrological regime of the Red River is negligible.

Discharging canal of the Ngu Kien pumping station (B2)

For the discharge canal of this PS, as designed, water will be pumped from the PS to the culverts through primary and secondary dykes of the Red River and then discharge to the canal section outside the Red River dykes.

The discharging canal is made of soil, 3.8 km long, 10-16 m wide with bottom elevation of +9.6-9.95 m, top elevation of +15.65 m. The elevation of secondary dyke at the discharging canal is +15.6 m, slope factor 1.5 with a through the secondary dyke. The top elevation of the discharging canal is not higher than the secondary dyke, thus, during the flood season it will not form an obstruction to the flow, and consequently does not affect the hydrology of Red River.

c. Impacts on hydrology of Red River of flood control investments in Nguyet Duc sub-basin (B3)

Nguyet Duc pumping station (B3)

The Nguyet Duc drainage PS with designed capacity of 80 m^3/s, ensuring the drainage for 19,600 ha of the sub-basin B3. Water will be pumped to through primary and secondary dykes of Red River through the discharging canal at Trung Kien commune, Yen Lac district.

Nguyet Duc Ps is 10 km downstream from Ngu Kien PS. The average flow of the Red River in the flood season is 8,000 m^3/s and the average river width at the outlets of PS Nguyet Duc is 2240 m. It is calculated that, with the discharge volume of the PS of 80 m^3/s, river flow would increase by 1% and water level at the discharge position increases by about only 0.14 cm and extends only about 3 km downstream from the discharging canal of Nguyet Duc PS. During the operation of Nguyet Duc pumping station at maximum capacity of 80 m^3/s, the total flow of Red River at this section will be 8080m^3/s, much lower than the maximum drainage capacity of Red River of 18,000 m^3/s. The impact of operation of Nguyet Duc pumping station to the hydrology of Red River is assessed as insignificant.

Discharging canal of Nguyet Duc pumping station

For the discharge canal of this PS, as designed, water will be pumped from the PS to the culverts through primary and secondary dykes of the Red River and then discharge to the canal section outside the Red River dykes.

By design, discharging canal from the Nguyet Duc pumping station will pass through the primary and secondary dykes of the Red River. The canal 3.15 km long and concretized with bottom is 8-15m wide, canal bottom elevation from +8.75 m, and top elevation from +14.82 m. The secondary dyke top elevation at the location of discharging canal is 14.82 m. As the top elevation of the discharging canal is similar to the elevation of the secondary dyke, this discharging canal will not affect the flood drainage of Red River.

Conclusions

It is estimated that a total of discharge flow of 115 m^3/s will be pumped from 02 PSs of Ngu Kien and Nguyen Duc to Red River and 30 m^3/s from Kim Xa PS to Pho Day River. However, water is then going from Pho Day River to Lo River and back to Red River (17 km upstream of Ngu Kien PS discharging canal). Therefore, the water flow in Red River will be increased by 145 m^3/s from the 3 PSs, which is insignificant compared to the maximum drainage capacity of 18,000 m^3/s in storm season.

d. Impacts on hydrology of Ca Lo River - down stream of Binh Xuyen Rivers system (Tranh, Cau Bon, Ba Hanh, Noi Rivers) in basin C

For Basin C, the project will conduct dredging of Binh Xuyen river network including Tranh River, Ba Hanh River, Cau Bon River and Noi River, construction and rehabilitation of 02 control gates Ton Bridge and Sat Bridge.

Figure 39. River system in the Project Area

The downstream of Binh Xuyen river network (i.e. Tranh, Ba Hanh and Cau Bon) is Ca Lo River that flows to Phuc Loc Phuong outlet then to the Cau River (see Fig 38 above), chapter 3). When the project is not implemented, water from the 3 rivers and Basin B flow to Ca Lo River then to Cau River. This results in increased risk and extent of flooding for Ca Lo River basin. Under the project, two control gates, Sat Bridge and Ton Bridge will be constructed. During the flood season, these gates will prevent flood water flowing from Basin B to Ca Lo River and only allowing water from Binh Xuyen river system flows downstream of Ca Lo River then to the Cau River. The water from basin B will be pumped to Pho Day and Red River through the constructed pumping stations.

Hydraulic calculation results with 10-year flood cycle (as shown in Table below) express that along with the construction of two regulating gates Sat Bridge and Ton Bridge, with dredging Binh Xuyen rivers and construction of 03 PSs at Sub-basins B1, B2 and B3, impacts are as follows:

- ✓ The risk of flooding for 310 ha project area will be reduced.
- ✓ The water level at upstream of Ton Bridge dyke on Cau Bon River, and at Kha Do Bridge on Ca Lo River would reduce 3-11 cm compared to the status.
- ✓ Flooding time on the tributaries of the Binh Xuyen 03 rivers would be reduced by 71 hours (representative comparison position at upstream of Ton Bridge), 39 hours on Ca Lo River (comparison position at Kha Do Bridge on Ca Lo River).
- ✓ Thus it could evaluate that the project activities have positive impacts in controlling and minimizing flood for both project areas and downstream of Ca Lo River basin.

Table 48. Calculation results at project basins with 10-year flood cycle for different alternatives

No.	**Alternatives**	**Unit**	**Entire area**	**B-1**	**B-2**		**B-3**		**C**	
				Vang	***Vu Di***	***Lac Y***	***Lac Y***	***Sau Vo***	***Ton Bridge***	***Kha Do***
*	Planned leveling elevation	m		12.00	9.00	8.90	8.80	8.80	10.50	9.00
*	Calculated water level	m		9.70	8.50	7.50	7.50	7.50	9.00	8.00
*	Existing (PA0)									
a	Water level									
	Max. water level	m		11.32	9.52	9.18	9.12	8.92	9.16	8.86
	24 hours Max. water level	m		11.31	9.51	9.16	9.10	8.90	9.03	8.84
	168 hours Max. water level	m		11.03	9.34	8.93	8.86	8.55	8.40	8.40
b	Flood retaining time	h		546	425	552	440	313	88	242
c	Affected area	ha	8363	308	2350		4145		1560	
I	Alternative PA1 (construction of 02 Ton Bridge - Sat Bridge gates only, without dredging and PS									

No.	Alternatives	Unit	Entire area	B-1	B-2		B-3		C	
				Vang	*Vu Di*	*Lac Y*	*Lac Y*	*Sau Vo*	*Ton Bridge*	*Kha Do*
a	Water level									
	Max. water level	m		11.32	9.48	9.13	9.07	8.91	10.09	8.85
	24 hours Max. water level	m		11.31	9.48	9.12	9.05	8.89	9.82	8.84
	168 hours Max. water level	m		11.01	9.29	8.86	8.78	8.53	8.44	8.44
b	Flood retaining time	h		542	419	539	437	310	167	242
c	Affected area	ha	8238	304	2236		4107		1591	
d	Effectiveness of flood reduction									
*	Reduction of flood time	h		4	6	13	3	3	-79	0
*	Reduction of flood area	ha	124	4	114		38		-31	
e	Total investment	10^6USD	5.72	0.00	0.00		0.00		5.72	
VI	Alternative: construction of 02 regulating gates, 03 PSs, dredging of Binh Xuyen 03 rivers									
a	Water level									
	Max. water level	m		11.55	8.04	7.07	7.04	6.84	9.13	8.79
	24 hours Max. water level	m		11.42	7.69	6.94	6.92	6.82	8.94	8.77
	168 hours Max. water level	m		9.24	6.57	6.47	6.47	6.46	8.29	8.29
b	Flood retaining time	h		101	0	0	0	0	17	203
c	Affected area	ha	2917	114	95		1459		1250	
d	Effectiveness of flood reduction									
*	Reduction of flood time	h		445	425	552	440	313	71	39
*	Reduction of flood area	ha	5446	194	2255		2687		310	
e	Total investment	10^6USD	114.82	11.73	29.59		63.39		10.11	

Source: Report on hydraulic of the project "VPFRWMP"

5.1.2.5 Assessment of Dam Safety

The project does not involve the construction of any new dam. However, there are dams in the project area and two of them, i.e. Xa Huong Dam and Thanh Lanh Dam, are located upstream of Basinc C where project supported structures will be built. As a result, the WB safeguards policy, OP/BP4.37, Safety of Dams, is triggered. During the project preparation and to comply with the requirements of OP/BP4.37, the Vinh Phuc Province has engages a dam safety review team led by a competent dam safety expert to conduct the dam safety review in October, 2015 and two dam safety assessment reports were prepared and submitted to Vinh Phuc Province on November 10, 2015. These two DSRs had been further updated in early December 2015 to reflect the on-going progress of activities in relation to the dam safety and incorporate the comments from the World Bank team dam specialist. Based on the conclusions of these two reports, Xa Huang Dam was classified as an unsafe dam, which requires major remedial works (including dam body seepage control, upgrade of spillway, renovation of irrigation tunnel and its intake, and installation of instruments), and Thanh Lanh Dam as a safe dam, which requires only minor remedial works (including installation of instruments and monitoring devices).

As Xa Huong Dam was classified as an unsafe dam, the Vinh Phuc Province paid close attention to the dam safety of Xa Huong Dam as it is the second largest earthfill dam in Vietnam and understood constantly remedial works whenever received funds from government. Based on the updated DSRs, the vertical curtain grouting as the first phase seepage control measure, had been completed in December 2014 and the blacket grouting on the upstream slope to form a complete barrier with the vertical curtain grouting to stop the seepage through the dam body was completed in January 2016. The construction of upgrading the spillway, increase the spillway width from 10 m to 14 m and replacement of gates, was approved by DARD in October 2015. The construction started in January 2016 and scheduled to be completed in April 2016. Upon the completion of above mentioned activities, the Xa Huong Dam would be out of its unsafe status.

To ensure the proper operation and maintenance of the dams, as proposed by the DSRs, there are still number of minor works required to be implemented, including the renovation of irrigation tunnel and its intake and downstream slope repair of Xa Huong Dam and installation of monitoring instruments and devices, as well as lightings and repair of access, for both Xa Huong and Thanh Lanh Dams. To complete these works as propoed, the Vinh Phuc Province had submitted to MARD on December 7, 2015 to apply for listing the outstanding remedial works in an approved World Bank supported project, i.e. Vietnam Dam Rehabilitation and Safety Improvement Project.

In addition, proper Operational and Maintenance Manuals, including Reservoir Operational Rules, and Emergency Preparedness Plans were required to be prepared and put in place for these two dams as immediate actions to be taken. The details are given in the sections below.

5.1.2.5.1. Assessment of Xa Huong Dam safety and its auxiliary works

Xa Huong dam is located in Minh Quang commune of Tam Dao District, about 15 km northwest from Vinh Yen City, Vinh Phuc province, which forms a reservoir in Trau Valley at the foot of Tam Dao Mountain in Xa Huong hamlet. The dam was started construction in 1977 and put into operation in 1984.

Xa Huong Reservoir, formed by a 41 m homogeneous earthfilled dam and with a total storage of 14.13 million m^3 and effective storage of 13.43 million m^3, is one of the large reservoirs in Vinh Phuc province, which plays an important role in economic development, especially the development of the province’s agriculture sector. Since its operation, Xa Huong Reservoir has undergone some major repairs and remedial works to improve the dam safety in 1991, 2009, 2013, 2015, due to improper construction when it was built, the degradation of the dam slopes and seepage appeared at higher level on the downstream slope of the dam. The remedial works completed most recently are the vertical curtain grouting in December 2014 and blacket on the upstream slope to form the complete seeage barrier in January 2015.

The key features of the dam and its appurtenants of Xa Huong Reservoir are summarized below:

- ✓ **Reservoir**: the total area of catchment: 24.0km^2; total storage: 14.13 million m^3; effective storage: 13.43 million m^3;

- ✓ **Earth Dam**: a homogeneous earthfilled dam, with the max height of 41.0 m and crest elevation at El. 94.0m. The crest width is 5.0 m and length 252 m.The downstream slopes are1:2.0 and1:2.25 and upstream are 1:2.75,1:3.5, and 1:4.5;
- ✓ **Intake Culvert**: Reinforced Concrete box culvert; Elevation of intake-culvert floor: +64.0m; Design flow: 2.11m^3/s;
- ✓ **Spillway**: Type of spillway: Controlled with an arc gate with the opening width of 10.0 m and design dischargeof 259.0m^3/s;
- ✓ The dam safety assessment report of the Xa Huong Dam shows that:
  - o The dam crest evelation does not meet the requirements of the prevailing regulations for dam design and safety, with current discharge capacity of the spillway, and slope stability analysis shows both upstream and downstream slopes do not meet the requirements too.
  - o After the seepage control measures, such as the vertical curtain grouting in parallel with the dam axis, being completed in December 2014, the leakage control through the dam has been greatly improved. Howeve, there are still factors shown that the hydraulic gradients of the phreatic lines at some sections are still greater than the allowed value and slope stability coefficient smaller than the safety value permitted under the current regulations for the works of Grade I. With the completion of blacket grouting covering the upper part of upstream slope and connecting to the previously completed curtain grouting, the seepage control would be considered as completed.
  - o The spillway is controlled by only onemanually operated arc gate, which is considered not safe in operation. The size of spillway is small, only 10 m wide, which is not capable of discharge the flood in due course according to the current regulations. The upgrade of spillway, increase its width to 14 m with two gates would increase the discharge capacity and the safety requirements would then be met.
  - o Water intake tower and culvert was degraded, and need to be repaired or replaced to ensure safe operation.
  - o The works to ensure safety for the dam, such as monitoring equipment, lights, markers warning downstream flood are either inexistent or out of order.
  - o There is no operational and maintenance procedure of the dam and its appurtenant to be approved by the relevant authorities.
  - o There is no preparedness plan in case of EPP

To ensure the safety and proper operation and maintenance of the Xa Huong Dam, the following is suggested by the DSR:

a. Earth Dam:

It is necessary to raise safety and stability for the downstream slope by the following solutions:

- ✓ To further control the seegae throught the dam body through grouting or other means to lower the saturation line (which is underway);
- ✓ To increase the downstream slope ratios or build the broader berm at the

downstream depending on the final result of seepage analysis after the completion of blacket grouting on the upstream slope;

- ✓ To install the piezometers or other instrument to monitor seepage through the dam body;
- ✓ To repair the drainage ditches on the dam slopes;
- ✓ To conduct detailed investigation and propose solutions to eliminate the termitesin the dam body; and
- ✓ To conduct regular inspection and propose the solutions to ensure the dam safety.

b. Spillway:

To improve the discharge capacity by expanding the spillway, it is proposed to:

- ✓ To rebuid a new spillway at the position of the existing spillway, i.e. increasing the width of the spillway opening up to 14 m. The spillway is divided into two compartments and regulated by two gates. The construciton of this upgrade started in January 2016 and expected to be completed in April 2016 prior to the flood season.

c. Monitoring equipment

- ✓ To repair and/or supplement the seepage monitoring equipment on the cross-section of the dam according to the requirements under current regulations. Supplement the monitoring equipment in front of and behind the seapage control measures completed as mentioned above to monitor and evaluate the effectiveness of measures;
- ✓ To supplement the water-level monitoring equipment;
- ✓ To install the cameras to monitor the operation of spillway gate; and
- ✓ To install equipment to monitoring subsidence and displacement for both dam and spillway.

d. Dam safety management

- ✓ To prepare and submit to relevant authorities for approval of Operataion and Maintenance Manual, including the operational rules, reservoir operating procedures, equipment maintenance procedures;
- ✓ To prepared and submit an Emergency Preparedness Plan (EPP) and provide temporary flood warning marks on traffic underground in the downstream prior to the permenant onces having be installed;
- ✓ To conduct a study and propose the solutions for relocation or limitation of the use of explosives in Quang Minh rock quarry to minimize unsafe risks for the reservoir; and
- ✓ To construct the wave wall to protect the dam, install the lighting system on at key locations for night-time inspection.

5.1.2.5.2. Assessment of safety of Thanh Lanh Dam and its auxiliary works

Thanh Lanh Reservoir is located in Trung My commune, Binh Xuyen District, the Vinh Phuc Province. The construction of the dam started in 2001 and put into operation in 2006. Head work include one main earthfill dam, one intake culvert on the left of the main dam, 2 auxiliary dams and 1 spillway located in the middle of Auxiliary dam 2.

Thanh Lanh Reservoir work of grade II (Under QCVN 04-05:2012/BNNPTNT) was designed for the purpose of supply the water to irrigate 1,200 ha of agricultural lands in four communes of Trung My, Thien Ke, Ba Hien and Son Loi. In addition, it is also used to prevent flooding for communes in the low land area of Binh Xuyen District, supplying the fresh water for residents in the beneficial area in the dry season etc..

Key features of Thanh Lang headwork

- ✓ **Reservoir**: total catchment area: 23.0 km^2, total storage: 10.62 million m^3, effective storage: 9.89 million m^3
- ✓ **Earth Dam**: Homogeneousearthfilled dam; Elevation of dam crest: +78.10 m; Width of dam crest: 5.0 m; Length of dam crest: 362 m; Max height of dam: 29.0 m; Downstream slopes: 1:2.75 to1:3.0; Upstream slopes: 1:2.75 to 1:4.5
  - Auxiliary dam 1: Homogeneous earth filled dam; Elevation of dam crest: +79.10 m; Width of dam crest: 5.0 m; Length of dam crest: 76 m; Max dam height (H_{max}): 12.0 m; Upstream slope: 1:3.0 and Downstream slope: 1:2.75
  - Auxiliary dam 2: Homogeneous earth filled dam; Elevation of dam crest: +79.10 m; Width of dam crest: 5.0 m; Length of dam crest: 159.0m; Max dam height (H_{max}): 9.1 m; Upstream slope: 1:3.0 and Downstream slope: 1:2.75
- ✓ **Intake culvert:** Type of culvert: RC box culvert; Floor Elevation of intake-culvert: +60.0 m; Length of culvert: 112.0 m; Dimension1.00 m**;**
- ✓ **Spillway:** Form of spillway: pragmatic Ophicerop with valve gate; Width of gate opening: 10.0 m; Weir Top Elevation of Spillway: +71.6 m

Based on the dam safety report of Thanh Lanh Dam, the key issues are shown below:

a. *Main dam:* Currently, the dam is stable and he upstream slope is reinforced by concrete slabs and in good condition. The downstream is protected by growing grass but the grass is sparse, the slope is eroded by rain at many locations andnecessary to add drainage ditches on the slope, backfill earth and additionally grow grass to prevent erosion.

b. *Auxiliary dam 1:* The dam is stable and the upstream slope using stone riprap is of good quality. On the downstream slope, the grass evenly grows, the equipment of additionally covering slope for seepage drainage is good quality. The macadam paved dam crest is eroded, it needs to be reinforced by using cast-in-situ concrete. It is necessary to construct wheel curbs or marker posts, and arrange lights on the dam crest to ensure traffic safety.

c. *Auxiliary dam 2:* The dam is stable and the upstream slope using stone riprap is good quality. On the downstream slope, the grass evenly grows, the equipment of additionally covering slope for seepage drainage is good quality. The seepage discharge through the dam is in the permitted limit. It is necessary to arrange lights to create favorable conditions for the operation and management.

d. *Spillway:* The spillway is structured by reiforced concrete, controled by a steel arch gate. At inspection, the spillway is in good condition. The equipment is at normal condiction and the spillway is maintained by mechanical equipment periodically in accordance with the operation procedures.

e. *Water intake culvert:* The water intake culvert is in good condition, the opening and closing is tightly, and its operation is normal.

f. *Operational road and house:* The operation house is of good quality, which ensures the requirements for accommodation, living and working of operational staff. The management road is concretized, and of good quality which ensures the favorable travel for operation.

g. *Monitoring equipment:* Currently, the seepage monitoring equipment is broken and needs to be repaired and replaced to ensure the monitoring data during the operation.

h. *Operation management:* Regarding staff management framework, it meets the requirements, which ensures the conditions for the dam safety. The document of Work management is sufficient.The operational staff are trained and qualified. The operation procedures and plans for flood prevention are in place.

In order to ensure the safety, efficiency, stability and durability, it is necessary to:

- To conduct inspection and analysis to see if jet grouting for seepage control is necessary;
- To add earth backfill on downstream slope to improve the slope stability of the dam complying with the requirements of the current standards and regulations;
- To pave crest access roads on the main dam and auxiliary dam No.1 with concrete;
- To repair, with fertile soil and grow the additional grass, as well as build the drainage ditches, on the downstream slopeof the main dam;
- To repair and/or replace the dam-body seepage monitoring system to ensure sufficient information and data;
- To install additional markers on auxiliary dam No.1 and the signals for the work and the load limit signs, the additional rule board for the entry and exit work; and
- To develop the Operation and Maintenance Manual, including the reservoir operational rules, and Emergency Preparedness Plan (EPP) and obtain the approval of such a plan from relevant authorites.

Based on the above suggestions and conclusions, the Vinh Phuc DARD has i) completed the works for the second phase of seepage control - i.e. blanket grouting on the upstream slope of the dam, from the top of vertical curtain grouting to the dam crest- in January 2016; and ii) with the government approval, started the construction of spillway expansion, increasing the width of spillway opening from 10m to 14m and the installation of two control gates, January 2016, its scheduled to be completed in April 2016. With the completion of this spillway expansion, the major remedial works will be completed and the dam's safety will upgrade to an acceptable safety level.

Vinh Phuc Province submitted to Ministry of Agriculture and Rural Development (MARD) an application on December 7th, 2015 to include the outstanding remedial works for Xa Huong and Thanh Lanh Dams in the Bank financed Vietnam Dam Rehabilitation and Safety Improvement Project. The works include the Xa Huong Dam's irrigation tunnel and its intake renovation and the installation of monitoring instruments for both dams. In the meantime, the Vinh Phuc PPC has committed to allocating government budget to carry out these remaining works in case this proposal is not materialized.

12. In addition to the progress made on the proposed remedial works and the submission of the application for outstanding remedial works, Vinh Phuc PMO has agreed on: i) preparing and submitting an action plan, including all necessary activities such as obtaining the government's approval for including the outstanding remedial works as discussed above, the schedule and government's approval to engage the competent dam safety specialist to prepare the Emergency Preparedness Plan (EPP); and ii) preparing and submitting the final draft Operation and Maintenance Manuals, including proper operational rules, for both Xa Huong and Thanh Lanh Dams.

5.1.3. Component 1: Impact Assessment for Flood Control Works in Basin B

5.1.3.1. Impacts during Preparation stage

Land acquisition

Land acquisition, displacement and resettlement will affect the PAHs both physically and mentally, even causing social problems and prolonged litigation. Relocating to the new places, these households might be affected severely by the new living environment at the resettlement sites and they need time to integrate into a new life, particularly new relations and works. Detailed impacts are assessed in the Section 5.2.

In addition, some aqua plants are also found in these aquatic ecosystem along Phan River basin and 3 rivers network in Binh Xuyen like water spinach (planted by local people), Eichhornia crassipes, Golden Shower, weed, etc. None of these species is listed as rare and endangered in the national and world red books.

All of these underwater species in the project area will be directly affected during the preparation and construction stages, which are unavoidable. However, given the scale and current situation of project area and the proposed construction methods these impacts are not serious and concentrated within the land acquisition area in Binh Xuyen, Yen Lac, Vinh Tuong districts and Vinh Yen city. These are temporary during the construction and they will be stable after operation.

Unexploded Ordinance (UXO) Impact

The project involves large scale excavation works and the project area was bombed heavily during the war period, thus, the risk on UXO is assessed as high. UXO removal is important so as to avoid any potential threat to works and safety for local people and workers. For sub-components, UXO issue needs to be carefully considered and removed before construction activities can commence.

5.1.3.2. Impacts during Construction

5.1.3.2.1. Generic environmental impacts

a. Impact on air quality

Air pollution could happen during construction due to dust, emissions and noise of machines. However, this is interrupted activities and in short period of time given the scope and scale of the big project. However, as scheduled the project will be implemented in 5 years from September 2016 until August 2021; construction will be divided into several contracts and implement in different times. Summary of earthwork volume and construction time of the subcomponents in the Basin B is presented in the table 48 below.

Impacts by dust and emissions from earthworks

The calculated volume of earthworks in Basin B under Component 1 is around 7.2 mil m^3 excavated materials of which about 6.14 million m^3 out of the volume could be reused for earthfilling in some works or for making construction materials. The rest 1.1million m^3 is the sludge /organic soil layer to be transported to disposal sites of Dong Mong and Kim Xa. The dredging and filling process will generate emissions and dust which affect quality of local air. Dust and emissions volume include:

- Dust from excavation:

Dust emission degree during dredging, filling, grounding depend on volume of excavation works. Dust emission is calculated based on pollution coefficient and volume of excavation and filling. According to the WB's guidelines (*Environmental Assessment Sourcebook, Volume II, Sectoral Guidelines, Environment, World Bank, Washington D.C 8/1991*) the pollution coefficient E is calculated as below:

Table 49. Amount of earthwork volume and construction time of the subcomponents in the Basin B

No	Work	Total dredged and excavated amount (m^3)	Total amount for backfilling and using as building materials (m^3)	Amount of organic soil that cannot be salvaged and has to be transported to the disposal sites (m^3)	Construction duration (month)
1	2	4=5+6	5	6	7
A	Sub-basin B1	515,165	451,500	63,665	
I	Pump station	90,441	70,382	20059	24
II	Lake dredging	424,724	381,118	43606	18
B	Sub-basin B2	2,540,787	2,372,977	167,810	
I	Pump station	808,713	808,713	-	18
II	Approaching canals and on-canal structures	559,175	550,028	9,147	18
III	Discharging canals and on-canal structures	680,822	574,027	106,795	24
IV	Dredging Phan River from Thuong Lac to Lac Y	485,328	433,459	51,869	24
V	Vinh Son regulation gate	2,670	2,670	-	18
VI	Lac Y regulation gate	4,080	4,080	-	18
C	Sub-basin B3	4,188,678	3,314,645	874,033.0	
I	Pump station	80,396	74,762	5,634.0	18
II	Approaching canals and on-canal structures	783,240	783,240	-	18
III	Discharging canals and on-canal structures	234,398	145,382	89,016.0	12
IV	Regulating lake in front of PS	591,166	591,166	-	24
V	Dredging Phan River section	156,306	119,414	36,892.0	6
VI	Dredging Sau Vo Lake	2,266,989	1,576,726	690,263.0	24
VII	Lake Assess Road of Sau Vo lake	76,183	23,955	52,228.0	18
E	Total	724,630	6,139,122	1,105,508	

$$E = k * 0,0016 * \frac{\left(\frac{\bar{u}}{2,2}\right)^{1,4}}{\left(\frac{M}{2}\right)^{1,3}} \quad (1)$$

In which: E - Pollution coefficient (kg/ton).

k - Molecular structure, average value 0,35.

$\bar{u}$ - Medium wind speed at the site.

M - Average moisture of the material.

From the average k, $\bar{u}$, M we calculate the E= 0,00299 (kg/ton).

BOX model is applied to estimate the emission flux in the construction area. The model is presented in the following formula:

$$PC = B + \frac{qL}{uH}$$ *Formula 5.2*

In which:

PC *Pollutant concentration (mg/m^3)*

B *Baseline air concentration (mg/m^3)*

q *Quantity of dust/emission generated (mg/s.m^2)*

u *Measured wind speed meters per second (m/s)*

– *L* *Area of construction site (m^2)*

H *Plume height (m)*

According to the project design, the earthwork activities mainly take place at the construction sites of pumping station headworks (pumping stations, intake and discharging canals), lake dredging, and river dredging in the Sub-basins B1, B2, and B3.

The calculated results of dust emissions in each sub-basin are presented in the following table:

Table 50. Total dust emissions of the construction works

No	**Construction works**	***Sub-Total (m^3)***	***Dust emissions***	***Dust concentration of baseline environment (mg/m^3)***	***Accumulated dust concentration (mg/m^3)***	***Technical Regulation QCVN 05:2013/ BTNMT***
A	***Sub-basin B1***	515,165	1,540.34			0.3
I	Pumping station	90,441	270.42	0.019-0.034	0.11	
II	Lake dredging	424,724	1,269.92		0.31	
B	***Sub-basin B2***	2,540,787	7,596.95			
I	Pumping station	808,713	2,418.05	0.015-0.075	0.47	
II	Approaching canals and on-canal structures	559,175	1,671.93		0.27	
III	Discharging canals and on-canal structures	680,822	2,035.66		0.29	
IV	Dredging Phan River from Thuong Lac to Lac Y	485,328	1,451.13		0.58	
V	Vinh Son regulation gate	2,670	7.98		0.01	
VI	Lac Y regulation	4,080	12.20		0.06	

No	Construction works	*Sub-Total (m^3)*	*Dust emissions*	*Dust concentration of baseline environment (mg/m^3)*	*Accumulated dust concentration (mg/m^3)*	*Technical Regulation QCVN 05:2013/ BTNMT*
	gate					
C	***Sub-basin B3***	4,188,678	12,524.15			
I	Pumping station	80,396	240.38		0.30	
II	Approaching canals and on-canal structures	783,240	2,341.89		0.34	
III	discharging canals and on-canal structures	234,398	700.85		0.18	
IV	Regulating lake infront of PS	591,166	1,767.59	0.013-0.055	0.41	
V	Dredging Phan River section	156,306	467.35		0.29	
VI	Dredging Sau Vo Lake	2,266,989	6,778.30		0.71	
VII	Assess Road across Sau Vo lake	76,183	227.79		1.09	

The results in the table above show that the accumulated dust amount caused by construction activities depends not only on the volume of dredged materials but also on the dust concetration of the baseline environment as well as the site of construction area. The calculation results show that the earthwork and dredging process will generate an amount of dust in the air that exceeds the permissible limit of the national technical regulation QCVN 05:2013/BTNMT at the construction sites of Nhi Hoang Lake (Sub-Basin B1), Ngu Kien pumping station and Phan River dredging (Sub-Basin B2); pumping station, approaching canal, regulating lake in front of the pumping station, Sau Vo Lake dredging, and construction of Sau Vo access road (Sub-Basin B3).

However, the dust volume is mostly dust fallout; with heavier weight, they quickly settle down to the ground. Therefore, the concentration of dust in the air will be reduced quickly by distance, starting from the construction site location.

In addition, the scope of construction of the entire Basin B is large and scheduled by different times in different phases, the construction sites are also far from the residential areas, these impacts are assessed as moderate and site-specific within the scope of earthwork and only last during construction period.

<u>Dust and emission from operation of machinery and equipment</u>

Most of the earthwork machinery and equipment are operating using diesel engines. The operation of these machinery and equipment will generate dust and emissions from fuel combustion. Given its fuel consumption rate, dust pollution loads and emissions generated from the fuel combustion of the excavators in a working shift are as follows:

Table 51. Fuel consumption and pollution load by excavator

Machine	**Consumed diesel (kg/shift)**	**Pollution load (kg/shift)**				
		NO_x	*CO*	*SO_2*	*VOC*	*Dust*
Excavator	94.5	1.89	0.473	18.9	2.363	0.473

Source: Environmental Geology, Ho Chi Minh National University Publishing House

Based on the average excavated volume of one shift at 1,000-1,200 m^3, the volume of dust and emissions generated from the operation of the machinery and equipment are shown in the following table:

Table 52. Dust and emissions volume generated from dredging machinery and equipment during construction period

No.	**Construction works**	**Excavated and dredged volume (m^3)**	**Machine's working shift (shift)**	**Consumed fuel (kg)**	**Pollution load (kg)**			
					Nox	*CO*	*SO_2*	*Dust*
A	***Sub-basin B1***							
I	Pumping station	90,441	82	7,770	14,685	3,675	146,847	3,675
II	Lake dredging	424,724	386	36,488	68,962	17,259	689,617	17,259
B	***Sub-basin B2***							
I	Pumping station	808,713	735	69,476	131,309	32,862	1,313,093	32,862
II	Approaching canals and on-canal structures	559,175	508	48,038	90,792	22,722	907,922	22,722
III	Discharging canals and on-canal structures	680,822	619	58,489	110,544	27,665	1,105,438	27,665
IV	Dredging Phan River	485,328	441	41,694	78,802	19,721	788,018	19,721
V	Vinh Son regulation gate	2,670	2	229	434	108	4,335	108
VI	Lac Y regulation gate	4,080	4	351	662	166	6,625	166
C	***Sub-basin B3***							
I	Pumping station	80,396	73	6,907	13,054	3,267	130,538	3,267
II	Approaching canals and on-canal structures	783,240	712	67,287	127,173	31,827	1,271,733	31,827
III	Discharging canals and on-canal structures	234,398	213	20,137	38,059	9,525	380,588	9,525
IV	Regulating lake in front of PS	591,166	537	50,787	95,987	24,022	959,865	24,022
V	Dredging Phan River section	156,306	142	13,428	25,379	6,351	253,791	6,351
VI	Dredging Sau Vo Lake	2,266,989	2,061	194,755	368,087	92,119	3,680,869	92,119
VII	Service road across Sau Vo lake	76,183	69	6,545	12,370	3,096	123,697	3,096

With dust and emissions loads as calculated in the table above, applying the BOX model with formula (5.2), we can calculate the emission concentration at the construction site. Calculation results are shown in the following table:

Table 53. Dust and emission concentrations generated from the operation of dredging machinery and equipment

No	Construction works	Average NO2- 1 hr (mg/m^3)		Average CO- 1hr (mg/m^3)		Average SO2- 1 hr (mg/m^3)		Average TSP- 1 hr (mg/m^3)	
		Baseline environment concentration	*Accumulated*	*Baseline environment concentration*	*Accumulated*	*Baseline environment concentration*	*Accumulated*	*Baseline environment concentration*	*Accumulated*
A	***Sub-basin B1***								
I	Pumping station	0.012-0.036	0.31	4.1-5.2	6.27	0.012-0.033	0.15	0.019-0.034	0.15
II	Lake dredging		0.42		12.60		0.58		0.59
B	***Sub-basin B2***								
I	Pumping station	0.015-0.036	0.79	4.1-5.5	9.63	0.012-0.043	1.24	0.015-0.075	1.16
II	Approaching canals and on-canal structures		0.56		7.37		0.86		0.81
III	Discharging canals and on-canal structures		1.26		8.12		1.05		0.98
IV	Dredging Phan River		0.97		6.41		0.75		0.71
V	Vinh Son regulation gate		0.39		5.59		0.02		0.03
VI	Lac Y regulation gate		0.56		5.65		0.02		0.04
C	***Sub-basin B3***								
I	Pumping station	0.02-0.035	0.29	4.1-5.7	6.12	0.013-0.032	0.13	0.013-0.055	0.14
II	Approaching canals and on-canal structures		0.68		13.48		0.80		0.93
III	Discharging canals and on-canal structures		0.43		7.75		0.31		0.30
IV	Regulating lake infront of PS		0.73		8.32		0.74		0.73
V	Dredging Phan River section		1.23		6.03		0.24		0.22
VI	Dredging Sau Vo Lake		4.12		11.39		2.81		2.68
VII	Service road across Sau Vo lake		3.67		6.33		0.13		0.14
	QCVN 05:2013	0.2		30		0.35		0.3	

The calculation results in the table above show that the construction activities will generate accumulated dust and emission concentrations that exceed the permissible limits in the Technical Regulation QCVN 05:2013/BTNMT at some construction sites. Specifically:

- ✓ NO_2 concentration exceeds the permissible limit at all construction sites;
- ✓ SO_2 concentration exceeds the permissible limit at the construction sites of Nhi Hoang Lake (Sub-Basin B1); pumping station, approaching canal, discharge canal and dredging of Phan River (Sub-Basin B2); approaching canal, regulating lake in front of the pumping station and dredging of Sau Vo Lake (Sub-Basin B3).
- ✓ Dust concentration exceeds the permissible limit at the construction sites of Nhi Hoang Lake (Sub-Basin B1), pumping station, approaching canal, discharge canal and dredging of Phan River (Sub-Basin B2); approaching canal, regulating lake in front of the pumping station and dredging of Sau Vo Lake (Sub-Basin B3).

However, impacts on the ambient air quality caused by the operation of the construction machinery and equipment are assessed as site-specific which take place only within the construction area.

However, impacts on the ambient air quality caused by the operation of the construction machinery and equipment are assessed as site-specific which take place only within the construction area. These impacts could be mitigated by application of standard measures during construction period.

<u>*Dust and emission impacts caused by transportation of dredged materials*</u>

A part of dredged materials will be salvaged for backfilling while the remaining will be transported to the designated disposal sites or to other areas for building materials (if the analysis results show that the dredged materials are not hazardous). The dredged materials will be transported by trucks with the load capacity of 5 to 10 tons.

The statistical results of dredged material volume to be transported to the disposal sites, the transportation vehicles, routes, and average transportation distance in kilometer per day are shown in Annex table 3.1 in the Appendix.

According to the rapid assessment of the World Health Organization (WHO), the volume of dust and emissions generated by the transportation process is calculated and shown in the following table:

Table 54. Emission factor and pollution load by material transportation

	Total dust	***SO_2***	***NO_x***	***CO***
Emission factor of WHO (g/km)	1.35	4.15	14.4	2.9

(Source: Aleaxander P. Econompoulos (1993), Assessment of Sources of Air, Water and Land

From the calculated average transport distance per day shown in Annex 3 and using the above emission factor, the pollution load of dust and emissions for each construction site in Basin B are calculated and demonstrated in the following table.

Table 55. Calculating pollution load of dust and emissions by vehicles transporting dredged materials

No	Works	*Average transport distance per day*	Daily average pollution load (g/day)				Transporting route
			TSP	*SO2*	*Nox*	*CO*	
A	***Sub-basin B1***						
I	Pumping station	32	43	132	460	93	Pho Day Dyke
II	Lake dredging	521	703	2,161	7,499	1,510	District Road 309, Pho Day Dyke
B	***Sub-basin B2***						
I	Pumping station	9,936	13,413	41,233	143,073	28,813	DR 303, 304, 305
II	Approaching canals and on-canal structures	6,666	8,999	27,663	95,988	19,331	DR 303, 304, 305
III	Discharging canals and on-canal structures	1,059	1,430	4,397	15,256	3,072	DR 303, 304, 305
IV	Dredging Phan River from Thuong Lac to Lac Y	3,882	5,240	16,109	55,895	11,257	DR 303, 304, 305, NH 2, 2A, 2C
V	Vinh Son regulation gate	23	31	96	331	67	DR 303, NH 2A
VI	Lac Y regulation gate	14	18	57	196	40	NH 2A
C	***Sub-basin B3***						
I	Pumping station	392	529	1,626	5,643	1,136	DR 303- Huong Canh - Tan Phong Road
II	Approaching canals and on-canal structures	2,631	3,552	10,918	37,886	7,630	DR 303- Huong Canh - Tan Phong Road
III	Discharging canals and on-canal structures	-2,087	-2,818	-8,662	-30,056	-6,053	DR 303- Huong Canh - Tan Phong Road
IV	Regulating lake in front of PS	2,932	3,959	12,169	42,226	8,504	DR 303- Huong Canh - Tan Phong Road
V	Dredging Phan River section	3,101	4,187	12,870	44,659	8,994	Bypass road of Vinh Yen City - NH2
VI	Dredging Sau Vo Lake	4,498	6,072	18,667	64,771	13,044	Lake access road- Tan Phong - Huong Canh - Dong Mong Road
VII	Service road across Sau Vo lake	202	272	836	2,902	584	Lake access road- Tan Phong - Huong Canh - Dong Mong Road

The results in the table above show that the volume of dust and emissions generated by the dredged material transport vehicles on site is relatively high, particularly the sites of Nhi Hoang Lake (Sub- Basin B1), Ngu Kien pumping station, approaching canal, discharging canal and dredging of Phan River (Sub-Basin B2), and Nguyet Duc pumping station, approaching canal, discharging canal, dredging of Sau Vo Lake and Sau Vo access road. The people participating in traffic and living along the transportation routes from the construction sites to Kim Xa and Dong Mong disposal sites such as provincial roads 303, 304, 305, 309, Huong Canh-Tan Phong, Vinh Yen bypass and National Highway 2 are subject to these impacts.

b. Noise Impacts

Noise is generated from vehicles, machinery and equipment.

During the construction, noise is mainly caused by operation of vehicles and construction machinery. The noise level is calculated as below:

$$L_p(X) = L_p(X_0) + 20 \log_{10}(X_0/X)$$

In which:

$L_P(X_0)$: noise level at distance 1m from the source (dBA)
$L_P(X)$: noise level at the calculated point
X: calculated point
X_0 = 1m

For each construction investment in the sub-basins B1, B2, and B3, accumulated noise level is calculated based on the separate noise levels of the machinery and equipment. The accumulated noise level is calculated following the formula below:

$$L_{\Sigma} = 10 \times lg \sum_i^n 10^{0,1Li}$$

In which:

- LΣ: Accumulated level
- Li: Source of noise i
- n: Number of sources of noise

The distance selected for assessment of noise level to the surrounding residential areas is from 20m to 50m. The results of noise level of each construction and transportation machinery and equipment as well as the accumulated noise level are calculated and presented in the following table.

Table 56. Accumulated noise level generated by the machinery and equipment

No.	**Transport vehicles and construction machinery**	**Noise level at distance of 1m from the source**		**Noise level at distance of 20m from the source**	**Noise level at distance of 50m from the source**
		Interval	*Average*		
01	Bulldozer		93.0	67.0	59.0
02	Roller	72.0 – 74.0	73.0	47.0	39.0
03	Excavator	72.0 – 84.0	78.0	52.0	44.0

No.	Transport vehicles and construction machinery	Noise level at distance of 1m from the source		Noise level at distance of 20m from the source	Noise level at distance of 50m from the source
		Interval	*Average*		
04	Tractor	77.0 – 96.0	86.5	60.5	52.5
05	Grader	80.0 – 93.0	86.5	60.5	52.5
06	Road paver	87.0 – 88.5	87.7	61.7	53.7
07	Truck	82.0 – 94.0	88.0	62.0	54.0
08	Concrete mixer	75.0 – 88.0	81.5	55.5	47.5
09	Mobile crane	76.0 – 87.0	81.5	55.5	47.5
10	Electric generator	72.0 – 82.5	77.2	51.2	43.2
11	Air compressor	75.0 – 87.0	81.0	55.0	47.0
12	Stake driver	95.0 – 106.0	100.5	74.5	66.5
	Accumulated noise level		84.5	58.5	50.5
	National Technical Regulation 26/2010/BTNMT applying for normal areas: 6 AM to 9PM is 70 dBA; from 9PM to 6AM is 55 dBA;				
	According to the Ministry of Health (MOH standard): noise at the production area 85 dBA for 8 hours of noise exposure				

Comparing the noise limits of the machinery with the National Technical Regulation on Noise-QCVN 26:2010/BTNMT and MOH standard shows that in general, the noise level at the distance of 20m from the noise source is lower than the allowable limit. Such noise level is assessed as medium since most of the construction sites are more than 20m far from the residential areas. Therefore, it can be said that the noise impacts caused by transport vehicles and construction machinery are assessed minor and insignificant. Those who are mainly subject to these impacts are staff and workers on site.

c. Impacts on surface water caused by dredging process

Impacts of dredging

It is estimated that some 7.2 million m^3 materials (soil and sludge) will be excavated. Most of the areas to be dredged are river basins including Phan River, lakes of Sau Vo, Rung, and Nhi Hoang etc.). The sediment of the Phan River basin as well as has a high content of organic substances. In addition, the analytical showed that at some sampling location in Phan river and at other construction sites, the contents of heavy metals in sludge samples are higher than allowable standard for agricultural land (e.g. Gia Bang Bridge, Vat Cach Bridge, Huong Canh, Son Loi at Phan River, site of wastewater treatment facility in Tam Hong). Therefore, the impacts caused by dredging could include the:

- ✓ At the dredging sites, the turbidity of water will be higher, decreasing the photosynthesis effect and oxygen content, causing pollution to the water. Long and interval dredging process would make the ecosystem recover slowly.

- ✓ In general, when soil and/or sludge are stirred, water quality in the dredging sites will much be affected, suspended solid will be increased and toxic substances in mud would be dissolved in water and get to the basin areas, causing instant and temporary impact to the aquatic life at the dredging site.

Transport of sludge from the dredging sites to the disposal sites could cause leakage and spills along the transportation routes. The level of leakage and spills depends on the volume of transported sludge and its saturation level. The possible sludge leakage and spill would cause not only social and environmental impacts but also impacts on traffic safety. Therefore, contractors shall strictly comply with the regulations on sludge transportation, construction solutions and transportation route as well as apply all the mitigation measures stated in the ESMP.

In short, impacts caused by dredging activities are evaluated as significant. However, they can be controlled and minimized by application of appropriate construction method and mitigation measures during construction period.

Impacts by wastewater during the construction

Wastewater during the construction, from concrete maintenance, concrete mixing, machinery and equipment cleaning etc. contains hazardous substances like cement, lubricant, oil, sludge etc. are toxic for the aquatic life. However, such wastes could easily be collected for treatment.

Wastewater from mortar preparing and concrete maintenance: At present, there is no ration available to calculate; however, according to the forecast and actual situation at the construction sites, this type of wastewater has small amount and is not enough to form water stream. Most of it will penetrate into the materials and gradually evaporate.

The nature of construction wastewater is high sediment content containing some toxic contaminants in cement, concrete additives and relatively high pH level. However, the proportion of sediment in wastewater is quite large, it is easy to deposit. Therefore, the mitigation measures for this type of wastewater is to collect and treat in the sediment ponds and then reuse as water source to serve the construction activities.

Impacts caused by wastewater containing grease and oil

Wastewater containing grease and oil comes from the maintenance/repair, washing point/stations for vehicles before letting them to main roads. Its volume depends on the number of vehicles in traffic and the weather (in rainy season, the vehicles require more frequent washing activity); According to the standard 3.4 - TCVN 4513:1988, the water amount needed for cleaning a big vehicle is from 300l to 500l.

This type of wastewater contains high content of grease and oil; therefore, if it leaks into the waterbodies around the construction sites (rivers and lakes to be dredged or other waterbodies surrounding the sites), it will affect the water quality by reducing the amount of dissolved oxygen in the water, leading to impacts on the growth and development of the aquatic species.

Impacts caused by workers' domestic wastewater

Domestic wastewater mainly contains residual, suspended substances (SS), organic substances (BOD5, COD), nutrients (N, P) and pathogenic micro-organisms. Assuming the water volume used by a worker is 100 l/day (*according to WHO*), the amount of wastewater is 85% ÷ 95% of the water amount supplied (*according to the Wastewater Treatment, Science and Technology Publishing House, Hanoi, 2002*) and the maximum number of workers in peak time at Basin B site is 1,279 workers/day, the maximum volume of domestic wastewater will be:

$$100 \times 10^{-3} \times 1279 \times 90\% = 115.11 \ (m^3/day)$$

Domestic wastewater is characterized by residual, suspended solids, organic matter such as BOD, COD... and microorganisms (which can carry many pathogenic microorganisms). The calculation results of pollutant load and concentrations in domestic wastewater are shown in the following table.

Table 57. Pollutant loads and concentrations in untreated domestic wastewater

No.	**Indicators**	**Pollutant discharge (g/person/day)**	**Pollutant load (g/day)**	**Pollutant concentration (mg/l)**	
				Not yet treated	*Technical Regulation QCVN 14:2008 Column B*
1	BOD_5	45 – 54	57,555-69,066	500-600	50
2	COD	72 – 102	92,088-130,458	800-1133	-
3	TSS	70 – 145	89,530-185455	778-1611	100
4	Oil	10 – 30	12,790-38,370	111-333	20
5	Total N	6 – 12	7,674-15,348	66.7-133.3	50
6	Ammonia ($N\text{-}NH_4$)	2.4 – 4.8	3,070-6,139	26.7-53.3	10
7	Phosphor	0.8 – 4.0	1,023-5,116	8.89-44.4	10
8	Total Coliform	10^6 - 10^9	1279×10^6 – 1279×10^9	1.56×10^6 – 1.56×10^9	5000 (MNP/100ml)

Source: WHO, 1993.

The data presented in the table above are calculated following the formula below:

$$C = \frac{C_0 .}{Q}$$

In which:

C: the concentration of pollutant in wastewater, (mg/L)

C_0: pollutant load, (g/day)

Q: discharge of wastewater, (m^3/day)

The calculation results in the table above show that the parameters of domestic wastewater that has not been treated are above the permissible limits stipulated in the Technical Regulation QCVN 14:2008/BTNMT on domestic wastewater quality by the MONRE. However, wastewater is mainly generated at the workers' camps in the Sub-basins B1, B2, and B3; therefore, the collection and treatment can easily be carried out.

Impacts of rainwater runoff

Rainwater runoff quality depends on the cleanliness of the atmosphere and the amount of surface substances that are washed away from the construction sites. Its volume, whereas, depends on the weather conditions in the area. During the rain, soil, sand and waste substances are gone with the rainwater runoff to get into the surrounding roads and water basins.

At the construction sites, the rainwater runoff quality depends only on the construction site surface as the air quality there is fairly good.

It contains mainly suspended substances and oil, lubricant washed away by rain, especially at the stage of construction when the construction site surface is not yet completed and easy to be washed away and eroded.

d. Generation of solid wastes

Domestic solid waste

The volume of domestic solid waste per capita in Vietnam is from 0.35 to 0.8 kg per day (according to Solid Waste Management, Construction Publishing House). Based on the consumption demands, development level of the locality and living conditions in the workers' camps, the volume of domestic solid waste per capita is calculated at 0.35 kg per day. The total number of workers on the construction sites during high time is 1,279 workers. Hence, the maximum volume of domestic solid waste produced during this period is calculated as follows:

$$1{,}279 \times 0.35 = 448 \text{ (kg/d)}$$

Such amount of solid waste would cause negative impacts on surface and ground water, unpleasant smell at the sites when it is disintegrated and washed away by rain. Inorganic substances such as bottles, nylon bags and other things in water causes impacts to the landscape and environment, and water quality and decrease of oxygen diffusion into water, thereby affecting the aquatic life.

Therefore, in addition to applying the measures stated in the ECOP, it is necessary to collect all the solid wastes from the spontaneous disposal sites scattered at the residential areas within the project area near the Phan River basin like the Thuong Lap Bridge area in Te Lo commune area etc. to other designated disposal sites, which are located far from Phan River in order to minimize the impacts by domestic solid wastes on the river water quality.

Construction solid wastes

Solid wastes from the construction include mainly cement bags, mortar, metal pieces etc. Their volumes depend on many factors including the construction procedure, project management, sources of construction materials supply, etc. Therefore, it is difficult to estimate the exact volume of these wastes; however, they can be controlled and managed by collecting for reuse or sale of scraps.

Apart from the abovementioned solid wastes, within the project scope, there is also a large amount of solid waste generated from the dredging activities. However, these wastes will be assessed in the section regarding site-specific impacts and mitigation measures (section 5.1.3.2.2) of the report.

Hazardous wastes

During construction, the required maintenance activities for machinery and vehicles will generate a certain amount of oily rags and waste oil and grease etc. This type of waste generation depends on the quality and operation frequency of construction machinery and vehicles.

Based on the estimate of quantity and types of construction vehicles and machines, construction duration in Basin B, it is estimated that about 3 m^3 of wastespent oil and 15 kg of oily rags and used light bulbs will be generated each month.

All the hazardous wastes must be collected, stored as regulated and only authorized organizations permitted transport and treatment. Inappropriate management of solid and hazardous waste could contribute to an unhealthy environment or act as source of disease, especially vector borne as well as pollute air and water environments. Therefore, the project needs to manage generated waste appropriately.

e. Impacts on soil

Construction solid wastes including cardboards, metal scraps, plastic boxes, excavated soil etc. if not treated would cause impacts on the soil environment. However, these kind of solid wastes are not classified as hazardous wastes and they are relatively easy to be collected and treated. Therefore, their impacts on the environment are insignificant.

The sludge and organic soil from the dredging will be collected to assigned disposal sites of the project including Dong Mong and Kim Xa sites. However, during the disposal process, land slide or soil erosion could happen to cause pollution to the surrounding areas if the disposal sites are not properly constructed.

Domestic waste from workers' camps are easily decomposed, generating bad odor. Without treatment, if wastes are directly disposed to the environment, soil will be polluted. However, such wastes are mostly concentrated in the workers' camps and thus are easy to collect and treat.

Solid waste containing oil is hazardous waste. Although the volume of this type of waste is small, if they are not properly collected and treated but discharged into receiving soil environment, they will cause adverse impacts on soil environment such as hardening soil, killing microorganisms in the soil, and severely affecting vegetation cover.

Wastewater from the construction containing cement, and wastewater from repair and washing points containing harmful factors like oil and lubricant when absorbed by the soil would make it compact and hardened.

Large volume of rainwater runoff would wash away the top soil; dissolve some nutrition substances in it especially when the covering plants are cut down, thereby negatively impacting the soil quality.

f. Impact on ecological environment

Construction phase is considered to cause the most impacts on the ecosystem in the region, including terrestrial ecosystem and aquatic ecosystem. These effects can include temporary impacts during construction period but also other long-term impacts.

The impacts can be listed as follows:

- Impacts on migration, inhabitation and foraging of fishes and aquatic species.

In the course of construction works, the use of machinery is unavoidable. The operation of these machines will cause noise and vibration affecting the habitats as well as migration of species, especially those living in the rivers where the construction activities are carried out.

The species affected by this process are mainly vertebrate species belonging to classes of fish or shrimps living in the rivers. Water diversion measures during the construction shall be applied.

During the dredging process, the flow would be diverged and the dredged work will be carried out in sections, thus, flow of the water courses and living environment for the aquatic species can be ensured. Also, the living beings can still move and seek for their foods.

- Cause environmental pollution and affect the inhabitation of the species in the aquatic ecosystem

According to the design, construction of works of Basin B will involve some machines and equipment. For that reason, leak of oil and lubricant into the river is quite possible. The amount of the leak is unable to be estimated as it depends on the construction plan and measures.

The results of construction supervision of many works on rivers show that waste oil floating surrounding the construction sites is often observed. The color of oil floating can be bright or even brown. The spreading scope is dependent on the weather and water velocity as well as riparian vegetation.

Oil leak into a river will cause directly impact on river water quality as well as the ecosystem there. Specifically, it will decrease the amount of dissolved oxygen in water, preventing the light and oxygen from infiltrating from the air into the water. It causes, therefore, direct impacts on aquatic creatures in the area as well as downstream. As a result, plankton, zooplankton and phytoplankton will have to find another habitat. These species without unable to move like aquatic plants, zooplankton and phytoplankton could die due to the lack of oxygen and changed living environment. However, this kind of impacts could be mitigated because oil and lubricant will be strictly controlled and collected during the construction to prevent them from leak or spill into the water flow.

The level of this type of impact is assessed as insignificant (some 20 m upstream and 50 m downstream for rivers and within a radius of some 10m for lakes from the construction site) and will last only in a short time.

g. Traffic Management

As the project involves a large amount of excavation and dredging works in rivers, lakes and drainage canals, it will generate correspondingly a large amount of excavated materials to be transported. This implies significant potential impacts on local road insfrastructure and road safety, especially on planned transporting routes.

In Basin B, calculation of transportation of dredged and excavacated materials using planned routes is presented in the following table

Table 57. Calculation of transportation of materials for each work in Basin B

No	***Works***	***Amount to be transported (m^3)***	***Distance (km)***	***Truck load (ton)***	***Total trips (trip)***	***Construciton duration (month)***	***Daily trips (trip/day)***	***Transporting route***
A	***Sub basin B1***							
I	Pumping station	90,441		7	13,566	24	38	Pho Day dyke
II	Dredging Nhi Hoang lake	424,724		7	63,709	18	236	PR 309, Pho Day Dyke
B	***Sub-basin B2***							
I	Pumping station	770,392	19.5	10	80,891	18	300	PR 303, 304, 305
II	Approaching canals and on-canal structures	530,458	19.0	10	55,698	18	206	
III	Discharging canals and on-canal structures	106,795	20.0	10	11,213	24	32	
IV	Dredging Phan River from Thuong Lac to Lac Y	434,738	18.0	10	45,647	24	128	PR 303, 304, 305, NH 2, 2A, 2C
V	Vinh Son regulation gate	1,740	20.0	7	261	18	2	PR 303, NH 2A
VI	Lac Y regulation gate	2,292	9.0	7	344	18	2	NH 2A
C	***Sub-basin B3***							
I	Pumping station	59,250.0	10.0	7	8,888	18	34	PR 303- Huong Canh – Tan Phong Road
II	Approaching canals and on-canal structures	397,799.0	10.0	7	59,670	18	222	
III	Discharging canals and on-canal structures	210,391.1	10.0	7	31,559	12	176	
IV	Regulating lake in front of PS	591,166.0	10.0	7	88,675	24	246	
V	Dredging Phan River section	156,306.0	10.0	7	23,446	6	262	Bypass road of Vinh Yen City - NH2
VI	Dredging Sau Vo Lake	2,266,989.0		10	238,034	24	662	Lake access road- Tan Phong - Huong Canh - Dong Mong Road
VII	Service road across Sau Vo lake	76,183.0		10	7,999	18	30	

From the calculated results in the table above shows that the transportation of materials will increase traffic pressure on the roads, especially on transport routes such as:

- ✓ Dredging Nhi Hoang Lake (B1): affected route is Provincial Road 309 and Pho Day Dyke from PR 39 to Kim Xa Disposal site.
- ✓ Ngu Kien pumping station, canals and dredging Phan River from Thuong Lap to Lac Y (B2): affected routes are PR 303, 304, 305, NH 2, 2A, 2C
- ✓ Works in sub-basin B3: affected routes are PR 303, NH 2, Tan Phong - Huong Canh to Dong Mong disposal site.

Survey results showed that these existing routes to be used for transporting materials are in good condition. Such National Highways 2, 2A and 2C is QL have high traffic density and PRs 303, 304, 305 and 309 have lesser density and will pass through many rural neighborhoods. Therefore, during transport of materials through these routes will potentially:

- ✓ Cause risks of traffic safety for the people
- ✓ Cause degradation to road infrastructure
- ✓ Increase the amount of dust and emissions with potential environment and human health impacts as well as the people living along the routes (see the detailed assessment of Section impacts of dust and emissions from active transportation of dredged material for basin B)

These impacts are assessed as temporary during construction period but the magnitude of impact is assessed as high and require a good management traffic management plan and close coordination with local authorities to ensure the potential impacts on traffic be mitigated to an acceptable level.

h. Risks and accidents

Work accident

In general, work accidents could happen at any stage of the project construction. Their reasons include the following:

- ✓ Environmental pollution can cause fatigue, dizziness or fainting for workers.
- ✓ Construction activites, unloading/loading and transportation of materials etc. without appropriate concentration would cause labor or traffic accidents.
- ✓ Accidents caused by carelessness, lack of protecting equipment, or lack of awareness of labor safety compliance.

<u>*Fire and explosion, leakage and spillage accidents.*</u>

Fire and explosion accidents could happen during the transportation and storage of fuel, or by the lack of safety of the temporary power supply, causing damages to people and assets during the construction. Their specific reasons are as follows:

- ✓ Temporary material and fuel storage for construction (petrol, DO oil, FO oil, welding gas etc.) is the source of fire/explosion, which could cause serious damages in terms of people, socio-economy and environment;

- ✓ Temporary power supply system for construction machines and equipment may cause electric shock, leakage, explosions. causing economic damages and accidents to workers;

It is necessary that the investment owner shall apply all necessary fire and explosion as well as leakage and spillage prevention measures to ensure labor safety for workers. These activities shall be practised regularly and therefore the risk of such accidents will be minimized.

5.1.3.2.2 Site-specific environmental impacts

a. Site-specific impacts during the construction of pumping stations, approaching and discharging canals

The construction of pumping station may cause some specific impacts including the following:

- ✓ Impact on the water drain process in the area: the pumping stations as well as the approaching and discharging canals are mainly constructed at the areas with cultivating activities and a number of irrigation canal systems. For that reason, their construction could affect water collecting and drain during the cultivation process, which cause a lack of water needed for irrigating and risk of inundation due to the fact that water could not be drained during heavy rains. And it may affect the plants productivity and thereby the farmers' livelihood.
- ✓ Risk of ground subsidence during the construction of pumping stations and collapse at construction areas of the canals. According to the design, a huge amount of soil needs to be excavated for the construction of the works. The excavation volumes of pumping stations are presented in the table below:

Table 58. Excavation volumes of pumping stations

No	**Work (pumpstation, approaching and discharging canals)**	**Volume (m^3)**
1	Kim Xa pumping station	90,441
2	Ngu Kien pumping station	2,048,710
3	Nguyet Duc pumping station	1,689,200

With such a huge volume of excavation and materials needed for the pumping stations construction, during the project preparation, if geological and hydraulic surveys are not properly and accurately implemented and no specific construction measures proposed, subsidence or collapse of the ground at the pumping stations and along the canals during the construction and even when it is put into operation are quite possible to happen.

Impacts on the soil quality in cultivation areas: Most kinds of cultivating soil are ranked from light to medium. The soil microorganism system includes mostly the species that play an important role in the soil improvement process (like earthworm, protein stabilizing bacteria etc.) During the construction, using heavy machinery and equipment is unavoidable, which causes impacts on the quality of the soil around (making it compact and hardened and its structure destroyed etc.) thereby affecting the microorganisms living in the soil. It then affects the plants productivity and quality.

However, all the mentioned above impacts are considered to happen only locally and at a small scale around the construction site and the soil quality will be reinstated later on when the works are put into operation.

b. Site-specific impacts during the rehabilitation of Phan River and the related works

In Basin B, dredging and embankment activities will be implemented for the river in order to ensure suitable flooding drain for the project area. Specifically:

- ✓ B2- Dredging of the river section from Thuong Lap to Lac Y of a length of 11.5km along the existing route into a depth of some 0.5-1.5m. In which, 3.77km of the river bank will be embanked by stone at the important locations (the river sections flowing through Tho Tang, Tan Tien, Cao Dai, Thuong Trung, Vinh Son, Binh Duong, Vu Di, Trung Nguyen, Binh Dinh, Dong cuong, Hoi Hop and Thanh Tru communes).
- ✓ B3-Dredging of the river section from Vac Lake discharging canal to to Sau Vo sluice gate with a length of 3.4km into a depth of some 1.2-1.5m.

The construction of the work components would cause some specific environmental impacts including the following:

- ✓ Risk of the river bank collapse: Phan River plays an important role in regulation of the river flows in Vinh Phuc province, especially in the rainy and flooding season. Therefore, collapse and subsidence of the works during the construction are possible to take place, especially at the important locations which need to be embanked and where the bridges are improved, if geological and hydraulic surveys are not properly conducted prior to the construction or no appropriate construction measures are applied.
- ✓ Local inundation: The risk of local inundation during the construction of the works over the river flow are quite possible to happen if prior to the construction, no proper measures for the flow direction and construction are applied by the contractor. It then increases the risk of local inundation if without specific mitigation measures. Details of the specific flow direction and construction measures will be applied for each specific construction package.

- ✓ Impact of dredging process to water quality and aquatic life and downstream users:

  According to the analysis of the TSS content of water samples in water bodies in the basin B (Sau Vo Lake, Nhi Hoang Lake, Rung Lake, Phan River),TSS concentrations in most samples excess QCVN: 08/2008/BTNMT - column B.

  Therefore, the dredging the bottom layer of sludge will be stirred and leads to increase the current water turbidity and level of TSS level, which consequently affect the water quality and aquatic life.

However, during the construction, the dredging and the lakes rivers will be carried out in section, with the application sheet piles surrounding each section to prevent the impact to other surrounding sections.

In addition, the dredging process is undertake in dry season, with the stream diversion. From the assessment of current state of biodiversity in Phan River (section 3.3), there is no endangered and rare species in these lake. In addition, only 08 households fishing on Phan river during off-season to be impacted. Thus, the impact of dredging process to aquatic life and down stream users are assesed low.

During the river dredging, the ecological flow of the river will be diverted with the dredging process only takes place at half river bed. Thus the ecological flow is not be disrupted and the impact will be minimized.

With the application of these above mentioned measures, the increase in turbidity is projected as follows:

+ For standing water bodies such as lakes of Nhi Hoang, Sau Vo and Rung: The turbidity will increase around the area to be dredged within a radius of about 10m

+ For running water bodies such as Phan River: The turbidity will increase from the point of dredging about 150m downstream and about 10 meters upstream

- ✓ Disposal of excavated sludge:

  According to the calculation result, the total excavation volume of the construction works in the Basin B is 7.24 mil m^3, in which the volume of the dredged materials that could be reused as consolidating or backfilling materials is 6.14 mil m^3. The remaining 1.1 mil m^3 is sludge or light organic soil unable to be used need to be transported to the disposal sites of Dong Mong and Kim Xa. According to the initial analytic result of the dredged materials, the content of heavy metals at some locations of the river are higher than stipulated in the standard QCVN03:2008/BTNMT for cultivating soil. Therefore, for these areas, additional analysis of organic substances as well as heavy metals such as Cu, Zn, As, Pb and Cd should be made, based on which to assess in an objective way as well as to apply suitable measures to manage the dredged materials.

  During the implementation period, comprehensive testing on sludg/soil will be carried out. If the analytic result shows the content of the concerning substances still higher than the QCVN 03:2008/BTNMT for commercial purpose, these materials shall only be stored at the Dong Mong disposal site in the cells with HDPE impermeable material. For the remaining locations at which the substances' contents are within the allowable limits, the materials could be stored in any of the 02 disposal sites of Dong Mong and Kim Xa or used as construction materials (if suitable).

- ✓ Odors and gases from the river dredging: The Phan River's sediment is characterized by high content of organic substances settled for a very long time in anaerobic conditions. Therefore, the organic substances decomposition will generate unpleasant odors and toxic gases such as CH4, H2S, etc. It is possible that the dredging activities will release these gases into the atmosphere, which contributes to increasing greenhouse gases in the air and unpleasant odors for the environment. However, these impacts are unavoidable for the dredging work of the bottom sediment. Using successive construction method and flow diversion technique, the concentration of odor and gases will be lesser during the construction phase.

- ✓ Impacts on the surrounding residential areas: Along the Phan River basin, there a number of residential areas and businesses. The construction therefore will affect the living and production activities, especially at the densely populated areas of Huong Canh and Tho Tang towns, Te Lo commune, etc. As water users of the River, they will be impacted by increased turbidity and deterioted water quality during dredging and during operation when flow regime is regulated. However, as mentioned above, the scope of impacts is identified as locally concentrated and successive dredging methods will largely reduce this risk.

- ✓ Interruption of traffic at construction sites of bridges' improvement: It will take place at the bridges that will be improved including Nam Lung Hoa, Dong Ve, Vinh Son, Yen Nhien, Van Xuan, Dong Lac, Tranh in Trung Nguyen commune. During the construction, the people' traffic will be affected/interrupted. Without proper construction measures, it would cause negative social impacts. Therefore, the contractors shall propose specific construction measures in order to minimize the impacts, e.g. building temporary bridges, closely cooperate with the local government etc.

c. Site-specific during the construction of lakes in B basin

According to the calculation result, the volumes of the dredged materials from the lakes in Basin B are presented in the table below:

Table 59. Volumes of dredged materials in Basin B

Basin	**Name of lake to be dredged**	**Dredged area (ha)**	**Dredged amount (m^3)**		**Organic sludge (m^3)**	**Volume of sludge reused for filling (m^3)**
B1	Nhi Hoang Lake	38.5	424724		43606	245,533
B2	Rung Lake	30.9	980634		98036	882570
B3	Sau Vo lake	176.51	3100000		775000	2325000
Total		249.4	4812134		1604536	3207570

Dredging of the mentioned above lakes would cause the following specific impacts:

- ✓ Impacts on the environment by the dredged materials: According to the result of the initial analysis, the contents of heavy metals of the dredged materials showed that they are within the allowable limit stated in the QCVN03: 2008/BTNMT for cultivation soil. However, additional analysis of the contents of organic substances and heavy metals such as Cu, Zn, As, Pb and Cd should be made in order to have a base for an objective assessment and proper measures for the dredged materials management. The management and treatment of the materials should also be implemented like for the dredged materials of the Phan River.

- ✓ Impacts on the air environment: like the sediment of the Phan River, dredging of the lake's sediment will also cause similar impacts on the air environment and human health due to its odors and toxic gases like CH4 and H2S etc. and the impacts are unavoidable. Using successive construction method in different part of the lake and flow diversion technique, the concentration of odor and gases will be lesser during the construction phase.

- ✓ Impacts on the aquatic ecosystem in the lakes: Dredging activities will cause disturbance to water quality and aquatic ecosystems in the lakes by removal of sediment that is used as habitat for aquatic species. The species can be suck up and displaced by dredging that can even cause death. However, the extent of the impacts will be mimimal, highly depending on the implementation measures. If all the water will drain prior to the dredging, all the creatures in the lakes will be impacted and when the lakes are put into use, a new ecosystem will take form. If the dredging will be conducted section by section, and the dredging area be separated from the remaining areas, the impacts on the aquatic ecosystem in the lakes would be minimized.

- ✓ Impacts on aquatic ecosystem of lakes to be dredged: An total area of 249.4 in 3 lakes of Nhi Hoang, Sau Vo and Rung will be dredged and fishing livelihoods and wildlife will be impacted, specifically::

  - Nhi Hoang Lake: 35 households are farming in this lake, mainly of barb, tilapia, grass carp, common carp. Existent plankton include 4 phyla: Cyanobacteriophyta, Chlorophyta, Euglenophyta and Bacillariophyta. Cholorophyta has the highest number of species of 57 and Bacillariophyta has 7 species

  - Rung Lake: 37 households are fish farming. Dominant species inlude Koi fish, snakehead fish, catfish, black carp, grass carp, Mrigal carp, tilapia fish, Crucian fish, Carassioides cantonensis, flag-tail fish, Chinese barb P. semifasciolatus, humpback fish, common sawbelly (H. leucisculus), R. giurinusand Japanese rice fish; Phytoplankton include 77 families of Coscinodiscaseae, Fragilariaceae, Naviculaceae, Nitzschiaceae, Scenedesmaceae, Desmidisceae, Oscillatoriaceae; 3 zooplankton orders, 2 zoobenthic groups.

  - Sau Vo Lake: 12 fish farming households for barb, tilapia, grass carp and common carp. Other aquatic species areshrimp, crab, goby fish etc. Cyanobacteria under 6 orders, 12 families, 33 genera of 4 phyla: Cyanobacteriophyta, Chlorophyta, Euglenophyta and Bacillariophyta; Cholorophyta : 64 species

  However, the magnitude of impact is significantly dependent on the construction measures to be introduced. As specified in the design, successive measures are used and the area to be dredged will be well protected with sheet pile instead of dredging in the whole area at a time. Therefore the impacts on aquatic ecosystem are likely to be lessened

- ✓ Risk of erosion and subsidence of the lakes' banks: the dredging of lakes could also bring about risks of soil erosion and subsidence of the lakes' banks especially at the important locations during the implementation of dredging. This would affect the construction package progress and quality as well as cause some other social impacts. Therefore, geological survey as well as proper implementation measures should be made prior to the implementation of dredging in order to minimize the risk of collapsing and subsidence of the lakes' banks not only during the dredging but also the operation later on.

d. Site-specific impacts for construction of disposal sites

For the project to be implemented, based the volume of dredged materials as well as other waste materials from all the project items of Components 1 and 2, the Vinh Phuc PPC has already planned 02 disposal sites for the materials i.e. Kim Xa and Dong Mong. Based on that, the sites are designed as follows:

- ✓ Kim Xa disposal site (in Kim Xa commune, Vinh Tuong province): is located outside the dyke the Pho Day River, bounded by the river in the North, East and South and borders on the left bank of the river in the West. This is an area cultivated by some commune people (1 crop of rice and 1 crop of another product) and managed by the PPC of the Kim Xa commune. The disposal site is planned of 3.8 ha in a lowlying part with elevation not higher than that of surrounding area (maximum +11 m). Only after the analysis result shows that the environmental parameters are within the allowable limits of the QCVN 03:2008/BTNMT for cultivation soil, all the dredged materials will be stored at the site as according to the planning. Upon the completion of the construction or the site is full of dredged materials, the site will be returned to the local authority for farming purposes.

- ✓ Dong Mong disposal site: is located in Huong Canh town, Binh Xuyen district. According to the plan, the site includes 02 smaller sites located along the two sides of the Huong Canh - Tan Phong road, of a total area of 54,31 ha. This site is currently cultivation land without any residential area. It is designed to have an elevation of +8.5m to + 8.8m and a capacity of 1,629,300 m^3. The site is divided into 13 different cells, one of which has an area of 2.98ha and a capacity of 90,000 m^3 lined with a HDPE material to store the dredged materials with contents of the substances higher than the QCVN 03:2008/BTNMT. According to the plan, after the project is finished, the site will be handed over to the locality for building up the Binh Xuyen district's administrative area.

Potential impacts by forming disposal sites include:

- ✓ Impacts by odors and gases generated by dredged sludge.Odors coming from the dredging activities will impact to the surrounding area. However, dredging process take place in a short time, and is carried out in the form of "rolling", sections by sections, so the direct impact in a small area is small.

- ✓ When these sites are created they are likely to be used by local people as domestic dumpsite and waste from other construction works nearby. This will lead to the degradation of local landscape and environment

- ✓ There is a risk of improper disposal of contaminated sludge to the designated site. This may lead to pollution for local environment and soil quality. To avoid this risk, a detailed monitoring on sludge quality should be carried out prior to construction and transportation and disposal of this type of waste will be strictly monitored to ensure sludge are disposed to appropriate designated site.

- ✓ Impact on land subsidence and erosion by formation of disposal sites. For both Kim Xa and Dong Mong, the geological survey has proven the relatively firm and stable foundation. For Kim Xa, the dredged material will be disposed to lowlying area of the site to the existing elevation of the surrounding area. Therefore, the risk of land subsidence and erosion is least likely. For Dong Mong site, it is will be constructed to the maximum elevation +8.5 m - 8.8 m, some 3m higher than the surrounding area. The risk of erosion should therefore be carefully taken into account in design and construction methods.

- ✓ Transport of dredged material to these sites will have potential impacts on sensitive receptors as these activities will create dust, noise, limited access and nuisance, especially for religious, educational and healthcare institutions. A list of those sensitive receptors is shown in Chapter 3 and relevant mitigation measures are presented in ESMP.

- ✓ As for Kim Xa and Dong Mong disposal sites, there is no impact on the households outside the disposal area. The distance from Dong Mong site to the nearest residential area (about three households) is about 500m while the distance from Kim Xa site to the nearest households is about 1km.

5.1.3.3. Impacts During the Operation of Flood Control Works in Basin B

During this phase, the impacts are evaluated mainly as positive, meeting the goals set by the project in terms of controlling and regulating flooding in the whole project area. These impacts are already analysed in the section concerning alternative impacts in the project and without-project scenarios.

In case of the " project" scenario, the project has already been identified and regulated at the very beginning of design in order to propose most optimal options.

The positive impacts that can be seen at both construction and operation phase include: mitigation of flooding situation and improvement of environment in the project area. The works that are implemented include dredging and improving drainage routes, construction of flood drainage works such as pumping stations, conducting and discharging canals, lakes etc.

In addition to positive impacts, during the operation, some other implicit social impacts could still take place and be quite specific if without proper control and specific mitigation measures.

Impacts due to the operation of pumping stations, approaching and discharging canals

The pumping stations include Kim Xa, Ngu Kien and Nguyet Duc will contribute to regulating the flow and controlling flood risks for Vinh Phuc Province. During their operation, some potential negative impacts include the followings could take place:

- ✓ Causing impacts on the aquatic ecosystems: It is noted that the pumping stations are only operated during the flood seasons. During the operation of pumps, with their sucking power, aquatic creatures moving near the sucking head would be sucked into the pump. However, this can be mitigated by application of appropriate measures, e.g. using net around the sucking pump head.

  It is noted that there are several threated speacies in the Red river at the confluence of Red River with Da, Lo and Thao rivers, which is about 20 km upstream of Ngu Kien pumping station, which outside the project area of influence (see section 3.3).

  However, no endangered and rare aquatic species, no migratory fish in the Red River and Pho Day section at the area of influence of pumping stations are recorded and detected. is detected and recorded in the project area.

  Given all analyses above, the impact of the operation of pumping station are assessed is insignificant

- ✓ Canal bank erosion: As already mentioned, if no proper geological surveys during the design and construction measures during the construction, the risk of erosion of the banks of canals and lakes are quite possible to happen. That's why thorough survey should be made and proper construction measures be implemented to mitigate these impacts.

- ✓ Impacts on the flood control function if no suitable operation and maintenance are applied: The flood control function will only meet requirements when the works are properly operated and maintained according to the technical procedure during the operation phase. If the pumping stations are improperly operated or their operation is stopped for any reason, flood drainage for the upstream area will be affected and the risk of inundation and flooding is quite possible to happen like before when the project has not yet been in place.

- ✓ Impacts on the hydraulic regime in the downstream area: Assessment in details of the impacts of drainage by the pumping stations on the downstream areas of the rivers are presented in section 5.1.2.4 , relating to the impacts on hydraulic regime of Red River and Pho Day River due to the operation of pumping stations of Component 1 of the project in this report.

- ✓ Impacts on the safety of local people (especially children): In rural areas, swimming and taking bath in lake or canal is a daily habit of people. Therefore, it could pose a threat to the safety of local people (especially children). The reason is that when pumps are operated, the flows in the conducting canals are high and children could be swept away into the sucking tanks in the station. c.2. Impacts due to the formation of retention lakes

Dredging Rung, Nhi Hoang and Sau Vo lakes and construction of some regulation lakes in front of pumping stations could pose threats to the local people especially children when swimming or bathing there.

In addition, when being put into operation, the lakes will become places where organic substances are settled and accumulated, especially sludge and plants swept away from the upstream sections of the Binh Xuyen and the Phan Rivers. The organic substances, when accumulated in the lakes, will be decomposed in time to generate some gases like CH_4, H_2S etc. This will require the periodical maintenance.

5.1.4. Component 1. Impacts Assessment for Flood Control work in Basin C

The project activities in Basin C include mainly dredging and improvement of the system of rivers in Binh Xuyen as well as improvement of some regulating gates in the rivers, specifically:

Improvement and dredging and increasing of the river bed according to the actual route together with diverting the routes at some sections on the Cau Bon and Tranh Rivers with a total length of 21.4 km, in which:

- ✓ Cau Bon River is 7.67 km long, of which 0.5 km will be regulated in terms of route and 0.28 km is the length of a new section, the width is designed to be 20-25 m, and the slope factor is 1.5;
- ✓ Tranh River has a length of 5.42 km (of which 0.21 km old route to be regulated and 0.27km new section), the designed bed width 15-25m, and the slope factor is 1.5;
- ✓ Ba Hanh River has a length of 7.5 km , the designed bed width 15-30 m, and the slope factor is 1,5;
- ✓ The channel connecting Cau Bon River with Tranh River is of 0.78 km length, the designed bed width 25 m, and the slope factor is 1,5.

Construction of the Ton bridge regulation gate on Cau Bon River with 03 gates (n x b x h = 3x6x8m), the culvert bottom's elevation is +2.4 m. In addition, there are some other auxiliary works such as concrete operation road of 1.16 km length and 5m width, an administration house of 400 m^2.

Construction of the Sat bridge regulation culvert on Ca Lo River with 03 gates (n x b x h = 3x6x8m), the culvert bottom's elevation is +1.0 m. There are also some auxiliary works there such as concrete operation road of 230 m length, and 5m width, an administration house of 400 m^2.

Embankment of 02 sections of the Sat bridge: Section 1: upstream of Thinh Ky Bridge. This section has a length of 103 m, with concrete embankment M200 at both sides with an elevation of the top of the embankment of +9.3m and a width of 1m; Section 2: downstream the regulation culvert, of a length of 410 m, with concrete embankment M200 at the right side with an elevation of +8.3m, and a width of 1m.

With the above mentioned activities, the anticipated social and environmental impacts are as follows:

5.1.4.1. Impacts during Preparation Stage

Impacts by the land acquisition

Like in Basin B, the project requires land acquisition for construction activities, thus will cause adverse social impacts in the area. Details of impact assessments are described in the

Section 5.2 of this report.

Impacts by UXO

The UXO impact for basin B is similar to that of basin C as described in section 5.1.3.1. UXO will be carefully cleared in order to ensure safety for the site clearance activities and the works to be constructed. The area to be cleared includes all the areas where the construction activities will be conducted. The clearing activities will be implemented by specialized army units.

5.1.4.2. Impacts due to the Construction of Flood Control Investments in Basin C

5.1.4.2.1 Generic environmental impacts

There are some general and site-specific environmental and social impacts during the construction of the works in Basin C. General impacts are similar to those identified for the construction of the works in Basin B, including the following:

a. Impacts on air quality

Impacts by dust and emissions from earthwork

According to the calculation, the volume of excavated soil and sludge for the works of Basin C of Component 1 is 1,352.462 m^3, in which some 1,064.543m^3 is dredged materials that could be reused for backfilling at some locations or as construction material. The remaining 287,918 m^3 is sludge and organic soil to be transported to the Dong Mong disposal site. The excavation, backfilling and transportation of these materials will cause dust and emissions, affecting the air quality in the area. The dust and emissions include:

Dust from the excavation

Based on the calculation method of dust volume arising from excavation in Basin B, the total amount of dust generated in Basin C is presented in the following table:

Table 60. Total dust amount by subcomponent in the Basin C

No	Construction works	*Total earthwork volume (m^3)*	*Total amount of generated dust*	*Dust concentration in the baseline environment (mg/m^3)*	*Accumulated dust concentration (mg/m^3)*	*QCVN 05:2013/ BTNMT*
I	Cau Bon River	334,585	1,000.41	0.024-0.035	0.40	***0.3***
II	Tranh River	293,523	877.63		0.35	
III	Ba Hanh River	567,524	1,696.90		0.68	
IV	Noi River	77,332	231.22		0.09	
V	Ton Bridge gate	38,280	114.46		0.05	
VI	Sat Bridge gate	41,217	123.24			

The calculation results in the table above show that the dredging of Cau Bon River, Tranh River and Ba Hanh River will increase the amount of dust in the air and exceed the permissible limit stipulated in the Technical Regulation QCVN 05:2013/BTNMT. However, the dust volume is mostly dust fallout; with heavier weight, they quickly settle down to the ground. Therefore, the concentration of dust in the air will be reduced quickly by distance, starting from the construction site location.

In addition, the scope of construction of the entire Basin C is large and scheduled by different times in different phases, the construction sites are also far from the residential areas, these impacts are assessed as moderate, and site-specific within the scope of earthwork and only last during construction period. These impacts could mitigated by application of standard measures during construction period

Dust and emissions from earthwork machinery and equipment

Applying the similar calculation as for Basin B, the amount of emissions generated by the operation of machinery and equipment by each construction work is shown in the below table.

Table 61. Total amount of dust and emissions generated by the dredging machinery and equipment during construction period

No.	**Construction works**	***Excavated and dredged volume (m^3)***	***Machine working shift (shift)***	***Consumed fuel (kg)***	**Emission loads (kg)**			
					Nox	**CO**	**SO_2**	**Dust**
I	Cau Bon River	334,585	304	28,744	54,326	13,596	543,260	13,596
II	Tranh River	293,523	267	25,216	47,659	11,927	476,588	11,927
III	Ba Hanh River	567,524	516	48,756	92,148	23,061	921,479	23,061
IV	Noi River	77,332	70	6,644	12,556	3,142	125,563	3,142
V	Ton Bridge gate	38,280	35	3,289	6,215	1,556	62,154	1,556
VI	Sat Bridge gate	41,217	37	3,541	6,692	1,675	66,923	1,675

With dust and emissions loads as calculated in the table above, applying the BOX model, we can calculate the emission concentration at the construction site. Calculation results are shown in the following table:

Table 62. Dust and emission concentrations generated from the operation of dredging machinery and equipment

No.	Construction works	Average NO_2- 1 hr (mg/m^3)		Average CO- 1hr (mg/m^3)		Average SO_2- 1 hr (mg/m^3)		Average TSP- 1 hr (mg/m^3)	
		Concentration in baseline environment	*Accumulated concentration*	*Concentration in baseline environment*	*Accumulated concentration*	*Concentration in baseline environment*	*Accumulated concentration*	*Concentration in baseline environment*	*Accumulated concentration*
I	Cau Bon River	0.02-0.031	0.34	4.2-5.5	6.81	0.15-0.031	0.41	0.024-0.035	0.46
II	Tranh River		0.32		7.23		0.37		0.43
III	Ba Hanh River		0.45		6.18		0.67		0.74
IV	Noi River		0.18		5.90		0.12		0.12
V	Ton Bridge gate		0.21		5.90		0.07		0.08
VI	Sat Bridge gate		0.19		6.22		0.07		0.08
	QCVN 05:2013		**0.2**		**30**		**0.35**		**0.3**

The calculation results in the table above show that the construction activities will generate accumulated dust and emission concentrations that exceed the permissible limits in the Technical Regulation QCVN 05:2013/BTNMT at some construction sites, particularly when dredging Tranh River, Ba Hanh River, and Cau Bon River with the concentrations of SO_2, CO, NO_x and dust that all exceed the permissible limits.

However, impacts on the ambient air quality caused by the operation of the construction machinery and equipment are assessed as site-specific which take place only within the construction area. These impacts could mitigated by application of standarded measures during construction period.

<u>Dust and emission impacts caused by transportation of dredged materials</u>

The statistical results of dredged material volume to be transported to the disposal sites, the transportation vehicles, routes, and average transportation distance in kilometer per day are shown in the Table PL3.1 in the Appendix.

Applying the emission factors and pollutant loads due to the transportation process according to the rapid assessment of the World Health Organization (WHO), the volume of dust and emissions generated at each construction site in Basin C is calculated and shown in the following table:

Table 63. Volume of dust and emissions generated by the dredged material transportation vehicles in the Basin C

No	**Construction Works**	***Daily transport distance in km***	Daily pollutant loads (g/day)				**Transport route**
			TSP	***SO2***	***Nox***	***CO***	
I	Cau Bon River	1,468	1,982	6,093	21,141	4,257	PR302, NH2A
II	Tranh River	1,422	1,920	5,902	20,480	4,124	PR310B,NH2A
III	Ba Hanh River	7,601	10,261	31,543	109,451	22,042	PR310,NH2A
IV	Noi River	997	1,346	4,139	14,362	2,892	PR302B, NH2A
V	Ton Bridge gate	313	423	1,300	4,512	909	PR302B, NH2A
VI	Sat Bridge gate	797	1,076	3,309	11,482	2,312	Ca Lo dyke, NH2A

The results in the table above show that the volume of dust and emissions generated by the dredged material transport vehicles on site is relatively high, particularly the sites of dredging Tranh River, Ba Hanh River, and Cau Bon River. The people participating in traffic and living along the transportation routes from the construction sites to Dong Mong disposal site such as provincial roads 302B, 310, Ca Lo Dyke and National Highway 2 (section from Huong Canh to Dong Mong) are subject to these impacts.

b. Impact by noise

With the mobilized equipment for the construction of works similar to those in Basin B, the impacts of noise during construction of works in Basin C are considered as varied from low to moderate as most of the construction areas are far from residential areas and this impact will be mainly related to the workers directly working at the construction site. This impact could be mitigated by application of appropriate management and construction practices.

c. Impacts on surface water

Impacts on surface water by dredging activities

Construction process requires excavation of 1,352,462 m^3 of dredged material, of which 287,918 m^3 of dredged material is sludge that cannot be used for leveling and thus will be transported to the disposal site. The analysis of dredged material quality from Cau Bon, Tranh and Ba Hanh Rivers showed that although the content of substances in 3 rivers sediment was not as high as one from Phan River, but since this sediment has been deposited at the river bed for a long time, sludge dredging would cause some potential environmental and social impacts as follows:

- ✓ The process of dredging will increase the turbidity in the river water of the river network in Binh Xuyen, causing reduction of capability to receive light, reduce photosynthetic efficiency and saturation of oxygen in water. Due to the fluctuation of water, the dirt will be removed from the sludge and diffused into water at different levels, leading to contamination of water environment. Slow and with interval dredging might because ecosystem is slow to recover;
- ✓ The sediment transportation by truck from dredging sites to the disposal site of waste materials might cause leakage and spillage of sludge along the transport route, thereby affecting environment, landscape, and traffic safety. Therefore, regulations and specific measures for transporting sludge is required in order to reduce the risk of sludge leakage and spillage. For example, dredged sludge must be dried before transporting, coverage is compulsory for transporting sludge, etc. Hence, the impacts on environment will be reduced to an acceptable level.

Impacts by wastewater generated from the construction process

With the volume of works to be constructed in Basin C, calculated results showed that the daily average volume of wastewater from the construction process is about 75 m^3. This wastewater is characterized by high concentration of suspended solids, and can be contaminated with the concrete admixtures and high pH level, etc. Therefore, this source of wastewater must be treated using appropriate method such as using sedimentation pond.

Impacts by domestic wastewater from workers

During the construction process of the works in Basin C, the estimated total number of workers involved in all construction sites at peak time in Basin C is 100 people/day. Applying the same calculation for the Basin B, the maximum amount of domestic wastewater in the Basin C is:

$$100 \times 10^{-3} \times 100 \times 90\% = 9 \ (m^3/day)$$

Domestic wastewater is characterized by residuum, suspended solids, organic matter such as BOD, COD... and microorganisms (which can carry many pathogenic microorganisms).

The calculation results of pollutant load and concentrations in domestic wastewater are shown in the following table.

Table 64. Pollutant loads and concentrations in untreated domestic wastewater

No.	Indicators	Pollutant discharge (g/person/day)	Pollutant load (g/day)	Pollutant concertation (mg/l)	
				Not yet treated	**QCVN 14:2008 Column B**
1	BOD_5	45 – 54	4500 – 5400	39.09-46.91	50
2	COD	72 – 102	7200 – 10200	62.55-88.61	-
3	TSS	70 – 145	7000 – 14500	60.81-125.97	100
4	Oil	10 – 30	1000 – 3000	8.69-26.06	20
5	Total N	6 – 12	600 – 1200	5.21-10.42	50
6	Ammonia ($N-NH_4$)	2.4 – 4.8	240 – 480	2.08-4.17	10
7	Phosphor	0.8 – 4.0	80 – 400	0.69-3.47	10
8	Total Coliform	10^6 - 10^9	$100x10^6$ - $100x10^9$	$0.87x10^6$ – $0.87x10^9$	5000 (MNP/100ml)

However, according to the assessment, although large volume generated, but it is scattered throughout the sites and generated source is mainly from workers' camp, thus the collection and treatment could be managed

d. Generation of solid waste

Domestic solid waste

The total number of workers involved in construction sites at peak time in Basin C is 100 people. Therefore, the maximum amount of domestic solid waste generated during this period is calculated as follows:

100x 0.5 = 50 (kg/day)

The environmental impacts caused by solid waste have been described in the section 5.1.3.2 as for Basin B. To minimize the impacts of domestic solid waste generated, during the construction process, the contractor must fully comply with the regulations on solid waste management as outlined in the ECOP of this report.

Construction solid waste:

Solid wastes are mainly: cement packages, spilled grout, debris, metal scrap, etc. The volume of this solid waste was difficult to estimate accurately. But it could be controlled through the daily amount generated. Also this kind of solid waste could be reused or sold as scrap, therefore this impact is evaluated as negligible and generated within construction area only.

In addition to the above-mentioned solid waste, with project particular, the solid waste arising from dredging activities also generated a large amount. However, this waste will be assessed in the section concerning site-specific impacts (5.1.4.2.2) and mitigation measures in this report.

Hazardous wastes

Like in Basin B, the required maintenance activities for machinery and vehicles will generate a certain amount of oil rags and spent oil and grease etc. Based on the estimate of quantity and types of construction vehicles and machines, construction duration in Basin C, it is estimated that about $0.5m^3$ of spent oil and 6 kg of oily rags and used light bulbs will be generated each month.

All the hazardous wastes must be collected, stored as regulated and only authorized organizations permitted transport and treatment. Inappropriate management of solid and hazardous waste could contribute to an unhealthy environment or act as source of disease, especially vector borne as well as pollute air and water environments. Therefore, the project needs to manage generated waste appropriately.

e. Impacts on ecological environment

Similar to the impact assessment for Basin B, the impacts on the ecological environment during the construction process in Basin C are mainly impacts on terrestrial and aquatic ecosystems in the basin of Binh Xuyen rivers. These impacts may include temporary impacts during the construction stage but there are long-term impacts as well. These impacts include:

- ✓ Impacts on migration, inhabitation and foraging of fishes and aquatic species living in Tranh, Ba Hanh and Cau Bon Rivers, upstream of Ca Lo River and in the irrigation canals system connected to the rivers.
- ✓ The process of dredging would affect to river water quality, then to the habitat of aquatic creatures.
- ✓ The participation of the construction equipment might cause grease and oil leakage, that would affect the growth of aquatic species living in the surrounding area.

These impacts are very difficult to avoid since the project particular is to dredge the rivers and build the regulating gates. However, as successive construction method is applied with flow diversion technique and cofferdam built to prevent water intrusion into the dredging area and oil and grease leakage into the surrounding water, the magnitude of the impact is assessed as varies from low to moderate, controllable and specific to the construction site (about 20m upstream and 50m downstream from the location of construction and impact period is during the construction only).

e. Traffic management

In Basin C, the excavation and dredging works in Binh Xuyen rivers and construction of control gates in Ton Bridge and Sat Bridge will require large amount of transporting vehicles. This implies huge potential impacts on local road insfrastructure and road safety.

Calculation of transportation of materials using planned routes in Basin C is presented in the following table.

Table 61. Calculation of transportation of materials for each work in Basin C

No	**Construction work**	**Amount to be transported (m^3)**	**Distance (km)**	**Truck load (ton)**	**Total trips (trip)**	**Construciton duration (month)**	**Daily trips (trip/day)**	**Transporting route**
1	Cau Bon River	269,061	5.5	7	40,359	12	224	PR302, NH2A
2	Tranh River	217,211	6.6	5	45,614	12	254	PR310B,NH2A
3	Ba Hanh River	567,524	13.5	7	85,129	12	474	PR310,NH2A
4	Noi River	77,332	6.5	7	11,600	6	130	PR302B, NH2A
5	Ton Bridge gate	38,280	5.5	7	5,742	8	48	PR302B, NH2A
6	Sat Bridge gate	41,217	13.0	7	6,183	8	52	Ca Lo dyke, NH2A

From the calculated results in the table above shows that the transportation of materials will increase traffic pressure on the roads, especially on transport routes of PR 302, 302B, 310, 310B and NH 2A.

Survey results showed that these existing routes to be used for transporting materials are in good condition. Such routes will pass through many rural neighborhoods, therefore, during transport of materials through they will potentially:

- ✓ Cause risks of traffic safety for the people
- ✓ Cause degradation to road infrastructure
- ✓ Increase the amount of dust and emissions with potential environment and human health impacts as well as the people living along the routes (see the detailed assessment of Section impacts of dust and emissions from active transportation of dredged material for basin C)

These impacts are assessed as temporary during construction period but the magnitude of impact is assessed as high and require a good management traffic management plan and close coordination with local authorities to ensure the potential impacts on traffic be mitigated to an acceptable level.

f.. Risks and incidents:

The impacts by risk and incident for the construction activities in Basin C were assessed similarly to the construction activities in Basin B (see section 5.1.3.2) and include the potential risk of work accidents, explosion incident, material leakage, fire incidents, etc. the extent of impacts by these risk and incident are evaluated as infrequent and scale of impacts would be within the construction site.

5.1.4.2.2 Site-specific environmental impacts

a. Rehabilitation of 3 river system in Binh Xuyen (Tranh River, Cau Bon River and Ba Hanh River)

The specific environmental impacts during construction of those works are including:

- ✓ Risk of erosion along river banks and at embankment locations: Tranh River, Ba Hanh River, Cau Bon River and Ca Lo River are irrigation works that have important roles in regulating the flows over area of Binh Xuyen District, Tam Dao of Vinh Phuc province and Me Linh (Hanoi), especially in the rainy season. Hence the risk of landslides and subsidence during construction is very likely to occur, especially at locations to be rectified onTranh and Cau Bon River and at key positions embanked in the Project. Without thorough survey on geological and basin hydrographic conditions at those positions before construction, as well as the specific construction measures during construction, the risk of erosion of river banks during construction and operation stages is likely to occur. This impact does not cause economic damage only, but reduce the capability to control and regulate flooding in the rainy season also. Therefore, the project should have detailed calculation for hydrographic model and geological survey in order to propose appropriate construction measures.

- ✓ Local flooding: the risk of flooding during construction works on the flow is likely to occur if the contractors would not apply the specific diversion and construction measures before commencing work. Beside drainage function, the dredged and rehabilitated rivers are the large irrigation works of the province, thus the river flow is usually high. Consequently, construction with blocking measure would result in flooding at upstream area and water-short at downstream, affect to local production. Hence, the construction measures are elaborated by each work such as avoiding construction during the rainy season and providing diversion measure before commencing work.
- ✓ Impact of dredging process to water quality and aquatic life and downstream users,

  According to the analysis of the TSS content of water samples in water bodies in the basin C (Tranh, Cau Bon, Ba Hanh and Noi Rivers),TSS concentrations in most samples excess QCVN: 08/2008/BTNMT - column B.

  Therefore, the dredging the bottom layer of sludge will be stirred and leads to increase the current water turbidity and level of TSS level, which consequently affect the water quality and aquatic life.

  However, during the construction, the dredging rivers will be carried out in section, with the application sheet piles surrounding each section to prevent the impact to other surrounding sections.

  In addition, the dredging process is undertake in dry season, with the stream diversion. From the assessment of current state of biodiversity in Binh Xuyen network River (section 3.3), there is no endangered and rare species in these lake. In addition, only 07 households fishing on these river during off-season to be impacted. Thus, the impact of dredging process to aquatic life and down stream users are assesed as low.

  During the river dredging, the ecological flow of the river will be diverted with the dredging process only takes place at half river bed. Thus the ecological flow is not be disrupted and the impact will be minimized.

  With the application of these above mentioned measures, the increase in turbidity is projected about 150m downstream and about 10 meters upstream. Thus, the impact to downstream water use is aso assessed as low.
- ✓ Environmental impacts by dredged material: as calculation results, the total volume of dredged material from construction of the works in Basin C is 1,352,462 m^3. Of which volume of dredged material canbe reused for backfilling and leveling is 1,064,543 m^3, the remaining 287,918 m^3 are unused and will be transported to Dong Mong disposal site. The results of initial analysis of the report on quality of dredged material showed that although sediment quality of 3 river system basin in Binh Xuyen has lower content of substances than that of Phan River sediments. However, prior to construction, a detailed testing will be carried out to assess the quality of sludge and appropriate disposal site. If the analysis shows that the content of heavy metals is still higher than QCVN 03: 2008 /BTNMT, the dredged material will only be taken on the planned cell, where the bottom layer was leakage resistant with HDPE material in Dong Mong disposal site (this disposal site was planned as an expansion urban). For dredged material from the positions that the analysis results below the levels of regulation, it might be poured into other cells in Dong Mong, or Kim Xa disposal sites, or could be used as construction material (if any).

- ✓ Odors and emissions generated from the dredged material: like Phan River sediment, sediment from 3 river system in Binh Xuyen is organic sediment deposited at bottom of river for long in submerged conditions. The process of digesting of organic matter will produce odors and toxic gases such as CH4, H2S, etc., so material dredging will provide an opportunity for releasing these gases into the atmosphere, contributing to the increase in the Greenhouse gases in the atmosphere, especially the offensive odor to people around. However, dredging activities take place in a short time, and follow the form of "rolling" so the direct impact in a small area is short.

b. Rehabilitation of regulating gates and auxiliary works along river

Together with rehabilitation and dredging rivers in Basin C, a number of works on the rivers are also be built as follows:

- ✓ Construction of Ton Bridge regulation gate on Cau Bon River with 3 doors (nx bxh=3 x 6 x 8m), regulation bottom elevation of+2.40m. Besides, this work also has auxiliary works such as concrete access road with 1.16km length, 5m width; administrative house with S=89 m^2.
- ✓ Construction of Sat Bridge regulation gate on Ca Lo River with 3 doors (n x b x h = 3 x 6 x 10m), regulation bottom elevation of +1.0m. Besides, this work also has auxiliary works such as concrete access road with 230m length, 5m width; operation house with S=89 m^2.
- ✓ Construction of those works also causes several specific potential social and environmental impacts:
- ✓ Impact on river aquatic ecosystem: With 23 regulating gates to be built in basin C, each of the culvert is small size. However, because the culverts are located between the rivers, construction would impact on the ecological environment of the river basin that is inevitably. Similar to the river dredging, impacts on river ecosystems by culvert construction activities include the disturbances to water quality and aquatic habitat in the lakes by removal of sediment that is used as habitat for aquatic species. The species can be suck up and displaced by dredging that can even cause death. However, the duration, magnitude and reversibility of the impact have been assessed to be low if appropriate mitigation measures shall be applied during construction activities. The aquatic species could move to find food or if it affected, they might move away from the construction area. In short, to minimize this impact, the contractor should have construction measure and reasonable diversion methods, and must adhere strictly to the terms of ECOP and ESMP as outlined in the report.
- ✓ Impact on the drainage process: The works are mostly in farming area, where there are many systems of infield irrigation canals. Therefore, the construction process requires to block and diverted flow of the river, which could affect water intake and drainage of people in the process of cultivation. Also, in some areas, when the drainage system was obstructed by construction activities, people could not take water to cultivate crops when irrigated and when it is rain, these places are at risk again flooding due to storm water could not drain off. This would affect crop yields and people’s livelihoods.

- ✓ The risk of erosion in the construction areas: The construction of gates on the rivers would have potentially risks of landslides at riverbanks during construction process. This would affect the progress and quality of works as well as some other social impacts. Therefore, studying of regional geological surveys, as well as prepare the appropriate construction measures is very necessary to take before construction to minimize landslides risk not during construction only but during operation also.

5.1.4.3 Impacts during Operation Phase

Like the works in Basin B, the impacts during operation stage of works in Basin C would be mostly positive impacts, meeting the objectives that the project was designed in controlling and regulation flooding for the entire project areas. Some potential negative impacts may also occur if applying some specific control and monitoring measures of the works. Specific:

- ✓ River bank erosion: As assessed in the construction stage, the process of designing and surveying projects without thorough surveys of the geological conditions and construction measures are not guaranteed, the risk of erosion of river banks could easily occur, especially in the rainy season when water level and flow velocity in the river are high. Therefore, the project should have thorough survey on the geological conditions; the key positions at risk of landslides need to be reinforced and fortified embankments. Also during operation stage, management and use unit and local residents should strengthen supervision and inspection, if any position is at risk of erosion, it should be reported immediately to the responsible parties for reinforcement and control to ensure that no subsidence and erosion will be happened.
- ✓ Accumulation and deposition of substances in the riverbed, especially downstream from the regulation gates. In fact, at the river, where there is a constant flow, the deposition and accumulation of substances in the riverbed is very likely to occur, especially in the dry season when water levels are low or in the river located adjacent to the downstream from regulation gates. The accumulation of substances in the riverbed would obstruct the flow in the rainy season and will affect the flood drainage function.
- ✓ During operation when flow regime is regulated, downstream users of the waterways may be affected. However, no aquafarming activities are recorded and there are about 7 households living on river fishing in these rivers and this impact is assessed as insignificant.

5.1.5. Component 2. Impacts Assessment for Investment Works on Water Environmental Management

5.1.5.1. Pre-construction stage

This component is implemented for improving water quality of Phan River part which runs across the province. The purpose of this component is to support the improvement of wastewater collection and management from small towns and villages along the Phan River in order to reduce Phan River’s water pollution.

The works of this component includes:

- ✓ Construction of 05 centralized wastewater collection and treatment facilities and some cascade pumping stations which divert water to centralized WWTPs in some towns (2 stations in Yen Lac town, 1 station in Tam Hong town, 2 stations in Tho Tang town. For Huong Canh, wastewater will be collected and transported to Quat Luu WWTP). Approximately, each station can serve for 20,000 people.
- ✓ Construction of 33 small-scaled WWTPs in rural areas, each serving for a minimum of 500 people. These WWTPs distribute along Phan River (within 3 kilometers from the rivers) in 15 densely-populated communes several households use tap water and toilets with septic tanks.

Assessment results show that the construction of centralized and scattered wastewater treatment stations in the preparation and compensation stages did not meet any obstacles due to construction fields are located at the lowlands, near the end of residential sewage drainage systems. These areas are easily flooded, and only able to use for cultivating 1-crop rice or aquaculture production with low economic efficiency. In the summer, these areas are often polluted by wastewater, causing loss to crops and livestock. Therefore, these land are most easily acquired and compensated.

According to statistical data of the project, to construct treatment stations in Component 2, the area of land needs to be acquired and compensated are as follows:

* For centralized WWTPs in 4 towns, including Huong Canh, Yen Lac, Tam Hong and Tho Tang:

- ✓ Total area of permanent land acquisition: 9.212 ha (of which, 7.44 ha for treatment stations, 0.032 ha for pumping station, 1.74 ha for newly constructed drains). 300 households affected by land acquisition for construction of WWTPs.
- ✓ Total area of land temporarily occupied for constructions: 0.9212 ha with 12 households affected.
- ✓ For decentralized wastewater treatment points distributed in residential land in communes belonging to Vinh Tuong district, such as: Lung Hoa, Lung Hoa 1, Yen Lap, Yen Lap 1, Vinh Son 1, Vinh Son 2, Binh Duong, Vu Di, Tan Tien 1, Tan Tien 2, Nghia Hung; communes belonging to Yen Lac district, such as: Dong Van, Dong Cuong; and communes belonging to Tam Duong, such as Hoang Lau and Hoang Dan.
- ✓ Total area of permanent land acquisition: 5.83 ha (of which, 4.95 ha for WWTPs, 0.93 ha for newly constructed drains) with 66 households affected.
- ✓ Total area of land temporarily occupied for constructions: 0.583 ha with 10 households affected.

Therefore, social impacts may occur during the land acquisition and compensation process for the construction of the subprojects in Component 2. To reduce these impacts, the project should comply with the compensation and resettlement policy, which is mentioned in the RAP reports.

Besides, during this stage, there remains potentially specific impacts related to the psychology of local people. In practice, local people do not want to construct wastewater treatment stations near to their houses due to unpleasant odors and other risks that wastewater treatment station can bring. Therefore, the location of wastewater treatment should be examined carefully, ensuring the distance away from residential areas prescribed by the government of Vietnam, while ensuring efficiency of the stations when they are in operation stage. Especially, the treatment technology must be suitable, ensuring economic efficiency and water quality for domestic use.

Impacts by UXO

The UXO impact for Component 2 is similar to that of Component 1 as described in section 5.1.3.1. UXO will be carefully cleared in order to ensure safety for the site clearance activities and the works to be constructed. The area to be cleared includes all the areas where the construction activities will be conducted. The clearing activities will be implemented by specialized army units.

5.1.5.2. Construction stage

5.1.5.2.1 Generic environmental impacts

Like in Component 1, construction activities of wastewater collection and treatment facilities under Component 2 are likely to have potential negative impacts on environment and society. However, in comparison with those of Component 1, these impacts is insignificant. Details of impacts are as follows:

a. Impact on air quality

** Dust and emissions generated by earthwork*

According to the calculation, to implement all works in Component 2 the total volume of dredged soil is 23,720 m^3. Of which, 11,675 m^3 is reusable soil for backfilling in the construction sites. The remaining 12,045 m^3 is un-reusable sludge/organic soil, which should be transported and dumped at construction disposal sites of Dong Mong and Kim Xa. The excavation, backfilling and transportation processes will cause dust and emissions, affecting air quality in the area. The amount of dust and emissions generated include:

Dust caused by excavation activities: Applying the formula as in Component 1, the amount of dust dispersed in Component 2 is calculated as below:

$$\Rightarrow \Sigma_{\text{dispersed dust}} = 23{,}720\ m^3 \times 0.3 kg/m^3 = 7{,}116 \text{ kg dust}$$

Although the amount is large, with heavier weight, they quickly disperse into the air and distribute throughout the construction works of the Component. Therefore, the impact is assessed low

Dust and emissions generated by excavators

In order to excavate 23,720 m^3 of soil, 19 working shifts of excavator are required (estimated 1,200 m^3 per working shift). Therefore, the amount of dust and emissions generated by fuel combustion of the excavators is calculated in the following table:

Table 65. Estimated amount of dust and emissions generated by the excavating machines in Component 2 (kg)

	NO_x	CO	SO_2	VOC	DUST
Pollution coefficient	1.89	0.473	18.9	2	0.473
Pollution load	37.36	9.35	373.59	46.71	9.35

With a load of dust and emissions as mentioned above and spreading out of the construction area in Component 2, the impact is considered low.

• *Dust and emissions from the sludge transportation vehicles*

Of the 23,720 m^3 of excavated soil, only 12.045 m^3 of organic soil and sludge need to be transported to the disposal sites. Applying the calculation method as for the Component 1, the amount of dust generated from the road surface due to the transport process is calculated at 873 kg, which will affect the extent along the transport route from the construction sites to the disposal sites. People and other subjects along the transport route will be mainly affected . However, the level of impact is considered insignificant due to wide scope of construction and long construction period.

• *Dust and emissions from transportation of construction materials*

From the demand for materials used in construction works in Component 2, a total of 155 trips is calculated. Material suppliers can be found near the construction area in the towns and the average distance for transportation is 8km.Thus, the total of transport distance is 155 trips x 8 km x 2 ways = 2480km. The amount of dust and emissions generated by the fuel combustion process of the transport vehicles is calculated and shown in the following table.

Table 66. Emissions of the transport vehicles of construction materials for Component 2

No.	**Load**	**Emissions load generated from driving vehicles (g)**					
		Dust	***SO_2***	***NO_x***	***CO***	***VOC***	***Pb***
1	Emission factor as WTO Rapid Assessment (g/km)	1.35	4.15	14.40	2.90	0.80	0.25
2	Emission load generated from the project activities (g)	3.348	10.229	35.712	7.192	1.984	620
3	Average emission load per hour (g/h)	0.39	1.19	4.13	0.83	0.23	0.07

This load of dust and emissions shows that this impact is low and within limits by QCVN

05:2013/BTNMT because of long construction time and dispersing in various locations.

b. Noise Impact

Similar to the Component 1, the impact of noise arises mainly from vehicles transporting construction materials and equipment. Machinery and equipment used in the Component 2 include bucket-wheel excavators, earth scraper, and trucks, etc. The initial assessment shows that as the WWTP construction sites belong to the Component 2 are far from the residential area and located in the low-lying sites, the degree of noise impacts is insignificant, mainly affecting workers operating the machinery and equipment. However, such impacts are temporary and intermittent.

c. Wastewater generation

Impacts of domestic wastewater

Approximately, there are 100 workers working in Component 2. The maximum volume of domestic wastewater in peak time is calculated as follows:

$$100 \times 10^{-3} \times 100 \times 90\% = 9.0\ (m^3/day)$$

Domestic wastewater contains many impurities, suspended solids, organic matter as BOD, COD… and microorganisms (which can carry many pathogenic microorganisms). Absence of appropriate wastewater collection and treatment measures will cause pollution to the surface water of the receiving sources. The calculation results of pollutant loads and concentrations are the same as the results for the Basin C.

The scope of the impact is within the workers' camps; however, the volume is not large, easily to be collected and treated. Hence, the degree of impact is assessed small.

wastewater from construction activities

Like in any other construction works, wastewater is generated from the construction, maintenance of concrete works. However, due to the small scale of all construction sites, the impacts of wastewater from the construction of 5 WWTPs and 33 small-scaled schemes are insignificant. Contractors only have to apply the mitigation measures as mentioned in the ECOP of the report.

Impacts of rainwater runoff

The current scale and scope of construction work under Component 2 are not large. However, due to the construction of wastewater collection network under Component 2, these impacts of rainwater runoff are considerable.

Rainwater can convey soil and pollutants from construction fields into water bodies, causing increased turbidity level and concentration of pollutant in water. Therefore, the construction under Component 2, especially the construction of wastewater collection network should be carried out in the dry season and the successive construction method should be used to minimize environmental impacts.

d. Impacts of solid waste

**Domestic solid waste*

With 100 workers working in the construction sites under Component 2, the amount of solid waste generated is calculated as:

100 x 0.5 = 50 (kg/day)

The amount of solid waste is distributed to several construction sites; therefore, the amount of solid waste in each work field is not too much. However, due to the easily decomposable nature of domestic solid wastes, if they are not managed well and efficiently collected, they will affect the surface and ground water, causing unpleasant odors. To minimize the impact, Contractors must comply with mitigation measures as outlined in ECOP and have to sign contract with local waste collection and treatment entities for daily waste collection and treatment as regulated.

** Construction solid waste:*

With the scale of construction work, the volume of solid waste is estimated as not large (about 10 kg/construction site/day) and can be reused or sold.

In addition to above-mentioned solid waste, there is a large amount of waste generated from dredging activities. However, this type of solid waste will be assessed in the section concerning site-specific impacts and mitigation measures of this report.

Hazardous wastes

Like in Basin B and C of Component 1, the construction activities for wastewater collection system and WTTPs will generate a certain amount of hazardous waste. Based on the estimate of quantity and types of construction vehicles and machines, construction duration in Component 2, it is estimated that about 0.3 m^3 of spent oil and 5 kg of oily rags and used light bulbs will be generated each month.

All the hazardous wastes must be collected, stored as regulated and only authorized organizations permitted transport and treatment. Inappropriate management of solid and hazardous waste could contribute to an unhealthy environment or act as source of disease, especially vector borne as well as pollute air and water environments. Therefore, the project needs to manage generated waste appropriately.

e. Impacts on ecological environment

The construction sites of wastewater treatment schemes mostly locate in the low-lying areas; some proposed construction sites are aquaculture land belonging to local people. Therefore, the construction activities will cause impacts on aquatic ecosystem in the area.

According to the assessment, the affected organisms are mainly aquatic species living in fresh water, including fish, shrimp and other aquatic species.

However, prior to construction, as land acquisition and compensation would be carried out, most of the aquatic species with high economic values will be harvested by local people. Therefore, the affected species are those with low economic values. The magnitude of impact is assessed as low.

f.. Traffic management

As calculated in the section of impacts on air quality, the construction activities under Component 2, number of vehicles transporting dredged materials from the sites to the disposal sites as well as the amount of construction materials are not considerable. However, as most of the transport vehicles are heavy vehicles that will pass through local roads in the area on their way to the construction sites, it is unavoidable that they will affect the local infrastructure. The duration of impact will take place throughout the construction process and concentrate at the construction sites. Overall, the magnitude of impact is assessed as medium.

5.1.5.2.2 Site-specific environmental impacts in construction stage

The site-specific environmental impacts in construction stage of Component 2 include:

a. Impact of dredged materials

As calculated, the total volume of dredged material from construction activities of the treatment schemes, pumping stations and wastewater collection systems of 5 WWTPs and 33 wastewater treatment schemes is 23,720 m^3. Of which volume of dredged material can be reused for backfilling and leveling is 11,675 m^3, the remaining 12,045 m^3 are unused and will be transported to Dong Mong and Kim Xa disposal sites.The initial analysis results on the quality of dredged materials in selected construction sites show that in some sites, the amount of organic matters and heavy metals in dredged sediment is higher than the standard level for agricultural land described in the QCVN03:2008/BTNMT. Therefore, prior to the dredging, it is necessary to conduct further analysis of content of organic matters and heavy metals such as Cu, Zn, As, Pb and Cd, providing objective bases for further assessment and preparation of suitable measures for dredged material management. If the analysis shows higher content of organic matters and heavy metals in comparison to QCVN03:2008/BTNMT, the dredged materials are only allowed to be transported to Dong Mong disposal site and disposed into certain plots with HDPF waterproof layer at the bottom. Otherwise, the dredged materials could be transported to disposal sites either in Dong Mong or Kim Xa or could be reused as construction materials (if possible).

b. The risk of erosion at the construction sites of WWTPs

As mentioned before, the locations of centralized or decentralized wastewater treatment stations and cascade pumping stations were selected in low terrains for easy collection of wastewater. The geological conditions of these areas are weaker than other places, resulting in the high risks of erosion and submission not only during construction but also during operation stage. To ensure the quality of the stations, prior to construction, thorough surveys on geology and hydrology and specific construction measures are required.

c. Odors and gases generated by dredged material:

Sludge dredged from WWTP construction sites often contains organic matter deposited under water in a long time. In anaerobic conditions, the decomposition of organic matter will produce odors and toxic gases such as CH_4, H_2S, etc., Dredging bottom sediment layers create conditions for these gases to emit into the atmosphere, generating greenhouse gases in the air and awful odors that make local residents uncomfortable. However, this is inevitable impact of all bottom sediment dredging activities. The magnitude of impact is assessed as moderate.

d. Impacts on local infrastructure

In addition to the impacts on transport infrastructure as described in the Component 1, the construction in the Component 2 also impacts local sewerage system due to the planning and establishment of the wastewater collection system. This may alter the residential wastewater drainage regime. However, these impacts are only instantaneous and in limited areas.

5.1.5.3. Operation stage

Like those in Component 1, the operation of the subprojects under Component 2 will bring many environmental and social benefits to local communities, reducing pollutions in residential area in particular and in Phan River basin in general. However, apart from positive effects, there are also several potentially risks which may cause harms to environment and society if are not controlled well.s

These impacts bear all specific characteristics of Component 2. In details:

a. Failure during operation of WWTPs

According to the investment project report, scale and technology of 5 concentrated wastewater treatment stations for towns as well as 33 decentralized wastewater treatment points in residential areas were carefully examined, ensuring that treated wastewater meets standards mentioned in the QCVN 14:2008/BTNMT column B. However, if any problems occur and the treatment system cannot control it, the whole amount of wastewater will go directly into the Phan River basin, affecting water quality and aquatic ecosystem there. Therefore, to reduce this risk, the maintenance and operation of the system should be carried out regularly.

b. Impacts of waste from the wastewater treatment system

** Impacts by odor and gases from WWTPs*

Wastewater from resident land will concentrate into areas where the treatment stations are located. Thus, these areas will regularly bear awful odors and emissions generated from wastewater such as CH_4, H_2S, etc. However, the impact is considered insignificant as these small-scaled WWTPs are scattered over a large area.

** Impact from WWTP waste sludge*

In addition, waste sludge will be generated during the treatment process. The amount of sludge may not be large but its component may include organic pollutants. Therefore, this sludge needs to be periodically dredged and handled as regulated. As the scale of these treatment facilities are small, the amount of the waste sludge are small. In addition, these are treatment facilities for domestic wastewater, thus, the sludge would be of high organic content like BOD, COD; but not heavy metal, chemicals like industrial waste. Thus, the magnitude of impacts from waste sludge is assessed as low.

5.1.6. Impact Assessment for Support and Assistance Activities

In 3 VPFRWMP components, Component 3 objective is to provide the Implementation Support, Technical Assistance and Institutional Strengthening. This component consists of:

- ✓ Supporting the implementation of the project: (i) consulting the research about sub-projects' feasibility and detailed design; (ii) procurement support; (iii) construction supervision; (iv) protection and supervision methods; (v) audit; (vi) supervising and evaluating project's implementation; (vii) hardware/software necessary for project's implementation; and (viii) other consultancy when needed.

- ✓ Supporting and building technical capacity: (i) Forecasting and warning flood as well as providing emergency response systems; and (iii) training government agencies and human resources in water resources management, flood models, pollution control, operation, maintenance, assets management.

With regards to the above supporting activities, potential impacts can be identified and evaluated including:

Impacts of consulting activities and supporting project management

For projects implemented with ODA budget in general and VPFRWMP in particular, the consulting support and project management are positive activities, which contribute to orienting project's implementation with the aim of achieving all initial targets as well as minimizing unnecessary costs. These activates are concretized by technical support and set up project management mechanism in the preparation and during the implementation process.

The scale of supporting activities may cover the entire project operation, help to direct the project and achieve the project's objects.

The objects affected by supporting activities not only cover all the affected objects made by the project but also other objects beneficiating from this such as contractors who participate in consulting process, construction contractors, local management agencies, the units managing operating activities like consulting, advanced training after the constructions are commissioned.

Impacts of supplying water quality supervision and flood warning system

Besides supporting activities in project's implementation and enhancing institutions, the project also provides emergency response systems, which play an important role in controlling water's quality and warning as well as controlling flood threat in project zone. The activites include the installation of small electric components to the gates to transmit data and the environmental impact is negligible. The activities of component 3 absolutely no construction work. Therefore no potential environmental impacts during construction. However, the process of installing water's quality supervision and warning flood system may have some potential effects, namely:

- ✓ If the systems flood warning is properly installed in the project zone, the threats and happenings of water's quality, flood threats in Phan River basin and other surrounding valleys will be informed as soon as possible to management agencies, local authorities to implement preventing plans, set up early mitigation measures in order to protect people and reduce economic and social damage for this area.

- ✓ Otherwise flood threats may happen and management agencies and local authorities have no awareness until it causes damage. As a result, huge negative impacts on economy, society and environment incur and large remedies are required.

Moreover, the training and capacity building on water resources management, flood modelling, pollution control, operation, maintenance, assets management, also have positive effects on the project.

5.2. SOCIAL IMPACT ASSESSMENT

5.2.1 The positive impacts on the basin-wide project area

VPFRWMP Project is to provide sustainable water environment for long-term socio-economic growth of Vinh Phuc province. Specifically, the project will focus on ensuring flood control in central basin of the province and prevent the rapid degradation of surface water quality. According to the overall urban planning of Vinh Phuc province by 2030 and vision to 2050, Vinh Phuc Province is divided into three areas: (1) urban, industrial and services area; (2) agriculture, forestry and fisheries development; and (3) nature conservation and tourism development. Of which, urban, industrial and services area covers the entire Vinh Yen city, part of Phuc Yen town and part of Binh Xuyen, Tam Duong, Yen Lac and Vinh Tuong district. This planning creates sustainable prosperity based on building a developed economy city together with improved social life, protected environment meeting standards of urban area Grade 1 and serving as an important role in the key economic zone in the North and of the country.

Thus, the Project is being planned and in the future the core urban center of the province (Vinh Yen city) would become a satellite town to Hanoi capital. The project will create a strong spread given the connection with suburbs (the neighboring districts of Vinh Yen city) of Vinh Yen city which will become urban suburbs of Vinh Phuc city in the 2020s as planned. We will create an urban area with a focus on trees and water surface.

Therefore, the basic and key social objective of the project is to protect existing ecological environment, support environment sanitation of residential areas along rivers, dredging lakes to increase the storage capacity and form chains of modern and civilized urban ecology areas with sustainable ecological systems in Sau Vo, Dam Vac and Dai Lai lakes; This will be a premise for Vinh Phuc to become a new urban area associated with tourism services, improved environmental and social living environments in the suburban areas of Hanoi.

Short-term objectives of the Project

- ✓ Controlling flooding risks, participating in flood absorption for Phan - Ca Lo river basin;
- ✓ Increasing flood drainage capacity, water storage capacity and regulating water for Phan and Ca Lo rivers meeting water demands communes along these rivers;
- ✓ Improving of ecological environment and forming the regulatory lakes, compatible with overall planning of urban construction of Vinh Phuc province until 2030 and

vision to 2050;

- ✓ Implementing step by step drainage solution planning for entire Phan and Ca Lo river basin in Vinh Phuc;
- ✓ Upgrading infrastructure of rivers, drainage channels in the event of heavy rain causing flooding. Creating trust to attract FDIs into the exploitation of infrastructure and connection with Trans-Asia route of Hanoi - Lao Cai, focusing on attracting investments into the development of Binh Xuyen, Ba Thien, Tam Duong Industrial Zones and inland ICD port.

5.2.2. Identification of potential negative impacts on basin-wide project

Assessment of negative impacts involves firstly the 3 year-one subprojects (include Dong Mong landfill; Sau Vo detention lake and Sau Vo access road; Improving and Dredging of Three-River Network in Binh Xuyen and Construction of Ton Bridge and Sat Bridge Control Gates Subproject)..

Negative impacts of 3 year-one subprojects are presented below:

Dong Mong landfill Subproject: The construction of Dong Mong landfill will cause impacts due to land acquisition in the area of Huong Canh Town in Binh Xuyen District. The subproject will acquire 528,624.5 m^2 of land belonging to 413 households and Huong Canh Town People's Committees (Town PC). 355 households are severely affected by losing 20% or more of their productive landholdings, 57 households are identified as vulnerable households, including those headed by single women with dependents, poor households, households with the disable, single elderly households, and social policy beneficiary households.

The Dong Mong landfill subproject will also impact 12 households temporarily, during the construction phase, impacts addressed by the ESIA and ESMP that will be reconfirmed and closely monitored during the project implementation. In addition, there are several graveyards that will be relocated at Dong Mong disposal site. During the survey preparation the cemetery was flooded, not allowing an exact estimation of impac, and according local people, at that time many graves cannot be identified.Therefore a detailed survey of graveyards in project sites will be undertaken for preparing the RAP for the affected graveyards.

During the detailed measuresment survey (DMS) in the implementation period, these impacts will be identified and compensated for land, displacement and reburial of graves, observing all the cultural practices of the affected. These compensation costs are mentioned in the policy framework prepared for the project and with the compensation and assistance principles established in this RAP, particularly the entitlement matrix in the Appendix 1 of the RAP.

Sau Vo Detention Lake and Sau Vo access road Subproject:

The subproject will be implemented in the area of three communes and one town in two districts, namely Binh Xuyen and Yen Lap, of VinhPhuc Province. The dredging of Sau Vo Lake and construction of Sau Vo access road along the lake will cause land acquisition impacts in the area of Binh Dinh and Dong Cuong communes (Yen Lac District), Tan Phong Commune and Thanh Lang Town (Binh Xuyen District). The subproject will acquire 2,229,090 m^2 of land belonging to 1,105 households and Commune People's Committees (CPCs) of three communes and one town. All of the households are affected in agricultural land and none of them will be affected in their house or any structure, 563 households are severely affected by losing 20% or more of their productive landholdings. Among the 563 affected households, 186 are identified as vulnerable households, including those headed by single women with dependents, poor households, households with the disable, single elderly households, and social policy beneficiary households.

Improving and Dredging of Three-River Network in Binh Xuyen and Construction of Ton Bridge and Sat Bridge Control Gates Subproject:

The subproject will acquire 72,297.6 m^2 of land belonging to 398 households and Commune/Town People's Committees (CPCs/Town PC) of eight communes and one town. 54 households are severely affected by losing 20% or more of their productive landholdings. 45 out of 398 households are identified as vulnerable households, including those headed by single women with dependents, poor households, households with the disable, single elderly households, and social policy beneficiary households. In which 42 vulnerable households will lose from 10% of their productive landholdings.

In conclusion, the 3 year - one subprojects mainly will acquire agricultural land, totalizing 1.916 affected households, among whom 952 affected households will be losing more than 20% or more of their productive landholdings, and with nor a single household residential land or business affected. This sub- project won't involve relocation of affected people.

5.2.2.1. Adverse Impacts on Involuntary Resettlement

Screening of adverse impacts on involuntary resettlement indicated that land acquisition as a result of the project is inevitable. Based on the technical information currently available, it is anticipated that out of three (03) project components, Component 1&2 involved in construction and rehabilitation of the rivers, retention lakes, irrigation and drainage/sewerage infrastructures can cause impacts of land acquisition and resettlement.

In the preparation stage, a close cooperation with the Vinh Phuc PMU and the consultations with relevant local authorities at district/commune levels, the technical consultant (FS Consultant) look at options of construction design. Each of them has attempted to minimize the impacts of resettlement especially to vulnerable people.

To date, the exact location and size of the dredging area, irrigation and drainage/sewerage systems, and landfill have not been yet identified. Thus the estimation of the scope of land acquisition as well as accurate number of households affected by the sub-projects is not available. Based on the accesible information, it is expected that Component 1&2 impacts of land acquisition are as follows:

Table 67. Estimated Project Affected Households

Items/Works	**No. of Project Affected Households (PAPs)**

	Total of PAPs	Households losing Agricultural Land	Severely affected (>20% of agricultural land)	Households losing Residential Land
Component 1: Flood risk management	3,947	5,779	589	13
Kim Xa pumping station basin area of 8,640 ha (Basin B1)	767	764	114	3
Kim Xa pumping station, estimated capacity of 45 m^3/s	262	259	39	3
Dredging So and Nhi Hoang retention lakes	335	335	50	
Improving Yen Lap 8-gate culvert		-	-	
Spoil landfill	170	170	25	
Ngu Kien pumping station basin area of 11.000 ha (Basin B2)	1,365	1,355	204	10
Ngu Kien pumping station, estimated capacity of 45 m^3/s	500	490	75	10
Phan river from Thuong Lap bridge to Lac	170	170	25	
Diversion canal from Phan river to Rung retention lake	285	285	43	
Dredging Rung retention lake of 50 ha	-	-	-	
Spoil landfill	410	410	61	
Nguyet Duc pumping station basin of 19,700 ha (Basin B3)	1,815	1,815	271	0
Nguyet Duc headwork pumping station outlet to Red river, estimated capacity of 75 m^3/s	1,540	1,540	230	
Phan river from Lac Y to Sat bridge	275	275	41	
Improving Sau Vo culvert	-	-	-	
Tam Dao zone 4, BX, PY (Flv= 32.160ha) (Basin C1)	0	0	0	-
Component 2- Water source management	366	366	55	-
Wastewater treatment plants (10 plants)	300	300	45	
Subsidiary works of wastewater pipeline	66	66	10	
TOTAL	4,313	4,313	644	13

Source: SA Screening, Sept 2015

Total number of households affected by remaining investments is about 4,313 HHs, in which estimate 644 households will be losing more than 20% or more of their productive landholdings. These sub- projects won't involve relocation of affected people.

Given the scope of resettlement impacts, a Resettlement Policy Framework (RPF) was prepared to establish resettlement principles, eligibility requirements for compensation, valuation methods or other forms of assistance, and describe the legal and institutional framework, organizational arrangements, funding mechanisms, community consultation and participation, and grievance redress mechanism to be applied to the project during the project implementation. Besides that, Resettlement Action Plan (RAP) for the subprojects were prepared consistent with the RPF, and will be submitted to the World Bank for review

Potential project's impacts assessed on the basis of consultations and depth interviews with key stakeholders, estimated that besided land acquition there are temporary impacts, during the construction time caused by the dredging activities of three-River Network in Binh Xuyen, including temporarily impacts on land and households economies.

In terms of graveyard, as part of census and detailed measurement survey, a detailed survey of graveyards in the subproject area will be undertaken during project implementation when the detailed design is available. The RAP will be updated to reflect findings related to graveyard prior to RAP approval and construction.

5.2.2.2. Impacts on Non-land Assets (Livelihood and Sources of Income)

Apart from land acquisition, the project interventions will have some impacts, both positive impacts (e.g. reduction of flooding; increasing agriculture production) and adverse impacts (e.g. reduced sources of income due to loss of agricultural land, land use for animal breeding, and temporary loss of income (estimated to be minor) from fishing activities (Sau Vo, So, Nhi Hoang and Rung retention lakes, changing alignment of existing drainage and sewerage that may cause temporary flooding and water cut). These are summarized as following:

Table 68.Summary of main social impacts of the flood fontrol component

Basins	Works	Positive impacts	Negative impacts
C	Tam Dao, Binh Xuyen, Phuc Yen: Renovation, dredging in combination with embankment of low-lying positions, three-river system in Binh Xuyen district; Construction of Ton bridge; Construction of Sat bridge.	Dredging Phan river will limit flooding, contributing to economic development and increasing productive land area for two seasons at the area where Phan river passes through; The area outside dike in Hoang Trung and Hoang Tan in Kim Xa commune is frequently flooded and people cannot cultivate. The placement of disposal	Aqua-culture households and fishing, secondary income generating activity in Sau Vo, So, Nhi Hoang and Rung retention lakes, likely to be impacted. Impacted HHs are part of public consultations and socio-economic survey. Calculation for compensation and rehabilitation measures will need
B3	Nguyet Duc pumping station basin includes: Nguyet Duc head pumping station discharged into the Red river; Sau Vo retention lake and access road; Phan river from Lac Y to Sat bridge; Renovation of Sau Vo culvert; Disposal site in Huong Canh town/ Binh Xuyen district		

Basins	Works	Positive impacts	Negative impacts
B2	Ngu Kien pumping station basin includes: Kim Xa pumping station, culverts crossing dike and outlet; Phan river from Thuong Lap bridge to Lac Y; Diversion canal from Phan river to Rung retention lake; dredging Rung retention lake; Disposal site in Vinh Ninh commune/ Vinh Tuong district.	site here will raise foundation elevation and limit flooding; Construction of pumping stations at Nguyen Duc, Kim Xa and Ngu Kien basins will reduce water level at Cau river, Ca Lo river, accordingly reducing flooding for not only Vinh Phuc but also whole downstream of Hanoi.	to ensure that livelihoods will not be worse off. Risks of unexpected accidents unless warning signs are installed adequately Increase social evils unless livelihood restoration programs are implemented adequately
B1	Kim Xa pumping station basin includes: Kim Xa pumping station, culverts crossing dike and diversion canal; Dredging So retention lake and Nhi Hoang retention lake; Renovation of Yen Lap 8-gate culvert; Disposal site in Kim Xa commune/ Vinh Tuong district.		

Table 69. Water & Environment Management

STT	Works	Positive impacts	Negative impacts
1.1	- 02 wastewater treatment plants in Huong Canh town	Building treatment plants will ensure that wastewater discharged into the environment meets environmental standards.	Primary agricultural Land acquisition is required for building treatment plants partially and more than 20%., Nor impacts on structures Limited access to public facilities during the construction.
	- 02 wastewater treatment plants in Tho Tang town		
	- 03 wastewater treatment plants in Yen Lac town		
	- 03 wastewater treatment plants in Tam Hong town		

Other Potential Impacts and Risks

Sexually Transmitted Infections: increased risks of exposure to HIV/AIDS during construction and post construction phase due to large volumes of transit traffic along the road. Women are at bigger risk to be posed by HIV/AIDS, road safety than man. Additionally, poor women and female-headed households in the Project area are at risk to suffer economically losing productive assets (houses, business, farm land) due to land acquisition.

5.2.2.3. Other Temporary Impacts

Negative Impacts on Project Area's Economic Activity

The construction associated activities also will cause direct and indirect impacts on the economic activities within the project area, particularly, road construction, as for the case of the road access to Sau Vo lake; (ii) changing temporary alignment of existing drainage and sewerage that may cause temporary flooding and water cuts, requiring traffic to take different routes or/ and reducing the number of lanes that can be used; (iii) reducing sales volume for local businesses along the roads; (iv) impeding the traffic and goods flow in and outside the Project area.

5.2.2.4. Potential impacts that are not related to OP 4.12 and covered by OP 4. 01.

Dong Mong landfilld: There are 12 HHs who would be temporarily affected during the construction period. Temporary impacts are expected during the disposal process. These impacts include noise, odor, and dusts, among others, affecting households living in the area adyacent to the disposal site. In case impacts are identified treatment measures (i.e. use of biological chemical) would be considered to de-odor and others as needed. These impacts are covered by the ESIA and the ESMP.

Sau vo Lake: Around 12 households that practice aquaculture would be temporarily affected, on a square of fishing production of about 21 hectares. The exact magnitude of impact (number of households) could not be estimated at this stage because the scope depends on the detailed engineering designs as well as the dredging location and construction time confirmation. Aquaculture households do not have land use right certificate (the lake is managed by local government as a practice), to extent to which they are affected depends on the agreements they made with local government in their lake rental contracts. In case, aquaculture households are affected, they will be compensated for as per agreements made in the lake rental contract in observance of the legal agreements that have been made the households (renter) and local government (landlord).There are no adverse impact envisaged for people living downstream the Sau Vo lake given that the impact due to dredging is confined with the construction area. Dredging material will be transported to Dong Mong land filed for disposal affecting water contained within the lake. Regarding Sau Vo Lake, by the time of RAP preparation, as the dredging location is not identified the socio-economic survey for aqua farming households was not undertaken. However, consultation with local HHs was been conducted. From the consultation meetings, the aqua farming households were informed that compensation will be made based on their contract with Thanh Lang Town People Committee. Moreover, the Project also established provisions on support for these households which are indicated in the RPF and RAP for Sau Vo Lake and its access road. The support will be more elaborated based on actual measurement of their losses before the construction commences.

The corresponding mitigation measures for those farming households are also proposed in the FS with sequential construction methods by small areas in the lake. Given that the construction will be conducted in the dry season, the HH impacts will be minimized. Regarding socio-economic profile of these HHs, (i) neither poor, ethnic minority nor vulnerable and ii) belonging to above average income group and having various sources of income: farming, animal raising, salary, hired wage. The socio-economic survey will be conducted when determining support for them before the construction. The survey results for these HHs will be updated in updated RAP and submitted to WB.

Impacts on fishing, aquaculture, and inland river transportation

For HHs fishing activities on the rivers, at that time of project preparation, the exact numbers of households were not documented, because the survey overlapped the dry the season. However, according to the verification of the CPCs, the number of households fishing on the rivers is small, seasonal, and occasional, and does not constitute a main income generation activity. Although, it is anticipated that those relying on fishing are mainly secondary income generation activities, the HHs should be consulted when the detailed designs of the subprojects are available. Effort should ensure construction operation takes into account the low season fishing for impacts

Therefore, these households will be identified and consulted, when the detailed engineering designs as well as the dredging location and construction time are confirmed. If there is any impact identified, these households will be consulted and entitled to compensation and support - as project's RPF.

Although, it is anticipated that those relying on fishing are mainly secondary income generation activities, the HHs should be consulted when the detailed designs of the subprojects are available. Effort should ensure construction operation takes into account the low season fishing for impacts

For aquaculture activities within the lakes, the Government is managing lake surface and all users of the lake have signed rental contracts which are renewed every year. No fishing activity (without contract) are allow in lake. 180 ha are currently rented for aquaculture. As such, these households will be compensated for their losses of income in accordance with o their contracts and supported for their temporary loss, in accordance with the project's RPF during construction period (See Section 3.2.2 in the RPF on how temporary impact are compensated). Within the project area, around 132 households who currently rent lakes for aquaculture would be compensated/supported. For Sau Vo Lake subprojects, (Year-1 subproject), only 12 households currently have contracts active be compensated if affected by the dredging of Sau Vo Lake. For others – to be confirmed during project implementation, survey and consultation with potentially when the detailed engineering designs are available during project implementation.

Because the number of households *relying on river fishing is* small – as confirmed by the CPC, the impact estimated, would be minor small. These specific impacts will be assessed before dredging operations take place, and respective RAPs.

For subprojects that involve dredging on the lakes, and or river's, fishers may be potential temporary affected during the construction operation. It is anticipated that those relying on fishing as secondary income generation activities, should be consulted when the detailed designs of the subprojects are available. Effort should ensure construction operation takes into account the low season fishing for impacts to be minimized. In case, impacts are not avoidable, compensation should be provided to the affected households - as per RPF, to ensure their livelihood will not be worsen off as a result from the project construction. In addition the ESMP and ESIA address potential related temporary impacts to be confirmed during project implementation

In Vinh Phuc Province *the small inland rivers* in Vinh Phuc Province are not used for transportation purposes, except for the Red River, through districts of Vinh Tuong and Yen Lac with total length of 41km and downstream area in Melinh District of Hanoi. The project does not involve construction in the Red River, so there will be no impact on the downstream users of the waterways during construction phase.

With regards to impact (temporary) related to fishing, aquaculture, a detailed consultation and Social Assessment will be conducted for households that will be affected by the dredging of the three lakes and the river systems. The consultation and detailed SA will be done when the detailed design and the construction measures are available to facilitate the detailed social assessment – both scope, magnitude of the social impact of the subprojects on the affected households, and mitigation measures. These affected households will include those who do fishing and aquaculture activities in the subproject lakes and rivers, and those who do farming in the riparian, which are using lake and river water for their crops. The SA findings will be used to develop plan to address identified impacts on these households, including impacts related to livelihood, and impacts outside involuntary land acquisition, resettlement, among other things.

Dust and Noise Pollution

It is also anticipated that the construction phase, as well as operation, of the proposed project will result in increased dust and noise pollution for the local people.

Incoming labor and local social concerns

Many respondents expressed their concerns on road safety during construction. In addition, people in the project area hope a good management system for incoming project workers will be in place to ensure there won't be conflicts between the project workers and the residents in the project area.

Assessment of Potentially Linked Project

Vinh Yen City is preserving the landscape of the city, developing ecotourism in combination with goals of green growth and green production promotion. Therefore, investment in green infrastructure is seen as a prerequisite solution for sustainable development in the region through a comprehensive improvement of living conditions and promoting economic development opportunities in the region and the local community. After phase of Vinh Yen Wastewater Drainage and Treatment Project and Secondary Cities Development Program (Green cities Program), Vinh Yen city, Vinh Phuc province, will help to bring a new face to the city according to the environmental criteria of class II urban under Decision 1909/QD - TTg dated 23 October 2014 of the Prime Minister recognizing Vinh Yen city to become a Class II urban of Vinh Phuc province.

The project preparation confirmed that the ADB Green Cities Program, to be implemented from 2016-2021 does not have any investments linked with the WB financed project. The ADB Green Cities Program has an approved SA and PSSA, including measures to bridge the gap between ODA donor and GoV regulation.

5.3. CUMULATIVE IMPACT ASSESSMENT

5.3.1. Environmental Cumulative Impact Assessment

The ESIA conducted a review of related large, recently completed and ongoing investments in the project to identify possible linkages and potential cumulative impacts of existing and planned projects with regard to their effect pollution loads within the Phan River and the associated Basin. The ESIA:

(a) Identified key project-related contributions to cumulative effects on selected resources of concern. These key Valuable Ecological Components (VECs) were initially determined to be

1. Water quality
2. Aquatic Bio-diversity[2]
3. The quality of life of local communities
4. Downstream water use

Given the dredging activities and wastewater treatment activities under the project, the inclusion of water quality as a resource of concern was a logical choice, as both these activities have impacts on water quality, in the first instance- potentially negative impacts, and in the second instance, positive impacts.

One of the key project objectives is to improve the lives of local communities through enhanced flood control and provision of basic services (wastewater treatment).

Downstream water use was included as there are fisheries activities along the river, although more detailed surveys ultimately indicated these activities to be relatively limited.

Although aquaculture was considered for inclusion as a VEC, aquaculture is only carried out during the rainy season (about April – September) while dredging activities can only be carried out during the dry season. As such, there is no cumulative impact on aquaculture due to dredging activities. Moroever, only a total of 180 ha of the three project lakes is devoted to aquaculture.

(b) Identified other linked and associated infrastructure projects within the spatial boundary of the Project Area, either recently completed, or planned for construction to coincide with the Vinh Puc FRM project. Identified the impact of industrial parks, borrow pits, and sand extraction operations within the spatial boundaries of the Project Area;

(c) Assessed the significance of the cumulative effects of projects on the VECs, by order of magnitude.

(d) The existence of the dredge disposal sites and extrajudicial sand extracting activities in the Project Area continues to place pressure on river water quality, and it is suggested that Vinh Phuc authorities, in collaboration with the Department of Natural Resources and Environment, prepare a management plan to curb and regulate these activities, and restrict release of these materials into the river.

Details of these key linked and associated subprojects, including ancillary aspects of the projects, are shown below.

Vinh Phuc Province, with the support of the Vietnamese Government, donors and

2 Discussions with DONRE and DARD, and a review of the literature, ultimately determined that there is no threatened aquafauna in the river, and that therefore cumulative impacts on aquatic biodiversity is limited.

international funding institutions, has been implementing various development programs and projects province-wide and in the Phan River region in particular. Key infrastructure projects include:

1. Programme of grade 2 urban development (Green City Project) for Vinh Yen City, Vinh Phuc province (financed by the ADB) .The project will improve water quality in the Phan River and contribute to effective flood control in the Project Area. The project involves: (i) rehabilitation dredging, and embankment of Vac Lake (60/163 ha) and 2 km long canal connecting Phan river and Vac Lake, (ii) construction of a park (44.2 ha)-using dredged material from the project, on the existing low land area next to the lake; and (iii) construction of waste water collection and treatment system for 07 wards in Vinh Yen city. During construction, negative cumulative impacts due to construction activites and material transporation are assessed as limited.

2. Vinh Phuc Improving Investment Environment Project (VPIIE) (financed by JICA). The project completed construction in 2014 and helps improve water quality of Phan River as the main recipient source.

3. Urban road integrating Dam Vac embankments (from the Dam Vac golf to Yen Lac - Vinh Yen road -financed by the Vinh Phuc province). The project will be completed by the end of 2016. The rehabilitation, diversion and dredging of the 1.3 km Phan River section could have negative impacts on water quality if the disposal of dredged materials is improperly handled, so dredge disposal sites must be carefully monitored. However, in the operational stage, the constructed route will form a dyke to control water from Vac Lake to Vinh Yen city urban area, contributing to flood prevention in the area, which has a positive cumulative impact.

4. Domestic wastewater treatment plant (WWTP) at Lung Hoa commune, Vinh Tuong District, Vinh Phuc Province (financed by Vinh Phuc Province). This project was completed by 2013, and has improved the water quality of Phan river

Based on the assessment and due diligence review, negative cumulative impacts from these linked and associated projects are deemed to be limited because most of them are either existing or will be completed by the time the VPFRWMP project will commence implementation. Only one project i.e. Green City project is under implementation at the same time as the Vinh Phuc FRM. However, based on the analyses on the design and construction plan, the timing of project acitivities as well as the location of the project site, it is assessed that there will be no significant negative cumulative impact on water quality of Phan river due to dredging. In addition, negative cumulative impacts due to construction activites and material transporation are assessed as limited. It is noted that and several projects will have a postive cumulative impact on the VPFRWMP by reducing the pollution load on waterways, through treating sanitation, which will allow the drainage and sanitation components of the VPFRWMP to operate more efficiently. Some measures, such as the Green City Project, will improve flood control in the Phan River basin, which will improve the quality of life for local communities. More details on the due diliegence review and the cumulative impact assessment of these projects are provided in Table 70.

In assessing cumulative impacts, in addition to the positive and negative impacts of related infrastructure projects, impacts of industrial parks, sand extraction and borrow pits within the Project area are also to be evaluated.

In addition to the abovementioned infrastructure project in Vinh Phuc, there are 8 large scale industrial parks (IPs) with a total area of 1,721 ha, including Khai Quang (214 ha); Kim Hoa (50 ha); Binh Xuyen I (288 ha); Binh Xuyen II (42 ha); Ba Thien I (327 ha); Ba Thien II (308 ha), Tam Duong II (361 ha). 3 IPs (Ba Thien I, Ba Thien II, Binh Xuyen) are under construction and 1 (Khai Quang) is operational. The IP management boards are responsible for organizing plan preparation, construction investment, managing and operating the drainage systems in IPs under their management.

According to the current regulations, all wastewater from industrial parks must be collected and treated to meet discharge requirements before discharging into the receiving water. In the only one running, that is, Khai Quang IP, its own wastewater treatment plant is operating and the post treatment water quality is assured by DONRE monitoring as satisfying environmental standards. Concretely:

- 04 IPs Binh Xuyen 1, Khai Quang, Tam Duong 1 and Tam Duong 2 IPs: treated waste water is will discharging to Phan River

- 02 IPs Ba Thien 1 and Ba Thien 2 IPs: wastewater is discharging to to Tranh river of Binh Xuyen river network

- 01 i.e. IP Binh Xuyen 2: wastewater will discharge to Cau Bon river of Binh Xuyen river network

- 01 IP Kim Hoa: waste water will discharge to Ca Lo River

There are borrow pits with legal permits in Districts of Tam Duong and Tam Dao as shown in the above figure. The environmental impact will increase if the project exploits the pits for use as backfill material. However, current calculation proves that all backfilling works will utilize dredged material from components in the Project and there is limited requirement for material from these borrow pits.

A list of potential sources of quarry and construction materials (sand extraction points) in Vinh Phuc for the project is presented in Table 7. They are all legitimate sources which are permitted by Vinh Phuc Department of Industry and Department of Natural Resource and Environment. It must be noted that the extrajudicial presence of sand extracting activities will contribute to increasing pressure on river water quality as well as the erosion risk of river banks.

The following figure and table 70 provide detailed description of the linked infrastructure projects. Given that these are Government projects, either self-financed or financed by international financial institutons, these are the ones with the most measurable cumulative impacts, and for which monitoring can be undertaken on a more systematic basis.The wastewater treatment plants in Industrial Parks and the borrow pits are subject to audit by the Department of Natural Resources and Environment.

Cumulative impacts of the ongoing and proposed projects in the Project Area are positive, in that through the installation of waste water treatment plants in both residential areas and industrial parks, the pollution load of untreated waste on the river is reduced. Moreover, several projects lead to improved flood control, which has economic and health and safety benefits to local communities. The existence the dredge disposal sites and extrajudicial sand extracting activities in the Project Area continue to place pressure on river water quality, and it is suggested that Vinh Phuc authorities, in collaboration with the Department of Natural

Resources and Environment, prepare a management plan to curb and control these activities, and restrict release of these materials into the river.

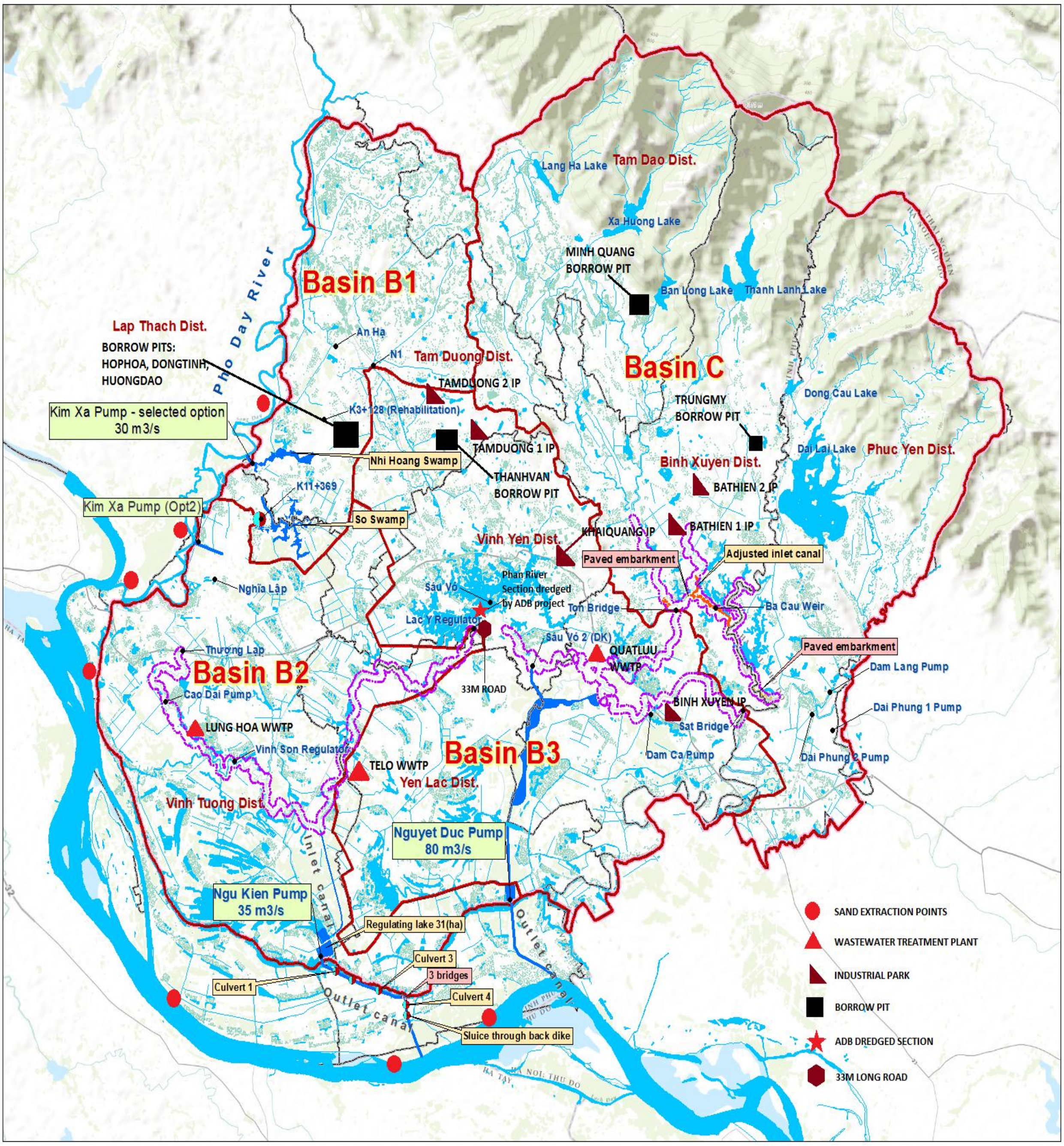


Figure 40. Map of Linked Project of VPFRWMP

Table 70. Summary of Linked Projects Of Vinh Phuc Flood Risk and Water Management Project (VPFRWMP)

1. Project Name	**Programme of Grade 2 Urban Development (Green City Project) for Vinh Yen City, Vinh Phuc Province**
Description	- Project category: Class B; - Total investment: 105 million USD - Funding source: ADB - Duration of project: 2016 - 2020- Construction works include: i) Rehabilitation, dredging and embankment for a part Vac Lake (60 of total 163 ha) and a 2 km long canal connecting Vac Lake and Phan River. ii) construction of a park (44.2 ha) on the existing low land area next to the lake; iii) construction of waste water collection and treatment system for 07 wards in Vinh Yen city including: + Construction of concentrated WWTP (8000m3/d) at Hoi Hop Ward, Vinh Yen City (for and treatment of wastewater 03 wards of Hoi Hop, Tich Son and Dong Tam); discharging wastewater to Coi Lake connecting with Phan river. + Construction of tertiary, secondary and primary wastewater collection system for 07 wards in Vinh Yen city i.e. Lien Bao, Khai Quang, Dong Da, Dong Tam, Tich Son, Ngo Quyen and Hoi Hop. The dosmestic wastewater from 04 wards Lien Bao, Khai Quang, Dong Da, and Ngo Quyen will be conveyed and treated by Quat Luu WWTP constructed under Vinh Phuc Improving Investment Environment Project (VPIIE). The wastewater from 03 wards Dong Tam, Tich Son and Hoi Hop will be treated by the Hoi Hop WWTP constructed under this project (see above). Vac Lake is located in the center of Vinh Yen City with a total surface area of about 163 ha of which about 32 ha (24 households) is currently being used for aquaculture. It is receiving water from most of the Vinh Yen city area and Ben Tre canal basin. Vac Lake intersects with Phan River at position K56 + 150 and are connected together through several canals. Therefore, the flow regime and water level of Vac Lake and Phan River are always interrelated. ***Relation to VPFRM Project*** The project involves rehabilitation and dredging of Vac Lake and dredging of a 2 km channel connecting Vac Lake and Phan River.
Current status	The project is in the pre-feasibility study stage and under pending approval by the Prime Minister for entering into the list of financed projects
Status of EIA/EMP	The project is selecting consultants for preparing the FS. The EIA report will be prepared by the FS consultant and must be approved by the Government of Vietnam and ADB prior to the project approval.
Assessment of cumulative impact	This project investments include dredged work of Vac Lake and 2 km long canal connect with Phan river. It will generate about 1.1 m3 of excavated soil, which will be used to level the low land area next to the lake area to construct a park of 44.2 ha. As the project is carried out at the same time to Vinh Phuc project, certain cumulative impacts during construction and operation need to be considered

	including: the increase in the turbidity of Phan river; impacts on dust, noise, traffic due to construction activities and material transportation; impact on aquaculture activities within the lakes. - Impact on water quality of Phan river: Vinh Phuc project involves the rehabilitation of Phan river; while this project involves the dredging of Vac lake and connecting canal to Phan river which may imply the cumulative impact on increase turbidity and thus water quality of Phan river. According to current construction plans, the construction of Vac lake and the connecting canal is carried out in 2018 in dry season (From October until the end of April), while the dredging of Phan river under Vinh Phuc FRM project will be carried out not early than 2018. In addition, the dredging process will carried out successively (section by section) with the application of sheet piles surrounding each section to prevent the impact to other surrounding and downstream areas. Most importantly, the connecting canal and Phan river is separated by a sluice gate which will be closed when the dredging process. Therefore cumulative impacts on turbidity of the river and other water impacts are not likely to occur. On the positive side, the construction of domestic wastewater collection system in 07 wards of Vinh Yen City and to convey wastewater to Quynh Luu WWTP and Hoi Hop WWTP also results in improving water quality in Phan River basin. - Impact on dust, noise, traffic due to construction activities and material transportation + The construction time of this project and that of VPFRWMP appear coinciding and carried out in B3 sub-basin of Vinh Phuc province. The main activities of this ADB project which mostly account for impacts on air, water, land of this project is the rehabilitation, dredging and embankment of the Vac lake and 2 km connecting canal. The main construction activities of Vinh Phuc FRM project in B3 area is the rehabilitation of Sau Vo lake. However, the construction sites of these two projects activities are distant (about 8 km from Sau Vo lake to Vac lake). In addition, the two lakes are not interrelated. Therefore, the cumulative impacts on dust, noise, vibration to environment and local people due to construction activities is assessed as not significant. + Regarding potential cumulative impacts due to transportation of dredged material. By design, the dredged material generated from dredging 60ha of the Vac lake is about 1.1mil m3. However, all of this material will be used for backfilling work for the construction of the green park next to Vac lake. The construction of wastewater collection and treatment system only result in small-scale material transportation. In considering these aspects, the cumulative impacts due to material transportation of these two project are assessed as small. - Positive cumulative impact on flood control In general, Vac Lake will help regulate and reduce flood from Vinh Yen northern area to Phan River. The proposed pumping stations of VPFRWMP upon completion will help to actively drain and control the highest water level in Vac Lake through lowering the flood level in Phan River, thereby preventing Vinh Yen centre and surrounding areas from local flooding. Overall, the project will contribute to effective flood control in the project area, while improving environment of Phan River. Thus the cumulative impact is assessed as positive. Negative cumulative impact on the quality of Phan river will not occur. Negative cumulative impacts due to construction activites and material transporation as well as aquaculture activities are assessed as insignificant, varied from small

	scale.
Due Diligence review	Surveying the impact extent and land acquisition prior to the project deployment will be carried out through social assessment (SA) and resettlement compensation (RAP). On that basis, the project will calculate and compensate affected households in compliance with regulations

2. Project Name	**Vinh Phuc Improving Investment Environment (VPIIE),**
Description	- Content and scale of construction: i) Construction of the primary, secondary wastewater collection system of grade 04 wards Lien Bao, Khai Quang, Dong Da, Ngo Quyen in Vinh Yen City, including 8.6 km combined drainage network and 25 km separate sewerage network. ii) Construction of 5 cascade pumping stations of submerged type iii) Construction of a concentrated WWTP at Quat Luu commune, Binh Xuyen district with a capacity of 4000 m^3/day. The treated wastewater will be then discharged to Phan river. - Project category: Class B - Total investment: VND 430 billion - Funding source: JICA - Duration of project: 2012 – 2014 ***Relationship with VPFRWMP*** The WWTP is located near Huong Canh Town. At the current period, it has not been operated at its full capacity. Under VPFRM component 2, the domestic wastewater from Huong Canh town will be collected and treated by this WWTP. The treated wastewater will be then discharged to Phan river.
Current status	The WWTP has been completed in 2014 and has been put under operation to treat wastewater for 04 wards of Vinh Yen city as planned.
Status of EIA	An EIA was prepared, evaluated by both Vinh Phuc DONRE and approved by the Provincial People's Committee and JICA.
Detail of EMP	Proposed mitigation measures in the approved EIA report of the WWTP project follow as: Mitigation measures to treat generated sludge of the WWTP Generated sludge from WWTP processing will be treated as follows: Activated sludge → Sludge pump → Sludge conveyor, press → transport to Vinh Yen city landfill. Control of treated wastewater quality from WWTP: According to the approved decision of the EIA report by Vinh Phuc Provincial People's Committee - Department of Natural Resources and Environment (DONRE), the effluent of the WWTP must meet standard of type B, QCVN 08:2008/BTNMT and discharged into the Phan River. Environmental management program has been proposed in the EIA report, has mentioned the roles and responsibilities of stakeholders in the implementation of the environmental management plans for the project. Environmental monitoring program has been proposed in the EIA report, including monitoring indicators, locations, frequency and applicable standards. Monitoring

	frequency of environmental quality is 3 months per time during the construction period and 6 months per time in the first operation year.
Assessment of cumulative impact	The project was completed and being operational since 2014, therefore there is definitely no cumulative impacts from construction activities. The constructed wastewater treatment system in VPIIE and VPFRWMP projects will collect and treat wastewater in certain wards of Vinh Yen city to the national permissible threshold (QCVN08/2008/BTNMT Class B). This will help improve water quality of Phan River as the main recipient source.Therefore the cumulative impact is assessed as positive.
Due Diligence review	The land acquisition and site clearance has been implemented since 2012 and completed in 2014. To date, the project has not received any claim from affected households. Survey results showed that livelihoods of affected households have been restored. The affected people have been compensated and supported in full accordance with related provisions of Vietnam laws.

3. Project Name	**Urban roads integrating Vac Lake embankments (from Vac Lake golf to Yen Lac - Vinh Yen road)**
Description	Scope of work: - Construction of the main roads of Nam Vinh Yen urban areas (33 m wide road, 2.7 km long), section from NH2 to Vac Lake Golf to Yen Lac - Vinh Yen road, forming a dyke to Vac Lake and preventing flooding for Vinh Yen urban area. - Diversion and rehabilitation of Phan River for section flows through Dong Tam ward of about 1.3 km long and 30 m wide. - Investor: Project Management Unit for Infrastructure and New Urban, Department of Construction, Vinh Phuc province - Funding source: Provincial budget - Total investment: VND 152 billion - Duration of the project: 2014 – 2016 ***Relationship with VPFRWMP*** The dredged and diverted river section flowing through Dong Tam Ward (B3 subbasin) will improve the capability of flooding drainage for Phan River.
Current status	At the moment, the project is in the stage of site clearance and construction preparation.
Status of EIA	EIA was prepared by investor, appraised by Vinh Phuc DONRE, and approved by Provincial People's Committee.
Detail of EMP	Mitigation measures during site clearance; construction and operation stages were proposed in the EIA report. The environmental monitoring and management program is also proposed with the frequency of every 3 months during construction phase and every 6 months during operation phase. Responsibilities of stakeholders involved in the environmental management and monitoring were also mentioned in the EIA report
Assessment of cumulative impact	The project is planned to be completed in 2016 while in VPFRWMP the dredging activities in Phan River will be undertaken from 2019. Therefore, there will be no construction cumulative impacts. The rehabilitation, diversion and dredging of 1.4km Phan River section that flows

	through Dong Tam Ward will help drain flood for Phan River basin. In operation stage, the constructed route will form a dyke to control water from Vac Lake to Vinh Yen city urban area, contributing to flood prevention in the area. In general, the cumulative impacts are evaluated as positive in flood control and enhanced capability of flood drainage for Phan River basin.
Due Diligence review	The land acquisition and site clearance of the project has been implemented from 2014 to the present. This work is expected to complete in December 2015. So far, the project has not received any complaints from households affected by the project.

4. Project Name	**WWTP at Lung Hoa Commune, Vinh Tuong District**
Description	Project description: The project consists of the collection system and concentrated domestic WWTP for Lung Hoa Commune, Vinh Tuong District The project is developed and implemented under the National Target Program on Building New Rural Areas of Vietnam for the period 2010-2020. The capacity of the WWTP is 350 m^3/day and treated wastewater to standard class B, TCVN 08:2008/BTNMT before being discharged into Phan River. - Investor: Department of Agriculture and Rural Development, Vinh Phuc province - Funding source: Provincial budget (budget for environmental protection) - Construction completed: 2013 ***Relationship with VPFRWMP project*:** In Lung Hoa commune bordering Phan River, previously, all domestic wastewater from residential areas has been discharged directly into lakes and ponds nearby, then into Phan River without treatment. This greatly affects water quality of Phan River. Since the project is completed, all domestic wastewater has been treated to wastewater in the area to the permissible limit (the standard class B, QCVN 08/2008) before being discharged into then into Phan River. This has contributed to improving environmental quality for the Phan River basin.
Current status	The construction is already finished and the WWTP put into operation from 2014 and still works well. The quality of effluent meets standard class B, QCVN 08:2008/BTNMT. Treated wastewater is discharged directly into Phan River section that traverses Lung Hoa commune.
Status of EIA	With the scale of the project, project prepared the Environmental Protection Commitment (EPC), which was evaluated and approved by the People's Committee of Vinh Tuong District
Detail of EMP	The project mitigation measures were proposed in the EPC with the environmental management and monitoring plan during construction and operation stages. Treated wastewater is proposed to meet QCVN 08:2008/BTNMT then discharged into Phan River basin

Assessment of cumulative impact	The project has been completed in 2013 thus there is no construction cumulative impact. The construction of WWTPs in Lung Hoa commune is implemented following national standards to make sure that treated wastewater meet with QCVN08/2008/BTNMT Class B. This will help improve water quality of Phan River as the main recipient source. Cumulative impacts of the project is evaluated as positive in improving environment and water quality in Phan River basin.
Due Diligence review	Given its small scale, land acquisition for the project was negligible and most of the villagers were highly supportive of the project. Therefore the project has not received any complaint from households affected by the project.

Listed below is a comprehensive table of the most relevant Valuable Ecological Components (VECs) that may be affected by VPFRWMP project. These VECS have been selected on the basis of their importance in affecting pollution loads in the Phan River and its basin. These VECs are interlinked in that decreases of water quality due to discharges from urban and wastewater treatment activities, and dredging activities, can impact both aqua-flora and aqua-fauna, and affect the quality of life of local communities, with regard to their access to clean water for domestic and agricultural use. This affects communities within the vicinity of the Project and facilities adding to cumulative impact, and those communities downstream. More details on the selection of these VECs are described above. On this basis, the following VECs were selected as those to be most significantly affected.

1. Water quality
2. Aquatic Bio-diversity
3. The quality of life of local communities
4. Downstream water use

Due to lack of detailed pollution data, the impacts of adjacent development projects are assessed by order/magnitude of impact. The assessment of the significance of the cumulative effects of projects on the VECs, by order of magnitude, is presented in the Table below.

Table 71. Screening of Cumulative Environment Impacts of VPFRWMP

Key factors	***Development Activities in Project Area***							**Overall score**
	Before 2015 (Completed)			**2015 - 2025 (On-going)**				
	WWTP at Lung Hoa commune, Vinh Tuong District	*IPs*	*Projects of Vinh Phuc improving the investment environment (VPIIE)*	*Urban roads integrating Vac Lake embankments (from Vac Lake golf to Yen Lac - Vinh Yen road)*	*Green Vinh Yen City Project*	*Sand extraction points*	*Borrow pits*	
Water quality	1	-2	2	1	±2	-1	0	±2
Aquatic Bio-diversity	±1	-1	2	±1	±2	-1	0	±2
The quality of life of local communities	2	3	2	2	2	-2	0	±3
Downstream water use	1	1	2	1	2	-1	0	±2

Note: *"+" and "-" respectively stand for positive and negative impacts*

"0,1,2,3" indicate the levels of impact, respectively negligible, minor, medium and significant

IPs include: Khai Quang; Kim Hoa; Binh Xuyen I; Binh Xuyen II; Ba Thien I; Ba Thien II, Tam Duong II.

The potential cumulative impacts caused by simultaneous construction of different facilities, both industrial and urban infrastructure-related, can be managed with coordination of schedules at the city level, and good construction management during implementation.

In summary, most potential urban infrastructure projects are likely to have largely positive impacts, through improving water treatment, solid waste management, and drainage along major roads, reducing water and air pollution, and improving the urban environment as well as performing vital flood control functions. While the industrial parks will impose significant impacts on groundwater and surface water quality, these can be mitigated to some extent by the proper operation and regular maintenance of the treatment plants under construction.

The Project itself has largely positive impacts, through improving water on Phan River as well as performing vital flood control functions. The potential cumulative impacts caused by simultaneous construction are limited in nature if well managed with coordination of schedules at the provincial level, and good construction management.

5.3.2. Social Cumulative Impact Assessment

The SA team conducted a systematic review of related documents, including the Feasibility Study, Hydraulic Modeling, the Environmental and Social Impact Assessment Report, to examine if there are any potentially cumulative impacts, particularly flooding, that may result as a result of the investments of the Project. The review confirms there is no cumulative impact, indicative of unexpected flooding, that could be identified during project preparation stage. During project implementation, when the detailed engineering designs for all subprojects are available, additional review to screen and confirm for cumulative impact (flooding) addressing potential flooding impacts, if needed. In case, the studies confirm that investments of the project may result in unusual flooding to a particular land area, impact assessment will be further done to confirm the magnitude of the impact. If the impact affects adversely the income generating activities and livelihoods of the people, and these impacts (permanent or temporary) could not be avoided, the affected people will be compensated for - as per project’s RPF.

CHAPTER 6.
ENVIRONMENTAL AND SOCIAL MITIGATION MEASURES

In order to minimize adverse environmental impacts, many measures haven been proposed since the preparation stage of the project. Surveys and design activities have been prepared with many alternatives to minimize the project's impacts during construction and operation processes. During the preparation of the project, effort has been made to avoid potential adverse impacts on resettlement and land acquisition by reducing scope and/or modification of the basic design of the project investment. In developing the mitigation measures the strategies to minimize and/or rectify the impacts have been applied and where appropriate compensation has been incorporated. The proposed mitigation measures to reduce the impacts due to land acquisition and resettlement are described in the RP.

This chapter identifies mitigation measures of the key project impacts during the pre-construction and construction (including site clearance, ground leveling, construction, and restoration) and operation phases. Given that most of the key impacts will occur due to civil works and transportation of construction/waste materials, many of the potential negative impacts on physical, biological, and social environment could be mitigated through a set of general measures that are typically applied to most of construction projects to minimize impacts such as noise, dust, water, waste, etc.

As part of the Environmental Management Plan (EMP) for the project these general measures have been translated into a standard environmental specification to be incorporated into the bidding and contract documents. These are referred to as Environmental Codes of Practice (ECOPs) and it will be applied to mitigate typical impacts of the project's civil works. These are referred to as Environmental Codes of Practice (ECOPs) and it will be applied to mitigate typical impacts of the project's civil works. Section 7.2 briefly explains the scope and content of the ECOPs, which are presented in the next Chapter 7.

However, for the VPFRWMP, there are specific impacts that require site-specific measures both during the construction and operation phases. These measures are incorporated into the EMP of the project.

However, for the subprojects of VPFRWMP project there are site-specific impacts that require site-specific measures both during the construction and operation phases. Section 6.1.2.2 discusses site-specific measures during construction for the subcomponents that require mitigation measures beyond those identified in ECOPs. Section 6.1.3 describes site-specific measures to mitigate impacts of the key subcomponents during the operation phase.

There are several strategies (avoidance, minimization, rectification, and/or compensation) that have been applied to mitigate the potential negative impacts identified in Chapter 4. During the preparation of the project, effort has been made to avoid potential adverse impacts on resettlement and land acquisition by reducing scope and/or modification of the basic design of the project investment. In developing the mitigation measures the strategies to minimize and/or rectify the impacts have been applied and where appropriate compensation has been incorporated. The proposed mitigation measures to reduce the impacts due to land acquisition and resettlement are described in the RP and RPF.

6.1. MEASURES TO MITIGATE ENVIROMENTAL IMAPCTS.

Clear the area before construction by qualified and licensed UXO clearance experts.

6.1.1. Measures to Mitigate Generic Impacts during Construction

The ECOPs describe typical requirements to be undertaken by contractors and supervised by the construction supervision consultant during construction. The ECOPs will be incorporated into the bidding and contract documents (BD/CD) annexes. Scope and content of the ECOPs is as follows:

Scope: Construction activities for small works governed by these ECOPs are those whose impacts are of limited extent, temporary and reversible, and readily managed with good construction practices.

The measures identify typical mitigation measures for the following aspects:

- ✓ Dust generation
- ✓ Air pollution
- ✓ Impacts from noise and vibration
- ✓ Water pollution
- ✓ Drainage and sedimentation control
- ✓ Management of stockpiles, quarries, and borrow pits
- ✓ Solid waste
- ✓ Management of dredged materials
- ✓ Disruption of vegetative covers and ecological resources
- ✓ Traffic management
- ✓ Interruption of utility services
- ✓ Restoration of affected areas
- ✓ Worker and public safety
- ✓ Communication with local communities
- ✓ Chance findings

6.1.2. Site-specific Measures to Mitigate Impacts for Works under each Component

6.1.2.1. Component 1- Flood Risk Management

a. Preparation and site clearance phase

During pre-construction period, key are mainly related to land acquisition, site clearance, and management of waste materials demolished during site clearance process. In addition, risks due to UXO in the construction area should also be taken into consideration. To mitigate these impacts the following measures will be carried out by the project:

- During detailed design, PMU will study carefully the scale and scope of the project implementation to minimize land acquisition impacts. At the same time, the PMU will closely coordinate with the local authorities to carry out dissemination activities so that the local communities understand the roles and significance of the project thus cooperate and supervise the contractors' performance during the project implementation process.
- The materials disposed during site clearance process must be managed and treated properly under the supervision of the PMU. The contractors are prohibited to dispose materials and waste at undesignated area, especially into the rivers. The salvageable materials will be salvaged to the maximum extent (for example, dredged soil that has good quality can be used for backfilling).
- With regards to landfills, to date, the project has planned 02 disposal sites, namely Dong Mong and Kim Xa, which have been approved by Vinh Phuc PPC. However, the project will calculate the storage capacity of each disposal site as well as study the materials to be disposed at each disposal site according to its future usage function and property of waste materials.
- Unexploded ordnance remove will be carried out in all of contruction sites in component 1 and component 2. The UXO remove activities need to complete before starting construction activities, the several step should follow during UXO remove:

- Coordinate with the appropriate agencies at the design stage to identify if UXO is a potential threat to works;
- Based on the findings, PMU will sign contact with an authorized agency for removing UXO;

b. Construction phase

** Site-specific measures for construction of Kim Xa, Nguyet Duc, and Ngu Kien pumping stations*

The subcomponent impacts are considered temporary, and localized varied from moderate to high-scale and most of them can be mitigated through the typical mitigation measures identified in ECOPs. Key site-specific impacts are mainly related to local flooding, impacts on the surrounding irrigation system, improper disposal of excavated materials, landslide and subsidence risk, impacts on the quality of agricultural soil due to the locations of these subcomponents that are close to agricultural land area. To mitigate these impacts the following measures will be carried out by the project:

✓ To mitigate risks of landslide during the construction, surveying the geology and hydrology in the area needs to be implemented seriously and precisely; simultaneously it is necessary to have specific construction measures to prevent the subsidence/landslide in the positions constructed the pumping station and along the canals.

✓ During detailed design, PMU will ensure that detailed design will provide installation of temporary and permanent drainage to avoid potential flooding, disruption to the irrigation system in project site during construction and operation.

✓ When dredging the topsoil layer for construction, the contractors will make use of good-quality dredged materials for backfilling. Only bad quality materials will be transported to the designated disposal site.

- ✓ It is necessary to check the contamination level of the dredged materials; if the concentrations of substances in the materials (especially heavy metals) are higher than permitted limitations as stipulated in the environmental technical regulations, these materials will be disposed only at Dong Mong disposal site according to the designated cells (the bottom layer covered with waterproof HDPE membrane)
- ✓ The construction activities should avoid harvest period in the area in order to minimize social and traffic impacts.
- ✓ In case the construction activities cause damages or degradation to the traffic roads, including inter-field pathways, the contractors must repair and restore in a timely manner not to affect the local residents.

** Site-specific measures for lakes dredging*

The impacts caused by the rehabilitation and dredging of lakes (Rung, Nhi Hoang, and Sau Vo) are considered temporary, and varied from moderate to high scale and most of them can be mitigated through the typical mitigation measures identified in ECOPs. Key site-specific impacts are mainly related to local flooding, impacts on the surrounding ecosystem, the transportation of dredged waste, especially surface sludge, traffic management, may cause impacts on the environment and landscape in the construction area, the transportation routes and landfills, water quality and aquatic life and downstream users. To mitigate these impacts the following measures will be carried out by the project:

- ✓ Concrete and detailed construction plan and construction methods/solutions should be developed, in which details on the dredging methods, plan, and transportation route to the landfills will be included.
- ✓ During construction phase, if the project causes impacts on the irrigation and drainage systems in the area, the contractors will have appropriate flow diversion solutions to ensure irrigation and drainage.
- ✓ Since the local people are using most of the lakes to be dredged for cultivation and aquaculture purposes, the project will inform the people to harvest their products prior to the construction commencement.
- ✓ As the area of the lakes to be dredged is rather large, the construction solution will be successive method, in which dredging will be carried out in part to minimize impacts on the landscape, ecosystem, and biodiversity in the area.
- ✓ When dredging the topsoil layer for construction, the contractors will make use of good-quality dredged materials for filling. Only bad quality materials will be transported to the designated landfill.
- ✓ The dredged materials, prior to removal out of the construction site, must be dry to prevent leakage/scattering along the transportation route.
- ✓ A detailed sludge quality monitoring shall be carried out during detailed design period to determine the quality of sludge and possible disposal method. if the concentrations of substances in the materials (especially heavy metals) are higher than permitted limitations as stipulated in the environmental technical regulations, these materials will be disposed only at Dong Mong disposal site according to the designated cells (the bottom layer covered with waterproof HDPE membrane)

- ✓ The construction should avoid rainy season to minimize drainage and prevent local flooding.
- ✓ To mitigate the impact to water quality and aquatic life and downstream users, following measures shall be applied: (i) the dredging process will be carried out in successively in section, with the application sheet piles surrounding each section to prevent the impact to other surrounding sections/area; (ii) Dredging activity shall only be carried out in dry season.

** Site-specific measures for dredging of Phan River, three river network in Binh Xuyen, and control gates*

The environmental and social impacts caused by the rehabilitation and dredging of Phan River and three river network in Binh Xuyen (Cau Bon, Tranh, and Ba Hanh Rivers) and rehabilitation of control gates are considered moderate, temporary, and most of them can be mitigated through the typical mitigation measures identified in ECOPs. Key site-specific impacts are mainly related to local flooding, impacts on the water ecosystem in the rivers, the transportation of dredged waste, especially surface sludge, may cause impacts on the environment and landscape in the construction area, the transportation routes and landfills, water quality and aquatic life and downstream users. To mitigate these impacts the following measures will be carried out by the project:

- ✓ Prior to construction, a concrete and detailed construction plan and construction methods/solutions should be developed, in which details on the dredging methods, plan, and transportation route to the landfills will be included. The construction plan shall be approved by Construction Supervision Consultant.
- ✓ The construction methods should be specific; there are plans for flow diversion at all construction sites to ensure drainage capacity. The construction sites must be enclosed to avoid sludge, spoil and waste runoff into the rivers, affecting river water quality.
- ✓ It is necessary to inform the local people to harvest their products on the rivers prior to construction as some people are growing vegetable such as water morning glory, cilantro, etc. and conducting aquaculture in the rivers.
- ✓ When dredging, the contractors will make use of good-quality dredged materials for filling. Only bad quality materials will be transported to the designated landfill.
- ✓ The non-contaminated dredged materials, prior to removal out of the construction site, must be dry to prevent leakage/scattering along the transportation route. The contamanited dredged material, if determined as contaminated shall be transported immediately out of project site to the designated cell in Dong Mong landfill.
- ✓ It is necessary to check the contamination level of the dredged materials; if the concentrations of substances in the materials (especially heavy metals) are higher than permitted limitations as stipulated in the environmental technical regulations, these materials will be disposed only at Dong Mong disposal site according to the designated cells (the bottom layer covered with impermeable HDPE geomembrane).
- ✓ The construction should avoid rainy season to minimize drainage and prevent local flooding.
- ✓ To mitigate the impact to water quality and aquatic life and downstream users, following measures shall be applied: (i) the dredging process will be carried out in successively in section, with the application sheet piles surrounding each section to

prevent the impact to other surrounding sections/area; (ii) Dredging activity shall only be carried out in dry season; (iii) stream diversion will be carried out to ensure that the flow is not being disrupted.

** Site-specific measures for construction of disposal sites*

The project has planned 02 disposal sites, namely Dong Mong and Kim Xa for the disposal of waste materials generated from dredging and construction process.

The impacts due to the construction of disposal site include the dust, odor and gases generated dredged sludge, landscaple, improper disposal of contaminated excavated materials to the designated disposal site, garbage disposal from surrounding; the risks that the disposal sites used by local people as domestic dumpsite and waste from other construction works nearby; land subsidence risk at Dong Mong disposal site during construction,

In order to mitigate environmental impacts caused by disposing dredging materials into the disposal sites, the disposal sites need to be designed to avoid impacts on the surrounding environment. Specifically:

- ✓ Kim Xa disposal site is a 3.8 ha area with capacity of 64,000 m^3. The disposal site is only for materials which contain the heavy metal level for agricultural land lower than Vietnamese technical regulation QCVN 03:2008/BTNMT.
- ✓ Dong Mong disposal site has the total area of 54,31ha, elevation of +8.5m - 8.8m and capacity of 1,629,300 m^3. The disposal site is divided into 13 different cells, one of which is 2.98ha area and has capacity of around 90,000 m^3 paved with HDPE to contain dredging materials within limits allowed by Vietnamese technical regulation QCVN 03:2008/BTNMT. The other cells without HDPE membrane are only for the materials which are through the analysis process of the content of substances; especially the heavy metal content in agricultural land must be lower than Vietnamese technical regulation QCVN 03:2008/BTNMT.
- ✓ The disposal of waste at the disposal sites may generate dust; therefore, surrounding these disposal sites, plant green trees to minimize dust into the air and at the same time create environmental landscape for the area.
- ✓ Prior to the completion of the project (disposal sites will be closed), the project should take measures to restore the site.
- ✓ If the disposed sludge materials still generate odors and gases, spray daily with biological products and sprinkle with lime to prevent odor.
- ✓ Awareness raising and coordination with local authorities to ensure that these sites will not be used as the dump site for local people and other projects in the province.
- ✓ To prevent the soil erosion and land subsidence risk at Dong Mong disposal site, the site will be divided into 13 cells and material will be fiflled in succucessively in each cell. During the disposal process, the cell will be compacted carefully and soil embankment surrounding each cell to prevent soil erosion.

** Mitigation measures for hazardous waste*

Athough hazardous waste of small volume but could create serious negative impacts on environment so that it must be collected, transported and treated by licensed agencies. At present Green Industrial Environment Company in Phuc Yen town is capable of handling part of the waste and the remaining will be handled by URENCO 10 Company in Hanoi. Contractors must comply with the following measures:

- ✓ Follow environmental regulations in handling hazardous materials including appropriate storing of materials.
- ✓ Fuels, oils storage sites and fuel filling activities shall be located away from water courses.
- ✓ Use and maintain vehicle and machinery properly to avoid accident spills. Prepare emergency plans in case of accidental spills.
- ✓ Collected, transported and treated under contract with company which has permit for treating hazardous waste disposal according to Circular 36/2015/TT-BTNMT on 30 June, 2015 of MONRE.

** Mitigation measures for Traffic Management*

- ✓ Traffic Management Plan to maintain safety, to minimize disturbance to local traffic and pedestrians and to maintain public and private access throughout the works areas. Such as: provincial roads 303, 304, 305, 309, Pho Day Dyke, Huong Canh-Tan Phong, Vinh Yen bypass and National Highway 2, 2A, 2C
- ✓ The Plan will show routes provided to maintain access, e.g., a passing lane retained along the road during construction or temporary bypasses, or scheduled access times.
- ✓ The Plan will be presented to communities and officials before finalization and approval by the CSC/PMU and subsequent implementation by the Contractor.

  - During the construction period, the contractor should coordinate with traffic polices on moderate the traffic flow during rush hours in the rural residential areas, towns and Vinh Yen City;
  - Place sign boards near construction sites to direct traffic means to slow down;
  - Provide lighting at construction site at night;
  - Place signs around the construction areas to facilitate traffic movement, provide directions to various components of the works, and provide safety advice and warning
  - Provide staff to instruct traffic at the entrances and exits of construction sites. To prevent traffic accident and risk to local people, the contractor shall provide safety measures as installation of fences, barriers warning signs, lighting system at these areas.
  - Avoid material transportation for construction during rush hour.

c. Measures to Mitigate Impacts during Operation phase

** Site-specific measures during the operation of drainage pumping stations, approaching and discharging canals*

Three pumping stations, namely Kim Xa, Ngu Kien, and Nguyet Duc, and the approaching and discharging canal system, when coming into operation, may cause some adverse impacts on the environment. However, these impacts are considered moderate, localized, and can be controlled if fully applying mitigation measures.

The site-specific impacts of these stations during operation are mainly related to flood control activities and safety for local people (especially children) and impacts on the aquatic species during its operation. In order to minimize these impacts, the project will carry out the following measures:

- ✓ The operation of the pumping stations as well as other headwork of the stations must adhere strictly to the prescribed procedures. Pumps and equipment in the pumping stations should be maintained regularly; approaching canals, discharging canals, inlet tanks, and discharge tanks in the pumping station area must be dredged regularly to prevent clogging, thus affects the drainage function of the project.
- ✓ Entrance gates of the pumping stations must be built to ensure that those who are not relevant will not enter because the pumps in these stations use three-phase electrical equipment, which easily causes unsafety to those who are unfamiliar with the stations.
- ✓ Iron fence should be placed surrounding the inlet tank to ensure safety for people. In addition to the iron fence, a net will also be arranged to prevent aquatic species as well as other substances in the water from being sucked into the pump, causing death of the species or damage to the pump.
- ✓ The workers operating the pumping stations must undergo careful and intensive training. In the pumping stations, there should be operation and maintenance procedures for the workers to operate accordingly.
- ✓ Regular checking and monitoring the risks of landslides in the pumping stations, canals, and discharge canals and around the regulating lakes in front of the pumping stations to have a proper reinforcing plan.
- ✓ At the regulating lakes in front of the pump stations as well as inlet and discharging canals, there should be warning signs of the depth and safety for people.
- ✓ It is prohibited to put fish or other aquatic species into the inlet and discharging canals of the pumping stations.

** Site-specific measures during operation of the lakes (Rung, Nhi Hoang, and Sau Vo)*

The lakes, including Rung, Nhi Hoang, and Sau Vo, will be dredged to regulate the flow before conveying to three pumping stations, Kim Xa, Ngu Kien, and Nguyet Duc, contributing to control and minimize flood risks. The operation may cause some negative impacts on the environment. However, these impacts are considered moderate, localized, and can be controlled if fully applying mitigation measures. The negative impacts are mainly related to the sedimentation in lakesover time, impacts on air quality due to accumulation of organic materials in the sediments, and erosion of lakeshore if not managed and monitored appropriately. The specific mitigations are proposed as follows:

- ✓ Before every rainy season, DONRE or agency responsible for managing the lakesshould check the water flow and calculate water storage capacity and regulation capacity of the lakes in a careful manner to increase flood control capacity in Phan River basin and other water bodies.

- ✓ Regularly check and monitor the risks of landslides around the lakes.
- ✓ Check and monitor the deposition of organic materials/soil and sand sediments; if the amount is high, it is necessary to dredge to ensure storage and regulating capacity of the lakes, at the same time, limit emissions such as CH4, H2S,... generated by the decomposition of organic matters in the sediments.
- ✓ Warning signs about the depth of the lakes should be placed around; prohibit swimming in the lakes.
- ✓ Prohibit growing water-fern as well as aquatic species in the lakes.

** Site-specific measures during the operation of dredged Phan River, three river network in Binh Xuyen, and control gates*

During operation, the overall impacts will be positive. However there are some risks that may cause negative impacts on the local environment and/or local residents if there are no effective management and protection measures. Main impacts related to sedimentation and erosion of riverbed, affecting drainage function. In addition, landscape and environment will be degraded overtime if they are not managed and protected properly. A number of measures are proposed below:

- ✓ Every year, DARD or management unit should check the flow and drainage capacity, sedimentation level of the riverbed, and erosion level of river banks to ensure drainage capacity during rainy season in order to prevent flooding for the upstream area. When detecting significant deposition of organic materials/soil and sand sediments and erosion of river banks, it is necessary to conduct dredging and embankment immediately.
- ✓ Increase education and communications to increase people’s awareness of environmental protection in Phan River basin and other rivers.
- ✓ Prohibit throwing domestic waste and other solid waste into the river or on two river banks.
- ✓ Growing water-fern as well as aquatic species in the rivers is forbidden in order to ensure drainage.

6.1.2.2. Component 2- Water Environmental Management

a. Pre-construction phase

With regards to the Component 2, the focus is given to develop wastewater collection network, five WWTPs, and a number of cascade pumping stations in the small towns, including Yen Lac, Tam Hong, Tho Tang, and Huong Canh. In addition, the project also invests in small-scale wastewater treatment facilities in 33 rural residential areas along Phan River.

Land acquisition for the component 2 is inconsiderable as most of the proposed locations for the construction of WWTPs are far from the residential areas (at least 200 m). Therefore, the adverse impacts during this phase are considered minor. The main impacts are related to the local people’s concerns as they do not want to have wastewater treatment facilities close to their living places. The specific measures are proposed as follows:

- ✓ It is important to study the appropriate locations of the WWTPs to ensure the proper distance from the residential areas as regulated by the GoV and at the same time ensure the efficiency in wastewater collection and treatment when the project comes into operation.

- ✓ During design phase, it is necessary to research and recommend appropriate wastewater treatment technology to ensure economic efficiency as well as effectiveness of domestic wastewater treatment from residential areas. The capacity of the WWTPs is also calculated based on the number of population and wastewater volume that needs collecting and treating. Particularly, it is important to take into consideration the increase of waste volume in the future due to the economic development planning and population growth in the area.
- ✓ Closely coordinate with the local authorities and mass organizations to carry out communications and education to raise people's awareness in the area where WWTPs are proposed to be located so that the local communities could understand, cooperate, and participate in contributing opinions and supervision when the WWTPs come into operation.

b. Construction phase

The environmental and social impacts caused by the construction of wastewater collection network and WWTPs are considered moderate, temporary, and localized and most of them can be mitigated through the typical mitigation measures identified in ECOPs. Key site-specific impacts are mainly related to local flooding, which affects the surrounding environment. In addition, the transportation of dredged materials, especially surface sludge at the backwater area (no water circulation) where WWTPs are expected to be located, may cause impacts on the environment and landscape of the construction area, transportation route, and landfills. To mitigate these impacts, the following measures will be carried out by the project:

- ✓ Develop concrete and detailed construction plan and construction methods/solutions, in which details of dredging method, plan, and transportation route to the landfills must be included, particularly for construction activities of WWTPs in 4 towns.
- ✓ The proposed locations of the WWTPs are often the low-lying areas; therefore, flooding may easily occur when it rains. Therefore, the contractors must have specific construction methods and flooding prevention plan during construction period as well as plans for diversion to ensure drainage in the area.
- ✓ When constructing wastewater collection network, successive construction methods should be applied to minimize impacts on the environment as well as local traffic. When construction activities are completed at each section, it is necessary to restore the environment of the section immediately to ensure traffic safety and the landscape in the area.
- ✓ When carrying out dredging, the contractors should make use of good-quality dredged materials for filling. Only bad quality materials will be transported to the designated landfill.
- ✓ The dredged materials, especially surface sludge, prior to removal out of the construction site, must be dry to prevent leakage/scattering along the transportation route.
- ✓ Check the contamination level of the dredged materials; if the concentrations of substances in the materials (especially heavy metals) are higher than permitted limitations as stipulated in the environmental technical regulations, these materials will be disposed only at Dong Mong disposal site according to the designated cells (the bottom layer covered with waterproof HDPE membrane)

- ✓ Avoid construction in rainy season to minimize drainage and prevent local flooding.

c. Measures to Mitigate Impacts during Operation Phase

Upon the completion of the project, the wastewater collection system and WWTPs will come into operation. Domestic wastewater produced from residential areas will be collected and treated before discharging into Phan River, contributing to improving the river water quality. However, there is possibility of occasional wastewater discharges below specified quality standards; issues related to odors and sludge from the treatment process or incidents related to operation and management of the WWTPs.

To mitigate these impacts, the following measures will be carried out by the project:

- ✓ Ensure that the contract for construction of the WWTPs includes provision of operations manual and training operators in the plant's operations and maintenance.
- ✓ Ensure the plants are operated, strictly following the operations manual. The operation staff of the WWTPs must receive periodic training on the operation of the plants.
- ✓ Ensure that the operations manual includes a regime of testing of: (i) discharge from the plant; (ii) sludge produced by the plant; and (iii) ambient air and water quality in the immediate vicinity of the plant.
- ✓ Ensure that detailed designs for the plant include tree planting and other means to isolate the plant from the surrounding residential area
- ✓ Ensure that the operations manual contains a procedure for emergency discharge in the event of plant breakdown, and that the procedure is communicated to downstream residents and local authorities tasked with managing emergencies of such nature
- ✓ Ensure that the operations manual includes a procedure for safely handling sludge from the plant. The ODA-PMU must develop and hand over to the management unit when the WWTPs come into operation to implement sludge management plan, including deposit of sludge in the tank and sludge in the temporary storage area in the plants (if any).
- ✓ Contract with specialized company to periodically collect and transport sludge for treatment (collection time depends on actual amount of produced sludge).
- ✓ Regularly dredge and augment the wastewater collection system to ensure drainage of wastewater to the plants. In addition, the discharge system behind the plants should also be cleared regularly.
- ✓ In addition, the operation of WWTPs will generate odors and gases (CH4, H2S etc.) from decomposed organics and sludge. To address waste sludge:
- ✓ Contract with specialized company to periodically collect and transport sludge for treatment in a similar manner to waste from septic tanks.
- ✓ Use as organic fertilizer after drying, adding microorganisms.
- ✓ Supplement to other WWTPs that use aerobic and anaerobic biotech (Quat Luu, Lung Hoa etc.)
- ✓ To address bad odors and gases:

- Situate WTTPs far from residential areas as stipulated in Vietnamese regulations to reduce health and environmental impacts.
- Fence the WWTPs with trees to create landscape and reduce odors and gases from treatment.
- Regularly dredge canals to reduce deposition and organic waste in the WWTPs.

6.2. MEASURES TO MITIGATE SOCIAL IMAPACTS

6.2.1. Involuntary Resettlement

Potential adverse social impacts due to acquisition of land and other assets trigger World Bank’s OP 4.12. In compliance with the provision of the policy, the project require the preparation of RPF and RAPs for each of the subprojects to address impacts caused by land acquisition. The RAPs address the relocation and livelihood impact of the Project on directly impacted communities and households. The Vinh Phuc PPC and authorized PMU ensured that any involuntary resettlement will be carried out in accordance with the agreed RPF/RAPs.

To meet the World Bank Policy requirements, payment for all assets (including land, structures, crops, and other assets) at replacement cost. Displaced people’s living should be restored to at least the pre-project level. In the community meetings, local authorities expressed their appreciation with regards to the World Bank's policy to restore livelihood of the affected people and to assist poor and vulnerable households.

The Resettlement Action Plan(s) per subproject include the special attention to gender and vulnerable group issues in accordance with the WB policy on Involuntary Resettlement. In this respect, the RAPs address the vulnerable group, gender and poverty issues particularly among the directly impacted households. The measures in the RAPs include provision of opportunities for increased women’s participation in decision making and in livelihood training, and ensuring that compensation will be given to both men and women.

6.2.2. Ethnic Minority

The SA confirmed that EM communities including in Cao Lan and San Diu, Nung and Dao are present in the proposed project area and could be potentially affected. A process of free, prior informed consultation with affected EM's communities of the Project during the project design was carried out and will be done for new subprojects to be identified during project implementation to ensure there is a broad community support for the subproject implementation.

EMPF/EMDP was prepared on the basis of a) social assessment prepared for the whole VPFRWMP project, and results of the environmental impact assessment; b) consultation with ethnic minority peoples present in the project areas and c) consultation with key project stakeholders, including Vinh Phuc Provincial's Department of Planning and Investment, Committee for Ethnic Minority Affairs, and the World Bank. These report's objective is to ensure that (i) affected EM peoples receive culturally appropriate social and economic benefits, and (ii) when there are potential adverse effects on EM, the impact are identified, avoided, minimized, mitigated, or compensated for.

6.2.3. The Framework and Plans prepared for impacts' mitigation of Phase 1 subprojects

The Project resettlement framework (RPF) and according to the Government of Vietnam and the World Bank OP 4.12 was prepared to guide the preparation of the resettlement plans defined during project preparation and for those that will be identified during project implementation. In order to minimize impacts caused by land acquisition, the project design proposed alternatives to select the optimal option to meet the following criteria (i) causing the smallest possible impacts on land acquisition; and (ii) ensuring optimal drainage purposes; (ii) including consultations' inputs provided by the local authorities and communities in the subproject area

The 3 RAPs and 1 EMDP were developed for the project's 3 year subprojects implementation.

(i) 3 RAPs for Sau Vo Detention Lake and Sau Vo Access Road Subprojects; Dong Mong Landfill subproject; Improving and Dredging of Three-River Network in BinhXuyen and Construction of Ton Bridge and Sat Bridge Control Gates Subproject. The 3 RAPs present the eligibility criteria for compensation of land and assets affected by the subproject, description of the income restoration program, implementation arrangement, implementation plan, estimated cost, monitoring and assessment, participation in consultation of the community and grievance redress mechanism. (ii) The EMDP for the improving and dredging of Three-River Network in Binh Xuyen and construction of the Ton Bridge and Sat Bridge control gates Subproject in a project site which will be impacting EM households. (The costs of the RAPs and EMDP are presented in the following section).

6.2.4 Temporary impact during construction that is related to aquaculture and fishing.

Aquaculture: The project plans to finance dreding operation for three lakes, including Sau Vo Lake (250 ha), Rung Lake (140 ha), and Nhi Hoang Lake (20 ha). Of the total water surface area (which is 410 ha), only 180 ha (44%) are currently used by 132 households for aquaculture purpose. These households could be potentially affected depending on the dredging methods to be adopted, and as such the exact impact could not be confirmed at the moment. During project implementation, socioecomic survey will be conducted with these households to understand in detail the potential impact on livelihood (including primary production) when detailed designs and construction methods are available to assess the impact on the livelihoods of these households. If there are any potential temporary impact, the impact will be compensated for – as per the households's contract, and as per project's RPF (Please see section of compensation temporary impact -3.2.2, in project's RPF).

It is also noted that the Government is managing lake surface and all users of the lake have signed rental contracts which are renewed every year. No fishing activity (without contract) are allowed in lake. As such, these households will be compensated for their losses of income in accordance with their contracts and will be compensated and supported for their temporary loss of income in accordance with the project's RPF during construction period (See Section 3.2.2 in the RPF on how temporary impact are compensated).

Fishing:

For fishing activities on the rivers, at that time, the exact numbers of households engaged in such activities have not yet identified since there are no fishing activities identified during the survey (dry season). However, according to the verification of the CPCs, the number of households fishing on the rivers is very small and varies from season to season and fishing in river is occasional and is not key income generation activities of the households. Therefore, these households will be identified and consulted (if any) when the detailed engineering designs as well as the dredging location and construction time are confirmed. If there is any impact identified, these households will be consulted and entitled to compensation and support - as project’s RPF.

CHAPTER 7.
ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

Based on the assessments of the potential adverse environmental impacts and mitigation measures proposed in Chapter 6 and chapter 7 of this report, this Chapter presents an Environmental Management Plan (EMP) for the project. EMP identifies the measures to be carried out for the project, including environmental monitoring program and implementation arrangements, taken into account the needs to comply with the government's EIA regulations and WB's environmental safeguard policies, including Environmental, Health, and Safety (EHS) Guidelines of the WB.

7.1. BASIC PRINCIPLES

7.1.1. Environmental Field

As part of the Environmental Impact Assessment (EIA), the Environmental Management Plan (EMP) is a safeguard instrument that is typically used in many projects and which consists of information and guidance for the process of mitigating and managing adverse impacts on the environment throughout the project implementation. It is common in Vietnam that an EMP includes a list of typical mitigation measures to be implemented by the contractors, an environmental monitoring program, organization arrangements, and en estimated monitoring cost.

There is a comprehensive regulatory framework in Vietnam related to the process of preparing environmental impact assessment, environmental standards, protection, land management and land use, cultural properties, and other aspects related to the construction and operation of facilities and infrastructure in Vietnam. This EMP is consistent with those provisions.

To facilitate effective implementation of the EMP, VP ODA-PMU will:

a) Establish Environmental and Social Unit (ESU) who is responsible for timely EMP implementation including monitoring, reporting, and capacity building related to safeguards regulations.

b) Assign Construction Supervision Consultant (CSC) who is responsible for monitoring the implementation of environmental mitigation measures taken by the contractor, which is a part of the construction contract and this requirement will be included in the Terms of Reference (ToR) of the Construction Supervision Consultant.

c) Recruit a qualified national consultant as Independent Environmental Monitoring Consultant (IEMC) to support the VP ODA-PMU in performing the tasks.

The Department of Planning and Investment (DPI), Department of Agriculture and Rural Development (DARD), Department of Natural Resources and Environment (DONRE), together with the DPCs and CPCs in the project area will be responsible for implementing mitigation measures during the project operation process. These agencies will ensure that the mitigation measures are implemented and provide adequate budget. The Provincial

Steering Committee (PSC) led by the Chairman or Deputy-Chairman of the PPC will provide overall policy guidance and oversee the project implementation. The roles and responsibilities of the specialized agencies and DPI, DONRE will also very important.

The mitigation measures proposed in EMP are divided into two key parts:

- ✓ Firstly, Environmental Codes of Practice (ECOP) includes generally typical impacts expected to occur during the construction process of the project. The mitigation measures to address these impacts will be provided in ECOP and a number of measures will be incorporated into the contract with construction contractors and design consultants.
- ✓ Secondly, the site-specific impacts and their respective mitigation measures which are not covered in ECOP, or which are of an order of magnitude that require mitigation measures not covered in the ECOPs, are described in more details in the EMP.

With regards to land acquisition and resettlement activities, or impacts related to indigenous peoples, mitigation measures are presented in separate reports (Resettlement Plan, Resettlement Plan Framework, and Ethnic Minority Development Plan). These activities will be implemented and monitored separately.

7.1.2. Social Field

Social problems arise, among others largely due to conflict between economic development and natural resources depletion. Economic losses and social costs from environment degradation often occur long after economic benefit of development has been realized. A social assessment helps understanding, minimizing and addressing social impacts. The social assessment (SA) involves a process for the project proposed to: understand how socio-cultural, institutional, historical and political contexts influence the social development outcomes of the project proposed investments; (ii) enhance equity, strengthen social inclusion and cohesion, promote transparency and empower the poor and the vulnerable in the project design and implementation of the project; (iii) create mechanisms to identify the opportunities, constraints, impacts and social risks associated with the proposed project design; (iv) set up a framework for dialogue on development priorities among social groups and grassroots organizations and other project stakeholders; and (v) identify and mitigate and compensated when required the potential adverse social impacts as a result of the project.

The project's social assessment (SA) covered the social aspects of both potential positive and negative impacts of the project's proposed activities. The SA identifies social impacts, to put in place suitable institutional, organizational and project specific mechanisms to mitigate the adverse effects These include among others aspects are related to involuntary resettlement, gender, indigenous peoples public health, and requirements to ensure public consultation, participation and communication of the affected population. The assignment undertook relevant laws and policies of the Government of Vietnam and safeguard policies of the World Bank (OP 4.12 and OP 4.10).

7.2. KEY MITIGATION MEASURES

7.2.1. Environmental Codes of Practice (ECOPs)

The full ECOPs are presented in this section. Below is the list of mitigation measures. Types of impacts covered in this document are:

- Dust generation
- Air pollution
- Impacts from noise and vibration
- Water pollution
- Drainage and sedimentation control
- Management of stockpiles, quarries, and borrow pits
- Solid waste
- Management of dredged materials and storage area
- Disruption of vegetative covers and ecological resources
- Traffic management
- Interruption of utility services
- Restoration of affected areas
- Labor and public safety
- Communication with local communities
- Chance findings

Table 72. Mitigation measures in accordance with ECOPs

Environmental and Social Issues	Mitigation Measures	Vietnamese Technical Regulations
1. **Dust generation**	• The Contractor is responsible for complying with relevant Vietnamese legislation and regulations with respect to ambient air quality. • The Contractor shall ensure that the generation of dust is minimized and is not perceived as a nuisance by local residents and shall implement a dust control plan to maintain a safe working environment and minimize disturbances for surrounding residential areas/dwellings. • The Contractor shall implement dust suppression measures (e.g. use water spraying vehicles to water roads, covering of material stockpiles, etc.) as required. • At each construction site, the Contractor will arrange only one entrance. As to vehicles from the construction site, their wheels must be ensured to be washed before entering the roads. • Material loads shall be suitably covered and secured during transportation to prevent the scattering of soil, sand, materials, or dust. • Exposed soil and material stockpiles shall be protected against wind erosion to prevent from spreading into the air when it is windy and the location of stockpiles shall take into consideration the prevailing wind directions and locations of sensitive receptors. • Workers on the construction site must be fully provided with personal protective equipment (PPE).	• QCVN 05: 2013/BTNMT:National Technical Regulation on Ambient Air Quality
2. Air pollution	• All vehicles must comply with Vietnamese regulations controlling allowable emission limits of exhaust gases.	• TCVN 6438-2005: Road vehicles.

Environmental and Social Issues	Mitigation Measures	Vietnamese Technical Regulations
	• Vehicles in Vietnam must undergo a regular emissions check and get certified named: "Certificate of conformity from inspection of quality, technical safety and environmental protection" following Decision No. 35/2005/QD-BGTVT; • There should be no burning of waste or construction materials on site. • Cement mixing and processing plants should be far from residential areas	Maximum permitted emission limits of exhaust gas. • Decision No. 35/2005/QD-BGTVT on inspection of quality, technical safety and environmental protection; • QCVN 05:2009/BTNMT: National Technical Regulation on Ambient Air Quality
3. Impacts from noise and vibration	• The contractor is responsible for complying with the relevant Vietnamese legislation with respect to noise and vibration. • All vehicles must have appropriate "Certificate of conformity from inspection of quality, technical safety and environmental protection" following Decision No. 35/2005/QD-BGTVT; to avoid exceeding noise emission from poorly maintained machines. • When needed, measures to reduce noise to acceptable levels must be implemented and could include silencers, mufflers, acoustically dampened panels or placement of noisy machines in acoustically protected areas. • Avoiding or minimizing transportation though community areas and avoiding as	• QCVN 26:2010/BTNMT: National Technical Regulation on Noise • QCVN 27:2010/BTNMT:National Technical Regulation on Vibration.

Environmental and Social Issues	Mitigation Measures	Vietnamese Technical Regulations
	well as material processing areas (such as cement mixing).	
4. Water pollution	• The Contractor must be responsible for complying with the relevant Vietnamese legislation relevant to wastewater discharges into watercourses. • Portable or constructed toilets must be provided on site for construction workers. Wastewater from toilets as well as kitchens, showers, sinks, etc. shall be discharged into a conservancy tank for removal from the site or discharged into municipal sewerage systems; there should be no direct discharges to any water body. • Wastewater over standards set by relevant Vietnam technical standards/regulations must be collected in a conservancy tank and removed from site by licensed waste collectors. • Make appropriate arrangements for collecting, diverting or intercepting wastewater from households to ensure minimal discharge or local clogging and flooding • Before construction, all necessary wastewater disposal permits/licenses and/or wastewater disposal contract have been obtained • At completion of construction works, wastewater collection tanks and septic tanks shall be safely disposed or effectively sealed off.	• QCVN 08:2008/BTNMT: National Technical Regulation on Surface Water Quality • QCVN 09:2008/BTNMT: National Technical Regulation on Underground Water Quality • QCVN 14:2008/BTNMT: National Technical Regulation on Domestic Wastewater • QCVN 40: 2011/BTNMT: National Technical Regulation on Industrial Wastewater.
5. Drainage and sedimentation	• The Contractor shall follow the detailed drainage design included in the construction plans, intended to prevent storm water from causing local flooding or	• TCVN 4447:1987: Earth works-Codes for

Environmental and Social Issues	Mitigation Measures	Vietnamese Technical Regulations
control	scouring slopes and areas of unprotected soil resulting in heavy sediment loads affecting local watercourses. • Ensure drainage system is always maintained cleared of mud and other obstructions. • Areas of the site not disturbed by construction activities shall be maintained in their existing conditions. • Earthworks, cuts, and fill slopes shall be properly maintained, in accordance with the construction specifications, including measures such as installation of drains, use of plant cover. • To avoid sediment-laded runoff that could adversely impact watercourses, install sediment control structures where needed to slow or redirect runoff and trap sediment until vegetation is established. Sediment control structures could include windrows of logging slash, rock berms, sediment catchment basins, straw bales, storm drain inlet protection systems, or brush fences. • Site de-watering and water diversions: In the case that construction activities require that work be carried out within the watercourse (e.g. dredging of lakes and rivers and construction of control gates), the work area must be dewatered to provide for construction in dry conditions. • Disposal of sludge, especially slurry, into the watercourses is prohibited. • Use techniques such as berming or diversion during construction to limit the exposure of disturbed sediments to moving water • Flow diversions or construction of cofferdams would require site-specific mitigation measures in the EMP.	construction. • Circular No. 22/2010/TT-BXD on regulation of construction safety. • QCVN 08:2008/BTNMT - National Technical Regulation on Surface Water Quality.

Environmental and Social Issues	Mitigation Measures	Vietnamese Technical Regulations
6. Management of stockpiles, quarries, and borrow pits	• Large-scale borrow pits or stockpiles will need site-specific measures that go beyond those in this ECOP. • All locations to be used must be previously identified in the approved construction specifications. Sensitive sites such as scenic spots, pagodas, temples, and areas of natural habitat, areas near sensitive receptors, or areas near water should be avoided. • Stockpile topsoil when first opening a borrow pit and use it later to restore the area to near natural conditions. • If the need for new sites arises during construction, they must be pre-approved by the Construction Engineer and agreed by the local authorities.	
7. Solid waste	• Hazardous wastes are not covered by these ECOPs and would require specific mitigation measures. • Before construction, a solid waste control procedure (storage, provision of bins, site clean-up schedule, bin clean-out schedule, etc.) must be prepared by Contractors and it must be carefully followed during construction activities. • Before construction, the Contractor must sign contract with the specialized unit for periodical waste collection and treatment (domestic waste collection cooperative); Solid waste can be stored temporarily on site at the location approved by the Construction Supervision Consultant and relevant local authorities; As for hazardous waste, the specialized unit defined in Circular 36/2015/TT-BTNMT on 30 June, 2015 of MONRE will be responsible. • The workers and contractors are prohibited to dispose waste into watercourses. • At all places of work (worker camps and construction sites), the Contractor shall	• Decree No.59/2007/ND-CP on waste management. • Circular No.36/2015/TT-BTNMT on hazardous waste management.

Environmental and Social Issues	**Mitigation Measures**	**Vietnamese Technical Regulations**
	provide litter bins, containers and waste collection facilities. Waste storage containers shall be covered, tip-proof, weatherproof and scavenger proof. • At each site or worker camp and maintenance area, the Contractor must arrange storage area or containers for hazardous waste (drum/plastic/composite containers can be used). These containers are only used to store hazardous waste and must be covered and labelled outside as “HAZARDOUS WASTE CONTAINER”. • No burning, on-site burying or disposal of solid waste shall occur. • Recyclable materials such as wooden plates for trench works, steel, scaffolding material, site holding, packaging material, etc. shall be collected and separated on-site from other waste sources for reuse, for use as fill, or for sale. • If not removed off site, solid waste or construction debris shall be disposed of only at sites identified and approved by the Construction Supervision Consultant and included in the solid waste plan. Under no circumstances shall the contractor dispose of any material in environmentally sensitive areas, such as in areas of natural habitat or in watercourses. • For hazardous waste such as oil and grease contained cloths, chemical waste, or broken glass, etc. must be collected and stored at the hazardous waste storage area for the specialized company to collect and treat periodically. It is prohibited to mix hazardous waste in domestic waste for treatment. • Recyclable solid waste shall be recycled by the collecting and recycling company. • Used oil and grease shall be removed from site to an approved used oil recycling company. • Used oil, lubricants, cleaning materials, etc. from the maintenance of vehicles and	

Environmental and Social Issues	Mitigation Measures	Vietnamese Technical Regulations
	machinery shall be collected in holding tanks and removed from site by a specialized oil recycling company for disposal at an approved hazardous waste site. • Used oil or oil-contaminated materials that could potentially contain PCBs shall be securely stored to avoid any leakage or affecting workers. The local DONRE must be contacted for further guidance.	
8. Management of dredged materials	• Large quantities of dredged materials, or materials that are contaminated would require mitigation measures not covered in this ECOP and will be included in the site-specific mitigation measures. • Dredging plan should be established including time schedule, method statement to meet the requirements of traffic safety, public health and environmental sanitation. In order to ensure dredging that is consistent with environmental regulations, key decision makers (local authority, DONRE, utility company, CSC, etc.) must be involved and concur in each key decision point in the process leading to preparation and implementation of a plan. • Characteristics of sediment should be determined by sampling and analysis if not already fully evaluated during the EIA. Dredge material that is contaminated would require special mitigation measures. • All dredged materials such as sludge and spoil will be gathered at a sludge control area to dry before being transported to the landfill. It is prohibited to transport wet sludge to prevent leakage to the transportation route. • Ensure that dredged material management plans incorporate environmental considerations in the identification of short-term and long-term disposal alternatives, consider methods to reduce dredging, and maximize the beneficial	• Decree No.59/2007/ND-CP on waste management. • Circular No.36/2015/TT-BTNMT on hazardous waste management.

Environmental and Social Issues	Mitigation Measures	Vietnamese Technical Regulations
	use of dredged materials. • Lixiviate from dredged materials should not be allowed to enter watercourses without appropriate filtering or treatment. • Collected dredged materials have to be processed, as per Vietnamese regulations on waste collection, to ensure safe and environmentally secure transportation, storage, treatment and management. • Those involved in handling of dredged materials should be specialized and be certified. • Sanitary landfill site should meet technical requirements, based on level of potential contamination. In the case of disposal at a dumpsite, a hazardous cell may need to be constructed if dredged material is contaminated by heavy metals.	
9. Disruption of vegetative cover and ecological resources	• The Contractor shall prepare a Clearance, Revegetation and Restoration Management Plan for prior approval by the Construction Engineer, following relevant regulations. The Clearance Plan shall be approved by Construction Supervision Consultant and followed strictly by contractor. Areas to be cleared should be minimized as much as possible. • The Contractor shall remove topsoil from all areas where topsoil will be impacted on by rehabilitation activities, including temporary activities such as storage and stockpiling, etc.; the stripped topsoil shall be stockpiled in areas agreed with the Construction Supervision Consultant for later use in re-vegetation and shall be adequately protected. • The application of chemicals for vegetation clearing is not permitted. • Scope of clearance must be within the allowed boundary. Prohibit expanding to affect surrounding ecosystem and biological resources.	• Law on Environmental Protection No.52/2005/QH11

Environmental and Social Issues	Mitigation Measures	Vietnamese Technical Regulations
	• No area of potential importance as an ecological resource should be disturbed unless there is prior authorization from CSC, who should consult with PMUs, IEMC and the relevant local authorities. This could include areas of breeding or feeding of birds or animals, fish spawning areas, or any area that is protected as a green space. • The Contractor shall ensure that no hunting, trapping shooting, poisoning of fauna takes place.	
10. Traffic management	• Before construction, carry out consultations with local government and community and with traffic police. • Significant increases in number of vehicle trips must be covered in a construction plan previously approved. Routing, especially of heavy vehicles, needs to take into account sensitive sites such as schools, hospitals, and markets. • Installation of lighting at night must be done if this is necessary to ensure safe traffic circulation. • Place signs around the construction areas to facilitate traffic movement, provide directions to various components of the works, and provide safety advice and warning. • Employing safe traffic control measures, including road/rivers/canal signs and flag persons to warn of dangerous conditions. • Avoid material transportation for construction during rush hour. • Passageways for pedestrians and vehicles within and outside construction areas should be segregated and provide for easy, safe, and appropriate access. Signpost shall be installed appropriately in both water-ways and roads where	• Law on Traffic and Transportation No. 23/2008/QH12 • Law on Construction No. 16/2003/QH11 • Law No. 38/2009/QH12 dated 19/6/2009 amending and supplementing a number of articles of the Laws concerning Capital Construction Investment. • Circular No. 22/2010/TT-BXD on regulation of construction safety

Environmental and Social Issues	Mitigation Measures	Vietnamese Technical Regulations
	necessary.	
11. Interruption of utility services	• Planned and unplanned interruptions to water, gas, power, internet services: the Contractor must undertake prior consultation and contingency planning with local authorities about the consequences of a particular service failure or disconnection. • Coordinate with relevant utility providers to establish appropriate construction schedules. • Do not construction in flood season • Provide information to affected households on working schedules as well as planned disruptions (at least 5 days prior to construction). • Interruptions of water supply to agricultural areas must also be avoided. • The contractor should ensure alternative water supply to affected residents in the event of disruptions lasting more than one day. • Any damages to existing utility systems of cable shall be reported to authorities and repaired as soon as possible.	• Decree No.73/2010/ND-CP on administrative penalization security and society issues
12. Restoration of affected areas	• Cleared areas such as borrow pits which are no longer in use, disposal areas, site facilities, workers' camps, stockpiles areas, working platforms and any areas temporarily occupied during construction of the project works shall be restored using landscaping, adequate drainage and revegetation. • Start revegetation at the earliest opportunity. Appropriate local native species of vegetation shall be selected for the planting and restoration of the natural landforms. • Spoil heaps and excavated slopes shall be re-profiled to stable batters, and grassed to prevent erosion;	• Law on Environmental Protection No.52/2005/QH11

Environmental and Social Issues	Mitigation Measures	Vietnamese Technical Regulations
	• All affected areas shall be landscaped and any necessary remedial works shall be undertaken without delay, including green-spacing, roads, bridges and other existing works • Trees shall be planted at exposed land and on slopes to prevent or reduce land collapse and keep stability of slopes • Soil contaminated with chemicals or hazardous substances shall be removed and transported and buried in waste disposal areas. • Restore all damaged road and bridges caused by project activities	
13. Labor and public safety	• Contractor shall comply with all Vietnamese regulations regarding labor safety. • Prepare and implement action plan to cope with risk and emergency • Preparation of emergency aid service at construction site • Equip construction camps and sites with first aid kits • Train workers on occupational safety regulations • If blasting is to be used, additional mitigation measures and safety precautions must be outlined in the EMP. • Ensure that ear pieces are provided to and used by workers who must use noisy machines such as piling, explosion, mixing, etc., for noise control and workers protection. • During demolition of existing infrastructure, workers and the general public must be protected from falling debris by measures such as chutes, traffic control, and use of restricted access zones. • Install fences, barriers, dangerous warning/prohibition site around the construction	• Circular No. 22/2010/TT-BXD on regulation of construction safety • Instruction No. 02 /2008/CT-BXD on safety and sanitation issues in construction agencies • TCVN 5308-91: Technical regulation on safety in construction • Decision No. 96/2008/QD-TTg on clearance of UXO.

Environmental and Social Issues	Mitigation Measures	Vietnamese Technical Regulations
	area which showing potential danger to public people • The contractor shall provide safety measures as installation of fences, barriers warning signs, lighting system against traffic accidents as well as other risk to people and sensitive areas. • If previous assessments indicate there could be unexploded ordnance (UXO), clearance must be done by qualified personnel and as per detailed plans approved by the Construction Engineer.	
14. Communications with local communities	• Maintain open communications with the local government and concerned communities; the contractor shall coordinate with local authorities (leaders of local wards or communes, leader of villages) for agreed schedules of construction activities at areas nearby sensitive places or at sensitive times (e.g., religious festival days). • Copies in Vietnamese of this ECOP and other relevant environmental safeguard documents are made available to local communities and to workers at the site. • Loss of amenities during the construction process is often an unavoidable source of inconvenience to users in sensitive areas. However, early consultation with those affected, provides the opportunity to investigate and implement alternatives. • Disseminate project information to affected parties (for example local authority, enterprises and affected households, etc.) through community meetings before construction commencement; • Provide a community relations contact from whom interested parties can receive information on site activities, project status and project implementation results; • Provide all information, especially technical findings, in a language that is understandable to the general public and in a form of useful to interested citizens	• Decree No.73/2010/ND-CP on administrative penalization security and society issues

Environmental and Social Issues	Mitigation Measures	Vietnamese Technical Regulations
	and elected officials through the preparation of fact sheets and news release, when major findings become available during project phase; • Monitor community concerns and information requirements as the project progresses; • Respond to telephone inquiries and written correspondence in a timely and accurate manner; • Inform local residents about construction and work schedules, interruption of services, traffic detour routes and provisional bus routes, blasting and demolition, as appropriate; • Provide technical documents and drawings to PC's community, especially a sketch of the construction area and the EMP of the construction site; • Notification boards shall be erected at all construction sites providing information about the project, as well as contact information about the site managers, environmental staff, health and safety staff, telephone numbers and other contact information so that any affected people can have the channel to voice their concerns and suggestions.	
15. Chance find procedures	If the Contractor discovers archeological sites, historical sites, remains and objects, including graveyards and/or individual graves during excavation or construction, the Contractor shall: • Stop the construction activities in the area of the chance find; • Delineate the discovered site or area; • Secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be arranged until the responsible local authorities or the Department of Culture and Information	• Law on Cultural Heritage No. 28/2001/QH10 • Law on Cultural Heritage No. 32/2009/QH12 for supplementary and adjustment.

Environmental and Social Issues	Mitigation Measures	Vietnamese Technical Regulations
	takes over; • Notify the Construction Supervision Consultant who in turn will notify responsible local or national authorities in charge of the Cultural Property of Viet Nam (within 24 hours or less); • Relevant local or national authorities would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the findings to be performed. The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; those include the aesthetic, historic, scientific or research, social and economic values; • Decisions on how to handle the finding shall be taken by the responsible authorities. This could include changes in the layout (such as when finding an irremovable remain of cultural or archeological importance) conservation, preservation, restoration and salvage; • If the cultural sites and/or relics are of high value and site preservation is recommended by the professionals and required by the cultural relics authority, the Project's Owner will need to make necessary design changes to accommodate the request and preserve the site; • Decisions concerning the management of the finding shall be communicated in writing by relevant authorities; • Construction works could resume only after permission is granted from the responsible local authorities concerning safeguard of the heritage.	• Decree No. 98/2010/ND-CP for supplementary and adjustment.

7.2.2. Site-specific EMP

The following table presents site-specific impacts and mitigation measures that are not fully addressed through the application of ECOPs. This may be because the impact is not a typical one and is not included in the ECOPs, because the severity of the impact goes beyond the scope of the mitigation measures in the ECOPs, or because simply of the very specific nature of the mitigation measure that is needed.

7.2.2.1. Site-specific impact and mitigation measures for Component 1 - Basin B

Table 73. Site-specific impacts and mitigation measures

Component 1- Flood Risk Management - Basin B	
Sub-component 1. Construction of pumping stations, approach and discharge canals.	
Pre-construction	
Impact:	✓ Land acquisition and resettlement (Permanent land acquisition area is 199,24ha with 352 AHs; temporary land acquisition area is 20,01ha with 178 AHs). ✓ UXO risk
Mitigation:	✓ Implementation of approved RP in accordance with its provisions ✓ The UXO remove activities need to complete before starting construction activities, the several step should follow during UXO remove: - Coordinate with the appropriate agencies at the design stage to identify if UXO is a potential threat to works; - Based on the findings, PMU will sign contact with an authorized agency for removing UXO;
Implementation mechanisms:	Approved RAP Plan for UXO clearance
Responsibility:	PMU
Fund source:	Province’s counterpart fund
Monitoring:	Independent Monitoring Consultant (IMC)
Construction	
Impact:	• local flooding, • impacts on the surrounding irrigation system, • improper disposal of excavated materials (156,734.00 m^3 in Kim

	Xa; 845,467.36 m^3 in Ngu Kien and 1,094,900 m^3 in Nguyet Duc) • landslide and subsidence risk, impacts on the quality of agricultural soil
Mitigation:	✓ To mitigate risks of landslide during the construction, surveying the geology and hydrology in the area needs to be implemented seriously and precisely; simultaneously it is necessary to have specific construction measures to prevent the subsidence/landslide in the positions constructed the pumping station and along the canals. ✓ During detailed design, PMU will ensure that detailed design will provide installation of temporary and permanent drainage to avoid potential flooding, disruption to the irrigation system in project site during construction and operation. ✓ When dredging the topsoil layer for construction, the contractors will make use of good-quality dredged materials for backfilling. Only bad quality materials will be transported to the designated disposal site. ✓ It is necessary to check the contamination level of the dredged materials; if the concentrations of substances in the materials (especially heavy metals) are higher than permitted limitations as stipulated in the environmental technical regulations, these materials will be disposed only at Dong Mong disposal site according to the designated cells (the bottom layer covered with waterproof HDPE membrane) ✓ The construction activities should avoid harvest period in the area in order to minimize social and traffic impacts. ✓ In case the construction activities cause damages or degradation to the traffic roads, including inter-field pathways, the contractors must repair and restore in a timely manner not to affect the local residents
Implementation mechanisms:	Contract conditions, supplementing those of the ECOP
Responsibility:	Contractor/Detailed Design Consultant
Fund source:	WB Credit
Monitoring:	Construction Supervision Consultant/PMU
Operation	
Impact:	✓ Impact the flood drainage in Red River basin due to the establishment of discharge canal crossing over the area outside the dyke

	✓ Impact on aquatic ecosystem due to the pumping machine operation ✓ Risk of canal bank erosion of approaching canals, discharging canals and pumping station construction works ✓ Impacts on the hydraulic regime in the downstream area ✓ Affect the safety of local people (especially children) and some minor impacts on the aquatic organisms.
Mitigation:	✓ Ensure the discharging canal's elevation is not higher than the dyke's elevation ✓ The operation of the pumping stations as well as other headwork of the stations must adhere strictly to the prescribed procedures. Pumps and equipment in the pumping stations should be maintained regularly; approaching canals, discharging canals, inlet tanks, and discharge tanks in the pumping station area must be dredged regularly to prevent clogging, thus affects the drainage function of the project. ✓ The workers operating the pumping stations must undergo careful and intensive training. ✓ Entrance gates of the pumping stations must be built to ensure that those who are not relevant will not enter. ✓ Iron fence should be placed surrounding the inlet tank to ensure safety for people. In addition to the iron fence, a net of maximum 3x3 cm will also be arranged to prevent aquatic species as well as other substances in the water from being sucked into the pump, causing death of the species or damage to the pump. ✓ At the regulation lakes in front of the pump stations as well as inlet and discharging canals, there should be warning signs of the depth and safety for people. ✓ It is prohibited to put fish or other aquatic species into the inlet and discharging canals of the pumping stations. ✓ Regular monitor and check at the areas having the risks of landslides such as the approaching canals, discharging canals and other structures to find out in time positions having the risks and have timely solutions.
Implementation mechanisms:	detailed design, city
Responsibility:	Contractor/Detailed Design Consultant
Fund source:	Provincial budget
Monitoring:	Operation Management Unit, Department of Agricultural and Rural Development, Provincial Flood Prevention and Control Committee

Component 1- Flood Risk Management - Basin B	
Subproject 1.2. Rehabilitation of Phan River and structures on the river	
Pre-construction	
Impact:	✓ Land acquisition and resettlement (Permanent land acquisition area is 51.08 ha with 451 AHs; temporary land acquisition area is 15.5 ha with 60 AHs). ✓ UXO clearance
Mitigation:	✓ Implementation of approved RP in accordance with its provisions ✓ Working with specialized unit to perform UXO clearance in the entire construction area
Implementation mechanisms:	Approved RP Plan for UXO clearance
Responsibility:	PMU
Fund source:	Province's counterpart fund
Monitoring:	Independent Monitoring Consultant (IMC)
Construction	
Impact:	✓ Risk of erosion at river banks and local flooding in construction sites ✓ Impact the surrounding residential areas where are crowded in the construction area such as Tho Tang, Huong Canh, Te Lo, etc. or traffic disruption during the construction crossing the river (bridges of Lung Hoa, Dong Ve, Vinh Son, Yen Nhien, Van Xuan, Dong Lac and Tranh) ✓ Impacts on river ecosystems ✓ Impacts from dredged material on surrounding environment and landscape, along transportation routes and at Dong Mong and Kim Xa disposal sites. ✓ Ambient air impacts by odors and gases (CH_4, H_2S etc.) from river sludge ✓ Quality of Phan River water will be decreased without raising people's awareness in protecting the basin; especially prohibit disposing waste into the river. ✓ An estimated 8 households who currently do fishing in part of the Phan River. ✓ Impacts to water quality, aquatic life and downstream users
Mitigation:	✓ Careful geological and hydrological surveying at Basin Before constructing and the construction has no specific constructing measures to prevent the risks of landslide and flood ✓ The construction must only be carried out in dry season, not in

	the rainy season. ✓ It is necessary to have alternative measures such as diversion to ensure drainage and avoid flooding; simultaneously, ensure the aquatic species' movement. ✓ With the length of dredging river is 48,6km; the dredging must be divergent by different phases to mitigate impacts on the water ecosystem. ✓ At the construction positions having structures on the river such as bridges namely Nam Lung, Dong Ve, Vinh Son, Yen Nhien, Van Xuan, Dong Lac and Tranh in Trung Nguyen commune; before constructing, there should be mitigation measures of impacts on people's transportation; for example, building temporary bridge, closely cooperate with the local government etc.etc. ✓ It is necessary to analyze further the content of organic substance as well as heavy metal such as Cu, Zn, As, Pb and Cd of the dredging materials, before constructing, to form the basis to assess objectively and have appropriate solutions for management of the dredging materials. If the analysis result shows that the content of organic substances and analyzed heavy metal is still higher than QCVN 03:2008/BTNMT, this dredging materials will be disposed to the designated cells in Dong Mong disposal which are waterproofed by HDPE geomembrane (This disposal is designated to be an urban area). Lastly, the materials which the analysis shows that their content of substances lower than the technical regulations may be disposed into either disposal sites (Dong Mong and Kim Xa) or may be reused as construction materials (if applicable). ✓ The dredging materials must be dry before being carried to the landfill. It is prohibited to carry wet mud when dredging which will spill over the road. ✓ Equip worker with adequate labour protection equipment when dredging. ✓ Fix and repair in time construction works damaged or degraded by the project. ✓ The contractor and project owner which is VP ODA-PMU need to cooperate closely with the local authorities of construction areas to implement the propaganda to let people understand and participate to monitor and cooperate during the construction. ✓ Impact on fishing (temporary) will be assessed prior to dredging when the detailed dredging methods are proposed on the basis of detailed design. Temporary impact on fishing will be compensated for as per RPF (See section 3.2.2 of RPF for details). ✓ To mitigate the impact to water quality, aquatic life and downstream users, following measures shall be applied: (i) the dredging process will be carried out in successively in section, with the application sheet piles surrounding each section to

	prevent the impact to other surrounding sections/area; (ii) Dredging activity shall only be carried out in dry season; (iii) stream diversion will be carried out to ensure that the flow is not being disrupted.
Implementation mechanisms:	Contract conditions, supplementing those of the ECOP, RAP to be prepared during implementation.
Responsibility:	Contractor/Detailed Design Consultant PMU (for RAP).
Fund source:	WB Credit
Monitoring:	Construction Supervision Consultant/PMU
Operation	
Impact:	✓ Risk of river bank erosion ✓ Organic accumulation at the bottom of the river decreases the water quality and water drainage capacity as well as increases the greenhouse gases risen from sediment in the river and emitted to the environment when possible ✓ Phan River water quality will be decreased without increasing people's awareness in protecting the basin; especially it is prohibited to dispose waste into the river
Mitigation	✓ Regular check along the river banks, especially critical positions; if finding out the risk of landslide or sedimentation in the riverbed, it is necessary to inform the local authority, operation and management unit of the basin immediately to have timely solutions. ✓ Regular check the flooding warning and Phan River water quality warning systems ✓ Educate and raise awareness of environmental protection for people alongside the basin
Implementation mechanisms:	Plan for operating the pumping station, canals, discharge canals is regulat ed by PPC/DARD
Responsibility:	Operation Management Unit
Fund source:	Provincial budget
Monitoring:	PPC/DARD

Component 1: Flood Risk Management - Basin B	
Sub-component 1.3. Rehabilitation and dredging of lakes (Rung, Nhi Hoang, and S Su Vo lakes)	
Pre-construction	
Impact:	✓ Land acquisition and resettlement (Permanent land acquisition area

	is 51.08 ha with 451 AHs; temporary land acquisition area is 15.5ha with 60 AHs). ✓ UXO clearance
Mitigation:	✓ Implementation of approved RP in accordance with its provisions ✓ Cooperate with specialized units to perform UXO clearing in the entire construction area
Implementation mechanisms:	Approved RAP Plan for UXO clearance
Responsibility:	PMU
Fund source:	Province's counterpart fund
Monitoring:	Independent Monitoring Consultant (IMC)
Construction	
Impact:	✓ The dredging materials impact the environment. Because the dredging materials are sedimentary mud accumulated in submerged conditions, they often contain organic substances and other toxic substances. Therefore, they could impact the disposal environment without appropriate management and treatment. ✓ The mud dredging will give the chances for some greenhouse gases such as CH_4, H_2S and the odor accumulated in the mud to emit, impacting the air environment and people's health, especially workers working in the construction area. ✓ Affect the water ecosystem in the lake due to the dredging process ✓ Transport dredging wastes, especially the surface mud, may impact the environment and scenery of the construction area, cause risks of traffic safety and health problems for the people and degradation to road infrastructure. ✓ With large amount of dredging materials, it likely has a risk of landslides at the lake bank during the dredging, affecting the construction quality as well as causing other social problems. ✓ Temporary impacts aquaculture (an estimated 132 households [180ha] at three lakes) and fishing (rivers) ✓ impacts to water quality, aquatic life and downstream users,
Mitigation	✓ Check further pollution of the dredging materials and manage them like in Phan River basin ✓ Around the lake, it is possible to grow trees to both have scenery and decrease pollution in terms of odor, dust and emissions raised during the construction work. ✓ Develop detailed plan and construction measures ✓ Inform people to cultivate products in the lake before the construction ✓ To avoid impacts on the water ecosystem in the lake, the dredging should be implemented part by part and the dredging area needs to be surrounded closely by fences to ensure the dredging and other construction materials do not spill around, avoid the impacts on

	scenery, ecosystem and biodiversity of the area. ✓ The dredging materials need to be dry before being moved out of the construction area to avoid leaking/falling out alongside the transportation road. ✓ The construction needs to avoid the rainy season to mitigate risks of flooding as well as impact the lake's drainage process. ✓ Impact on aquaculture (temporary) will be compensated as per lake area contract and compensated as per RPF for temporary loss of income (See section 3.2.2 of RPF for details). ✓ Impact on fishing (temporary) will be assessed (including primary production) prior to dredging when the detailed dredging methods are proposed on the basis of detailed design. Temporary impact on fishing will be compensated for as per RPF (See section 3.2.2 of RPF for details). ✓ To mitigate the impacts to water quality, aquatic life and downstream users, following measures shall be applied: (i) the dredging process will be carried out in successively in section, with the application sheet piles surrounding each section to prevent the impact to other surrounding sections/area; (ii) Dredging activity shall only be carried out in dry season
Implementation mechanism	Approved RAP
Responsibility:	Contractor/Detailed Design Consultant/Geological and hydrological surv eying unit PMU responsible for carrying out RAP
Fund source:	WB Credit
Monitoring:	Construction Supervision Consultant/PMU
Operation	
Impact:	✓ Sedimentation in lakes over time ✓ Affecting air quality due to accumulation of organic materials in the sediments ✓ Erosion of lakeshore if not managed and monitored appropriately. ✓ Affect flood control function without operation and maintenance as prescribed. ✓ Affect the safety of local people (especially children) and some minor impacts on the aquatic organisms. ✓ Organic accumulation in the lake
Mitigation:	✓ Before each rainy season, DARD or the lake management unit needs to check the water amount in the lake and calculate the water containing and regulatory capacity carefully to improve the capacity of flooding control for Phan River basin and other waters ✓ Check and monitor the organic materials/soil and sand sedimentation, if they are much, it is necessary to dredge to ensure the containing and regulatory capacity of the lake as well as mitigate arising emissions such as CH4, HsS, etc. risen from the decomposition of organic substances in the sediment. ✓ It is essential to put warning signs of the lake depth and prohibition

	of people's swimming in the lake around it. ✓ It is prohibited to put duckweed and some other aquatic vegetation in the lake. ✓ The operation of the pumping stations as well as other headwork of the stations must adhere strictly to the prescribed procedures. Pumps and equipment in the pumping stations should be maintained regularly; approaching canals, discharging canals, inlet tanks, and discharge tanks in the pumping station area must be dredged regularly to prevent clogging, thus affects the drainage function of the project. ✓ Entrance gates of the pumping stations must be built to ensure that those who are not relevant will not enter. ✓ Iron fence should be placed surrounding the inlet tank to ensure safety for people. In addition to the iron fence, a net will also be arranged to prevent aquatic species as well as other substances in the water from being sucked into the pump, causing death of the species or damage to the pump. ✓ The workers operating the pumping stations must undergo careful and intensive training. ✓ At the regulation lakes in front of the pump stations as well as inlet and discharging canals, there should be warning signs of the depth and safety for people. ✓ It is prohibited to put fish or other aquatic species into the inlet and discharging canals of the pumping stations.
Implementation mechanisms:	Plan for operating the pumping station, canals, discharge canals is regulated by PPC/DARD
Responsibility:	Operation Management Unit
Fund source:	Provincial budget
Monitoring:	Operation Management Unit, Department of Agricultural and Rural Development, Provincial Flood Prevention and Control Committee

Component 1- Flood Risk Management - Basin B	
Sub-project 1.4. Disposal sites	
Pre-construction	
Impact:	✓ Land acquisition and resettlement (Permanent land acquisition area is 76.21 ha with 605 AHs; temporary land acquisition area is 7 ha with 97 AHs). ✓ There are several graveyards that will be relocated at Dong Mong disposal site. As the cemetery area was being flooded during the survey period; therefore, it was impossible to observe. According to Project Affected People (Aps), many graves had been buried and several of which was unidentified. ✓ UXO clearance

Mitigation:	✓ Implementation of approved RP in accordance with its provisions ✓ During the detailed measuresment survey (DMS) process during implementation period, these impacts will be identified and compensated for land, displacement and reburial of graves. These compensation costs are mentioned in the policy framework prepared for the project and with the compensation and assistance principles established in this RAP, particularly the entitlement matrix in the Appendix 1 of the RAP. ✓ Cooperate with specialized units to perform UXO clearing in the entire construction area
Implementation mechanisms:	Approved RAP Plan for UXO clearance
Responsibility:	PMU
Fund source:	Province’s counterpart fund
Monitoring:	Independent Monitoring Consultant (IMC)
Construction	
Impact:	✓ Capacity of the disposal site: total capacity of the two designated disposal sites will be 1,693,300 m, total quantity of the materials needed to be disposed is 1,393,426 m ✓ Impact flood drainage capacity of Pho Day River at Kim Xa disposal site. ✓ Impact the surrounding areas’ scenery and environment from by odors and gases generated by dredged sludge ✓ Soil erosion and land subsidence of Dong Mong site during the material disposal
Mitigation	✓ To avoid impacts on environment of the disposal area, during the dredging, the materials which are reusable to cover the site or reusable as construction materials needed to be made the most of. Only materials which are not reusable because of their structure or because they contain pollutants (after being analyzed) will be moved to the landfill. ✓ Before dredging, the materials need to be analyzed of environmental parameters (including content of organic substances and some heavy metals), if the content of organic substances is high and that of some heavy metals exceed permitted technical regulations according to QCVN 03:2008/BTNMT for agricultural land, this material will only be disposed into the designated cells with HDPE membrance in Dong Mong disposal site. ✓ The disposal sites large as Dong Mong is divided into cells, only filling another cell only after one cell is full. A full cell needs to be compacted carefully to avoid impacts on the local environment. Particularly, Dong Mong disposal site needs designation of some cells with HDPE membrane to contain dredging materials having high content of organic substances and content of heavy metals exceeding QCVN 03:2008/BTNMT for agricultural land. ✓ Because the disposal sites are out of the surrounding dyke, the consolidation of the surrounding bank by rock embankment

	cannot be implemented. However, this surrounding bank can be consolidated by soil bank with good structure, ensuring keeping disposal materials of not being washed out by flood. ✓ Regarding Kim Xa disposal site, to mitigate impacts on Pho Day River discharge the filled material should be well compacted. ✓ To prevent the soil erosion and land subsidence risk at Dong Mong disposal site, the site will be divided into 13 cells and material will be fiflled in succucessively in each cell. During the disposal process, the cell will be compacted carefully and soil embankment surrounding each cell to prevent soil erosion.
Implementation mechanisms:	Detailed design, contract conditions, supplementing those of the ECOPs
Responsibility:	Contractor/Detailed Design Consultant
Fund source:	WB Credit
Monitoring:	Supervision Consultant/PMU
Operation	
Impact:	✓ Affect flood control function without operation and maintenance as prescribed. ✓ Affect the safety of local people (especially children) and some minor impacts on aquatic species. ✓ When these sites are created they are likely to be used by local people as domestic dumpsite and waste from other construction works nearby. This will lead to the degradation of local landscape and environment
Mitigation	✓ The operation of the pumping stations as well as other headwork of the stations must adhere strictly to the prescribed procedures. Pumps and equipment in the pumping stations should be maintained regularly; approaching canals, discharging canals, inlet tanks, and discharge tanks in the pumping station area must be dredged regularly to prevent clogging, thus affects the drainage function of the project. ✓ Entrance gates of the pumping stations must be built to ensure that those who are not relevant will not enter. ✓ Iron fence should be placed surrounding the inlet tank to ensure safety for people. In addition to the iron fence, a net will also be arranged to prevent aquatic species as well as other substances in the water from being sucked into the pump, causing death of the species or damage to the pump. ✓ The workers operating the pumping stations must undergo careful and intensive training. ✓ At the regulation lakes in front of the pump stations as well as inlet and discharging canals, there should be warning signs of the depth and safety for people. ✓ It is prohibited to put fish or other aquatic species into the inlet and discharging canals of the pumping stations.
Implementation mechanisms:	Plan for operating the pumping station, canals, discharge canals is regulat ed by PPC/DARD

Responsibility:	Operation Management Unit
Fund source:	Provincial budget

7.2.2.2. Site-specific impact and mitigation measures for Component 1 - Basin C

Component 1. Dredging river network in Binh Xuyen and control gates - Basin C	
Pre-construction	
Impact:	✓ Land acquisition and resettlement (Permanent land acquisition area is 18.58ha with 110 AHs; temporary land acquisition area is 11hawith 120 AHs). ✓ UXO clearance
Mitigation:	✓ Implementation of approved RP in accordance with its provisions ✓ Cooperate with specialized units to perform UXO clearing in the entire construction area
Implementation mechanisms:	Approved RP Plan for UXO clearance
Responsibility:	PMU
Fund source:	Province's counterpart fund
Monitoring:	Independent Monitoring Consultant (IMC)
Construction	
Impact:	✓ Impacts of this Basin are similar to the dredging and building the structures on Phan River in Basin B of this report including e.g. risk of erosion along river banks and at embankment locations, local flooding etc. Moreover, sufficient attention should be paid to the capacity and safety of Xa Huong dam. ✓ Temporary impact (estimated 7 households) on fishing during dredging. ✓ impacts to water quality, aquatic life and downstream users,
Mitigation:	Beside mitigation measures as mentioned in subproject: dredging Phan River and building structures on it. Impact on fishing (temporary) will be assessed prior to dredging when the detailed dredging methods are proposed on the basis of detailed design. Temporary impact on fishing will be compensated for as per RPF (See section 3.2.2 of RPF for details). ✓ To mitigate the impacts to water quality, aquatic life and downstream users, following measures shall be applied: (i) the dredging process will be carried out in successively in section, with the application sheet piles surrounding each section to prevent the impact to other surrounding sections/area; (ii) Dredging activity shall only be carried out in dry season; (iii) stream diversion will be carried out to ensure that the flow is not being disrupted.
Implementation	Contract conditions, supplementing those of the ECOP

mechanism:	RAP for Binh Xuyen
Responsibility:	Contractor/Detailed Design Consultant
Fund source:	WB Credit
Monitoring:	Construction Supervision Consultant/PMU
Operation	
Impact:	✓ Main impacts related to sedimentation and erosion of riverbed, affecting drainage function. ✓ Landscape and environment will be degraded overtime if they are not managed and protected properly.
Mitigation:	✓ Every year, DARD or management unit should check the flow and drainage capacity, sedimentation level of the riverbed, and erosion level of river banks to ensure drainage capacity during rainy season. When detecting significant deposition of organic materials/soil and sand sediments and erosion of river banks, it is necessary to conduct dredging and embankment immediately. ✓ Increase education and communications to increase people's awareness of environmental protection in Phan River basin and other rivers. ✓ Prohibit throwing domestic waste and other solid waste into the river banks. ✓ Growing water-fern as well as aquatic species in the rivers is forbidden in order to ensure drainage. ✓
Implementation mechanism:	Detailed design, contract conditions, supplementing those of the ECOP
Responsibility:	Contractor/Detailed Design Consultant
Fund source:	WB Credit
Monitoring:	Construction Supervision Consultant/PMU

7.2.2.3. Site-specific impact and mitigation measures for Component 2

Table 74. Typical environmental impacts and mitigation measures

Component 2- Water Environmental Management	
Construction of structures to gather and WWTPs for 4 towns and 33 dispersed residential areas	
Pre-construction	
Impact:	✓ Land acquisition and resettlement (Permanent land acquisition area is 15.042ha with 116 AHs; temporary land acquisition area is 1.504ha with 22 AHs). ✓ UXO clearance

Mitigation:	✓ Implementation of approved RP in accordance with its provisions ✓ Cooperate with specialized units to perform UXO clearing in the entire construction area
Implementation mechanism:	Approved RP Plan for UXO clearance
Responsibility:	PMU
Fund source:	Province’s counterpart fund
Monitoring:	Independent Monitoring Consultant (IMC)
Construction	
Impact:	✓ The risk of erosion at the construction sites of WWTPs ✓ Transportation of the dredging waste, especially surface mud in projected treatment station positions which are stagnant ponds (no water circulation) may impact the environment and scenery of the construction area, transportation road and also the landfill. ✓ Local flooding, affecting the surrounding irrigation system as well as quality of agricultural land in the area.
Mitigation:	✓ Develop plan and construction measures specifically and in details, which have details in dredging methodology, plan and route of transport to the landfill, particularly when constructing the waste water treatment stations for the four towns. ✓ It is necessary to have specific construction measures, flooding prevention options during the construction, and diversion measure to ensure drainage in the area. - When constructing the waste water gathering network, it is essential to environmentally restore each route after finishing construction on it. ✓ Make use of appropriate dredged materials for filling in the construction work or others. The remaining will be transported to the designated landfill. ✓ The dredging materials need to be dry before being moved out of the construction area to avoid leaking/falling out alongside the transportation road.- Check the contamination level of the dredged materials; if the concentrations of substances in the materials (especially heavy metals) are higher than permitted limitations as stipulated in the environmental technical regulations, these materials will be disposed only at Dong Mong disposal site according to the designated cells (the bottom layer covered with waterproof HDPE membrane) ✓ The construction needs to avoid rainy season to mitigate the drainage and prevent flood in the area. ✓ Avoid/restrict construction during harvest period of people in the area.
Implementation mechanism:	Contract conditions, supplementing those of the ECOP
Responsibility:	Contractor/Detailed Design Consultant
Fund source:	WB Credit
Monitoring:	Construction Supervision Consultant/PMU
Operation	
Impact:	✓ Possibility of occasional wastewater discharges below specified quality standards; issues related to odors and sludge from the treatment process or incidents related to operation and management of the WWTPs. ✓ Impacts of odor and gases from sludge waste in WWTPs
Mitigation:	✓ Ensure that the contract for construction of the WWTPs includes provision of operations manual and training operators in the plant’s

	operations and maintenance. ✓ The operation staff of the WWTPs must receive periodic training on the operation of the plants. ✓ Ensure that the operations manual includes a regime of testing of: (i) discharge from the plant; (ii) sludge produced by the plant; and (iii) ambient air and water quality in the immediate vicinity of the plant. ✓ Ensure that detailed designs for the plant include tree planting and other means to isolate the plant from the surrounding residential area ✓ Ensure that the operations manual contains a procedure for emergency discharge in the event of plant breakdown, and that the procedure is communicated to downstream residents and local authorities tasked with managing emergencies of such nature ✓ Ensure that the operations manual includes a procedure for safely handling sludge from the plant. The ODA-PMU must develop and hand over to the management unit when the WWTPs come into operation to implement sludge management plan, including deposit of sludge in the tank and sludge in the temporary storage area in the plants (if any). ✓ Contract with specialized company to periodically collect and transport sludge for treatment (collection time depends on actual amount of produced sludge). ✓ Use sludge waste as organic fertilizer for soil revitalization after treated with drying and adding microorganisms. Or it can be transported to other WWTPs in Quat Luu and Lung Hoa for example to supplement microorganism during treatment. ✓ Regularly dredge and augment the wastewater collection system to ensure drainage of wastewater to the plants. In addition, the discharge system behind the plants should also be cleared regularly.
Implementation mechanism:	Loan agreement, Plan for operating pumping station, approaching canals and discharging canals regulated by PPC/DARD
Responsibility:	Construction Operation and Management Unit
Fund source:	Provincial budget
Monitoring:	Operation and Management Unit, DARD, district divisions of agriculture, Provincial Flooding Prevention and Control Committee

The scope of the technical assistance would also include assisting the PMU's environmental staff with the review of contract documents on the bidding packages for construction items of the project to ensure compliance with environmental safeguard policies and impact mitigation and monitoring requirements as well as provide general environmental guidance as requested by the PMU to enhance overall project implementation and performance. Given the nature, locations, and scale of construction, it is anticipated that the safeguard technical assistance support and training will be provided at least during the first 3 years of the project implementation. The WB safeguard specialists will participate in the capacity building in particular in the training activities as appropriate.

7.2.2.4. General Emergency Preparedness and Response Plan

Applicable Standards

The applicable reporting requirements are as follows:

1. Law on Work Health and Safety, 84/2015/QH13 dated 25 June 2015
2. Joint Circular No. 01/2011/TTLT-BLDTBXH-BYT of January 10, 2011 of MoLISA and MoH on guiding the organization of labor safety and sanitation work in labor-employing establishments; and
3. Circular No. 19/2011/TT-BYT of June 6, 2011 of MoH on guiding the management of labor hygiene, laborers' health and occupational diseases.

Roles and Responsibilities

All workers and visitors:

- Understand and comply with the provisions set out in this plan;
- Have a working mobile phone with him/her, or be accompanied by someone who has a working mobile phone; and
- Report all emergencies to the Contractor General Manager on-site.

Contractor General Manager:

- Ensure all personnel on-site understand the requirements and responsibilities in emergency response;
- Organise and facilitate emergency drills;
- Act as a first point of notification in case of an emergency;
- Implement and co-ordinate immediate emergency response with available resources;
- Notify the PMU Health, Safety and Environmental (HSE) Manager of the emergency status as required by the communication protocol;
- Ensure all personnel are accounted for and moved to a place of safety in emergency cases; and
- Ensure that suitable and sufficient equipment for emergency response is available, is fit for purpose and maintained.

HSE Management and Monitoring Officer:

- Monitor and evaluate the effectiveness of the response.

PMU environmental staff

- Arrange resources within PMU to support emergency response, when necessary;
- Liaise with external resources (e.g. local government, police, etc.) for support, when necessary;
- Monitor and evaluate the effectiveness of the response; and
- Make briefings to PMU management on incident and response status.

c. Assembly Point

If directed to perform evacuation by the Contractor Supervisor - Workers, proceed to the assembly point next to the site office (to be identified following determination of site office location).

d. Emergency Procedures

Vehicle Accidents

Vehicle accidents may include, but are not limited to:

- Vehicle roll-over; and
- Vehicle crash with another vehicle, structure or with a person (worker or person from the local community).

Procedure:

- Stop work immediately;
- Turn off the vehicle, if possible;
- Have passengers of the vehicle(s) exit the vehicle and move to a safe place, if possible;
- If there is an injury, follow the procedure for medical emergencies (see below); and
- If there is a fuel/chemical spill, follow the procedure for spill emergency (see below).

Adverse Weather

Potential adverse weather events include, but are not limited to:

- Heavy rain;
- Strong wind; or
- Typhoon
- Severe flood

The potential for earthquake and tsunami happening at the site is considered unlikely.

Procedure:

The Contractor General Manager will check the national and local weather forecast each morning prior to work commencing. Should adverse weather be predicted, depending on the severity and timing of the weather expected. If adverse weather is expected to be serious, lengthy and soon (e.g. in the case of a typhoon or flood), the Contractor General Manager shall contact all workers to not come to work. If the weather is less serious and is not expected to last long, the Contractor Supervisor - Workers will cover this situation during the daily toolbox talk, continue to monitor the weather situation throughout the day and issue instructions as necessary to stop work, make their worksites safe, and find a safe sheltering location (either back at the site office, if sufficient time to return, or locally to the active works (in the case of the latter, the worker shall call the Contractor Supervisor – Workers to inform them where and when they are in the sheltering location). If the Contractor Supervisor – Workers does not hear from a worker(s) within 15 minutes of instruction to shelter, the Contractor Supervisor – Workers shall mobilise to the location by any possible vehicle to ensure the safety of the worker(s).

Chemical/Fuel Spill

A spill of chemical/fuel has the potential to cause soil and groundwater contamination, if not controlled and cleaned up timely and properly. Chemical/fuel spills include, but are not limited to, the following:

- Fuel spill during refuelling;
- Fuel/oil/grease leaks during vehicle parking or operating; and
- Breaking of fuel tanks on vehicles.

Spill response facilities: A spill kit shall be provided on each heavy equipment (bulldozers and excavators), in the HW and hazardous materials storage areas, and in any designated fuelling locations. A spill kit includes a drip tray, absorbent materials, and impermeable bags to collect contaminated soil and used absorbent materials, and a small spade used for collecting contaminated soil.

Procedure:

- When there is a spill, immediately use the absorbent materials to absorb the spilled materials and locate the drip tray to collect the spilled flow (if the spill continues);
- Collect the used absorbent materials into an impermeable bag;
- Use the spade to collect the contaminated soil into the impermeable bag; note that there should be no contaminated soil left (stained soil must be collected to the full horizontal and vertical depth of the impact);
- Transfer the filled impermeable bag to the Hazardous Waste Storage Area for storage;
- If the spill is larger than one spill kit or person can handle, request another worker to support (e.g. to bring more spill kits);
- Use work gloves, safety glasses, long sleeved tops and trousers during the above response process and minimise direct contact with the spilled fuel/oil; and
- At and around the location of release, samples shall be taken to confirm whether any contaminated soil/groundwater remains. The number of samples will depend on the scale of the release and the estimated impacted area. The parameters to be analysed will depend on the substance released. Depths where samples are to be taken should be at ground surface and immediately above groundwater table. These should be identified in a sampling plan prepared by the HSE Management and Monitoring Office in consultation with appropriately qualified technical staff. Response to any remaining contamination should be defined accordingly.

Sanitary Effluent Spill

A spill of sanitary effluent has the potential to cause surface water, soil and groundwater contamination and nuisance/health hazard to nearby households, if not controlled and cleaned up timely and properly. Sanitary effluent spills can occur during emptying and transportation of effluent from septic tanks being demolished on site.

Spill response facilities: A spill kit shall be provided on each septic tank collection truck. A spill kit includes impermeable bags to collect contaminated soil and a small spade used for collecting contaminated soil.

Procedure:

- When there is a spill, immediately stop the flow;
- Use the spade to collect the contaminated soil into the impermeable bag; note that there should be no contaminated soil left (contaminated soil must be collected to the full horizontal and vertical depth of the impact);
- Transfer the filled impermeable bag to the Waste Storage Area for storage;
- If the spill is larger than one spill kit or person can handle, request another worker to support (e.g. to bring more spill kits);
- Use work gloves, safety glasses, long sleeved tops and trousers during the above response process and minimise direct contact with the spilled effluent.

Electrocution Due to Electrical Cable Collision

While the works are undertaken within a 10m radius of electrical cables and poles is prohibited, electrocution may happen as the result of:

- Collision with power cables and poles;
- Take down of cable poles; and
- Hitting underground cables.

Procedure:

When an electrocution occurs:

- Stop work immediately;
- Isolate the power source, if possible and safe to do so (e.g. using a non-conductive rod to detach cables);
- If there is an injury/medical need, follow the procedure for medical emergencies (see below); and
- Contractor HSE Manager will inform EVN for further action (e.g. stopping power and conduct repair), coordinate authority inspection and facilitate the interface with authorities/media, if required.

Medical Emergency

A medical emergency is a situation in which, due to an acute illness or injury, there is an immediate risk to a person's life or long-term health. Medical emergencies include, but are not limited to, the following:

- Injuries from vehicle accidents;
- Wildlife attacks, e.g. snake bites or bees attack;
- Heat stress;
- Electrocution; and
- Unexploded-ordnance incidents.

Procedure:

- Report the injury to the First Aider, stating your name, location, nature of emergency and assistance required;
- Where safe to do so, stay in the location until assistance arrives;
- The First Aider will co-ordinate first aid response; the First Aider can give first aid as far as they are capable. If further medical attention is required, then the injured shall be transferred to the nearest medical clinic (see below for details) at communal level or for further treatment in Province and City level:

➢ <u>Phuc Yen Regional General Hospital</u>
  - Address: 47 Nguyen Trai, Phuc Yen Town, Vinh Phuc Province
  - Emergency Contact Number: +84 02113870298

➢ <u>Vinh Phuc Provincial General Hospital</u>
  - Address: 01 Ton That Tung, Vinh Yen City, Vinh Phuc Province
  - Emergency Contact Number: +84 0211.3861206 - Hotline: 0965.05.10.10

➢ <u>Vinh Yen City General Hospital</u>
  - Address: 02 Le Loi, Vinh Yen City, Vinh Phuc Province
  - Emergency Contact Number: + +84 211 3861 271

➢ <u>Vinh Tuong District Hospital</u>
  - Address: Vinh Tuong Town, Vinh Tuong District
  - Emergency Contact Number: +84 0211.3823.584

➢ <u>Yen Lac District Hospital</u>
  - Address: Yen Lac Town, Yen Lac District
  - Emergency Contact Number: +84 0211.3852.791

➢ <u>Tam Duong District Hospital</u>
  - Address: Hop Hoa Town, Tam Duong District
  - Emergency Contact Number: +84 0211.3897.588

➢ <u>Binh Xuyen District Hospital</u>
  - Address: Huong Canh Town, Binh Xuyen District
  - Emergency Contact Number: +84 0211.3899.442

Within two working days from receiving an occupational accident investigation record and the minutes of the meeting about disclosure of the occupational accident investigation record, the First Aider must prepare statistics of the occurred occupational accidents and records in a Statistic Book with following principles:

- Every occupational accident that has happened to workers must be recorded;
- When a worker suffers from multiple occupational accidents, each accident must be separately recorded;
- Every occupational accident that has happened to workers that cause them to take one day off or more must be recorded.

Fire

Flammable hazardous materials and wastes will be present onsite (including fuels, oils, etc.). A fire can also be caused by using ignition sources nearby (e.g. smoking or cooking by workers and residents) or engine incidents.

All the bulldozers, excavators, hazardous waste and materials storage areas, and the site office must be equipped with one portable 2 kg fire extinguisher in each location (type will depend on the immediate fire risk). The fire extinguishers must be in good working condition. The Contractor Supervisor – Vehicles and Devices shall perform monthly checks and replace as needed – tags shall be kept on the extinguishers which indicates their validity.

Procedure:

- Upon identification of a fire incident, try to suppress the fire if it is deemed possible and safe to do so using the available suppression equipment);
- If it is not possible to do so, move to a safe location (up wind and sufficient distance) and report the fire to the fire brigade stating your name, location, the status of the fire;
- Report the fire to the Contractor General Manager; and
- The Contractor General Manager will inform all workers and visitors on-site and ensure they are all accounted for and in safe locations. They shall also inform the PMU HSE Manager, who shall inform the applicable government department and any households on or off site who may be in danger and advise them to evacuate.

e. Communication Protocol

If an emergency is identified, all workers/visitors need to notify the Contractor General Manager by mobile phone call. Specific communication requirements for each incident type are provided within the procedures above.

Each personnel on-site will be provided with a card containing all the relevant emergency contacts. The contacts tentatively will be defined for Contractor General Manager, Contractor Supervisor, Contractor HSE Manager, PMU HSE Manager, HSE Management and Monitoring Officer, Wards/Districts People's Committee, Wards/Districts People's Police, Fire Emergency and Medical Emergency.

Once PMU's permanent HSE Site Supervisors are assigned to replace HSE Management and Monitoring Officers, the contact numbers need to be updated.

g. Drills

Emergency drills for all emergency scenarios outlined above within two weeks of commencement of the contract, and again should the contract extend beyond six months.

The Contractor General Manager is required to plan and facilitate the drills, identify and implement any corrective actions based on the performance, report to the PMU HSE Manager on the outcome of the drills, and communicate to all workers regarding the lessons learned. Drill plans and records shall be prepared and kept on file.

h. Reporting

Reporting to PMU

Spill Incident/Accident Notification

The Contractor General Manager must notify the PMU HSE Manager of any major spill incident/ accident (larger than 180 litres – volume of a drum) immediately using the fastest means (mobile phone/line telephone), providing the following information:

- Description of the incident/ accident including the location, the material spilled, the volume spilled, and whether any sensitive receivers have been impacted;
- Description of the immediate response taken to stop and clean up; and
- What the next steps are.

Occupational Accident Notification

The Contractor General Manager must notify PMU any accidents that have resulted in a fatality, or serious or multiple injuries (workers or local people) using the fastest means (mobile phone/line telephone), providing the following information:

- Description of the incident/ accident including the location, the number of fatalities/injured, how it occurred;
- Description of the immediate response taken to secure the situation and get medical attention; and
- What the next steps are.

The Contractor General Manager shall complete an Incident Investigation Form (refer to Incident and Non-conformance Section) and submit it to Vinh Phuc PMU immediately after receiving the accident case file from the local Police Department at the locality where the accident happened. The Contractor General Manager must regularly update Vinh Phuc PMU on the progress of closure of associated corrective actions.

Regulatory Reporting to Local Authority

Spill Incident/Accident Investigation Report

A Spill Incident/Accident Investigation Report shall be prepared by the Contractor immediately after each accidental release of hazardous materials/chemicals with a volume of more than 180 litres (equal to a standard drum size) and submit to Vinh Phuc DONRE. The report shall include the following information depending to the polluted objects, but not limited to:

- Description of incident/ accident;
- Incident/ accident investigation;
- Surface/Groundwater quality; and
- Soil Quality.

Occupational Accident Declaration Report

For accidents that result in a fatality, or serious or multiple injuries, the Contractor General Manager shall notify the Inspectorate of the Services of DoLISA of Vinh Phuc Province, Police Department of Vinh Yen City and relevant Districts where project's subcomponents are undertaken using the fastest means (directly or by phone, fax, email).

For accidents happening to workers in traffic (except for accidents on internal routes belonging on the Project site) that cause death or seriously injure two persons or more, the Contractor General Manager shall use either the accident case file from the Traffic police department that handled the case, written confirmation from the local authorities, or written confirmation from the local Police Department at the locality where the accident happened to make a statement to the Inspectorate of the DoLISA of Vinh Phuc Province and other relevant authorities in Districts.

As defined in Joint Circular 12/2012/TTLT-BTDTBXH-BYT, the content of an Occupational Accident Declaration Report shall include the following information:

- Description of the accident: time, place, summary; and
- Victim's information: name, date of birth, gender, position, health status.

I. Plan Review

Management reviews of this plan may be triggered in the event of significant control weaknesses being identified from drills, inspections, audits, as follow up to an incident, etc.

7.2.3. Social Action Plan

Proposed Interventions for livelihood restoration

Assistance for Agricultural Extension Services

There are reported to be serious problem in the lack of skills related to agricultural development despite the economy of the area being dependent mainly on agricultural sector. Many households surveyed indicated poor farming techniques as one of the many reasons for rural poverty among the farming households. Agricultural extension services should be extended to such families with focus on techniques that can be help their perfomance and need to improve or stabilize their income as a result of the project intervention.

Assistance for Vocational Training Facilities

There is a need for providing vocational training to households affected by the project. Appropriate skill training programs should be defined in consultation with the households taking into consideration their priorities, needs and education level. The training programs should focus on ensured job provision. In this respect, coordination with potential employers is necessary.

The vocational training schools are managed under the Ministry of Education and Training in the Project Area. These vocational training centers would need to provide courses such as IT, garment industry, mechanical, electrical, mushroom making, husbandry and other technical assistance on agricultural activities. It has the courses for the high school pupils, even rural household in some extension programs. The skills training should be provided to both male and female in the project area, and should also be given to the households with vulnerable members.

External Assistance Provided to Villagers

About one-third of the surveyed respondents reported that their villages are provided with social assistance. The main sources of such assistance are the government and local authorities, mainly coming from the People's Committees (PCs) at the commune and village levels, Women's Union, and associations such as Farmers' Associations in the communes and villages. Other sources, although only a few reported, includes non-governmental organizations (NGOs), Red Cross, and overseas Vietnamese.

These should be considered during project implementation for impacted households in consultation with them to bring in the support from governmental program, the local mass organization such as Women's Union, Farmers' Association, and Youth's Union. Connection with on-going national program such as the Target Program for Clean Water and Sanitation should also be brought to severely affected households, particularly those who are poor and thus meet the criteria of the national program. Effort should be made by local district and commune government to bring the severely affected households into their consideration as potential beneficiaries under the national and provincial development programs.

Sexually Transmitted infections (STIs)

During project implementation, it is anticipated there would a large number of incoming workers would concentrate in the construction sites. As experience shows from similar construction related projects, the prevalence of STIs among affected workers would increase if preventive measures are not taken to ensure the workers are safeguarded against the contraction of STIs, which include HIV/AIDS. A community health action plan was developed by the project on the basis of previous project's experience, and on the basis of the consultation with the communities to ensure the workers are protected and communication of the STI is under control.

To mitigate and address the risks related to HIV/AIDS awareness and prevention awareness program should pay particular attention to women. The project will need to address the needs for better dissemination of information on HIV/AIDS and other risks, such as drug abuse. The HIV/AIDS program should include awareness campaigns at the construction sites and in the communities, developing peer educators and community monitoring combine with the awareness on safe migration, and by community PMU and Woman Union of project communes monitoring and public campaigns.

Table 75. Social Action Plan Framework for the VPFRWMP

Issues	Objectives/outcome	Proposed Actions	Agencies Involved	Indicators	Notes
Land Acquisition and Resettlement	- AH are compensated according to WB policy and will have their income will be restored; - Landless households will receive plot in serviced resettlement site	- Prepare Resettlement Plans in accordance with WB Safeguard Policy. - As part of the RAPs, income restoration programs will be prepared and funded under	- PMU - Centre for Land Fund Development - Local authorities - Consultants	- Resettlement Plans including IRP are prepared and uploaded on the WB's Vietnam Development Information Center (VDIC) in Hanoi. - Number of Landless HH with secure tenure (HH) - Number of HH who restored livelihoods (HH)	- Estimated cost of the RAP (for 03 year 1 subprojects) 336,128,899,738.68 VND, equivalent to 14,986.375.65 USD
Livelihoods Associated with Aqua-culture households and fishing as secondary income generating activity in Sau Vo, So, Nhi Hoang and Rung retention lakes.	Affected will be involved in public consultations and socio-economic survey, the basis to define of compensation and rehabilitation measures and costs to ensure that their livelihood will not be worsen off resulting from the project construction	As part of the RAPs, income restoration programs (IRPs) will be prepared	- PMU - Centre for La5nd Fund Development - Local authorities - Consultants	- Income Restoration Plan is prepared and uploaded on WB's Vietnam Development Information Center (VDIC) in Hanoi	Activites and costs are to be estimated and defined. Implementation to be carried out by a consultant
Access and Mobility	- Increasing flood drainage capacity, water storage capacity and regulating water for Phan and Ca Lo rivers meeting water demands communes along these rivers; - Improving of ecological environment and forming the regulatory lakes;	- The detailed design will incorporate POD concepts such as bicycle lanes, sidewalks and green space. - Technical drawings include access to existing houses/shops during construction;	- PMU - Department of Construction - Department of Transportation - Centre for Land Fund Development - Local authorities - Consultants	- Increased in square of productive land due to improvement of flooding. - Developed economic condition for project area	Detail design and cost to be defined and implementation to be carried out by a consultant

Issues	Objectives/outcome	Proposed Actions	Agencies Involved	Indicators	Notes
Risk of STIs	- Minimize risks of exposure to STIs during construction and post construction phase due to large volumes of transit traffic along the proposed works.	- A STIs Awareness and Prevention Program will be prepared and implemented. - HIV/AIDS awareness and prevention measures to be included in the contractors' contracts.	- PMU - Vinh Phuc PPC, District and ward/communes Woman union - Preventive health Centre - Contractors - Local authorities - Consultants	- STIs Awareness and Prevention Programs will be prepared. - STIs awareness and prevention measures included in the contractors' contracts	- Implementation and monitoring of this activity will be carried out by the detailed design and implementation by a consultant;
Women	- Gender concerns are to be main-streamed in all project components, as part of the RAPs, STIs Awareness and Prevention Program, Income Restoration Strategy, Labor issues, & Communication Plan. - Maximize Employment of Women during Construction	- Gender Action Plan Prepared	- PMU - Vinh Phuc PPC, District and ward/communes Woman union - Local authorities - Consultants	- A gender strategy is prepared for the activities stated above. - Indicators of the Gender Plan monitored	- See Annex 1 for the full Gender Action Plan
Labour	- Contractors' contracts to include conditions to ensure occupational health and safety; do not differentiate payment between women and men, for work of equal value; prevent use of child labor; and comply with the government's labor laws and related international treaty obligations; - Maximize Employment of Women and poor HH during Construction	- Contractor's contract have been reviewed to ensure that clauses related to Occupational health and safety (OH&S) and gender equity issued are included - Priority for women and poor HH for unskilled labour;	- PMU - Social unions (Youth union, woman union…) - District Centre for Employment Introduction - Local authorities - Contractors - Consultants	- Clauses related to: i) OH&S; ii) promotion of gender equity and prevention of gender-based discrimination; and iii) prevention of use of child labour have been included in contractors' contracts. - Number of local workers employed by gender - Male and female unskilled workers will receive equal pay for equal work;	- Monitoring of this activity will be carried out by the DDIS consultant - No cost; Part of DDIS monitoring activities.

Mitigation measures for temporary impacts

With regards to temporary impacts on land, or others (i.e. water cuts for households/individuals, traffic), these impacts will be minimized and compensated as part of the RAPs project during implementation. The project will ensure to inform people concerning construction schedule in advance so for example affected households could actively select crop varieties that have growth duration suitable to the construction schedule. Actions to be put in place include:

- ✓ Raising community awareness of traffic safety and social evils prevention during the construction period;
- ✓ Contracts with contractors to include measures for transporting materials or sludge and comply with the regulations on the load of vehicles transporting materials and waste. Include that when local infrastructure is damaged due to the transport activities, tconstruction or others, they must restore the affected infrastructure to its original

Table 76. Social Mitigation Measures

Adverse impacts	**Mitigation Measures**	**Implementing agency**
Temporary effects on agricultural	Announcement to local people before the construction	VP-ODA PMU should require contractor to closely work with local authorities for timely information dissemination on for each commune.
Traffic effects and increased social evils	Raising community awareness of traffic safety and social evils prevention for the local people	VP-ODA PMU should closely with the relevant authorities to develop a communication strategy for these issues. Based on the available communication system in communes to disseminate the project contents to households.
Infrastructure affects	The contractors comply with the rules of the materials transportation and infrastructure rehabilitation.	VP-ODA PMU should require contractors to comply with the contract provisions on the load and the measures to ensure the environmental sanitation during the transport materials as well as provisions for offsets when infrastructure damaged.

7.3. ENVIRONMENTAL AND SOCIAL MONITORING PROGRAM

Objective and Approach

Main objective of the Environment Monitoring program is to ensure that (a) the potential negative impacts of the project are minimized; (b) the EMP is effectively implemented; and (c) the EMP is adequate to mitigate the potential negative impacts. Given that monitoring the implementation of the RP will be conducted separately, the environmental monitoring program will comprise (a) monitoring the safeguard performance of the contractor during site clearance and construction, (b) environmental quality monitoring, (c) monitoring compliance to GoV and donor requirements, and d) effectiveness of the EMP.

Monitoring of Contractor's Safeguard Performance

Three levels of safeguard monitoring will be implemented: routine monitoring, periodic monitoring, and community monitoring as follows:

- Routine monitoring: The routine monitoring will be made by the Construction Supervision Consultant (CSC) as assigned by PMU. The CSC will include the monitoring results in the project progress reports;
- Periodic monitoring (every six months): As part of the overall monitoring of the EMP, the ESU assisted by the Independent Environmental Monitoring Consultant (IEMC) will also monitor the contractor performance every 6 months and the results will be reported to the PMU and the WB;
- Community monitoring: Monitoring by local communities will be conducted following the Government practices with the technical and management support from the PMU.

Environmental Quality Monitoring

To ensure an acceptable level of environmental quality, monitoring of dust, noise, vibration, air quality, and water quality will be made at project specific locations that are likely to be significantly affected by the construction activities, or requested by local authorities and communities for specific purposes. ESU/IEMC will be responsible for the monitoring of the program.

The environmental monitoring and supervision for pre-construction, construction and operation phases for the entire project is presented in the below table. Sampling locations are described in Annex…. and the number of samples are made in accordance with progress of each work.

Table 77. Monitoring content, frequency and location by phase

No	Monitoring content	Pre-construction	Construction	Standard
I	**Noise Monitoring**			
	1. Monitoring parameter		Leq, L50, Lmax	QCVN 26/2010/BTNMT

No	Monitoring content	Pre-construction	Construction	Standard
	2. Monitoring frequency		Every 3 months	
	3. Monitoring location	Baseline monitoring locations will be selected in accordance with construction sites at monitoring periods.		
II	**Air quality monitoring**			
	1. Monitoring parameter		SS, CO, NO2, SO2, HC, microclimate	QCVN 05 :2013/BTNMT, QCVN 06:2009/BTNMT
	2. Monitoring frequency		Every 3 months	
	3. Monitoring location	Baseline monitoring locations will be selected in accordance with construction sites at monitoring periods.		
III	**Surface water monitoring**			
	1. Monitoring parameter		pH; temperature, SS, DO, BOD5, COD, NH4+, NO2-, NO3-, PO43-, oil and grease, coliform	QCVN 08:2008/BTNMT;
	2. Monitoring frequency		Every 6 months	
	3. Monitoring location	Baseline monitoring locations will be selected in accordance with construction sites at monitoring periods.		
IV	**Ground water monitoring**			
	1. Monitoring parameter		pH, SS, hardness, DO, NH4+, NO3-, SO42-, As, Mn, Fe, Chloride, Coliform	QCVN 09:2008/BTNMT;
	2. Monitoring frequency		Every 6 months	
	3. Monitoring location	Baseline monitoring locations will be selected in accordance with construction sites at monitoring periods.		
V	**Wastewater monitoring**			
	1. Monitoring parameter		pH, H2S, SS, DO, COD, BOD5, NH4+, NO3-, NO2-, SO42-, As, Hg, Cu, Pb, Fe, Cd, Mn, Cr (IV),	QCVN 14:2008/BTNMT;

No	Monitoring content	Pre-construction	Construction	Standard
			E.coli, Coliform	
	2. Monitoring frequency		Every 3 months	
	3. Monitoring location	Baseline monitoring locations will be selected in accordance with construction sites at monitoring periods.		
VI	**Dredged Sludge (if required in Dredged Material Management Plan)**			
	1. Monitoring parameter	pH, Cu, Pb, Zn, Cd, As, Hg, Cr, Fe, Chlorinated Organic Pesticides (DDD, DDT)		QCVN 43:2012/BTNM; QCVN 03:2008/BTNMT; QCCVN 07: 2009/BTNMT
	2. Monitoring frequency	Once before excavating for construction and when necessary		
	3. Monitoring location	As indicated in Dredged Material Management Plan		
VII	**Soil environment**			
	1. Monitoring parameter		pH, Cd, As, Zn, Hg, Fe, Cr, Pb, Cu, Chlorinated Organic Pesticides (DDD, DDT)	QCVN 03:2008/BTNMT;
	2. Monitoring frequency		Every 6 months	
	3. Monitoring location	Baseline monitoring locations will be selected in accordance with construction sites at monitoring periods.		
VIII	**Plankton**			
	1. Monitoring parameter		Zooplankton, zoobenthos, Phytoplankton, plankton, benthos, algae	
	2. Monitoring frequency	Once		
	3. Monitoring location	Baseline monitoring locations will be selected in accordance with construction sites at monitoring periods.		
IX	**Traffic: Contractors monitor and report traffic state in new roads and construction sites.**			

Table 8.4. Monitoring locations

Sample	Work	No.of locations	Place	Note
Surface water	Town WWTPs	5	Yen Lac, Tam Hong, Tho Tang	01 surface water sample in each WWTP
	Pumping stations	3	Kim Xa, Nguyet Duc, Ngu Kien	01 surface water sample in each PS
	Lakes to be dredged	10	Sau Vo, Rung, Nhi Hoang, regulating lake in front of Nguyet Duc PS	04 samples in Sau Vo, 02 samples in Rung, 02 samples in Nhi Hoang, 02 samples in the lake in front of Nguyet Duc PS
	Disposal sites	8	Dong Mong, Kim Xa	04 samples in each site
	Phan River	25	Along Phan River	Evenly distributed
	Binh Xuyen rivers	6	Binh Xuyen	01 sample in each river
	Canal from Sau Vo Lake to Nguyet Duc Ps	2	Nguyet Duc, Yen Phuong	02 samples along the canal
	Canal from Rung Lake to Phan River	2	Vinh Tuong	02 samples along the canal
	Total	61		
Ground water	WTTPs	5	Yen Lac, Tam Hong, Tho Tang	01 sample in each WWTP
	PSs	3	Kim Xa, Nguyet Duc, Ngu Kien	01 sample in each PS
	Lakes	3	Sau Vo, Rung, Nhi Hoang, regulating lake in front of Nguyet Duc PS	01 sample for each lake
	Disposal sites	2	Dong Mong, Kim Xa	01 sample for each site

Sample	**Work**	**No.of locations**	**Place**	**Note**
	Total	14		
Wastewater	Rural WWTPs	33	WTTP sites	01 sample for each WTTP
	Town WWTPs	10	Yen Lac, Tam Hong, Tho Tang	02 sample for each of 5 WTTPs
	Total	42		
Air quality and Noise	WTTPs	5	Yen Lac, Tam Hong, Tho Tang	01 sample in each WWTP
	PSs	3	Kim Xa, Nguyet Duc, Ngu Kien	01 sample in each PS
	Lakes	8	Sau Vo, Rung, Nhi Hoang, regulating lake in front of Nguyet Duc PS	02 samples for each lake
	Disposal sites	2	Dong Mong, Kim Xa	01 sample for each site
	Binh Xuyen rivers	3	Hanh River, Tranh River, Cau Bon River	01 sample for each river
	Phan River	10	Thuong Lap – Lap Y; Lap Y – Sat Bridge	Evenly distributed
	Total	31		
Soil	WTTPs	5	Yen Lac, Tam Hong, Tho Tang	01 sample in each WWTP
	PSs	3	Kim Xa, Nguyet Duc, Ngu Kien	01 sample in each PS
	Lakes	4	Sau Vo, Rung, Nhi Hoang, regulating lake in front of Nguyet Duc PS	01 sample for each lake
	Total	12		

Sample	Work	No.of locations	Place	Note
Dredged material	WTTPs	10	Yen Lac, Tam Hong, Tho Tang	02 samples in each WWTP
	Lakes	100	Sau Vo, Rung, Nhi Hoang, regulating lake in front of Nguyet Duc PS	Sau Vo: 35; Rung: 15 Nhi Hoang: 14; regulating lake in front of Nguyet Duc PS: 36
	Binh Xuyen Rivers	8	Binh Xuyen	02 samples each river
	Phan River	25	Thuong Lap – Lap Y; Lap Y – Sat Bridge	Evenly distributed
	Total	143		
Plankton	Phan River	10	Thuong Lap – Lap Y; Lap Y – Sat Bridge	Evenly distributed
	Binh Xuyen Rivers	8	Binh Xuyen	Binh Xuyen
	Lakes	6	Sau Vo, Rung, Nhi Hoang	02 samples each lake
	02 disposal sites	2	Kim Xa, Dong Mong	01 sample each site
	05 WTTPs	5	Yen Lac, Tam Hong, Tho Tang	01 sample in each WWTP
	03 PSs	3	Kim Xa, Nguyet Duc, Ngu Kien	01 sample in each PS
	Total	34		

Table 8.5. Cost estimate for sampling

no	Content	Unit	No.sample	Price (VNĐ)	Amount (VNĐ)	Amount (USD)
1	Surface water	Sample	207	2.403.600	497.545.200	22.729
2	Ground water	Sample	47	3.098.700	145.638.900	6.653
3	Wastewater	Sample	53	5.475.000	290.175.000	13.256
4	Air	Sample	170	1.697.100	288.507.000	13.180
5	Soil	Sample	29	4.757.800	137.976.200	6.303
6	Dredged material	Sample	144	4.787.100	689.342.400	31.491
7	Plankton	Sample	34	3.403.632	115.723.488	5.287
8	Other				1.818.400.000	83.070
IEMC total cost					3.983.308.188	181.969
IEMC total cost (rounded)						182.000

Table 8.6. Cost estimate for analysis

Unit: thousand VND

Content	Parameter		No.sample	Price	Amount
Surface water	1	Temperature	207	69.400	14.365.800
	2	pH	207	69.400	14.365.800
	3	SS	207	167.400	34.651.800
	4	DO	207	67.900	14.055.300
	5	BOD5	207	153.600	31.795.200
	6	COD	207	238.600	49.390.200
	7	NH4+-N	207	194.900	40.344.300
	8	NO2--N	207	188.500	39.019.500
	9	NO3--N	207	188.500	39.019.500
	10	PO43--P	207	248.000	51.336.000
	11	Oil& grease	207	459.600	95.137.200
	12	Coliform	207	357.800	74.064.600
Ground	1	pH	47	71.600	3.365.200

water	2	Suspended solids	47	162.600	7.642.200
	3	Hardness (CaCO3)	47	205.400	9.653.800
	4	DO	47	90.100	4.234.700
	5	NH4+-N	47	193.400	9.089.800
	6	NO3--N	47	183.700	8.633.900
	7	SO42-	47	224.500	10.551.500
	8	As	47	376.000	17.672.000
	9	Hg	47	376.000	17.672.000
	10	Mn	47	303.700	14.273.900
	11	Fe	47	303.700	14.273.900
	12	Chloride	47	210.500	9.893.500
	13	Coliform	47	397.500	18.682.500
Wastewater	1	pH	53	69.400	3.678.200
	2	H2S	53	242.900	12.873.700
	3	DO	53	67.900	3.598.700
	4	SS	53	167.400	8.872.200
	5	COD	53	238.600	12.645.800
	6	BOD5	53	153.600	8.140.800
	7	NH4+-N	53	194.900	10.329.700
	8	NO2--N	53	188.500	9.990.500
	9	NO3--N	53	188.500	9.990.500
	10	Cu	53	322.300	17.081.900
	11	Pb	53	335.900	17.802.700
	12	Fe	53	322.300	17.081.900
	13	Cd	53	335.900	17.802.700
	14	Mn	53	322.300	17.081.900
	15	SO42-	53	242.200	12.836.600
	16	Cr VI	53	322.300	17.081.900
	17	As	53	388.000	20.564.000
	18	Hg	53	404.100	21.417.300
	19	Fluorine	53	252.400	13.377.200
	20	Ecoli	53	357.800	18.963.400
	21	Coliform	53	357.800	18.963.400

Air	1	Temperature, humidity	170	44.000	7.480.000
	2	Wind velocity	170	43.400	7.378.000
	3	TPP	170	152.800	25.976.000
	4	NO2	170	309.800	52.666.000
	5	SO2	170	388.800	66.096.000
	6	CO	170	262.800	44.676.000
	7	HC	170	395.500	67.235.000
	8	Noise	170	100.000	17.000.000
Soil	1	Cd	29	340.600	9.877.400
	2	pH	29	233.300	6.765.700
	3	As	29	353.900	10.263.100
	4	Zn	29	328.900	9.538.100
	5	Hg	29	353.900	10.263.100
	6	Cr VI	29	328.900	9.538.100
	7	Fe	29	328.900	9.538.100
	8	Pb	29	344.600	9.993.400
	9	Cu	29	328.900	9.538.100
	10	Chlorinated Organic Pesticides (DDD. DDT)	29	1.815.900	52.661.100
Dredged material	1	pH	144	233.300	33.595.200
	2	Cd	144	340.600	49.046.400
	3	As	144	377.700	54.388.800
	4	Zn	144	331.600	47.750.400
	5	Hg	144	351.300	50.587.200
	6	Cr VI	144	328.900	47.361.600
	7	Fe	144	328.900	47.361.600
	8	Pb	144	347.300	50.011.200
	9	Cu	144	331.600	47.750.400
	10	Chlorinated Organic Pesticides (DDD. DDT)	144	1.815.900	261.489.600
Plankton	1	Zooplankton	34	581350	19.765.900

	2	Zoobenthos	34	581350	19.765.900
	3	Phytoplankton	34	539116	19.329.944
	4	Plankton	34	581350	19.765.900
	5	Benthos	34	581350	19.765.900
	6	Algae	34	539116	19.329.944
Total					2.164.908.188

Note: Cost for sample analysis is specified in Decision no.1182/QĐ-UBND date April 27, 2009 of Vinh Phuc PPC on cost norm for environmental monitoring and analysis in Vinh Phuc Province and Decision no. 2090/BTNMT dated September 29, 2014 by MONRE on cost norm for environmental monitoring and analysis of plankton.

Monitoring effectiveness of the ESMP

The ESU assisted by IEMC will monitor performance of the EMP implementation during the detailed design/bidding stage as well as during construction and first year operation of the facilities to ensure that (a) appropriate dredging and disposal of drainage sludge is properly carried out, in accordance with the DMMP, 9b) other impacts identified in the EMP are effectively managed and mitigated; and (c) traffic management is adequate and the level of impacts are acceptable (no complaints or outstanding cases. Results/are to be properly kept in the project file for possible review by PMU and the WB.

7.4. ORGANIZATION ARRANGEMENT FOR ESMP

Organization

Table 8.7 and Figure 8.1 below summarizes roles and responsibilities of the key parties and their relationships regarding the implementation of the EMP while those for the PMU, CSC, and IEMC are highlighted below while more details are provided in Section 8.4.2.

- Contractors are responsible for implementing mitigation measures. Measures will be included in bidding documents and costs are to be included in construction bids;
- CSC is responsible for monitoring the day-to-day implementation of mitigation measures. Cost included in CSC service contract;
- IEMC will be responsible for environmental monitoring which includes support to the PMU for implementing supervision and monitoring, and reporting on the implementation through monitoring reports.

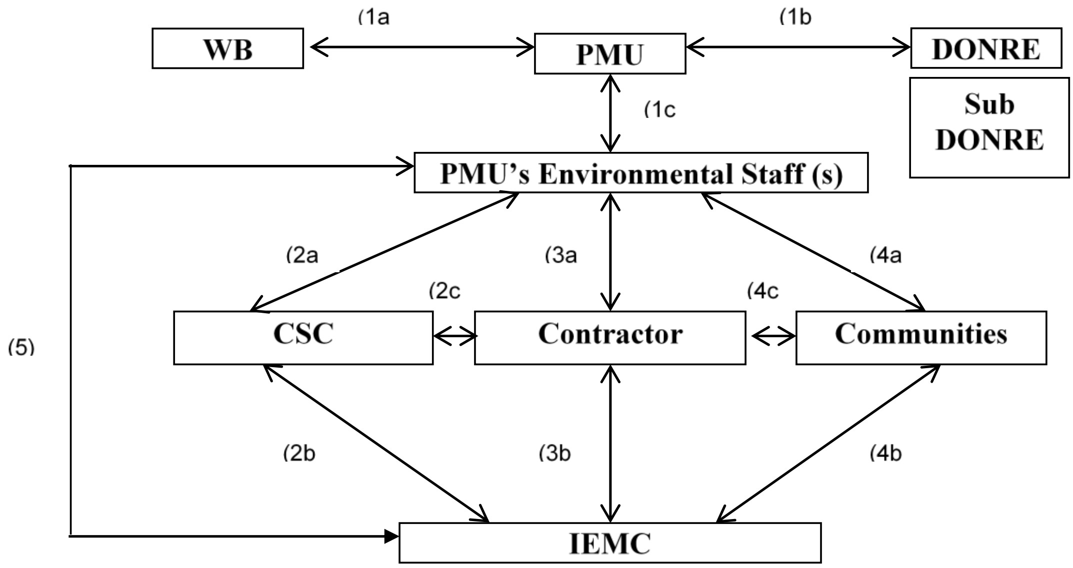


Figure 8.1. Organization Diagram for the EMP Implementation.

Table.. Roles and responsibilities of key parties (Description referred to Figure 8.1)

Description	**Roles/Responsibilities**
(1a) (1b)	Based on quarterly reports of IEMC, PMU is responsible for preparing periodic reports to submit to WB and to the City DONRE.
(1c)	PMU assigns the safeguard staff (ESU) to review and check the related sections in the Contract Documents on the bidding packages for construction items of the project to ensure compliance with EMP PMU assigns the safeguard staff (ESU) to supervise, manage and carry out EMP activities and also assigns CSC to closely supervise/monitor safeguard performance of the contractor, including undertaking the environmental monitoring program. PMU/ESU establishes a hotline communication with local community to be responsive to the complaints, comments, and/or recommendations from local people and/or the public throughout the site clearance and construction period.
(2a)	CSC submits periodic monitoring report of environmental mitigation measures to PMU; Recommends to the PMU to suspend in part or completely, construction works if it does not meet labor safety and environmental protection requirements of the contract. PMU reviews CSC's periodical reports to ensure compliance with mitigation measures.
(2b)	CSC: Support, collaborate with IEMC to establish, collect and point out information about essential environmental parameters in the field and information for construction implementation; IEMC: Monitor the implementation of the EMP every 3 months including submission of the field report. Create database of results from environmental supervision and monitoring and train PMU in using such

Description	Roles/Responsibilities
	database Coordinate with CSC on monitoring and preparation of safeguard reports on EMP performance; enhance capacity for CSC through a training program on environmental supervision
(3a)	Contractor: Before construction, with assistance from IEMC, prepare a site-specific environment management plan (SEMP) during site clearance and construction process as part of their construction method statement, then submit it to CSC and/or PMU for review and approval; During construction, the contractor has to submit a monthly report on safeguard issues, mitigation, and results throughout the construction period. In case of unexpected problem, the contractor will consult CSC/PMU. PMU/CSC: reviews the SEMP and can propose change as deemed necessary to be in line with the legal obligations as well as appropriate to each specific site. Daily supervision and monitoring of contractor's safeguard performance will be responsibility of the CSC.
(3b)	Contractor: Carry out the EMP required during site clearance and construction, including conduct self-monitoring and submission of report. IEMC: periodically supervise and monitor the overall project EMP implementation including provision of safeguard training to PMU/ESU staff, community, CSC, and contractors as needed. The training will be designed to enhance the effectiveness of the EMP implementation and reporting.
(4a)	Community: According to Vietnamese practice, the community has the right and responsibility to routinely monitor environmental performance during construction to ensure that their rights and safety are adequately protected and that the mitigation measures are effectively implemented by contractors and/or PMU. In case of unexpected problems, they will report to CSC/PMU and/or call the hotline. PMU: Encourage, support and create good conditions for local community to participate in the environmental supervision and monitoring activities. PMU/CSC will review and response to the requests and/or recommendations made by community to ensure that the potential negative impacts are adequately mitigated.
(4b)	Community: Support and collaborate with IEMC during periodic monitoring and provide inputs to the overall safeguard issues that require attention and/or mitigation. IEMC: Strengthen local community's capacity and relevant agencies through preparation of relevant documents necessary for monitoring, supervision, and reporting including preparation of a database for the activities. IEMC: assist PMU and communities for the implementation of Information-Education-Communication (IEC) activities within Component 4 with regard to environmental hygiene, sanitation, road safety, etc.
(5)	IEMC supports PMU/ESU to implement the EMP in line with Government's environmental regulations as well as the WB safeguard policies. In consultation with DONRE, IEMC will establish specific environmental monitoring program for the project to be implemented by CSC at key

Description	Roles/Responsibilities
	locations as shown in detailed design documents. PMU is responsible for preparation of the 6-month progress reports to be submitted to WB and DONRE, based on quarterly reports submitted by IEMC.

Specific Responsibilities of PMU, CSC, and IEMC

a. Project Management Unit (PMU)

–PMU is responsible for implementing the EMP during the detailed design and construction stages. EMP implementation during operation stage is the responsibility of the facilities operators. PMU will set up an Environmental and Social Unit (ESU) to ensure timely and effective implementation of the EMP, including preparation of reports on safeguard compliance as required by Government and WB.

–PMU/ESU is responsible for ensuring that the related sections in the Contract Documents on the bidding packages for construction items of the project are in compliance with the EMP.

–PMU/ESU is responsible for communicating with relevant local, provincial and national departments; and with parties responsible for implementing and supervising EMP, especially with the provincial Department of Natural Resources and Environment (DONRE) and the concerned wards/communes during planning, monitoring, operation, and management.

–PMU/ESU will coordinate with community organizations to encourage them to actively participate in the planning, management, and implementation of the project, including monitoring of the contractor's performance.

–To ensure effective monitoring and timely implementation of the EMP, PMU/ESU will hire national environmental consultants to assist in carrying out and monitoring the EMP implementation. Responsibilities of the Independent Environmental Monitoring Consultant (IEMC) will be described below.

–For supervision and monitoring of contractor's performance, PMU will be responsible for: (a) Checking project implementation indicators relating to environment; (b) Unannounced inspections to ensure that mitigation measures are being implemented as presented in construction contract by contractor; (c) Reviewing periodic report of construction supervision consultant (CSC) to ensure compliance with mitigation measures; and (d) Based on the periodic reports by CSC and IEMC, PMU will prepare report on environmental compliance of subproject to submit to WB and DONRE (This is part of the submission of a 6-month progress report to WB).

–PMU will coordinate closely with relevant enterprises on water supply, environmental sanitation, solid waste collection and to monitor operation and maintenance during project implementation.

b. Independent Environmental Monitoring Consultant (IEMC)

The IEMC will be responsible for assisting the PMU in EMP implementation. This also includes advising the CSC, contractors and communities on environmental compliance, and carrying out the monitoring program in accordance with regulations and procedures of the Government and World Bank. Once the detailed operational implementation of the environmental monitoring program is discussed by PMU and World Bank, the IEMC will be responsible for quarterly checking, and supporting the PMU staff to supervise overall project activities to ensure that unified environmental protection policies of the Government and World Bank are applied and supervised during project implementation. The IEMC will be responsible to: (1) provide training and capacity building for construction management for PMU/ESU staff, including field engineers and/or consultants (CSC) in supervising the EMP implementation of the contractor; (2) ensure active participation of the local communities and schools in the project areas, (3) monitor environmental parameters to assess the overall impacts of the project, and (4) establish environmental training program.

Specifically, the IEMC's responsibilities include:

–Ensuring that the approved EMP and all project loan agreements related to environmental safeguards are fully applied and complied during project implementation.

–Assessing the effectiveness of mitigation measures which are provided by contractor and CSC in implementation process; providing proposals and recommendations to the PMU on necessary improvement and supplementation to meet the safeguard requirements.

–Reporting periodically (every 3 months) to the PMU on actual EMP performance during project implementation.

–Establishing standard procedures, methods and forms to assist the PMU and CSC to assess contractors' progress in implementing required impact mitigation and monitoring measures.

–Assisting the PMU's environmental staff to review and check the related sections in the Contract Documents on the bidding packages for construction items of the project to ensure compliance with environmental protection policies and impact mitigation and monitoring requirements.

–Measuring, taking samples and monitoring periodically environmental parameters (once per 3 months) during the time of environmental monitoring contract.

–Assistance in the preparation of documents and implementation of training program on environmental monitoring and supervision for contractors, CSC and relevant staffs of PMU (environmental staffs and coordinators of packages).

–Via PMU, discussing with relevant enterprises (if necessary) to find suitable solutions for unexpected risks relating to environmental sanitation.

c. Construction Supervision Consultant (CSC)

The CSC is responsible for monitoring the safeguard performance of the contractor during site clearance and construction, including oversight of the self-monitoring to be conducted by contractor. With regard to safeguards, the CSC's main responsibility will include, but not be limited to, the following:

–Assist IEMC to establish, collect and provide information about both essential environmental indicators on-site and construction work.

–Ensure that construction work complies with approved EMP, relevant indicators and standardized operation in documents for environmental impact mitigation and monitoring.

–Monitor the mitigation measure implementation of contractor, propose and deploy supplementary measures in time to complete mitigation measures and to meet the environmental management safety requirements of project.

–Make action plans/urgent solutions to cope with environmental problems, urgent situation and damages happening in construction

–Recommend PMU to suspend partially or completely construction work if labor safety and environmental protection requirements of the contract are not complied with.

–Organize regularly discussions with relevant enterprises and other stakeholders to provide information about implementation plans and necessary working program to enhance people's awareness of environmental protection during construction process.

d. Construction Contractor

–The construction contractor's responsibilities in respects of all aspects of the works, including the environmental aspects, are set out in the contract between it and the PMU.

–Construction contractors have their own responsibilities for both carrying out environmental impact mitigation measures and compliance with approved EMP during assembling construction of project packages. In the preparation of technical method statement, contractor will study the project's approved EIA report and propose a construction method that includes environmental mitigation and protection measures that are aligned with the recommendations of the approved EMP.

–Contractor's method statement will be submitted to PMU and CSC for review, as well as to IEMC as deemed necessary. Changes, if there are any, will be evaluated for feasibility and for legal issues (laws, decrees, circulars and other regulations) before suitable adjustments are approved for specific cases on-site.

–During construction work, construction contractor will be closely supervised by PMU, CSC, IEMC, environmental authorities and local community on EMP observation.

Reporting Arrangements

The PMU will prepare reports twice per year for submission to the World Bank including the compliance with the EMP. The report will contain the monitoring results and assessments of the IEMC that show project progress and the status of implementation of the EMP. The reports will cover, among other matters as appropriate, the following:

- Contractor's compliance with mitigation measures
- Wastewater and environmental sanitation issues
- Existing flood situation where relevant
- Traffic and water supply conditions

- Quality of waste-water receiving water bodies
- Potential project-related risks and risk management issues
- Consultation with local communities in key project areas

7.5. CAPACITY BUILDING PROGRAM

7.5.1. Technical Assistance support for the implementation of safeguards

An assessment of safeguards implementation capacity of existing PMU staff indicates that PMU staffs have limited knowledge on WB safeguard requirements as well as limited knowledge of environment and social issues. Such lack of capacity represents a risk to project implementation of safeguards requirements contained in the EMP and, as required by the WB policy, is to be addressed through capacity building. Therefore, it is proposed to provide capacity building through technical assistance that will support the PMU during the implementation of the safeguards requirements. The technical assistance will provide the necessary technical support the PMU in its work with contractors as well as other entities involved in the implementation of the EMP.

The scope of the technical assistance would cover support from experts and training that would cover both the knowledge on safeguards requirements and procedures for the project as well as training that covers both specific knowledge on safeguard procedures and requirement for the project staff, consultants, and national contractor would be important. This would include, for example, assistance in the preparation of documents and implementation of training program on environmental management and environmental monitoring for contractors, CSC and relevant staffs of PMU (environmental staffs and coordinators of packages) to do their tasks. It would also include assisting the PMU's environmental staffs with the review of contract documents on the bidding packages for construction items of the project to ensure compliance with environmental protection policies and impact mitigation and monitoring requirements as well as provide general environmental guidance as requested by the PMU to enhance overall project implementation and performance.

Given the nature, locations, and scale of construction, it is anticipated that the safeguard technical assistance support and training will be provided at least during the first 3 years of the project implementation. The WB safeguard specialists will participate in the capacity building in particular in the training activities as appropriate.

7.5.2. Training programs proposed

Table below provides examples of the basic trainings for safeguards during project implementation. The training programs will be developed and delivered by the Technical Assistance team for the implementation of safeguards for the PMU training. The PMU/IEMC with the support of the Technical Assistance team for the implementation of safeguards will provide the training to contractors, CSC and other groups.

Other more specific and tailored training will be developed and agreed upon between PMU, IEMC and the Technical Assistance team for the implementation of safeguards during project implementation based upon a reassessment of needs and the status of safeguards implementation.

- ✓ Target groups for the training: include PMU staff, ESU staff, field engineers, CSC, construction contractors, local authorities, and community representatives in the project area. Training of workers and drivers is the responsibility of the contractor.
- ✓ Training schedule: At least 1 month before the construction of the first contract. The training can be adjusted in line with the implementation schedule of the subproject/contracts.
- ✓ Training frequency: The basic training programs proposed in Table 77 will take place every six months on a yearly basis and its content updated and adapted to implementation issues. Training frequency and content will be reassessed during implementation depending on needs. It is foreseen that the training program for PMU staff will continue until year three of implementation. Three days of training for CSC and contractors are also planned to take place twice a year on an annual basis for at least two years.

Table 78. Training programs for capacity building on environmental supervision and management

I. Targets	- **PROJECT MANAGEMENT UNIT**
Training course	Environmental supervision, monitoring and reporting
Participators	Environmental staff and technical staff
Training Frequency	Soon after project effectiveness but at least 1 month before the construction of the first contract. The follow-up training will be scheduled as needed.
Time	Two days of training twice a year to be repeated on a yearly basis until year three of implementation
Content	General environmental management relating to project including requirements of WB, DONRE, cooperating with other stakeholders Environmental supervision of the project includes: Requirements for environmental supervision; Supervision and implementation of mitigation measures; Community participation in environmental supervision Guide and supervise contractor, CSC, and community representatives in implementation of environmental supervision. Forms used in environmental supervision; Risk response and control; Other areas to be determined; Receiving approach and submit forms.
Responsibilities	IEMC, PMU with support of the Technical Assistance team for the implementation of safeguards

II. Targets	**CSC, CONTRACTOR, WARD/COMMUNE AUTHORITIES, AND REPRESENTATIVES OF LOCAL COMMUNITIES**
Training course	Implementation of mitigation measures
Participators	CSC; on-site construction management staff; environmental staff of contractor; commune/ward authorities; and representatives of residential groups, community based supervision groups at contruction sites.
Training Frequency	1 month prior to construction for each site
Time	2 days
Content	Overview of environmental monitoring; Requirements of environmental monitoring; Potential environmental impacts and mitigation Role and responsibilities of contractors and CSC Content and methods of environmental monitoring; Response and risk control; Introduce monitoring forms and guide how to fill in the forms and incident report; Other areas to be determined; Preparation and submission of reports.
Responsibilities	IEMC, PMU,CSC, contractor, commune/ward authorities, representatives of residential groups, community based supervision groups at contruction sites.

7.6. ESTIMATED COST

7.6.1. Estimated EMP cost

Table 78 provides an estimated cost for EMP implementation (excluding the resettlement cost and RP and EMDP independent monitoring). The EMP cost will comprise (i) cost for implementation of the mitigation measures by contractor, (ii) cost for supervision by the CSC, (iii) cost for environmental monitoring consultant (IEMC), (iv) monitoring of environmental quality, and (v) PMU safeguard management costs, including technical assistance support for the implementation of safeguards and training. Costs for the implementation of the mitigation measures during construction will be part of the contract cost while cost for monitoring of SEMP by the CSC is provided for in the construction supervision contracts. Costs for PMU operations related to EMP are provided for in the project management budget of the PMU, including basic safeguards training and allowances for people who participate in the monitoring program. After project completion, the cost for environmental monitoring of the constructed facilities will be funded by the province's operations and maintenance budgets.

It is noted that the participation of communities in EMP implementation is voluntary, and without salary, for the benefits of the communities and individual families. However, to encourage the participation of community members, the cost for materials, equipment used for monitoring and allowances for people who are voted to implement monitoring are taken into account. Following Decision No. 80/2005/QD-TTg dated 18/4/2005 of Prime Minister on regulations of community investment supervision and Joint Circular guiding the implementation of the Decision No. 80/2005/QD-TTg "*cost for supporting the investment supervision of community in commune/ward are calculated in cost estimation of commune/ward fatherland front and are guaranteed by commune/ward people's committee budget; cost for propagation, training courses, guiding, closing of community investment monitoring at district and provincial level are calculated in cost estimation of district/province Fatherland Front and are guaranteed by district/province people's committee budget*".

Table 79. Estimated EMP implementation cost (mil. USD)

Expenditure item	**Cost (mil. $US)**	**Funding sources**
(a) Implementing mitigation measures during construction	Part of the contracts	WB
(b) Supervising safeguards during construction	Included in construction and supervision contracts	WB
(c) ESU under PMU	From provincial budget for environmental protection Excluded from project cost	Counterpart fund
(d) IEMC	176,683	WB
(e) Environmental safeguard capacity building program	250	WB

Table 80. Estimated cost for IEMC

No.	**Items**	**Unit**	**Quantity**	**Rate (VND)**	**Amount**	
					VND	*USD*
1	Specialist salaries (5 specialists)	Month/ person	40	25,000,000	1,000,000,000	45,683
2	Technician salaries (5 technicians)	Month/ person	22	8,000,000	176,000,000	8,040
3	Per diem	Day/person	120	350,000	392,520,000	17,908
4	Travel cost	Trip/person	112	1,200,000	134,400,000	6,140
5	Organize	Course	8	6,500,000	52,000,000	2,376

No.	Items	Unit	Quantity	Rate (VND)	Amount	
					VND	*USD*
	training					
6	Office supplies	Monitoring batch	16	2,000,000	32,000,000	1,462
7	Office and communications	Monitoring batch	16	2,000,000	32,000,000	1,462
8	Environmental quality monitoring				2,164.908.188	98.988
	Total				3,938.308.188	181.969

The environmental quality monitoring and IEMC costs are consistent with the national regulations for reference purpose. However, the final costs will be updated during detailed design process.

7.6.2. Estimated Social cost

All the activities proposed as par of the project's mitigation program above would be implemented with national resources. The total cost over five years has been estimated at VN 735,000. Beneficiaries of the programs are based on criteria of: a) vulnerability; b) poverty/income; and c) female-headed households. The table below summarizes the activities by component and year.

Table 81.Estimated Budget for Proposed Mitigation Program (USD)

No	Content	Unit Cost	Total
1	Gender action plan	1,000	530,000
2	Information disclosure	1,000	100,000
3	Community Health Action Plan	1,000	105,000
Total (VND)			**735,000**
Total (US$)			**32,666**

All necessary costs to carry out the activities proposed in this EMDP will be funded by the Government of Vietnam. VP-ODA PMU will coordinate the EMDP EM peoples present in the subproject area will receive culturally appropriate socioeconomic benefits.

The costs for reducing the damages due to the transport activities, and to restore the affected infrastructure to its original conditions before returning to the locality are included in RAP accordingly

Table 82. Cost estimates of EMDP implementation

Activities	Monitoring and evaluation indicators		Costs (VND)	Implementation proposals
	No. of beneficiaries	No. of courses		
Technical training on agricultural production and livestock raising	840	7	232,400,000	Organize courses in the communes in the proposed area
Training on business skills and capacity (ILO *Start Your Business* program)	420	7	241,500,000	Organize courses in the communes in the proposed area
Communications on traffic safety, social evils prevention,	6,832		252,000,000	Broadcasting system in the communes in the proposed area Basic communications during the project construction phase
Subtotal			725,900,000	
Contingency cost			72,590,000	
Management cost			36,295,000	
Total (VND)			**834,785,00**	

For purpose of preparing the Project costs of 1st phase of project (3 sub-projects), a preliminary budget estimate is prepared. Compensation rates for residential and agricultural land, houses, structures, trees and crops used to estimate resettlement budget are based on a quick replacement cost survey conducted by consultants and staffs of Vinh Phuc ODA PMU. In order to establish a set of reference market prices, affected people and LFDC were consulted on compensation rates. Following Table summarize the estimated resettlement budget of the project.

Table 83. Summary of Cost Estimate for Compensation and Resettlement

No.	Type of Impacts	Quantity/ Area	Rates	Unit	In amount (VND)
River system in Binh Xuyen RAP					
Compensation and				VND	24,967,813,950

Assistance				
Compensation			VND	11,077,604,850
Compensation for productive land	71,604.30	60,000	VND	4,296,258,000
Compensation for residential land in urban area	693.30	4,000,000	VND	2,773,200,000
Compensation for business land	4,685.90	60,000	VND	281,154,000
Compensation for trees and crops	141,671.10	5,500	VND	779,191,050
Compensation for aquatic products	3,890.80	7,500	VND	29,181,000
Assistance for public land	60,804.60	48,000	VND	2,918,620,800
Compensation for temporary land acquisition (3 rice crops)	110,000	5,500	VND	1,815,000,000
Assistance			VND	12,075,209,100
Training, job changing and finding supports	71,604.30	150,000	VND	10,740,645,000
Life stability support			VND	1,042,489,500
Less than 30%	44,443.30	15,000	VND	666,649,500
From 30% to 70%	98	12,000	VND	211,680,000
More than 70%	38	12,000	VND	164,160,000
Site clearance support (bonus)			VND	157,074,600
Residential land	693.30	20,000	VND	13,866,000
Productive land	71,604.30	2,000	VND	143,208,600
Assistance for vulnerable households	45	3,000,000	VND	135,000,000
External monitoring cost			VND	600,000,000
Management cost			VND	511,356,279
Cost of implementing unit (2%)			VND	511,356,279
Subtotal (I+II+III)			VND	26,079,170,229
Contingency cost (15%)			VND	3,911,875,534
TOTAL (V+VI)			VND	29,991,045,763
Equivalent to USD			*USD*	*1,338,886*

Dong Mong disposal site RAP

No.	Type of Impacts	Quantity/ Area	Rates	Unit
Compensation and Assistances			VND	96,467,717,350.0
Compensation			VND	30,269,817,850.0
Compensation for land	410,755.00	60,000	VND	24,645,300,000.0
Compensation for crops	471,559.60	5,500	VND	2,593,577,800.0
Compensation for aquaculture	14,975.90	7,500	VND	112,319,250.0
Assistance for public land	60,804.60	48,000	VND	2,918,620,800.0
Assistances			VND	66,197,899,500.0
Training, job changing and finding supports	414,315.00	150,000	VND	62,147,250,000.0
Life stability support			VND	3,051,019,500.0
Less than 30%	66,601.30	15,000	VND	999,019,500.0
From 30% to 70%	664.00	12,000	VND	1,434,240,000.0
More than 70%	143.00	12,000	VND	617,760,000.0
Site clearance support (bonus)	414,315.00	2,000	VND	828,630,000.0
Assistance for vulnerable households	57	3,000,000	VND	171,000,000.0
Management cost			VND	1,929,354,347.0
Cost of implementing unit (2%)			VND	1,929,354,347.0
Subtotal (I+II)			VND	98,397,071,697.0
Independent monitoring	Lump sum	200,000,000	VND	200,000,000
Contingency cost (15%)			VND	14,759,560,754.6
TOTAL (III+IV)			VND	113,356,632,451.6
USD			*USD*	*5,060,563.9*

Sau Vo Lake and Access road RAP

Type of Impacts	Quantity/ Area	Rates	Unit	In amount (VND)
Compensation and Assistances			VND	166,175,632,160
Compensation			VND	72,888,051,880
Compensation for land	557,243.39	60,000	VND	33,434,603,400
Compensation for trees and crops	1,191,077.80	5,500	VND	6,550,927,900
Compensation for aquaculture	225,603.00	7,500	VND	1,692,022,500
Assistance for public land	650,218.71	48,000	VND	31,210,498,080
Assistances			VND	93,287,580,280
Training, job changing and finding supports	557,243.39	150,000	VND	83,586,508,500
Life stability support			VND	8,028,585,000
Less than 30%	210,231.00	15,000	VND	3,153,465,000
From 30% to 70%	1,285.00	12,000	VND	2,775,600,000
More than 70%	486.00	12,000	VND	2,099,520,000
Site clearance support (bonus)	557,243.39	2,000	VND	1,114,486,780
Assistance for vulnerable households	186	3,000,000	VND	558,000,000
Management cost			VND	3,323,512,643
Cost of implementing unit (2%)			VND	3,323,512,643
Subtotal (I+II)			VND	169,499,144,803
Independent monitoring	Lump sum	500,000,000	VND	500,000,000
Contingency cost (15%)			VND	25,424,871,720
TOTAL (III+IV)			VND	194,924,016,523
USD				*8,682,584.25*

Exchange rate: 1$ = VND 22,400

The cost for the allowances and resettlement assistance includes of the items which were described in the entitlement matrix (See the RAPs).

Regarding monitoring cost, Vinh Phuc ODA PMU is responsible for contracting with a monitoring consulting firm, specialized on social sciences or anthropology to carry out the independent monitoring of the project resettlement implementation. Because the cost of monitoring work has not yet detailed norms set by the Government, it is estimated as 4.1 billion VND x 3 specific subprojects for 6 quarterly monitoring reports and one post-resettlement evaluation. An/some interested independent monitoring institution(s) will prepare the technical and financial proposals for bidding and actual cost will be decided through procurement for independent monitoring.

CHAPTER 8.
PUBLIC CONSULTATION

8.1. OBJECTIVES OF PUBLIC CONSULTATION

8.1.1. EIA public consultation

Implementing ESIA requires information disclosure and public consultation in terms of environment to ensure approval of the government, NGO organizations as well as affected people in project areas. Community involvement is regarded as one of fundamental conditions, ensuring supports and showing local government and community opinions towards the project. Thanks to public consultation, some of negative impacts together with undefined mitigation measures are probably clarified and added in the report. In fact, the public involvement in project preparation could have leaded to a better relationship between the project and community and more valuable opinions from the public.

Project implementation of public consultation must be follow these principles: Regulations in Environmental Protection Law no 55/2014/QH13; Decree no 18/2015/NĐ-CP on February 14, 2015 of environmental protection zoning, strategic environmental evaluation, environmental impact assessment and environmental protection plan; Circular no 27/2015/TT-BTNMT on May 29, 2015 conducted by the Ministry of Natural Resources and Environment of strategic environmental evaluation, environmental impact assessment and environmental protection plan. Besides, public consultation has to be implemented in line with WB safeguard policies (in OP4.01).

Purpose of public consultation:

Disclosing information of project contents and proposed activities for the community, relevant NGO organizations, and local government in project areas;

Gathering opinions of the government, community, organizations and advisory expert group in terms of environmental issues, especially undefined environment problems in the report. Based on this, public opinions are noted and integrated into project design as well as environment management plan;

Ensuring accurate evaluation of entire environmental impacts and proposal for mitigation measures of environmental impacts with best results.

Fundamental principles of public consultation:

Implementation must follow regulation in Provision 4, Article 12, Decree 18/NĐ-CP dated February 14, 2015 for information disclosure and consultation of relevant communities;

Towards group A project's, public consultation is implemented in two times: (i)1st time: after completion of environmental screening and before TOR approval of ESIA preparation; (ii) 2nd time: when ESIA drafts are completed.

8.1.2. Social communication consultation

8.1.2.1. Information Disclosure during RAP Preparation

Information disclosure and public consultations are conducted during the project preparation and implementation processes to ensure that affected households and key stakeholders are timely informed about land acquisition, compensation and resettlement. This is also an opportunity for the affected people to participate and express their opinions with regards to resettlement implementation programs. The resettlement preparation in coordination with the representatives of the DPCs, Town PC and CPCs in the subproject area, and leaders of the villages organizes public meetings and consultations in order to inform and guide about the next steps in a timely manner. Organizations and individuals concerned about land acquisition and impacts and resettlement had and will take part of the public meetings and consultations. Representatives of mass organizations in the subproject that area attended the meetings and consultations included the Vietnam Women's Union, and Fatherland Front and Vietnam Farmers' Union.

Key topics covered in the public consultations are as followings:

- ✓ Disseminate key information related to policies of the World Bank, the Government, and VP-FRWMP applied to the subprojects.
- ✓ Provide locals with project on resettlement, environment, gender as well as ethnic minority issues through village loudspeaker system and project information brochures/leaflets.
- ✓ Collect opinions and feedback of the local communities regarding the project implementation.
- ✓ Collect opinions and comments of the residents on design and resettlement options as well as their aspirations and expectations are recorded.
- ✓ Respond questions to local communities concerning the project and safeguard policies. CPCs and VP-PMU provided answers to questions to local residents related to project and local policies. Local communities, representatives of the CPC's and other stakeholders' contributions and comments, were reflected in the meeting minutes.

During the preparation of the RPF, in coordination with the local authorities meetings and consultations with the affected households were carried out. This included the preparation of information on the project that was distributed in the meetings.

8.1.2.2. Public Consultation during RAPs preparation

Public consultations were conducted covering the following topics:

- ✓ Inform the local authorities as well as affected people in the subproject area about the subproject in a fully, freely and democratic manner.
- ✓ Send RAP preparation announcement to the local authorities at city/district and ward/commune levels.

- ✓ Collect feedback from the potentially affected households, including those who are not adversely affected but whom are beneficiaries.

Survey of the affected households, included: Impacts of the subproject on people's lives in the area; advantages and difficulties of resettlement; Impacts of construction on people's lives, local infrastructure; comments on the proposed compensation and resettlement plan.

8.1.2.3. EMDP consultation

Consultation with the EM peoples present in the subproject area and with other stakeholders was conducted, on the basis of identified impacts, with the aims to: a) avoid social conflicts that may arise as a result of the subproject, b) avoid/minimize adverse impacts caused by the subproject, and c) learn about opportunities brought by the subproject to ensure EM peoples present in the subproject area could receive socioeconomic benefits that are culturally appropriate to them. The EMDP was prepared on the basis of on free, prior, and informed consultation as per OP 4.10.

Inquiry techniques, used to solicit the feedbacks of the EM peoples included: group discussions, participant observations, community meetings. The consultant team provided support to use EM peoples' language, when required. To ensure language comfort from part of the EM consulted, each EM groups were consulted separately. A local person (of the same EM group) was invited to join the consultation just in case local EM language was required. It should be noted that the person who led the consultation process and interview has extensive experience background with EM peoples in Vietnam.

8.2. IMPLEMENTATION METHODS

8.2.1. Environmental Field

This is an A-type project, thus according to WB's requirements, consultation is implemented into two times in environmental impact assessment process. Design and environment advices are coordinated with the project management unit, government and communities in affected areas to implement consultation in line with WB's requirements

8.2.1.1. The first consultation:

The consultation is conducted in the first stage of FS preparing to finalize terms of references for the report. This consultation's purpose is to disseminate information of the project, responsibilities and ESIA action plan. Opinions of the community and stakeholders are collected and evaluated to complete advisory missions.

The first consultation conference was held on August 14, 2015, which include 3 main points: (i) Overview of project scale, scope and investment's sectors; ESIA report making; (ii) Discussing, contributing opinions towards project contents as well as notes for the task of making ESIA report; and (iii) distributing consultation forms to delegates for evaluations and opinions at the conference;

- ✓ Participants include: 243 representatives of local departments, offices, people's committees in districts, cities, people's committees in communes, wards and towns and local communities in project areas. Details are as the followings:

- ✓ 05 representatives of 04 departments including: Department of Planning and Investment, Department of Natural Resources and Environment, Department of Construction, Department of Transport, Department of Agriculture and Rural Development;
- ✓ 09 representatives of People's Committees in 07 districts/cities in the project area namely Vinh Yen, Phuc Yen, Tam Duong, Tam Dao, Yen Lac, Vinh Tuong;
- ✓ 229 delegates including leaders of People's Committees in communes/wards/towns and representatives of residents in administrative region of communes/wards/towns in the area

The consultant's results are as followings: (i) project information (objectives, content, locations, expected progress) have been disseminated widely to government, relevant departments and residents in the project and surrounding areas; and (ii) Collected opinions at conference or in consultation forms were gathered, analyzed, evaluated and used as fundamental information resources for other reports such as: environmental impact assessment report, technical design report, social impact assessment report, compensation and resettlement plan report, ethnic minority plan report, etc..

8.2.1.2. The second consultation:

The second public consultation was implemented after draft ESIA was completed.

The objective of second public consultation is such as: (i) getting the feed back from AHs; local authorities and NGOs on the project impacts which are identified; (ii) evaluation the proposed mitigation measurements in the draft report. The final report will be revised according to this consultation results.

The contents of second public consultation are such as: (1) Providing a brief document on the environmental impact of the project and mitigation measurements; and (2) Organization 06 public consultation meetings to introduce the project and consulting the community comments on the draft ESIA. Participants included as following: local government (CPC/DPC), local NGOs (Vinh Phuc province Federation of Scientific Societies and local organizations such as: Fatherland Front, Women's Union, Farmers' Associations, etc.) and households in the project area.

The results of 2nd public consultation such as:

(1) The consulted 43/43 wards/communes had written response to the project. The most of wards/communes in the project area agreed with the contents' EISA report; Specific comments of wards/communes focus on the content as following:

- ✓ The local flooding situation has existed since long and have significantly affected to the life and production activities of the local people. If the project is implemented which will improve the living conditions as well as crop yields of farmers.
- ✓ This project is for community project. The project will construct infrastructure for social development, therefore, completely support the project and agree with the content of the draft ESIA. However, the aspiration of local authorities is the project

stakeholders must comply with the commitment to the management and protection of the local environment; compensation and supporting policies for people in the project area as the contents of the presented ESIA.

- ✓ The construction measures must heed commuter traffic conditions, cultivation conditions, seasonality of the local people. The construction process must to fastly and timely carry out and ensure technique to avoid the delays, errors affecting the interests of local people and communities. In case, if If there is any the damage outside the project scope, should be responsible for compensation and reimbursement promptly and reasonably prevent damage to local people and communities;
- ✓ The construction plans, construction methods and mitigation mesurements; construction schedule should be specificly and widely publicized to the local people and authorities who can actively collaborate with the project and implement community supervision for the implementation of the project.

(2) 06 public consultation meetings were implemented such as: Yen Lac district (2 meetings); Binh Xuyen district (1 meeting); Vinh Tuong district (2 meetings); Tam Duong, Tam Dao districts, Phuc Yen town and Vinh Yen city (1 meeting) There are 471 participants, in which:

- ✓ 05 participants from DARD, DONRE, DPI, DoT, DoC;
- ✓ 02 participants from NGO (Vinh Phuc province Federation of Scientific Societies).
- ✓ 13 participants from 07 DPC in the project area: Vinh Yen, Phuc Yen, Tam Duong, Tam Dao, Binh Xuyen, Yen Lac, Vinh Tuong;
- ✓ 451 participants are commune/ward/town authotities, head of zone/village in 43 wards/communes in the project area and representative of local people.

The location, time, participant and detail content of 06 public consultation meeting are presented in table 7.1.

8.2.2. Social Field

8.2.2.1. RAP

Public consultations were attended by the 1,349 of affected households, CPCs, and mass organizations such as Farmers' Union and Women's Union. During the consultations discussed opinions collected from the local communities, addressing potential designed alternatives.

Key information disseminated in the meetings included: (i) scope and objectives of the subproject; (ii) processes and procedures related to compensation, assistance and resettlement; and (iii) resettlement impacts.

8.2.2.2. EMDP

Consultation process: seven consultation exercises were implemented with 66 ethnic people in the communes' in the project area and adjacent communes. The primarily group techniques included group discussions, participant observations, community meetings, ensuring that the free, prior, and informed consultation were addressed. Discussions with the EM communities were conducted at the cultural houses of the hamlets. These meetings were informed beforehand to the affected communities, to ensure their participation.

8.2.2.3. Social Assessment

During the project preparation of the SA, a socio-economic survey in 21 communes/wards in 04 project basins was carried out with participation of total 965 surveyed household, in which 330 beneficiary households and 635 affected households between August and September 2015, in 07 project communes with participation of about 90 EM people. In the project area, EM (mainly San Diu) living in Tam Dao - Basin C - which is upstream of three-river network of Binh Xuyen. Within the project, in Tam Dao there are big lakes (Lang Ha in Ho Son commune, Ban Long and Xa Huong in Minh Quang, Cuu Yen spring and Nga Hoang spring in Hop Chau commune). These lake flows through the springs and Binh Xuyen district to form a three-river system (Ba Hanh, Tranh and Cau Bon rivers).

The results of survey and consultation with local authorities showed that the dredging of three-river system of Binh Xuyen will not involve land acquisition of the population living in Tam Dao, but might be impacted on their livelihood and living conditions.

8.3. PUBLIC CONSULTATION RESULT

8.3.1. Environmental public consultation

Results of two consultations are as the table below, Images of the conferences, minutes of consultations and table of questionnaire forms are attached in Appendix 5.

No.	Area	Date	Participants		Public opinions	Feedbacks from PMU/Advisory Unit
			Local government	*Community/ affected households*		
I. The first consultation's results: TOR consultation - Consulting assessment mission of environmental impacts of the project						
	Provincial Representatives	8/14/2015	5		- Paying attention to current facilities and natural living condition of wild and plant life in project areas; - Considering more about impact assessment on aquatic life after dredging which affects to under-Red River environment when the project comes in action - Evaluating carefully impacts on the flow of Phan and Ca Lo River as well as the groundwater level in Sub-basins B1, B2 - It is necessary for a regular monitoring mechanism on the flow, removing illegal river banks, embankments which are regarded as obstructions of the flow thus prevent people from fishing (Hoang Lau commune, Tam Duong district)	Managing and advising Unit has noted all comments thus consider and gather all these feedbacks in environmental impact assessment activities of the project. Mitigation measures are proposed later.
	Tam Duong District	8/14/2015	4	43	- Support policies towards ethnic minority groups as well as particularly difficult areas affected by the project are needed - Bo Yen village, Huong Dao commune, Tam Duong district has Ben Tre canal which is in polluted condition. The canal is considered to bring into investment and resettlement category of the project; - Communicating effectively for the project to the community to acknowledge the project's importance and implementing fully benefits and individual responsibilities in the terms. - Duy Phien commune each year has about 60 ha of the flood area which is needed to improve through project implementation - It is necessary to evaluate fully social impacts, especially compulsory resettlement activities (just in case; - Proposed construction measures must ensure efficiency of drainage reducing and minimize impacts on communities	- All feedbacks are appreciated and analyzed to bring out particular assessments current situation in the region. Design plan and construction as well as appropriate policies and measures thus are based on this information to conduct.

	Vinh Tuong	8/14/2015	13	48	- The project has a huge investment amount, proper and essential objectives, therefore project should be implemented as soon as possible. Managing and allocating appropriately are also required to use reasonably the investment amount, ensuring effectiveness in construction and resettlement; - The project should be implemented as soon as possible to improve constant inundation in recent years; - Dredging in small river branches flowing into Phan Rivers considered to be added in the plan, avoiding local inundation; - It is suggested to conduct consultations in certain commune, helping people, especially related households with interests from the project, have acknowledgement about project content and policies to coordinate with the project for a good implementation; - It is required to follow strictly social and environmental policies such as compensation and resettlement policy; employment creation for people whose land is recovered; wide communication for communities to gain policy information, thus lead to good implementation; - Investigation and design work has to be completed in a good manner in order to take full advantages of invested constructions and minimize negative impacts towards residents; - Flood situation each year in Lung Hoa commune is very serious, crops are lost in many years because Phan River is not upgraded and dredged. It is necessary to renovate Phan River, protecting farmer's crops; - Project construction and implementation must be in line with actual situation, ensuring the best efficiency.	All public feedbacks are appreciated; All examined activities of current situation, fields, communication and information disclosure are implemented strictly in the coming time to acknowledge actual situation thus lead to particular measures in line with each area. This includes design and construction plan, community support policies, etc.
	Binh Xuyen	8/14/2015	10	30	- Agree with the project; however, implementing project categories close to reality is required to increase good effects when it comes into action; - Research scope and objectives have been demonstrate quite detail and clear; however, when conducting, overall assessing of environmental impacts, especially water environment of local rivers, is needed, avoiding spreading negative impacts;	• All opinions are appreciated. Evaluation and gathering opinions into the project's action plan come later.

					- Current situation of sanitation, waste water treatment in Dao Duc is facing challenges and affecting to people's health. The project's owner should consider to invest to improve pollution situation and living condition for local people; - Fieldwork units are proposed to do surveys on actual situation to have appropriate investment and take advantages of effectiveness with the aim of improving people's living condition as well as sanitation in project areas - It is needed to apply measures to impacts on areas which are not included in the project scope and the manufacturing area which are not recovered, avoiding damages for local people. - It is also important to coordinate with the local government in order to resolve problems of policies, resident inquiries related to the project, ensuring resident's interests and social security condition.	
	Yen Lac	8/14/2015	15	40	– Agree to the project's content; however, research and surveys are necessary for key investments, ensuring efficiency as targeted – Extending the river flows can damage to transport and farming on both sides of the river basins; therefore, effective transport plan is needed, allowing people can do farming the remain area; – Construction process has to follow the planned progress, involving measures to natural resource protection such as river water quality and underwater creatures; – Investigation and design work for construction has to be accurate to insure good flood control objectives and proper construction measures, minimizing impacts as well as generated waste which harm to the community; – It is better to conduct the project soon to improve local inundation and pollution; – Dredging Phan River is regarded as essential activity because current situation of sedimentation, erosion, encroachment has caused obstacles, narrowing the river areas	All contribution feedbacks are noted and noticed in the project process including research, construction and implementation, leading the best efficiency.

					which lead to slow drainage and inundation along the river. This affects both people's living and farming; – Sanitation in Lien Chau commune still have problems, the environment is polluted in many resident areas because of wastewater and solid waste; therefore, fieldworks and investment are necessary to improve the local situation.	
	Tam Dao	8/14/2015	2	9	– The project should take more care of ethnic minority areas and consider to invest in categories of clean water supply in the area; – In Hop Chai commune - Tam Dao, partial inundation, waste and wastewater pollution are significant concerns to be involved in the project – The area of Cuu Yen stream is needed for the project to check as this is an area receiving a large amount of water from Tam Dao Mountain. The project also should extend the flow from Tao Dao to Bon Bridge to improve inundation;	• All the feedbacks are appreciated. The project does further research to have appropriate measures.
	Vinh Yen	8/14/2015	4	8	– The project covers a large area, therefore strict management in terms of quantity and quality of missions, progress and implementing time is very important to ensure all targeted objectives; – Agree to the project objectives and proposed categories, the project should be conducted soon; – It is important to coordinate closely to the local government in management and implementation activities; taking seriously responsibilities towards the community;	• All the feedbacks are appreciated.
	Phuc Yen	8/14/2015	2	9	– The project should investigate and add a support category of wastewater collection system and treatment in Phuc Yen town and villages along Ca Lo River into component 2; – It also requires good communication, conducting policies in terms of compensation, resettlement, employment creation for affected people, ensuring their living condition; – Dredging, extending and resolving pollution problems in the entire area of Ca Lo River to make sure effective agricultural	• All the feedbacks are appreciate; • Consulting surveys, designing work, social and environmental assessment have to be integrated with the feedbacks in planning process of project design, construction, social and environmental

					irrigation and drainage, avoiding inundation; – When implementing in Thinh Ky Bridge, it is needed to notice drainage problems of the lake areas in Binh Xuyen district and Phuc Yen town; – The project includes many different categories so that careful investigation is very important to evaluate each category towards resident area; exchanging information with the community is also needed to provide proper solutions; – The project has to protect current constructions, avoiding damages and degradation which affect to people's life.	policies of the project.
	II. The result of 2nd public consultation: draft ESIA					
1	Binh Xuyen	31/12/2015	2	93	- Tan Phong commune is under downstream sector of Lien Son cannal as well as this project. The local people affraid that this area will become currently home to the garbage, sewage water cannal and can cause environmental pollution. The project should note to better manage measures in the operation project. - Propose to appropriated survey, geodesy and construction measures to avoid the riverbank erosion in the dredging three rivers system in Binh Xuyen; Avoid to affect the cultivation of agricultural land area on either side. During construction if affects the quality of irrigation water led to crop losses, the need to take measures to handle, effective avoid detriment to the people; - Drainage cannal of Nghe lake had affected by the construction of the Binh Xuyen 2 Industrial Zone (regularly flow localized flooding), suggest renovating the drainage canal to solve flooding the Thong Nhat village. - Construction plans must be specific and widely publicized for local people; as well as the construction unit have to comply with commitments and avoid prolonged influence local traffic, living, and production. - Consider carefully the access road of waste from the	- The problem in the design of roads, a bridge over the cannal the issue of erosion control handle both sides of the river, the access road was noted and calculated in the design project; - For the announcement of plans, construction plans; management and operation agency of the project, the PMO acknowledge and implement in the corresponding period; - For concerns about pollution waste flows, the project is also consider to propose adding the construction of collector station and waste scattered in communes along

					dredging location to Dong Mong disposal site, if using the current route is the road from Ham Rong bridge over Huong Canh to Dong Mong is not reasonable because the road is narrow, densely populated with some schools, clinics, markets. It has shortcomings and potential risks; - Working closely with local authorities to have solve the problems that arise and avoid any unnecessary problems during project implementation; - Currently, the local waste water management is not a reasonable and affect the water quality of the rivers in the region, irrigation water. The items of collection and WWTP at Son Loi should be added in this project. - Agree with the policy of building disposal site in the Huong Canh town for the dredging of water bodies in the project, but the project have to comply with such commitments, not collecting more types of waste living and other wastes to affect environmental conditions surrounding area. - Presented environmental impacts mitigation measures is reasonable, however, the project have to mechanisms for checking and supervision and constructive communication mechanisms, flexible collaboration with local people	the coast Phan river. For the suggested Nghe Lake canal improvement the PMO acknowledge and put on recommendations made in the next phase of the project.
2	Phuc Yen, Vinh Yen,Tam Dao and Tam Duong	31/12/2015	7	92	- The local authorities and people agreed to implement the project due to meet the needs of the community, to help improve the situation of flooding and environmental sanitation; - Require the project to comply with the commitments and measures as in the preliminary ESIA report was presented. - Require local authorities to participate directly in the project implementation process to protect benefits for the loca people and communities. - In the implementation process will be the impact on the environment, however, the project has also foreseen, evaluate and propose measures for satisfactory impact	- The PMO noted the comments and transfered to all relevant units from design consultants, contractors, and consultants of social, environmental, resettlement, etc. to perform seriously its duty to ensure good efficiency projects; - The addition of items of collection and WWTP are being considered and recommended to ensure the

					management; proposed construction units to do well this mitigation measures. - Currently, the local waste water management is not a reasonable and affect the water quality of the rivers in the region, irrigation water. The items of collection and WWTP at Tam Duong and Tam Dao districts should be added in this project.	conditions for effective investment and management on the whole region.
3	Yen Lac	31/12/2015	2	84	- The renovation, dredging or/and new construction the approaching and discharging cannals can cause separating the fields. The project have to note, consider the opening of infield roads or bridges two canal facilitates the cultivation and movement of people; - Van Chi village in Nguyet Duc basin is contaminated by waste at the end of the Lien Son canal; To proposed the project note and has measures good management from the outset to avoid similar situation. - Cannal/river is where waterlogging drainage, but either to waterwaste drainage, therefore, recommended to the project have to note controlling effluent quality; concurrently with design plans and both sides of the bottom appropriate channel to prevent infiltration and groundwater pollution in surrounding area. - Nguyet Duc will build pumping station with a total area of 21ha, the proposal should make clear that getting moldy, determine the area, recovery plans, as well as calculate carefully the construction plans, building and management and operation of items; risks or incidents that may occur to ensure the best performance for the project and harmonizing the interests of local communities; - Both sides of Phan river are being encroached and flow narrow, residential garbage usually be filled rivers causing siltation and pollution, especially in the segment through the craft village; recommended to the project have to	- The PMO recognized the comments; - The returning, replacement infield road/bridge was noted and included in the design plans of the project; - The project has examined the current situation of environmental pollution in the project area; especially in areas along Phan river and will have proposals to build the WWTP at the logical point to solve the problem of environmental pollution in the local area and rivers. - For the construction of Nguyet Duc pumping station, the determination of the area, specific markers will be locally made specifically in the later stages; for the design, construction, management and operation of the station will then be calculated and implemented

					satisfactory plan to unfreeze the flow and solve pollution.	to ensure safety standards.
4	Yen Lac	31/12/2015	2	63	- The construction should reasonably design and carryout and not influence to people living and transportation. - Suggest the construction have to comple with plan and avoid prolonged affecting transportation of people; Contractors should also do good work to minimize dust such as water pulverizing; refund the original ground for people after finishing construction. All the information related to the project must openly and transparently; extensive propaganda and consistency to all agencies, organizations and people know the implementation guidelines for the parties to understand the rights and responsibilities for the project to implement roles thier, thus helping to implement the project. During the implementation process if the losses incurred outside should be responsible for compensation and reimbursement promptly and reasonably prevent damage to people and communities;	- The PMO recognized the comments; - The design, construction and operation plans of the items are taken into account all factors such as traffic conditions; residential status, production situation of the local population in order to minimize the impact on daily life and production conditions; - The PMO has noted information dissemination and transparency related to the project as well as will be tried its best to implement these activities in accordance with regulations; - The project will be public and transparent all relevant policies related to he compensation and reimbursement for the damage of the people
	Vinh Tuong	31/12/2015	1	65	- The people agreed and responded with project implementation; - Under the B3 basin, this is a low-lying area, frequently flooded, theredore, the project implementation is necessary; however the project have to study local conditions, rational design plans, to ensure good performance for the project; - The project have to give a detailed map; simultaneously	- All of comments are noted; - The supporting ocuments as ESIA; map; construction schedule of the project will be publicized locally according to local regulations can actively collaborate and easily access people, as well

					providing construction schedules, construction plans; mitigation measures to the authorities and people can access easily, to local authorities initiative in coordinating and people can easily monitor and coordinate with the project. - After expanding the riverbed can cause erosion on both sides, the project should embankment or reasonable remedial measures, avoid landslides in the future. - Working closely with local authorities to have plans to solve the problems that arise and avoid any unnecessary problems during project implementation;	as monitoring the entire process of project implementation. The design plans, prevent landslides and ensure the effectiveness of flood drainage, etc. are noted by the PMO and wil be suggested design consultant in the design process
	Vinh Tuong	31/12/2015			- There is concern about river erosion problem, the problem of local roads, irrigation water for farming operations on the remaining area of both sides of the river. - The construction should strictly implement monitoring stages, including local representatives to ensure proper construction design, project quality as well as avoid errors and minimal impact on the environment and daily life of the people. Construction unit should be noted to measures to ensure safety on the roads transporting sludge to occur absolutely no incidents regrettable accident; Incase of damage to roads, bridges have to seriously overcomed and returned; - Suggest public policies and plans for compensation; public construction schedules, construction plans, construction methods so that people can track and monitor.	- The river erosion problem, the problem of local roads, irrigation water, etc. are noted by the PMO and wil be suggested design consultant in the design process - In the course of construction, the monitoring activities will be implemented in earnest: in addition to the supervision of the investor, there is an independent monitoring and environmental quality monitoring to ensure the compliance of contractors; and timely detection of adverse effects to treatment plans accordingly. - All of documents related to compensation, resettlement and the environment have been made public at the headquarters of the CPC, so

						that people can access.

8.3.2. Social public consultation

8.3.2.1. RAP public consultation results

a) Dong Mong disposal site

The project affected people (PAPs), local authorities, and mass organizations expressed their supports towards the project implementation. However, they also have various concerns and worries. Specifically:

- ✓ The local authorities and people support fully the project implementation in the area of Huong Canh Town. It is requested that during the implementation process, the stakeholders of the project must comply with the policies and laws of the Government as well as regulations of Vinh Phuc Province. The people should be informed six months in advance concerning the time and location of acquisition.
- ✓ PAPs request that the compensation must be in compliance with the set policies and the compensation rates of the project must be close to the actual prices. As Binh Xuyen District borders Hanoi, people expect that the compensation rates should be close to the compensation rates in Hanoi City. Temporary impacts must be compensated and returned to the affected people for cultivation. If the remaining area is smaller than 30 m^2, the project should acquire it to ensure farming.
- ✓ According to the representative of the mass organizations, as most households in the project area are engaged in agriculture, the project should give priority to arrange works for the new local labors.

b) 3 rivers system in Binh Xuyen RAP

- ✓ The affected households are concerned about temporary impacts due to the impoundment for dredging/construction activities. They request the PMU to calculate carefully these impacts and prepare the compensation plan.
- ✓ The detailed measurement survey must be conducted in close coordination with the local authorities.
- ✓ It is requested to acquire the area indirectly affected by the project.
- ✓ Detailed impacts on each household are not quite clear, and it is requested that the project will provide more details soon.
- ✓ The compensation rates must be close to the actual prices in the locality.
- ✓ The representatives of local authorities and mass organizations as well as PAPs request that (i) the design units to closely coordinate with the authorities; (ii) local authorities and people would like to add more project components; (iii) it is requested to add the gravity control gate at ThichTrung (Go River) and Dam Guoc and embankment for ThichTrung, Van Giao and De Hen hamlets in order to enhance the effectiveness of the project.

c) Sau Vo Lake and Access road RAP

- ✓ The compensation of the project should be consistent, and delivered fast, and important underlined, not be delayed. The PAPs also requested clarification regarding regulations on compensation for permanently affected land as well as temporary impacts (in case if the lake dredging causes impacts on rice fields or leads to fish deaths); impacts emerged during construction period must be compensated; the unviable remaining area must be acquired and policies on reclaimed land area. The major concern among PAPs is about "land combination and exchange", which was carried out, negotiated, agreed and certified by the CPCs; So when implementing, the Project will implement compensation and assistance payment on the basis of the CPCs' certification on land consolidation and the compensation is at replacement costs.
- ✓ The commune leaders requested that the project owner and Vinh Phuc Provincial Land Fund Development Center should coordinate closely with the authorities during the land clearance process in order to identify accurately land owners and users.

All participants agreed and supported the project implementation as well as its policies and expected that the project would be implemented soon so that people would have better opportunities in developing production and improving living standards.

Public consultations after the completion of the draft RAP will be organized with the aims to provide information and consult with the PAHs and concerned organizations and individuals regarding (i) results of impact calculations; estimated compensation rates; and entitlements; (ii) compensation payment procedures and Opinions and comments of the PAPs will be collected fully and accurately, thereby, creating opportunities for the PAPs to take part in developing their resettlement plan in order to ensure transparency and democracy in development.

8.3.2.2. EMDP public consultation results

The EM communities and households in the subproject area confirmed that they were informed about the subproject. As to the EM communities in the communes adjacent to the subproject area, they were also aware of the subproject through consultation meetings organized by the consulting agency. Through the public consultations, the EM people were aware of the benefits and positive effects brought by the subproject. In addition, adverse impacts caused by the subproject were also identified.

Being fully informed about the subproject, the EM communities have given their broad support for the subproject implementation. In addition, they have specific comments and suggestions which focus on two aspects: (i) recommendations related to the subproject construction activities; and (ii) proposals related to community development. Their comments are summarized as follows:

- ✓ The subproject should be implemented in a timely manner to minimize the impact;
- ✓ Support clean water provision
- ✓ Organize technical training courses on livestock raising; provide financial support and information on market for livestock products for people; establish small-scale

livestock raising enterprise models.

- ✓ Organize technical training courses on agricultural production with focus on clean vegetable growing model for exports.
- ✓ Support people in using available financial resources to invest in activities that generate economic benefits for the households.

8.3.2.3. SA public consultation results

Table 84. The result of public consultation during the SA

Results
✓ Screen the area where ethnic minorities are living in Vinh Phuc ✓ Find out cultural identities and festivals of ethnic minorities
✓ Tam Dao District ✓ Support the implementation of project since the project will contribute to improve existing drainage system ✓ In this area, there is 12,067 of ethnic minority people living (San Diu, accounting for 43% of total population). ✓ The project will not affect ethnic minority
✓ Binh Xuyen District ✓ Support the implementation of project since the project will reduce flooding situation in commune. ✓ In this area, there is 4,270 of ethnic minority people living (San Diu, accounting for 30.2% of total population). ✓ The project will not affect ethnic minority
✓ Phuc Yen Town ✓ Support the implementation of project since the project will reduce flooding situation in commune ✓ In this area, there is a 6,435 of ethnic minority people living (San Diu, accounting for 6.7% of total population). ✓ The project will not affect ethnic minority

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSION

Environmental Aspect

The project implementation is consistent with the Vinh Phuc socio-economic development masterplan. The ESIA was prepared to identify all potential positive and negative impacts to the natural environment, local economy and society, to propose mitigation measures, and to delineate an environmental management and monitoring plan.

The assessment of potential negative impacts as identified in the report, include general impact and site-specific impacts for each component and each basin (B and C). The impacts are assessed according to the phases of the project including project preconstruction phase, construction phase and operation phase.

During the preconstruction stage, the negative impacts identified are mainly related to land acquisition, compensation and resettlement and clearance of UXO.

In the construction phase of the project, environmental impacts are mainly related to the generation of dust, emissions from dredging operations, earthworks, transportation and the operation of facilities and vehicles or wastewater from construction, domestic wastewater of the workers, construction and domestic solid waste. To minimize these impacts, mitigation measures have been proposed and ECOPs will be included in the contract for the construction contractors and construction supervision consultants.

In addition to the general environmental impacts, a number of site-specific environmental impacts are identified and mainly related to the dredging works of the Phan river basin, Binh Xuyen rivers, retention lakes and pump stations. They include impacts on the hydrological regime, the impact of the dredged material, the risk of erosion in the dredged areas, affecting aquatic ecosystems, the risk of flooding etc. For each impact, the ESIA report recommended appropriate mitigation measures. These include, for example:

- ✓ Diversion measures for dredging works to ensure sufficient drainage capacity of rivers and successive construction measures for reducing impacts on aquatic habitats
- ✓ Dredged materials are carefully checked on heavy metals. They must be dried and transported to appropriate sites, e.g. heavy metal loaded materials are disposed in Dong Mong site.
- ✓ Avoid transportation of dredged material using roads in densely populated areas.
- ✓ Avoid construction in rainy season and farming time.

An environmental monitoring and supervision program has been proposed, in accordance with the scale of the project and the regulations of the government of Vietnam and the WB on environmental monitoring during project implementation in which the responsibilities of each unit are well indicated. The monitoring and supervision results will be submitted to the environmental authorities of Vietnam and the World Bank on a regular basis.

The ESIA has also been disclosed to the local authorities and people in the Project area and constructive and mostly positive comments were received from stakeholders consulted.

SocialAspects

The Project will generate positive environmental, social and economic impacts during the operational phase. This includes (i) Increasing flood drainage capacity, water storage capacity and regulating water for Phan and Ca Lo rivers meeting water demands for communes along these rivers; (ii) improving of ecological environment and forming the regulatory lakes, compatible with overall planning of urban construction of Vinh Phuc province until 2030 and vision to 2050; (iii) implementing step by step drainage solution planning for entire Phan and Ca Lo river basin in Vinh Phuc; (iv) upgrading infrastructure of rivers, drainage canals in the event of heavy rain causing flooding and (iv) creating trust to attract FDIs into the exploitation of infrastructure and connection with Trans-Asia route of Hanoi - Lao Cai, focusing on attracting investments into the development of Binh Xuyen, Ba Thien, Tam Duong Industrial Zones and inland ICD port.

The alternative design were reviewed carefully. However, involuntary resettlement is inevitable. It is estimated that 6,229 households could be affected throughout project life, of which an estimated 1,916 would be affected households under the three year-one subprojects. None of EM peoples are potentially affected as a result of permanent land acquisition although some 20 EM households could be potentially temporarily affected during the construction of the Binh Xuyen subproject as a result of land acquisition and possible fishing activities.

RECOMMENDATIONS

Environmental Aspect

As a large-scale project Vinh Phuc Flood Risk and Water Management aims to bring more socio-economic benefits to Vinh Phuc province. Therefore during the implementation of the project the cooperation and coordination of related agencies, especially the support from the World Bank for financial and technical assistance, is needed.

The project implementation will generate some potential negative impacts, therefore measures to minimize environmental impact in accordance with ECOPs and EMP must be executed throughout the project life and community and local governments should work together to strengthen supervision.

Social Aspect

The main negative social impacts related to the project includes: i) involuntary resettlement; iii) loss of livelihoods; iii) impacts on vulnerable groups; iv) impacts on safety and health.

These impacts will be mitigated through a number of plans and programs prepared for the Project:

- Resettlement Policy Framework
- Ethnic Minority Policy Framework
- Resettlement Action Plan;
- Ethnic Minority Development Plan
- Social Action Plan
- Gender Action and Monitoring Plan
- Community Health Action Plan
- Stakeholder Participation Plan

The PMU will be in charge of the implementation of these plans and programs and will ensure appropriate implementation in order to minimize negative impact to livelihood of local people, propose PMU to develop micro finance programme, agricultural Extension Services and training course on business development skills for affected households.

This social assessment will be updated during detailed design to take into account the possible changes in design.