PEOPLE'S COMMITTEE OF THAI NGUYEN PROVINCE
PEOPLE'S COMMITTEE OF THAI NGUYEN CITY
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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

(Final Report)

DYNAMIC CITIES INTEGRATED DEVELOPMENT PROJECT (DCIDP)

THAI NGUYEN CITY SUBPROJECT

THAI NGUYEN, MARCH 2018

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DYNAMIC CITIES INTEGRATED DEVELOPMENT PROJECT (DCIDP)

THAI NGUYEN CITY SUBPROJECT

PROJECT OWNER
PEOPLE'S COMMITTEE OF THAI NGUYEN CITY

CONSULTANT
VIETNAM AE INVESTMENT AND CONSULTANT JOINT STOCK COMPANY

THAI NGUYEN, MARCH 2018

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ABBREVIATIONS

AHs	Affected households
CC	Climate change
AC	Asphalt concrete
CeC	Cement concrete
CSC	Construction Supervision Consultant
DCIDP	Dynamic Cities Integrated Development Project
DED	Detailed Engineering Design
DOC	Department of Construction
DOF	Department of Finance
DONRE	Department of Natural Resources and Environment
DOT	Department of Transport
DPI	Department of Planning and Investment
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
ECOP	Environmental Code of Practice
ESMP	Environmental and Social Management Plan
EMS	Environmental Monitoring System
FS	Feasibility Study
HH	Households
IEMC	Independent Environmental Monitoring Consultant
MOC	Ministry of Construction
MONRE	Ministry of Natural Resources and Environment
ODA	Official development assistance
PPMU	Province Project Management Unit
PPU	Project Preparation Unit
PSC	Project Steering Committee
RAP	Resettlement Action Plan
RPF	Resettlement Policy Framework
P/CPC	Provincial / City People's Committee
URENCO	Urban Environment Company
WB	World Bank
WHO	World Health Organization

EXECUTIVE SUMMARY

Background

The Dynamic Cities Development Project (DCIDP) will support secondary cities1: (i) improve access to, and reliability of, urban services for the bottom 40% of population; (ii) promote the development of neighborhoods with access to high quality public spaces and public transport; and (iii) support continued socio-economic growth. The Project is implemented in five cities of Thai Nguyen (Thai Nguyen Province), Yen Bai (Yen Bai Province), Hai Duong (Hai Duong Province), Tinh Gia (Thanh Hoa Province) and Ky Anh (Ha Tinh Province). The implementation duration of DCIDP is estimated at 6 years, from 2018 to 2023. Total project investment is 395 million USD.

Thai Nguyen City Subproject consists of components similar to components of DCIDP: Component 1 - ***Structural component:*** (1) Construction of South North road & Huong Thuong bridge; (2) Construction of Huong Thuong - Chua Hang Road; (3) Upgrading of Dong Bam Residential Area Road; (4) Upgrading of Dan Bridge; (5) Upgrading of Le Huu Trac Road; (6) Rehabilitation of Xuong Rong Drainage Ditch; (7) Rehabilitation of Mo Bach Drainage Ditch; (8) Construction of Huong Son Kindergarten; (9) Upgrading of Phan Dinh Phung Kindergarten; and Component 2 - ***Non-structural component:*** aim to strengthen capacity of province in economic planning and spatial planning to ensure relevance with the strategies and efficiency of the city's infrastructure investments. Total investment for implementing Thai Nguyen City Subproject is 100 million USD.

Legal and technical bases for ESIA

According to the screening results, Thai Nguyen City Subproject is classified into Category B on Environment due to relatively potential impacts and risks that are site-specific, reversible and mitigable through design alternatives. WB's safeguard policies to be applied to Thai Nguyen City Subproject include: (a) Environmental assessment (OP 4.01); (b) Natural Habitats (OP/BP 4.04); (c) Physical cultural resources (OP/BP 4.11); (d) Involuntary resettlement (OP/BP 4.12); and (e) Forests (OP/BP 4.36). This ESIA is prepared based on OP 4.01. ESIA include the proposed works for the Component 1 - Structural component of the Sub-Project.

Description of the Subproject

Thai Nguyen City Subproject include the items of construction, upgrading and rehabilitation of 9 works: (1) Construction of the South North road (L=3.2km, B_{base} = 41m, elevation varies from 24 to 27m) – Huong Thuong bridge (L=319.4m, live load HL93, Clearance height >4.75m); (2) Construction of Huong Thuong – Chua Hang road (L=5.72km, B_{base} = 41m, elevation varies from 25.7 to 29.3m), Mo Linh 1 stream overpass (L=128.5m, live load HL93, clearance height of 5-7m); (3) Upgrading and newly building of Dong Bam road (L=3.4km, B_{base} = 15.5-36m, elevation varies from 27 to 29m), Mo Linh 2 stream overpass (L=82.3m, live load HL93, clearance height of 4-6m); (4) Upgrading of Dan bridge (L=42.0m, live load HL93, Surface elevation +38.5m); (5) Upgrading and Newly-building of Le Huu Trac road (L=1.7km, B_{base} = 27m, elevation varies from 34 to 39m; (6) Rehabilitation and embankment of Xuong Rong ditch (L=3.2km, B cross section = 8-25m; wastewater collection pipeline of 3.8km long); (7) Rehabilitation and embankment of Mo Bach ditch (L=3.8km, B cross section = 8-25m; wastewater collection pipeline of 6.6km long); (8) Construction of Huong Son kindergarten (S = 6,151 m^2, 24 classrooms, 500 pupils); (9) Upgrading of Phan Dinh Phung kindergarten (S =

[1] The urban serves as a political, economic, cultural, scientific, technical and service center, a traffic hub in the province. The urban population is 150,000 people or more, the urban population density is 6,000 people / km^2 or more, the rate of non-agricultural labor in the total urban labor force from 75%. The infrastructures are built on a synchronized and complete surface;

3,330 m^2, 18 classrooms, 400 pupils). Each work item will be implemented from 15 to 24 months (from January 2020 to December 2023).

Environmental and social background

In October/2017, 23 air samples, 23 samples of surface water, groundwater, 06 samples waste water and 22 sediment and soil samples were monitored and analyzed to evaluate quality of environmental baseline at the subproject area. The results of field surveys and environmental monitoring showed that the quality of air, surface water, groundwater, soil and sediment was quite good. However, at some locations near the roads: crossroads of the South North road and Cach Mang Thang Tam road, Mo Bach due to high traffic density, noise level exceeds 1.1 times compared than the permitted limit. At the drainage ditches of Xuong Rong and Mo Bach, although the analyzed indicators are within permitted levels as stipulated in Vietnamese Standard but the water has black color and odor.

Most of the subproject sites are far from residential areas: The works are located within Thai Nguyen city, so they are all located in the residential areas, except for some roads passing through paddy fields. Some sensitive works include: (1) Huong Thuong commune kindergarten located 230m from the ending point of the South North – Huong Thuong bridge; (2) 80 ha of rice irrigation from Huong Thuong pumping station is affected by relocation of the pumping station; (3) Linh Trung communal house located nearby Km0+800 of Huong Thuong – Chua Hang road; (4) Thong hamlet lake located nearby Km1+700 of Huong Thuong – Chua Hang road; (5) Nam Son hamlet church located nearby Km^2+400 of Huong Thuong – Chua Hang road (serving spiritual life of 380 Christians); (6) Cemetery in Chua Hang ward located about 80m from the ending point of Huong Thuong – Chua Hang road; (7) Monument to War Heroes and Martyrs in Chua Hang ward located about 120m from the ending point of Huong Thuong – Chua Hang road; (8) Cemetery in Nhi Hoa village located about 130m from the road passing through Dong Bam residential area; (9) Cemetery near Dong Bam residential area located about 50m from the road passing through Dong Bam residential area; (10) Thai Nguyen Provincial Mental Hospital located about 90m from the starting point of Le Huu Trac road; (11) Thai Hai primary school and kindergarten located about 30m from Mo Bach drainage ditch. No physical culture resource is affected in 9 subproject areas.

Environmental and social impacts and risks

Potential negative impacts and risks of the subproject have been identified. Most of the impacts are temporary, localized and reversible due to the medium-scaled works. These impacts are mitigable by application of appropriate technologies and site-specific mitigation measures, close monitor by Contractors and consultation with local people.

- ***Generic impacts***

Dust, exhaust gases, noise, vibration, wastewater, solid waste from construction and domestic activities of workers. These impacts are considered as LOW to MEDIUM for each works and mitigable.

- ***Site-specific impacts***

Impacts of land acquisition: It is estimated that the Subproject implementation will permanently acquire 491,642 m^2 land owned by 1,317 households and managed by 14 people's Committees of communes/wards/towns, of which the paddy land occupies the most (35.07%), followed by residential land (24.74%), annual crops land (14.96%) and perennial crops land (10.26%). The types of production forest land, aquaculture land and organizations' land occupied the lowest proportion (<10%). A total of AHs of the Subproject is 1,347 households, of which 1,317 households are affected on land and 30 households are affected on graves (58 graves to be affected and relocated). Out of 1,317 households affected on land, there are: (i) 415 households are affected on residential land, including 133 relocated households; (ii) 862 households are

affected on agricultural land (paddy land, crop land), of which 299 households are severely affected; 73 vulnerable households; (74 households are affected on business of consumer goods, vegetables, fruits and coffee; (v) 13 households are affected on aquaculture land; (vi) 27 households are affected on production forest land (planting acacia, melaleuca). Details are shown in the RAP of the Subproject.

Impacts on water environment occur at two ditches of Xuong Rong and Mo Bach and 04 bridges (Huong Thuong, Mo Linh 1, Mo Linh 2, Dan). Excavation and backfilling for reinforcement of embankment, piers and abutment as well as dredge of Xuong Rong and Mo Bach ditches will contribute to increase in suspended solid wastes which are swept away toward the downstream. In addition, the run-off may sweep pollutants in the area (construction materials, soil, sand, grease and wastes, etc.) to water bodies (Cau river, Mo Linh stream, Xuong Rong and Mo Bach ditches), causing water pollution. These impacts are assessed from LOW to MEDIUM, temporary and mitigable.

Impacts by erosion, subsidence and damages on existing structures: During construction, some activities such as piling, excavation at the construction sites of NH3 overpass, Xuong Rong and Mo Bach ditches, Huong Son and Phan Dinh Phung kindergartens can cause subsistence or damages on surrounding areas. These impacts are assessed as HIGH in case of rains and LOW in case of no rain and mitigable by selection of appropriate construction methods and time.

Impacts on waterway transport on river: These impacts occur at the construction site of Huong Thuong bridge and prolong within 20 months. Due to frequency of waterway transport of 1-2 trips/day, these impacts are assessed as LOW and mitigable.

Impacts on learning and teaching at Phan Dinh Phung kindergarten: Construction of the existing kindergarten for building new school will affect the teaching and learning of 350 children and 26 teachers and parents' picking up children. These impacts will prolong within 15 months and assessed as MEDIUM and mitigable.

Malodor from dredged materials: These impacts occur at the two ditches of Xuong Rong and Mo Bach. Total dredged sludge volume from the two ditches is 30,050 m^3 (mainly organic sludge), in which there are 24,400m^3 from Mo Bach and 5,650m^3 from Xuong Rong. The dredging activities will disturb the current balance, evaporate persistent organic compounds and cause offensive malodors, affecting workers and local people.

Water leakage from dredged materials during dredging of Xuong Rong and Mo Bach ditches. It is estimated there is 20% of total dredged sludge volume. Thus, the total amount of water leaking from the dredged materials is 6,010 m^3, equivalent to 16.69 m^3/day. This water volume is led back to Xuong Rong and Mo Bach ditches. Results of sediment monitoring at Xuong Xuong and Mo Bach ditches showed that the sludge showed no sign of contamination with heavy metals, so the seepage water compositions contained high content of TSS, affecting aquatic life of the receiving sources. These impacts are assesses LOW and mitigable.

Impacts on agricultural production activities: There are 862 affected households. Impacts on agricultural production take place in the South North road and Huong Thuong bridge, Huong Thuong - Chua Hang road, Dong Bam road, Le Huu Trac road, Xuong Rong and Mo Bach ditches. These households lost land or the construction process affects their cultivation (waste, wastewater, construction materials filling in fields, causing damage to rice and crops). These impacts are assessed as LOW and mitigable.

Impacts on groundwater quality due to pile driving or drilling activities at the distance of 8 - 20 m at the construction sites of Huong Thuong, Mo Linh 1, Mo Linh 2, Dan bridges and NH3 overpass or at 02 ditches of Xuong Rong and Mo Bach. During the pile drilling, bentonite containing additives will be submerged in the water cascade complex and infiltrate into the groundwater fountains, causing pollution. Contaminated surface water will penetrate into soil, which is reason for groundwater pollution. These impacts are assesses as LOW and mitigable.

Impacts on traffic at the construction sites of bridges: These impacts will occur at the construction sites of Dan bridge and National Highway 3 overpass (on Le Huu Trac road). Dan bridge is the unique bridge connecting two ends of Quang Trung road, the construction of Dan bridge will affect traffic within approximately 18 months, affecting about 500 households living on the two bridge ends, affecting about 12,000 vehicle trips per day (including motorcycles, cars, passenger cars and trucks). The construction of NH 3 overpass will affect traffic on National Highway 3 with potential risks of traffic accidents. This is an important route to connect Hanoi and the Northern mountainous provinces; therefore the traffic flow passing through the area is huge. However, the impacts are assessed as LOW due to appropriate mitigation measures.

Business interruption: Construction of the South North road, Huong Thuong - Chua Hang road, Le Huu Trac road will affect 74 business households. These households are trading in cake, candy, fruits, vegetables and coffee restaurants and beverages. However, theses impacts are assessed as LOW and mitigable.

Dust and exhaust gases from welding stage occur during the construction of bridge items such as Dan bridge, Mo Linh 1 and Mo Linh 2 bridges, and National Highway 3 overpass and Huong Thuong bridge. The types of chemicals contained in welding rod will generate smoke that contains toxic substances, causing environment pollution and affect the health of the workers. The electric welding creates extremely strong light and can cause serious injuries to workers' eyes. These impacts are assessed as LOW and mitigable.

Risks and unsafety in construction nearby the production forest might happen in the works of Huong Thuong - Chua Hang road, Le Huu Trac road and Mo Bach ditch. Construction near the production forest might cause: (i) Potential risks for workers who are directly involved in construction by insects, bees, mosquitoes or snakes, predators; (ii) Workers may get diseases such as influenza, dengue fever, malaria, gastrointestinal disease, and skin diseases; (iii) workers' hunting and trapping animals for food, cutting down trees for firewood; (iv) risks of forest fire due to workers' carelessness in cooking and smoking. However, this impact is assessed as LOW and mitigable through the compliance with rules and regulations on construction site and appropriate construction methods.

Impacts on sensitive works: The construction of different subproject items may affect 11 sensitive works located near the construction sites of 5 work items: (1) South North road & Huong Thuong bridge; (2) Huong Thuong – Chua Hang road; (3) Upgrading and construction of Dong Bam road; (4) Upgrading and Construction of Le Huu Trac road; (5) Rehabilitation of Mo Bach stream drainage ditch. Dust, noise, vibration and traffic accidents during the construction will affect studying, teaching and pick-up of 300 pupils in Huong Thuong kindergarten, 350 pupils at Thai Hai kindergarten and teachers as well as parents of pupils. In addition, spiritual and cultural activities of local people in communal house, church, cemetery will also be affected, especially risks of conflicts between workers and 380 Christians at Nam Son hamlet church. These impacts are assessed as LOW and mitigable.

Mitigation measures

Mitigation measures of generic impacts

Mitigation measures for site-specific impacts for each impact source have been mentioned above in each phase of the Subproject, including mitigation measures of generic impacts (ECOPs), mitigation measures of site-specific impacts for sensitive works as well as mitigation measures of social impacts.

Site-specific impacts

Social impacts: (i) Mitigation of impacts by land acquisition of households in the Subproject area; and (ii) priority construction methods require minimal land acquisition area. The estimated

cost of implementing the RAP for subproject works is 402,970,000,000 VND, (equivalent to 18,111,000 USD)

Mitigation of impacts on water environment: Carry out dredging in dry season; wastewater is poured into settling tanks before discharging into environment; strictly prohibit contractors to discharge waste into river; construction materials must be covered with canvas and gathered far from water resources; Dredged materials are transported to Da Mai and Tich Luong ward disposal sites on daily basis.

Mitigation of impacts caused by erosion, subsidence and damages to existing structures: Notify the local people of construction time; reinforcement before dredging; Closely monitoring the vibration level; Do not carry out dredging works in rainy season; Do not place heavy machineries and transportation vehicles near the canals, ditches.

Mitigation of impacts on waterway transport on river: Coordinate with the local authority to inform local people of the construction plan prior to construction; Coordinate with waterway management unit to flag the signal system on the inland waterway where means of transport will travel through.

Mitigation of impacts on studying and teaching at Phan Dinh Phung kindergarten: Inform pupils at least one month in advance of the estimated relocation schedule to temporary place; Consult with parents on measures to minimize the psychological effects of children during the relocation process; Ensure water supply, electricity supply and facilities at the temporary place of teaching and learning; Notify the local community around the temporary place of teaching and learning of the teaching and learning plan of Phan Dinh Phung Kindergarten; Relocate to a temporary place of learning and teaching nearby the current place of the kindergarten.

Mitigation of impacts by malodor from dredged materials: Notify the construction progress of each section dredging for surrounding people; Dredged materials are transported to the disposal site by specialized vehicles; Do not gather dredged material along the ditches; Use lime powder to limit malodor dispersion, if necessary; Do not construct at the rest time, limit construction after 18h; Consult closely with local people and communities for appropriate mitigation measures; Provide adequate personal protective equipment for all workers; Prepare the dredged material management plan before construction commencement.

Mitigation of impacts by leaking water from dredging of Xuong Rong and Mo Bach ditches: Dredging activities are only carried out in the dry season; Water leaking from sediment must be deposited in settling tank/trap before discharging into river; The process of transporting dredged materials must use specialized vehicles with containers; No dredging at the time of water intaking for agricultural production activities of the local people; Prepare the dredged material management plan before construction commencement.

Mitigation of impacts on agricultural production: Informing the community of the construction schedule at least two week before the construction; Arrange drainage around the construction sites to prevent soil erosion and sedimentation into the rice fields and irrigation canals; Regularly check the affected on-field irrigation canals to ensure they are not blocked by construction spoil or waste and if they are affected, provide alternative irrigation water from canals to the locations the local people request; Immediately rehabilitate irrigation canals if they are damaged by construction activities to ensure that water supply for the rice fields is maintained; Closely consult with the local community to ensure that suitable solutions to problems are taken and communities' concerns related to construction activities are addressed.

Mitigation of impacts on groundwater quality: Coordinate with the local authority to inform local people of the construction plan prior to construction; Coordinate with the management unit of waterway to flag the signal system on the inland waterway the transport will travel through; Provide the workers with all appropriate PPE and ensure that life jackets are used in proximity to water. Safety staff must be available at all times for timely rescue in case of

incidents; Place warning boards along the construction route, both on land and water surface (arrange the road and waterway traffic guide).

Mitigation of impacts on traffic circulation at the construction site of bridges: Ensure that the contract requires the contractor, before commencing work, to provide a construction plan with a detailed health, safety, environment and traffic management plan, which has to be provided to the local authorities and approved by CSC; Inform local residents in advance (at least one week) of construction and work schedules, interruption of services, traffic routes. Inform the community of the planned night construction at least 2 days in advance; Put and maintain bulletin boards at the construction site, containing the following information: full name and phone number of the Contractor, Site Manager, Supervision Consultants and Subproject Owner, duration and scope of work; Contractors should provide lighting at all construction sites at night; security guard staff at construction sites to moderate vehicles entering and exiting the construction site; Put road construction warning signs at the site and maintain them for the duration of the work; Sediment shall be transported out of construction site or transfer site within the day. Do not transport sediment during rush hours; Limit the construction area to that within the designated site boundary; Assign staff to control traffic during transportation, loading and unloading, at construction sites and sediment transfer site.

Mitigation of impacts due to business interruption: Inform the street household businesses of the construction activities and their potential impacts such, waste, dust, and noise, traffic, and construction schedule at least 02 weeks before start of the construction; Provide safe and easy access to the household businesses putting clean and strong thick wood panels or steel plates over the open ditches or manholes; Do not use machines generating loud noise and high vibration levels near the household businesses; Spray sufficient water to suppress dust during dry and windy days at least three times a day at site that is near household businesses; Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes, and to guard high risk operations; Cleaning up construction areas at the end of the day, especially construction areas in front of business shops; Manage the worker force to any avoid the conflict with the local people and household businesses; Compensate goods, products damaged by construction activities of the subproject; Immediately address any issue/problem caused by the construction activities and raised by the local household businesses.

Mitigation of impacts due to dust and exhaust gas from welding: Clearly notify the local community of the welding plan; Do not weld in the head of wind direction, the area is easy to fire; Provide labor protective equipment for workers; Provide eye protection equipment for workers directly involved in the welding process; Provide signboards or warning signs for the welding areas.

Mitigation of impacts on sensitive works

Inform local people of the construction schedule; Do not transport and use machines with high noise and construct items generating much dust, noise through the Church in primary religious festivals; Install fences and barriers for the areas at danger/ prohibited areas surrounding the construction site with potential risks to community; Increase the frequency of watering 4 times per day for the areas near Huong Thuong commune kindergarten, Thai Hai kindergarten and Nam Son hamlet church; Request workers to strictly comply with labor regulations; Hire local labor.

Environmental and Social Management Plan

ESMP of Thai Nguyen City Subproject includes mitigation measures of negative impacts, roles and responsibilities for ESMP implementation, monitoring specialists, environmental compliance frameworks, reporting organizations, environmental monitoring program, capacity building program and ESMP implementation cost. In particular, the cost of environmental

quality control is about 3,441 USD and the cost of independent environmental monitoring is 98,629 USD and the cost of capacity building is 20,000 USD and cost for HIV/AIDS awareness training is USD 12,302.

During the development process, the ESMP requires the involvement of several stakeholders and agencies with specific roles and responsibilities. They are the Provincial Subproject Management Unit, Thai Nguyen Department of Natural Resources and Environment, Contractor, Construction Supervision Consultant (CSC), Independent Environmental Monitoring Consultant (IEMC) and local community.

Public Consultation and Information Disclosure

Public consultation: Public consultations have been carried out for two rounds in 14 wards/communes/towns of Thai Nguyen city in August and November, 2017. Participants of the public consultation meetings include representatives of the authorities, mass unions and affected households. Local authorities and people of ward/commune in the subproject area totally agreed with the implementation because it will bring many socio-economic and environmental benefits. However, it was required to ensure environmental sanitation during construction process, particularly prevention from dust, gas, damage of roads and construction needs to be fast to ensure scheduled progress.

Information disclosure: The first draft of ESIA in Vietnamese have been disclosed at offices of 14 communes/wards and Thai Nguyen city PMU in November 2017 to carry out public consultation. The final draft of ESIA in English have been disclosed at offices of 14 communes/wards and Thai Nguyen city PMU on November 24th, 2017. The final ESIA in English will be disclosed in the internal website and publically on November 28th, 2017.

INTRODUCTION

A. Background of the Subproject

A.1 Overview

DCIDP will support secondary cities[2] that have demonstrated both current significance and future growth potential as province- and region-level urban economic centers. Consistent with Vietnam's National Master Plan and aligned with the World Bank's Twin Goals, the objective of the proposed project is to provide improved urban infrastructure services and support integrated urban planning and management in the project cities. As consistent with the cities' approved master plans, the proposed operation will also provide financing for the strategic municipal infrastructure that will help the cities: (i) improve access to, and reliability of, urban services for the bottom 40% of population; (ii) promote the development of neighborhoods with access to high quality public spaces and public transport; and (iii) support continued socio-economic growth (e.g., by enhancing productivity and localization economies, removing infrastructure constraints, improving connectivity, facilitating local job creation, etc.). The proposed operation will also support the project cities in addressing fundamental urban development challenges through technical assistance (TA) for improved urban planning and management that will promote more compact, sustainable urban development, and the development of higher quality neighborhoods.

The Project covers five cities of Thai Nguyen (Thai Nguyen Province), Yen Bai (Yen Bai Province), Hai Duong (Hai Duong Province), Tinh Gia (Thanh Hoa Province) and Ky Anh (Ha Tinh Province). Each of the project cities benefits from significant endowments, which have driven strong local and regional economic growth over the past decade.

The development objectives of the proposed project and components. The development objectives of the DCIDP are to increase access to improved urban infrastructure services and enhance integrated urban planning and management capacity in the project cities. The project is proposed two following components:

- **Structural Component**: A series of municipal investments will be financed in each project city to improve the access to and quality of critical urban infrastructure services, including those in urban environmental sanitation, and urban transport. The selection of infrastructure sub-projects will be aligned with the respective updated city master plans of each city and will be rigorously prioritized to ensure that these: (i) improve access to, and reliability of, urban services for the bottom 40% of the population; (ii) promote the development of neighborhoods with access to high-quality public spaces and public transport; (iii) support continued socio-economic growth; and (iv) meet accepted standards for technical and economic soundness
- **Non-Structural Component:** A comprehensive package of TA and project implementation support will be provided to the PPCs of the project cities to strengthen their capacities for economic and spatial planning, and to ensure the strategic relevance and efficiency of the municipal infrastructure investments to be financed under the structural component of the project. To meet specific demands of each project city, technical assistance activities will include: (i) strategic socio-economic spatial planning; (ii) integrated urban management and planning (including public transport development strategies); (iii) urban asset management; (iv) disaster risk management; and (v)Specialized development planning for key cities.

[2] The urban serves as a political, economic, cultural, scientific, technical and service center, a traffic hub in the province. The urban population is 150,000 people or more, the urban population density is 6,000 people / km^2 or more, the rate of non-agricultural labor in the total urban labor force from 75%. The infrastructures are built on a synchronized and complete surface;

A.2. Thai Nguyen City Subproject

Thai Nguyen city is located in the center of Thai Nguyen province. It is the political, economic, cultural, educational and science technical centers of Thai Nguyen province. In recent years, the provincial government and Thai Nguyen city have focused on infrastructure development and environmental improvement. The objectives that Thai Nguyen city has been focusing its resources on are the completion and development of an urban infrastructure system that is fully aligned with the WB's twin goals of eliminating extreme poverty and boosting shared prosperity. Being selected to join the DCIDP, Thai Nguyen City will have more resources to gradually improve and develop sustainably urban infrastructure serving the people and economic growth of the locality. The Subproject's objectives are as follows:

- Overall objectives: To increase access to improved urban infrastructure services and enhance integrated urban planning and management capacity.
- The specific objectives of the Subproject include: (i) strengthening connectivity and improving the quality of the urban transport infrastructure; (ii) Improving the environmental quality of the residential area due to the wastewater pollution in the city center area, improving drainage capacity of some of main drainage ditches of the city; (iii) Strengthening the capacity of the city to meet the need for kindergarten education.

To achieve these objectives, the Subproject will cover two components as follows:

Component 1 - Structural Component: Newly-built or upgraded works as follows:

- Works No. 1: South North road & Huong Thuong bridge Construction
- Works No. 2: Huong Thuong - Chua Hang Road Construction
- Works No. 3: Dong Bam Residential Area Road Upgrading
- Works No. 4: Dan Bridge Upgrading
- Works No. 5: Le Huu Trac Road Upgrading
- Works No. 6: Xuong Rong Stream Drainage Ditch Rehabilitation
- Works No. 7: Mo Bach Stream Drainage Ditch Rehabilitation
- Works No. 8: Huong Son Kindergarten Construction

  Works No. 9: Phan Dinh Phung Kindergarten Upgrading

Component 2 - Non-Structural Component: Institutional arrangements, strengthening capability in urban management and investment implementation, including:

- Integrated urban development planning strategy
- Public transport system development strategy
- Drainage system management and wastewater quality monitoring

This ESIA is prepared for the structural component (including 9 rehabilitated, upgraded or newly-built works), not including the non-structural component.

B. Related Subprojects and Planning

➢ General planning of Thai Nguyen city to 2035

- The master plan for socio-economic development of Thai Nguyen province by 2020, vision to 2030 and Thai Nguyen city's general planning to 2035 clearly define the specific objectives for development of the city as follows:
- Development of the city into a multi-modal transportation center as an important traffic focal point connecting the Northern mountainous provinces with the Northern delta provinces;
- Development of the cities along Cau river

- Development of centers of education, training and health. Development of modern cultural and artistic centers with Viet Bac regional ethnic identity.

Thus, the proposed items of subproject are fully in line with the general planning of Thai Nguyen city.

➢ **Other related planning and subprojects**

The construction process of nine (09) works items will generate wastewater and stormwater runoff. Stormwater from works flows along the main culverts, then focuses on Mo Bach stream, Xuong Rong stream and run out Song Cau or flow out Cau bridge. Wastewater will be collected at the culverts system and treated at wastewater treatment stations located in wards, including: Gia Sang (Q = 17,600 m^3/day night in 2020,); Huong Son Ward (Q = 10,300 m^3/day night in 2020). This is fully in compliance with Urban and Industrial Parks Drainage Planning of Thai Nguyen Province by 2025, vision to 2050 as the approved Decision No. 2004/QD-UBND dated November 29th 2013 by Thai Nguyen Provincial People's Committee.

Dong Bam road and Huong Thuong - Chua Hang road putting into operation will improve the efficiency of the project "Adjustment of technical infrastructure system planning, space solutions, architecture, landscape and urban design of the European Quarter along Cau river "under the Decision No.3586/QD-UBND, dated December 26th 2016 by Thai Nguyen Provincial People's Committee.

When Dong Bam road, Huong Thuong - Chua Hang road, North South - Huong Thuong road, Le Huu Trac road are put into operation, which will facilitate the connection between industrial parks and Thai Nguyen city, in accordance with the industrial development planning of Thai Nguyen province in the period 2016 - 2025, vision to 2030 under Decision No.2501/QD-UBND, dated September 28th 2016 by Thai Nguyen Provincial People's Committee;

Dredging works of Mo Bach Stream and Xuong Rong drainage ditch will contribute to the improvement of drainage capacity and flood control in Thai Nguyen city, in accordance with the "Project "Adjustment, supplementary of detailed flood prevention planning for diked rivers in Thai Nguyen province by 2020, orientation to 2030 " which was approved under Decision No.3034/QD-UBND dated November 14th 2016 by Thai Nguyen Provincial People's Committee.

➢ **Completed and ongoing projects for promotion of local socio-economic development**

Currently, a number of infrastructure investment projects have been implemented in Thai Nguyen city as follows:

- The project on "Northern Mountainous Urban Development Program - Thai Nguyen City" is expected to be completed in 2020. Some items of the project: Upgrading of Viet Bac Road, improvement of the infrastructure for residential areas in Hoang Van Thu ward, rehabilitation of Xuong Rong regulation lake, construction of Ben Tuong bridge, upgrading of Tan Long bridge and construction of infrastructure for some residential areas and urban wastewater drainage ditch.
- The project on "Drainage and wastewater treatment system in Thai Nguyen city" is expected to be completed in 2017 and the project "Drainage and wastewater treatment system in the South of Thai Nguyen city" is estimated to be completed in 2020. Two projects have been put into operation, estimated to cover 85% of the residents' demand in Thai Nguyen city.
- Hanoi - Thai Nguyen Expressway project will be completed in 2017, which will become an important road connecting Thai Nguyen city, Hanoi capital and Northern mountainous provinces;
- The project on construction investment of technical infrastructure works of trade promotion center complex under construction combined with high end residential area

- Picenza Plaza Thai Nguyen.

These projects will be completed in the period from 2017 to 2020. 2020 is the period of completion when it is less harmful to the environment, thus there will be no cumulative impacts in case of Thai Nguyen City Subproject is under the construction phase. At the same time, the projects are scattered over the wards, communes in Thai Nguyen city with locally-characterized impacts at the scope of construction or upgrading of the works. DCIDP - Thai Nguyen City Subproject is not linked with the ongoing projects in the City.

The bridges and roads construction projects facilitate the transportation of constructional materials and machines to the construction site. Two projects on construction of wastewater treatment system contribute to deal with wastewater treatment issues at workers camps of the construction items.

C. Competent agencies and organizations in charge of approving the investment subproject and ESIA

Agency approving the investment subproject: Thai Nguyen City People's Committee

- Address: No 10 - Nguyen Du street - Trung Vuong ward - Thai Nguyen city
- Tel: 02083.858.156 Fax: 02083.854.998

ESIA approver: Ministry of Natural Resources and Environment

- Address: No. 10 – Ton That Thuyet street – Hanoi
- Tel: 0243.8343 911 Fax: 0243.7736892

D. Legal and technical basis of ESIA preparation

Dynamic Cities Integrated Development Project – Thai Nguyen Subproject, Thai Nguyen province will be subject to comply with current Laws on Environmental Protection of the Government of Viet Nam and the World Bank, as follows:

D.1. Legal documents and technical standards of GoV

- ***Laws***

- Law on Environmental Protection (LEP) No. 55/2014/QH13 passed by the 13thNational Assembly of the Socialist Republic of Vietnam on June 23, 2014 and effective from January 01st, 2015;
- The Law on Construction No. 50/2014/QH13 passed by the 7th National Assembly of the Socialist Republic of Vietnam on 18th June 2014 and effective from January 01st, 2015;
- Land Law No. 45/2013/QH13 of the 13th National Assembly of the Socialist Republic of Vietnam dated November 29, 2013 and effective from July 01, 2014;
- Law on Water Resources No. 17/2012/QH13 passed by the 13th National Assembly of Vietnam, 3rd session dated June 21, 2012;
- Labor Law No. 10/2012/QH13 passed by the 13th National Assembly of the Socialist Republic of Vietnam dated June 18, 2012;
- Law on Urban Planning No. 30/2009/QH12 the 12th National Assembly of the Socialist Republic of Vietnam dated June 17, 2009;
- Law on Biodiversity No. 20/2008/QH12 passed by the 12th National Assembly of the Socialist Republic of Vietnam dated November 13, 2008;
- Law on Chemicals No. 06/2007/QH12 passed by the 12th National Assembly of the Socialist Republic of Vietnam dated November 21, 2007;
- Law on amendment and supplement of a number of articles of Law on Fire Prevention and Fighting No.40/2013/QH13 passed by the 13th National Assembly of the Socialist

Republic of Vietnam dated November 22, 2013.

- Law on Road Transport No. 23/2008/QH12 passed by the 12th National Assembly of the Socialist Republic of Vietnam dated November 13, 2008;
- Law on Inland Waterway Navigation No. 23/2004/QH11 passed by the 11th National Assembly of the Socialist Republic of Vietnam dated June 15, 2004;
- Law on Complaints No. 02/2011/QH13 issued on November 11, 2011;
- Law on Cultural Heritages No. 10/VBHN-VPQH issued on July 23, 2013;
- Law on Occupational Safety and Health No. 84/2015/QH13 issued on June 25, 2015;
- Law on dykes No. 79/2006/QH11 issued on November 29, 2006;
- Law on plant protection and quarantine No. 41/2013/QH13 issued on November 25, 2013.

➢ ***Decrees***

- Decree No. 18/2015/ND-CP dated February 14th, 2015 of the Government on environmental protection planning, strategic environmental assessment, environmental impact assessment and environmental management plan.
- Decree No. 19/2015/ND-CP dated February 14, 2015 of the Prime Minister detailing the implementation of a number of articles of the Law on Environmental Protection;
- Decree No. 59/2015/ND-CP dated June 18, 2015 of the Government on management of construction investment projects;
- Decree No. 42/2017/ND-CP dated April 05, 2017 of the Government on amendment and supplement of a number of articles of the Government's Decree No. 59/2015/ND-CP dated June 18, 2015 on management of construction investment projects;
- Decree No. 16/2016/ND-CP dated March 16, 2016 of the Government on management and use of official development assistance concessional loans granted by foreign sponsors;
- Decree No. 46/2015/ND-CP dated May 12, 2015 of the Government on quality management of construction works;
- Decree No. 201/2013/ND-CP dated November 27, 2013 of the Government detailing implementation of a number of articles of the Law on Water Resources;
- Decree No. 38/2015/ND-CP dated April 24, 2015 of the Government on management of waste and discarded materials.
- Decree No. 80/2014/ND-CP dated August 06, 2014 of the Government on wastewater drainage and treatment;
- Decree No. 43/2014/ND-CP dated May 15, 2014 by the Government detailing the implementation of some articles of the Land Law 2013.
- Decree No. 44/2014/ND-CP dated May 15, 2014 of the Government regulating land prices.
- Decree No. 47/2014/ND-CP dated May 15, 2014 of the Government providing regulations on compensation, support and resettlement when the State recovers land.
- Decree No. 155/2016/NĐ-CP dated November 18, 2016 of the Government on sanctioning of administrative violations in the field of environmental protection;
- Decree No. 25/2013/ND-CP dated March 29, 2013 of the Government on environmental protection charges for wastewater;
- Decree No. 67/2012/ND-CP of the Government amending and supplementing a number of articles of the Government's Decree No. 143/2003/ND-CP dated November 28, 2003, detailing the implementation of Articles of the Ordinance on exploitation and protection of irrigation works;
- Decree No. 113/2010/ND-CP dated December 03, 2010 of the Government stipulating determination of damages to the environment.

- ***Circulars***
  - Circular No. 27/2015/TT-BTNMT dated May 29, 2015 of MONRE on strategic environmental assessment, environmental impact assessment and environmental protection plans;
  - Circular No. 36/2015/TT-BTNMT dated June 30, 2015 of MONRE on management of hazardous wastes;
  - Circular No. 37/2014/TT-BTNMT dated June 30, 2014 of the Ministry of Natural Resources and Environment detailing compensation, support and resettlement when the State recovers land;
  - Circular 30/2014/TT-BTNMT on land allocation, land lease, conversion of land use purpose and land acquisition;
  - Circular No. 32/2013/TT-BTNMT dated October 25, 2013 of MONRE on promulgation of national technical regulations on environment;
  - Circular No. 30/2011/TT-BTNMT dated August 01, 2011 of MONRE on technical procedures for monitoring groundwater.
  - Circular No. 19/2016/TT - BYT dated June 30, 2016 of MOH on guidelines for occupational health and safety management;
  - Circular No. 22/2010/TT-BXD dated December 03, 2010 of MOC on labor safety in work construction.
- ***Decisions***
  - Decision No. 31/2014/QD-UBND dated 22/8/2014 of Thai Nguyen People's Committee promulgating regulations on compensation, assistance and resettlement when the State recovers land in Thai Nguyen province.
  - Decision No. 20/2016/QD-UBND dated 6/7/2016 of the Thai Nguyen People's Committee amending and supplementing a number of articles in the regulations on compensation, assistance and resettlement when the State recovers land in the province of Thai Nguyen issued in conjunction with Decision No. 31/2014/QD-UBND dated 22/8/2014 of the provincial People's Committee.
  - Decision No. 38/2014/QD-UBND dated September 8, 2014 promulgating the regulation on land allocation quotas; Limits on recognition of land use rights; The minimum land area and land area are re-determined in the province of Thai Nguyen.
  - Decision No. 61/2016/QD-UBND dated December 25, 2016 of Thai Nguyen People's Committee stipulates the compensation rate for houses and architectural objects when the State recovers land in Thai Nguyen province.
  - Decision No. 01/2017/QD-UBND dated January 12, 2017 of the Thai Nguyen People's Committee on the compensation rate of plants and animals when the State recovers land in Thai Nguyen province.
  - Decision No. 57/2014/QD-UBND dated December 22, 2014 on the regulation on land price in 2015 in Thai Nguyen province, applied for 05 years (2015 - 2019).
  - Decision 04/2008/QD-BXD dated April 03, 2008 of Ministry of Construction on Vietnam Building Code.
- ***Applicable standards and regulations:***
  - QCVN 01:2009/BYT: National technical regulation on drinking water quality.
  - QCVN 02:2009/BYT: National technical regulation on domestic water quality.
  - QCVN 08-MT:2015/BTNMT– National technical regulation on surface water quality;
  - QCVN 09-MT 2015/BTNMT– National technical regulation on ground water quality.
  - QCVN 14:2008/BTNMT: National technical regulation on domestic wastewater.

- QCVN 38:2011/BTNMT: National technical regulation on Surface Water Quality for protection of aquatic lives;
- QCVN 39:2011/BTNMT: National technical regulation on Water Quality for irrigated agriculture.
- QCVN 05:2013/BTNMT: National technical regulation on ambient air quality.
- QCVN 06:2009/BTNMT: National technical regulation on hazardous substances in ambient air.
- QCVN 26/2016/BYT - National technical regulation on microclimate - Permissible value of microclimate in the workplace;
- QCVN 03-MT:2015/BTNTM - National technical regulation on the allowable limits of heavy metals in the soils;
- QCVN 15:2008/BTNMT -Soil quality - National technical regulation on the pesticide residues in the soils.
- QCVN 43:2012/BTNTM- National technical regulation on sediment quality;
- QCVN 26:2010/BTNMT - National technical regulation on noise;
- QCVN 27:2010/BTNMT -National technical regulation on vibration;
- TCVN 6705:2009 - Normal solid wastes - Classification;
- TCVN 6706:2009 - Hazardous wastes – Classification;
- QCVN 07:2009/BTNM: National technical regulation on hazardous waste thresholds.
- TCVN 7957:2008 - Drainage and sewerage - External networks and facilities - Design standard.
- TCXDVN 33:2006 - Water supply - Distribution system and facilities - Design standard.
- TCXDVN 260:2002 – Kindergarten – Design standard
- QCVN 07:2016/BXD: National Technical Regulation on Technical Infrastructure Works
- QCXD VN 01:2008/BXD – Vietnam building code –Building planning;
- QCVN 04-05:2012/BNNPTNT - National technical regulation on hydraulic structures - The basic stipulations for design;
- QCVN 22:2016/BYT -National technical regulation on lighting - Permissible levels of lighting in the workplace;
- QCVN 24:2016/BYT – National technical regulation on noise - Permissible exposure levels of noise in the workplace;
- QCVN 26:2016/BYT - National technical regulation on microclimate - Permissible value of microclimate in the workplace;
- QCVN 27:2016/BYT - National technical regulation on vibration - Permissible levels in the workplace;
- QCVN 18:2014/BXD - National technical regulation on Safety in Construction.

➢ ***Legal documents related to the subproject:***

- Dispatch No.2318/VPCP-QHQT of the Government Office dated 14/3/2017 "Approving the Dynamic Cities Integrated Development Project, funded by WB"
- Decision No. 260/QD-TTg dated 27/02/2015 of the Prime Minister approving the master plan on socio-economic development in Thai Nguyen province towards 2020 and vision to 2030;
- Decision No. 2486/QD-TTg dated 20/12/2016 of the Prime Minister approving the adjustment of Thai Nguyen city master plan, Thai Nguyen province by 2035;
- Decision No. 1064/QD-TTg dated 08/7/2013 of the Prime Minister approving the

master plan on socio-economic development in the Northern midland and mountainous region by 2020;

- Decision No. 936/QD-UBND dated 20/4/2017 of Thai Nguyen Provincial People's Committee on establishing a steering board and group assisting the Steering Committee of the Dynamic Cities Integrated Development Project – Thai Nguyen city Subproject;
- Five year socio-economic development plan in 2016 - 2020 of Thai Nguyen Province, Thai Nguyen city;
- Memorandum of understanding on site surveys and workshops between WB's mission and recommendations on participation in the Dynamic Cities Integrated Development Project;
- Zoning and subdivision planning were and are being carried out in Thai Nguyen city;
- Information, data provided from Departments and agencies of the city, province.
- Data from field surveys (from June to October 2017) carried out by environmental and social consultants.
- Data and documents created by the Subproject Owner
- Prefeasibility Study Statement for the Dynamic Cities Integrated Development Project – Thai Nguyen city subproject, June 2017.
- Feasibility Study Statement for the Dynamic Cities Integrated Development Project – Thai Nguyen City Subproject, October 2017.
- Basic design drawings for the Dynamic Cities Integrated Development Project – Thai Nguyen City Subproject, October 2016.

D.2. World Bank Safeguard Policies

The Dynamic Cities Integrated Development Project (DCIDP) - Thai Nguyen city subproject has been reviewed and screened and is classified into B category in environment in accordance with the WB's Environmental Assessment Policy (OP/BP 4.01). The Project implementation may cause environmentally and socially negative impacts which are at low to medium, site specific, avoidable and mitigable through mitigation measures. For identifying all negative impacts and mitigation measures, the Subproject Owner has developed an Environmental and Social Impact Assessment (ESIA) report to comply with environmental and social management requirements of WB and Vietnam. Negative impacts of the subproject will be addressed by synchronously applying mitigation measures set forth in the Environmental and Social Management Plan which is inseparable part of ESIA and which includes monitoring plans and approvals of requirements on health and safety for construction workers. In the subproject implementation progress, ESMP execution will be a requirement for the Subproject Owner and construction contractors.

(1) At subproject level

WB's safeguard policies to be applied, including: (a) Environmental assessment (OP 4.01); (b) Natural Habitats (OP/BP 4.04); (c) Forests (OP/BP 4.36); (d) Physical cultural resources (OP/BP 4.11); (e) Involuntary resettlement (OP/BP 4.12).

(2) At Subproject level

Environmental assessment (OP/BP 4.01)[3]

[3]Full treatment of OP/BP 4.01 can be found at the Bank website:
http://web.worldbank.org/WBSITE/EXTERNAL/PROJECTS/EXTPOLICIES/EXTSAFEPOL/0,,contentMDK:20543912~menuPK:1286357~pagePK:64168445~piPK:64168309~theSitePK:584435,00.html

The construction and rehabilitation of the urban infrastructure under the subproject involve: i) new construction and rehabilitation of urban roads and bridges; ii) upgrading of drainage canals and associated urban roads; iii) construction of sewage collection systems; and iv) rebuild or newly-build kindergarten. Construction and operation of these urban infrastructures would have adverse environmental and social impacts requiring appropriate measures which are addressed in details in subsequent chapters of the ESIA.

The majority of the potential adverse impacts relate to land acquisition and construction activities. These include commonly known construction impacts and risks, such as: i)safety risks related to unexploded ordinances; ii)increased level of dust, noise, vibration; iii) pollution risks related to generation of waste and wastewater, particularly large amount of excavated/dredging materials; iv) traffic disturbance, and increased traffic safety risks; iv) interruption of existing infrastructure and services; v) disturbance to daily socio-economic activities in subproject area and social disturbance; vi) health and safety issues related to the public and the workers at construction sites; vii) social impacts associated with construction disrupting businesses by construction related activities and mobilization of workers to the construction site, etc.

The potential impacts during operation include the impacts on traffic safety of the newly built roads. The induced impact may include localized urban development in some city areas. Nevertheless, it is not anticipated that there would be significant induced and cumulative impacts during construction and operation.

Natural habitats (OP/BP 4.04)[4]

The subproject will be implemented in urban areas and will not involve significant conversion or degradation of critical natural habitats or other natural habitats. However, some civil works will be implemented on existing natural habitats such as construction of the bridges would have some potential adverse impacts on natural habitats of the rivers, including loss of benthic habitats and disturbance of benthic organisms. The potential impacts and their associated mitigation measures have been identified and addressed in the subproject ESIA and ESMP.

Forests (OP/BP 4.36)[5]

The screening results of the Subproject show that the Subproject will affect 14,500 m^2 production forest land owned by 27 households (mainly planting acacia and cajuput). This impact will affect income and livelihoods of affected people; potential risks for workers who are directly involved in construction by insects, bees, mosquitoes or snakes, predators or get diseases such as influenza, dengue fever, malaria, gastrointestinal disease, and skin diseases; potential risks of workers' hunting and trapping animals for food, cutting down trees for firewood; or risks of forest fire due to workers' carelessness in cooking and smoking. However, this impact is mitigable through the compliance with rules and regulations on construction site and appropriate construction methods incorporated in the bidding documents and contracts with construction units;

Physical cultural resources (OP/BP 4.11)[6]

[4]Full description of OP/BP 4.04 is available at http://web.worldbank.org/WBSITE/EXTERNAL/PROJECTS/EXTPOLICIES/EXTSAFEPOL/0,,contentMDK:20543920~menuPK:1286576~pagePK:64168445~piPK:64168309~theSitePK:584435,00.html

5Full description of OP/BP 4.36 is available at https://policies.worldbank.org/sites/ppf3/PPFDocuments/Forms/DispPage.aspx?docid=1574&ver=current

[6] OP/BP 4.11 is accessible at http://web.worldbank.org/WBSITE/EXTERNAL/PROJECTS/EXTPOLICIES/EXTSAFEPOL/0,,contentMDK:20543961~menuPK:1286639~pagePK:64168445~piPK:64168309~theSitePK:584435,00.html

The subproject does not have potential impacts on important Physical Cultural Resources (PCRs). However, it involves civil works with excavation and the relocation of graves, which are also considered PCR. Mitigation measures for the relocation of graves have been included in the subproject Resettlement Action Plan (RAP) and ESMP, as appropriate. In any event, a chance finds procedure will be prepared and included in the subproject ESMP, and bidding and contractual documents.

Involuntary Resettlement (OP/BP 4.12)[7]

Screening of the proposed subproject shows that it would affect 1,347 households (HHs), and about 133 HHs may have to relocate. These impacts will cause substantial social risks such as loss of income and livelihood and disrupted social bonds due to loss of land and/or relocation. However, all potential impacts and risks could be predicable, mitigatable and manageable by applying all possible mitigation measures including design alternatives, compensation at replacement cost, provision of land plots in resettlement sites to be constructed within subproject ward/commune for relocated households, and provision of livelihood restoration package for severely and vulnerably affected households. All the potential social impacts and associated mitigation measures have been included in a Resettlement Action Plan (RAP) for implementation.

World Bank Group Environmental, Health, and Safety Guidelines[8]

World Bank-financed subprojects should also take into account the World Bank Group 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.

The EHS Guidelines contain the performance levels and measures that are normally acceptable to the World Bank Group and are generally considered to be achievable in new facilities at reasonable costs by existing technology. The environmental assessment process may recommend alternative (higher or lower) levels or measures, which, if acceptable to the World Bank, become subproject- or site-specific requirements. This subproject should conform to these Guidelines.

In addition, the ESIA must also comply with International Conventions to which Vietnam is a member (eg, International Water Resources and Climate Change, etc.). In addition, the Bank's EHS team will guide information about environmental, social, health and safety issues related to the investment sector. Environmental guidelines related to the ESIA include emission sources, environmental quality of ambient air, noise, wastewater, solid waste, sludge / sediment and water quality.

E. ESIA Implementation Arrangements

For the subproject, Thai Nguyen People's Committee plays a role as the Subproject Owner and Thai Nguyen city PMU is the representative of the Subproject Owner for subproject execution. The Subproject Owner has signed an agreement with Viet Nam AE Investment and Consultant Joint Stock Company to carry out Environmental and Social Impact Assessment in the course of subproject preparation. ESIA preparators are shown in the following table:

[7] Detail of OP/BP 4.12 is available at http://web.worldbank.org/WBSITE/EXTERNAL/PROJECTS/EXTPOLICIES/EXTSAFEPOL/0,,contentMDK:20543978~menuPK:1286647~pagePK:64168445~piPK:64168309~theSitePK:584435,00.html

[8] The EHS Guidelines can be consulted at www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines.

Table 1: List of ESIA preparators

No.	Name	Titles, degrees and majors	Tasks during ESIA preparation
Representative of the Subproject Owner			
1.	Vu Thi Bich Thuy	Master in Economics	Leader of whole subproject
2.	Dang The Son	Construction Engineer	Public consultation
3.	Vuong Thai Hung	Bachelor in Environment	Public consultation
ESIA Implementation unit			
4.	Doan Manh Hung	MSc in Environment Studies	Leader of the ESIA preparation – General management of the ESIA preparation, field surveys and preparation of chapters 1, 3, 4 and 5.
5.	Pham Ngoc Trang	MSc in Environment Studies	Field survey, public consultation, preparation of chapters 1, 3, 4 and 5
6.	Nguyen Xuan Trung	Environmental Hydrology Engineer	Field survey, public consultation, preparation of chapters 2, 3 and 4.
7.	Do Thanh Tung	Bachelor in meteorology	Field survey, public consultation, preparation of chapters 2, 3 and 4.
8.	Bui Thi Phuong Ngoc	Master in Environmental Studies	Environmental monitoring, sampling; Analysis and processing of results, and preparation of chapter 2.
9.	Le Thi Thanh Hoa	Environmental Engineer	Site survey, public consultation, environmental monitoring and sampling.
10.	Vu Trong Bang	MSc in water resources planning and management	Site survey, public consultation and preparation of chapter 6.
11.	Vu Xuan Son	MSc in Business and Management	Site survey, public consultation, preparation of introduction part and chapters 2, 3 and 4.
12.	Nguyen Manh Truong	Bachelor in Sociology	Site survey, public consultation, preparation of introduction part and chapters 2, 3 and 4.

Also, the environmental and social impact assessment is prepared with coordination of:

- PPMU: Thai Nguyen City People's Committee.
- Consultants for preparation of FS, RAP and ESIA
- Thai Nguyen Department of Transport, Department of Natural Resources and Environment;
- Communal/ward people's committees and affected community in Subproject area.

F. Environmental and social assessment methods

In the process of preparation of ESIA, the Consultant has used the following methods:

➢ ESIA preparation methods

❖ *Rapid Assessment Method*

Rapid Assessment Method was issued by the World Health Organization (WHO) in 1993. In this report, pollution load coefficients are referred to in WB's ESIA guideline (Environmental Assessment Manual, volume II, Sector Guideline, Environment, WB, Washington DC 8/1991 and Exhaust Gases Manual, non-industrial and industrial sources, Netherlands). These coefficients are used for forecast and assessment of environmental impacts in Chapter 3 of ESIA.

❖ *Impact matrix method*

The method is used in chapter 3, 4 of the report. By this method, the relation between impacts of each activity under the subproject and environmental issues, elements is displayed in the impact matrix. Accordingly, these impacts will be put into studies so as to assess environmental impacts from construction activities of the subproject.

❖ *Environmental modeling*

Environmental modeling is used in chapter 3, the method:

- Use Gauss, Sutton models to forecast the spreading level and extend of TSP, PM10, SO_2, CO, NO_2;
- Forecast noise reduction by distance generated from machines and construction equipment during construction, carried out by Federal Highway Administration (FHWA);
- Forecast noise reduction by distance generated from machines and construction equipment during operation.

❖ *Expert method*

The method is used throughout the subproject implementation process from preparing outline, determining study scale, environmental issues, surveying natural and ecological conditions, identifying and analyzing, proposing mitigation measures and developing environmental monitoring programs.

❖ *Comparison methods*

The method is used for assessing the quality of environment, waste flows and pollution loads by comparison with regulations, related environmental standards, regulations of the Ministry of Health as well as research topics and related experiments.

❖ *Identification method*

The method is used with following procedures:

- Description of environmental system.
- Determination of subproject's components affecting the environment.
- Adequate identification of waste flow and related environmental issues for specific assessment activities.

❖ *Listing method*

- Description listing sheet: The method lists environmental components to be studied in combination with data from measurements, forecasts and assessments;
- Simple listing sheet: The method lists environmental components to be studied which are likely to be affected.

❖ *System analysis method*

This method is carried out based on considerations into waste sources, impact sources, affected

receptors, environmental components, etc., for example, components in a system have a close relationship together, then, determining, analyzing and assessing impacts.

- **Others**

  - ***Public consultation***

During the course of report preparation, the Consultant coordinated with the Client to hold consultations with leaders and local people at office of the commune/ward People's Committees to collect information necessary for environmental impact assessment of the subproject. Specially, in early July and August, the Consultant and Client held consultations with leaders of 14 wards/commune/townships in relation with the contents as follows: Information collection, introduction to them about benefits and potential negative impacts caused by the Subproject to environment and their life. The Consultant coordinated with the local authorities in organizing consultations with communities in the subproject area.

After ESIA report has been prepared, in November 2017, the PMU conducted consultations in 14 communes/wards in relation with the draft report's contents. Accordingly, all responses and expectations from local people in 14 subproject communes/wards have been recorded.

On the other hand, the consultations with local officials and people on local socio-economic development status have been also carried out.

The method of public consultation is applied in Chapter 6 of this report.

  - ***Information and data inheritance, summary and analysis method***

The method is to determine, assess natural and socio-economic conditions in subproject area through data and information collected from various sources such as Statistical Yearbook, locally socio-economic reports, environmental current status, hydrological and meteorological documents and related researches.

At the same time, inheritance from done researches and reports is very crucial because achieved results will be promoted and shortages will be dealt with and developed.

  - ***Site survey method***

Consulting agency has conducted visits in Subproject areas, surveys on geographical and topographical conditions, sampling locations, surveys on current status of water supply, drainage, power supply, etc. Collected results will be utilized to analyze social and natural conditions in subproject area.

  - ***Sampling and sample analysis in labs***

In October 2017, the Client coordinated with Thai Nguyen Center of Natural Resources and Environment Monitoring in organization the monitoring, sampling and analyzing air, surface water, groundwater, soil and sediment samples in the subproject area to evaluate current status of quality of environment compositions. The sampling, analyzing and storage of samples complied with the applicable standards and regulations. This method is applied in item 2.1.4, Chapter 2 of the report.

CHAPTER 1. SUBPROJECT DESCRIPTION

1.1. Overview

1.1.1. Name of the Subproject

The Dynamic Cities Integrated Development Project – Thai Nguyen City Subproject

1.1.2. Subproject Owner

Subproject Owner: Thai Nguyen City People's Committee (CPC)

Represented by: Ms. Vu Thi Bich Thuy – Deputy Chairman of CPC

Address: No. 10, Nguyen Du street, Trung Vuong ward – Thai Nguyen city;

Tel: 0208 3 855571; Fax: 0208 3 854988

1.1.3. The objectives of the Subproject

- **Overall objectives**

To increase access to improved urban infrastructure services and enhance integrated urban planning and management capacity

- **Specific objectives**

Strengthening connectivity and improving the quality of the urban transport infrastructure, reducing congestion and traffic accidents, reducing transportation costs and facilitating the development of production, services and trade for the city and neighboring areas;

Reducing the flooding status and risk, improving the wastewater pollution in some residential areas. Increasing investment efficiency of wastewater treatment plants implemented by the completed subprojects;

Improving the quality and addressing the needs of kindergarten education in Huong Son and Phan Dinh Phung wards.

1.1.4. Locations of work items under the Subproject

09 work items of Thai Nguyen City Subproject include: upgrading and construction of 4 roads and re-building 01 bridge; rehabilitation and construction of embankments for protecting two ditches; newly-building 02 kindergartens. The work items are implemented in 14 wards/communes of Thai Nguyen city, Thai Nguyen province. Locations of the proposed work items under DCIDP – Thai Nguyen city Subproject are shown in Figure 1 and Table 2 below.

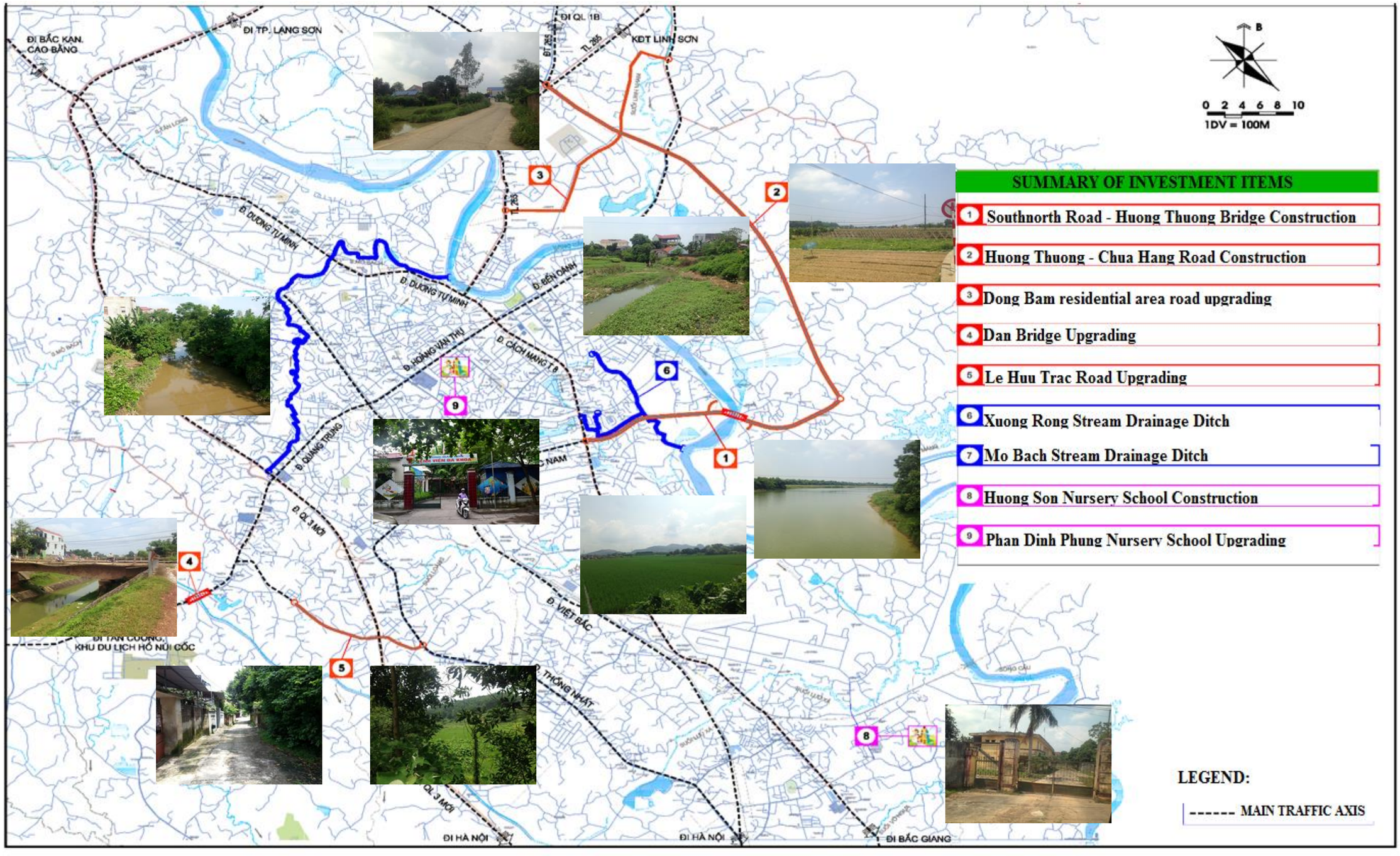
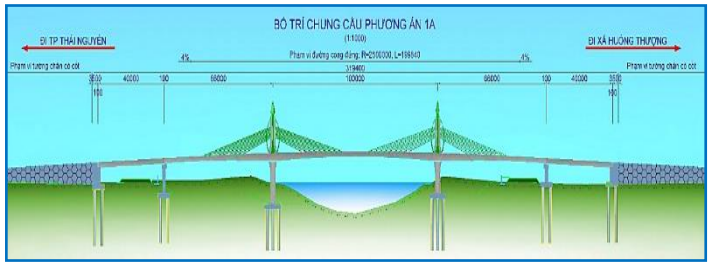
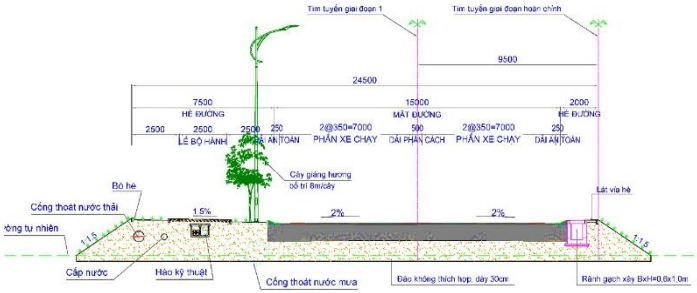
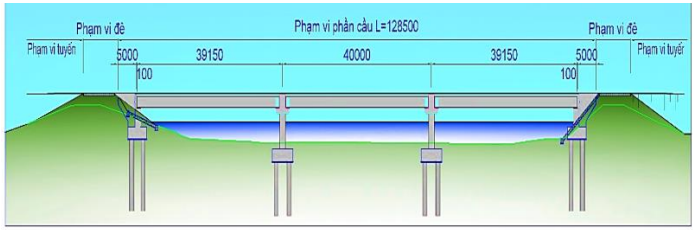


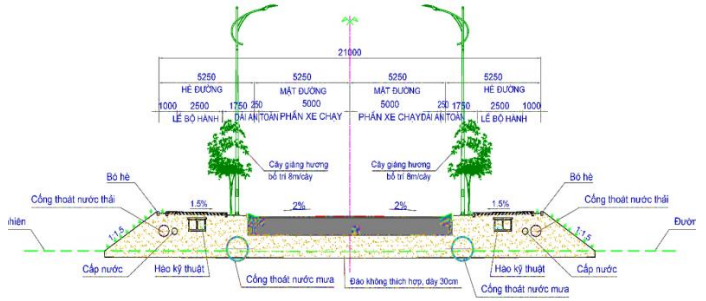
Figure 1: Locations of work items under the Subproject

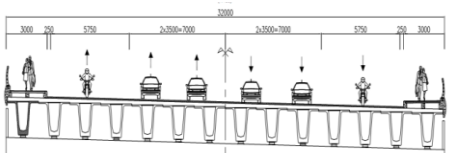
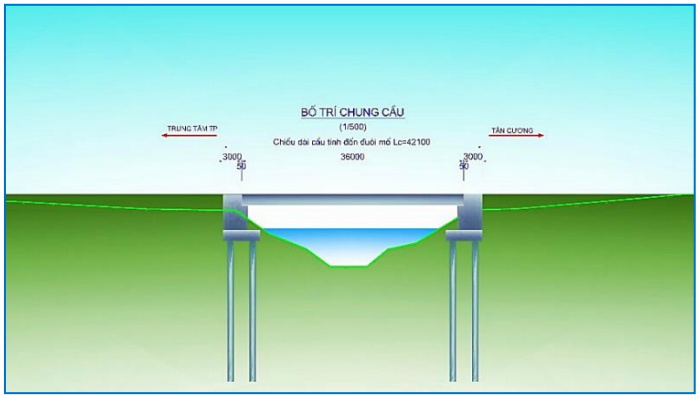
1.2. Work items of the Subproject

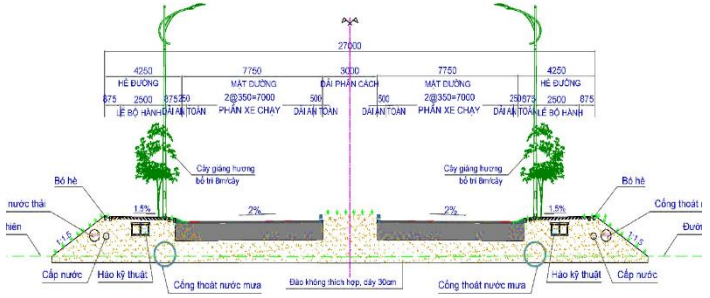
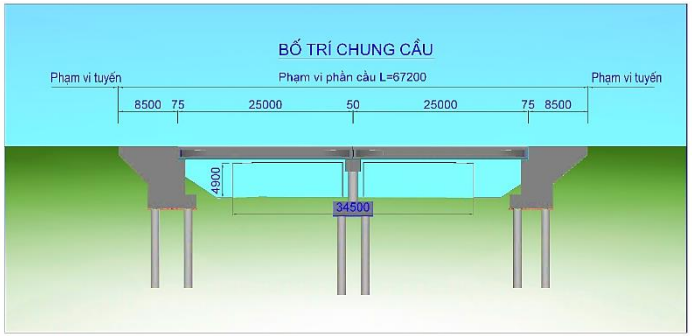
Table 2: Detailed description of work items

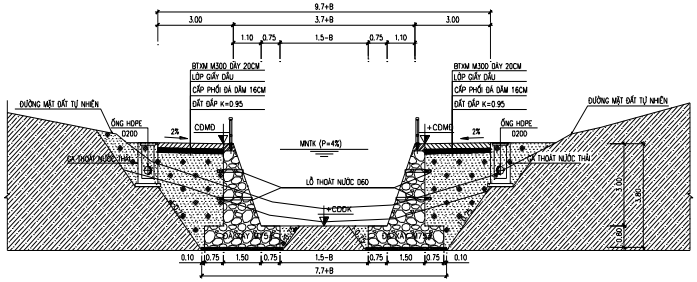
No.	Item	Location	Specifications	Land acquisition, resettlement	Picture
1	Southnorth Road & Huong Thuong Bridge Constructio n	- Location: Tuc Duyen, Gia Sang wards and Huong Thuong commune. - The From cross-road between Southnorth road and Cach Mang Thang Tam road. - The ending point connects to Huong Thuong - Chua Hang road. • **Current status of use:** - The road is 3.2km long, including 400m of earth road, 900m passing through the residential area, 1,581m passing through the rice land of the local people. - Current technical status: This is a new road, connecting residents in two sides of Cau river. - Current resident status: Population is sparsely populated, mainly concentrated in the starting point of the route and Huong Thuong bridge area. The distance to the nearest residential area is 5-10m.	• **Southnorth road** - L = 3.2km, V_{TK} = 50km/h - B_{base} = 41m, $B_{surface}$ = 4x3.5m. - Median strip: B = 10.5m. - Sidewalk in two sides B = 2x7.5m - Road elevation: Average elevation is 25.7m, which is 0.1-0.3 m above current ground. • **Huong Thuong bridge** - Service life: 100 years - Live load HL 93 - L = 319.4m - B_{base} = 23.5m, $B_{surface}$ = 4x3.5m. - Median strip: B = 2.5m - Sidewalk in two sides: B = 2x2.5m. - Clearance height: H > 4.75m. - Navigation: BxH = 40x6m • **Auxiliary works** - Retaining wall L = 150m; - Local interchanges and tapered sections - Xuong Rong 2 bridge: slab deck structure 15m, B = 41m; - Stormwater and wastewater drainage system along the road. - Protection and traffic safety works; Sidewalks - trees; Lighting system.	- S: 13.17ha. - AHs: 448 HHs - Relocated HHs: 80 HHs	 *Typical cross-section of Southnorth road*  *Structure of Huong Thuong bridge*

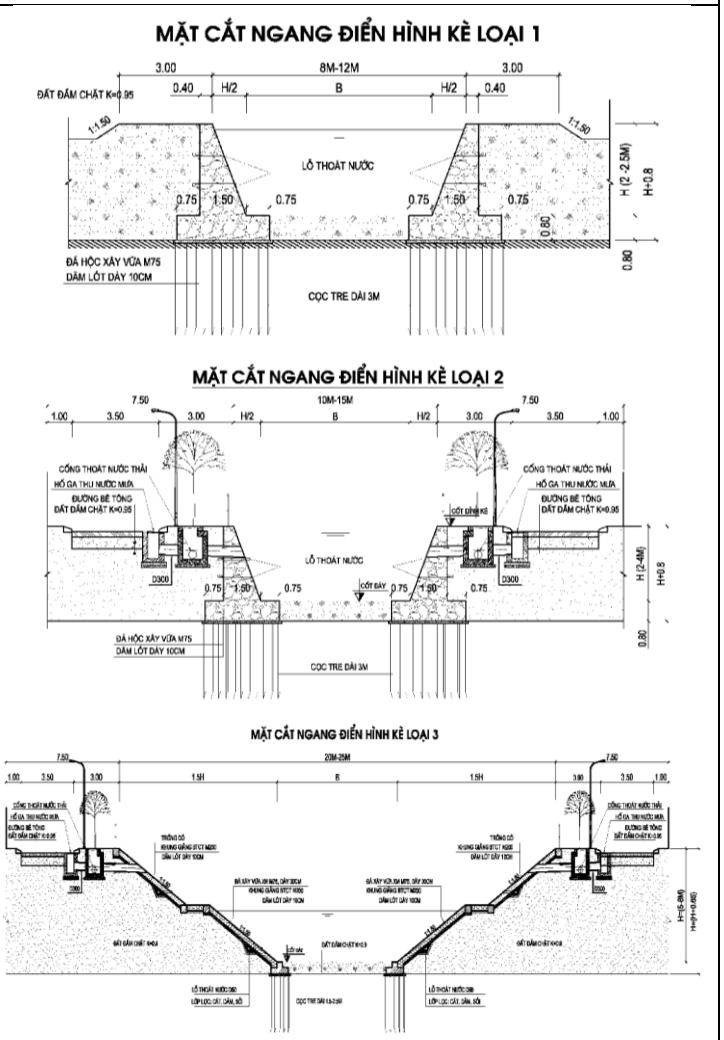
No.	Item	Location	Specifications	Land acquisition, resettlement	Picture
2	Huong Thuong - Chua Hang Road Construction	- Location: Chua Hang ward, Dong Bam, Linh Son and Huong Thuong communes. - The starting point: Connects to the Southnorth road - Huong Thuong bridge. - The ending point: Intersects with Chua Hang island in Chua Hang ward. • **Current status of use:** - The road is 5.72km long, including 300m of earth road, 3,972m passing through the residential area, 3,902m passing through the rice land of the local people. - Current technical status: This is a new road, terrain is mainly flat land, interlaced in the residential areas. - Current resident status: Population is sparsely populated, mainly concentrated in the ending point of the route. The distance to the nearest residential area is 5-10m.	• **Hupng Thuong – Chua Hang road** - L = 5.72km, V_{TK} = 50km/h - B_{base} = 24.5m, $B_{surface}$ = 4x3.5m - Median strip B = 0.5m - Safety strip adjacent to sidewalk B = 2x0.25m - Right and left sidewalks: B = (7.5 + 2)m - Road elevation (varying from 25.7 to 29.3m, which is 0.00m – 0.50m above current ground. • **Mo Linh stream overpass** - Service life: 100 years - L = 128.5m - Live load HL 93 - B_{base} = 18m, $B_{surface}$= 4x3.5m. - Left sidewalk: B = 2.5m • **Auxiliary works:** - Local interchanges and tapered sections - Stormwater and wastewater drainage system along the road. - Protection and traffic safety works; Sidewalks - trees; Lighting system.	- S: 14.45 ha. - AHs: 321 HHs - Relocated HHs: 10 HHs	 Building location of Huong Thuong Chua Hang road  Cross-section of the road  Structure of Mo Linh 1 bridge

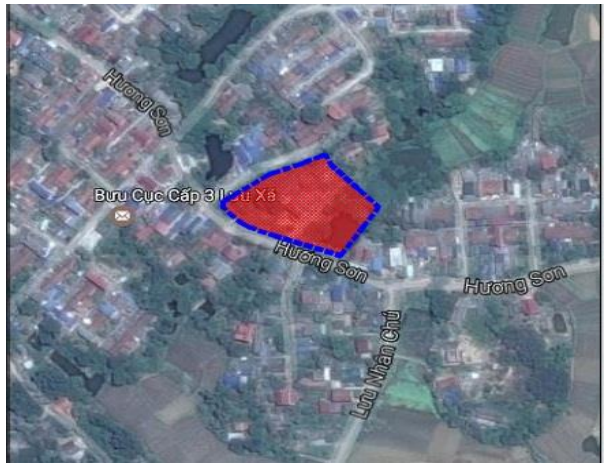
No.	Item	Location	Specifications	Land acquisition, resettlement	Picture
3	Dong Bam Residential Area Road Upgrading	- Location: Dong Bam commune - The starting point: intersects with NH1B - The ending point: Intersects with NH17 • **Current status of use:** about 800m of the beginning of route crosses agricultural land, 900m follows up the existing route, and the rest mainly crosses agricultural land. - Current technical status: This is a new road, terrain is mainly flat land, interlaced in the residential areas. - Current resident status: Population is sparsely populated, mainly concentrated in the middle of the route. The distance to the nearest residential area is about 10m.	- L = 3.4km, VTK = 50km/h. - B_{base} = 21.0m; $B_{surface}$ = 2x5.0m - Safety strip adjacent to sidewalk B = 2x0.25m - Sidewalk B = 2x5.25m. - Road elevation varies from +27m to +29m, which is 0.5 – 3.0m above the current ground. • **Auxiliary works:** - Local interchanges and tapered sections - Stormwater and wastewater drainage system along the road. - Protection and traffic safety works; Sidewalks - trees; Lighting system.	- S: 5.74 ha. - AHs: 137 HHs Relocated HHs: 3 HHs	 Construction location of Dong Bam road   Cross-section layout of Dong Bam

No.	Item	Location	Specifications	Land acquisition, resettlement	Picture
4	Dan Bridge Upgrading	- Location: Thinh Dan ward. - Current status of use: located on Quang Trung street which is the main traffic route connecting Thai Nguyen and Tan Cuong. The bridge crosses Nui Coc lake irrigation canal. - Current technical status: The bridge is 42m long, bridge surface B = 7m, degraded and being a knot on the Quang Trung route, causing traffic jams. - Current population status: sparsely populated, about 7-8 households living near the subproject area, about 30-50m far away.	• **Dan bridge** - Service life: 100 years - Live load HL 93 - L_{bridge} = 42m, V_{TK} = 50km/h. - B_{bridge} = 32m, Bsurface = 4x3.5m - Sidewalk: B = 2x3.0m • **Auxiliary works:** - Lighting system, drainage system and electric transmission line in two ends of bridge.  Cross-section of Dan bridge	- S: 0.68ha. - AHs: 7 HHs - No relocated HH.	 Building location of Dan bridge  Overall layout of Dan bridge
5	Le Huu Trac Road Upgrading	- Location: Thinh Dan and Tan Lap wards. - The starting point: connects with the existing Le Huu Trac road; - The ending point: intersect between 3/2 road and Thanh Nien Xung Phong road; - Current status of use: the road is 1.7 km long, including 150m	• **Le Huu Trac road** - L = 1.7km, V_{TK} = 50km/h. - B_{base} = 27.0m. $B_{surface}$ = 4x3.5m - Median strip B = 3.0m - Edge strip in two sides of median strip: B = 2x0.5m. - Safety strip adjacent to sidewalk B = 2x0.25m.	- S: 4.78ha - AHs: 185 HHs - Relocated HHs: 30 HHs.	

No.	Item	Location	Specifications	Land acquisition, resettlement	Picture
		passing existing concrete road, 1000m passing through the land for rice cultivation of local people, 550m along the existing road and residential areas. - The current technical status: narrow road, width of about 8.0m, roadbed is defective and degraded, technical infrastructure is not complete. - Current population status: The route mainly passes through the agricultural land, with 30-40 households living along the road.	- Sidewalk B = 2x4.25m. • **National highway 3 overpass** - L_{bridge} = 67.2m; B_{bridge} = 8.5m. - Carriage-way width B = 2x3.5m - Safety strip B = 2x0.25m - Bridge railing: B = 2x0.5m • **Auxiliary works:** - Local interchanges and tapered sections - Stormwater and wastewater drainage system along the road. - Protection and traffic safety works; Sidewalks - trees; Lighting system.		 Location of newly-built and upgraded Le Huu Trac road  Proposed cross-section  Overall layout of Highway 3 overpass

No.	Item	Location	Specifications	Land acquisition, resettlement	Picture
6	Xuong Rong Stream Drainage Ditch	- Location: Tuc Duyen and Gia Sang wards. - Current status of use: This is main drainage line for Tuc Duyen, Gia Sang wards and nearby residential areas. - Current technical status: The drainage ditch is open ditch, has been deposited up to 4m, unguaranteed drainage width. Along the banks of the ditch are shrubs. - Population status: Currently, around 100 households living nearby the ditch	• **Xuong Rong ditch:** - Scope: Dredging and widening the section of the ditch, reinforcing the ditch by concrete. - L =3,200m. - Structure: Combined section B = 8-25m. • **Auxiliary works:** - Building access road by cement concrete along the road, with width of B=3m - Washing wharf is built along two ditch banks with distance of 200m/wharf, width B=5m and mortar stone structure. - The railing system is arranged in the side of canal bank - Wastewater drainage system: Wastewater collection pipeline D300, length L = 3805m; 176 manholes; box culvert BxH=2x2m with length L = 150m; - 02 stepping wastewater pumping stations	- S: 1.91ha - AHs: 57 HHs - Relocated HHs: 6 HHs.	 Location of the works  Typical cross section
7	Mo Bach Stream Drainage Ditch	- Location: The wards of Quang Trung, Tan Thinh, Thinh Dan, Quang Vinh and Hoang Van Thu. - Starting point: Intersects with Quang Trung road at Dan overpass. - Ending point: Mo Bach bridge - Current status of use: This is main wastewater and sotrwater drainage line for Quang Trung, Tan Thinh, Thinh Dan, Quang	• **Mo Bach stream:** - Scope: Dredging and widening the ditch's section, consolidation of the ditch banks - L =3,854 m. • **Structure:** - Combined section with width B = 8-25m. Rubble embankment in combination with concrete brace and grass planting. - Section type 1: At chainage **Km1+20**. Preserve the status-quo, additional rock	- S: 7.48ha - AHs: 183 HHs - Relocated HHs: 4 HHs	 Location of Mo Bach ditch

No.	Item	Location	Specifications	Land acquisition, resettlement	Picture
		Vinh and Hoang Van Thu wards. - Current technical status: This is open ditch, be deposited, which affects drainage. - Population status: Along the banks of the ditch are vacant land space with wild plants and at some sections, residents are living nearby the ditch.	embankment for locations without embankment. - Section type 2: **From Km1+2- to K2+0**. B = 10m-15m; Bđt=Bđp=7.5m. - Section type 3: From **Km2+0 – Km2+840.** B = 20m-25m; Bđt=Bđp=7.5m. • **Auxiliary works:** - Wastewater collection system along the canal - Total length of pipeline: 6613m - 96 wastewater drainage manholes; - 100 households connecting to the drainage ditch; - Residue and gas release valve - 02 wastewater drainage pumping stations: Station 1: Flow Q= 12.22(m^3/h), H=11.29m. Pressure pipeline DN110, L=1300m; Station 2: Flow Q=12.22(m^3/h), H=4.64m, Pressure pipe DN110, L = 50m.		

No.	Item	Location	Specifications	Land acquisition, resettlement	Picture
8	Huong Son Kindergarten Construction	- Location: Huong Son ward - Status-quo is the 1-2 storey block (S = 450m^2) seriously degraded and has no resident living. - Technical status: Currently, the cement concrete road is existing with width from 5-12m. - Population status: The northeast borders on the rice fields, the southwest borders on Huong Son road, the Northwest borders on the alley, the Southeast borders on 5 households.	- S = 6,151 m^2, 24 classrooms, 500 pupils. - Structure: • Permanent building, reinforced concrete, brick wall, heat resistant and waterproof roof, artificial grass roof • Construction area: 1,934 m^2 • Green park: 1,248 m^2 • Internal traffic area: 2,792 m^2 - Auxiliary works: • Campus, fence, kitchen, lodge, parking lot • Lighting system • Water supply and drainage system • Fire prevention and fighting system	- S: 6,151 m^2 - AHs: 6 HHs - No relocated HH.	 Building location of Huong Son kindergarten  Layout of Huong Son kindergarten

No.	Item	Location	Specifications	Land acquisition, resettlement	Picture
9	Phan Dinh Phung Kindergarten Upgrading	- Location: Phan Dinh Phung ward - Current status of use: The school was put into operation since 1998 with 10 classrooms and 350 pupils. This is one-storey block (S = 1,725m^2). Facilities have been seriously degraded, not meeting the needs of the surrounding people. - Technical status: The subproject area had cement concrete road with width of about 8m. - Population status: Surrounding the subproject area adjacent to residential areas. This closest distance is about 3m.	• S = 3,300 m^2, 18 classrooms, 400 pupils. • Structure: - Permanent building, reinforced concrete, brick wall, heat resistant and waterproof roof, artificial grass roof - Construction area: 1,344 m^2 - Green park: 910 m^2 - Internal traffic area: 990 m^2 • **Auxiliary works:** - Brick walls surrounding - Campus, fence, kitchen, lodge, parking lot - Lighting system - Water supply and drainage system - Fire prevention and fighting system	- S: 3,330 m^2 - AHs: 3 HHs - No relocated HH.	 Building location of Phan Dinh Phung kindergarten  Layout of Phan Dinh Phung kindergarten

1.3. Auxiliary works

The auxiliary works are mainly camps, kitchens, bath rooms and warehouses.

Most of the construction sites have large premises with quite convenient location for gathering materials as well as building workers' camps.

Workers' camps are built of steel columns with walls surrounded by corrugated sheets, canvas and roof covered with corrugated sheets or cement fiber, cement floors. The number of workers is minor, short construction time and utilization of local laborers, so simple camps will be set up to ensure daily living conditions for workers.

Kitchens: Kitchens are set up temporarily near the campsite by iron columns, corrugated iron roofs and walls. Materials for cooking are mainly gas and wood.

Toilets: Mobile toilets will be arranged by the Client.

Electricity and water: 100% of the camps use electricity from the national grid. There are 8 among 9 works using tap water. In particular, the works of Huong Thuong - Chua Hang road uses bored well water purchased from local households since tap water has not been brought to this area.

Warehouses: Warehouses are located near the workers' camps to gather constructional materials such as cement, grease, steel, iron, etc. Technical specifications of the warehouse are as follow: steel columns, corrugated iron roof, surrounding walls are made of B40 steel, cement floor. Sand, gravel, stone, brick are stored at the construction site.

Table 3: Some reference locations for building site camps

In the middle of Southnorth road (Works No. 1)

In the middle of Huong Thuong – Chua Hang road (works No.2)

At the starting point of Dong Bam road (Works No.3)

At the ending point of Dong Bam road (Works No.4)

At the starting point of Le Huu Trac road (Works No.5)

In the middle of Le Hu Trac road, nearby Highway 3 overpass (Works No.5)

Xuong Rong drainage ditch area (Works No.6)

Corn rice in Trai hamlet, nearby Mo Bach ditch (Works No.7)

Vacant land in the middle of Mo Bach stream route (Works No.7)

In the campus of Huong Son kindergarten (Works No.8)

1.4. Construction method and technologies

Thai Nguyen city subproject is a multi-disciplinary subproject with diversified investment subprojects. Therefore, works construction methods and technology will be proposed based on each category of works, technical specifications, conditions of construction at the subproject location and requirements on construction, etc. Design and construction shall be implemented in compliance with the current standards, processes and regulations of Vietnam and refer to the foreign standards, processes and regulations which are allowed to apply in Vietnam. The construction methods described below are excerpted from the "pre-feasibility study" report of the subproject.

1.4.1. Generic construction methods

Site preparation: handover the construction site to the construction Contractor.

Mobilization of workers, construction equipment; agreement, construction permission.

Prior to construction, the contractor shall carry out rehabilitation of surveyor's stakes and center stakes. The system of surveyor's stakes and center stakes should be verified and accepted by the Consultant before construction. The Contractor shall additionally install necessary extra stakes for the construction, especially in special locations including changing slope, roundabout, transition place between excavation and backfilling, etc. The surveyor's stakes shall be taken out of the impact scope of construction vehicles and fixed by other piles and carefully protected so that the main stakes can be quickly restored according to design location in case construction test is required.

The requirements of positioning and molding consist of determination of positions including the center, axis of the works, the roof foot of backfilled soil, roof top edge of excavated soil, landslide support, boundary of foundation hole, the edge of material mine, width of the side ditches, top ditches, cross sections of excavation or backfilling, etc. The positioning of the works should be witnessed by the Supervision Consulting Engineers; the records of measurement should be saved for later examination.

Site clearance: The obstacles and structures of works within the construction scope should be dismantled. All objects including trees, stumps, roots, grasses, trash and other obstacles should be excavated, cleaned and transported out of the construction site and then dumped at the designated location. Clearance, digging poles and ditches will be carried out up to the necessary depth in accordance with the requirements of excavation within the construction site.

Bridges, culverts and drainage works located on the roads which are being used, will not be allowed to be removed or displaced without proper traffic assurance measures.

Road surface within the scope of removal should be dug to the prescribed depth, and if the excavated material is not utilized according to requirements, they will be smashed into pieces less than 300mm, gathered and transported into the location as prescribed;

Removal of the road surface should be carried out carefully to avoid damage to sections adjacent to road surface or neighboring works that have been required to be kept in the original position.

The materials obtained during the preparation process of the construction site, which are determined to be reusable for other work items, shall be collected at the specified location within the construction site. The determination of suitability of the utilized material is evaluated by the experimental methods or evaluation and approval from the supervision consultants.

The unsuitable and non-recycled materials will be treated as waste materials and transported or disposed at the designated location. The Contractor is responsible for applying for permits for waste material collection sites.

Leveling is carried out to create prefabrication site plan and gather materials: Backfilling the site with materials utilized from excavated base (organic, mold, leveling excavation). Leveling, backfilling the site is implemented with tightness K90. The above section is paved with crushed aggregate subbase course and compacted K95 to create the surface for the site.

Construction of workers camps, equipment gathering site.

1.4.2. Road construction method

Construction of roadbase:

- Excavating and removing organic soil layer, clear the site;
- Treating soft soil in each section;

- Backfilling soil layer-by-layer and roll at the tightness K=0.95.
- Backfilling the roadbase (K=0.98) and suspension by each phase until the designed elevation is met.

Construction of road surface: New road surface is constructed with an order from bottom to the top:

- Paving a macadam aggregate type 2 with thickness of 25cm;
- Paving a macadam aggregate type 1 with thickness of 25cm;
- Applying prime coat;
- Paving an asphalt concrete19 layer with thickness of 7cm;
- Applying of tack coat;
- Paving an asphalt concrete 12.5 with thickness of 5cm.

Construction of drainage system: Construction of horizontal drainage culvert, longitudinal ditch system at the same time with construction of roadbase:

- Construction of culvert foundation;
- Installation of culvert pipe;
- Construction culvert joints;
- Soil backfilling in 2 sides of culvert body and culvert back by each layer with thickness from 15cm to 20cm and compacted at required level for roadbase (K=0.95).

Construction of sidewalks:

- Gathering materials
- Leveling as follow design elevation
- Construction of the curb: Leveling, compacting to achieve the design compaction coefficient, using pre-cast concrete components for curbing

Local road intersection: Tapering from the edge of road surface to local road, reinstate the road pavement structure following the structure of former local road surface.

1.4.3. Bridge construction method

❖ ***NH3 overpass construction method***

Apart from the basic construction methods similar to those of the river overpass below, including construction of abutment, piers and upper structures of the bridge, there are construction methods of NH3 overpass as follows:

- Tentative construction duration: 3-4 months;
- Construction method: Mainly take place at nights;
- Instructive signs and warning signs will be equipped on the construction site;
- Warning signs and instructive signs of work ahead, speed limit signs will be equipped on the NH_3;
- Disclose publically about the construction of NH3 overpass via the mass media such as television, broadcasting and newspapers;
- Construction activities will be allowed until permission from the NH3 authority.

❖ ***River overpass construction method***

Abutments:

- Leveling the site, installing equipment for bored pile construction;
- Drilling holes; pouring pile concrete;
- Excavating soil in foundation hole to the designed elevation, pouring concrete, backfilling soil to the uppermost surface of the foundation.
- Installing scaffolding and formwork, reinforcing steel, pouring and treating concrete;
- Removing scaffolding and formwork.
- Completing of abutment.

On-land piers:

- Leveling the site, installing equipment for bored pile construction.
- Drilling holes, keeping and stabilizing drilling holes, pouring bored pile concrete;
- Excavating soil in foundation hole to the designed elevation, pouring concrete, backfilling soil to the uppermost surface of the foundation;
- Installing scaffolding and formwork.
- Backfilling to the elevation of natural ground and completing piers.

In-water piers:

- Installing equipment for bored pile construction on floating system.
- Drilling holes, keeping and stabilizing drilling holes, pouring pile concrete.
- Placing sheet pile coffer-dam, excavating soil within the coffer-dam, pouring concrete to seal the bottom, pumping water of foundation hole, installing formwork, reinforcing steel for the foundation and pouring concrete.
- Installing scaffolding and formwork, installing steel reinforcement for the piers, pouring concrete.
- Removing scaffolding and formwork.
- Clearing the river bottom, completing piers.

Bridge superstructures:

- Casting girder
- Constructing the casting platform/formwork. Concreting and maintaining concrete.
- Taking girder to the construction site. Launching girder at required position by crane or by specialized erection girder.
- Constructing of girder deck and concrete handrail curb.
- Constructing waterproofing bridge deck, paving asphalt concrete, completing bridge.

1.4.4. Methods of ditch dredging and construction

Methods of stormwater, wastewater diversion system

- Embank retaining dike to prevent the flow in construction segments; each segment is about 30m long.
- Drain water in the foundation by pumps with capacity of 50Cv
- Use water pipeline PVC D200 for Mo Bach ditch and D150 for Xuong Rong ditch to ensure drainage during the construction phase.

Foundation excavation for wastewater drainage system

- Use steel piles U200x100x4, then retain soil by steel plate with thickness of 5mm, distance of 1m between two piles.
- Use horizontal wooden support for the foundation

- Excavate the foundation to the designed elevation, then lay a stone 2x4 layer and a sand layer with thickness of 15cm after construction of culvert pipe.
- Arrange a drainage ditch with dimension 10x15cm on the foundation for implementing construction.

Sludge dredging:

- For the first segment with a length of 30m, dredging the foundation and manually gathering dredged sludge, then transporting the dredged materials to dumping site.
- For remaining segments, dredging sludge by excavator with the bucket's capacity of 0.8 m^3, excavating 2 times and using 5-ton or 10-ton truck for transporting the dredged materials.

Concreting work:

- Pour concrete manually, mixing and compacting the concrete by machines, and transporting concrete manually.
- Methods: Concreting the foundation by chutes placed from the foundation top to the bottom. The chutes must be placed firmly and must not put on rebar and formwork.
- Install the scaffold platform for construction of foundation wall, wall height >2m; use appropriate elephant hoses or chutes for pouring concrete to avoid materials dropping from the height >1.5m.

Stone work:

- Dimension of the stone for building wall must be at least 25cm.
- Stone is laid manually on mortar with non-straight stacked bonds. Before laying, the mortar must be kept moist.
- The volume of stone wall should be maintained by watering at least 12 hours.
- Drainage pipe must be made from plastic PVC ϕ 60, the quantity of pipes is set forth in the Design. In any cases, the top of the wall should be flatted by mortar.

For embankment:

Due to the requirement of anti-landslide construction, embankments should be carried out according to the successive construction method with the following steps:

- Step 1: Manual weathering and transportation to the gathering site is carried out at unused vacant land area adjacent to the construction site and then transferred to the dumping site;
- Step 2: Construction of cofferdam is implemented manually in combination with excavator;
- Step 3: Excavation of soil and leveling aims to create construction at elevation of +0.4 ÷ 0.5;
- Step 4: Driving 2 rows of eucalyptus interleaving 2 edges of stone gabions;
- Step 5: Excavation of gabion foundation is implemented to the elevation of -2.10m;
- Step 6: Construction of bamboo fence layer adjacent between gabion and backfilled soil.
- Step 7: Construction of gabion;
- Step 8: Backfilling soil to create embankment roof;
- Step 9: Construction of embankment roof beam frame;
- Step 10: Placing stones tightly into the embankment;
- Step 11: Breaking cofferdam
- Step 12: After finishing the embankment roof, the concrete road is constructed on the embankment top. Completing the works and cleaning the ground.

For construction of roads behind embankment:

The construction methods for road and bridge include the following steps:

- Preparation
  - + Positioning and localization of works;
  - + Preparation of construction camps and workers camps;
  - + Mobilization of machinery and equipment.
- Construction of concrete roads
  - + Step 1: Excavation and dredging of organic soil
  - + Step 2: Covering the ground according to standard hardness in each design layer
  - + Step 3: Excavation of the road foundation according to the width of each section; Installing the formwork and pouring cement concrete under the formwork.
  - + Step 4: Drawing the formwork => completion.
- Construction of asphalt concrete layer
  - + Step 1: Excavation and dredging of organic soil
  - + Step 2: Covering the ground according to standard hardness in each design layer
  - + Step 3: Excavation of the road foundation according to the width of each section
  - + Step 4: Spreading and compacting each soil layer, type 2 and type 1 (in the roadbed) to the standard hardness in the design layers.
  - + Step 5: Drawing the formwork => completion.

1.4.5. Methods for construction of Kindergarten

Methods of foundation excavation

- Excavate the foundation at designed elevation mechanically and manually: excavate soil mechanically 0.1m above designed elevation, then carry out manual excavation.
- Excavate trench and water collection hole surrounding the foundation for drainage.
- In case of foundation flooding due to rain: Drain water in the foundation following the drainage system by using pump with capacity from 5-25 m^3/h.
- In the course of construction, it can be rainy, the positions with soft soil will be supported by formwork to prevent soil erosion into the foundation.
- Excavated soil will be successively transported, only qualified soil is used for foundation backfilling.

Construction, plastering and tiling

Lay the first tile line for standardizing following lines:

- Tiling separate room: Lay the first two tile lines, closet to 2 vertical edges of the room inwards from the door.
- Titling the room with shared corridor: the first two tiles must be started from the horizontal mortar joints of the corridor and make sure that the vertical joint of the room coincides with the horizontal joints of the corridor. At corners which are not wide enough for laying full tiles, the tiles will be cut and tiled in the inmost brick course in the room.
- In case tiles of the corridor are in a different size, the first brick course must depend on the bonding of separate room.
- A mortar layer with 2cm thick must be applied in advance for titling.
- Gently hit the wooden mallet or the trowel hand on the tiles to get matched with the

datum line.

- Keep lean mortar dry before laying bricks.
- When the mortar is dry, clean the mortar joints with soft brushes.
- Water mortar joints by bare amount of water.
- Apply grout in joints and spread it over the tiles
- Sprinkle white powder cement on these joints
- Sweep the tile with brooms or soft brushes.

1.4.6. Removal of power posts

- Dismantle all components, re-stretch electric wire, install ceramic electrical insulators
- Place new electric posts; for posts on sidewalk, install an outdoor three-phase sub-switch with voltage of 24kv, DN-24kv-630A, 01 Zinc Oxide Surge Arrester 24kv, support components TU and TI, lightning arresters, insulated chairs, ladders.
- Utilize available measurement tools
- Insulation: Use ceramic electrical insulator 24kv
- Power post: Centrifugal concrete post with a height of 16m
- Post Foundation: cylinder reinforced concrete foundation with lean concrete M50; pre-cast concrete M150; concrete base M200.
- Cross-arm brace: by shaped steel with zinc coating
- Earthing and lightning protection: Re-earthing all power posts with resistance of no more than 10Ω.

1.4.7. Regulatory requirement on the minimum distance between residential/business areas and the infrastructure

The Minimum environmentally safe distance for each works accounted into the design. There are three work could have mininum environmentally safe distance: wastewater pumping station; Phan Dinh Phung and Huong Son kindergarten; Xuong Rong stream and Mo Bach stream.

Table 4: Minimum environmentally safe distance

N	Works	Minimum environmentally safe distance	Legal
1	02 wastewater pumping stations of Xuong Rong stream	20m	- Decision 04/2008/QD-BXD - Vietnam Building Code. Regional and Urban Planning and Rural Residental Planning - TCVN 7957:2008: Drainage and sewerage - External Networks and Facilities - Design Standard - TCXDVN 33:2006 - Water supply - Distribution system and facilities - Design standard.

N	Works	Minimum environmentally safe distance	Legal
2	02 Kindergarten: Phan Dinh Phung and Huong Son	In the case of these kindergartens, the near roads surround these kindergartens have low traffic density, so there is no minimum distance between kindergarten with surounding objects	TCXDVN 260:2002 – Kindergarten – Design standard If kindergarten near roads with high traffic density, the distance from the edge of the road to the outside of the walls of living rooms, bedrooms and classrooms must be not less than **12m**
3	Xuong Rong stream and Mo Bach stream	- Running through residential area: **10m** - Do not running through residential area: **5m**	Decree 43/2015/ND-CP providing the establishment and management of water source protection corridors.

1.5. List of machines and equipment

List of expected machines and equipment to be used as follows:

Table 5: Typical construction machines and equipment

No.	Equipment	Quantity	No.	Equipment	Quantity
1	Rod vibrator 1.5KW	10	19	Launching girder	5
2	Drilling machines ED, KH, Soilmec	5	20	Barbender 5KW	15
3	Vertical drilling machine 4.5KW	5	21	Air compressor jack hammer	15
4	Diesel air compressor 240 m^3/h	10	22	Diesel air compressor 360 m^3/h	5
5	10 ton truck crane	2	23	Mortar mixer 80L	10
6	Welding machine 23KW	10	24	Mortar pump 9 m^3	10
7	Power Jack 250T	5	25	Pneumatic-tyred crane 16T	2
8	Pump 20KW	10	26	Concrete pump machine 50 m^3/h	4
9	Diesel air compressor 600 m^3/h	10	27	Dump truck 10T	50
10	Power Jack 500T	2	28	Water truck 5 m^3	5
11	Chain Pulley Block 3T	4	29	Combined roller	10
12	Crawler crane 25T	5	30	Bulldozer	10
13	Electric winch 5T	5	31	Motor grader	10
14	Drilling machine TRC-15	1	32	Crawler excavator 1.6 m^3	2
15	Cable Cutter 10kW	10	33	Rubber-tyred excavator	3

No.	Equipment	Quantity	No.	Equipment	Quantity
16	Cable feed machine 15KW	10	34	Grader	5
17	Form vibrator	10	35	Girder casting bed	10
18	Rod vibrator 2.8KW	10	36	Asphalt pave finisher	5

(Basic design statement of the subproject, October 2017)

1.6. Raw materials and fuel demand

1.6.1. Construction volume of work items

Demands for materials and fuel for work items under DCIDP – Thai Nguyen Subproject are shown in Table 5:

Table 6: Summary of main items of DCIDP - Thai Nguyen City Subproject

No.	Volume	Unit	Southnorth road & Huong Thuong bridge	Huong Thuong - Chua Hang road	Dong Bam road	Dan bridge	Le Huu Trac road	Xuong Rong ditch	Mo Bach stream	Huong Son kindergarten	Phan Dinh Phung kindergarten
1	Excavated soil	m^3	69,341	94,884	175,156	5,735	88,519	9,473	94,041	4,036	1,642
2	Backfilled soil	m^3	246,604	397,416	298,379	4,449	172,176	27,822	30,669	7,844	1,922
3	Sandfill	m^3	3,119	39,254	39,254	-	-	-	468	7	72
4	Rubble	m^3	-	-	-	124	-	13,650	26,058	-	-
5	Geotextile fabric	m^2	59,695	688	28,733	-	13,094	-	-	-	-
6	Concrete	m^3	91,970	103,575	85,714	3,275	54,910	2,100	7,626	2,015	967
7	Ballast	m^3	35,289	51,962	12,976	2,879	10,404	1,625	1,311	-	236
8	Steel	Ton	4,293	1,714	1,714	536	142	58	311	138	46
9	Organic dredging	m^3	-	-	-	-	-	5,650	24,400	-	-
10	Volume of excavated soil for backfilling	m^3	55,473	75,907	140,125	4,588	70,815	7,578	75,233	3,229	1,314
11	Volume of exhaust excavated soil	m^3	13,868	18,977	35,031	1,147	17,704	1,895	18,808	807	328

1.6.2. Material resources

Selected constructional materials include backfilled soil, cement, sand, rock, steel, etc. These are available materials in Thai Nguyen city. Constructional materials are purchased at the constructional material suppliers, borrow pits, rock quarry, sand-gravel pits which have been issued mining license and approved environmental impact assessment report or environmental protection committee. The location and transportation distance of materials are presented in Table and Table .

Table 7: Constructional Material Suppliers

Pit/Quarry	Location	Reserve (W) / Capacity (CS)	Duration (years)	License and Decision on approval of EIA and EPC (Environmental Protection Commitment)	Works using materials
Borrow pits					
Borrow pits: La Danh, Hoa Trung and Song Cau township (*Owner: Thai Son JSC.*)	La Danh, Hoa Trung hamlets and Song Cau towns, Dong Hy district, Thai Nguyen	- W = 815.833 m^3 - CS = 395.00 m^3/year	2032	- License No.03/GP-UBND issued on 04/1/2011 - Decision No.3027/QD-Dong Hy people's Committee dated 29/11/2010	All 9 works
Borrow pits: Theo Cay, Minh Lap and Hoa Thuong (*Owner: Viet Cuong private enterprise*)	Theo Cay, Minh Lap and Hoa Thuong, Dong Hy district, Thai Nguyen	- W = 611.076 m^3 - CS = 20.000 m^3/year	2041	- License No.181/GP-UBND issued on 24/01/2011 - Decision No.14/QD-Dong Hy people's Committee dated 06/01/2011	All 9 works
Rock quarry					
Na Lay rock quarry *(Owner: Viet Cuong private enterprise*)	Quang Son commune, Dong Hy district, Thai Nguyen	- W = 1.022.736 m^3 - CS = 45.0000 m^3/year	2033	- License No.1978/GP-UBND issued on 25/8/2010 - Decision No.1773/QD-Dong Hy people's Committee dated 09/8/2010	- Dong Bam road, - Southnorth road & Huong Thuong bridge, - Huong Thuong - Chua Hang road, - Xuong Rong drainage ditch, - Huong Son kindergarten - Phan Dinh Phung kindergarten
Moi hamlet rock quarry *(Owner: Viet Cuong private enterprise*)	Moi and Tan Long hamlets, Dong Hy district, Thai Nguyen	- W = 8.700.000 m^3 - CS = 300.000 m^3/year	2041	- License No.1257/GP-UBND issued on 20/5/2011 - Decision No. 1114/QD-UBND dated 29/4/2011	
Lan Dam II rock quarry *(Owner: Hai Binh Co., Ltd.*)	Quang Son commune, Dong Hy district, Thai Nguyen	- W = 1.200.000 m^3 - CS = 40.000 m^3/year	2041	- License No.230/GP-UBND issued on 26/01/2011 - Decision No. 89/QD-Dong Hy people's Committee dated 17/01/2011	

Dau hamlet rock quarry *(Owner: An Khanh Mining JSC.*)	Dau and Yen Lac hamlets, Dong Hy district, Thai Nguyen	- W = 6.066.759 m^3 - CS = 185.000 m^3/year	2041	- License No.1156/GP-UBND issued on 09/5/2011 - Decision No.1045/QD-UBND dated 10/5/2010	- Le Huu Trac road, - Dan bridge, - Mo Bach drainage ditch
Sand-gravel pits					
Sand-gravel pits: Linh Nham river, Khe Mo - Hoa Thuong - Linh Son *(Owner: Quan Son cooperative*)	Linh Nham, Khe Mo, Hoa Thuong and Linh Son hamlets, Dong Hy district, Thai Nguyen	- W = 191.003 m^3 - CS = 11.100 m^3/year	2031	- License No.1482/GP-UBND issued on16/6/2011 - Decision No. 1533/QD-Dong Hy people's Committee dated 23/5/2011	- Dong Bam road - Huong Thuong - Chua Hang road - Phan Dinh Phung kindergarten - Xuong Rong drainage ditch, - Mo Bach drainage ditch,
Sand-gravel pits: Hoa Khe, Nam Hoa and Van Han streams *(Owner: Thai Nguyen Black Metallurgical JSC*)	Hoa Khe, Nam Hoa and Van Han streams, Dong Hy district, Thai Nguyen	- W = 315.883 m^3 - CS = 24.000 m^3/year	2025	- License No.1977/GP-UBND issued on 25/8/2010 - Decision No. 1213/QD-Dong Hy people's Committee dated 22/06/2010	- Southnorth road & Huong Thuong bridge
Sand-gravel pits: Lo Nam Tien hamlet, Van Kim hamlet, Cau Son hamlet *(Owner: Truong Phat Construction Co., Ltd)*	Trung Thanh commune, Pho Yen district, Thai Nguyen	- W = 1.392.000 m^3 - CS = 48.000 m^3/year	2042	- License No.100/GP-UBND issued on 19/01/2012 - Decision No. 8090/QD-Pho Yen People's Committee dated 11/7/2011	- Dan bridge, - Le Huu Trac road - Huong Son kindergarten
Dam hamlet sand-gravel pit *(Owner: Truong Phat Construction Co., Ltd.)*	Dac Son commune, Pho Yen district, Thai Nguyen city	- W = 624.771 m^3 - CS = 48.000 m^3/year	2027	- License No.101/GP-UBND issued on 19/01/2012 - Decision No. 8089/QD-Pho Yen People's Committee dated 11/7/2011	

Gathering point of constructional material supplier is 150m away from Dan bridge

Construction material supplier for the work item of Le Huu Trac road is 50m away from NH 3 overpass

Gathering point của constructional material supplier in the beginning of Le Huu Trac road is 50m away from the road

Gathering point ofconstructional material supplier at the end of Le Huu Trac road is 50m away from the road

Gathering point ofconstructional material supplier located in the beginning of the Southnorth road – Huong Thuong bridge is 500m away from the road

Construction material supplier is around 500m away fromXuong Rong drainage ditch

Construction material supplier is around 500m away from Xuong Rong drainage ditch

Construction material supplier is 1km away from Mo Bach ditch

Construction material supplier is 2km away from Dong Bam road 2km, and 1km away from Huong Thuong - Chua Hang road

Figure 2: Some constructional material suppliers in Thai Nguyen province

With the abundant suppliers of construction materials, close transport distance, the supply of construction materials for work items is relatively easy.

Table 8: Transportation route of materials

No.	Work items	Material supplying places	Transportation route	Distance (km)
1	Southnorth road & Huong Thuong bridge	- Borrow pits: La Danh, Hoa Trung and Song Cau township - Borrow pits: Theo Cay, Minh Lap and Hoa Thuong	NH 1B (7km) – Cach Mang Thanh Tam road (2km) – Alley (2km) – Subproject area	11
		- Na Lay Rock quarry - Xom Moi Rock quarry - Lan Dam II Rock quarry	NH 1B (13km) – Bac Kan (0.5km) - Cach Mang Thanh Tam road (3.5km) – Subproject area	17
		- Sand-gravel pits: Hoa Khe, Nam Hoa and Van Han streams	Provincial road 265 (13km) – Subproject area	13
		- Other materials: Material suppliers near the subproject area		< 2km
2	Huong Thuong - Chua Hang road	- Borrow pits: La Danh, Hoa Trung and Song Cau township - Borrow pits: Theo Cay, Minh Lap and Hoa Thuong	NH 1B (3km) – Subproject area	3
		- Na Lay Rock quarry - Xom Moi Rock quarry - Lan Dam II Rock quarry	NH 1B (11km) – Subproject area	11
		- Sand-gravel pits: Linh Nham river, Khe Mo - Hoa Thuong - Linh Son	NH 1B (6km) – Subproject area	6
		- Other materials: Material suppliers near the subproject area		< 2km
3	Dong Bam road	- Borrow pits: La Danh, Hoa Trung and Song Cau township - Borrow pits: Theo Cay, Minh Lap and Hoa Thuong	NH 1B (4km) – Subproject area	4
		- Na Lay Rock quarry - Xom Moi Rock quarry - Lan Dam II Rock quarry	NH 1B (12.5km) – Subproject area	12.5
		- Sand-gravel pits: Linh Nham river, Khe Mo - Hoa Thuong - Linh Son	NH 1B (7.5km) – Subproject area	7.5
		- Other materials: Material suppliers near the subproject area		< 2km

No.	Work items	Material supplying places	Transportation route	Distance (km)
4	Dan bridge	- Borrow pits: La Danh, Hoa Trung and Song Cau township - Borrow pits: Theo Cay, Minh Lap and Hoa Thuong	NH 1B (7km) – Cach Mang Thanh Tam road (2km) – Bac Kan (1.2km) – Luong Ngoc Quyen (1.5km) - Quang Trung (4km) – Subproject area	15.7
		- Dau hamlet Rock quarry	Inter-commune road (8km) – NH 3 (20km) – Quang Trung road (2km) - Subproject area	30
		- Sand-gravel pits: Lo Nam Tien hamlet, Van Kim hamlet, Cau Son hamlet - Dam hamlet sand-gravel pits	Cach Mang Thanh Tam road (Song Cong town, 12.5km) – Thinh Duc (5.5km) - Subproject area	18
		- Other materials: Material suppliers near the subproject area		< 2km
5	Le Huu Trac road	- Borrow pits: La Danh, Hoa Trung and Song Cau township - Borrow pits: Theo Cay, Minh Lap and Hoa Thuong	NH 1B (7km) – Cach Mang Thanh Tam road (2km) – Bac Kan (1,2km) – Luong Ngoc Quyen (1,5km) - Quang Trung (3.5km) – Le Huu Trac (1km) - Subproject area	16.2
		Dau hamlet Rock quarry	Inter-commune road (8km) – NH 3 (20km) – Quang Trung road (1,5km) – Le Huu Trac (1km) - Subproject area	30.5
		- Sand-gravel pits: Lo Nam Tien hamlet, Van Kim hamlet, Cau Son hamlet - Dam hamlet sand-gravel pits	Road 30/4 (6km) – Road 3/2 (3km) – NH 3 (16km) - Subproject area	25
		- Other materials: Material suppliers near the subproject area	Urban roads and alleys	< 2km
6	Xuong Rong drainage ditch	- Borrow pits: La Danh, Hoa Trung and Song Cau township - Borrow pits: Theo Cay, Minh Lap and Hoa Thuong	NH 1B (7km) – Bac Kan (0.5km) - Cach Mang Thanh Tam road (3.5km)	11
		- Na Lay Rock quarry - Xom Moi Rock quarry - Lan Dam II Rock quarry	NH 1B (11km) – Bac Kan (0.5km) - Cach Mang Thanh Tam road (3.5km)	15
		- Sand-gravel pits: Linh Nham river, Khe Mo - Hoa Thuong - Linh Son	NH 1B (9km) – Bac Kan (0.5km) - Cach Mang Thanh Tam road (3.5km) – Alley (2km) – Subproject area	15
		- Other materials: Material suppliers near the subproject area	Urban roads and alleys	< 2km

No.	Work items	Material supplying places	Transportation route	Distance (km)
7	Mo Bach drainage ditch	- Borrow pits: La Danh, Hoa Trung and Song Cau township - Borrow pits: Theo Cay, Minh Lap and Hoa Thuong	NH 1B (7km) – Bac Kan (1km) Duong Tu Minh (0.5km) – Subproject area	8.5
		- Dau hamlet Rock quarry	Intercommune road (8km) – NH 3 (15km) - Subproject area	23
		- Sand-gravel pits: Linh Nham river, Khe Mo - Hoa Thuong - Linh Son -	NH 1B (9km) – Bac Kan (1km) Duong Tu Minh (0.5km) – Subproject area	10.5
		- Other materials: Material suppliers near the subproject area	Urban roads and alleys	< 2km
8	Huong Son kindergarten	- Borrow pits: La Danh, Hoa Trung and Song Cau township - Borrow pits: Theo Cay, Minh Lap and Hoa Thuong	NH 1B (7km) – Bac Kan (0.5km) - Cach Mang Thanh Tam road (3.5km) – Trinh Ba (1km) – Luu Nhan Tru (300m) – Huong Son (500m) – subproject area	16.3
		- Na Lay Rock quarry - Xom Moi Rock quarry - Lan Dam II Rock quarry	NH 1B (11km) – Bac Kan (0.5km) - Cach Mang Thanh Tam road (7km) m- Trinh Ba (1km) – Luu Nhan Tru (300m) – Huong Son (500m) – subproject area	20.3
		Sand-gravel pits in Lo Nam Tien, Van Kim and Cau Son hamlets - Sand-gravel pit in Dam hamlet	– Road 30/4 (6km) – road 3/2 (5.5km) – Huong street (0.7km) – Luu Nhan Tru (2km) - Subproject area	14.2
		- Other materials: Material suppliers near the subproject area		< 2km
9	Phan Dinh Phung kindergarten	- Borrow pits: La Danh, Hoa Trung and Song Cau township - Borrow pits: Theo Cay, Minh Lap and Hoa Thuong	NH1B (7km) – Bac Can (0.5km) – Hoang Van Thu (1.2km) – subproject area	9
		- Na Lay Rock quarry - Xom Moi Rock quarry - Lan Dam II Rock quarry	NH1B (11km) – Bac Can (0.5km) – Hoang Van Thu (1.2km) – subproject area	13
		- Sand-gravel pits: Linh Nham river, Khe Mo - Hoa Thuong - Linh Son	NH1B (9km) – Bac Can (0.5km) – Hoang Van Thu (1.2km) – subproject area	11
		- Other materials: Material suppliers near the subproject area		< 2km

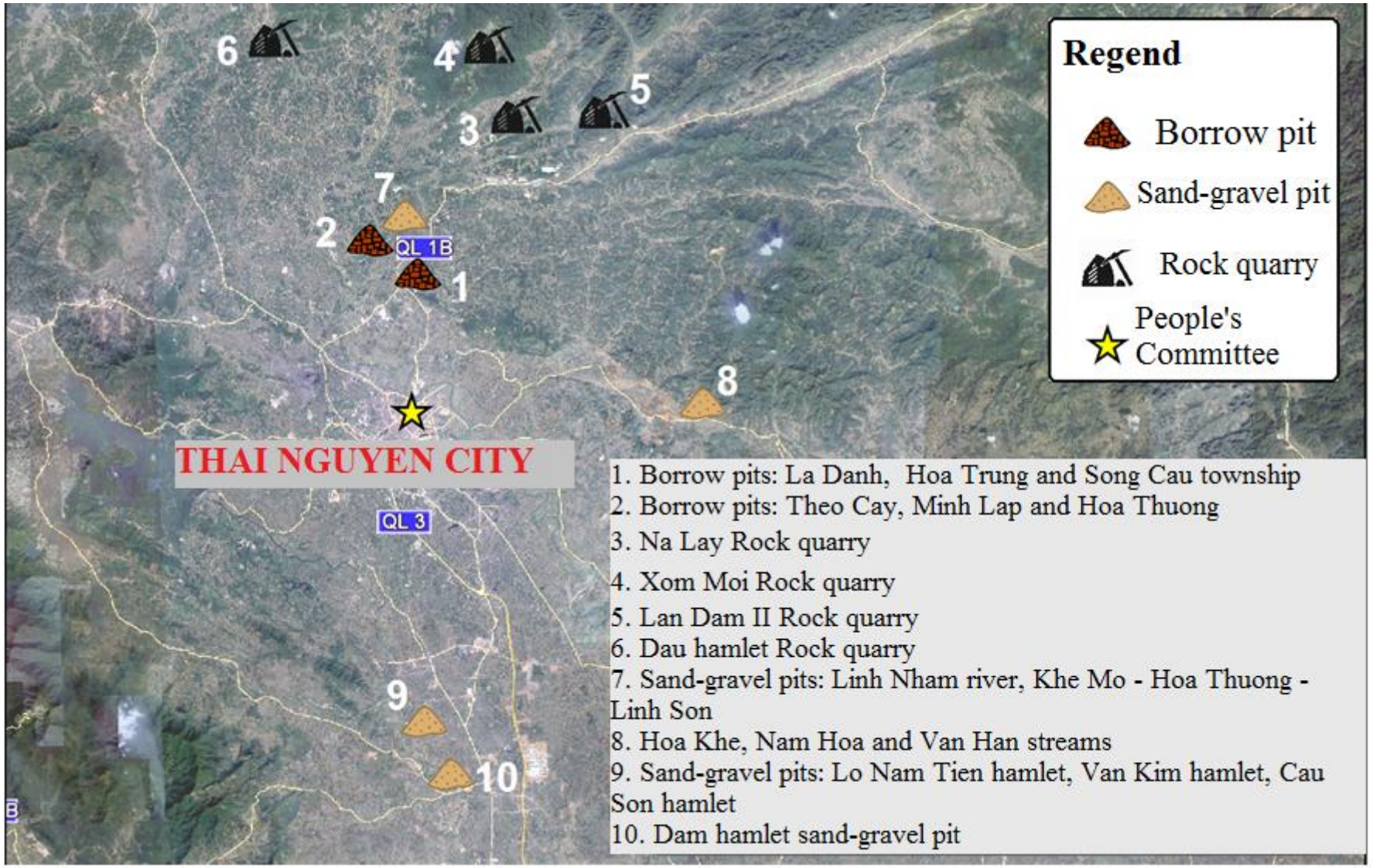


Figure 3: Map of some quarries supplying constructional materials for DCIDP – Thai Nguyen city Subproject

1.6.3. Disposal site

Construction waste from work items will be transport to two disposal sites which have been licensed by Thai Nguyen City People's Committee:

- (i) Da Mai disposal Site is located in Tan Cuong Commune, 15km away from Thai Nguyen city center with an area of 25ha, with an estimated reserve of 1,000,000m^3 from the beginning of 2017.
- (ii) The second disposal site is located in group 1, Tich Luong ward, Thai Nguyen city, 5km away the center. The area of disposal site is 10ha, the permitted volume is 40,000 m^3. Residential are rice fields is around the disposal site. The nearest residential area is about 100m away, the nearest rice field about 80m away from the disposal site and separated by concrete road (width of 6m.)

Therefore, the capacity of to disposal sites fully meets volume of waste materials and solid waste from the work items. Details of the transportation routes from the construction site to Da Mai disposal site and Tich Luong ward disposal site are shown in Table 9.

Table 9: Transportation route to Da Mai disposal site and Tich Luong disposal site

No.	Work items	Transportation route	Distance (km)
1	Southnorth road & Huong Thuong bridge	Inter-commune road – Tich Luong ward disposal site	2-5
2	Huong Thuong - Chua Hang road	Inter-commune road – Tich Luong ward disposal site	2-5
3	Dong Bam residential area road	Inter-commune road – Tich Luong ward disposal site	5 – 7
4	Dan bridge	Quang Trung – provincial road DT267 – Da Mai disposal site	8.5
5	Le Huu Trac road	Quang Trung – provincial road DT267 – Da Mai disposal site	10
6	Xuong Rong drainage ditch	Xuan Hoa – Tuc Duyen road – inter-commune road – Tich Luong ward disposal site	3-5
7	Mo Bach stream drainage ditch	Quang Trung – provincial road DT267 – Da Mai disposal site	11
8	Huong Son kindergarten	Huong Son road - Luu Nhan Chu – NH 37 – Gang Thep road – road 3/2 – NH 3 - Quang Trung – provincial road 267 – Da Mai disposal site	20
9	Phan Dinh Phung kindergarten	Hoang Van Thu - Quang Trung – provincial road267 – Da Mai disposal site	12

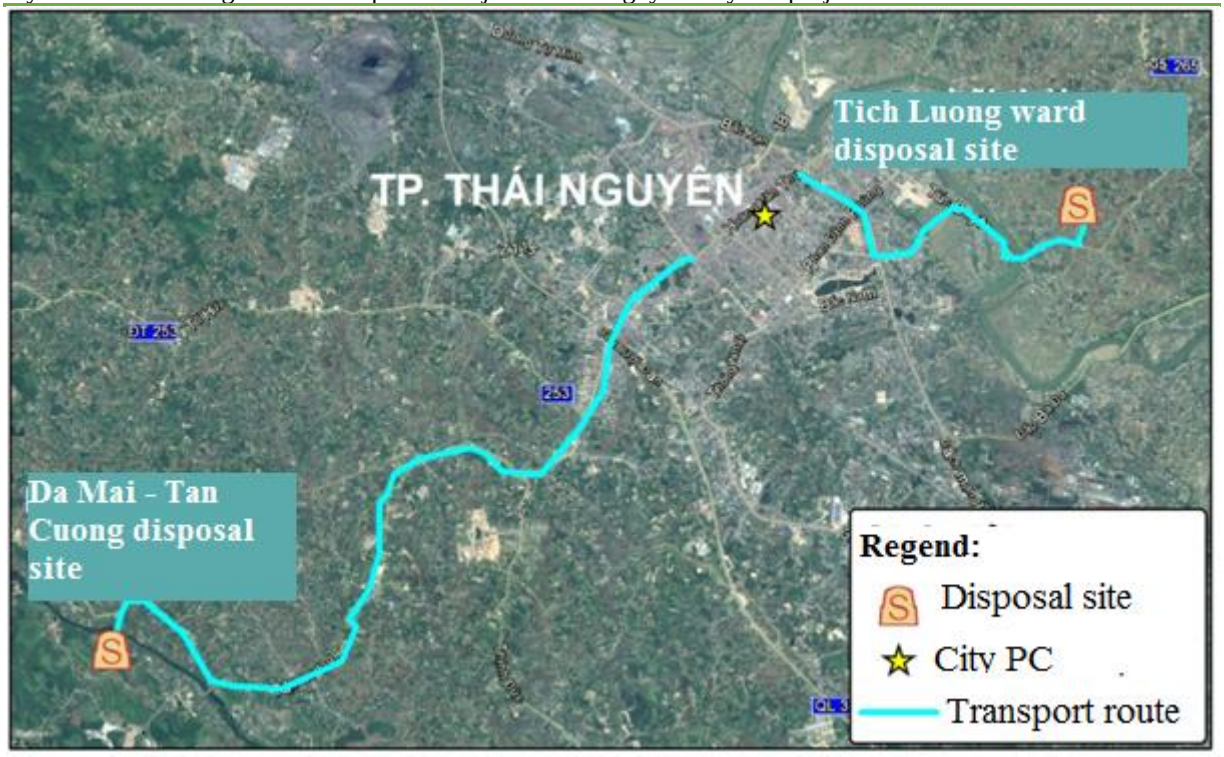


Figure 4: Map of location and distance from Thai Nguyen city center to Da Mai disposal site and Tich Luong ward disposal site

1.6.4. Labor force demand

Demand for construction workers for each item is about 30-70 people. In order to reduce expenses, create jobs for local laborers and minimize environmental and social impacts caused by gathering of workers, local laborers will be given priority (it is expected that local workers account for 60-70% of the workers), of which: (i) The working age of the workers is mainly from 18-35 years; (ii) about 5% of the working age workers is from 35-50 years old (those are highly skilled workers or managers). At each construction site, about 25% of the workers are women, 75% are male.

Table 10: Tentative quantity of labor force at construction site

No.	Work item	Workers (people)
1	Southnorth road & Huong Thuong bridge	60
2	Huong Thuong - Chua Hang road	70
3	Dong Bam residential area road	40
4	Dan bridge	30
5	Le Huu Trac road	60
6	Huong Son kindergarten	40
7	Phan Dinh Phung kindergarten	50
8	Xuong Rong drainage ditch	30
9	Mo Bach stream drainage ditch	30

Due to the limited number of workers at each construction site, the supply source of labor force in the locality is high, so the subproject can easily recruit local workers for the construction activities of the subproject.

1.7. Subproject implementation schedule

The tentative implementation schedule of Thai Nguyen city Subproject is shown in the table below:

Table 11: Summary of proposed subproject implementation schedule

No.	Item	Time	
		Begin	**Finish**
A	Subproject preparation stage	June 2017	June 2018
-	Preparation of prefeasibility study (Investment Policy Proposal)	June 2017	August 2017
-	Preparation of feasibility study and component reports	August 2017	Nov 2017
-	Approval of subproject instrument and loan agreement negotiation	Nov 2017	March 2018
-	Detailed design of items	02/2018	June 2018
B	Subproject implementation stage	July 2018	Dec 2022
-	Site clearance (According to the construction progress of each work item)	July 2018	June 2020
-	Completion of procedures and dossiers for construction commence of works	July 2018	June 2020
-	Invitation for Construction Bids	August 2019	Jan 2020
-	Construction commence	Jan 2020	Dec 2022
C	Subproject completion stage	Jan 2023	Dec 2023
-	Completion of subproject final settlement and procedures for closing subproject as stipulated	Jan 2023	Dec 2023

(Basic design statement of the subproject, October 2017)

1.8. Investment capital

Total investment of DCIDP - Thai Nguyen City Subproject is shown in the table below:

Table 12: Total investment of the subproject

No.	Items	After-tax construction cost		Allocation of implementation costs (million VND)		Allocation of implementation costs (USD)	
		Million VND	USD	Counterpart fund	IBRD loan	Counterpart fund	IBRD loan
1	**COMPENSATION, ASSISTANCE AND RESETLEMENT COST**	**349,565**	**15,536,232**	**349,565**	**-**	**15,536,232**	**-**
2	**DIRECT COSTS**	**1,510,592**	**67,137,426**	**43,851**	**1,466,741**	**1,948,930**	**65,188,495**
2a.	***Component 1: Structural component – Rehabilitation and construction of urban technical infrastructure***	***1,369,565***	***60,869,565***	**-**	***1,369,565***	**-**	***60,869,565***
	Southnorth Road & Huong Thuong Bridge Construction	552,174	24,541,063	-	552,174	-	24,541,063
	Huong Thuong - Chua Hang Road Construction	373,913	16,618,357	-	373,913	-	16,618,357
	Dong Bam Residential Area Road	117,391	5,217,391	-	117,391	-	5,217,391
	Dan Bridge Upgrading	56,522	2,512,077	-	56,522	-	2,512,077
	Le Huu Trac Road Upgrading	69,565	3,091,787	-	69,565	-	3,091,787
	Xuong Rong Drainage Ditch Rehabilitation	34,783	1,545,894	-	34,783	-	1,545,894
	Mo Bach Stream Drainage Ditch Rehabilitation	104,348	4,637,681	-	104,348	-	4,637,681
	Huong Son Kindergarten Construction	34,783	1,545,894	-	34,783	-	1,545,894
	Phan Dinh Phung Kindergarten Upgrading	26,087	1,159,420	-	26,087	-	1,159,420
2b	**Component 2: Non-structural component**	***141,027***	***6,267,861***	***43,851***	***97,176***	***1,948,930***	***4,318,930***
	Subproject preparation consultancy cost	24,286	1,079,365	24,286		1,079,365	-
	Subproject implementation consultancy cost (phase 2)	97,176	4,318,930		97,176	-	4,318,930

No.	Items	After-tax construction cost		Allocation of implementation costs (million VND)		Allocation of implementation costs (USD)	
		Million VND	USD	Counterpart fund	IBRD loan	Counterpart fund	IBRD loan
	Integrated urban development planning strategy	13,043	579,710	13,043	-	579,710	-
	Public transport system development strategy	2,174	96,618	2,174	-	96,618	-
	Drainage system management and wastewater quality monitoring	4,348	193,237	4,348	-	193,237	-
3	**CONTINGENCY**	**276,595**	**12,293,112**	**56,584**	**220,011**	**2,514,838**	**9,774,647**
4	**SUBPROJECT IMPLEMENTATION FINANCIAL COST (CAPITALIZATION)**	**113,329**	**5,036,857**	**-**	**113,329**	**-**	**5,036,857**
	Front-end fee	3,150	140,000	-	3,150	-	140,000
	Commitment fee	10,744	477,500	-	10,744	-	477,500
	Interest rate of IBRD loan by locality	99,436	4,419,357	-	99,436	-	4,419,357
	GRAND TOTAL (1+ 2 + 3 + 4):	**2,250,082**	**100,003,627**	**450,000**	**1,800,082**	**20,000,000**	**80,000,000**

➢ **Capital sources and proposed capital structure**

Total investment for implementing the Subproject is US$ 100,000,000, of which:

- IBRD loan from WB: US$ 80,000,000;
- Counterpart fund: US$ 20,000,000

1.9. Subproject Management and Implementation

➢ Subproject Steering Committee and Task Force

On April 20, 2017, Thai Nguyen Provincial People's Committee issued Decision No.936/QD-UBND on the establishment of Subproject Steering Committee and the task force to assist the Steering Committee of the Dynamic Cities Integrated Development Project - Thai Nguyen City Subproject. Accordingly:

- The Steering Committee consists of the head who is leader of Thai Nguyen PPC, deputies who are leaders of Thai Nguyen City PC and the Department of Planning and Investment of the province, and members as leaders of the Department of Finance, Department of Construction, Department of Natural Resources and Environment, Department of Transport and representatives of leaders of Thai Nguyen city.
- Subproject Steering Committee has following tasks:
    + Direct Thai Nguyen city People's Committee, the Departments and relevant units in completing the subproject investment preparatory activities, subproject management and implementation in accordance with Vietnam laws and WB's regulations;
    + Complete the Subproject to submit for the PPC's consideration and reporting the Standing Committee of the provincial Party Committee for making policy in accordance with the procedures to ensure the Dynamic Cities Integrated Development Project – Thai Nguyen City Subproject to be implemented with the committed progress, guaranteed quality and investment efficiency.

Along with the establishment of the Subproject Steering Committee, a task force is established to assist the Steering Committee. The task force consists of representatives of leaders of Thai Nguyen city, Department of Planning and Investment, Department of Finance and leaders of specialized departments of other departments.

➢ Organizational Structure of the Subproject

Executive Agency: Thai Nguyen PPC

Subproject Implementing Agency/Client: Thai Nguyen City People's Committee is assigned to act as the Client, taking responsibility for implementing the subproject and on behalf of Thai Nguyen PPC for undertaking assigned tasks under its authority.

Subproject Management Unit: To assist the subproject owner to prepare a master plan and annual detailed plan for subproject implementation; Assist the subproject owner in conducting procurement and contract management activities; Assist the subproject owner in the disbursement, financial and property management of the subproject. Operation and maintenance of subproject equipment; Technical supervision and management of contractors under direct control in the course of subproject implementation; Prepare for the subproject owner to make acceptance and hand over the outputs of the subproject after completion, completion of the audit and handover of assets of the subproject; Make a subproject progress report as required by the Government of Vietnam and at the request of the Donor and the Subproject Owner; Maintain subproject records, provide information to designated auditors. Prepare the Subproject Completion Report and Final Settlement Report.

The PMU staff consists of 15 people who have experience in implementing similar subprojects. Professional qualifications and training of PMU members are in the fields of construction, transportation, economics, architecture, environment and accounting.

- Master: 4 people

- Bachelor / engineer: 11 people

It is responsibility of 01 Master of Environment and other technical support staff for environmental management of the subproject. The environmental staff of the PMU has at least 10 years of experience. He will be responsible for: i) monitoring of the incorporation of environmental solutions and associated mitigation measures into the bidding documents and subproject contracts, including construction and CSC contracts; iii) cooperate with CSC to monitor the contractor's compliance with the environment and take appropriate actions when problem arises.

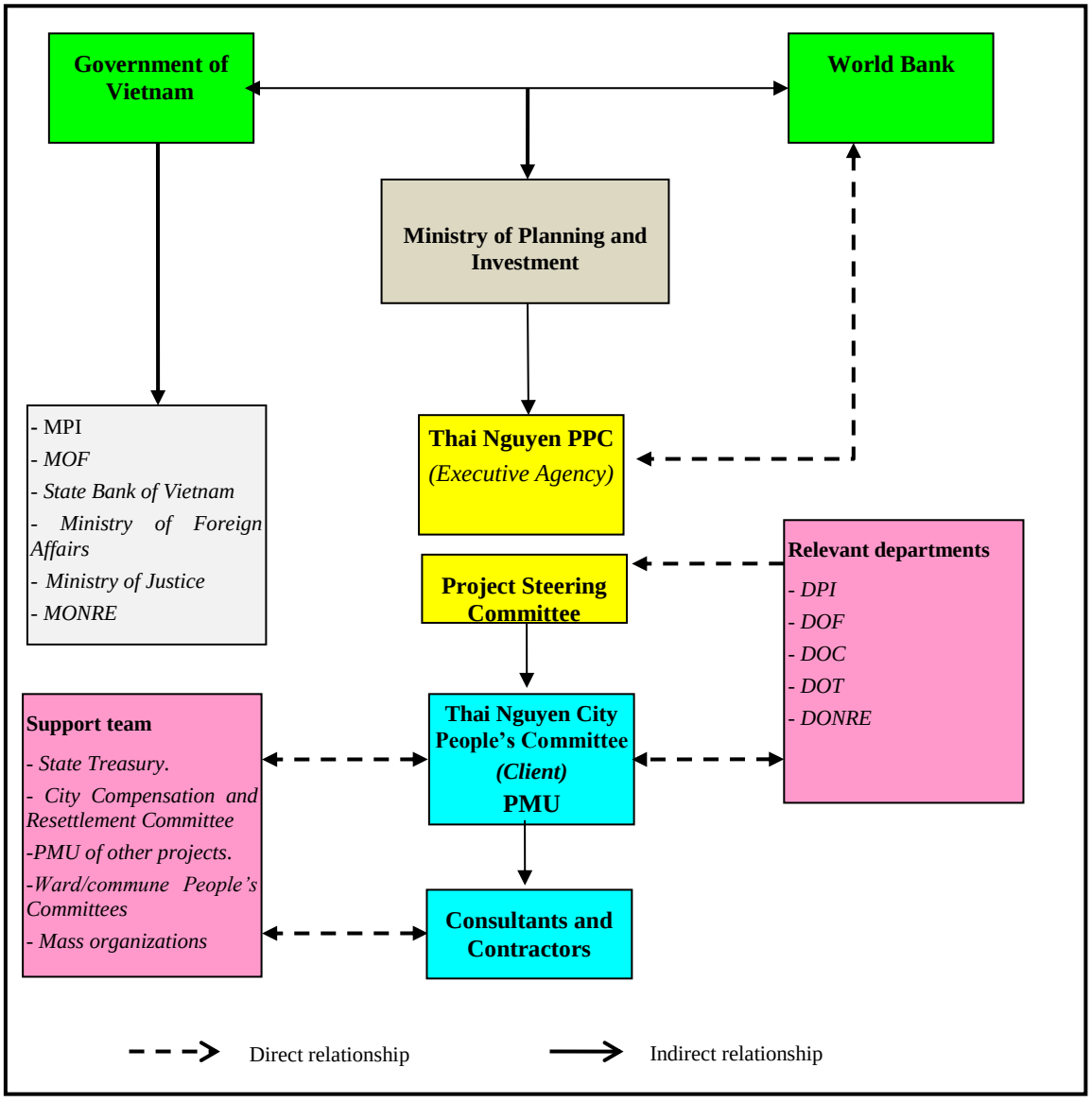


Figure 5: Subproject Organizations and Management Structure

CHAPTER 2. NATURAL ENVIRONMENTAL AND SOCIO-ECONOMIC CONDITIONS

2.1. Natural conditions

2.1.1. Geographic location, topography and geology

a) Geographic location

Thai Nguyen city is located in the center of Thai Nguyen province, with geographical coordinates from 21^0 to $22^027'$ North latitude and from $105^025'$ to $106^014'$ East longitude, about 80km away from Hanoi capital to the North and 50km away from Noi Bai International Airport. The DCIDP is implemented in 14/32 wards/communes of Thai Nguyen city.

Total natural area of Thai Nguyen city up to 2016 was 22,313.6 ha and administrative boundaries as follows:

- The North: Borders on Co Lung commune, Vo Tranh commune (Phu Luong district), Hoa Thuong and Khe Mo communes (Dong Hy district);
- The South: Borders on Song Cong city;
- The East: Borders on Ban Dat commune (Phu Binh district);
- The West: Borders on Dai Tu district and Pho Yen town.

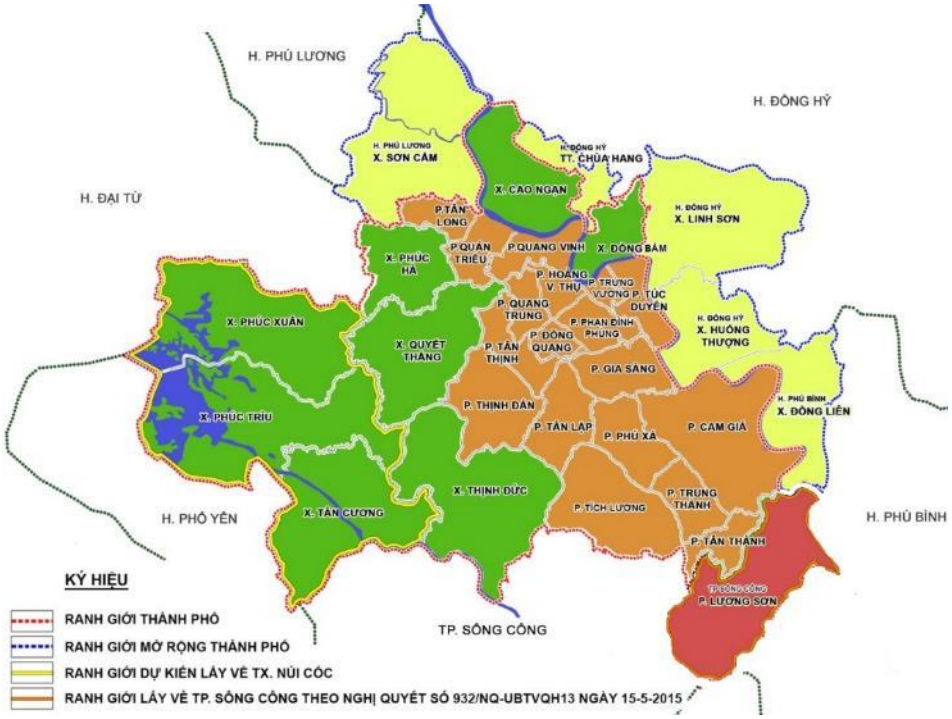


Figure 6: Map of administrative boundaries of Thai Nguyen city according to the approved planning 2016

b) Geological features

Thai Nguyen City is located on the hills and mountains, thus it is suitable for investment in the construction of high-rise buildings, industrial works, bridges and culverts, etc.

In September, 2017 Yen Ma Survey Design and Construction Joint Stock Company prepared the geological survey report regarding geological conditions in some subproject areas as follows:

1. Huong Thuong bridge

- Layer 1: Mud at river bed is dark grey, from fluid plastic to soft plastic condition; depth of bottom layer is 1.8m.
- Layer 2: Yellowish brown clay, semi-rigid, depth of bottom layer is 6.8m.
- Layer 3: Yellowish brown gravel, solid, depth of bottom layer is 10.5m.
- Layer 4: Limestone degenerates into blue grey, white gray with strongly-broken weathered RQD = 0-21%, depth of bottom layer is 16.5m.
- Layer 5: Limestone degenerates into blue grey, white gray with medium-broken weathered RQD = 27-55%, depth of bottom layer is 24.6m.

2. Dan bridge

- Surface layer: Mantle consists of brown grey clay mixed with trees roots; depth of bottom layer is 1.6m.
- Layer 2: Yellowish grey clay, rigid plastic yellow, depth of bottom layer is 5.4m.
- Layer 3: Yellowish grey clay, semi-rigid brown grey, (the product of strongly-weathered process comes from stone), depth of bottom layer is 9.2m.
- Layer 4: Clay stone is strongly-weathered has block structure, fine-grained, drill core is taken under macadam, clot, depth of bottom layer is 20.7m.
- Layer 5: Sand stone is weathered from strong level to medium level, block structure, fine-grained, drill core is taken under macadam, clot, bar with TCR=63%, RQD=23%, depth of bottom layer is 27.2m.
- Layer 6: Limestone is blue grey, light grey, weathered from strong level to medium level, block structure, fine-grained, drill core is taken under bar with TCR=56%, RQD=35%, depth of bottom layer is 33.3m.
- Layer 7: Limestone is blue grey, light grey, weathered from strong level to medium level, block structure, fine-grained, drill core is taken under bar with TCR=84%, RQD=71%, depth of bottom layer is 40.0m.

3. Mo Bach stream

- Layer 1: Clay mixed with rubble, heterogeneous condition; depth of bottom layer is 1.0m.
- Layer 2: Clay mixed with brown grey, black grey, soft plastic condition; depth of bottom layer is 4.7m.
- Layer 3: Clay mixed with yellowish brown, rigid plastic; depth of bottom layer is 9.0m.

4. Xuong Rong ditch

- Layer 1: Clay mixed with sand, organic, heterogeneous condition; depth of bottom layer is 1.1m.
- Layer 2: Clay mixed with brown grey, black grey, from fluid plastic to soft plastic condition; depth of bottom layer is 4.9m.
- Layer 3: Clay mixed with yellowish brown, rigid plastic; depth of bottom layer is 9.0m.

5. Le Huu Trac road

- Layer 1: Backfilled soil, components are clay loam, brick; gravel mixed with grit, laterite, and depth of bottom layer is 0.8m.
- Layer 2: Clay sand is yellow grey, white grey, plastic, depth of bottom layer is 3.6m.
- Layer 3: Sand is red brown, brown violet, white spots mixed with grit, rigid; depth of

bottom layer is 10.0m.

6. Huong Son Kindergarten

- Layer 1: Mantle consists of brown grey clay mixed with trees roots; depth of bottom layer is 0.5m.
- Layer 2: Yellowish grey sand clay, white grey, rigid plastic, depth of bottom layer is 4.9m.
- Layer 3: Clay loam is yellowish grey, white grey, semi-rigid (the product of strongly-weathered process comes from granite stone; depth of bottom layer is 10.1m.

7. Phan Dinh Phung Kindergarten

- Layer 1: Mantle consists of brown grey clay mixed with trees roots; depth of bottom layer is 0.3 m.
- Layer 2: Clay loam is yellowish grey, white grey, rigid plastic (origin of eluvi), depth of bottom layer is 4.5m.
- Layer 3: Clay loam is yellowish grey, white grey, semi-rigid (the product of strongly-weathered process comes from granite stone, depth of bottom layer is 12.5m.
- Layer 4: Shale is strongly-weathered, block structure, fine-grained, drill core is taken under macadam, clot, depth of bottom layer is 15.0 m.

It can be concluded that engineering geological properties of the subproject area are relatively good and suitable for construction of high buildings, industrial zones, bridges and roads.

c) Topographical features

Thai Nguyen city is located in a midland and plain region. The city's terrain is relatively plain. Laying between the gentle slope upside-down-bowl hills are low land plains.

- Average elevation ranges from 26m to 27m.
- The lowest elevation varies from 20m to 21m.
- Elevation of hilly areas is from 50m to 60m.

The city slopes toward the Northwest-Southeast, with a gradient of 4%. Because of the upside down bowl terrain, the drainage relies much on the flumes, natural streams and creeks.

Construction works are within Thai Nguyen city and belong to this type of terrain.

2.1.2. Climate Meteorological Condition

Thai Nguyen city is characterized by tropical monsoon climate, which is divided into four distinct seasons: Spring - Summer - Autumn - Winter (with generic climate features of the Northern climate) including climate is dry and cold in the winter, otherwise it is hot, wet and rainy in the summer.

Due to the influence of topography, Thai Nguyen has two climate zones with various features: the Northern area has long winters, low temperature, more rain in the summer; the Southern climate is more diverse with shorter winters, hotter summers and appearance of thunderstorms. Heavy thunderstorms often cause long-lasting floods, sometimes even flash floods, which cause a lot of damage to local people. There is rare appearance of special climatic phenomena, however, their impacts also have considerable impacts on production and life of the people in the province.

a) ***Temperature***

The average temperature in the subproject area is about 23.2^{o}C, the highest monthly average temperature is 28^{o}C (July) and the lowest is 16.^{o}C (January). The temperature range

between the hottest and coldest months is 12^{o}C.

Characteristics of monthly and yearly average temperatures are presented in Table 13.

Table 13: Monthly and yearly average temperatures

Unit: ^{0}C

Month / Station	1	2	3	4	5	6	7	8	9	10	11	12	Year
Thai Nguyen	14.5	16.2	20	24.1	27.9	28.4	28.5	28.1	27.7	23.8	21	16.2	23

Source: Thai Nguyen Meteorological Station (2010÷2016)

Remark: Generally the temperatures in the subproject areas are quite cool, good for the health of workers in case of outdoor construction. Thanks to cool temperature, incidents affecting the health of workers including heat stroke, headache and dehydration occur less frequently.

b) ***Rainfall***

Total annual average rainfall in Thai Nguyen province is quite high, about 2026mm/year.

Rainy season usually starts from May to late September, accounting for 75 ÷ 80% of total annual rainfall. From June to August, in case the Southwest monsoon prevails, the rainfall reaches about 880mm, representing over 50% of total annual rainfall.

Rainy less season (November ÷ April in the next year): Precipitation accounts for about 25-20% of total annual rainfall. The month has the lowest average rainfall including December, January and February and the monthly average rainfall is usually less than 7.6 mm.

Table 14: Monthly average rainfall

Unit: mm

Month / Station	1	2	3	4	5	6	7	8	9	10	11	12
Thai Nguyen	25	35	62	121	232	338	410	347	237	146	49	24

Source: Thai Nguyen Meteorological Station (2010÷2016)

Remarks: Due to the large average amount of rainfall in the subproject areas, the construction of embankments, foundations, ceilings, bridge piers, dredging in the rainy season is not carried out. Heavy rain also leads to washing away of the material to canals and ditches, thus there should take measures to cover the works and building materials in the rainy season.

c) ***Moisture, sunshine***

Along the subproject area, the annual average humidity is about 81.9%. The wettest period in the months at the end of winter (March) with the monthly average humidity of 85.1 ÷ 85.8%; and in August, average humidity reaches 85.1%. The driest season belongs to the first months of winter (June, July) and early summer (May, June). During the year, the minimum falls in December with the average humidity of 76.9%. The monthly average humidity is presented in Table .

Table 15: The monthly, yearly average relatively humidity

Unit: %

Month / Station	1	2	3	4	5	6	7	8	9	10	11	12	Year
Thai Nguyen	79.7	81.3	85.1	85.8	82	82.8	83.6	85.1	82.5	80.1	77.9	76.9	81.9

Source: Thai Nguyen Meteorological Station (2010÷2016)

Remark: Moisture is quite high and environment is humid, which can easily lead to the spread of infectious diseases including influenza, viral fever, dengue fever. Hence, clearance of bushes is extremely necessary.

d) ***Wind***

The yearly average wind speed is 1.3m/s (Table). In winter, the prevailing wind direction is North Eastern and Northern wind; wind speed is 1.2 ÷ 1.6 m/s. Meanwhile, in the summer the prevailing winds are South-Eastern and south wind is 1.2 ÷ 1.4m/s.

Table 16: Monthly, yearly average wind speed

Unit: m/s

Month / Province	1	2	3	4	5	6	7	8	9	10	11	12	Year
Thai Nguyen	1.4	1.5	1.4	1.6	1.6	1.4	1.4	1.2	1.2	1.3	1.3	1.3	1.3

Source: Thai Nguyen Meteorological Station (2010÷2016)

Remarks: Wind is the main reason causing dust and gas emission in the construction site. Therefore, construction materials should be collected at the end of the wind direction: (i) North Eastern and Northern in winter; and (ii) South Eastern and South in summer.

e) ***Atmosphere sustainability***

Atmosphere sustainability of the subproject area is classified as category B (medium unsustainable), defined according to the average wind speed of the subproject area of 1.3 m/s, along with daytime solar radiation and cloud cover at night according to the Pasquill classification (Table).

Table 17: Classification of atmospheric stability

Wind speed at altitude of 10m (m/s)	Day by sunshine			Night by clouds	
	Strong (h_o> 60°)	Medium (h_o= 35°÷60°)	Light (h_o= 15°÷35°)	Cloudy, cloud> 4/8	Less cloudy, cloud <4/8
< 2	A	A-B	B-C	-	-
2	A-B	B	C	E	F
3-4	B	B-C	C	D	E
5-6	C	C-D	D	D	D
>6	C	D	D	D	D

Source: Pasquill, 1961

Note:

A: extremely unsustainable.
B: medium unsustainable.
C: poor unsustainable
D: Neutral.
E: medium sustainable.
F: sustainable.
ho: High angle from the sun.

2.1.3. Hydrological conditions

Thai Nguyen city is influenced by the hydrographic regime of Cau river –the main drainage axis of Thai Nguyen city and Thai Nguyen province.

1. Cau river

Cau river, the section passing through Thai Nguyen city is about 22km long, flows toward the North-South direction. Average water flow in the dry season was about 135 m^3/s, even up to 4300 m^3/s in the flood season (1959). Average water level is about 1.5-2m in the dry season, and from 6 to 8m in the flood season. Cau river at the construction location of Huong Thuong bridge also have upper features. At the bridge construction location, the width of the river is about 100m, the height from the water to the bridge toe is about 10m (at the time of survey in August 2017).

2. Xuong Rong ditch

Located in Gia Rang ward and Tuc Duyen ward. Xuong Rong ditch connects to Xuong Rong Lake and Gia Sang lake, the end of the ditch connects to Bong Toi ditch. Water flows smoothly, v = 0.2-0.4m^3/s. Average water level of 0.5m; The deepest water level is only up to 1m, or up to 1.5m in the rainy season. The last discharge point of Xuong Rong ditch is Cau river.

3. Mo Bach ditch

Mo Bach stream spreads across four wards of Quang Trung, Tan Thinh, Quang Vinh and Hoang Van Thu. The first section of the route to the main stream of Mo Bach stream flows smoothly, v = 0.2-0.5m^3/s, the water level is 0.5-1.3m (can be up to 2.4m in the rainy season). The section from the intersection with the main stream of Mo Bach stream to Mo Bach bridge flows more tightly, v = 0.7-1.2m^3/s, the water level is 1-1.5 m (can be up to 3 m in the rainy season). The river section nearby Cau river has open river bed B = 4-7m, causing the water level to decrease to 0.8-1.3m, v = 0.5-0.9m^3/s.

4. Ho Nui Coc diversion canal

Nui Coc lake is 16 km away from Thai Nguyen city center to the West. The largest capacity of the lake is 175.5 million cubic meters. The lake has diversion canal system for irrigation in length of 74km long and width of 10m. At the construction location Dan bridge, water flows smoothly, the height from the water surface to the bridge toe is about 3m.

5. Mo Linh stream

Linh Son commune and Dong Bam ward are separated by Mo Linh stream. Mo Linh stream flows into Cau river at the location near Ben Oanh. At the construction site of Mo Linh 1 and Mo Linh 2 bridges, water flows smoothly at speed of v = 0.3-0.6m^3/s, water level from 0.5-1.7m (water level may reach 3m in flood season). The average water level of less than 1.7 m in dry season is favorable for construction of bridges. However, during the flood season, measures must be taken to prevent the risk of falling into water.

6. Other rivers and streams

In addition to 5 main rivers and streams in Thai Nguyen city, there are some ponds, lakes and small canals for drainage and flooding prevention for the city.

2.1.4. Status of flooding in Thai Nguyen city

In recent years, due to the unequal development between economic development and infrastructure, many streets in Thai Nguyen city have been flooded in the rainy season. Statistics of the average flooded area from 2005 to 2015 are as follows:

Table 18: Statistics of average flooded area in flood season of Thai Nguyen city

No.	Wards/ communes	Flooded area (ha)		No.	Wards/ communes	Flooded area (ha)	
		Residential land	Cultivation land			Residential land	Cultivation land
1.	Quang Vinh ward	80	20	8.	Cam Gia ward	45	45
2.	Tuc Duyen ward	25	16	9.	Dong Bam ward	6	0
3.	Gia Sang ward	150	50	10.	Huong Thuong commune	176	65
4.	Phan Dinh Phung ward	48	10	11.	Linh Son commune	120	0
5.	Hoang Van Thu ward	0	0	12.	Chua Hang ward	24	15
6.	Thinh Dan ward	0	25	13.	Dong Lien commune	40	4
7.	Huong Son ward	0	5	14.	Tan Thinh ward	40	3

(*Basic design statement of the subproject, October 2017*)

(a) Hoang Van Thu road

(b) Luong Ngoc Quyen road

(c) Minh Cau road

(d) Huong Son road

Figure 7: Some pictures of flooding in roads of constructional material transportation in the rain on June 23, 2017

Source: baomoi.com

2.1.5. Natural disasters and environmental incidents

Areas of potential landslides, seismic activity mainly concentrated in the southwest associated with Tam Dao range, and the Northwest associated with the mountain ranges of Phu Ngu arch and the northern mountainous area Thai Nguyen city. The earth cracking occurred in the area of Thai Nguyen city is not much, however, with quite large scope, causing considerable impacts on the natural environment and socio-economic conditions.

According to the Journal of Science and Technology 2013, cracks and landslides in Yen Ngua hill in Mo Bach ward of Thai Nguyen city occurred in September 1992. Accordingly, a huge triangular block of rock with edges's dimension of 30 x 22 x 20m slipped from Yen Ngua hill and crushed a street with permanent houses from 1-3 floors (total 16 households). This was a serious cracking and landslide. The province spent hundreds of millions of dong overcoming the consequences. The study shows that the phenomenon of cracking and landslides occurs mainly due to geological conditions and impacts of human beings.

In June 1995, a case of landslide in the southeast of Hong mountain in Dai Tu district occurred in a place of large slope, creating a huge sliding block with width from 3 to 400m and slipping length of 1500m.

On April 15, 2012, a large volume of soil and rock from the disposal site No. 3, Phan Me coal mine landslide to the area of Khuon 1 hamlet, Phuc Linh commune, Dai Tu district, as a result, it buried 10 houses, killed 6 persons and injured one person. At the same time, it is estimated that 40 households have to be relocated to other place. Estimated damage is about VND 15 billion.

On August 31, 2017, on the route of Thai Nguyen- Cho Moi, the section passing through the area of Tong Co hamlet, Yen Dinh commune (Cho Moi), a landslide of slope occurred, resulting in 350m^3 of rock and soil falling down, making traffic completely blocked.

2.1.6. Climate change in Thai Nguyen

In Thai Nguyen in recent years, there have been more and more clear signs of climate change impacts in many fields, but have not been fully studied and evaluated in a systematic manner. Climate change has caused land degradation, droughts, and loss of agricultural production across the province. It has affected one third of the land area, threatened food security, caused hunger and poverty for more than one million people in Thai Nguyen, especially poor communes in mountainous areas. Some impacts of climate change in Thai Nguyen are as follows:

- Climate change caused impacts on the socio-economic development plan of Thai Nguyen province. The fact is that economic growth has been high but not sustainable. The implementation of socio-economic development plan and planning has not been fully integrated effectively with environmental protection, limiting greenhouse gas emissions, climate change resilience.
- Climate change caused impacts on natural resources and environment: Thai Nguyen is considered as a region with rich and diverse mineral resources. In mountainous and midland areas, heavy rains with high intensity caused flash floods, sludge/rock floods, and slides, etc., which made it more difficult to conduct surveys, observation and exploitation of minerals, simultaneously increase the emission of toxic metals in mine waste, polluting the environment.
- Climate change for water resources: The main impacts of climate change are changes in temperature, evaporation and rainfall, leading to changes in flow during the year, flow in the flood and dry season as well. In addition, extreme weather events (flash floods, floods and frosts, etc.) occur more frequently and are more difficult to predict.

2.1.7. Current status of environmental quality

Observation and measurement of environmental parameters of air, water, soil and sediment has been conducted by the monitoring center resources and environment in Thai Nguyen province in September 2017 and October 2017.

- **Selection of measuring and sampling locations and parameters**

In order to ensure proper and adequate assessment of the status of environmental components, the selection of environmental monitoring and sampling locations is based on the following key features: (i) The selected point represents the current status of regional environment; (ii) characteristics of emission sources; (iii) Sensitive characteristics of the receiving objects. Compilation of the quantity and parameters of air, water, soil and sediment samples shall be conducted as follows (the monitoring location is shown in Figure 9 and the attached annex):

Table 19: Location of the environmental monitoring of the Thai Nguyen sub-project

Sample	Quantity	Monitoring indicators	Comparison standards
Air	23	Temperature, humidity, wind speed, total suspended dust, NO_2, SO_2, CO, noise level	QCVN 05:2013/BTNMT, 1 hour QCVN 26:2010/BTNMT
Surface water	14	pH, temperature, SS, DO, BOD_5, COD, NH_4^+, NO_2-, NO_3-, PO_4^{3-}, grease, Coliform	QCVN 08-MT:2015/BTNMT
Ground water	09	pH, SS, Hardness ($CaCO_3$), DO, NH4+, NO_3-, SO_4^{2+}-, Asen (As), Mn, Fe, Chloride, Coliform	QCVN 09-MT:2015/BTNMT
Wastewater	06	pH, SS, TDS, COD, BOD_5, NO_2-, NO_3-, Cu, Pb, Fe, Cacdimi (Cd), Mangan (Mn), Sulphate SO_4^{2+}, Cr, Asen (As), mercury (Hg), Fluoride, Coliform	QCVN 40:2011/BTNMT
Soil	15	Cd, As, Zn, Hg, Cr, Fe, Pb, Cu, Chlorine pesticides	QCVN 03-MT:2015/BTNMT
Sediment	07	pH, Cd, As, Zn, Hg, Cr, Fe, Pb, Cu, Chlorine pesticides.	QCVN 43:2012/BTNMT

- **Measurement and analytic results of environmental status**

1. Ambient air quality

Table 20: Analytic results of ambient air quality of the subproject area

No.	Works	Symbol	Measurement and analysis indicators				
			Noise (*) dBA	Dust (*) µg/m³	NO_2 µg/m³	SO_2 µg/m³	CO µg/m³
1	Southnorth road & Huong Thuong bridge	K15	**77**	0.13	<0.08	<0.026	<5
2		K16	68.1	<0.1	<0.08	<0.026	<5
3		K17	62.9	<0.1	<0.08	<0.026	<5
4	Huong Thuong - Chua Hang road	K1	59.9	<0.1	<0.08	<0.026	<5
5		K2	58.3	<0.1	<0.08	<0.026	<5
6		K3	60.5	<0.1	<0.08	<0.026	<5
7		K4	64.1	<0.1	<0.08	<0.026	<5
8	Dong Bam road	K12	50.9	0.16	<0.08	<0.026	<5
9		K13	58.1	<0.1	<0.08	<0.026	<5
10		K14	59.9	<0.1	<0.08	<0.026	<5
11	Dan bridge	K9	62.7	0.22	<0.08	<0.026	<5
12	Le Huu Trac road	K10	61	<0.1	<0.08	<0.026	<5
13		K11	**70.3**	<0.1	<0.08	<0.026	<5
14	Huong Son kindergarten	K7	60.2	0.12	<0.08	<0.026	<5
15		K8	59.9	<0.1	<0.08	<0.026	<5
16	Phan Dinh Phung kindergarten	K5	60.9	0.12	<0.08	<0.026	<5
17		K6	61.6	0.17	<0.08	<0.026	<5

No.	Works	Symbol	Measurement and analysis indicators				
			Noise (*) dBA	Dust (*) µg/m³	NO_2 µg/m³	SO_2 µg/m³	CO µg/m³
18	Xuong Rong drainage ditch	K18	**72.2**	<0.1	<0.08	<0.026	<5
19		K19	53.4	<0.1	<0.08	<0.026	<5
20		K20	51.2	<0.1	<0.08	<0.026	<5
21	Mo Bach stream drainage ditch	K21	**73**	<0.1	<0.08	<0.026	<5
22		K22	63.6	<0.1	<0.08	<0.026	<5
23		K23	**73.4**	0.13	<0.08	<0.026	<5
QCVN 05:2013/BTNMT, within 1 hour				0.3	0.2	0.35	30
QCVN 26:2010/BNTNMT			70				

❖ ***Remarks:***

- The measurement results show that except for the noise levels at 05 locations, the analytical indicators are within the permitted limit of QCVN 05:2013/BTNMT, within 1 hour due to the fact that there are no production activities near the subproject area but daily living activities of people.
- For 05 locations with noise level higher than standards. The reason is that these are the main intersections of the city and there are many vehicle travelling at time of measurement.
- The current status of air in the subproject areas has not shown signs of pollution, which is convenient for the construction.

2. Surface water

Table 21: Analytic results of surface water quality of the subproject area

No.	Works	Symbol	Measurement and analysis indicators											
			pH	DO mg/l	^oC	BOD_5 mg/l	COD mg/l	TSS mg/l	NO_3^- mg/l	NO_2^- mg/l	NH_4^+ mg/l	PO_4^{3-} mg/l	Grease mg/l	Coliform MPN/100ml
1	Southnorth road & Huong Thuong bridge	NM8	7.3	2.7	26.9	-	23.81	25.46	1.23	<0.03	<0.05	<0.1	<0.3	4500
2		NM9	6.8	5.7	27	-	25.98	14.03	2.69	<0.03	0.128	<0.1	<0.3	1800
3	Huong Thuong - Chua Hang road	NM1	7	5.7	28.8	4.01	8.73	16.9	1.42	0.04	0.11	<0.1	<0.3	1200
4		NM2	7	5.6	28.9	5.2	8.8	25.7	1.43	0.06	0.21	<0.1	<0.3	2300
5	Dong Bam road	NM7	7.3	5.9	28	-	14.96	10.84	1.62	<0.03	0.17	<0.1	<0.3	3800
6	Dan bridge	NM5	6.8	5.3	28	7.92	15.07	9.5	0.95	<0.03	0.09	<0.1	<0.3	1500
7	Le Huu Trac road	NM6	7.3	5.1	29.7	-	23.18	12.54	2.35	<0.03	0.09	<0.1	<0.3	2200
8	Huong Son kindergarten	NM4	7.1	5.3	29.9	16.32	38.09	11.4	<0.3	<0.03	0.137	<0.1	<3	2800
9	Phan Dinh Phung kindergarten	NM3	7.2	4.4	29.2	21.88	46.36	34.1	0.45	<0.03	0.72	<0.1	0.5	3500
10	Xuong Rong drainage ditch	NM10	6.8	2.1	29.7	-	35.62	32.15	0.92	<0.03	0.229	<0.1	<0.3	7100
11		NM11	7	2.9	27.1	-	28.09	21.35	1.07	<0.03	0.49	<0.1	<0.3	4900
12	Mo Bach stream drainage ditch	NM12	6.9	4.6	27	-	18.01	15.40	1.03	<0.03	0.09	<0.1	<0.3	1900
13		NM13	6.6	2.3	28	-	28.64	23.97	1.89	<0.03	0.28	<0.1	<0.3	4000
14		NM14	7.2	5.2	28.8	-	22.30	21.07	3.21	<0.03	0.22	<0.1	<0.3	2400
QCVN 08-MT:2015/BTNMT		B1	5,5-9,0	>=4	-	15	30	50	10	0.05	0.9	0.3	1	7500
		B2	5,5-9,0	>=2	-	25	50	100	15	0.05	0.9	0.5	1	10000

❖ ***Remarks:***

The analytic results show that analysis indicators of all samples are within permitted limits according to Standard QCVN 08-MT:2015/BTNMT, Column B1. Therefore, surface water of the subproject area has no sign of pollution.

3. Underground water

Table 22: Analytic results of groundwater quality of the subproject area

No.	Works	Symbol	Measurement and analysis indicators											
			pH	**DO mg/l**	**TSS mg/l**	**Hardness mg/l**	**As mg/l**	**Mn mg/l**	**Fe mg/l**	**Cl- mg/l**	**SO_4^{2-} mg/l**	**NO_3^- mg/l**	**NH_4^+ mg/l**	**Coliform MPN/100ml**
1	Southnorth road & Huong Thuong bridge	NN7	5.7	1.8	<2.5	106	0.0007	0.017	<0.3	54.99	74.22	3.24	<0,05	<3
2	Huong Thuong - Chua Hang road	NN1	6.2	1.8	<2.5	122	0.0008	0.014	<0.3	62.05	8.72	7.19	<0,05	<3
3	Dong Bam residential area road	NN6	6.4	1.5	<2.5	70	0.002	0.242	<0.3	45.67	52.41	2.49	<0,05	<3
4	Dan bridge	NN4	6.2	1.5	<2.5	126	<0.0005	0.077	<0.3	19.17	16.37	<0.3	0,14	<3
5	Le Huu Trac road	NN5	5.9	2.8	<2.5	80	0.0013	0.127	<0.3	23.98	24.12	1.86	<0,05	<3
6	Huong Son kindergarten	NN3	6.3	1.3	<2.5	220	0.0033	0.385	<0.3	19.95	25.87	0.32	0,5	<3
7	Phan Dinh Phung kindergarten	NN2	6.3	1.3	<2.5	226	0.0035	0.828	1.417	47.11	6.48	<0.3	<0,05	<3
8	Xuong Rong Stream drainage ditch	NN8	6.2	2	<2.5	116	0.0009	0.04	<0.3	5.64	24.92	10.46	0,05	<3
9	Mo Bach stream drainage ditch	NN9	5.7	1.6	<2.5	52	0.0009	0.032	<0.3	13.26	32.18	1.23	<0,05	<3
QCVN 09-MT:2015/BTNMT			5,5-8,5	-	-	500	0.05	0.5	5	250	400	15	1	3

❖ ***Remarks:***

- Analytical results show that all the analysis indicators meet the criteria of QCVN 09: 2008/BTNMT, groundwater in the subproject area has no signs of pollution. Therefore, when construction at the location of Huong Thuong - Chua Hang road, bored well water can be used for domestic purposes.

4. Wastewater

Table 23: Analytic results of wastewater pollution indicators of the subproject area

No.	Works	Symbol	Measurement and analysis indicators																
			pH	COD mg/l	TSS mg/l	TDS mg/l	As mg/l	Cd mg/l	Pb mg/l	*Cr mg/l	Cu mg/l	Hg mg/l	Mn mg/l	Fe mg/l	F- mg/l	SO_4^{2-} mg/l	NO_3^- mg/l	NO_2- mg/l	Coliform MPN/100ml
1	Phan Dinh Phung kindergarten	NT1	6.9	79.36	32.25	183	0.0029	<0.0005	0.0017	<0.01	0.0037	0.0005	0.117	0.34	<0.08	21.12	0.45	<0.03	4200
2	Xuong Rong drainage ditch	NT2	6.3	126.34	63.08	791	0.0062	<0.0005	0.0052	<0.01	0.0035	0.0012	0.315	0.858	<0.08	12.32	25.47	0.09	3900
3		NT3	7.3	35.04	33.5	973	0.0082	<0.0005	0.0022	<0.01	0.0025	0.0011	0.474	0.867	<0.08	36.82	7.32	1.52	4500
4	Mo Bach stream drainage ditch	NT4	7.8	82.73	45.36	977	0.0052	0.0005	0.0023	<0.01	0.0059	0.0009	0.452	0.863	<0.08	96.32	15.21	<0.03	4700
5		NT5	6.8	64.92	36.05	825	0.0012	0.0006	0.0047	<0.01	0.0038	0.0012	0.323	0.647	<0.08	52.87	10.38	<0.03	3600
6		NT6	6.3	92.63	56.79	973	0.0107	0.0008	0.0049	<0.01	0.0092	0.0007	0.492	0.932	<0.08	92.36	48.64	0.05	5000
QCVN 14:2008/ BTNMT		A	5-9	-	50	500	-	-	-	-	-	-	-	-	-	-	30	-	3000
		B	5-9	-	100	1000	-	-	-	-	-	-	-	-	-	-	50	-	5000

❖ ***Remarks:***

- The analysis results show that the content of heavy metals in water is not large because this is the area for discharge of domestic wastewater. However, high concentration of COD and NO_3 in wastewater indicates that the wastewater is contaminated with organic matter and has an unpleasant malodor, affecting the daily living activities of the households along the two ditches.
- Therefore, it is not allowed to discharge domestic wastewater directly into the ditches during construction phase. The Client must use mobile toilets at workers' camps.

5. Soil quality

Table 24: Analytic results of soil quality of the subproject area

No.	Works	Symbol	Measurement and analysis indicators							
			Fe mg/kg	Zn mg/kg	Hg mg/kg	As mg/kg	Cd mg/kg	Pb mg/kg	Cu mg/kg	Cr mg/kg
1	Southnorth road & Huong Thuong bridge	D12	764.25	32.89	<0.5	<3	<1.5	8.21	12.65	52.21
2		D13	1325.63	42.65	<0.5	4.07	<1.5	12.74	28.91	18.43
3	Huong Thuong - Chua Hang road	D1	1283	77	<0.5	5.1	<1.5	8.1	54.6	33.1
4		D2	1172	79	<0.5	5.5	<1.5	6.3	40.8	40.6
5	Dong Bam road	D10	892.38	23.51	<0.5	<3	<1.5	7.01	12.69	9.23
6		D11	624.81	52.47	<0.5	3.6	<1.5	11.05	18.42	7.62
7	Dan bridge	D7	1695.02	73.9	<0.5	5.07	<1.5	19.12	18.21	13.6
8	Le Huu Trac road	D8	1186	79.31	<0.5	3.2	<1.5	19.66	45.3	32.12
9		D9	2693.72	62.14	<0.5	<3	<1.5	26.03	22.05	25.22
10	Huong Son kindergarten	D5	795.21	88	<0.5	<3	<1.5	36.01	64.4	28.1
11		D6	1921	66	<0.5	<3	<1.5	35.4	8.2	13.9
12	Phan Dinh Phung kindergarten	D3	728.41	62	<0.5	3.3	<1.5	<3	42.3	15.6
13		D4	631.2	51	<0.5	3.2	<1.5	5.6	53.2	22.7
14	Xuong Rong drainage ditch	D14	1531.55	52.41	<0.5	3.31	<1.5	9.74	60.44	32.10
15	Mo Bach stream drainage ditch	D15	1362.88	52.76	<0.5	6.74	<1.5	10.24	72.95	40.38
QCVN 03-MT:2015/BTNMT			-	200	-	15	1.5	70	100	150
			-	200	-	15	2	70	100	200

❖ ***Remarks:***

- The results show that the quality of soil is good without signs of pollution. The analytical indicators meet the standards because of only agricultural and livelihood activities but no industrial activities happen near the subproject.
- Thus, excavated soil can be used to backfilling for other works.
- The residual amount of excavated soil is not contaminated by heavy metals so it can be used for leveling the ground for planting trees or used for other purposes.

6. Sediment

Table 25: Analytic results of sediment quality of the subproject area

No.	Works	Measurement and analysis indicators							
		Fe mg/kg	Zn mg/kg	Hg mg/kg	As mg/kg	Cd mg/kg	Pb mg/kg	Cu mg/kg	Cr mg/kg
1	Xuong Rong drainage ditch	762.51	32.81	<0.5	4.56	<1.5	22.45	18.74	16,95
2		1028.69	55.73	<0.5	4.79	<1.5	17.22	20.04	10,32

No.	Works	Measurement and analysis indicators							
		Fe mg/kg	Zn mg/kg	Hg mg/kg	As mg/kg	Cd mg/kg	Pb mg/kg	Cu mg/kg	Cr mg/kg
3		115.90	44.86	<0.5	6.17	<1.5	33.91	42.75	32,18
4	Mo Bach stream drainage ditch	699.82	12.78	0.06	6.95	1.8	24.97	65.21	11,84
5		1458.01	65.93	<0.5	8.77	2.31	22.95	90.33	56,87
6		847.32	92.41	<0.5	13.39	1.92	65.65	57.79	21,53
7		824.92	46.89	0.08	10.24	2.1	44.67	26.92	62,47
QCVN 43:2012/BTNMT		-	315	0.5	17.0	3.5	91.3	197	90

❖ ***Remarks:***

The results show that all the analysis indicators of heavy metal in the sediment samples of the two ditches of Xuong Rong and Mo Bach are both below the permitted level (QCVN43:2012/ BTNMT). As a result, dredged material from two ditches can be used to leveling the lowland area for planting trees or to be disposed at two disposal sites of Da Mai and Tich Luong.

2.1.8. Status of biological resources

The subproject ecosystem around construction sites is the agricultural ecosystem; There are no national forest or protected areas near the sites. Plants in the subproject area mainly are food crops such as rice, corn, potato, cassava, fruit trees and timbers such as longan, guava, jackfruit, eucalyptus and acacia. Surrounding the subproject area, no precious plants are found

Terrestrial animals in the subproject area are those familiar to the human such as flowerpecker, sparrow, lizards, frog. The aquatic ecosystem includes fish: anabas, carp, hypophthalmichthys, shrimp, crab, algae, pistia, etc.

Due to poor aquatic ecosystems, no fishing activity is found in Cau river and Cong river, the section running through Thai Nguyen city.

In general, the fauna and flora in the subproject area are common ones without any specious species and having no value in terms of ecology.

2.2. Socio-economic conditions

2.2.1. Economic conditions

Thai Nguyen city is the political, economic, cultural, educational, medical, tourist and service center of Thai Nguyen province and the Northern Midland and Mountainous region. The GDP growth rate (at constant price 1994) in the city was 15.1% in the period 2011-2015 and 15.5% in 2016. The average GDP per capita was 60 million VND/person/year in 2015. The economic structure focused on three main areas, including: services, commerce accounted for 49.27%; Industry, construction accounted for 47.53%; Agro-forestry accounted for 3.2%.

2.2.2. Social conditions

➢ **Population and labor force**

According to statistical data of Thai Nguyen city statistics office, the total population of Thai Nguyen city up to 2016 was 333,580 people, excluding around 250,000 temporary residents

(pupils, tourists, workers in the industrial parks who are temporarily registering for residence for work and health care, etc.). According to Decision No. 2486/QD-TTg dated December 20, 2016, the city's population is expected to increase by about 50,000 people.

Labor structure and labor force (as of 2016): The working-age population of the city was 141,651 people, accounting for 49.2% of the total population of the city. The number of laborers in the urban area was 104,982 people, of which 99,418 are non-farm laborers, accounting for 95% of the total labor force in the urban area.

Table 26: Scope, population and density of subproject wards/communes

No.	Wards/communes	Area (km^2)	Population	Density (persons/km^2)	No. of HHs	Poverty rate (%)
1	Dong Bam	402.22	6103	15.2	1608	2.24
2	Linh Son	15.5	9720	627	2372	6.0
3	Huong Thuong	8.15	6490	796	1617	9.0
4	Gia Sang	419.16	12421	29.6	3539	0.76
5	Phan Dinh Phung	266.12	21507	80.8	5732	0.66
6	Hoang Van Thu	157.71	20531	130.2	4072	0.34
7	Thinh Dan	650.79	20116	30.9	2984	1.58
8	Tan Lap	441.09	13880	31.5	2545	2.79
9	Chua Hang ward	3.02	10948	3625	3136	2.38
10.	Huong Son	395.88	13479	34.0	3584	1.2
11	Quang Vinh	312.38	7135	22.8	1851	2.43
12	Tan Thinh	306.45	16637	54.3	2513	1.79
13	Tuc Duyen	290.15	9785	33.7	2632	1.75
14	Quang Trung	198.06	26394	133.3	3513	0.31

(Source: Thai Nguyen City Statistic Office - 2016)

- **Current status of land use**

The total natural area of the province was 17,069.8 hectares by 2015, accounting for 4.84% of the province's total area. Under Decision No. 2486/QD-TTg dated December 20, 2016, the area of the city was expanded by 5,243.8 hectares to Son Cam commune (Phu Luong district) to the north; Chua Hang town, Linh Son commune, Huong Thuong commune (Dong Hy district), and Dong Lien commune (Phu Binh district) to the East. Total natural area of Thai Nguyen city to present is 22,313.6 ha.

Table 27: Area of natural land in subproject wards/communes

No.	Wards/communes	*Area (km^2)*	Types of land (ha)					
			Agricultural	*Forestry*	*Aquaculture*	*Residential land*	*Specialized land*	*Unused land*
1	Dong Bam	4.02	211.2	0.45	4.25	66.23	83.54	3,89
2	Linh Son	15.5	365	307	31.8	42.6	218.7	18,4
3	Huong Thuong	8.15	331	206	21.7	35.6	138.4	19,1
4	Gia Sang	4.19	183.5	5.41	7.86	61.43	123.75	17,84
5	Phan Dinh Phung	2.66	12.5	1.96	5.63	134.65	98.33	0,47
6	Hoang Van Thu	1.57	4.92	1.48	3.16	73.02	67.5	0,05
7	Thinh Dan	6.5	341.75	60.97	14.84	74.32	130.67	5,09

No.	Wards/communes	*Area (km^2)*	Types of land (ha)					
			Agricultural	*Forestry*	*Aquaculture*	*Residential land*	*Specialized land*	*Unused land*
8	Tan Lap	4.41	209.08	49.66	5.74	55.46	104.65	9,92
9	Chua Hang ward	3.02	122.5	0.14	1.83	60.18	110.38	5,63
10	Huong Son	3.95	230.23	4.58	12.67	66.54	56.58	1,83
11	Quang Vinh	3.12	174.36	0.16	1.62	52.1	50.61	3,66
12	Tan Thinh	3.06	96.78	8.48	3.8	51.34	139.24	3,27
13	Tuc Duyen	2.9	110.14	0.39	1.18	78.83	60.07	7,55
14	Quang Trung	1.98	35.08	0.01	2.79	70.93	83.17	2,42
	Total	**65.03**	**2.428.04**	**646.69**	**118.87**	**923.23**	**1.465.59**	**99.12**

(Source: Thai Nguyen City Statistic Office - 2016)

➢ **Education and training**

Thai Nguyen city is the third largest education and training center in the country with many universities, colleges, intermediates with the number of annual trainees about 100 thousand pupils. Presently, there are 226 kindergartens in Thai Nguyen province, of which 196 schools are overloaded. Therefore, the construction of Huong Son and Phan Dinh Phung kindergartens is necessary to offload for the city's education infrastructure.

➢ **Health care**

Thai Nguyen city is home of Thai Nguyen General Hospital which is the biggest hospital in the Northern Midland and Mountainous region. In addition, there are also Thai Nguyen University of Medicine and Pharmacy and nine Provincial Hospitals under the Department of Health. The city has 28 commune/ward medical stations. The total number of health establishments in the city is over 210 establishments.

According to a report by the Provincial Preventive Medicine Center in 2016, the measles/rubella vaccination campaign for children aged 16-17 reached 95.7%. The infectious diseases such as hand - foot – mouth disease, measles, rubella, dengue fever and so on were controlled from spread over the community. There are no cases of dangerous diseases such as influenza AH5N1, H1N1, cholera and zika. The incidence of HIV and sexually transmitted diseases has declined. The number of cases added in 2016 was 417, down 7% from 2015.

Thus, with the demand for workers at each construction site ranging from 30-70 people (most utilizing on-site workers), this workforce does not put much pressure on the local health infrastructure. Therefore, local health facilities are fully capable of preventing and curing diseases for the workers of the subproject.

2.2.3. Physical cultural resources

Thai Nguyen city is a tourist center of Thai Nguyen province and the Northern mountainous provinces. This is home of Nui Coc Lake tourist site which is famous for its many beautiful landscapes (which is 16km far from Thai Nguyen city). Up to 2017, in Thai Nguyen city, no any historical relic has been ever discovered during the excavation and construction, therefore, the possibility of discovering any cultural heritage during the construction process is very low.

2.3. Infrastructures and services

2.3.1. Transport

The urban transport infrastructure of Thai Nguyen city by 2016 is the major national and provincial road axis (such as NH 3, NH 1B, NH 37, Hanoi - Thai Nguyen Expressway, Thai Nguyen - Cho Moi road, provincial road 262, provincial road 267 and provincial road 270).

Presently, the city's urban traffic network consists of 56 roads with good surface quality. The width of the access roads to the works ranges from 6 to 23m. Most of the roads are asphalt concrete and cement concrete ones.

Table 28: Access roads to the works

No.	Works	Access roads		
		Asphalt road (B>14m)	**Asphalt road (B=7-13m)**	**Cement concrete and earth road**
1	Southnorth Road & Huong Thuong Bridge Construction	South - North road, Cach Mang Thang Tam road,	Gia Sang road, Hoang Ngan road, Xuan Hoa road, Tuc Duyen road	Earth road and concrete road
2	Huong Thuong - Chua Hang Road Construction	NH 7	Tuc Duyen road	Earth road
3	Dong Bam Residential Area Road	Bac Kan road, NH 1B, QL17		Concrete roads in Dong Bam commune
4	Dan Bridge Upgrading	Quang Trung road, the provincial road DT267	Thinh Duc road	-
5	Le Huu Trac Road Upgrading	Quang Trung road, Hanoi - Thai Nguyen expressway	Le Huu Trac road, Thanh Nien Xung Phong road, Thong Nhat road	Earth road and concrete road
6	Huong Son Kindergarten Construction	Cach Mang Thang Tam road, Gang Thep road	Trinh Ba road, Luu Nhan Chu road, Huong Son road	-
7	Phan Dinh Phung Kindergarten Upgrading	Cach Mang Thang Tam road, Hoang Van Thu road	Minh Cau road, Phan Boi Chau street, Nguyen Dinh Chieu road .	-
8	Xuong Rong Drainage Ditch Rehabilitation	South - North road, Cach Mang Thang Tam road .	Hoang Ngan street, Xuong Rong road, Gia Sang road	Concrete road
9	Mo Bach Stream Drainage Ditch Rehabilitation	Quang Trung road, Viet Bac road, Bac Kan road.	Nong Lam dyke road, Duong Tu Minh road	-

2.3.2. Water supply conditions

Currently, in Thai Nguyen city, there are two water supply plants which supply water for domestic and production purposes:

- Tuc Duyen water supply plant: capacity of 10,000 m^3/day.night, exploiting groundwater.
- Tich Luong water supply plant: capacity of 30,000 m^3/day.night, taking surface water from Nui Coc canal.

Water supply network: Transmission and distribution pipeline diameter from DN100 to DN700, service network diameter from DN25 to DN75. The total length of the water supply pipeline network in the city is about 486.35 km.

Although the plants operating exceeding the designed capacity, they only meet about 75% of demands of the city's population, mainly central areas. 25% of residents are using bored well water.

The construction location of camps of 8/9 works has access to tap water. Huong Thuong - Chua Hang road construction site must use well water from nearby households. Since groundwater in this area has not been polluted, use of bored well water will not affect health of local people and workers (Analytic results of groundwater quality are shown in item 2.1.7 and attached to the annex).

2.3.3. Water drainage

At present, domestic wastewater in the city is collected into the incomplete common sewage system. The sewer system is gravity, mainly serves for the collection of surface stormwater and wastewater from households living in two road sides. Domestic wastewater drainage system has not been equipped for the residential areas, but all naturally discharge into the fields, rivers and streams.

- Total sewers: The total length of sewers and ditches is about 21,750m, only 0.16km of sewers per 1km of road.
- The ditches and sewers discharge into the natural streams flowing in the city, including 9 main streams: Tan Long, Mo Bach, Xuong Rong, Loang, Luu Xa, Vo Ngua, Cong Ngua, Quang Vinh and Gia Sang streams.
- Residential areas have not been equipped without drainage system, wastewater and stormwater will be discharged into the low-lying land areas near the households. This water amount will follow the irrigation sewers from one field to another and finally flow into the streams, and then into Cau river.

Currently, Thai Nguyen city is implementing two subprojects on wastewater drainage and collection using ODA funded by the French Government (to be completed in 2017) and the Kingdom of Belgium (to be completed in 2020).

Wastewater from the camps of the items of Dan bridge, Huong Son kindergarten, Phan Dinh Phung kindergarten, Xuong Rong drainage ditch and Mo Bach Stream will be collected in the common sewer system of the city.

Wastewater from the camps of the items of Dong Bam road, Huong Thuong – Chua Hang road, Southnorth road & Huong Thuong bridge and Le Huu Trac road will flow through the settling basins before discharging into Cau river.

2.3.4. Power supply

The power supply system in Thai Nguyen city is managed and operated by Thai Nguyen Power Company under the Northern Power Corporation. Current power supplied to the city is from 220 KV and 110 KV girds. Power is transmitted through the medium and low-voltage 220 KV and 110 KV grid.

Currently, 100% of Thai Nguyen city people are connected to the national grid. Therefore, the subproject areas are equipped with the power supply system from the national grid for construction and living activities. In the event of a grid failure, the contractor uses generators for minor repairs to limit the interruption of construction work.

2.3.5. Solid waste management

There are two waste collection units in Thai Nguyen city: (i) Thai Nguyen Urban Environment and Construction Joint Stock Company which specializes in collection and treatment of domestic waste and construction waste; (ii) Hanoi Urban Environmental One Member Limited Company (URENCO) which specialize in collection and treatment of hazardous waste.

According to the environmental status report of Thai Nguyen city in 2016, about 150 tons of waste was discharged from the city each day. The collection rate was about 85% of waste volume. The rest (15%) is buried, burned or dumped into the nature.

Solid waste after collection will be transported to Da Mai disposal site of 25ha, located 20km from the city center to the southwest. Construction waste was often classified and utilized for leveling. Hazardous waste is collected and transported to the waste disposal complex of Nam Son - Soc Son - Ha Noi.

2.3.6. Flooding and wastewater pollution

The water drainage system in Thai Nguyen city is a general drainage system but not complete. In the rainy season, surface water of the city flows to the natural streams and then to Cau River. There are nine main streams for drainage for the city's basins, including Tan Long Stream, Mo Bach, Xuong Rong, Loang Stream, Luu Xa Stream, Vi Ngua Stream, Cong Ngua Stream and Quang Vinh Stream. It is possible to divide the central area of Thai Nguyen city into the main drainage basins as follows:

- The northern area includes: Quan Trieu and Tan Long wards; stormwater is collected into Lang Um stream and flows to Cau river;
- The western area includes: Tan Lap, Tan Thinh, Thinh Dan, Quang Trung, Quyet Thang and Quang Vinh wards, waste is collected into Mo Bach stream and flows to Cau river;
- The center of the city consists of 02 main drainage ditches. The line 1 includes Hoang Van Thu, Dong Quang, Quang Trung and Phan Dinh Phung wards, water is collected into Cong Ngua stream and flows to Cau river. The line 02 includes Dong Quang, Phan Dinh Phung, Hoang Van Thu, Trung Vuong, Tuc Duyen and Gia Sang wards. Water is collected into Xuong Rong stream and flows to Cau river;
- The southern basin includes Cam Gia, Huong Son, Tan Lap, Phu Xa and Trung Thanh wards. Water is discharged into Loang stream and flows to Cau river.
- Along the main drainage routes of the city, such as Cong Ngua stream and Xuong Rong stream, the section crossing Dong Quang and Phan Dinh Phung wards to Cach Mang Thang Tam road, has been solidified. The remaining sections and Mo Bach streams, Loang stream, Xuong Rong stream, the section from Cach Mang Thang Tam road to Cau river have the water collecting system on natural ground. Several sections of the ditch bed have been eroded due to residents' encroachment on the two sides. So when there are heavy rains, some points are flooded locally, like Xuong Rong stream basin including Luong Ngoc Quyen road, the section passing through the General Hospital, Hoang Van Thu road section from the central round island to the intersection with Minh Cau road and almost entire Minh Cau road. Mo Bach stream basin includes Quang Trung road section intersecting with Z115 road to Dan overpass, and some points of residential areas in Tan Thinh, Quang Trung, Quyet Thang and Quang Vinh wards, which cause significant impacts on environmental sanitation, local traffic jam, affecting the life and business, production activities of people in the affected area.

Currently the city is carrying out 02 investment subprojects on drainage and wastewater treatment funded by the ODA fund of the French Republic and the Kingdom of Belgium. It is expected that the two systems will be completed by the end of 2017 and 2020. Currently, wastewater is collected into drainage sewers for direct discharge to natural drainage ditches / streams. Uncollected wastewater and drainage sewer systems usually discharge directly to the natural surface or the nearest ditches cause serious pollution.

Shortcomings of the drainage system as well as the state of environmental sanitation of the city has been causing some consequences such as:

- The risk of flooding in some central areas of the city when rainfall is intense; Environmental pollution along the natural drainage ditches/streams due to influence of stagnant wastewater in the ditch;
- The risk of spreading diseases related to wastewater pollution in high-lying population

areas; Urban landscape is affected by pollution, indirectly creating negative effects on the overall image of the city.

2.3.7. Environmental and social conditions in the specific Subproject areas

Environmental and social conditions of the areas along the works under DCIDP - Thai Nguyen city Subproject are as follows

1. Southnorth road & Huong Thuong bridge Construction

The road starts at the junction between the existing north-south road and Cach Mang Thanh Tam road (CMT8) and ends at the Huong Thuong commune kindergarten.

- The starting point of the road: The existing North-south road is about 25m wide, including 15m of road surface for vehicles and sidewalks from 3 ~ 6m. CMT8 road passes through the study area has a width of about 30m with a hard median strip. The surrounding area is crowded (location 1, Figure 8)
- The ending point of the road: The ending point of the road is the agricultural land located in front of Huong Thuong commune kindergarten. The household living nearest is 500m away from the ending point (position 7, Figure 8).

The current environmental and social conditions of the subproject road can be divided into three types: passing through the residential areas, passing through rice fields and across Cau River.

- The road passes through the area of crowded population density with many permanently-built houses (location 2 & 5, Figure 8)
- The road passes through rice fields is relatively flat terrain, convenient for construction work. The road crosses some local roads (locations 3 & 6, Figure 8).
- At the location across Cau River, there is Huong Thuong bridge which is a type of suspension bridge with a width of 2.5m, the load of less than 3.5 tons. Population is distributed close to the two ends of the bridge. The road connecting to the bridge towards Tuc Duyen ward is now asphalted road with a road surface of about 5m width; In the side of Huong Thuong commune is local concrete surface road of 5m width (location 4, Figure 8).

Environmental status: The environmental quality of air, soil, and water in the subproject area has no any sign of pollution, and the activities of waste generation are mainly from daily life, agriculture and transport means of small load. However, special attention should be paid to the noise emission during the construction phase at the work head of the subproject.

2. Huong Thuong - Chua Hang Road Construction

The starting point connects to the Southnorth road near Huong Thuong kindergarten and Martyrs cemetery. The nearest households are located 400m from the starting point of the road (location 1, Figure 9)

From Km0 + 800 to Km1 + 700 is the fields, the nearest household is 600m away the subproject area. In the area, there is Linh Trung temple, Nam Son hamlet church, Nhi Hoa village cemetery and Thong hamlet lake near the subproject road (locations 2 & 3, Figure 9)

The area from Linh Son junction (Km3 + 900) to the intersection with Dong Bam road has about 40 households located along the subproject road (locations 4 & 5, Figure 9)

The ending point area: The junction between the provincial road 265 and Nui Voi road in Chua Hang ward is crowded residential area (location 6, Figure 9).

Environmental status: The route is mainly through the field, so the quality of the environment is good, however, the noise issues at the end of the road (Chua Hang island, Chua Hang ward) should be pay attention.

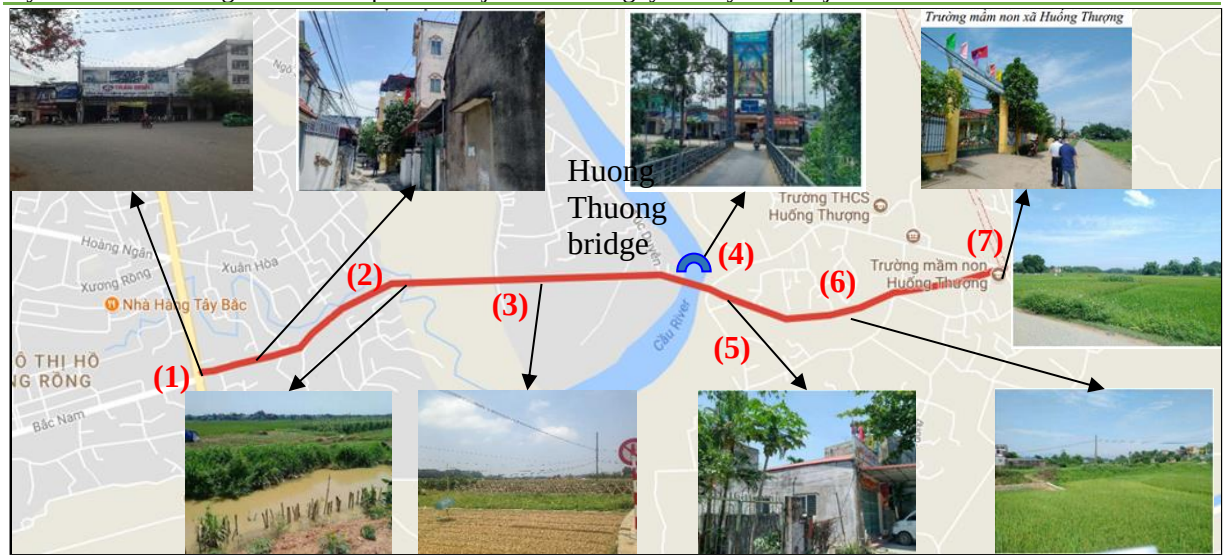


Figure 8: Current status of Southnorth road – Huong Thuong bridge

Figure 9: Current status of Huong Thuong – Chua Hang road

3. Dong Bam Residential Area Road Upgrading

The starting point of the road: adjacent to the subproject "Cau river right dyke construction, the section passing through Thai Nguyen city. This area is agricultural land grown with crops and vegetables and located around 300m away from the residential area (location 1, Figure 10).

From Km0 - Km0 + 950 is the existing aggregated road. Both sides are bare or cultivated land of the households. The closest household is about 700m from the subproject road (location 2, Figure 10).

From Km950 to the ending point of the road is the existing cement concrete road. The road is

under good condition, ensuring easy access during construction. There are about 20 households living along the road (locations 3 & 4, Figure 10).

The ending point: There are about 30 households living along the subproject road (location 5, Figure 10).

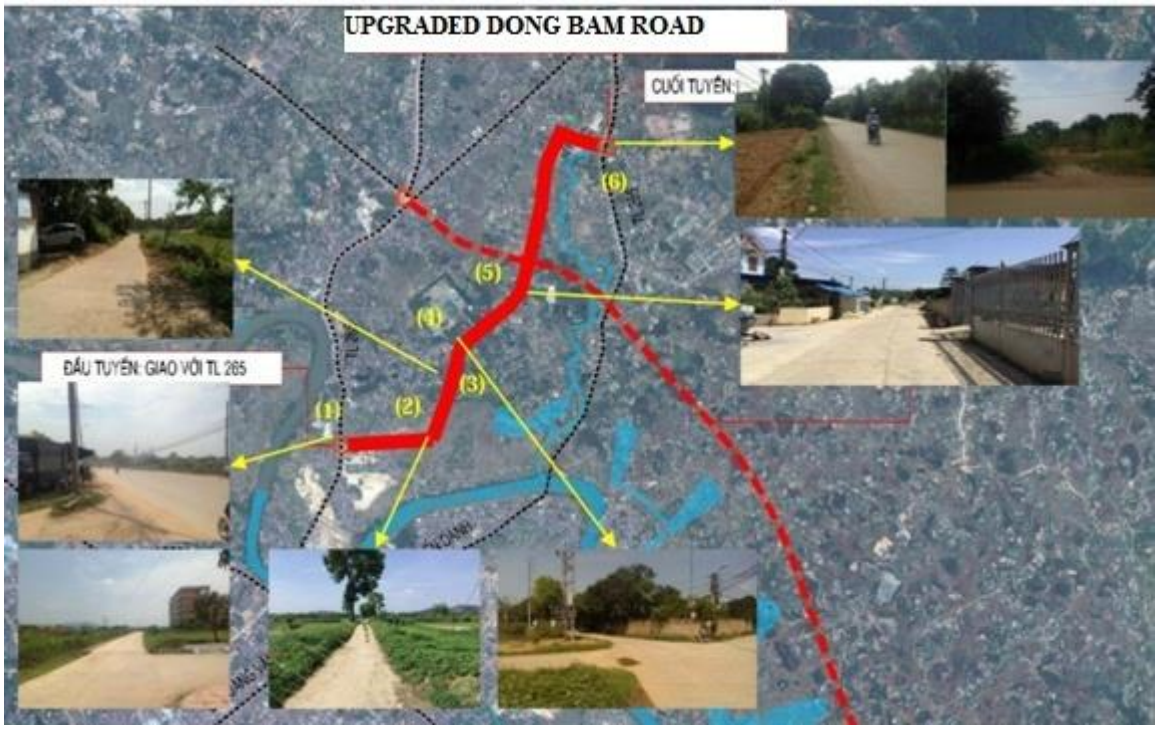


Figure 10: Current status of Dong Bam road

4. Dan Bridge Upgrading

Dan bridge is located on Quang Trung road which is a route to Ho Nui Coc Lake tourist resort and Tan Cuong tea region.

The two ends of the bridge, residents are concentrated not much, however, houses were permanently built. The difference between households' houses and the bridge is large (50-100cm)

It is about 500m away from Dan church, and 1km from the alley is Dan pagoda

400 - 500m away from the bridge end to the center of the city is Luong Ngoc Quyen Secondary School and Ngo Quyen High School.

Environmental status: Generally, environmental quality in the construction site is good, however, it should pay attention to issues related to dust, noise during the construction phase.

Figure 11: Current status of Dan Bridge

5. Le Huu Trac Road Upgrading

Le Huu Trac road is currently over 800m long with asphalt road surface width of 10.5m, without sidewalks on either side.

The section from Le Huu Trac road to the intersection with Hanoi - Thai Nguyen expressway is mainly field land, garden land of people and some sections of earth roads.

The end section of Hanoi - Thai Nguyen Expressway to NH 3 has many households living. The houses in this area are mostly three-storeyed permanent houses and garden land.

The status of the subproject road can be divided into three types: (i) passing through existing cement concrete roads and residential areas; (ii) passing through rice fields; (iii) and passing through NH 3.

- (i) The subproject road will pass through approximately 400m of existing cement concrete road and residential land of the local people at the beginning and the end of the road. The starting point is the alley section of the Le Huu Trac road (existing) with cement concrete surface of 100m length, with residential areas on either side. The regional houses are class IV houses and two-stored permanent houses (location 1, Figure 12); The ending point is cement concrete road of about 130m in length with dense population density. The regional houses are mainly 3-storeyed permanent houses (locations 5 & 6, Figure 12).
- (ii) Most of the road crosses the rice and garden land of the people (locations 2 & 3, Figure 12).
- At the intersection with NH 3, the subproject will build a new bridge with width of 8.5m (location 4, Figure 12).

Environmental status: The soil, water and air environment in the subproject area has no any signs of being polluted due to the passage through the agricultural land area but mainly daily life activities of local people. However, attention should be paid to the problems of dust and noise during the construction phase for residential areas at the end of the road.

Figure 12: Current status of Le Huu Trac road

6. Xuong Rong Drainage Ditch Rehabilitation

The current status of Xuong Rong drainage ditch is divided into 3 types: (i) Located in the residential area (sections 1,2 & 3, Figure 13); (ii) one side is 50m from the residential area, one side is the rice field (sections 5 & 6, Figure 13); (iii) Gia Sang Lake (location 4, Figure 13).

- (i) Along the ditch is the earth bank. The ditch bed has locations that are 7-8m encroached. The drainage width of the ditch is 1.5-15m. The two sides of the ditch are mainly paddy fields and fruit tree gardens. The ditch has bad smelt since wastewater from residential areas along the banks of the ditch and other areas is directly into the ditch. The distance to the closest household is 5.0m.
- (ii) Along the right bank, there are gardens and crop land, while the left bank is the residential area No.7 of Tuc Duyen Ward under construction. The width of the ditch is 8-38m. Although this section is diluted from Cau river water, it is still polluted and bad smelt.
- (iii) Gia Sang lake: Gia Sang lake had previously two small ones with a total water surface area of about 3.1 ha in the rainy season and approximately 4ha in the rainy season. The largest width of the lake is up to approximately 270m. However, nowadays since it has been encroached and deposited, the water surface area of the two lakes is about 1.9ha and the largest width of the lake is only about 120m and 02 lakes are separated independently. No wastewater collection system has been equipped surrounding the lake to prevent wastewater from residential areas. Wastewater from residential areas towards the lake and the elevated areas are discharged directly into the lake. The residential areas of the resettlement site of the wastewater plant and the residential area No.1 of Gia Sang ward are frequently flooded in rainy season.

Environmental status: The area of the works is contaminated with malodors from the wastewater drainage system, affecting the living conditions of the households living along the ditch. Water quality in some areas shows signs of organic pollution. In addition, the background environment in the subproject area is good.

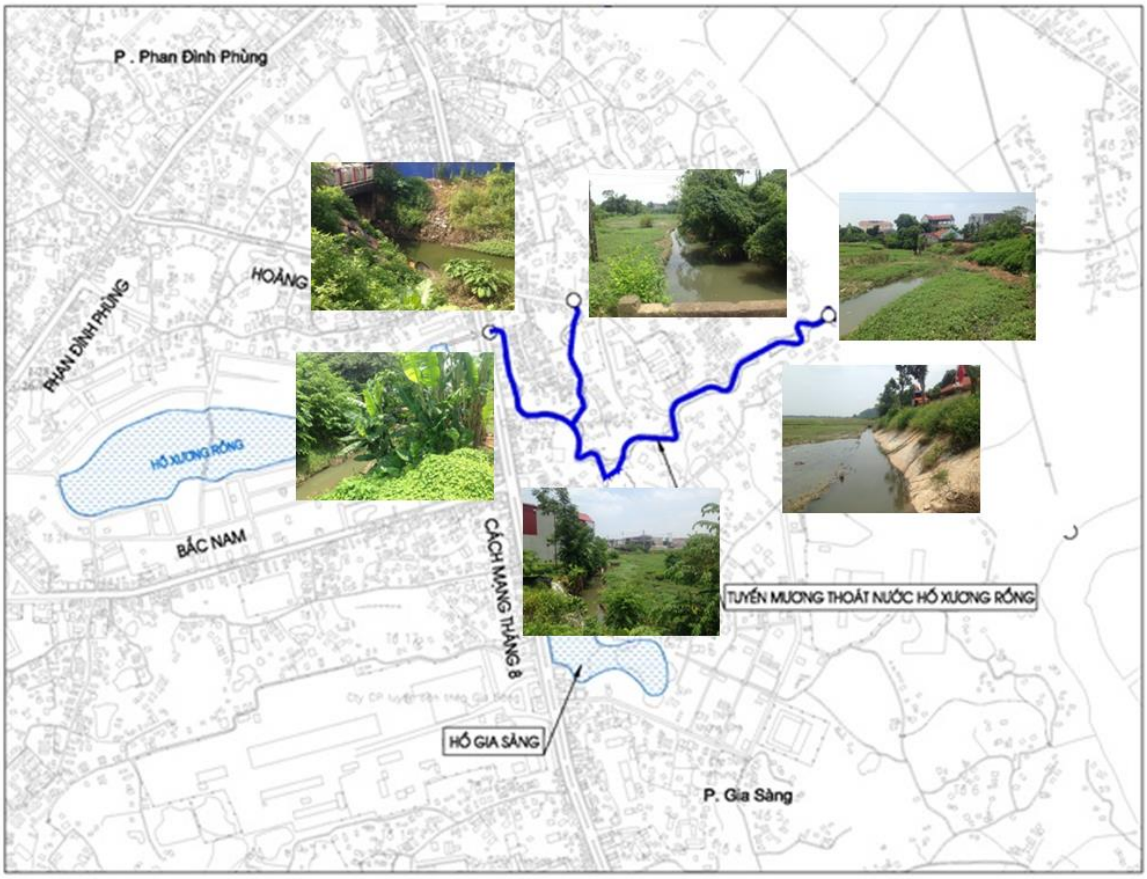


Figure 13: Current status of Xuong Rong drainage ditch

7. Mo Bach Stream Drainage Ditch Rehabilitation

Mo Bach stream has now many narrowed sections due to landslide or land encroachment by local people in the two sides. In addition, stream bed is often clogged by mud, construction materials and domestic waste. The two sides of the stream are waste and shrubs, banana trees, longan trees, etc.

The starting point intersects with the Dan overpass. This is located near the intersection of Quang Trung road and NH 3. The location nearby Quang Trung road is an orthopedic and rehabilitation hospital

The ending point is the intersection with Cau river. Two stream banks are bushes. At the intersection, water flows tightly.

Environmental status: The area of the works is contaminated with malodors from the wastewater drainage system, affecting the living conditions of the households living along the ditch. Water quality in some areas shows signs of organic pollution. In addition, the background environment in the subproject area is good.

Figure 14: Current status of Mo Bach stream

8. Huong Son Kindergarten Construction

The area of Huong Son kindergarten is public land managed by Huong Son ward, Thai Nguyen city.

The land area is about 6,000 m^2, interleaved in the residential area.

Current status: This is a vacant land or deserted two-storeyed houses. The road borders the local concrete road to the South, borders Huong Son street to the South and West, borders to the existing residential area to the East.

Environmental status: There has been no sign of pollution of soil, water and air at the construction site. However, problems of dust, noise should be paid attention to during the construction phase.

Figure 15: Current status of Huong Son kindergarten

9. Phan Dinh Phung Kindergarten Upgrading

Phan Dinh Phung kindergarten was put into operation in 1998, there are 10 classes with 350 pupils. The campus area is 1,725 m^2. At present, the school is degraded.

The location of the school is interleaved in the residential areas in the center of Thai Nguyen city

- The front side of the school is a 10m wide alley
- The right of the school is the land managed by the People's Committee, which is being used by people for gardening.
- The left side of the school has a part of land managed by the People's Committee where local people are currently planting trees and raising chickens and a part of residential land where people are building class IV house.
- The behind side of the school is the land of local people where a motel range was built for rent.

Environmental status: There has been no sign of pollution of soil, water and air at the construction site. However, problems of dust, noise should be paid attention to during the construction phase due to residents living around the subproject area.

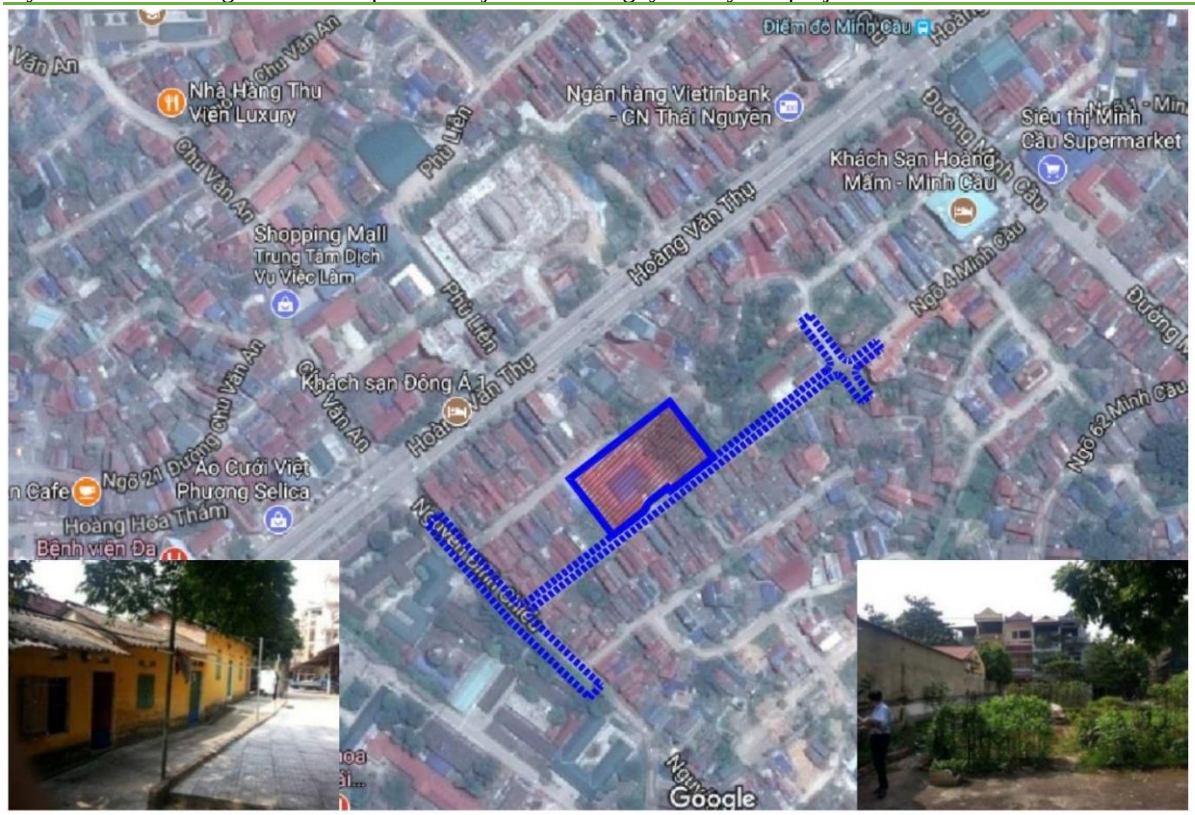


Figure 16: Current status of Phan Dinh Phung kindergarten

2.3.8. Description of sensitive works

Table 29: Description of sensitive works near the subproject area

Sensitive works	Characteristics of works
1. Southnorth Road & Huong Thuong Bridge Construction	
Kindergarten in Huong Thuong commune 	- Located at the end of Southnorth road, Huong Thuong bridge, about 230m from the end point of the road. - The kindergarten serves for about 300 pupils in Huong Thuong commune. - Studying time takes place all days in a week, starting time: 7h-8h and ending time 16h30 - 17h30.
Water pumping station is near Huong Thuong bridge 	- Located at downstream of Huong Thuong bridge under the works of Southnorth road, Huong Thuong bridge. - This pumping station will be moved for this works implementation. - This pumping station takes water directly from Cau river to irrigate for the fields in Huong Thuong commune with area more than 10 hectares. - The pumping station operates intermittently due to depending on the seasons, mainly in the dry season (from January to April). The operation frequency is about 7 days to timely catch up with the cultivation progress.
2. Huong Thuong - Chua Hang Road Construction: There are 5 sensitive works	

Sensitive works	Characteristics of works
Linh Trung village temple 	- Situated along Huong Thuong – Chua Hang road (Km0+800). - There is no land occupation under this works. - The worship activities are mainly on the 1st and 15th of the months (lunar calendar). There is only one day for god worship in Linh Trung village temple.
Thong hamlet lake 	- Located along Huong Thuong – Chua Hang road (Km1+700). - This is a large lake with area of about 2.5 ha, which stores and supplies water for farming and aquaculture for the whole surrounding area.
Nam Son hamlet church 	- Located about 70m (Km2+400) away from Huong Thuong – Chua Hang road. - Area of the works is about 2,000m^2. - Local people often go to the church at the weekend and on 24 December every year.
Cemetery in Chua Hang ward 	- Located about 80m away from the end point of Huong Thuong – Chua Hang road. - Area of the works is about 1.0 ha. - Worship activities are not continuous and mainly on Qingming festival, 15th July (lunar calendar) and tending graves at the end of Lunar year.
Monument to War Heroes and Martyrs in Chua Hang ward 	- Located about 120m away from the end point of Huong Thuong – Chua Hang road. - Area of the works is about 6,400 m^2. - Worship activities are not continuous, mainly on 27th July every year.
3. Dong Bam Residential Area Road Upgrading: There are two sensitive works	
Cemetery in Nhi Hoa hamlet 	- Located about 130m away from the road passing Dong Bam residential site. - Area of the works is about 1.0 ha. - Worship activities are not continuous and mainly on Qingming festival, 15th July (lunar calendar) and tending graves at the end of lunar year.

Sensitive works	Characteristics of works
Cemetery is near Dong Bam residential site 	- Located about 50m away from the road passing Dong Bam residential site. - Area of the works is about 1,000 m^2. - Worship activities are not continuous and mainly on Qingming festival, 15th July (lunar calendar) and tending graves at the end of lunar year.
4. **Dan Bridge Upgrading:** There is no sensitive works	
5. **Le Huu Trac Road Upgrading:** There are one sensitive works	
Thai Nguyen Mental Hospital 	- Located about 90 away from the starting point of Le Huu Trac road. - Area of the works is about 3,000 m^2. - No. of staff: 50 persons - No. of patients: 850 persons
6. Huong Son Kindergarten Construction: There are no sensitive works	
7. Phan Dinh Phung Kindergarten Upgrading: There are one sensitive works	
Phan Dinh Phung kindergarten 	- Located within scope of construction of Phan Dinh Phung kindergarten. - During the construction of the kindergarten, pupils will have to relocate to other place for studying. - Area of school campus is about 1,700 m^2 with 10 classes, more 26 teachers and over 350 pupils. - Studying time takes place all days in a week, starting time and ending time: 6h30 – 7h30, 11h-12h, 13h-14h and 16h30-17h30.
8. Xuong Rong Drainage Ditch Rehabilitation: There are no sensitive works	
9. Mo Bach Stream Drainage Ditch Rehabilitation: There are one sensitive works	
Thai Hai kindergarten and primary school 	- Located about 30m away from Mo Bach drainage ditch. - Area of school campus is about 7,200m^2 with 24 classes including kindergarten and primary classes. The school has about 50 teachers and over 350 pupils. - Studying time takes place all days in a week, starting time and ending time: 6h30 – 7h30, 11h-12h, 13h-14h and 16h30-17h30.

CHAPTER 3. ANALYSIS OF ALTERNATIVES

3.1. Current situation and considered alternatives

The main objective of the analysis and comparison of alternatives regarding technical design alignment aims to compare the environmental and social impacts among the alternatives. The selected alternatives will be based on integrated considerations in terms of technical, economic, effective, environmental and social aspects.

3.2. Cases "With" and "Without" the subproject

The sub-project has been implemented in 14 wards and communes of Thai Nguyen city. According to the survey results of the subproject area, it can be seen that: (i) quality of air, soil and water have not been reduced by pollutants (except for water quality at Mo Bach stream and Xuong Rong ditch); (ii) There is a lack of ring roads in the Northern and Northeastern area of Thai Nguyen city to connect with neighboring districts; (iii) Insufficient urban traffic system and cross-section of the road have not yet met the demand for transport and the nature of urban roads; (iv) The urban protection cofferdam system is still incomplete, thus the city is still flooded in the flood season,; (v) Current drainage system is a common and incomplete drainage system and Mo Bach stream and Xuong Rong ditch has been polluted; (vi) The kindergarten infrastructure has not met the actual development needs. Therefore, in case the Thai Nguyen City Subproject is not implemented, the environmental and social disadvantages will continue to exist including:

- Risk of traffic safety on the existing road is increased due to deterioration of the roads in the traffic flow area which has increased over the years. At Dan bridge area, the small bridge surface width forms a bottleneck in combination with a elevation difference of about 2m between Dan bridge surface and Quang Trung road, causing difficulties for the means of transport and forming a potential location of traffic accidents risks at alarming level (there are about four traffic accidents each year). Without expansion and upgrading of the works, traffic accidents are likely to be unavoidable.
- Vehicles must take long time to travel and pay high operation costs when passing through the communes and wards in the Northern and North Eastern area as well as the East West corridor to the South of Thai Nguyen city. If there are no traffic works including Huong Thuong - Chua Hang road, Southnorth road and Huong Thuong bridge, and Dong Bam residential area, the connection with the Northern and Northeastern areas of Thai Nguyen city, which mainly passes through Gia Bay Bridge and Ben Oanh Bridge will contain the potentials to cause traffic jams and safety. Le Huu Trac road to the South of city which is completed, will form an urban network, reducing the traffic pressure for roads in the central urban area.
- There is a serious shortage of educational facilities in Huong Son and Phan Dinh Phung wards. Without the implementation of the works, it will lead to overload of kindergarten education and training system in the area.
- The risk of flooding and environmental pollution will continue to exist in urban city areas. If Mo Bach and Xuong Rong ditches are not rehabilitated, floods, environmental pollution, urban landscapes, malodors and environmental sanitation are likely to be unavoidable.

Status of environmental and social issues in the case of "WITH" and "WITHOUT" the subproject is compared in the table below.

Table 30: Environmental quality in the case of "WITH" and "WITHOUT" the subproject

Issues	In case "Without" the subproject	In case "With" the subproject
A	***Transport - bridges and urban roads connection improvement works***	
Environment	- There is no change in air, water, soil environment	- Purpose of land use is changed, water is not affected, - Increased traffic density causes smoking and pollution - Urbanization, services development leads to increased generation of waste water and waste
Economy	- People have few opportunities for economic development	- People have many opportunities for economic development (business, trade, employment for companies, factories). - People can easily access to job opportunities in Thai Nguyen city center
Society	- Local people do not lose their land, they do not have to relocate to new residence without affecting their livelihood	- 1,098 households are affected, including 123 relocated households.
	- Bridges and roads are degraded causing traffic unsafety - The roads are congested, local people get many difficulties in travelling	- Bridges and roads are repaired or replaced to ensure traffic safety - Bridges, roads are expanded in accordance with the planning to help smooth transport
	- People living along the left bank of Cau river are facing many difficulties in accessing to services in the urban area of Thai Nguyen city	- People living along the left bank of Cau river can easily access to the city center via Southnorth road - Huong Thuong bridge, Huong Thuong- Chua Hang road and Dong Bam road.
B	***Flooding prevention and sanitation improvement works***	
Environment	- The air is polluted by malodor from the two channels.	- Environmental sanitation is improved, air is fresher.
	- Wastewater and sludge are increasing causing negative impacts on Cau river water. - Contaminated wastewater seeps into soil, which makes soil quality reduced.	- There has separate waste water pipelines, which will later be put into 02 wastewater treatment systems under construction of the city, wastewater pollution will be reduced. - Waste water is less polluted → Pollution level in the soil is less.
	- Lack of environmental sanitation landscape is increasing.	- The landscape environment is improved better.
	- The drainage situation of two channels is increasingly difficult situation, leading to increased inundation.	- Stormwater drainage is more effective by improved inundation.
	- There is appearance of erosion, encroachment of narrow ditch bed from local people.	- There is no appearance of erosion and ditch bed encroachment by construction of embankment.

Economy	- People have few opportunities for economic development.	- Improved landscape and environment leads to increased land price, developed services → Livelihood is improved.
Society	- Local people do not lose their land, they do not have to relocate to new residence without affecting their livelihood	- 240 households are affected, including 10 relocated households.
	- Environmental pollution is the habitat of flies, mosquitoes, mice → epidemic development	- Environment is improved, the epidemic situation is reduced. - Health of local people is improved due to doing exercise, walking along embankment along Mo Bach ditch
C	***Social infrastructure works***	
Environment	- There is no change in air, water, soil environment. - The expected area for construction of Huong Son kindergarten is an abandoned location affecting aesthetic beauty of the area.	- There is no change in air, water, soil environment. - The landscape at the construction site of Huong Son kindergarten is improved.
Economy	- No change	- The land price at the construction site of Huong Son kindergarten will increase.
Society	- No loss of land	- 09 households are affected, none of households have to relocated.
	- The infrastructure of Phan Dinh Phung kindergarten is degraded.	- Infrastructure degradation is issued, the quality of kindergarten education is improved.
	- Learning and teaching at Phan Dinh Phung School is stable and unaffected.	- Their education at Phan Dinh Phung kindergarten was affected for one year by the demolition of the old school, the construction of a new school.
	- The needs of kindergarten education is not solved.	- Pressure on the demand for kindergarten education in Thai Nguyen city is reduced.
	The planned area for construction of Huong Son kindergarten is the gathering place of the persons with bad qualities, causing instability in the area.	- The landscape and safety as well as security is improved in the construction area of Huong Son kindergarten.

3.3. Analysis of technical alternatives

3.3.1. Description of the considered criteria

The considered criteria for selecting alternatives are described in detail in the following table:

Table 31: Criteria are considered for comparison between alternatives

No.	Alternatives	Criteria to be considered
1	Transport - bridges and urban roads connection improvement works	- Location - Advantages - Disadvantages

		- Technical field - Landscape - Site clearance - Construction cost (excluding contingency)
2	Flooding prevention and sanitation improvement works	- Technical solution - Advantages - Disadvantages - Environmental and social impacts - Investment costs
3	Social infrastructure works	- There is only one alternative of construction according to the planning

3.3.2. Construction of Southnorth road and Huong Thuong bridge

➢ **Alignment alternative**

Two road alternatives for Southnorth road and Huong Thuong Bridge were considered as follows:

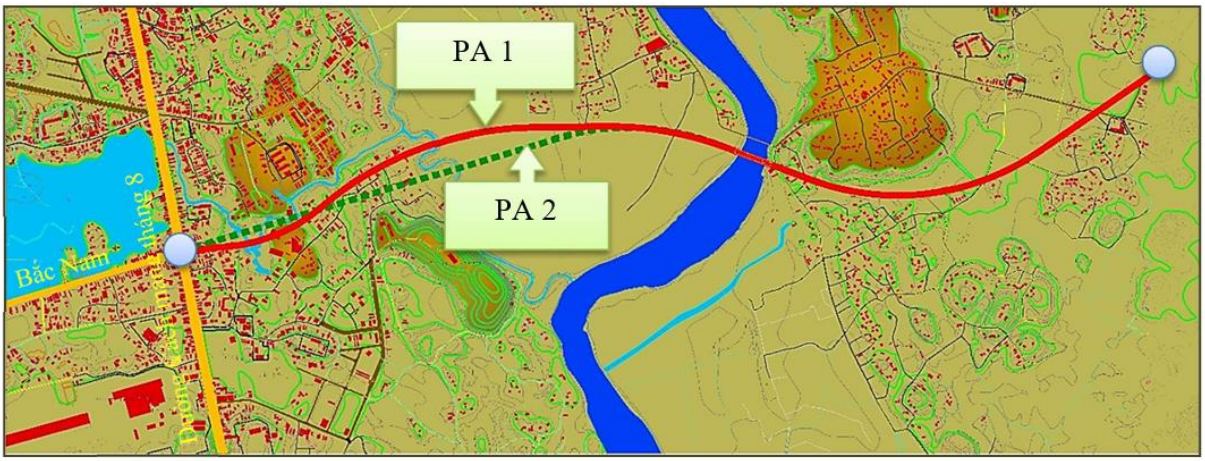


Figure 17: The proposed alignment alternative of Southnorth road and Huong Thuong Bridge

The impact magnitude of the two alternatives is compared as in the table below

Table 32: Comparison of the alignment alternatives of Southnorth road and Huong Thuong bridge

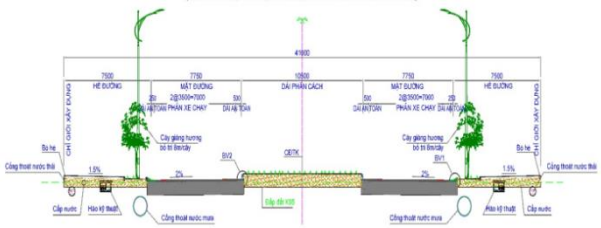
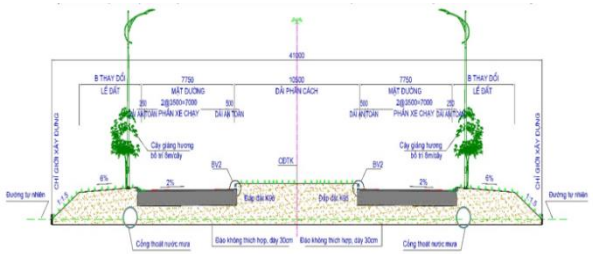
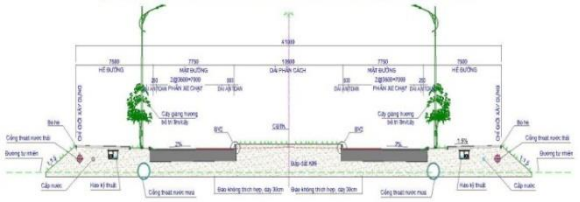
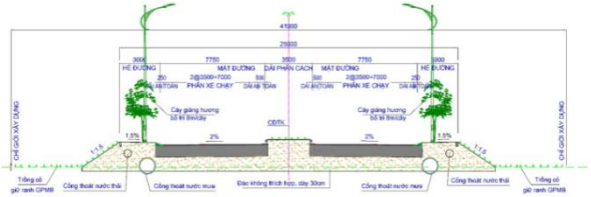
Items	Alternative 1 (the selected alternative)	Alternative 2
Location	- Closely follow the planning, the road follows according to the topographic conditions and the current status of the residential area, the route slightly inclines to the right of Xuong Rong drainage ditch. - Total length of the road is about 3.2km.	- The straight road follows the existing Southnorth road and then coincides with Xuong Rong drainage ditch. - Total length is about 3.16km
Advantages	- The road closely follows the planning alternative, thus there will have little impacts on other planning subprojects. - The first section of the road is next to Xuong Rong drainage ditch, thus, this ditch will not be affected or moving this	- Direction of straight road from the current Southnorth road, the alignment alternative is better than that of alternative 1.

Items	Alternative 1 (the selected alternative)	Alternative 2
	channel is unnecessary.	
Disadvantages	- The road runs un-straightly to the top of the road, the alignment alternative seems not to be good.	- The road runs straightly into Xuong Rong drainage ditch, thus it is necessary to improve the ditch or give potential solutions, leading to an increase in investment cost. - The road section runs at the lowest point of the waterbody area, causing the unstable risks of road surface during the exploitation process.

- **Cross-section alternatives**

Three investment alternatives for cross-section width are considered for the works items. Advantages, disadvantages and alternatives are analyzed in the table below.

Table 33: Comparison of Cross-section alternatives of the Southnorth road, Huong Thuong bridge

No	Alternative 1	Alternative 2	Alternative 3
1	**Description of Alternatives**		
	• B_{base} = 41m, of which: - Carriage way : 4x3.5m - Median strip planted grass : 10.5m - Marginal lane in two sides of median strip : 2x0.5m - Safety lane adjoining sidewalk : 2x0.25m - Sidewalks : 2x7,5m, depending on each section • The section passing through residential area: Tiled sidewalk  • The section passing through agricultural land area : soil foundation 	• B_{base} = 41m, of which: - Carriage way : 4x3.5m - Median strip planted grass : 10.5m - Marginal lane in two sides of median strip : 2x0,5m - Safety lane adjoining sidewalk : 2x0.25m - Sidewalks : 2x7.5m, finished for entire route  • Phase 2 uses median strip for dividing into 2 lanes	• B_{base} = 25m, of which: - Carriage way : 4x3.5m - Median strip planted grass : 3.5m - Marginal lane in two sides of median strip : 2x0.5m - Safety lane adjoining sidewalk : 2x0.25m - Sidewalks : 2x3m  • Phase 2: site clearance of two sides, 8m of each side

No	Alternative 1	Alternative 2	Alternative 3
	• Phase 2 uses median strip for dividing into 2 lanes		
2	**Advantages**		
	• Site clearance costs will be reduced as the present compensation unit price is lower than that of future. • The subproject will newly build road without existing works, so it will be active in investment, not require relocation of infrastructure • In addition, since the roadbed is made over the entire 41m of site clearance range for the finalization stage, it will prevent the risk of re-encroachment of site.	• Due to complete investment, entire route will be synchronous and more aesthetic; • In addition, since the roadbed is made over the entire 41m of site clearance range for the finalization stage, it will prevent the risk of re-encroachment of site.	• Reduced investment cost in phase 1 due to narrowing of road's width.
3	**Disadvantages**		
	• The overall route is not beautiful due to the sidewalk is not invested entirely.	• Due to sidewalk investment for entire route, construction cost is high. • The volume of site clearance is higher due to site clearance for foundation slope of the road	• The high risk of site re-encroachment and many difficulties • Difficulties in pavement expansion due to second site clearance and relocation of infrastructure
4	**Technical comparison**		
	• Meet technical requirements according to applicable standards. • Almost no impact on the road surface invested in phase 1 when expansion into 6 lanes in Phase 2	• Meet technical requirements according to applicable standards. • Almost no impact on the road surface invested in phase 1 when expansion into 6 lanes in Phase 2	• Meet technical requirements according to applicable standards. • Great influence when expansion into 6 lanes in the future due to relocation of infrastructure.
5	**Comparison of landscape**		

No	Alternative 1	Alternative 2	Alternative 3
	• Beautiful and airy landscape • However, because the pavement has not been fully invested, it makes sense that the route is not synchronous.	• Beautiful, airy and synchronous landscape entire route	• The landscape is worse than Alternative 1 and 2, the route is narrow.
6	**Site clearance**		
	• Site clearance for one time with total cost less than Alternative 3 • Shorter site clearance time, more convenient than Alternative 3	Same as Alternative 1	• Total cost of site clearance higher than Alternative 1 and 2 but lower cost for phase 1; higher cost for phase 2 and facing with more difficulties
7	**Construction cost (Excluding contingency – Billion Dong)**		
	Phase 1 : 142,028 Phase 2 : 137,218 Total : 279,246	Phase 1 : 155,326 Phase 2 : 124,571 Total : 279,897	Phase 1 : 133,331 Phase 2 : 168,359 Total : 301,690

Table 34: Comparison of alternatives based on ranking score

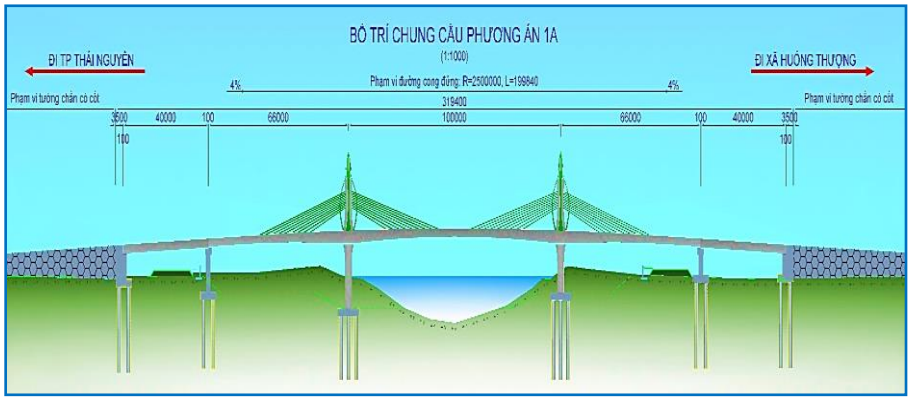
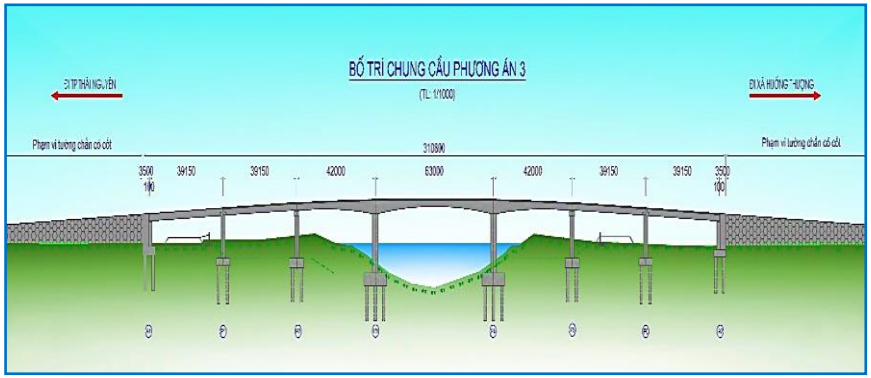
Comparison criteria	Density	Cross-section solution					
		Alternative 1		**Alternative 2**		**Alternative 3**	
		Rank	Score	Rank	Score	Rank	Score
(1)	(2)	(3)	(4) = (2)*(3)	(5)	(6) = (2)*(5)	(7)	(8) = (2)*(7)
Specifications	25%	2	0.5	3	0.75	1	0.25
Landscape	30%	2	0.6	3	0.9	1	0.3
Site clearance	25%	3	0.75	2	0.5	1	0.25
Construction cost	20%	3	0.6	2	0.4	1	0.2
Total score			2.45		**2.55**		1.0

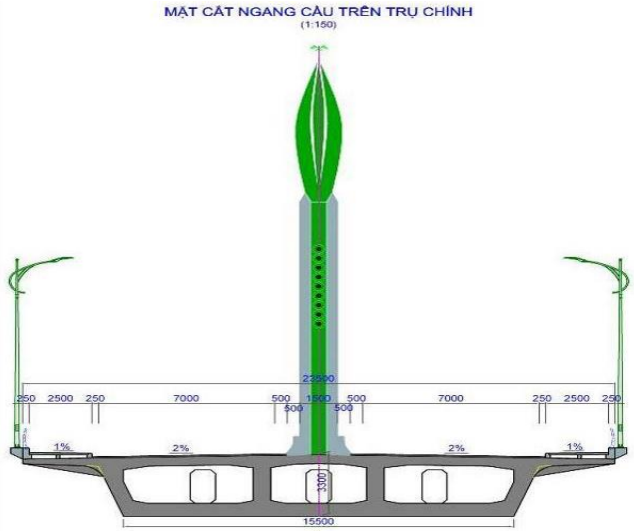
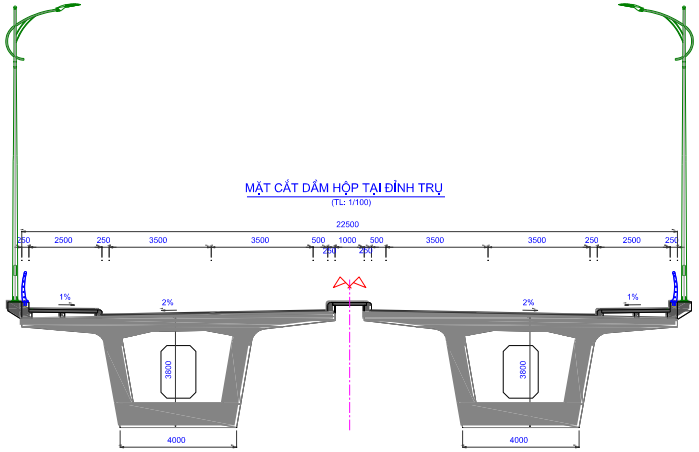
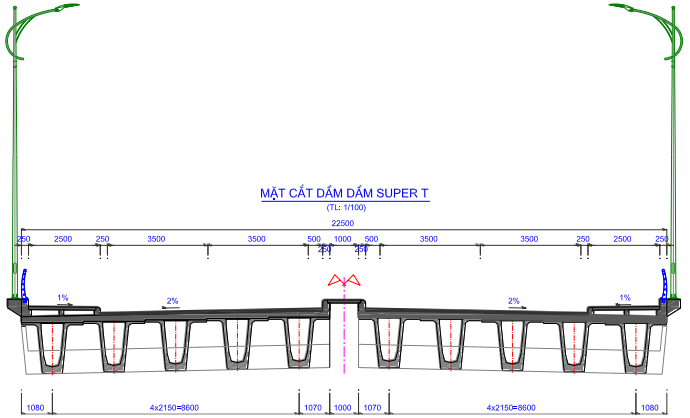
According to above-mentioned comparison, it can be seen that Alternative 2 has more advantages than and total highest ranking score out of 3 alternatives. Therefore, Alternative 2 is suggested to be selected alternative for investment.

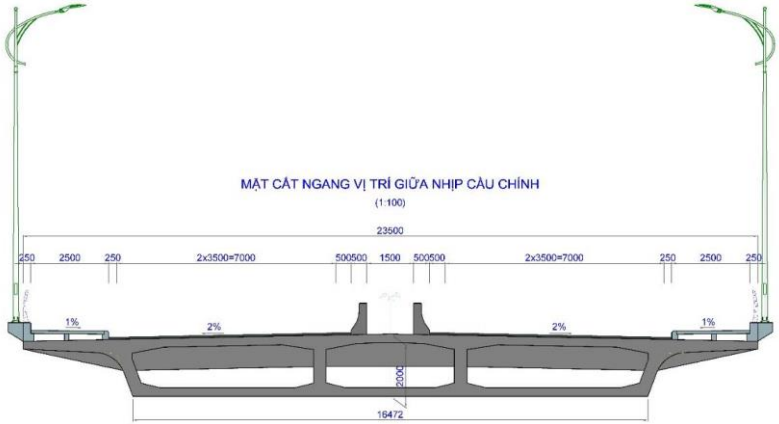
➢ **Structural alternatives of Huong Thuong bridge**

2 structural alternatives of Huong Thuong bridge are proposed and selected as below.

Table 35: Comparison of structural alternatives of Huong Thuong bridge

No.	Alternative 1	Alternative 2
1	**Description of Alternatives**	
	Low cable-stayed bridge of reinforced concrete, main span length of 100m  - Span layout: 40+(66+100+66)+40m. Total length of the bridge to the end of the abutment is about 319.4m; - Upper structure: main span is pre-stressed reinforced concrete box girder structure by the construction method of balanced cantilever. - The tower of reinforced concrete is styled beautifully with language expressing the development viewpoint of Thai Nguyen city as “Gray into Green”. - High-strength steel stays, covered by protective tubes with colors suitable for landscape to enhance the aesthetics of the building.	**Pre-stressed reinforced concrete box girder bridge**  - Span layout: 2x39.15+(42+63+42)+2x39.15m. Total length of the bridge to the end of the abutment is about 310.6m; - Upper structure: main span is pre-stressed reinforced concrete box girder structure by the construction method of balanced cantilever. Approach span has span structure of assembled Super T. - Substructure: Supporting pier of cast-in-site reinforced concrete, the foundation is expected as drilled pile foundation

No.	Alternative 1	Alternative 2
	- Approach span with pre-stressed reinforced concrete box structure cast in place on the scaffolding system - Substructure: Supporting pier of cast-in-site reinforced concrete, the foundation is expected as drilled pile foundation • Cross-section of bridge: 	• Cross-section of bridge:  

No.	Alternative 1	Alternative 2
	 • Total width about 23.5m distributed as below: - Carriage way: 4x3.5m - Median strip: 2.5m - Marginal lane in two sides of median strip: 2x0.5m - Safety lane adjoining sidewalk: 2x0.25m - Sidewalks: 2x2.5m - Handrail: 2x0.25m	- Total width about 22.5m distributed as below: - Carriage way: 4x3.5m - Median strip: 1.5m - Marginal lane in two sides of median strip: 2x0.5m - Safety lane adjoining sidewalk: 2x0.25m - Sidewalks: 2x2.5m - Handrail: 2x0.25m
2	**Technical comparison**	
	Meet technical requirements according to applicable standards.	Meet technical requirements according to applicable standards.
3	**Comparison of construction technologies**	
	More complicated than Alternative 2 However, many contractors are capable of executing	Manufacturing technology is simple and familiar to domestic contractors.
4	**Aesthetics of works**	

No.	Alternative 1	Alternative 2
	• High aesthetics. • Cau River is only 100m wide, so it is more suitable for Landscape than Alternative 2	• Lower aesthetics than Alternative 1
5	**Maintenance**	
	Moderate maintenance cost	Lowest maintenance cost
6	**Construction cost (excluding contingency)**	
	396,514 billion dongs	283,264 billion dongs

Total score of each alternative is determined by sum of multiplication between density and rank

Table 36: Comparison of alternatives based on ranking score:

Comparison criteria	Density	Structural alternatives			
		Alternative 1 *Low cable-stayed bridge with main span 100m*		**Alternative 2** *Pre-stressed reinforced concrete box girder bridge*	
		Rank	Score	Rank	Score
(1)	(2)	(3)	(4) = (2)*(3)	(9)	(10) = (2)*(9)
Specifications	20%	3	0.8	4	0.2
Construction technologies	10%	2	0.4	4	0.1
Aesthetics	40%	4	0.8	1	0.4
Maintenance	10%	3	0.4	4	1.6
Cost	20%	2	0.2	4	0.4
Total score			**3.1**		2.8

Basing the above comparison, Alternative 1 (Low cable-stayed bridge main span 100m) has highest total score, therefore, Alterative 1 is suggested to be selected alternative for executing.

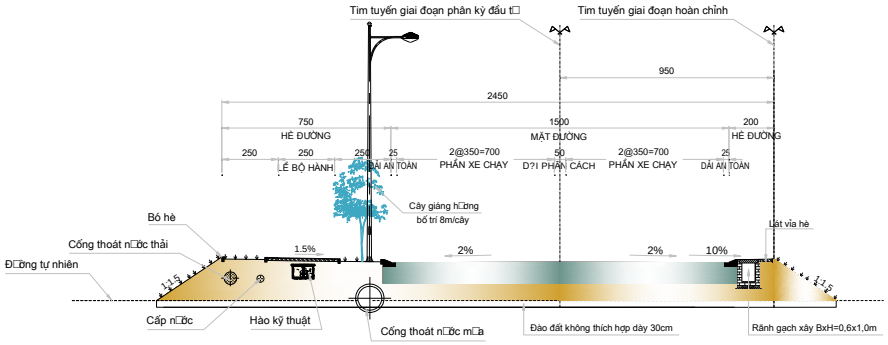
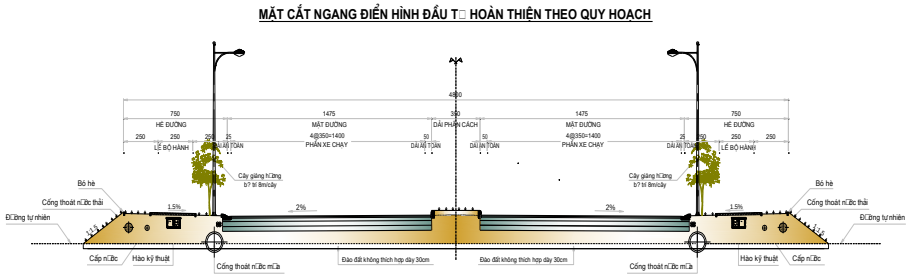
3.3.3. Construction of Huong Thuong – Chua Hang road

The alignment alternative (following the alignment alternative in the planning, with specific adjustments at some locations to minimize cost of site clearance and limit the impacts on cemetery land, defense land). Therefore, the alignment alternative is suitable to the actual conditions in the area.

- **Cross-section alternatives of the road**

Two cross-section solutions of Huong Thuong – Chua Hang road are reviewed and compared in the table below.

Table 37: Comparison of Cross-section alternatives of Huong Thuong – Chua Hang road

STT	Alternative 1	Alternative 2
1	**Description of alternatives**	
	• B_{base} = 24.5m, of which: Carriage way: 4x3.5m; Median strip planted grass: 0.5m; Safety lane adjoining sidewalk: 2x0.25m; Sidewalks: 7.5m + 2m • Cross section: 	• B_{base} = 48.5m, of which: Carriage way: 8x3.5m; Median strip planted grass: 3,5m; Safety lane adjoining sidewalk: 2x0.5m + 2x0.25m; Sidewalks: 2x7,5m • Cross section: 
2	**Advantages**	
	• Reduced investment cost for phase 1	• Total cost lower than Alternative 1 due to only construction and site clearance for one time • Actively in investment of infrastructure (electricity, water)
3	**Disadvantages**	
	• High cost of site clearance for phase 2, more complicated than phase 1. • Total cost for both 2 phases higher than Alternative 2.	• High cost of construction and site clearance.
4	**Technical comparison**	
	• Meet technical requirements according to applicable standards.	• Meet technical requirements according to applicable standards.
5	**Investment cost (billion dongs)**	
	Site clearance : **96,475** Construction cost : **201,671**	Site clearance : **131,083** Construction cost : **513,219**

Total score of each alternative is determined by sum of multiplication between density and rank.

Table 38: Comparison of alternatives based on ranking score

Comparison criteria	Density	Cross-section solution			
		Alternative 1		Alternative 2	
		Rank	Score	Rank	Score
(1)	(2)	(3)	(4)=(2)*(3)	(5)	(6)=(2)*(5)
Specifications	25%	2	0.50	1	0.25
Landscape	30%	2	0.60	1	0.30
site clearance	25%	1	0.25	2	0.50
Construction cost	20%	1	0.25	2	0.50
Total score		**1.60**		1.55	

From above tables, it can be seen that Alternative 1 has more advantages and higher ranking scores than Alternative 2. Therefore, Alternative 1 is recommended as research alternative for investment.

- **Structural alternatives of Mo Linh bridge**

Length of the span aperture selected, in addition to the requirements for suitability with natural conditions and the control points of the subproject, also must be suitable with the scale, technical grade, architectural requirements and exploitation characteristics. Therefore, 3 span structural alternatives have been considered and compared.

Table 39: Comparison of structural Alternatives of Mo Linh bridge

No.	**Comparison criteria**	**Alternative 1** *Single span girder bridge, 03 Super-T spans, construction scale according to phase 1 investment phasing*	**Alternative 2** *Single span girder bridge, 04 girder I spans, construction scale according to phase 1 investment phasing*	**Alternative 3** *Single span girder bridge, 03 Super T spans, complete construction according to the planned cross section*
1	Specifications	Meet technical requirements according to applicable standards.	Meet technical requirements according to applicable standards.	Meet technical requirements according to applicable standards.
2	Construction technologies	Processing technologies and simple and familiar to national contractors.	Processing technologies and simple and familiar to national contractors.	Processing technologies and simple and familiar to national contractors.
3	Aesthetics	Moderate aesthetic structure	Moderate aesthetic structure	Moderate aesthetic structure
4	Construction duration	Around 15 months	Around 15 months	Around 18 months
5	Maintenance	Low cost of maintenance	Low cost of maintenance	Low cost of maintenance
6	Construction cost (billion dong)	**55,828**	56,825	111,658

Total scores of each alternative are determined by sum of multiplication between density and rank

Table 40: Comparison of alternatives based on ranking score

Comparison criteria	Density	Structural alternatives					
		Alternative 1		Alternative 2		Alternative 3	
		Rank	Score	Rank	Score	Rank	Score
(1)	(2)	(3)	(4)=(2)*(3)	(5)	(6)=(2)*(5)	(7)	(8)=(2)*(7)
Specifications	20%	2	0.40	1	0.20	3	0.60
Construction technologies	10%	3	0.30	2	0.20	1	0.10
Aesthetics	20%	3	0.60	2	0.40	1	0.20
Maintenance	10%	1	0.10	3	0.30	2	0.20
Cost	40%	3	1.20	2	0.80	1	0.40
Total		**2.60**		1.90		1.50	

Basing on the above comparison tables, Alternative 1 with simple span bridge using Super T girder has bridge cross section according to phase 1 investment phasing has been recommended as research alternative for the next stages of the subproject.

3.3.4. Upgrading and construction of Dong Bam road

The alignment alternative of Dong Bam road is designed in accordance with the planning of Thai Nguyen city. The alignment of the works is as follows: From the starting point (the location adjacent to the subproject "construction of Cau river right dyke, the section passing through Thai Nguyen city at the intersection between the underground tunnel and the right bank dyke of Cau river), the route will coincide with the existing aggregate road with length of about 950m, to Km 0 + 950, the route will coincide with the existing cement concrete road in the direction of the main axis of Nhi Hoa hamlet, then go straight to the end of the route connecting to Huong Thuong - Chua Hang road at Km1 + 800.

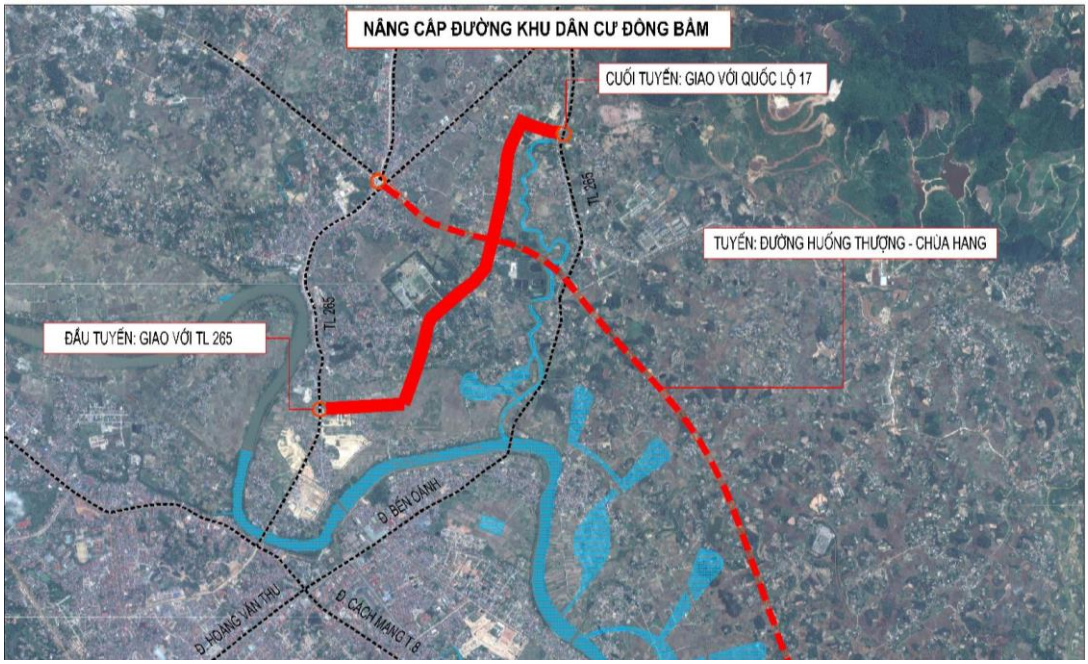
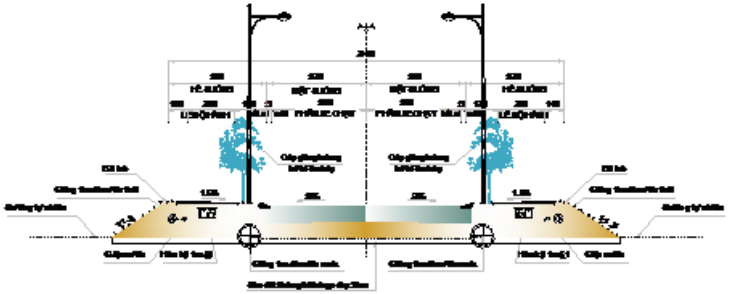
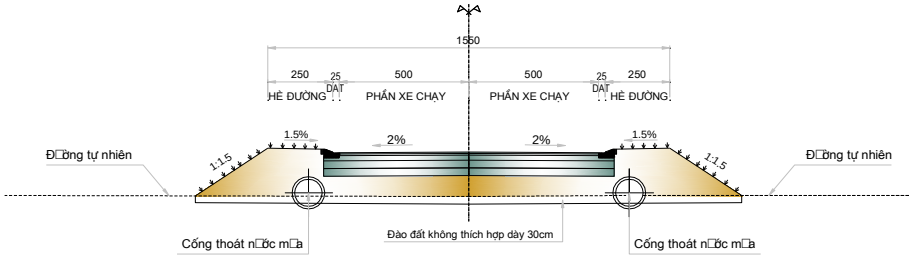
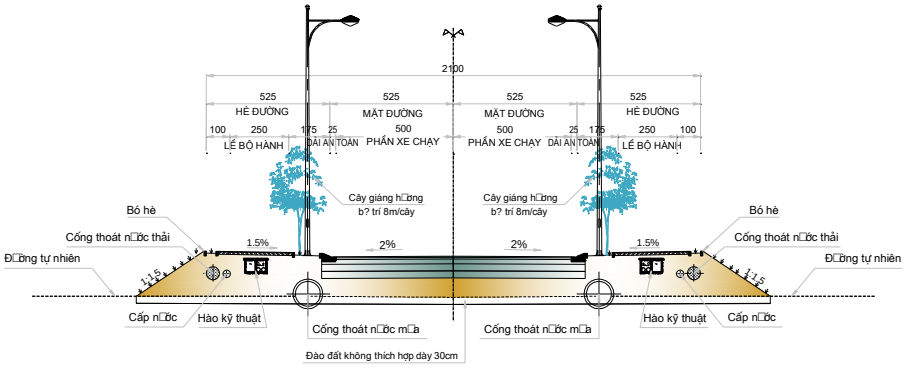


Figure 18: The proposed alignment alternative of Dong Bam

➢ **Cross-section solution**

Two cross-section alternatives of Dong Bam road have been reviewed and analyzed as the table below.

Table 41: Comparison of cross-section alternatives of Dong Bam road

<table>
<tr><th>TT</th><th>Alternative 1</th><th>Alternative 2</th></tr>
<tr><td>1</td><td colspan="2">Description of alternatives</td></tr>
<tr><td></td><td>• From KM0+00 to KM0+950: $_{Bbase}$ = 21m; Carriage way: 2x5m; Safety lane adjoining sidewalk: 2x0,25m; Sidewalks: 2x5,25m
TYPICAL CROSS-SECTION FOR PHASE 1 INVESTMENT PHASING (FROM KM 0+00 TO KM 0 + 950
 
• From KM0+950 to KM3+00:
- B_{base} = 15m
- Carriage way : 2x5m
- Safety lane adjoining sidewalk : 2x0.25m
- Sidewalks : 2x2.5m
 
</td><td>Entire route is built synchronously: B_{base} = 21m; Carriage way: 2x5m; Safety lane adjoining sidewalk: 2x0.25m; Sidewalks: 2x5.25m
MẶT CẮT NGANG ĐIỂN HÌNH ĐẦU T□ HOÀN THIỆN THEO QUY HOẠCH
 
</td></tr>
<tr><td>2</td><td colspan="2">Advantages</td></tr>
<tr><td></td><td>Cost of construction and site clearance lower than Alternative 2</td><td>The route is built synchronously with sidewalks wider than Alternative 1
Aesthetics higher than Alternative 1</td></tr>
</table>

3	**Disadvantages**	
	Section 2 has narrower sidewalks, therefore, the route is not synchronous. Aesthetics is lower than Alternative 2 Walking in sidewalks is not convenient as Alternative 2	High construction and site clearance cost
4	**Technical comparison**	
	Meet technical requirements according to applicable standards.	Meet technical requirements according to applicable standards.
5	**Total investment (billion dong)**	
	Cost of site clearance : **45,072** Construction cost : **142,96**	Cost of site clearance : 65,00 Construction cost : 168,567

Total scores of each alternative are determined by sum of multiplication between density and rank.

Table 42: Comparison of alternatives based on ranking score

Comparison criteria	Density	Cross-section solution			
		Alternative 1		Alternative 2	
		Rank	Score	Rank	Score
(1)	(2)	(3)	(4)=(2)*(3)	(5)	(6)=(2)*(5)
Specifications	25%	2	0.50	1	0.25
Landscape	30%	2	0.60	1	0.30
site clearance	25%	1	0.25	2	0.50
Construction cost	20%	1	0.25	2	0.50
Total score		**1,60**		1,55	

From above tables, Alternative 1 has more advantages and highest total ranking score. Therefore, Alternative 1 has been recommended as research alternative for the prevailing investment phase.

- **Structural alternatives of Mo Linh 2 bridge**

Mo Linh 2 Bridge is built synchronously with Huong Thuong – Chua Hang road with only one construction alternative.

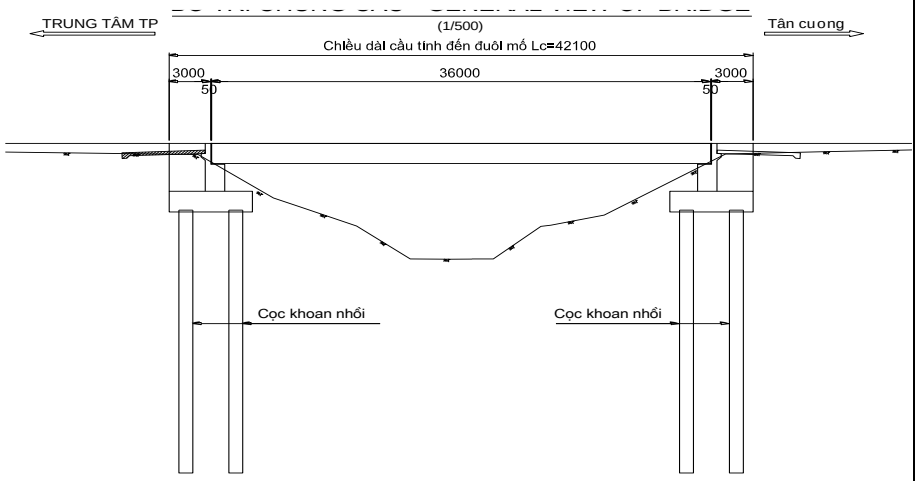
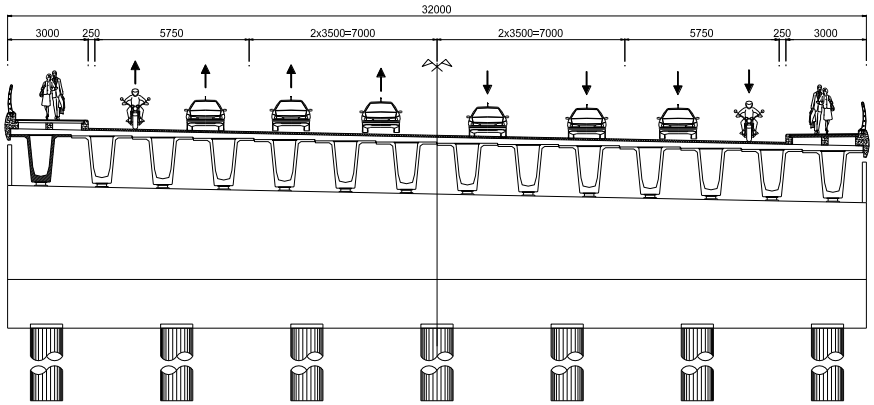
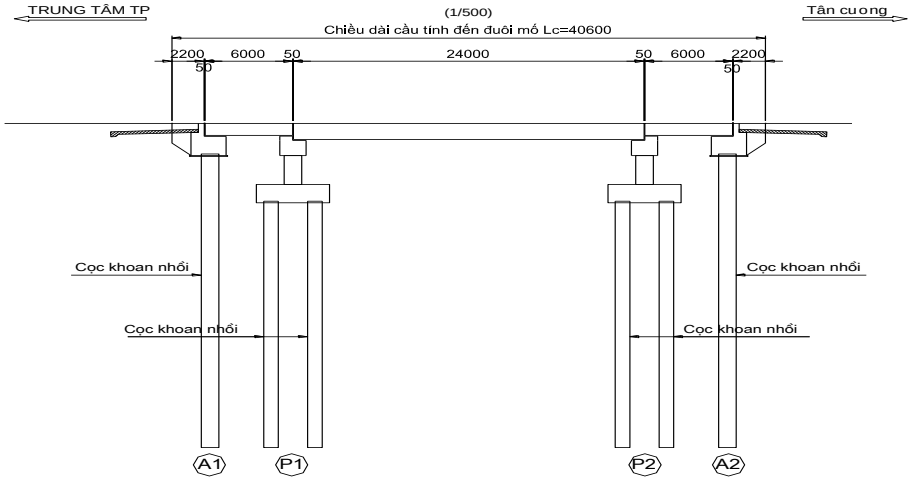
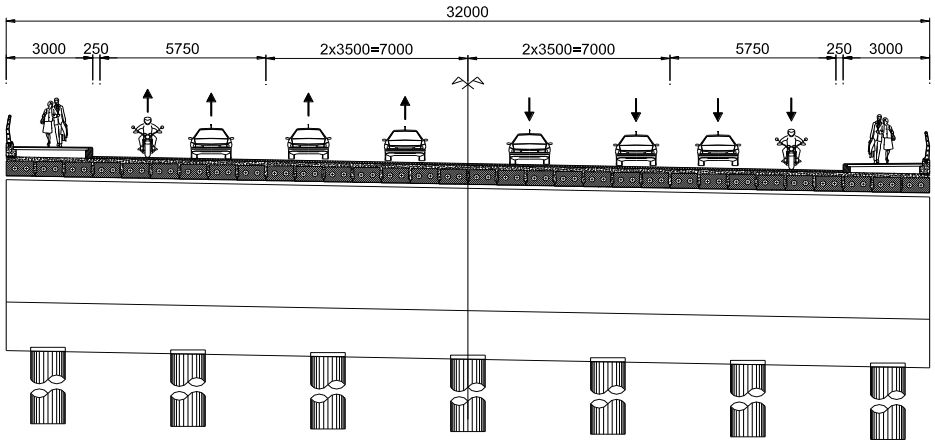
3.3.5. Rebuilding of Dan bridge

➢ **Structural alternatives of Dan bridge**

Two structural alternatives of Dan bridge have been considered and analyzed as the table below.

Table 43: Comparison of structural alternatives of Dan bridge

No.	Alternative 1	Alternative 2
1	Description of alternatives	
	• Specifications: - Demolition of existing bridge, - Construction of Super-T girder one span bridge - Length: 242.1m; - B=32m - Lanes: 4 lanes for motorized vehicles 4x3.5m, 2 combined lanes 2x5.75m - Safety lane: 2x0.25m - Sidewalks: 2x3m.	• Specification - Demolition of existing bridge, - Construction of Super-T girder one span bridge - Length: 240.6m; - B=32m - Lanes: 4 lanes for motorized vehicles 4x3,5m, 2 combined lanes 2x5,75m - Safety lane: 2x0,25m - Sidewalks: 2x3m.

	• Upper structure: including one span of Super – T girder • Substructure: includes two abutments of cast-in-site reinforced concrete. Foundation structure of drilled pile. • Cross section:   	• Upper structure: including 3 spans of pre-stressed reinforced concrete slab girder with length of L=24m and L=6m • Substructure: includes two abutments and two piers of cast-in-site reinforced concrete. Foundation structure of drilled pile. • Cross section:  

No.	Alternative 1	Alternative 2
2	**Technical comparison**	
	Meet technical requirements according to applicable standards.	Meet technical requirements according to applicable standards.
3	**Construction technologies**	
	Construction technologies are familiar to the national and international contractors	Construction technologies are familiar to the national and international contractors
4	**Aesthetics**	
	One-span bridge is more airy, the construction will less affect water supply stream for the city	Three-span bridge is not airy. During the construction will much affect water supply stream for the city
5	**Maintenance**	
	Lower cost of maintenance.	Higher cost of maintenance.
6	**Construction cost**	
	56,522 billion dong	52,142 billion dong

The alternatives are evaluated based on the density of the criteria and ranking according to the alternatives. In particular, density is evaluated based on the priority level of criteria. Since Dan bridge only serves the transport needs, the criteria given are considered equally. Total score of each alternative has been determined by of multiplication between density and rank.

Table 44: Comparison of alternatives basing ranking scores

Comparison criteria	Density	Structural alternatives			
		Alternative 1: *Super – T girder*		**Alternative 2:** *Pre-stressed reinforced concrete slab girder*	
		Rank	Score	Rank	Score
(1)	(2)	(3)	(4) = (2)*(3)	(5)	(6) = (2)*(5)
Specifications	20%	4	0.8	3	0.6
Construction technologies	20%	3	0.6	4	0.8
Aesthetics	20%	4	0.8	3	0.6
Maintenance	20%	4	0.8	3	0.6
Cost	20%	3	0.6	4	0.8
Total score			**3.6**		3.4

Basing on the above comparison table, Alternative 1 (Super – T girder bridge) has highest total ranking score, therefore, Alterative 1 has been recommended as research alternative for next phases of the subproject.

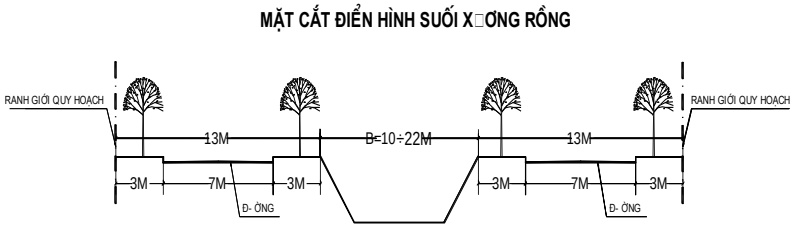
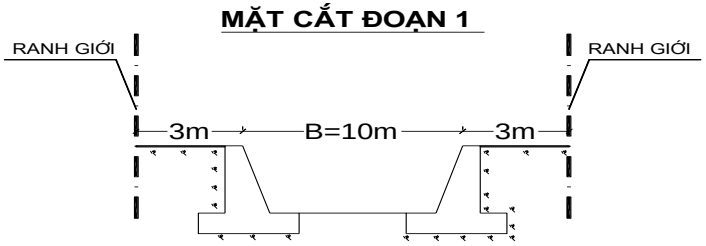
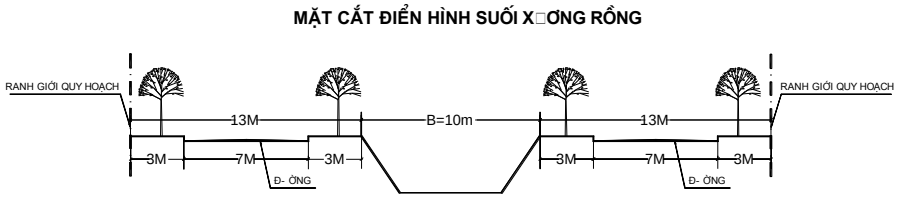
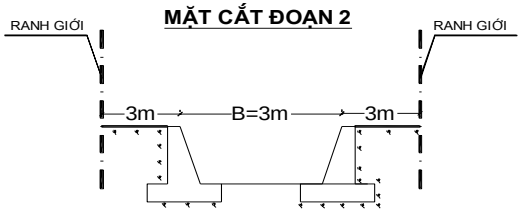
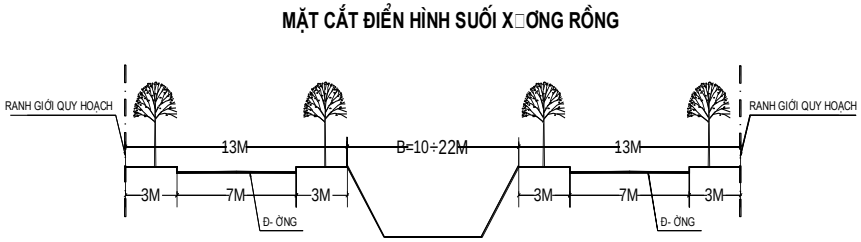
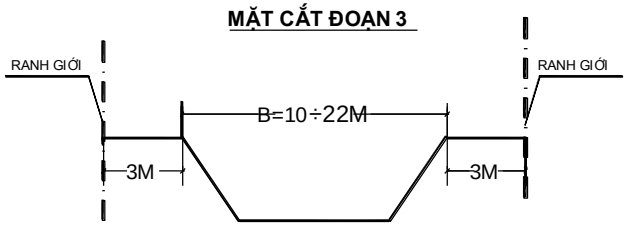
3.3.6. Upgrading and construction of Le Huu Trac road

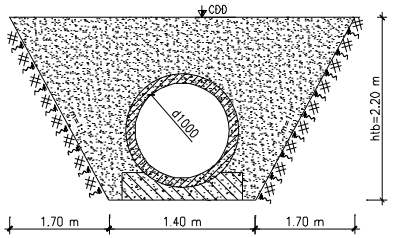
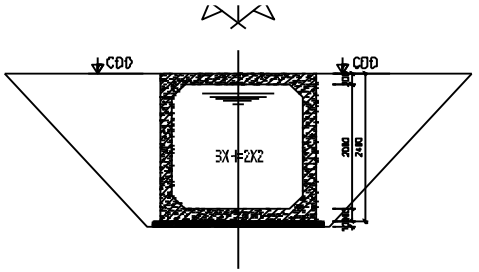
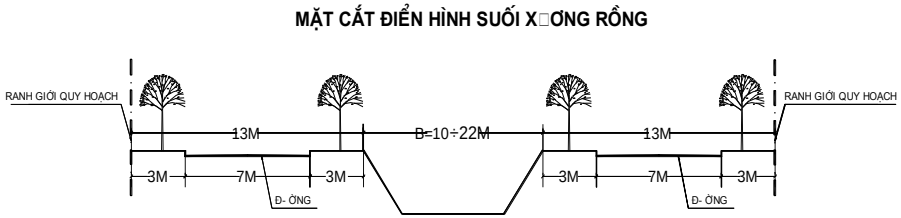
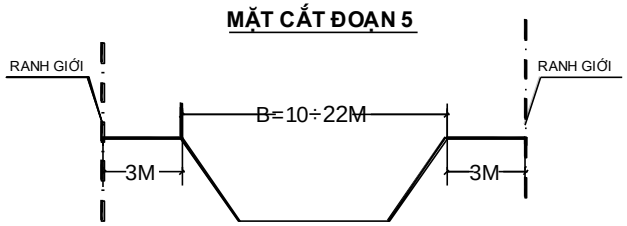
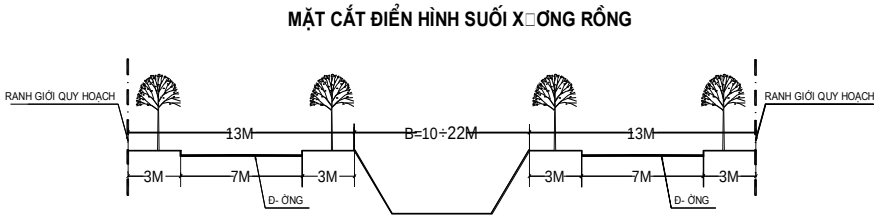
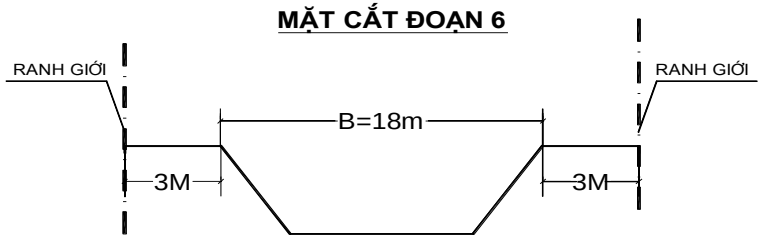
Le Huu Trac road is built according to the planning and has no alternative.

3.3.7. Rehabilitation of Xuong Rong ditch

Pursuant to the drainage planning for urban areas and industrial zones of Thai Nguyen province up to 2025 and vision to 2050, two preliminary design alternatives of Xuong Rong ditch's section have been reviewed and analyzed as follows:

Table 45: Comparison of cross-section alternatives for Xuong Rong ditch

<table>
<tr><th>NO.</th><th>Alternative 01</th><th>Alternative 02</th></tr>
<tr><td>1</td><td colspan="2">Design cross-section alternatives</td></tr>
<tr><td></td><td colspan="2">Section 1: From the start section (KS_1) to (KS_4)</td></tr>
<tr><td></td><td> 
</td><td> 
</td></tr>
<tr><td></td><td colspan="2">Section 2: From (KS_12) to (KS_15).</td></tr>
<tr><td></td><td> 
</td><td> 
</td></tr>
<tr><td></td><td colspan="2">Section 3: From (KS_4) to point (KS_22)</td></tr>
<tr><td></td><td> 
</td><td> 
</td></tr>
<tr><td></td><td colspan="2">Section 4: From Xuong Rong ditch (KS_4) to Gia Sang regulation lake</td></tr>
</table>

NO.	Alternative 01	Alternative 02
		
	Section 5: Bong Toi ditch from (KS_16) to (KS_22)	
		
	Section 6: Xuong Rong ditch from (KS_22) to Cau river (KS_26)	
		
2	**Technical solutions**	
	- Section1: From the start section (KS_1) to (KS_4) + Stone embankment is arranged along 02 stream banks, the stream has trapezoidal cross section. Width of stream is Bs=10m-22m, walkway is	- Section1: From the start section (KS_1) to (KS_4) + Vertical stone embankment, width of stream Bs=10m, walkway is arranged along 02 sides, road surface is Bd=3m. Scale of cross-section: Bs+Bdp+Bdt=10m+3m+3m=16m

NO.	Alternative 01	Alternative 02
	arranged along 02 sides, road surface is 7m, sidewalk is 2x3m. Scale of cross-section: Bdt + Bs + Bdp = 13m + (10m-22m) + 13m = 36m-48m - Section2: From (KS_12) to (KS_15). + Stone embankment is arranged along 02 stream banks, the stream has trapezoidal cross section. Width of stream is Bs=10m, walkway is arranged along 02 sides, road surface is 7m, sidewalk is 2x3m. Scale of cross-section: Bdt + Bs + Bdp = 13m + 10m + 13m = 36m - Section 3: From (KS_4) to (KS_22) + Stone embankment is arranged along 02 stream banks, the stream has trapezoidal cross section. Width of stream is Bs=10m-22m, walkway is arranged along 02 sides, road surface is 7m, sidewalk is 2x3m. Scale of cross-section: Bdt + Bs + Bdp = 13m + (10m-22m) + 13m = 36m-48m - Section 4: From Xuong Rong ditch (KS_4) to Gia Sang regulation lake: + Construction of culvert with the same diameter compared with that of the covered culvert (D1000). - Section 5: Bong Toi ditch from (KS_16) to (KS_22): + Stone embankment is arranged along 02 stream banks, the stream has trapezoidal cross section. Width of stream is Bs=10m-22m, walkway is arranged along 02 sides, road surface is 7m, sidewalk is 2x3m. Scale of cross-section: Bdt + Bs + Bdp = 13m + (10m-22m) + 13m = 36m-48m. - Section 6: Xuong Rong ditch from (KS_22) to Cau river (KS_26) + Stone embankment is arranged along 02 stream banks, the stream has trapezoidal cross section. Width of stream is Bs=10m-22m, walkway is arranged along 02 sides, road surface is 7m, sidewalk is 2x3m. Scale of cross-section: Bdt + Bs + Bdp = 13m + (10m-22m) + 13m = 36m-48m	- Section2: From road (KS_12) to (KS_15). + Vertical stone embankment, width of stream Bs=3m, walkway is arranged along 02 sides, road surface is Bđ=3m. Scale of cross-section: Bs+Bdp+Bdt=3m+3m+3m=9m - Section3: From (KS_4) to (KS_22) + Tilting roof stone embankment follows the current stream, shaping of some sections aims to create favorable conditions for the flow. Width of stream B=10m-22m, construction of concrete road is carried out along 02 sides with width of 3m. Scale of cross-section: Bdt + Bs + Bdp = 3m + 10m-22m + 3m = 16m-28m. - Section 4: From Xuong Rong ditch (KS_4) to Gia Sang regulation lake: + Construction of reinforced concrete box culverts with size of BxH=2mx2m. - Section 5: Bong Toi ditch from (KS_16) to (KS_22): + Tilting roof stone embankment follows the current status, the stream has trapezoidal cross section, shaping of some sections aims to create favorable conditions for the flow. Width of stream B=10m-22m, construction of concrete road is carried out along 02 sides with width of 3m. Scale of cross-section: Bdt + Bs + Bdp = 3m + 10m-22m + 3m = 16m-28m. - Section 6: Xuong Rong ditch from (KS_22) Cau river (KS_26) + Tilting roof stone embankment is arranged along 02 sides of the stream banks, the stream has trapezoidal cross section, shaping of some sections aims to create favorable conditions for the flow. Width of stream B=18m, of concrete road is carried out along 02 sides with width of 3m. Scale of cross-section: Bdt + Bs + Bdp = 3m + 10m-22m + 3m = 16m-28m

NO.	Alternative 01	Alternative 02
3	**Technical analysis**	
	Advantages: - Complying with the approved drainage planning. - Ensuring flood drainage. - Being convenient for travelling, development for attracting investment. - Being convenient for the operation of ditch and stream system. **Disadvantages** - Significant impact on compensation in case of site clearance and people's lives are affected. - Breaking of the detailed planning subproject.	**Advantages** - Complying with the current status of drainage. - Complying with drainage ditches which has been invested for construction. - Being convenient for travelling, development for attracting investment - Limiting the negative impacts **Disadvantages:** - The stream system and landscape walkway is not synchronized. - The detailed planning subproject requires adjustments.
4	**Social impacts**	
	Advantages: - Meeting the people's travel demand and creating a clean environment landscape for the area. - Minimizing damage caused by food and environmental sanitation issues **Disadvantages:** - Significant impact on compensation in case site clearance and people's lives are affected. - During the construction process, the lives of local people will be affected by factors including noise, dust, etc.	**Advantages:** - Insignificant impact on compensation in case of site clearance and people's lives are less affected. - Minimizing damage caused by food and environmental sanitation issues **Disadvantages:** - During the construction process, the lives of local people will be affected by factors including noise, dust, etc.
5	**Investment costs**	
	The investment cost is high, cost of compensation and site clearance is high.	The investment cost is low, cost of compensation and site clearance is low.

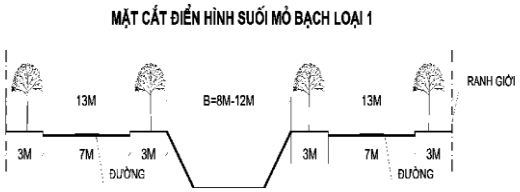
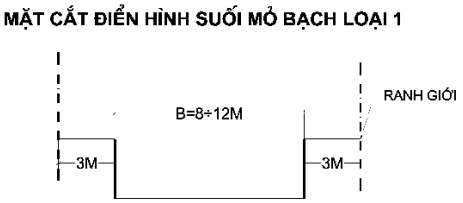
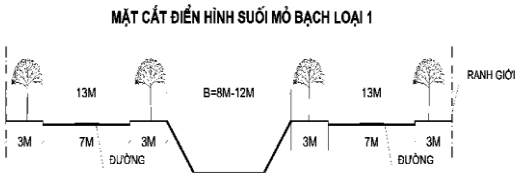
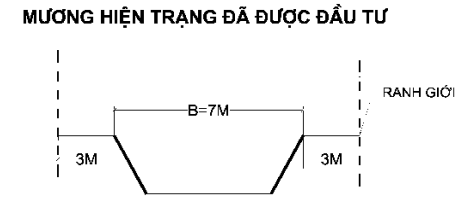
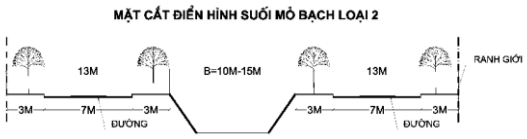
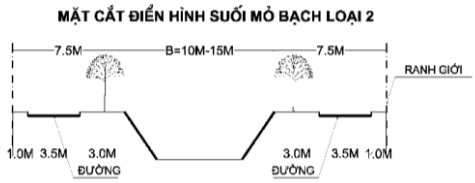
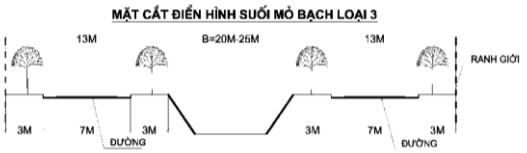
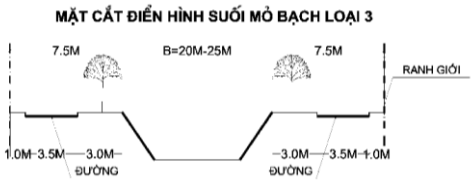
Based on the analysis, it is recommended that Alternative 02 is selected as the basic design alternative.

3.3.8. Mo Bach stream drainage ditch rehabilitation

➢ **Design alternatives of section**

Design alternatives of the ditch's section are determined preliminarily based on the planned section scope and results of survey and evaluation along the ditch. Two section alternatives are presented and analyzed in the table below.

Table 46: Comparison of design alternatives of Mo Bach stream's section

<table>
<tr><th>NO</th><th>Alternative 1</th><th>Alternative 2</th></tr>
<tr><td>1</td><td colspan="2">Designed cross-section alternatives</td></tr>
<tr><td rowspan="8"></td><td colspan="2">Section 1: From head of route (KS_1) to the bridge on the road Z115 (KS_13)</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td colspan="2">Section 2: From the road Z115 (KS_13) to the end of Residential area 4, Tan Thinh ward (KS_20).</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td colspan="2">Section 3: From the end of residential area 4 in Tan Thinh ward (KS_20) to the intersection with Mo Bach main stream (KS_25)</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td colspan="2">Section 4: From the intersection with Mo Bach main stream to the end of the route intersecting with Cau river.</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>2</td><td colspan="2">Technical alternatives</td></tr>
<tr><td></td><td>• The section from start section (Dan overpass) to the bridge on the road Z115 (KS_13):
- Stone embankment is arranged along 02 stream banks,
- The stream has trapezoidal cross section.
- Width of stream is Bs=8m-12m,</td><td>• The section from start section (Dan overpass) to the bridge on the road Z115 (KS_13):
- Keeping status-quo at the positions with existing stone embankment. Additional design for positions without stone embankment, vertical stone embankment,
- Width of stream is Bs=8m-12m.</td></tr>
</table>

NO	Alternative 1	Alternative 2
	- Walkway is arranged along 02 sides, road surface is 7m, sidewalk is 2x3m. - Scale of cross-section: Bđt + Bs + Bđp = 13m + (8m-12m) + 13m = 34m-38m	
	• The section from the road Z115 (KS_13) to the end of the residential area 4, Tan Thinh ward. - Stone embankment is arranged along 02 stream banks, - The stream has trapezoidal cross section. - Width of stream is Bs=8m-12m, - Walkway is arranged along 02 sides, road surface is 7m, sidewalk is 2x3m. - Scale of cross-section: Bđt + Bs + Bđp = 13m + (8m-12m) + 13m = 34m-38m.	• The section from the road Z115 (KS_13) to the end of the residential area 4, Tan Thinh ward. - Keeping status-quo of invested stream embankment. - The stream has trapezoidal cross section, Bs=7m, bottom width of 5m. -
	• From the end of the residential area 4 to Mo Bach stream main line: - Stone embankment is arranged along 02 stream banks, - The stream has trapezoidal cross section. - Width of stream is Bs=10m-15m, - Walkway is arranged along 02 sides, road surface is 7m, sidewalk is 2x3m. - Scale of cross-section: Bđt + Bs + Bđp = 13m + (10m-15m) + 13m = 36m-41m.	• From the end of the residential area 4 to Mo Bach stream main line: - Stone embankment is arranged along 02 stream banks. - Width of stream is B=10m-15m, - Concrete road is built in two sides with road's width of 3,5m, sidewalks of 3.0mx1.0m. - Scale of cross-section: Bđt + Bs + Bđp = 7.5m + 10m-15m + 7.5m = 25m-30m.
	• The intersection section with Mo Bach stream main line to Mo Bach bridge (intersects with NH 3): - Stone embankment is arranged along 02 stream banks, - The stream has trapezoidal cross section. - Width of stream is Bs=20m-25m, - Walkway is arranged along 02 sides, road surface is 7m, sidewalk is 2x3m. - Scale of cross-section: Bđt + Bs + Bđp = 13m + (20m-25m) + 13m = 46m-52m.	• The intersection section with Mo Bach stream main line to Mo Bach bridge (intersects with NH 3): - Stone embankment is arranged along 02 stream banks, - The stream has trapezoidal cross section. - Width of stream is Bs=20m-25m, - Walkway is arranged along 02 sides, road surface is 3.5m, sidewalk is 3mx1m. - Scale of cross-section: Bđt + Bs + Bđp = 7.5m + (20m-25m) + 7.5m = 35m-40m.
	• The intersection section with Mo Bach stream main line to Mo Bach bridge (intersects with NH 3): - Stone embankment is arranged along 02 stream banks, - The stream has trapezoidal cross section. - Width of stream is Bs=20m-25m, - Walkway is arranged along 02 sides, road surface is 7m, sidewalk is 2x3m. - Scale of cross-section: Bđt + Bs + Bđp = 13m + (20m-25m) + 13m = 46m-52m.	• The intersection section with Mo Bach stream main line to Mo Bach bridge (intersects with NH 3): - Stone embankment is arranged along 02 stream banks, - The stream has trapezoidal cross section. - Width of stream is Bs=20m-25m, - Walkway is arranged along 02 sides, road surface is 3.5m, sidewalk is 3mx1m. - Scale of cross-section: Bđt + Bs + Bđp = 7.5m + (20m-25m) + 7.5m = 35m-40m.

NO	Alternative 1	Alternative 2
3	**TECHNICAL ANALYSIS**	
	Advantages: - Complying with the approved drainage planning. - Ensuring flood drainage. - Being convenient for travelling, development for attracting investment. - Being convenient for the operation of ditch and stream system.	**Advantages** - Complying with the current status of drainage. - Complying with drainage ditches which has been invested for construction. - Being convenient for travelling, development for attracting investment
	Disadvantages - Significant impact on compensation in case of site clearance and people's lives are affected. - Breaking of the detailed planning.	**Disadvantages:** - The stream system and landscape walkway is not synchronized. - The detailed planning subproject requires adjustment.
4	**Social impacts**	
	Advantages: - Meeting the people's travel demand and creating a clean environment landscape for the area.	**Advantages:** - Insignificant impact on compensation in case of site clearance and people's lives are less affected.
	Disadvantages: - Significant impact on compensation in case site clearance and people's lives are affected. - During the construction process, the lives of local people will be affected by factors including noise, dust, etc.	**Disadvantages:** - Travelling is not continuous in entire route. Walkway cannot be arranged in the start section. - During the construction process, the lives of local people will be affected by factors including noise, dust, etc
5	**Investment cost**	
	The investment cost is high, cost of compensation and site clearance is high.	The investment cost is low, cost of compensation and site clearance is low.

Through the analysis, Alternative 2 has been recommended for the phase of feasibility study.

3.3.9. Construction of Huong Son and Phan Dinh Phung Kindergartens

Two pre-schools will be built according to the planning of Thai Nguyen city in accordance with the education and training development subproject of Thai Nguyen in the period 2016 – 2020 approved by Thai Nguyen City People's Committee on March 16, 2016. Thus, two items of construction of the pre-schools have no alternatives.

CHAPTER 4. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Environmental and social impacts assessment caused by activities of the Dynamic Cities Integrated Development Project - Thai Nguyen City Sub-project in the phase of preparation and implementation of construction and completion for putting into use aims to quantify impacts that may affect environment, society and human health during the process of the subproject implementation, at the same time, based on this basis, it is proposed measures to minimize the negative impact appropriately for this type of subproject. The scope of environmental and social impact assessment of the subproject includes the work items:

1. Construction of Southnorth road and Huong Thuong bridge with length of 3,200m (including Huong Thuong bridge), with width of 41.0m. The starting point is located at T-junction intersecting Southnorth road and August Revolution road; the ending point intersects with Huong Thuong- Chua Hang road in Huong Thuong commune.
2. Construction of Huong Thuong- Chua Hang road with length of 5,720m and width of 24.5m. The starting point connects with Southnorth road – Huong Thuong bridge in Huong Thuong commune, the ending point intersects with Chua Hang round island in Chua Hang ward.
3. Upgrading of Dong Bam residential site road with length of 3,400m, width from 21.0 m to 36.0 m. The starting point intersects with the National Highway 1B; the ending point intersects with the National Highway 17.
4. Upgrading of Dan bridge with length of 42.0m, width of 32.0m, access road at two heads of the bridge is 100m long for each side.
5. Upgrading of Le Huu Trac road with length of 1,700m and width of 27.0m. The starting point connects with the existing Le Huu Trac road; the ending point is located at intersection between 3/2 road and Thanh nien Xung phong road.
6. Improvement of drainage system for Xuong Rong ditch with length of 3,200m.
7. Improvement of drainage system for Mo Bach ditch with length of 3,854 m.
8. Construction of Huong Son kindergarten (area of 6,151m^2, scale of 24 classrooms and functional rooms).
9. Upgrading of Phan Dinh Phung kindergarten (area of 3,330 m^2, scale of 18 classrooms and functional rooms).

4.1. Positive impacts

The completed sub-project will receive positive changes including a more beautiful urban landscape, sustainable environment and favorable travel among areas of the city, contributing to promoting trade and creating a stable environment to attract foreign and domestic investment. The subproject will also create a motivation force for comprehensive economic, cultural and educational development. At the same time, living conditions of local people are improved in both quality and economic conditions of households.

❖ ***Positive impacts on the group of 4 traffic roads and 1 bridge works***

These work items will support the city to implement priority investments in transportation as identified in the general planning of Thai Nguyen City, Thai Nguyen province, by 2035. The investment of traffic infrastructure works shall:

- Connect the urban main vertical axis, promote connection between the new and existing densely populated areas in the city center, enhance connectivity among interregional cities and strengthen the public transport options of Thai Nguyen city;
- Form the main East-West transport axis connecting Hanoi - Thai Nguyen Expressway, National Highway 1B and the existing urban main axis road system of the city in order to reduce traffic flow, congestion and accidents;

- Connect between two banks of Cau river, create the motivation to attract investment, implement the planning and develop the new dynamic city to the East of Cau river in Thai Nguyen city;
- Create a motive force to shift the agricultural economic structure to services and trade in the areas along Cau river;
- Create opportunities to exploit agricultural land fund in the sub-project area, create motivation to increase productivity and change the form of agricultural production for local people. Minimize travel and transportation costs, thereby improve business production efficiency of local people and businesses;
- Increase accessibility of local residents in the area with services and facilities in the central areas of the city.

❖ ***Positive impacts on the group of 02 drainage system improvement works***

The works was built with the goal of solidifying the ditch bank in order to protect the flood drainage corridor from being re-encroached and connect appropriately and efficiently with the on-going subprojects on environmental hygiene and flood prevention with the purpose:

- Improvement and enhancement of environmental quality in the city center along Xuong Rong and Mo Bach ditches;
- Minimization of flooding in the rainy season and improvement of drainage capacity for the city's main drainage roads;
- Improvement of public health, living conditions of local people in the subproject area, limiting the risk of disease caused by wastewater;
- Improvement of infrastructure and landscape for the city, creating the motivation to form a civilized city, a clean, green and nice city.

❖ ***Positive impacts on the group of 02 kindergarten construction works***

The works is built to complete the kindergarten system of the city, contributing to gradually accomplishing the objectives set out in the subproject on development of education and training in Thai Nguyen city in the period 2016-2020.

- Address the current situation which is the lack of classrooms and at the same time facilitate school-age children to have easier and more convenient access to schools, increase the number of children attending school, especially for children at kindergarten age;
- Improve the kindergarten education infrastructure. New facilities will help to improve the quality of teaching and caring for the children, and children will be well cared for and well-educated in a better environment, thereby developing their thinking and physical abilities.

❖ ***Creation of motivation and development potential for Thai Nguyen city***

Location of the subproject in the regional driving force role: Thai Nguyen city acts as the economic, political and cultural center of Thai Nguyen province. Thai Nguyen is a development center for aspects including economy, culture, physical training and sports, education, science and technology, health care, tourism and services in the Northern Midlands and Mountains. This is one of the important advantages that Thai Nguyen city should use to create the driving force with the aim to exploit its strengths from the strongly-thriving economic triangle of Hanoi - Hai Phong - Quang Ninh. In the future, Thai Nguyen will be located in the economic growth quadrangle of Hanoi - Hai Phong - Quang Ninh - Thai Nguyen and developed along National Road 18 connecting Northwestern region, Viet Bac with Cai Lan deep port and National Highway 5 Expressway connecting with Hai Phong port.

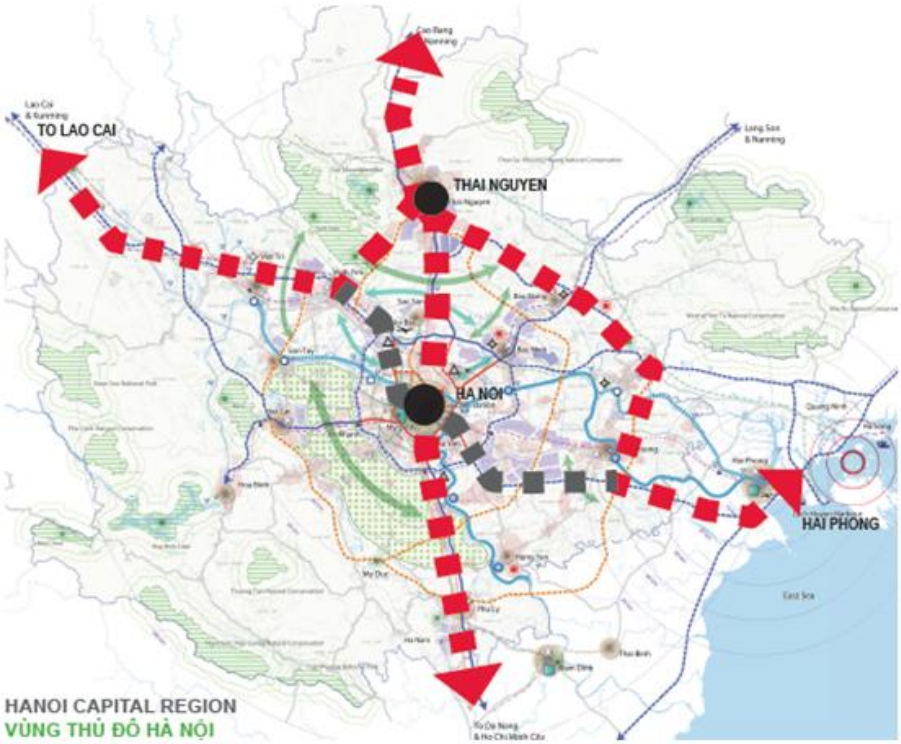


Figure 19: Location of Thai Nguyen province in regional connection

The investment in construction items of traffic roads, improvement of water drainage ditches, construction of kindergarten will contribute to improving infrastructure of the city, ensuring the capacity to serve the needs of production development, service trade and domestic life of local people. At the same time, it will also improve the environment landscapes, living conditions, strengthen connection among areas in the city and connect the regional transport, etc. Thereby, it can create a driving force for economic and social development, step by step stabilize the life of local people in Thai Nguyen city. The construction items creating motivation for socio-economic development through:

- ***Convenient transportation connection***

Thai Nguyen has a well-developed and convenient external transport network: (i) National Highway No.3 is not only the Southern gateway connecting Thai Nguyen with Hanoi, the provinces in Red River Delta and other provinces in the country, but also the Northern gateway through Bac Kan province to Cao Bang; (ii) National Highway 37, 1B, along with provincial roads and district roads system are important traffic circuits linking Thai Nguyen with neighboring provinces. As a result, construction of sub-project roads is a great motivation for socio-economic development and urban development in the Eastern region of Cau River (including Thai Nguyen City and surrounding areas), connecting the suburbs and the city center. At the same time, formation of roads connecting Thai Nguyen city and Hanoi satellite towns will stimulate the development of trade, financial services, inter-urban and inter-regional banks and premise to form a modern commercial and financial center.

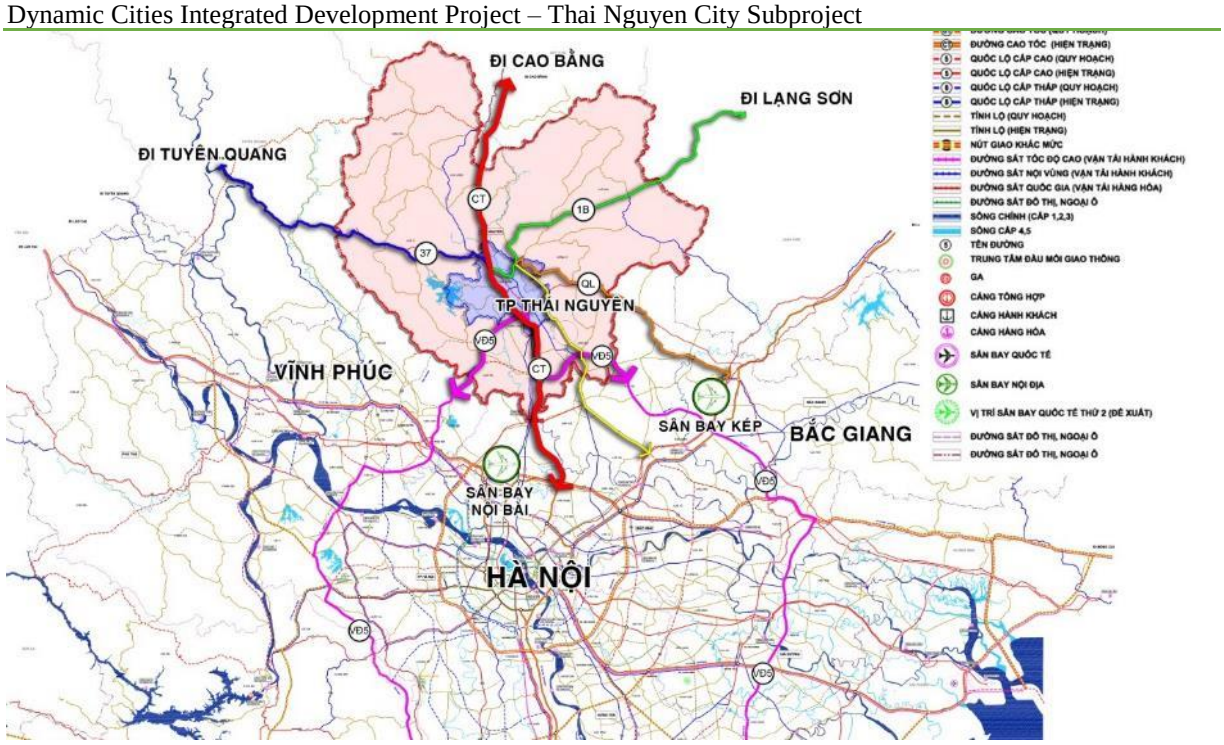


Figure 20: External traffic connection of Thai Nguyen City with the provinces in neighboring areas

- ***Creation of driving force to promote competitiveness of the province***

The improvement of traffic conditions, infrastructure of Thai Nguyen city contributes to improving business environment and attracting investment of domestic and foreign enterprises. Up to 2016, there were 677 off-budget investment subprojects with total investment of VND 143,000 billion. In terms of FDI investment attraction, there were 114 enterprises and 116 subprojects with total registered capital of USD 7,185 million and USD 6,432 million was disbursed in 2016. Favorable business environment and reasonable policies in supporting enterprises have been attracting businesses to invest in the province and it is an important driving force promoting the socio-economic development of the province in the next time.

4.2. Potential environmental and social impacts

Potential environmental and social impacts are screened in the Table 47 below.

Table 47: Level of negative impacts of the DCIDP - Thai Nguyen subproject

Components	*Physical*			*Biological*		*Social*				*Others*	
	Air, noise, vibration	***Soil, water***	***Solid waste, dredged sludge***	***Forest, natural ecosystem***	***Fish, aquatic life***	***Land acquisition, resettlement***	***Indigenous peoples***	***Physical cultural resources***	***Livelihood, community disturbance***	***Local flood, traffic, safety***	***Off-site impacts***
Items of bridges and roads: 01 bridge (L=42m) and 04 roads (L=13.82km). Total AHs are 1,098 households, including 123 relocated and 66 vulnerable households.											
Preparation	N	N	N	N	N	M	N	N	L	N	N
Construction	M	M	M	N	L	N	N	L	L	L	L
Operation	L	N	N	N	N	N	N	N	L	L	L
Remarks	- Medium and low impacts can be best addressed through ECOPs - Impacts on sensitive works. - Impacts on water environment. - Traffic interruption. - Risks of abutment subsidence during construction. - Impacts on groundwater quality during drilling phase. - Impacts on water transportation. - Impacts on agricultural production.										
02 works of rehabilitation of Mo Bach and Xuong Rong drainage ditches (L=7,054m). Total AHs are 240 households, including 10 relocated households and 7 vulnerable households.											
Preparation	N	N	N	N	N	M	N	N	L	N	N
Construction	M	M	M	N	L	N	N	L	L	L	L
Operation	N	L	N	N	N	N	N	N	L	L	N
Remarks	- Medium and low impacts can be best addressed through ECOPs. - Impacts on water environment. - Community disturbance and traffic issues. - Risks of landslide and subsidence during construction. - Malodor and exhaust gas caused by dredging. - Impacts on agricultural production.										

Components	*Physical*			*Biological*		*Social*				*Others*	
	Air, noise, vibration	***Soil, water***	***Solid waste, dredged sludge***	***Forest, natural ecosystem***	***Fish, aquatic life***	***Land acquisition, resettlement***	***Indigenous peoples***	***Physical cultural resources***	***Livelihood, community disturbance***	***Local flood, traffic, safety***	***Off-site impacts***
02 works of kindergartens (S=9,451m^2, a total of 42 classrooms and functional rooms). A total of 9 AHs, no relocated household or vulnerable household.											
Preparation	L	L	L	N	N	M	N	N	L	N	N
Construction	M	M	M	N	L	N	N	L	L	L	L
Operation	N	L	N	N	N	N	N	N	L	L	N
Remarks	- Medium and low impacts can be best addressed through ECOPs. - Concerns about road traffic safety. - Risks of local community's safety and health. - Concerns about existing children of Phan Dinh Phung kindergarten.										
Notes: (1) The following criteria are used for the assessment of level of impacts: None (N) – no impact; Low (L) – Small works, minor impacts, localized, reversible, temporary; Medium (M) –Small works in urban/sensitive areas, medium scale works with moderate impacts of which most are reversible, reducible and manageable, localized, temporary; High (H) –Medium scale works in small urban /sensitive area, large scale works with significant impacts (socially and/or environmentally) of which many are irreversible and require compensation; Both M and H need monitoring and implementation of the mitigation measures as well as adequate institutional capacity on safeguard. (2) Small and medium scale works, most impacts are localized, temporary, and can be mitigated through the application of good engineering and construction management practices and with close supervision and monitoring and close consultation with local communities.										

4.3. Impacts and risks during the pre-construction phase

Generic impacts during preparation include (1) land acquisition; (2) safety risks associated with unexploded ordnance (UXO). As the sub-project is constructed on the successive basis or due to the short preparation time, impacts caused by the dismantling, site clearance, dredging, embankment or camp preparation will be associated with the construction phase and presented in the next part.

4.3.1. Impacts of land acquisition

1. Affected area

The subproject consists of 9 work items (construction of 4 roads, construction of one bridge, rehabilitation of two drainage ditches and construction of 2 kindergartens). It is expected that the Subproject will require acquisition of 491,642 m^2 of land. Details of level of impacts of land acquisition of each works are shown in Table 48 below.

Table 48: Land area affected by subproject implementation

No.	Name of works	Affected land area (m^2)										Total affected land area (m^2)
		Residential land	Annual crops land	Perennial crops land	Paddy land	Production forest land	Aquaculture land	Organizations' land	Public land	Traffic and irrigation land	Unused flat land	
1	Southnorth road & Huong Thuong bridge	30,828	14,367	5,035	57,047	-	1,679	-	605	20,335	1,852	131,747
2	Huong Thuong - Chua Hang road	29,874	19,434	17,871	37,541	3,743	1,773	-	-	31,137	3,158	144,530
3	Dong Bam residential area road	3,263	11,897	-	12,662	-	229	18,338	319	10,673	11	57,392
4	Dan bridge	235	105	-	-	-	-	-	-	6,296	127	6,763
5	Le Huu Trac road	14,259	452	2,845	6,951	10,663	-	-	-	12,638	19	47,826
6	Xuong Rong drainage ditch	2,846	125	149	-	-	-	82	-	15,855	-	19,056
7	Mo Bach stream drainage ditch	1,130	3,518	7,506	2,507	94	-	5,041	972	48,573	5,505	74,847
8	Huong Son kindergarten	-	-	389	267	-	98	5,397	-	-	-	6,151
9	Phan Dinh Phung kindergarten	80	-	436	-	-	-	2,814	-	-	-	3,330
	Total	**82,514**	**49,897**	**34,230**	**116,974**	**14,500**	**3,779**	**31,672**	**1,896**	**145,507**	**10,672**	**491,642**

Source: Resettlement Action Plan of the Subproject, 2017

Notes:

- Types of public land, traffic, irrigation land and unused flat land under the management of commune/ward People's Committees, and not eligible for compensation and assistance;
- The affected public land is cemetery land;
- Organizations' land is the land that has been allocated to state organizations, enterprises (empty land has not been used by organizations).
- Agricultural land includes types of land for planting annual crops, perennial crops, paddy land, productive forest land and aquaculture land.

Unit: %

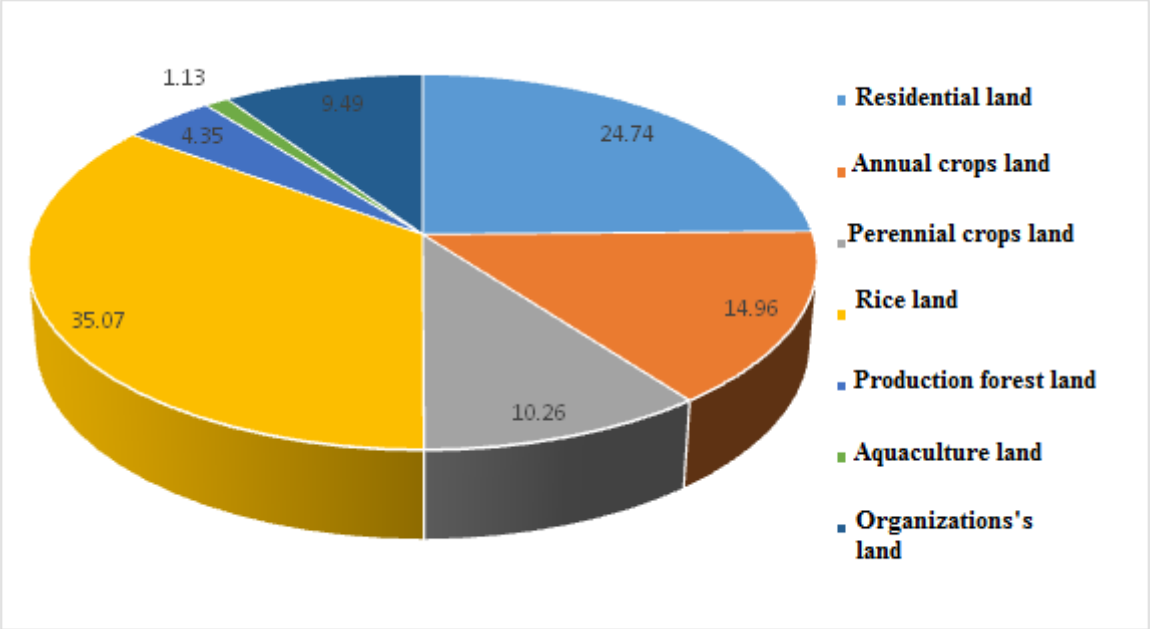


Figure 21: Rate of land occupancy of the Subproject

According to Table 48 and Figure 21, a total of seven types of land are occupied for the construction of the subproject works affecting the local communities. Of which the paddy land occupies the most (35.07%), followed by residential land (24.74%), annual crops land (14.96%) and perennial crops land (10.26%). The types of production forest land, aquaculture land and organizations' land occupied the lowest proportion (<10%). According to the scale, objectives and characteristics of each group of works, there will be diverse impacts:

- For traffic works: Mostly newly-built roads are used to connect the residential areas, thus affecting mainly agricultural land (especially paddy land, accounting for from 43.19% to 59.30 % of total affected area).
- For the works of rehabilitation of drainage system: They will mainly affect the traffic and irrigation land (Xuong Rong ditch will acquire 83.20% while Mo Bach ditch will acquire 64.90% of total affected land area).
- For Huong Son and Phan Dinh Phung kindergartens, two kindergartens will occupy mainly land of the organizations, about 85% of the total land area affected.

Out of 9 construction items, the works of Southnorth road and Huong Thuong bridge, Huong Thuong - Chua Hang road and Le Huu Trac road have the most land occupancy (residential land accounts for 20-30% agricultural land accounts for 43-60% of the total affected land area). This indicates that the households affected by these three works have a high level of disturbance in daily life and livelihoods. In contrast, for the works of Dan bridge, Huong Son and Phan Dinh Phung kindergartens, affected households have little disturbance in daily life and livelihoods (residential land only accounts for less than 3.5%, agricultural land only accounts for about 13% of total affected area).

Impacts due to land occupancy are assessed as "MEDIUM" due to: (i) Although these impacts are long-term, the extent of impacts is local, concentrated in 14 wards / communes of Thai Nguyen city; (ii) In the future, after the works are put into operation, the value of land use in the adjoining areas is increased; (iii) In addition, these impacts can be mitigable through the compensation, support and resettlement, livelihood restoration and other support measures ... implemented through the Resettlement Action Plan of the Subproject.

2. Affected households

A total of AHs of the Subproject is 1,347 households, of which 1,317 households are affected on land and 30 households are affected on graves (58 graves to be affected and relocated).

Out of 1,317 households affected on land:

- 415 households are affected on residential land, including 133 relocated households;
- 862 households are affected on agricultural land (paddy land, crop land), of which 299/862 households are severely affected (of which 267/299 households lost 20% or more of total agricultural production land and 32/299 households fall into vulnerable groups, losing 10% or more of total agricultural landholding);
- 13 households are affected on aquaculture land (including ponds, small lakes of households for raising fishes on self-sufficient basis rather than commercial purposes);
- 27 households are affected on production forest land (planting acacia, melaleuca).

Out of 1,347[9] AHs, 70 households are vulnerable ones (including 13 poor households, 42 policy households, 4 elderly households and 14 households headed by female with dependents). 74 households are affected on business (small-scaled business of daily consumers such as cake, candy, fruit, vegetables, and so on. No ethnic minority household is affected by the construction of work items under the Subproject.

Details of households affected by each works are shown in Table below.

[9] One household may suffer one and/or more types of impacts;

Table 49: Number of AHs of Subproject

No.	Name of works	Total AHs	Households affected on residential land	Households affected on agri. land		HHs affected on aquaculture	HHs affected on production forest land	HHs affected on graves	HHs affected on structures	HHs affected on crops and trees	Vulnerable HHs	Affected business HHs	Relocated HHs
				Partially [10]	Severely[11]								
1	Southnorth road & Huong Thuong bridge	448	139	178	115	8	-	8	139	440	22	57	80
2	Huong Thuong - Chua Hang road	321	61	150	102	3	5	-	61	321	17	8	10
3	Dong Bam residential area road	137	8	93	30	1	-	5	8	132	20	-	3
4	Dan bridge	7	6	1	-	-	-	-	6	7	-	-	-
5	Le Huu Trac road	185	117	12	35	-	21	-	117	185	7	9	30
6	Xuong Rong drainage ditch	57	47	9	1	-	-	-	47	57	3	-	6
7	Mo Bach stream drainage ditch	183	36	120	9	-	1	17	36	166	4	-	4
8	Huong Son kindergarten	6	-	-	5	1	-	-	-	6	-	-	-
9	Phan Dinh Phung kindergarten	3	1	-	2	-	-	-	1	3	-	-	-
	Total	**1,347**	**415**	**563**	**299**	**13**	**27**	**30**	**415**	**1,317**	**73**	**74**	**133**

Source: Resettlement Action Plan of the Subproject, 2017

[10] Partially affected HHs are those losing less than 20% of total agricultural production land area.

[11] Severely-affected HHs are those losing 20% or more (10%or more for vulnerable HHs) of toal agricultural production landholding.

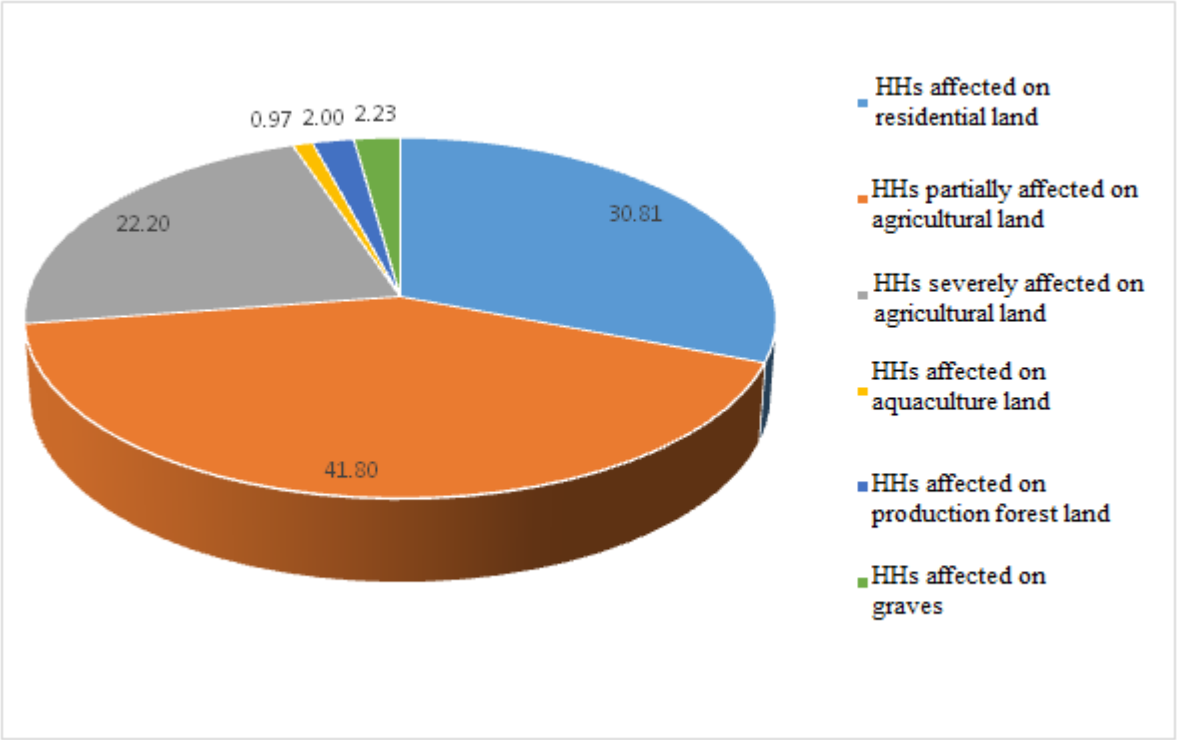


Figure 22: Proportion of AHs of the Subproject

Table 49 and Figure 22, the most important subproject to 862 households affected agricultural land (accounting for 64%), followed by 415 households affected by residential land (30.81%). under the influence of less than 6%. Although this effect has been going on for a long time and affected households in 14 wards / communes of TP Nguyen City, however, this impact is assessed as "MEDIUM" due to:

- The number of affected households only accounts for 3.23% of total households in 14 wards/communes (total number of affected households by DCIDP Thai Nguyen is 1,347 households while total number of households in 14 communes/wards is 41,698 households).
- The number of households affected on residential land and structures (housing, kitchens, yards, walls, gate piers) is 415 households, accounting for 30.81% of total Ahs. The demolition of housing, kitchens and walls, and relocation of housing, temporary works will cause disturbance of life of 415 households, especially 133 households that have to be relocated.
    + Affected households without relocation will have to repair and rebuild their houses and other structures.
    + Relocated households will be entitled to compensation and self-relocation option or arranged resettlement in the residential sites such as the residential area 11 of Thinh Dan ward, Dong Bam residential area, Tan Lap residential area and Tuc Duyen ward residential area.
- The number of households affected on agricultural land is 862 households. These households are affected on livelihoods and agricultural production interruption, especially 299 households severely affected on agricultural land. However, the extent of impacts on farming households is insignificant. Almost households affected on agricultural land have enough land for planting paddy, crops (vegetables, bean, corn, potatoes, cassava, etc.) and fruit trees. Furthermore, in recent years, the income from agriculture in the household income structure has trend of decreasing.
- The number of households affected on aquaculture and production forest land is 13 and

27 households respectively, accounting for 0.97% and 2.0% of total affected households. The impacts on these households is low due to aquaculture, productive forest plantation are secondary sources of livelihood, accounting for a small proportion of the income of these households. Moreover, they are only affected a small part of the area of aquaculture land and production forest land.

According to the scale, types and investment objectives of the work items, newly-built roads have a higher number of affected households (accounting for about 80.99%) than those of the rehabilitated drainage ditches (accounting for 17.82%) and construction of two kindergartens (accounting for 1.19%). Technical alternatives, construction methods, local factors, and consultations with local authorities and people have been and will be considered in detail in the next phases to minimize the number of households affected by the work items. At the same time, affected households will be compensated for land, trees, structures ... and allowances (such as relocation allowance, livelihood restoration allowance, job changing, etc.) in accordance with the Resettlement Action Plan of the Subproject.

3. Impacts on housing and structures

The implementation of the subproject will affect 415 households on housing and structures, of which: (i) 282 households are affected partly on housing or structures; (ii) 133 households are totally affected on housing and structures and need to be relocated. Table 49 summarizes the types of housing and structures affected by each work item.

Table 50: Summary of impacts on housing and structures

No.	Works	HHs affected on housing and structures (HHs)	Relocated households (HHs)	Affected structures								
				Houses with two storages or more (m^2)	One-storage house (m^2)	Grade 4 house (m^2)	Kitchen (m^2)	Auxiliary works (m^2)	Walls (m^2)	Yard (m^2)	Water tank (m^2)	Gate pier (m^2)
1	Southnorth road & Huong Thuong bridge	139	80	2,149	1,800	438	166	101	435	497	76	26
2	Huong Thuong - Chua Hang road	61	10	729	1,767	186	126	66	210	317	97	37
3	Dong Bam residential area road	8	3	235	248	56	18	50	65	71	34	6
4	Dan bridge	6	-	-	-	-	-	-	6	53	-	8
5	Le Huu Trac road	117	30	2,410	532	-	46	61	180	180	13	36
6	Xuong Rong drainage ditch	47	6	266	327	58	27	23	50	-	9	-
7	Mo Bach stream drainage ditch	36	4	252	325	82	18	31	66	37	15	6
8	Huong Son kindergarten	-	-	-	-	-	-	-	34	-	-	-
9	Phan Dinh Phung kindergarten	1	-	-	-	-	-	8	23	-	8	-
	Total	**415**	**133**	**6,042**	**4,999**	**820**	**400**	**340**	**1,069**	**1,155**	**252**	**119**

Source: Resettlement Action Plan of the Subproject, 2017

According to Table 49, the works of Southnorth road and Huong Thuong bridge will cause most impacts on housing and structures (houses account for 36.99%, structures account for 39.01%), followed by the works of Le Huu Trac road (houses account for 24.8%, structures account for 15.47%), Huong Thuong – Chua Hang road (houses account for 22.61%, structures account for 25.58%). Whereas other work items, the proportion of housing and structures to be affected is lower than 10%.

Partial or whole demolition of housing and structures will affect psychology of affected households, cause daily life interruption. However, the impacts are assessed as "MEDIUM" and are mitigable through the implementation of the Resettlement Action Plan of the Subproject.

4. Impacts on livelihoods

According to the socio-economic survey results, 41.1% of households have primary income from agricultural production, The Subproject will affect livelihoods of 1,317 households affected on agricultural land, trees and crops. Total affected agricultural land area is 219,383 m^2, of which 1,865 fruit trees of kinds (including longan, grapefruit, banana, etc.); 3,318 timber trees (Acacia, Melaleuca, Eucalyptus...). Table 51 below summarizes agricultural land area and trees to be affected by each work item.

Table 51: Summary of affected trees and crops

No.	Works	AHs	Affected production land area (m^2)	Timber trees (trees)	Fruit trees (trees)
1	Southnorth road & Huong Thuong bridge	440	78,128	712	456
2	Huong Thuong - Chua Hang road	321	80,362	890	681
3	Dong Bam residential area road	132	24,788	146	90
4	Dan bridge	7	105	2	1
5	Le Huu Trac road	185	20,911	584	149
6	Xuong Rong drainage ditch	57	274	45	41
7	Mo Bach stream drainage ditch	166	13,625	925	428
8	Huong Son kindergarten	6	754	6	8
9	Phan Dinh Phung kindergarten	3	436	8	11
	Tổng	**1,317**	**219,383**	**3,318**	**1,865**

Source: Resettlement Action Plan of the Subproject, 2017

According to Table 51, when construction of the items of Southnorth, Huong Thuong bridge, Huong Thuong - Chua Hang road, it will cause higher impacts on income and livelihoods than other work items because the affected production land area and trees are higher than others. The occupancy rate of agricultural land of the work items of Southnorth road and Huong Thuong bridge and Huong Thuong – Chua Hang road is 35.61% and 36.63%, respectively. The occupancy rate of remaining 7 work items is less than 30% (of which Dan bridge has the smallest occupancy rate of 0.05%).

Households likely to be negatively affected or at risk of poverty due to loss of productive land include: (i) households headed by women (unmarried, widowed or disabled husband) with dependents, (ii) the disabled (with no working capacity), the elderly without support; (iii) the poor according to the criteria of the Ministry of Labor, War Invalids and Social Affairs (with poor household certificates); (iv) landless households, (v) ethnic minority groups living separately, and (vi) policy households with war invalids and martyrs, heroic Vietnamese mothers or revolutionaries.

Households are insignificantly affected on production land area: (i) 563 marginally affected

households, losing less than 20% of production land area, account for 41.8%; (ii) 267 severely affected households, losing more than 20% of production landholding, accounting for 19.82%; (iii) 32 vulnerable households severely affected, losing more than 10% of production landholding, accounting for 2.38%; (iv) about 36% households are affected on trees and crops. Moreover, these impacts are scattered in 14 communes/wards of Thai Nguyen city, focusing on the initial phase of the subproject, then these impacts will be decreased because affected households will find out new livelihood sources and stabilize their lives. At the same time, in addition to compensation payments for affected land, trees and crops, affected households are also entitled to livelihood restoration allowances (subsistence allowance, production stabilization allowance, vocational training, job changing and job creation allowance). Therefore, these impacts are assessed as "MEDIUM" and are mitigable through the implementation of Resettlement Action Plan of the Subproject.

5. Impacts of production forest land acquisition

Construction of 3 out of 9 work items under the Subproject will affect household's production forests, including (i) Huong Thuong – Chua Hang road; (ii) Le Huu Trac road, and (iii) Mo Bach ditch.

Total affected production forest land area is 14,500 m^2, owned by 27 households. Namely:

Table 52: Affected production forest land area

No.	Work items	Affected area (m^2)	No. of affected households (HH)
1	Huong Thuong – Chua Hang road	3,743	5
2	Le Huu Trac road	10,663	21
3	Mo Bach ditch	94	1
	Total	14,500	27

Acquisition of production forest land for the construction of the Subproject's works will affect livelihoods and production practices of the affected households. This impact will be long-term but mainly on the first 3-6 months after acquisition of production forest land. At the same time, this impact is assessed as LOW, because: (i) The occupied area of production forest is minor (about 2.95% of the total land area occupied by the subproject; (ii) main trees are acacia and cajeput of 1-2 years old, so the economic value is not high, (iii) The area of occupied productive forest land of each household is less than 10%; (iv) According to the socio-economic survey results, in addition to sources of income from production forests, local people also earn income from other agricultural production activities or work as hired laborers. These impacts are mitigable through the compensation and support policies mentioned in the Resettlement Action Plan of the subproject.

Figure 23: Current status of production forest in the Subproject area

6. Impacts on relocated households

Relocated households will have psychological effects and changes in community relationships. The relocated households need time to adapt to the new living environment with access to new

services such as health care, markets, schools and so on. Other social relationships will gradually develop due to the relocation to the new residence places. According to Table 49, the number of relocated households of the Subproject is 133 households (accounting for 9.87% of total affected households) due to construction of 4 roads and rehabilitation of 2 drainage ditches. Out of 6 works involved in relocated households, the item of Southnorth and Huong Thuong bridge will cause most households to be relocated (80 relocated households, accounting for 60.15%), followed by the item of Le Huu Trac road (30 relocated households, accounting for 22.56%). Whereas 4 remaining works have relocated households of less than 10%. Relocated households will be entiled to compensation payments or self-relocation option at the existing residence place or arranged to resettle in the resettlement sites such as the residential area 11 in Thinh Dan ward; (ii) Dong Bam ward residential area, (iii) Tan Lap residential area, (iv) Tuc Duyen ward residential area. These residential areas are located about 1-5km away the city center and easily accessible through the roads. The residential areas are developed with full infrastructures such as power supply, water supply and drainage, health care centers, markets and schools in a distance from 0.5km to 2km. Daily activities of relocated households will be ensured. Therefore, these impacts are assessed as "MEDIUM" and are mitigable through allowances to relocated households (including relocation allowance, house rent allowance or self-relocation allowance) in compliance with the Resettlement Action Plan of the Subproject.

7. Impacts on business

The Subproject will affect 74 business households (at 3 items of Southnorth road, Huong Thuong bridge, Huong Thuong – Chua Hang road and Le Huu Trac road). During the construction, three roads will directly affect 74 households due to interruption of business activities (small-scale trading of daily consumers such as cake, candy, fruits, vegetables, etc.). However, these impacts are assessed as "LOW" due to: (i) small scale of trading; (ii) this is only secondary income source of households while their primary income source comes from agricultural production, public servants and cadres; (iii) households are eligible to compensation payments and allowances due to loss of income sources and business (production/business stabilization allowance, transportation allowance, job interruption allowance).

Figure 24: Status of production and business at the subproject area

The business interruption will take place during the construction, in local manner (within households). However, when the works is put into operation, it will contribute into development of household business and these impacts are mitigable through the Resettlement Action Plan which has been prepared separately for the Subproject.

8. Impacts on spirituality due to relocation of graves

The Subproject will require relocation of 58 graves of 30 households under 3 work items, including the Southnorth road and Huong Thuong bridge (15 graves), Dong Bam residential area road (10 graves) and rehabilitation of Mo Bach stream drainage ditch (33 graves). The relocation of all graves is relatively complicated and costly. For Vietnamese people, graves are

religious and spiritual issues, so the relocation should be done carefully. The cost of relocation not only includes the costs of exhumation, transporting and newly-building graves, but also the costs of worship according to the spiritual life of each locality.

Waste arising from the relocation of graves includes excavated soil and buried materials. Soil can be used for filling the holes. Buried materials should be collected and buried on site to avoid injuries or spreading pathogenic bacteria. The amount of waste from relocation of graves is minor, and can be collected and easily treated.

Impacts by relocation of graves are assessed as "MEDIUM" and local within households and scattered in 5 wards/communes under 3 work items of the Subproject. The duration of impacts is short; mainly take place in the pre-construction phase. These impacts are mitigable through relocation of graves within the cemeteries of the wards/communes and in close consultation with affected households to ensure appropriateness with the local customs. These negative impacts are mitigable through the Resettlement Action Plan which has been prepared for the subproject.

Figure 25: Some images of affected graves

9. Impacts on vulnerable households

The land acquisition for construction of the work items under the Subproject will affect 73 vulnerable households[12], accounting for 5.42% of total AHs (These work items include construction of 4 roads, and rehabilitation of Mo Bach and Xuong Rong ditches). In terms of income, their restoration ability will be slower than that of other households due to their limited internal resources (finance, labor, knowledge or skills) - requiring more assistances. However, these impacts are assessed as "LOW" because, in addition to compensation payments and allowances as stipulated in the subproject policies, the vulnerable households will be entitled to additional allowances to facilitate them to restore their livelihoods. These allowances include (i) provision of an apartment in the form of purchase or renting for residence (depending on the choice of the AHs); or (ii) cash assistance equivalent to 30 kg of rice/person/month within 6 months. The assistance policies for vulnerable groups will be implemented through the Resettlement Action Plan which has been prepared separately for the subproject.

10. Change of land use purposes

According to Table 48, land use purpose will be most changed due to construction of 4 roads, including Southnorth road, Huong Thuong – Chua Hang road, Dong Bam road and Le Huu Trac road as well as rehabilitation of Xuong Rong and Mo Bach ditches. Total occupied land

[12] ***Vulnerable groups****:* Groups of people who might suffer disproportionately or face the risk of being further marginalized by the effects of resettlement and specifically include: (i) women headed household (single, widow, disabled husband) with dependents, (ii) disabled (loss of working ability), the elderly alone, (iii) poor people according to the criteria issued by the MOLISA (with poor household certificates), (iv) the landless household, and (v) ethnic minorities and (vi) policy households such as War invalids and martyrs, heroic Vietnamese mothers and revolutionaries

area of these 6 works is 47.54 ha, including 8.22 ha of residential land, 21.81 ha of agricultural land and the rest of traffic, irrigation and public land. The Subproject's occupancy of residential land and agricultural land will change the land use structure at the locality, affecting income sources and livelihoods of affected households. However, these impacts are assessed as "LOW" because: (i) land use structure at the subproject area has shifting trends of increase in density of the service-industry and decrease in density of the agricultural sector; (ii) after the works are put into operation, value of land surrounding the works will be increased (from agricultural land into urban residential land); (iii) easier access, promoting local economic development.

The positive impacts brought by the Subproject are much higher than the negative impacts. These negative impacts are mitigable through the Resettlement Action Plan which has been prepared for the Subproject.

4.3.2. Unexploded Ordnance-related Safety Risks

1. Risks of no clearance of unexploded ordnance (UXO)

If the subproject does not conduct demining of unexploded ordnance (UXO), the risks that may occur during the construction phase of major work items are the risks of explosion of unexploded ordnance from the war. The objects are directly affected are workers, local people and surrounding infrastructure. These impacts are assessed as "HIGH" and last long-term, affecting the psychology, health, properties and life of workers and people surrounding the incident area. At the same time, the impacts caused by UXO explosion are on large scale, affecting the air, causing soil degradation. However, these impacts are mitigable through clearance of unexploded ordnance and explosives conducted by the functional units.

2. Risks from demining

In case the demining for the work items (4 roads including the Southnorth road, Huong Thuong - Chua Hang road, Dong Bam road, Le Huu Trac road and rehabilitation of Xuong Rong ditch, Mo Bach ditch), risks can occur for deminers who are directly conducting the demining of UXO. The demining may cause explosions of explosive materials due to improper techniques of demining, causing dangers to the lives of the clearers. These impacts are assesses as "HIGH", but are mitigable because the demining will be conducted by a military unit with full functions, technical facilities, qualifications and experiences in demining.

Figure 26: Illustrative images of demining

Therefore, the demining is important to avoid the potential threats to the surrounding infrastructure and the safety of residents and workers. For subprojects, UXO should be carefully considered and demined before commencement of construction activities. Impacts from UXO have a significant negative impacts on health, life and infrastructure if mitigation measures are not taken, with high risks to health, life and infrastructure. Demining must be completed prior to commencement of construction activities.

4.4. Impacts and risks during the construction phase

Activities to be conducted during the construction of work items under Thai Nguyen City Subproject include:

- Leveling, building workers' camps and on-site offices;
- Operations of machinery and workers;
- Transportation, gathering of materials and fuel for construction;
- Dredging 02 drainage ditches, Xuong Rong and Mo Bach;
- Excavation and backfilling, foundation for roads, bridge and 02 kindergartens - Huong Son, Phan Dinh Phung;
- Drilling bored piles, construction of abutments and piers of Dan bridge, Huong Thuong bridge, Mo Linh 1/2 bridge;
- Pile driving/expressing for embankment reinforcement of Xuong Rong and Mo Bach ditches;
- Backfilling, site reinstatement, paving roofs of Xuong Rong ditch, Mo Bach ditch and bridges;
- Spreading layers of aggregate rubble, or asphalt for roads;
- Transportation of materials to the disposal sites.

4.4.1. Generic impacts during the construction phase

4.4.1.1. Impacts on air quality

1. Dust and pollutants causing air pollution

a. Dust from excavation, embankment and ground leveling

The excavation and ground leveling process is considered to be the most significant source of dust emission in the construction phase for all construction works. In the case of intensive construction in the rainy season, dust pollution will be the highest. The dust concentration can be up to 10 to 15 times higher than the permitted limit. The concentration of dust will be reduced gradually after completion of the work items.

According to the FS of the Subproject, total volume of excavation and leveling for the work items is shown in the table below:

Table 53: Excavation and backfilling volume of work items

No.	Volume	Unit	Southnorth road and Huong Thuong bridge	Huong Thuong - Chua Hang road	Dong Bam residential area road	Dan bridge	Le Huu Trac road	Xuong Rong ditch	Mo Bach ditch	Huong Son kindergarten	Phan Dinh Phung kindergarten
			1	2	3	4	5	6	7	8	9
1	Excavated soil	m^3	69,341	94,884	175,156	5,735	88,519	9,473	94,041	4,036	1,642
2	Backfilling land	m^3	246,604	397,416	298,379	4,449	172,176	27,822	30,669	7,844	1,922
3	Filling sand	m^3	3,119	39,254	39,254	0	0	0	468	7	72
4	Total volume	m^3	319,064	531,554	512,789	10,184	260,695	37,295	125,178	11,887	3,636
5	Conversion into ton	Ton	478,596	797,331	769,184	15,276	391,043	55,943	187,767	17,831	5,454

Conversion factor $1m^3$ = 1.5 tons of rock and soil

The dust emission level during the ground leveling depends on volume of excavation, backfilling and ground leveling. The amount of diffused dust is calculated based on the pollution factor and the volume of excavated/backfilled soil. According to the guidelines of the World Health Organization, the pollution factor E is calculated using the following formula:

$$E = k * 0,0016 * \frac{\left(\frac{\bar{u}}{2,2}\right)^{1,4}}{\left(\frac{M}{2}\right)^{1,3}} \quad \text{(CT1)}$$

Of which:

- E - Pollution factor (kg/ton).
- k – Particle structure, average value of 0.35.
- $\bar{u}$ - Average wind speed in the subproject area (1.3 m/s).
- M - Average moisture content of the material (20%).

From the conditions of average particle structure, average wind speed and moisture content of excavated/backfilled materials, the pollution factor E = 0.00535 (kg/ton) has been identified.

The construction duration of the work items varies from 15 to 24 months (depending on volume, geographical conditions and construction methods). Average dust concentration per hour at the construction site is calculated according to the table below:

Table 54: Dust emission concentration from excavation, backfilling and ground leveling

Works	Southnorth road and Huong Thuong bridge	Huong Thuong - Chua Hang road	Dong Bam residential area road	Dan bridge	Le Huu Trac road	Xuong Rong ditch	Mo Bach ditch	Huong Son kindergarten	Phan Dinh Phung kindergarten
	1	2	3	4	5	6	7	8	9
Total dust volume (kg)	2,560.27	4,265.36	4,114.78	81.72	2,091.90	299.27	1,004.47	95.39	29.18
Surface area (m^2)	131,200	138,425	67,200	7,744	45,900	14,550	28,400	6,151	3,330
Effect volume on site (m^3)	1,312,000	1,384,250	672,000	77,440	459,000	145,500	284,000	61,510	33,300
Load (kg/day)	4.267	7.899	9.144	0.151	4.649	0.554	1.395	0.212	0.065
Surface dust emission factor (g/m^2/day)	0.03252	0.05706	0.13607	0.01954	0.10128	0.03809	0.04912	0.03548	0.01947
Average concentration (1h) (mg/m^3)	0.4065	0.7133	1.7009	0.2443	1.2660	0.4761	0.6140	0.4435	0.2434
QCVN 05:2013/BTNMT (mg/m^3)	0.3								

Calculation results of dust concentration showed that total average dust concentration per hour in the subproject area when carrying out construction items exceeded the permitted limited in accordance with Standard QCVN 05: 2013/BTNMT (limit: 0.3 mg/m^3), the highest of 5.67 times at Dong Bam residential area road, about 4 times at Le Huu Trac road. The dust impacts on the residential areas adjacent to Dong Bam and Le Huu Trac roads are assessed as "MEDIUM" due to:

- The density of residents living along the two sides of: (i) Dong Bam road is not much, mainly concentrated at the chainage Km1 + 650 to Km2 + 550m; (ii) Le Huu Trac mainly concentrated at the chainage K1 + 150 to the end of the route. In the residential areas, the level of new road base basically follow the existing ground level, so the excavation works in this area is minor.
- Excavation and embankment activities mostly take place in low-lying areas, the fields along the roads since the ground level at the area is low and needs to be elevated.
- Degree of dust emission: Localized at the site of excavation, not widely because the source of emission is the point source and the construction site is airy with many trees.
- Dust emitted from excavation unless mitigation measures are applied, will affect:
    + Daily living activities, the travelling of people nearby the subproject area.
    + Potential risks to public health: eye and lung diseases due to the concentration of suspended dust in the air higher than normal.

In addition, the dust from the ground leveling process also affects a part of resident who are living near Huong Son, Phan Dinh Phung kindergartens, the Southnorth road and Huong Thuong bridge, at the end of Huong Thuong - Chua Hang road. In reality, the amount of dust emission is not much compared with the calculation due to different construction time of each item (mainly focus on the first 1-2 months in the construction phase) and not occur simultaneously. The construction sites are scattered in 14 wards/communes of Thai Nguyen city. In addition, the dust emission concentration is rapidly reduced compared to the distance to the source and the mitigation measures mentioned in Chapter 5 will minimize the impacts of the dust on the ambient air environment as well as on local people near the subproject area.

b. Dust and exhaust gas from operations of construction equipment

To calculate the emissions (CO, NO_2, SO_2) due to the operation of machinery and equipment during construction such as excavation, leveling, mixers, pile drivers, ... (using one ton of oil with internal combustion engine, this ESIA based on the documents by Natz Transport, Shun Dar Lin, 2005. The emission factor of exhaust gases is presented in the table below.

Table 55: Emission factor of exhaust gases

Used oil factor (kg/ton of rock and soil)	Emission factor (kg/ton of oil)		
	SO_2	NO_2	CO
0.1	2.8	12.3	0.05

Source: Natz Transport and Shun Dar Lin 2005

Therefore, the volume of exhaust gases from the excavation of rock and soil is estimated specifically in the table below:

Table 56: Estimated volume of exhaust gases from construction equipment

Works	Southnorth road and Huong Thuong bridge	Huong Thuong - Chua Hang road	Dong Bam residential area road	Dan bridge	Le Huu Trac road	Xuong Rong ditch	Mo Bach ditch	Huong Son kindergarten	Phan Dinh Phung kindergarten	QCVN 05:2013
	1	2	3	4	5	6	7	8	9	
Total volume of rock and soil (ton)	478,596	797,331	769,184	15,276	391,043	55,943	187,767	17,831	5,454	-
Required volume of oil (ton)	47.86	79.73	76.92	1.53	39.10	5.59	18.78	1.78	0.55	-
Concentration of SO_2 (mg/m^3)	0.021	0.037	0.089	0.013	0.066	0.025	0.032	0.023	0.013	0.35
Concentration of NOx(mg/m^3)	0.093	0.164	0.391	0.056	0.291	0.109	0.141	0.102	0.056	0.2
Concentration of CO (mg/m^3)	0.00038	0.00067	0.00159	0.00023	0.00118	0.00045	0.00057	0.00041	0.00023	30

In general, the level gas emission generated by on-site construction vehicles is not high, and within the permitted limits of Standard QCVN 05:2013/BTNMT. The objects who suffer these impacts are workers at the construction site and the neighboring residential areas such as the starting point of the Southnorth road and Huong Thuong bridge, the residential area near Huong Thuong bridge, the ending point of Huong Thuong – Chua Hang road, Nhi Hoa residential area belonging to Dong Bam road, the starting point and ending points of Le Huu Trac road, the residential area near Dan bridge, the residential area near Huong Son and Phan Dinh Phung kindergartens, etc. These impact are localized at the construction site with a radius of 50-100m from the construction site. The impact duration is about 8 – 10 hours in day. The impacts are assessed as "LOW" and mitigable through ECOPs.

c. Dust and exhaust gases from transportation of materials and disposal

The process of transportation of materials and fuels from the supplying areas to the construction sites or the process of transportation of excess solid waste from the works to the disposal sites will raise dust and exhaust gases from vehicles (main exhausted gases include CO, SO_2, NO_2). Dust and exhaust gases will directly affect the transporters and the people living along the transport routes. Impacts caused by transportation of materials and disposal include:

- Dust and exhaust gases that will obstruct visibility, affect the health of workers, road users and residents living along the transportation and disposal routes.
- The transportation process can cause traffic jams, traffic unsafety, affecting people's travel activities.
- Affecting the activities of trading and living of people along transportation and diposal routes.
- Unshieled or scattered materials in the course of transportation will cause loss of urban aesthetics, affecting environmental sanitation conditions along the transportation route.

The level of impact of dust and exhaust gases depends on many factors such as the distance of transportation, type of engine, engine volume, type and volume of used fuel, air operations, road quality, etc. To estimate the amount of dust and exhausted gases generated, this ESIA uses the method of "pollution factor" by the United States Environmental Protection Agency (USEPA) and the World Health Organization (WHO) to apply to diesel vehicles with load of 10 tones running on the urban roads as follows: (i) Dust 0.9 (g/km); SO_2 4.29S (g/km, S = 0.05% - content of sulfur in fuel; CO 6.0 (g/km); NO_x 1.18 (g/km).

From the amount of dust and exhaust gases, the model SUTTON is applied to determine average concentration of the pollutants at a certain time with the linear emission source as follows:

$$C = \frac{0{,}8E\left\{\exp\left[\frac{-(z+h)^2}{2\sigma_z^{\,2}}\right]+\exp\left[\frac{-(z-h)^2}{2\sigma_z^{\,2}}\right]\right\}}{\sigma_z \times u} \quad \text{(CT2)}$$

In the formula CT2, there are:

- C – Concentration of pollutants in air (mg/m^3)
- E - Load of pollutant from discharge source (mg/ms)
- z – Height of calculated point (m)
- h - The height of the pavement against the surrounding ground (m)
- u – Average wind speed in the area (m/s)

The pollutant diffusion coefficient σ_z in vertical orientation (z) and the atmospheric stability as defined as "Class B" in the study area, is determined according to the following fomular:

$$\sigma_z = 0.53 \text{ x } 25^{0.73} \text{ (m)}$$

Of which: x is the distance from the calculated point to the discharge source in the wind direction. The method of calculation is dividing the point coordinates by the horizontal axis (x) and the vertical axis (z). For the subproject area, the average wind speed of the area is 1.3 m/s. Atmosphere stability is defined as Class B.

Diffusion coefficient σ_z depends on the level of atmospheric diffusion, the value σ_z in vertical orientation is calculated according to Slade with the atmospheric stability of class B and distance x = 25m from the calculated center line of the road to the two sides.

❖ ***Dust and exhausted gases from transportation of materials to the construction site***

According to the pre-feasibility study report, the total volume of materials (soil, sand, cement, iron, steel ...) to be transported is shown in Table 57. The amount of dust and gas generated according to pollution factor of USEPA and WHO is calculated in Table 58. The material transportation routes are shown in Figure 27. The concentration of dust and exhaust gases during transportation of materials is shown in Table 59 (according to the formula CT2).

Table 57: Volume of transportation of materials and counts of vehicles transporting

Works	Southnorth road and Huong Thuong bridge	Huong Thuong - Chua Hang road	Dong Bam residential area road	Dan bridge	Le Huu Trac road	Xuong Rong ditch	Mo Bach ditch	Huong Son kindergarten	Phan Dinh Phung kindergarten
	1	2	3	4	5	6	7	8	9
Total volume of materials (ton)	507,359	804,629	498,558	11,882	276,710	59,328	14,872	11,305	3,364
Total turns of vehicles (turns)	50,736	80,463	49,856	1,188	27,671	5,933	1,487	1,130	336
Construction duration (days)	600	540	450	540	450	540	720	450	450
Turns of vehicles transporting in 1 day (including departure and arrival)	170	300	222	6	124	22	6	6	2
Average transport distance (km)	15	8	10	20	20	15	10	20	10

Table 58: Emission rate of materials transport vehicles

Parameters	Emission rate (mg/ms)								
	Southnorth road and Huong Thuong bridge	Huong Thuong - Chua Hang road	Dong Bam residential area road	Dan bridge	Le Huu Trac road	Xuong Rong ditch	Mo Bach ditch	Huong Son kindergarten	Phan Dinh Phung kindergarten
	1	2	3	4	5	6	7	8	9
Dust	0.0525	0.0500	0.0450	0.0050	0.0500	0.0075	0.0025	0.0050	0.0025
CO	0.3500	0.3333	0.3000	0.0333	0.3333	0.0500	0.0167	0.0333	0.0167
NO_2	0.0688	0.0656	0.0590	0.0066	0.0656	0.0098	0.0033	0.0066	0.0033
SO_2	0.0125	0.0119	0.0107	0.0060	0.0119	0.0197	0.0006	0.0012	0.0006

Table 59: Concentration of pollutants during the transportation of materials

Parameters	Emission volume (mg/m^3)									QCVN 05:2013
	Southnorth road and Huong Thuong bridge	Huong Thuong - Chua Hang road	Dong Bam residential area road	Dan bridge	Le Huu Trac road	Xuong Rong ditch	Mo Bach ditch	Huong Son kindergarten	Phan Dinh Phung kindergarten	
	1	2	3	4	5	6	7	8	9	
Dust	0.139	0.123	0.138	0.134	0.139	0.134	0.134	0.134	0.134	0.3
CO	0.171	0.149	0.166	0.137	0.169	0.139	0.135	0.137	0.135	30
NO_2	0.141	0.124	0.140	0.134	0.140	0.135	0.134	0.134	0.134	0.2
SO_2	0.135	0.119	0.135	0.134	0.135	0.136	0.134	0.134	0.134	0.35

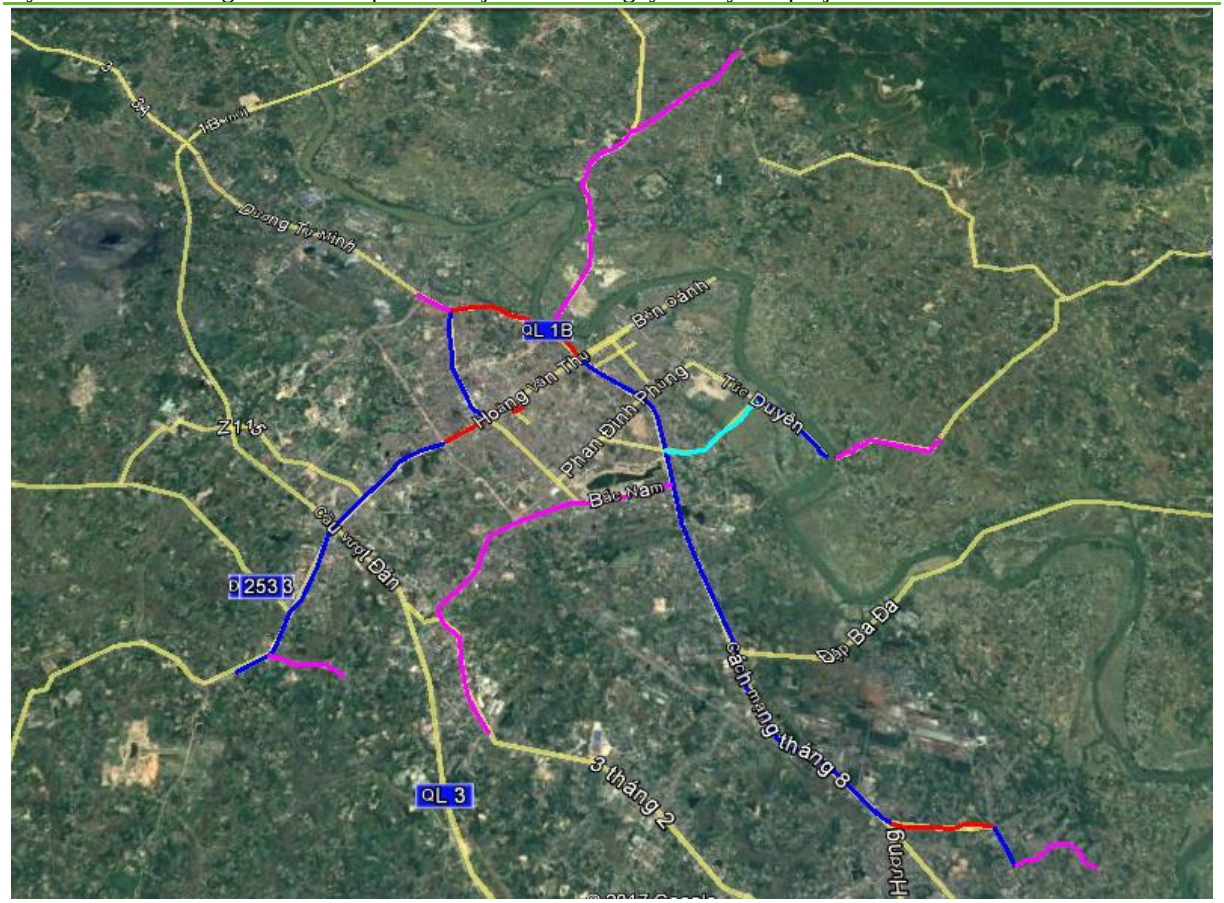


Figure 27: The transportation routes of materials for construction

According to the calculation results in Table 59, the concentration of dust and exhaust gases caused by transportation of construction materials is lower than the permitted limit of Standard QCVN 05:2013/BTNMT within one hour. However, dust and exhaust gases from the transportation can combine with dust and exhaust gases from means of transport operating on daily basis, along with hot weather, can affect the health and daily living activities of the people living along the roads such as Quang Trung, Cach Mang Thang Tm, Bac Can, Luong Ngoc Quyen, Duong Tu Minh, Le Huu Trac, Luu Nhan Chu, Huong Son, Provincial Road 265 and inter-commune roads (the distance from the road to houses of households varies from 5 to 50m.) The impacts occur during the construction of the work items, gradually decrease until the operation of the works. The impacts are concentrated within 8-10 hours per day. Specifically:

- For the work items of construction of roads (works 1, 2, 3 and 5), the transportation volume of materials is large, the vehicle volume ranges from 124-300 turns per day, the average transport distance is 15km. Dust and exhaust gases directly affect the households living along the National Highway 1B, the provincial road 265 and Cach Mang Thang Tam road, however, the population density is not large. Impacts are assessed as "MEDIUM" and can be mitigable.
- For the remaining works (works 4, 6, 7, 8 and 9), the transportation volume of materials is not much, the vehicle volume varies from 2 to 22 turns per day, the distance is from 10 to 20km. At the same time, the transport routes are favorable so the impacts of dust and exhaust gases on these work items are assesses as "LOW" and mitigable.

❖ ***Dust and exhaust gases from transportation of residual solid waste to the disposal site***

According to the pre-feasibility study report, the total volume of residual solid waste (unreusable waste, waste from demolition and ground leveling, etc.) to the disposal sites is shown in Table 60. The amount of dust and gas generated according to pollution factor of

USEPA and WHO is calculated in Table 61. The transportation routes of residual solid waste to the disposal sites are shown in Figure 28. The concentration of dust and exhaust gases during transportation of materials is shown in Table 62 (according to the formula CT2).

Table 60: Transportation volume of residual solid waste to the disposal sites

Works	Southnorth road and Huong Thuong bridge	Huong Thuong - Chua Hang road	Dong Bam residential area road	Dan bridge	Le Huu Trac road	Xuong Rong ditch	Mo Bach ditch	Huong Son kindergarten	Phan Dinh Phung kindergarten
	1	2	3	4	5	6	7	8	9
Total volume of residual solid waste (ton)	29,520	24,917	10,080	581	10,328	1,746	4,260	1,344	500
Total turns of vehicles (turns)	2,952	2,492	1,008	58	1,033	175	426	134	50
Construction duration (days)	60	60	45	20	45	45	60	15	30
Turns of vehicles transporting in 1 day (including departure and arrival)	100	84	46	6	46	8	16	18	4
Average transport distance (km)	5	5	7	8.5	10	20	12	5	11

Table 61: Emission volume of vehicles transporting residual solid waste

Parameters	Emission volume (mg/ms)								
	Southnorth road and Huong Thuong bridge	Huong Thuong - Chua Hang road	Dong Bam residential area road	Dan bridge	Le Huu Trac road	Xuong Rong ditch	Mo Bach ditch	Huong Son kindergarten	Phan Dinh Phung kindergarten
	1	2	3	4	5	6	7	8	9
Dust	0.0100	0.0088	0.0070	0.0021	0.0100	0.0050	0.0030	0.0013	0.0028
CO	0.0667	0.0583	0.0467	0.0142	0.0667	0.0333	0.0200	0.0083	0.0183
NO_2	0.0131	0.0115	0.0092	0.0028	0.0131	0.0066	0.0039	0.0016	0.0036
SO_2	0.0024	0.0021	0.0017	0.0005	0.0024	0.0131	0.0007	0.0003	0.0007

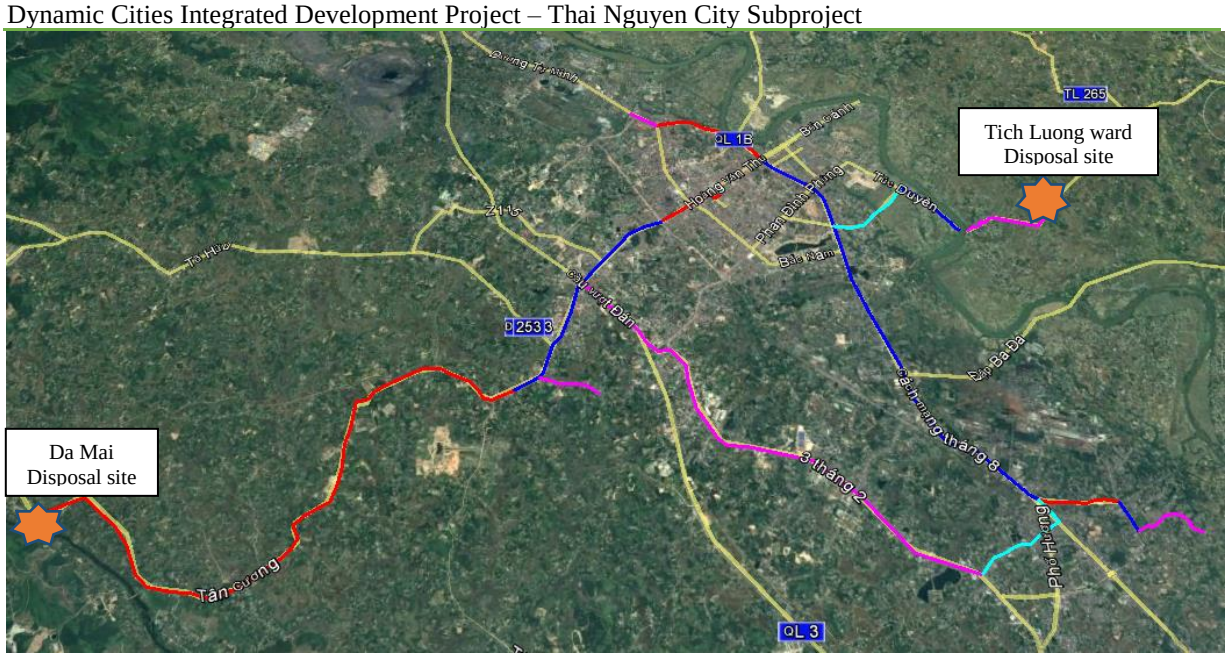


Figure 28: Transportation routes of residual solid waste to the disposal sites

Table 62: Concentration of pollutants during transportation of solid waste to disposal sites

Parameters	Emission volume (mg/m^3)									QCVN 05:2013
	Southnorth road and Huong Thuong bridge	Huong Thuong - Chua Hang road	Dong Bam residential area road	Dan bridge	Le Huu Trac road	Xuong Rong ditch	Mo Bach ditch	Huong Son kindergarten	Phan Dinh Phung kindergarten	
	1	2	3	4	5	6	7	8	9	
Dust	0.135	0.119	0.134	0.134	0.135	0.134	0.134	0.134	0.134	0.3
CO	0.141	0.123	0.138	0.135	0.141	0.137	0.136	0.134	0.135	30
NO_2	0.135	0.119	0.134	0.134	0.135	0.134	0.134	0.134	0.134	0.2
SO_2	0.134	0.118	0.134	0.134	0.134	0.135	0.134	0.134	0.134	0.35

Thus, concentration of dust and exhaust gases from transportation of solid waste to the disposal sites is lower than the permitted limits according to Standard QCVN 05:2013/BTNMT within one hour. Impacts are intermittent, mainly concentrated in the early phase of construction and decrease until the works are put into operation.

- The transportation of solid waste for two works of the Southnorth road and Huong Thuong bridge and Huong Thuong – Chua Hang road will affect "MEDIUM" the households living along the roads such as Xuan Hoa, Tuc Duyen, National Highway 1B, Provincial road 265 due to large volume of solid waste and high vehicle flow (around 100 turns per day). However, these impacts are mitigable through appropriate technical solutions.
- 07 remaining works will affect "LOW" the households living along the roads such as Quang Trung, Hoang Van Thu, Huong Son, Gang Thap, Road 3/2 and Tan Cuong road due to insignificant transportation volume of solid waste, intermittent operation and vehicle flow from 4 to 46 turns per day. These impacts are mitigable through ECOPs.

d. Dust pollution during mixing of constructional materials

During the construction, the mixing of sand, cement, concreting also causes local dust pollution at the construction site and the nearby residential areas (especially on sunny days). Referring to the measurement results at some sites located at a distance of 50-100m from the construction site at the end of the wind direction shows that the concentration of dust in ambient air environment is 20-30 mg/m^3, 60-100 times higher than limits according to Standard QCVN

05:2013/BTNMT. Meanwhile, the material gathering area is not located in the residential areas (the minimum distance to the nearest residential area is about 100m, excluding two kindergartens of Huong Son and Phan Dinh Phung). Moreover, due to the large layout, this impact affects mainly the workers. For two kindergartens of Huong Son and Phan Dinh Phung, the distance to the households is from 30 to 50m, so dust in the process of mixing materials affect not only workers but also residents surrounding the construction sites. However, this impact is assessed as "LOW" because the impact scope is localized at each construction site, the impacts occur during the construction time, about 10 hours intermittently per day. These impacts are mitigable through appropriate technical measures.

Figure 29: Residential area nearby two kindergartens Huong Son and Phan Dinh Phung

2. Noise

During the construction phase of the subproject, noise is mainly generated from:

- Transportation of constructional materials and residual solid waste;
- Construction and dismantling of work items;
- Operations of equipment at the construction site.

Noise affects primarily the construction workers and people living nearby the subproject area and along the transportation routes. High noise level will affect public health such as insomnia, fatigue and psychological discomfort. Noise also reduces the working capacity of workers on the site, making them less mentally-minded, more likely to lead to occupational accidents.

According to Standard QCVN 26:2010/BTNMT, the maximum allowable noise level is 70dBA in the production areas and the lowest noise level is 45dBA at medical centers, libraries, nursing homes and schools from 21h to 6am. For residential areas, the maximum allowable noise level shall not exceed 70dBA.

In addition to the pollution sources of dust and smoke caused by excavation, backfilling and operations of vehicles, the operation of vehicles and construction equipment such as bulldozers, compactors, cranes, hoists, drillers, concrete mixers, excavators, trucks and so on also causes noise pollution and great concussion. The predicted level of noise generated by the construction equipment is shown in the table below.

Table 63: Emission level due to constructional machines and equipment

No.	Machines, equipment	Noise level (dBA) 1,5m away source
1	Truck of 10 tons	70 - 96
2	Bulldozer	93
3	Compactor (roller)	72 – 74
4	Excavator	72 – 84

No.	Machines, equipment	Noise level (dBA) 1,5m away source
5	Bucket excavator	72 – 93
6	Scraper, blader	80 – 93
7	Concrete mixer	75 – 88
8	Concrete pump	80 – 83
9	Concrete vibrator	85
10	Electric generator	72 – 83
11	Self-propelled driller	75 – 106
12	Hoist	76 – 87

(Source: United States Environmental Protection Agency – Noise from constructional machines and equipment NJID, 300.1, 31/12/1971)

However, the noise level will gradually decrease per the distance and determined by the formula below:

$$Lp=Lp(X0) + 20\log10(X0/X)$$

Of which:

- Lp(X0): Noise level is 1.5m away source (dBA);
- X0 = 1.5m;
- Lp(X): Noise level at calculated point (dBA);
- X: Calculated point (m).

Maximum noise level per the distance due to operations of the constructional equipment is shown in the table below:

Table 64: Maximum noise level per distance

No.	Machines, equipment	Noise level is 1.5m away source (dBA)	Noise level is 15m away source (dBA)		Noise level is 30m away source (dBA)		Noise level is 50m away source (dBA)		Noise level is 100m away source (dBA)		Noise level is 200m away source (dBA)	
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
1	Truck of 10 tons	70-96	50.0	76.0	44.0	70.0	39.5	65.5	33.5	59.5	27.5	53.5
2	Bulldozer	93	73.0		67.0		62.5		56.5		50.5	
3	Compactor (roller)	72-74	52.0	54.0	46.0	48.0	41.5	43.5	35.5	37.5	29.5	31.5
4	Excavator	72-84	52.0	64.0	46.0	58.0	41.5	53.5	35.5	47.5	29.5	41.5
5	Bucket excavator	72-93	52.0	73.0	46.0	67.0	41.5	62.5	35.5	56.5	29.5	50.5
6	Scraper, blader	80-93	60.0	73.0	54.0	67.0	49.5	62.5	43.5	56.5	37.5	50.5
7	Concrete mixer	75-88	55.0	68.0	49.0	62.0	44.5	57.5	38.5	51.5	32.5	45.5
8	Concrete pump	80-83	60.0	63.0	54.0	57.0	49.5	52.5	43.5	46.5	37.5	40.5
9	Concrete vibrator	85	65.0		59.0		54.5		48.5		42.5	
10	Electric generator	72-83	52.0	62.5	46.0	56.5	41.5	52.0	35.5	46.0	29.5	40.0

No.	Machines, equipment	Noise level is 1.5m away source (dBA)	Noise level is 15m away source (dBA)		Noise level is 30m away source (dBA)		Noise level is 50m away source (dBA)		Noise level is 100m away source (dBA)		Noise level is 200m away source (dBA)	
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
11	Self-propelled driller	75-106	55.0	86.0	49.0	80.0	44.5	75.5	38.5	69.5	32.5	63.5
12	Hoist	76-87	56.0	67.0	50.0	61.0	45.5	56.5	39.5	50.5	33.5	44.5
QCVN 26:2010/BTNMT (6-21h)							70 dBA					

On the other hand, there are many sources of noise on the construction site, so the noise in reality will be greater due to the resonance between them. Additional noise is shown below:

Table 65: Additional noise in case of many activities at the same position

Difference in noise levels (dB)	Additional noise (dB)	Difference in noise levels (dB)	Additional noise (dB)
0	3.0	7	0.8
1	2.6	8	0.6
2	2.1	10	0.4
3	1.8	12	0.3
4	1.5	14	0.2
5	1.2	16	0.1
6	1		

(Source: Le Trinh – Environmental Impact Assessment – Methodologies and applications - Science and Technics Publishing House)

According to the calculation results in Table 64, the noise level at the distance of 30m of construction vehicles and equipment is within the permissible limit (<70dB). The noise level decreases when the construction distance is far from the affected area. Out of the above noise sources, the most significant is the mobile noise of vehicles transporting building materials crossing the residential areas.

- For the work items of construction of roads (Works 1, 2, 3 and 5): The households are living along both sides of the materials transport route (a distance of about 20m) or are living away from the construction site (> 50m). As a result, noise mainly affects construction workers and a small number of people at the beginning of the Southnorth road and Huong Thuong bridge, at the end of Huong Thuong-Chua Hang road, at the beginning and the end of Le Huu Trac road. Trac, in the middle of Dong Bam residential area road.
- For the items of construction of Dan bridge, rehabilitation of Xuong Rong and Mo Bach ditches: Noise only affects workers at the construction site due to the distance of 50m from the construction site to the closest households.
- For the item of construction of Huong Son and Phan Dinh Phung kindergartens: As there are several households living surrounding the construction site, in a distance from 5m to 30m, noise from vehicles and construction equipment will affect directly daily life of residents.

However, according to the calculation results, the noise levels in the construction sites are LOW, arising in short time, scattered across 14 wards. The devices do not operate at the same time, but depending on the stages/shifts or depending on the progress, the workload of the items, each type of machine will be used differently, leading to the resonance impact at the same

location is very low. In addition, vehicles and equipment are periodically inspected and noise will be stopped when construction is completed. Noise can be mitigated by measures such as the provision of protective equipment and anti-noise equipment.

3. Vibration

The vibration is generated mainly from the high-capacity and regular-operation equipment on the construction site, including bulldozers, excavators, air compressors and so on from the ground leveling, pile driving, bridge piers and abutments. The vibration directly affects the workers involved in the operation of equipment and machine as well as people living nearby and construction of the infrastructure surrounding the construction sites. The vibration affects the lives, business and structures of houses and other architectural structures of the people and even it is the cause of the incidents causing cracking or collapsed houses. When the intensity is small and the effect is short, the vibration has positive effects such as increasing muscle force and reducing fatigue. In case of high intensity and long effect, it will cause discomfort to the body. Vibration combined with noise causes the hearing organs to become too tired, affecting the health of people.

Typical vibration level of some construction equipment is shown in the table below:

Table 66: Vibration level of some typical construction equipment

No.	Types of vehicles and equipment	Reference vibration level (vertically, dB)
1	Excavator	80
2	Bulldozer	79
3	Heavy truck	74
4	Roller	82
5	Air compressor	81

Source: United States Environmental Protection Agency – Vibration from constructional machines and equipment NJID, 300.1, 31 – 12 – 197

To forecast the decreased vibration level, the formula below is used:

$$L = L_0 – 10\lg (r/r_0) – 8.7a (r – r_0)\ (dB)$$

Of which:

- L is vibration per dB at distance "r" meter from the source;
- Lo is vibration per dB measured at distance "ro" meter from the source. Vibration at distance ro = 10 m is often recognized as source vibration.
- a is internal reduction coefficiency of vibration for clayed ground, 0.5.

Forecast results are shown in the table below.

Table 67: Vibration reduction level per distance of construction

No.	Equipment	Source vibration (r_0=10m)		Vibration level at distance							
				r=12m		r=14m		r=16m		r=18m	
		L_{aeq} (dB)	L_{veq} (mm/s)	L_{aeq} (dB)	L_{veq} (mm/s)	L_{aeq} (dB)	L_{veq} (mm/s)	L_{aeq} (dB)	L_{veq} (mm/s)	L_{aeq} (dB)	L_{veq} (mm/s)
1	Excavator	80	1.72	70.5	0.58	61.1	0.20	51.9	0.07	42.6	0.02
2	Bulldozer	79	1.53	69.5	0.51	60.1	0.17	50.9	0.06	41.6	0.02
3	Heavy truck	74	0.86	64.5	0.29	55.1	0.10	45.9	0.03	36.6	0.01
4	Roller	82	2.17	72.5	0.73	63.1	0.25	53.9	0.08	44.6	0.03
5	Air compressor	81	1.93	71.5	0.65	62.1	0.22	52.9	0.08	43.6	0.03

No.	Equipment	Source vibration (r_0=10m)		Vibration level at distance							
				r=12m		r=14m		r=16m		r=18m	
		L_{aeq} (dB)	L_{veq} (mm/s)	L_{aeq} (dB)	L_{veq} (mm/s)	L_{aeq} (dB)	L_{veq} (mm/s)	L_{aeq} (dB)	L_{veq} (mm/s)	L_{aeq} (dB)	L_{veq} (mm/s)
QCVN27:2010/BTNMT, permitted level 75dB from 6 ÷ 21h and background level from 21h÷6h.											
DIN 4150, 1970 (Federal Republic of Germany), 2mm/s: no damage; 5mm/s: mortar peeling; 10mm/s: Possible damage to bearing elements; 20 ÷ 40mm/s: damage to bearing elements.											

Based on the calculation results in Table 67, the vibration level of vehicles and equipment at distance of 12m is within the permissible limit of Standard QCVN 27: 2010/BTNMT (<75dB) and will decrease when the affected location is far away from the source of vibration. The vibration of the construction equipment directly affects the workers at the construction site. However, the impacts of vibration should be noted in the construction sites near the residential areas but at a low level:

- The Southnorth road and Huong Thuong road: The residential area is located at the beginning of the road and the building location of Huong Thuong bridge, in a distance of 5-20m.
- Huong Thuong – Chua Hang road: The residential area is located at the end of road, in a distance of about 5-30m.
- Dong Bam road: Nhi Ha hamlet residential area, in a distance of about 5-10m.
- Le Huu Trac road: The residential area is located at the begining of the , nearby the existing Le Huu Trac road and at the end of route near the intersection between Thong Nhat road and Thanh Nien Xung Phong road.
- The residential area and houses of people living surrounding (5-20m far away) two kindergartens of Huong Son and Phan Dinh Phung.

The vibration impacts are assessed as "LOW" because operation duration of the equipment is intermittent; the impacts are localized at the construction site. Operators of equipment work on shift basis and equipped with labor protective equipment. Vibration impacts are mitigable through the application of construction methods and construction plans suitable for each construction site.

4.4.1.2. Impacts on water quality

1. Domestic wastewater from workers' camps

At each construction site there are about 30 to 70 workers involved in the construction. Workers are most concentrated in the early stage of the subproject and will gradually decrease when the works is put into operation. With the water consumption norm of 100 liters/person/day (Pursuant to Decree No.88/2011/ND-CP and Decree 80/2014/ND-CP, took effect since January 01, 2015), with 100% of water supply standard (100 liters/person/day), the total daily amount of domestic wastewater generated at each construction site ranges from 3.0 to 7.0 m^3 per day.

Domestic wastewater of workers at the construction site is the main reason affecting the quality of water in the surrounding area. Domestic wastewater contains many residues, decomposable organic matters, nutrients and pathogenic bacteria, which can cause pollution of surface water and groundwater if treatment is not conducted timely. At the same time, domestic wastewater, if not being collected, could be at risk of spreading diseases (gastrointestinal, respiratory and skin diseases) affecting workers and people living near the construction site.

Basing on volume of pollutants shown in the Report on status of urban wastewater - Vietnam Academy of Science and Technology - Hanoi University of Science and Technology in 2016, the volume of pollutants generated into environment per each person is shown in the table below:

Table 68: Volume of pollutants generated per each person daily

No.	Pollutants	Volume (g/persons/day)
1	BOD_5	45 - 54
2	Suspended solid	70 - 145
3	Animal and vegetable fats and oils	10 - 30
4	NO_3^- (based on Nitrogen)	6 - 12
5	PO_4^{3-} (based on phosphorus)	0,8 - 4,0
6	Coliform	10^6- 10^9 MPN/100ml

Source: Report on Urban Wastewater Status - Vietnam Academy of Science and Technology - Hanoi University of Science and Technology, 2006

The amount and concentration of pollutants in domestic wastewater at the construction sites of the subproject are calculated based on the amount of pollutants, the number of workers, the flow of wastewater. The results are presented in table below:

Table 69: Pollution load in domestic wastewater

No	Works	Pollutant load (g/day)					
		BOD_5	**TSS**	**Fats and oils**	**NO_3^-**	**PO_4^{3-}**	**Coliform**
1	Southnorth road & Huong Thuong bridge	29.7	645	120	54	14.4	1.5 x10^6
2	Huong Thuong - Chua Hang road	34.65	752.5	140	63	16.8	1.7 x10^6
3	Dong Bam residential area road	19.8	430	80	36	9.6	2.0 x10^6
4	Dan bridge	14.85	322.5	60	27	7.2	2.2 x10^6
5	Le Huu Trac road	29.7	645	120	54	14.4	3.7 x10^6

Concentration of pollutants in untreated domestic wastewater is calculated according to the formula below:

$$M = \frac{m}{V} \qquad \text{(CT3)}$$

Of which:

- M: Concentration of pollutant to be calculated
- m: Pollution load (kg/day) according to Table 69.
- V: Total volume of arising wastewater (m^3/d.n)

Calculation results are shown in the table below.

Table 70: Concentration of pollutants in untreated domestic wastewater

No.	Pollutants	Concentration of pollutants in untreated domestic wastewater (mg/l)	QCVN 14:2008/BTNMT (column B)
1	BOD_5	582	50
2	TSS	1265	100
3	Animal and vegetable fats and oils	235	20
4	NO_3^- (based on Nitrogen)	106	50
5	PO_4^{3-} (based on phosphorus)	28	10
6	Coliform	100x10^6 - 60x10^9 MPN/100ml	5000 MPN/100ml

The calculation results in the table above show that untreated wastewater has much higher pollutant concentration than limits according to standard QCVN 14:2008/BTNMT (column B). This type of wastewater usually contains total suspended solids (TSS), organic matters (BOD, COD), nitrogen and phosphorus matters as well as microorganisms that need to be controlled and treated before discharging into the environment. This is a significant source of pollution. In the absence of appropriate treatment measures, these substances can directly affect the living environment of workers and people around the subproject area, causing diseases and directly affecting groundwater and surface water. The surface water areas that may be affected include Cau river surface water (used for agricultural production activities) at the building location of Huong Thuong bridge, surface water at Mo Linh stream (used for agricultural production activities), at the construction site of Mo Linh 1 and 2 bridges, surface water at Ho Nui Coc diversion canal (used for the purpose of supplying water to the domestic water supply plant) at the construction site of Dan bridge Dredges, surface water at Xuong Rong and Mo Bach ditches (used for agricultural production activities).

However, the impacts caused by domestic wastewater is considered as "LOW" due to: (i) the volume of domestic wastewater generated daily in each workers' camp is not large, and the Contractor also uses local labor or rents the household houses, therefore, the amount of wastewater generated is lower than the calculated amount; (ii) impact is localized in each workers' camp; (iii) discontinuous discharge of wastewater during the day; (iv) Short construction time (15-24 months, depending on construction items). Impacts caused by domestic wastewater can be mitigated through appropriate management and technical measures for each construction site.

2. Construction wastewater

Construction wastewater is mainly generated from the activities☹i) concrete mixing for building bridges and embankments; (ii) washing materials and equipment for construction.

- Concrete mixing activities at the construction site use concrete mixers of 250 liters, total capacity of 30 m^3/h. According to the document, Technologies for concrete and special concrete by Pham Duy Huu – The Construction Publishing House 2009, the amount of water needed for concrete mixing with a capacity of 30m^3/h is 9.69m^3 of water for washing aggregate and 5.4 m^3 water for concrete mixing. Of which, 80% of the aggregate wash water amount will be recycled and reused. As a result, wastewater in the concrete mixing process at the construction site is 20% x 9.69 = 1.94 (m^3/h). On average, the concrete mixing takes place within 02 hours per day, so the amount of wastewater generated from concrete mixing is 1.94 x 2 = 3.88 m^3 per day.
- The amount of wastewater used to wash the construction equipment is estimated at 0.5 m^3 per day.

Thus, the amount of wastewater at each construction site is 4.38 m^3/day, equivalent to 39.42 m^3/day for all 9 works. Construction wastewater typically has a high pH (typically pH> 12), contains a high content of suspended solids and no toxic ingredients. This amount of construction wastewater, if not treated, will cause sedimentation, which will affect the receiving water bodies. The affected water bodies include Cau river, Mo Linh stream, Xuong Rong ditch and Mo Bach ditch. In reality, this amount of wastewater is reused to moisten the materials or to moisten the excavation/backfilling areas on the construction site. At the same time, the amount of waste generated at each construction site is small, the construction period is short (15-24 months), the impact is considered locally at the construction site. Moreover, the frequency of wastewater generated from the concrete mixing process is discontinuous. Therefore, the impacts caused by construction wastewater are assessed as "LOW" and are mitigable.

3. Run-off rainwater

Rainwater is considered as clean water if it is not exposed to pollutants such as wastewater, exhaust gases, polluted soil and sludge, etc. The main affected objects are the water bodies at the receiving area of run-off rainwater on the construction site. Pollution elements in run-off rainwater in the construction phase mainly include soil, stone, oil, grease, domestic waste washed out by rainwater and becoming a source of pollution to the surface water, groundwater and soil. The amount of run-off rainwater in the subproject area is determined according to the following formula:

$$W = \psi \times q \times F/1000 \ (m^3/day)$$

Of which:

- W: Volume of run-off rainwater, m^3;
- Ψ: Surface flow coefficient, ψ = 0.2 – 0.95, selected ψ = 0,2 (because the subproject area has many trees, canals and crops land);
- q: Maximum daily rainfall at calculated zone, 100mm;
- F: Area of calculated zone (m^2).

Calculation results of run-off volume at the construction sites of the Subproject are shown in Table 71.

Table 71: Run-off at construction sites

No.	Items	Flow Q (m^3)								
		Southnorth road and Huong Thuong bridge	Huong Thuong - Chua Hang road	Dong Bam residential area road	Dan bridge	Le Huu Trac road	Xuong Rong ditch	Mo Bach ditch	Huong Son kindergarten	Phan Dinh Phung kindergarten
		1	2	3	4	5	6	7	8	9
1	Surface area (m^2)	131,200	138,425	67,200	7,744	45,900	14,550	28,400	5,974	3,330
2	Calculated rainfall intensity (mm)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
3	Surface flow coefficient	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
4	Run-off rainwater volume (m^3)	2,624	2,769	1,344	155	918	291	568	119	67

According to the research by WHO, concentration of pollutants in runoff rainwater is typically from 0.5 and 1.5 mg N/l; 0.004 - 0.03 mg P/l; 10 - 20 mg COD/l and 10 - 20 mg TSS/l. The receiving sources of runoff rainwater are Cau river, Mo Linh stream, Xuong Rong ditch and Mo Bach ditch. Rainwater runs off over the construction site, swept away with the objects, loose rock, soil, surface mineral salts and leak oil and grease, which will increase the content of suspended substances, organic matters, increased turbidity, oil and grease in the water, causing adverse impacts on the aquatic ecosystem of the water source. If there are no rainwater drainage ditches, run-off rainwater can affect the construction items such as damaging or destroying the items under construction. Impacts occurr during the rainy season from May to September. However, the impact caused by runoff rainwater is assessed as "LOW" because:

- The construction site is regularly cleaned up by the workers, thus limiting objects, loose soil, rock swept away by rainwater.
- At each construction site, rainwater drainage systems are arranged properly.
- The construction activities mainly take place in the dry season with short construction time.

Impacts caused by run-off rainwater are mitigable through appropriate technical and management measures.

4.4.1.3. Impacts of solid waste

1. Construction solid waste

Causes of solid waste generation during construction include excavation, backfilling, ground leveling, dredging of waste sludge, transportation of materials and residual solid waste, construction activities; maintenance of vehicles and construction equipment, etc. Solid wastes include soil, stone, sand from excavation and scattering. In addition, there are also scrap steel, iron, kinds of cement bags; wood chips and broken bricks, etc.

Table 72: Volume of solid waste during construction of work items

No.	Rate of loss	Volume of solid waste (ton)								
		Southnorth road and Huong Thuong bridge	Huong Thuong - Chua Hang road	Dong Bam residential area road	Dan bridge	Le Huu Trac road	Xuong Rong ditch	Mo Bach ditch	Huong Son kindergarten	Phan Dinh Phung kindergarten
		1	2	3	4	5	6	7	8	9
1	Volume of materials	507,359	804,629	498,558	11,882	276,710	59,328	14,872	11,305	3,364
2	Minor loss rate (0.005%)	25.37	40.23	24.93	0.59	13.84	2.97	0.74	0.57	0.17
3	Significant loss rate (0.01%)	50.74	80.46	49.86	1.19	27.67	5.93	1.49	1.13	0.34

Note: The loss rate of materials according to norm of building materials as stipulated in Dispatch No. 1784/BXD-VP dated August 16, 2007 and Dispatch No.1776/BXD-VP, dated August 16, 2007 of the Ministry of Construction

However, these wastes, if not well controlled, can interfere with construction and increase the amount of dust in and around the construction site, affecting workers and people living nearby the subproject area. The residential areas can be affected, including those nearby Huong Son kindergarten, Phan Dinh Phung kindergarten, Southnorth road and Huong Thuong bridge and at the end of Huong Thuong - Chua Hang road.

In addition, after the construction process, some other types of solid waste such as broken bricks, scrap steel, iron, cement bags can be generated. However, these types of solid waste are reusable or sold to demanding units, so these types of solid waste are less likely to be discharge into the external environment.

This impact is assessed as “LOW” due to: (i) Minor volume of waste generation and localized impact in the construction site; (ii) Short-term construction duration; (iii) daily collection and transportation of solid waste to the local disposal sites of Da Mai and Tich Luong ward twice a week. Simultaneously, this impact is mitigable through the mitigation measures set forth in ECOPs.

2. Domestic solid waste

Domestic solid waste is generated from the daily activities of the workers in the camps. The main components of domestic solid waste include biodegradable organic substances and non-biodegradable inorganic substances such as nylon bags, bottles and old personal items. Average generation volume of domestic solid waste is about 0.3 - 0.5 kg/person/day (Vietnam National Environment Report 2011 - Solid Waste), with the number of 30-70 workers per construction site. The amount of domestic solid waste is shown in Table 73.

Table 73: Volume of daily waste at construction sites

No.	Items	Workers	Volume of waste (kg/day)
1	Southnorth road & Huong Thuong bridge	60	18 - 30
2	Huong Thuong - Chua Hang road	70	21 - 35
3	Dong Bam residential area road	40	12 - 20
4	Dan bridge	30	9 - 15
5	Le Huu Trac road	60	18 – 30
6	Xuong Rong drainage ditch	40	12 - 20
7	Mo Bach stream drainage ditch	50	15 – 25
8	Huong Son kindergarten	30	9 - 15
9	Phan Dinh Phung kindergarten	30	9 - 15
	Total	410	123 - 185

According to Table 73, total average volume of domestic solid waste of the Subproject is 154 kg/day, with the construction duration from 15 to 24 months and total volume of domestic solid waste from 69.3 – 110.88 tons. If domestic solid waste is not collected and treated properly:

- It can obstruct the flow during the construction process, creating the premise for inundation, flow congestion (at the building location of Huong Thuong bridge, Mo Linh 1, Mo Linh 2, Dan bridge, Xuong Rong and Mo Bach ditches).
- It can obstruct traffic when transporting construction materials to the construction sites and construction activities of workers (mainly concentrated on construction of the Southnorth road, Huong Thuong-Chua Hang road, Dong Bam road and Le Huu Trac road).
- Solid domestic wastes containing organic matters, containing pathogenic agents if not properly collected, transported and treated, will cause significant risks to the water and air environment as well as indirectly affect health of the people and construction workers (in all 9 works).

However, the impact caused by domestic waste is assessed as "LOW" and are mitigable because: (i) the amount of waste generated on each site is minor and collected daily by the construction workers; (ii) impact is localized at the construction sites; (iii) The contractor employs local labor to limit the amount of domestic waste generated; (iv) workers' camps are concentrated far from the residential areas.

3. Hazardous solid waste

Hazardous waste sources from construction of the subproject items: (i) oil contaminated materials from machine maintenance; (ii) wasted asphalt from road construction; (iii) empty bags, lubricating oil containers, asphalt, oil, petroleum and painting tanks; (iv) excessive oil, welding rods; (v) Batteries, light bulbs, and cartridges from office at the site. Volume of hazardous materials depends on the number of equipment/machines, workers and materials:

- Maintenance of construction equipment, vehicles, and machines at the site will discharge lubricating oil residue, oil bottles and oil-contaminated rags, etc. (about 5kg/month). If the wastes are not collected and treated, they will affect beautiful landscape, contaminate surface and underground water in subproject area. The Subproject Owner should propose hazardous material collected and treated measures in compliance with regulations (Circular No. 36/2015/TT-BTNMT on waste management) to mitigate environmental impacts. All maintenance and reparation activities of construction equipment and machines must be carried out in reparation centers.
- Asphalt is a liquid or semi-solid substance which has high viscosity and black color. This is petrochemical products whose main component is bituminous; it can cause

damages or negative impacts on environment and people's health unless being stored or used in line with technical process. Especially, dense asphalt which is stored at high temperature may cause fires, explosion or burning in the course of transportation and use. Wasted asphalt must be collected and kept in specialized tanks for hazardous materials, then, it will be transported and treated by a Unit hired by the Subproject Owner in accordance with regulations on hazardous material management. Volume of wasted asphalt is estimated about 10kg/month/construction site.

- Amount of generated wastes from bags, oil containers, and asphalt, oil, petroleum and painting tanks is insignificant (about 10-30 kg/month of each site). However, the wastes will affect beautiful landscape and cause soil and water contamination risks unless being collected.
- Welding rods at the site from the activities of shaping steel frame. It is estimated about 5-7% of excessive welding rods equivalent to 1.5kg (for a bridge) rods which need to be collected. However, welding rods are generated discontinuously and with few amount, it will be collected in regulated hazardous material yards.
- Amount of hazardous wastes from office activities are insignificant, about 1-3kg/month for 1 site.

Uncollected hazardous materials will impact:

- Grease and oil penetrated into water will directly affect aquatic animals in canals at subproject area (Cau River, Mo Linh stream, Xuong Rong, Moc Bach streams, Ho Nui Coc canal, etc.). This will curb the growth and development and may kill aquatic species.
- Heavy metal by chains will penetrate in foods and affect people's health.
- Because river bank areas at the subproject site are agricultural land, river water pumped for irrigation may be contaminated with grease, oil and heavy metal, leading to limited growth of plants and pollution of cultivation land.

However, hazardous waste generated level in the construction site is assessed to be not high, localized in each area and short-time in construction period. Hazardous materials will be collected, managed and treated in accordance with regulations on hazardous waste collection and management. The impacts are considered as LOW and mitigable through management and treatment measures which are suitable to each site.

4.4.1.4. Impacts on Physical Cultural Resources

The construction of subproject items including transport roads, bridges, ditches, kindergartens during requires soil excavation at different depths: (i) piling embankment foot at depth from 8 to12m (embankment of Mo Bach and Xuong Rong ditches); (ii) drilling piles or pre-cast pile to construct bridge piers/abutment at the depth of 20m (05 bridges of Huong Thuong, Dan, expressway flyovers, 2 bridges cross Mo Linh stream); (iii) excavation of organic soil to build roadbase at the depth of 0.5m from the road surface (04 roads and 02 kindergartens). Chance find can be encounter into during carrying out these activities. However, possibility of chance find is low because almost all items are constructed on existing base (Xuong Rong, Moc Bach ditches, Dan Bridge, Huong Son and Phan Dinh Phung kindergarten); moreover, the excavated and drilled depth is not deep; subproject area is not the place which has many physical, cultural and archeological values. However, chance find will be compliance with regulated finding procedures (in ECOP).

4.4.1.5. Transport interruption

Construction of 04 roads (in which there are 4 bridges of Huong Thuong, Mo Linh 1, Mo Linh 2 and bridges crossing National Highway 3) and Dan bridge will impacts transport activities in subproject areas. At local intersections, people's travel will be affected. Because 04 bridges on these roads are new, people's travel in the region will not be affected, excepting for Dan Bridge

which plays an important role in connection to Ho Nui Coc tourism Area and Tan Cuong Tea Region – crucial tourism destinations of Thai Nguyen province. Construction of Dan Bridge will affect transport activities within 18 months, affecting 500 local households in both bridge ends and 12,000 vehicle trips/day (motorbikes, cars, passenger buses, trucks).

However, during construction of bridges and roads, temporary paths will be arranged for facilitate local people's travel. Successive construction methods is to be applied to avoid traffic congestions. Expectedly, these impacts will be stopped upon completion of road and bridge construction; the items are supported strongly by local people, thus the impacts are considered to be LOW and mitigable through mitigation measures during construction.

Figure 30: Current status of bridges and intersection point at subproject area

4.4.1.6. Social impacts, women and children

❖ ***Social impacts***

Social impacts mainly related to the labor influx from other provinces to the subproject area and construction activities. It is expected to construct 09 sites with 30-70 workers/site. The impacts affect people surrounding subproject area and local infrastructure, including:

- (i) Conflicts between construction workers and local people because of differences in terms of habits, customs, culture, lifestyle, job creation and income. The impacts may be more severe in construction site with crowded residents such as Huong Son, Phan Dinh Phung kindergarten, Xuong rong and Mo Bach ditches.
- (ii) Conflicts between local people and Contractor due to wastes generated from construction activities such as dust, solid waste, hazardous materials and spoils, causing negative impacts on plants, rice and crops or erosion and landslide leading to burial of crops on lands along North-South route and Huong Thuong Bridge, Huong Thuong road – Chua Hang, Dong Bam road, Le Huu Trac road.
- (iii) Domestic wastewater and wastes released from worker camps into the environment may cause conflicts with local community. Conflicts may be occurred from workers who use local resources such as water and food, leading to price increase.
- (iv) Crowded workers can cause social disturbances and other issues related to security, social evils as gamble, prostitution and drug use. Besides, workers in some locations within or near residential areas (Huong Son, Phan Dinh Phung kindergarten, Xuong Rong and Mo Bach ditches) may conflicts with local people because of uncollected and untreated wastewater and wastes which cause negative impacts on local people such as malodor, environmental landscape and health.
- (v) Use of local workers for the subproject will contribute to reducing potential risks of child labor abuse which affects mental and physical health and development capacity of children, and limiting conflicts with local community.
- (vi) Impacts on existing infrastructure and related services:
    + Transportation of materials and construction wastes (use 10-ton trucks) may lead to deterioration of transport infrastructure (Quang Trung, Cach Mang Thang 8,

Bac Can, Luong Ngoc Quyen roads, PR 265, etc.).

+ Activities of cranes, excavators may break existing electrical wires along NH in sections with urban and residential areas Huong Son, Phan Dinh Phung kindergartens, Xuong Rong and Mo Bach ditches)
+ North-South route and Huong Thuong bridge, Huong Thuong – Chua Hang roads, Dong Bam road, Le Huu Trac road will cut rice field, leading to interruption of irrigation activities.

- (vii) Disturbed transport and increased traffic risks: construction equipment and machines used for the subprojects will increase traffic density in local roads (Quang Trung, Cach Mang Thang 8, Bac Can, Luong Ngoc Quyen roads, PR 265, etc.), contributing to traffic disturbances and accidental risks, traffic congestion.

However, social impacts are assessed as "LOW" because: (i) number of workers in 09 subproject area are various; these impacts are localized in construction site; (ii) Contractor will utilize local labors in construction activities, apply measures controlling ages of hired labors; (iii) impacts mainly happens in construction period and in short period of time; (iv) irrigation and drainage ditches will be newly built and connected to existing system before old ditches being dismantled; (v) traffic density and frequency in subproject area is low. Therefore, social impacts may be controlled by mitigation measures taken during the construction period.

❖ ***Impacts on women***

There is a concentration of 30-70 workers on a construction site, in which men account for about 75% and women represent about 25%. This can cause social disturbances, affecting directly women on the construction site or women living around the subproject area and their families during the construction phase. At some previous similar works, unmarried women may be marginalized in making homes or they will become single mothers. Married women can be affected with their current family happiness. In addition, they may be exposed to infectious diseases, social diseases including HIV/AIDS, syphilis and so on. If this impact occurs, it will cause mental and psychological disturbances to women and long-term impacts (their next generation may be affected). This impact only occurs during the construction process of work items (15-24 months). However, the impact on women is considered INSIGNIFICANT because: (i) According to socio-economic survey results, the subproject area has not been reported any negative impacts on women at construction sites: (ii) Number of working women is insignificant and Contractors give priorities to hire local labor; (iii) Training, information disclosure for workers on social diseases and prevention are carried out; (iv) Development of rules, regulations, sanctions and responsibilities for construction workers is also implemented at each construction site; (v) The contractor coordinates with local authorities to manage number of workers at the site.

❖ ***Use children labor***

In order to reduce the cost in construction of works items, some jobs do not require high qualifications, thus, there is potential risk that the Contractor employs child labor (according to Vietnamese regulations, children are understood to be under 15 years old). Due to limited knowledge, children may be subjected to abuse of labor force that affects their psychology, health and learning abilities. However, the impact is assessed at INSIGNIFICANT level because: (i) According to the socio-economic survey, the subproject area has not been recorded any issues related to the use of child labor; (ii) The contractor commits not to recruit child labor for the subproject implementation; (iii) The Subproject Owner coordinates with the local authority and relevant agencies to strictly control the use of labors of the Contractor; (iv) No use of child labor is one of the required conditions in the bidding documents.

4.4.1.7. Generic risks during the construction phase

1. Risk of fire, explosion and fuel leakage

Fire and explosion can occur in the following situations: (i) transportation and storage of fuel; (ii) temporary power supply system or the use of generators failing the safety requirements can cause electrical problems and lead to fire; (iii) fire due to welding, asphalt burning; (iv) gas leaks when cooking from workers camps; (v) the operation process of machines, welding and means of transport using petrol and diesel without complying with fire regulations. If fire or explosion occurs, serious damage can occur, affecting:

- Lives of workers and local people;
- Major impacts on natural environment (air, soil, biological resources, etc.);
- Psychology, confusion for local people and communities;
- Lives, economy and society at the surrounding area;
- Damage to the works under construction and adjacent infrastructures.

The Client and contractors will prepare a specific plan for emergency response to fire and explosion incidents on the construction site. At the same time, contractors shall carry out fire prevention and fighting and strictly comply with prevention measures from leakage, fire and explosion. Fire prevention will be carried out by the Contractor on a regular basis to minimize the possibility of incidents and reduce the magnitude of negative impacts.

2. Risk of working at height and working on water surface

Risks from working at height can occur during the construction process of works including Huong Son, Phan Dinh Phung kindergartens and National Highway No 3 overpass (under Le Huu Trac road). The risk of working on water surface can happen during the construction process of Huong Thuong, Mo Linh 1, Mo Linh 2, Dan bridges and improvement of two Xuong Rong and Mo Bach ditches. Workers are affected people. Workers can get risk falling down to a height of 2 to 10 meters (during the process of construction or operation of machine and equipment) to hard surface or into water causing injury or death to workers; or construction materials and machinery falling down from 2 to 10 meters high, can injury workers under construction on the ground. The causes of this risk are: (i) Carelessness of workers during the construction process; (ii) errors of technical equipment, machines, scaffolds; (iii) Lack of safety equipment at the construction site; (iv) Lack of training on safety and knowledge technologies, inability of employees and lack of knowledge to predict potential risks and ways to avoid accidents; (v) Working without wearing any personal protective equipment can increase the probability of unexpected accidents. This risk is assessed as HIGH without appropriate mitigation measures.

3. Risk of short circuit and electric shock

Short circuit and electric shock can occur because: (i) construction vehicles may break existing electric lines at the construction site; (ii) the temporary power supply system for machines and equipment during the construction process can cause short circuit, electric shock, etc.; (iii) the use of generator is unsafe. If these incidents occur, they will affect health or life of workers, local people living near the subproject area and cause damage to property, affect psychology of local people in the area. The Client and contractor will develop a specific plan for emergency response to short circuit and electric shock on the construction site. Contractors should regularly inspect electrical systems and wires, train workers on occupational safety and fire safety to minimize the possibility of incidents and reduce the magnitude of negative impacts.

4. Risk of safety and health

❖ ***Safety and public health risks***

The site demolition process can result in accident risks to local people as well as dismantling workers;

The risks of traffic accidents, work accidents, fire and explosion incidents, short circuit and electric shocks related to construction activities will also affect safety of community;

In the construction phase, there are more construction workers (there are between 30 and 70 workers at each construction site) to temporarily reside in the locality and so on. Medical examination and treatment for community at health stations will get more difficulties in cases of spreading of diseases including dengue fever, malaria, diarrhea, red eyes, etc.

Without effective management of the camps, solid wastes and stagnant waste water, the environment will be polluted. This creates favorable conditions for flies and mosquitoes to thrive and can develop diseases including diarrhea, dengue fever, etc. These diseases affect health of local community.

Concentration of workers may also lead to an increase in social evils including prostitution, gambling, etc. It may lead to an increased risk of HIV/AIDS infection and other sexually transmitted diseases in the locality.

The transportation process of raw materials and fuel, resulting in an increase of traffic vehicles on the existing roads, smoke, dust and noise from construction activities will also have impacts on health and safety risks of local people.

The impact magnitude is predicted from small to medium level because: (i) impacts are local at each construction site; (ii) construction time is not too long from 15-24 months; (iii) number of workers are from 30 to 70 workers per site, moreover the contractor employs local staff; (iv) workers are trained on occupational safety, traffic safety, environmental sanitation and so on. This impact can be mitigated through ECOPs.

❖ ***Risk of worker safety and health***

Construction activities including excavation, backfilling, leveling, loading and unloading of building materials, operation of equipment (excavators, cranes, trucks, welding machines and concrete mixers), and construction at height or on water surface and so on contain the risk of labor accidents, traffic accidents or the risk affecting health of workers without appropriate control measures. In addition, the storage and use of fuels including electricity, gas and petrol can be at the risks such as electric shock, fire; explosion, gas leak, etc. This will directly affect health and safety of workers. Occupational accidents can happen during any construction phase of the subproject. Work accidents during the construction process can be caused by:

- Workers working on rivers (embankments, bridges and rivers) are at risk of drowning, and workers working at height (construction of high-rise buildings) may fall owning to carelessness or fatigue or non-compliance with the labor safety during the construction process in the area;
- Health condition: Especially workers work outdoors under hot weather (temperature can be up to 38^0C - 40^0C in summer);
- Operation of machines and equipment is used for unloading materials, equipment, dredging, excavation, construction and transportation of materials;
- Landslide occurs in deeply-excavated areas, abutments, embankments;
- Injury is caused by insect bites or broken glass when working in the bushes during site clearance process;
- Extreme weather conditions including heavy rain, storms, flash floods or extremely hot;
- Demolition of the existing bridges: Accidents can occur if people and vehicles travel on the bridges which are being destroyed;
- The risks of infectious diseases, social diseases and sexually transmitted diseases.

In general, the risk to safety and health of workers is assessed as "LOW" because: (i) impacts are localized at the construction site and scattered in the local subprojects area; (ii) construction

time of work items is short; (iii) the contractor equips workers with protective equipment, arranges reasonable construction time and provides training to ensure traffic safety and occupational safety on the construction site; (iv) Fuel storage areas are not located near the camp and are regularly inspected to minimize the risk of fire and explosion; (v) Training on fire and explosion prevention and fighting will be implemented; (vi) Propaganda, dissemination and guidelines in the prevention of infectious diseases and sexually transmitted diseases will be carried out. These impacts are mitigable through appropriate solutions including training on occupational safety and traffic safety, etc. before and during the construction and provision process of adequate protective equipment for workers.

5. On-Site Flooding

The on-site flooding can be derived from ground excavation and leveling which cut drainage system in combination with heavy rain. If temporary drainage system is not arranged, on-site flooding will affect workers, local residents and construction site. Long-lasting flooding can (ii) lose local beautiful landscape, affect environmental sanitation and cause potential congestion-related epidemics; (iii) damage construction works. Items which are prone to flooding: Xuong Rong, Mo Bach ditches, Huong Son and Phan Dinh Phung kindergartens, Dan Bridge. On-site flooding mainly happens in rainy season (from May to September). The on-site flooding is assessed to be MEDIUM because: (i) in Thai Nguyen the stormwater and wastewater drain in a common drainage system; (ii) Xuong Rong, Mo Bach ditches are drainage canals but have small and narrow bed; (iii) inner drainage culvert system is small and the water is quickly stagnated when it rains. However, the flooding can be mitigated by technical measures.

(a) Hoang Van Thu road

(b) Luong Ngoc Quyen road

(c) Minh Cau road

(d) Huong Son road

Figure 31: Flooding due to heavy rain in Thai Nguyen city center

4.4.2. Site specific impacts

1. Impacts on water environment

Rehabilitation and construction of Xuong Rong and Mo Bach ditches and 04 bridges (Huong

Thuong, Mo Linh 1, Mo Linh 2, Dan) require excavation, backfilling and dredge which cause a large volume of spoils. Excavation and backfilling for reinforcement of embankment, piers and abutment as well as dredge of Xuong Rong and Mo Bach ditches will contribute to increase in suspended solid wastes which are swept away toward the downstream. In addition, the run-off may sweep pollutants in the area (construction materials, soil, sand, grease and wastes, etc.) to water bodies (Cau river, Mo Linh stream, Xuong Rong and Mo Bach ditches), causing water pollution. This will leading to increasing suspended substances in water, affecting habitats of plants and animals in the subproject area. However, there are no endemic animals and plants found in the area. Excavation, backfilling and dredging activities are taken place in dry seasons when water in rivers and ditches is at lowest level. Therefore, impacts are taken place within 15-24 months for each bridge, embankment and will be stopped until the works are in operation. In conclusion, impacts are considered to be from low to medium, temporary and mitigable.

Cau River (item 1)

Ho Nui Coc diversion canal (item 4)

Xuong Rong ditch (item 6)

Mo Bach ditch (item 7)

Figure 32: Surface water at some subproject sites

2. Erosion and subsidence impacts and damages on existing infrastructure

During construction, some activities such as piling in embankment foot; pile drilling for construction of abutments/piers; excavation of existing soil can cause subsistence or damages on surrounding areas. Constructed items which have potential impacts on surrounding structures include: bridge across NH3, Xuong Rong and Mo Bach ditches, Huong Son and Phan Dinh Phung kindergartens. The impact level is considered to be high in case of rain whereas it is assessed to be LOW because: (i) construction activities are occurred in dry season; (ii) the impacts are localized and in short time in construction areas; (iii) piling and pile drilling are carried out in sparsely populated area and about 50m from surrounding infrastructure; (iv) construction activities of Huong Son and Phan Dinh Phung kindergartens near residential areas mainly are excavation of organic soil ground at a depth of 0.5m; (v) construction on stable

ground. The impacts can be controlled by monitoring in combination with suitable construction methods and measures.

Area of bridge across NH3

Area of Huong Son kindergarten

Area of Phan Dinh Phung kindergarten

Figure 33: Existing structures in construction sites

3. Impacts on waterway transport

Out of 05 bridges across rivers (Huong Thuong, Mo Linh 1, Mo Linh 2 and Dan bridge), there is only Huong Thuong bridge is cross Cau river which has waterway activities. Within 20 months of construction, waterway transportation will be affected or circulation width will be narrowed down. However, the transportation are operated at low rate and frequent (1-2 trips/day). Normally, the activities are transportation of agricultural products by small boats. Thus, the impacts are considered to be at low level. The Subproject Owner and Contractor will closely work with local waterway management agency to grasp information about alternative ways for boats so that impacts can be mitigated.

Figure 34: Waterway transportation in Cau River through Huong Thuong Bridge

4. Impacts on school activities of Phan Dinh Phung kindergarten

Construction of Phan Dinh Phung kindergarten will require dismantlement of existing one, two-floor buildings, leading to disturbances to teaching and learning of 350 children and 26 teachers in Phan Dinh Phung kindergarten. According to the survey results, consultation with the President of the Kindergarten and the construction plan and methods of the work items, the teachers… teachers and children will move to another place to continue the school activities. Such impacts consist of: (i) interruption of teaching and learning activities of Phan Dinh Phung kindergarten; (ii) impacts on children's psychophysiology when moving to another place; (iii) Impacts on teaching activities due to lack of teaching aids; (iv) impacts on daily activities e.i parents pick up children to school; (v) disturbances to daily activities of residents surrounding

new teaching and learning place; (vi) impacts on transport conditions in the new place. However, such impacts are assessed at MEDIUM level because:

- Impacts are localized in new teaching and learning place;
- Short-time and discontinuous impacts during construction (15 months), impacts are severe in 1-2 month after removal and gradually ease with time.
- Temporary place is about 0.5 – 2.0 km away from existing kindergarten, so local transport activities will be insignificantly affected;
- The temporary place is in Phan Dinh Phung ward and almost all children are living in the ward, so local community's daily activities will not be disturbed.

After Phan Dinh Phung kindergarten is rebuilt and come into operation, teaching and learning conditions and aids will be highly improved. It can be seen that positive impacts will be much higher in comparison with the impacts caused by removal to temporary place. In addition, the impacts from removal can be mitigated by suitable mitigation measures.

Figure 35: Current status of existing infrastructure of Phan Dinh Phung Kindergarten

5. Impacts of Malodors from dredged spoils

Xuong Rong and Mo Bach ditches will be dredged with a length of 3,200 m and 3,854m respectively and at a depth from 0.5-1.0m, about 0.8m on average. Total dredged sludge volume from the two ditches is 30,050 m^3(mainly organic sludge), in which there are 24,400m^3 from Mo Bach and 5,650m^3 from Xuong Rong. The dredged sludge will be loaded on specialized trucks and transported to Da Mai gathering site or Tich Luong landfill.

However, the activities will disturb the current balance, evaporate persistent organic compounds and cause offensive malodors. Gases emitted from anaerobic digestion are NH_3, H_2S, CH_4, amines, organic acids, volatile organic compounds (VOCs), etc. Malodors from dredged spoils will cause direct impacts on workers and local residents near subproject areas. In addition, sludge contains pathogenic bacteria, viruses, and helminthes, parasites which can affect workers' and local people's health.

Dredged spoils in Xuong Rong ditch

Dredged spoils in Mo Bach ditch

Figure 36: Current status of ditches needing to be dredged

❖ ***Malodor from dredged spoils***

According to findings from Cambridge Environmental Research on malodor intensity:

- Malodor detection: 1 Ou/m^3
- Slight malodor: 5 Ou/m^3
- Distinctive malodors with strong smell: 10 Ou/m^3

Because of similarity about natural conditions between work items to be dredged by the subproject and other items in Thai Nguyen city, the malodor emission from the sludge ranges from 5.42 - 8.42 Ou/m^3. Impacts from the malodors are forecasted by Screen View model and shown in Figure 37.

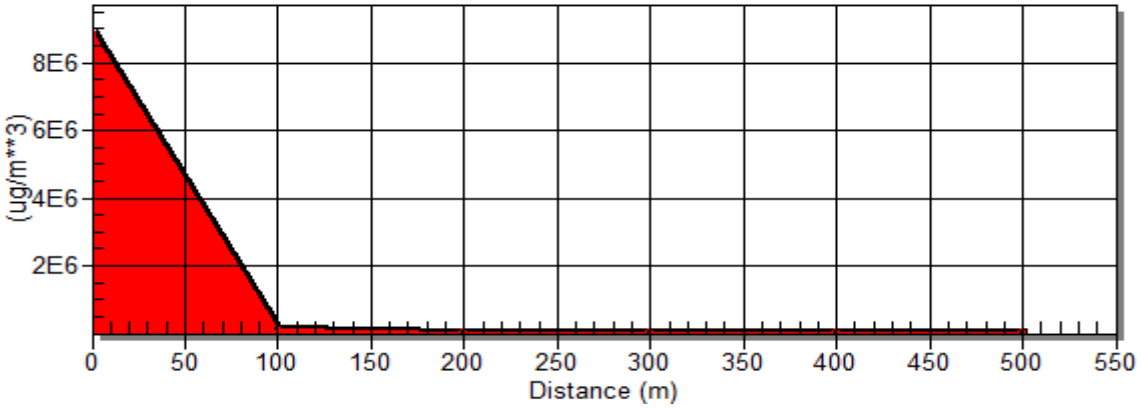


Figure 37: Malodor from dredging process

❖ ***Exhaust gases from dredged spoils***

Dredged spoils can have stink from organic sediment, clay sediment or malodors from NH_3 and CH_4 in the process of anaerobic digestion in water. Gas emission from dredged materials is forecasted and shown in Figure 38 and Figure 39.

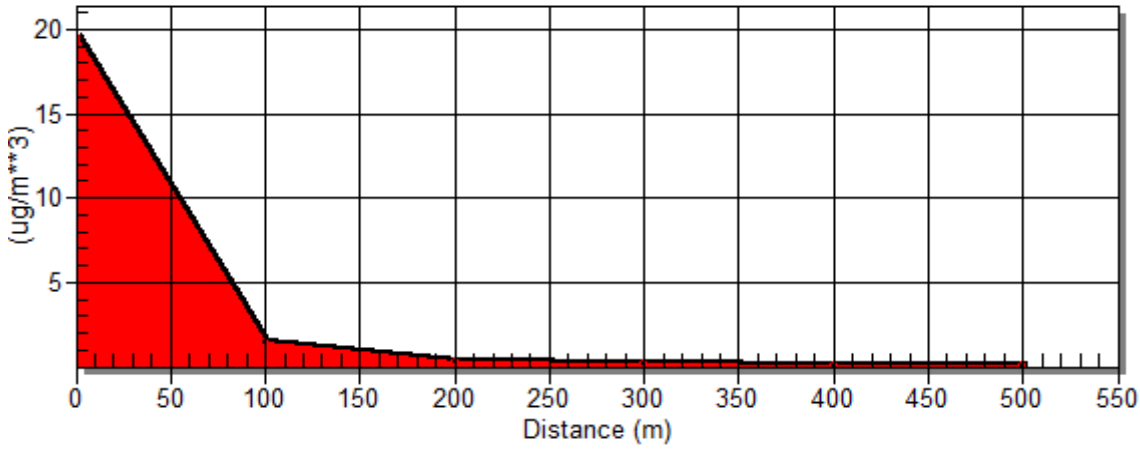


Figure 38: NH_3 emission from dredged sludge

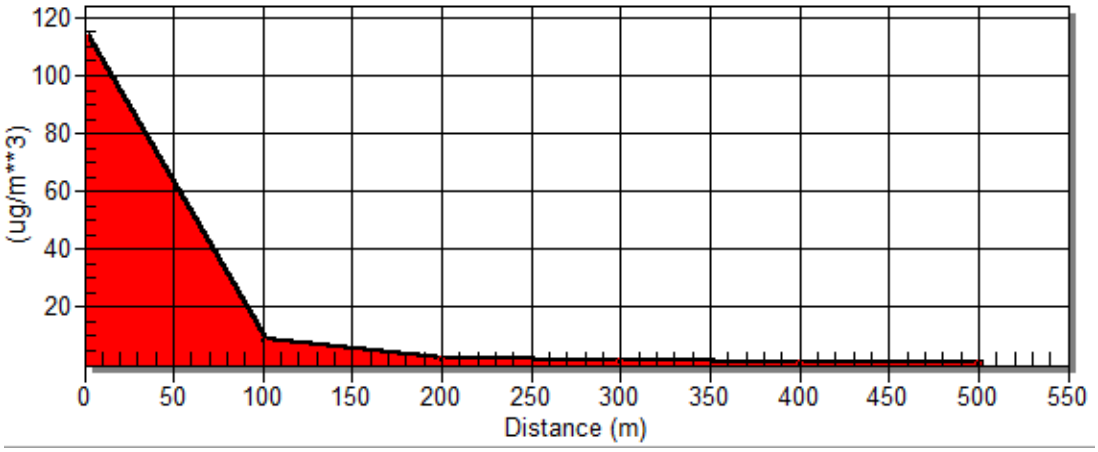


Figure 39: CH_4 emission from dredged sludge

According to results from Figure 37, Figure 38 and Figure 39:

- Offensive malodor from construction site is at LOW level.
- Emission from dredged materials is not high and lower than allowable limits (200 µg/m^3) at QCVN 06:2009/BTNMT – National Technical Regulation on hazardous substances in ambient air.

Therefore, impacts from malodors and emission of dredged spoils from Xuong Rong and Mo Bach ditches are assessed at LOW level: (i) distance from residents to the work items is >50m; (ii) successive construction methods applied in the course of construction, thus, impacts are localized within dredging area; (iii) dredged sludge is transported to Da Mai gathering site or Tich Luong landfill; (iv) dredged sludge load is not large; (v) the dredging is taken place in construction period (about 20-24 months). At the same time, the malodor and exhaust gases from dredged materials can be mitigated through dredged material management plans which are suitable to construction measures and local conditions.

6. Water leakage from dredged materials during dredging of Xuong Rong and Mo Bach ditches

Total volume of sludge to be dredged for 02 items of Mo Bach and Xuong Rong ditches is 30,050 m^3. Sludge is transported by specialized vehicles from the construction site to the disposal site of dredged materials – Da Mai and Tich Luong ward disposal sites. However, sludge is dewatered before transporting, estimated at 20% of total dredged sludge volume. Thus, the total amount of water leaking from the dredged materials is 6,010 m^3, equivalent to 16.69 m^3/day. This water volume is led back to Xuong Rong and Mo Bach ditches. Results of

sediment monitoring at Xuong Xuong and Mo Bach ditches showed that the sludge showed no sign of contamination with heavy metals, so the seepage water compositions contained high content of TSS, affecting aquatic life of the receiving sources.

Impacts are assessed as LOW because: (i) Impacts are localized at the construction site; (ii) Volume of seepage water is minor and led back to Xuong Rong and Mo Bach ditches with low speed and flow to limit turbidity to the receiving sources; (iii) Aquatics in two ditches are mainly normal species with low economic value; (iv) dredging does not occur at time of water supply for agricultural production. These impacts are mitigable through the dredged material management plan which has been prepared in relevant with the construction methods and local conditions.

Figure 40: Reference image of sludge dredging from canals and ditches

7. Impacts on agricultural production activities

The Subproject implementation will affect 862 households on agricultural production (rice and crops). The impacts on agricultural production of the Subproject are as follows:

- Although construction activities are carried out in a sequential manner, it may affect agricultural production activities at different stages of sowing, planting and harvesting.
- Overflow water from the site, if not properly managed, can contaminate irrigation water and soil, affecting yield of crops.
- Construction waste and domestic waste, if not regularly collected, can lead to the sedimentation of agricultural land areas.
- Improper collection of materials at locations will affect the access of local people to farming areas.
- Domestic wastes, construction wastes, wastewater, if not well controlled, will directly affect cultivation households.
- Excavation and embankment activities can increase the turbidity of the water, affecting irrigation.
- Construction of the roads can separate agricultural land areas, local roads, affecting the movement and cultivation of local people.

Impacts on agricultural production take place in the Southnorth road and Huong Thuong bridge, Huong Thuong - Chua Hang road, Dong Bam road, Le Huu Trac road, Xuong Rong and Mo Bach ditches.

However, the impacts are assessed as LOW because: (i) the items are contructed on successive basis, therefore, these impacts are localized only at the construction site: (ii) the Subproject Owner and Contractor arrange the temporary roads if construction activities affect traffic circulation; (iii) the Subproject Owner and Contractor will arrange water supply and drainage for agricultural production areas; (iv) Wastewater and waste are collected daily by workers and local authorities; (v) Time for excavation and embankment is arranged appropriately and inform

local communities and limit excavation and embankment in water bodies at the time of water supply for agricultural production; (vi) Impacts will only occur during construction and end when the works comes into operation (15-24 months).

Figure 41: Current status of agricultural production

8. Impacts on groundwater quality

Pile driving or drilling activities at the distance of 8 - 20 m at the construction sites of Huong Thuong, Mo Linh 1, Mo Linh 2, Dan bridges and NH3 overpass or at 02 ditches of Xuong Rong and Mo Bach may affect groundwater because:

- When passing through shallow water layers (12 ÷ 20 m), part of the pile body with bentonite containing additives will be submerged in the water cascade complex. Bentonite with potential toxic additives will penetrate this complex and infiltrate into the water fountains containing pollutants from the piles.
- During construction, contaminated surface water will overflow in the gaps between the spaces and the underground boreholes. When intruded, dirt can contaminate groundwater.

These impacts are considered as LOW because most of bentonite volume is collected to minimize impacts on surface water and groundwater. In addition, the pile driving only happens in the dry season when water level and water use demands in this area are low in short-term (about 1 – 2 weeks) and localized at the construction site.

9. Impacts on traffic at the construction sites of bridges

The Subproject will build 5 bridges, however, the three bridges of Huong Thong, Mo Linh 1 and Mo Linh 2 are built on the new route, and therefore, they will not affect current traffic circulation. Construction of two bridges, including Dan bridge and National Highway 3 overpass (on Le Huu Trac road) will affect traffic circulation at the construction site of the bridges.

❖ ***Dan bridge***

Dan bridge is built on Quang Trung road which plays an important role in traffic connection to Ho Nui Coc tourist area and Tan Cuong tea area, at the same time being one of the important tourism destinations of Thai Nguyen province. The construction of Dan bridge will affect traffic within approximately 18 months, affecting about 500 households living on the two bridge ends, affecting about 12,000 vehicle trips per day (including motorcycles, cars, passenger cars and trucks).

However, impacts on traffic at the construction site of Dan bridge are considered as LOW because: (i) the works will build each compartment, therefore, Dan bridge will be maintained to ensure current traffic circulation. Dan bridge will be destroyed and rebuilt after Compartment 1 is completed; (ii) the Contractor will equip traffic signs and arrange staff to direct traffic during the construction period of the bridge.

Figure 42: Traffic status at construction site of Dan bridge

❖ ***National Highway 3 overpass***

National Highway 3 overpass is built on Le Huu Trac road. At present, National Highway 3 overpass has one compartment with the width of 8.0m. The works will build additional compartment 2 of the width B = 8.0m to the right of compartment 1 (towards the end of the route). The construction will not affect traffic on the existing Le Huu Trac road; however, it will affect traffic on National Highway 3 with potential risks of traffic accidents due to high speed of 100km/h in maximum and high density from 6am to 6pm every day. This is an important route to connect Hanoi and the Northern mountainous provinces; therefore the traffic flow passing through the area is huge. However, the impacts are assessed as MEDIUM because: (i) The Subproject Owner and the Contractor will arrange speed limit signs when passing through the construction site, and arrange attention signs, etc. These signs are arranged at appropriate distances of approximately 2 km from the construction site in both ways; (ii) The construction time is not too long (about 3-4 months); (iii) impacts are localized only at the construction site; (iv) The construction plan is publically informed to the local communities via the mass media such as television, broadcasting or newspapers, etc.; (v) The construction method is successive and the construction mainly takes place at nights with the sufficient provision of lighting system at the construction site and at instructive areas; (vi) Close coordination with the highway authority will be made to have appropriate measures for traffic diversion and construction; and (vii) the Subproject Owner should obtain permission from the NH3 authority beforce commencement of construction.

Figure 43: Traffic status at National Highway 3 overpass

10. Business interruption

Construction of the Southnorth road, Huong Thuong-Chua Hang road, Le Huu Trac road will affect 74 business households (small business of daily consumers such as cake, candy, fruits, vegetables and coffee restaurants). In addition to risks of safety, noise and dust from construction activities and construction equipment, business households may temporarily experience business disruption (15 to 20 months) due to limited marketing. However, theses impacts are assessed as LOW because: (i) construction items are constructed on a successive basis, thus interruption of business activities is localized (within scope of household); (ii) short-

term impact duration (2-3 months for each household); (iii) when the subproject goes into operation, it will contribute to the development of the household business. These impacts are mitigable through the Resettlement Action Plan which has been separately prepared for the Subproject.

Figure 44: Status of production and business at the subproject area

11. Dust and exhausted gases from welding stage

The construction of bridge items such as Dan bridge, Mo Linh 1 and Mo Linh 2 bridges, and National Highway 3 overpass and Huong Thuong bridge will definitely be involved in welding. The types of chemicals contained in welding rod will generate smoke that contains toxic substances, causing environment pollution and affect the health of the workers. The electric welding creates extremely strong light and can cause serious injuries to workers' eyes. In unexpected cases, welding can lead to blindness. In addition, welding producing toxic smoke if prolonged exposure can cause severe chronic diseases, even in high concentration, victims can be acute poisonous.

Table 74: Load of pollutants during welding

Pollutants	Diameter of welding rod (mm)				
	2.5	**3.25**	**4**	**5**	**6**
Welding smoke (containing other pollutants) (mg /welding rod)	285	508	706	1,100	1,578
CO (mg/welding rod)	10	15	25	35	50
NOx (mg/welding rod)	12	20	30	45	70

Source: Pham Ngoc Dang, Air Environment Pollution, Science and Technics Publishing House, 2004

According to the feasibility study, the total amount of welding rods used is approximately 250 kg for 5 bridges. It is assumed that use of welding rods with average diameter of 4 mm and 25 welding rods per kilogram, the load of toxic gases generated from welding during the construction process is as follows:

- Welding smoke: 4.41 kg
- CO: 0.16 kg
- NOx: 0.19 kg

Welding smoke and exhaust gases from welding appear thoroughly the construction of bridges (450 - 600 days), thus the pollution concentration is dispersed. Moreover, the impacts are discontinuous and localized only at the construction site. The residential areas located far away from the construction area (about 50m), impacts caused by welding will affect some workers who are directly engaged in construction. Therefore, the impacts from welding are assessed as LOW and mitigable.

Figure 45: Reference image of welding activity when constructing the bridge

12. Risks and unsafety during construction nearby production forests

There are 3 out of 9 work items under the Subproject to be constructed nearby the households' production forests, including (i) Huong Thuong – Chua Hang road; (ii) Le Huu Trac road, and (iii) Mo Bach ditch.

Construction near the production forest might cause potential risks for workers who are directly involved in construction by insects, bees, mosquitoes or snakes, predators; Workers may get diseases such as influenza, dengue fever, malaria, gastrointestinal disease, and skin diseases when they are living and working near the production forest. This will directly affect live and health of workers.

In addition, construction near the production forest will cause potential risks of workers' hunting and trapping animals for food, cutting down trees for firewood; risks of forest fire due to workers' carelessness in cooking and smoking. This will significantly affect the flora and fauna living near the project area, risk of biodiversity loss or conflicts between workers and local communities.

However, this impact is assessed as LOW and locally happen at construction site and in a short time (during the construction period of 15-24 months): (i) It is the production forest with main trees of acacia, cajuput, therefore, the diversity is low; (ii) There is no wildlife animals (tigers, leopards, deer, etc.) living in the Subproject areas, therefore hunting forest animals or being attacked by predators will not happen; (iii) Workers will be trained and raised awareness of forest protection and forest fire prevention. At the same time, workers only work within the area of occupied land, not encroach on the production areas of local people; (iv) workers are provided with labor protection equipment to prevent insects, mosquitoes and mosquitoes; (v) At each construction site, medical cabinets will be equipped at each construction site for first aid in cases of beating by insects, bees, mosquitoes or diseases related to dengue fever, malaria, digestive diseases and skin diseases. At the same time, the construction sites are only about 1-2km away from the medical stations, therefore, it is convenient for first aid for workers. This impact is mitigable through the compliance with on-site rules and regulations and the appropriate construction and mitigation measures for each site.

13. Impacts at the disposal sites

Waste, which is dumped into 02 disposal sites, can be divided into two types of waste of construction and sludge

- ***Da Mai disposal site***

Waste of construction is dumped into a separate area. For sludge dredging, the dumping site is a hole with waterproof tarpaulin and using lime powder during disposal. Da Mai disposal has waste water and rainwater drainage system. There is no any problems happen during operation. Therefore, impacts by dumping at Da Mai disposal site is very small and the project owners do not need to have additional measures to protect the environment at the disposal site.

- ***Tich Luong disposal site***

The dumping ground of Tich Luong Ward is about 80m from the rice field and separated by a 6m wide concrete road. The nearest house is 100m away. This is a rural residential area with no domestic water supply system, underground pipes or cables around the area. Therefore, impacts at Tich Luong disposal site as following:

- The risk of traffic accidents during the transportation of waste
- The risk of sewage sludge leak and infiltrate into the ground water. This is the biggest impact because local people use ground water for living activities.
- Overflowing rain water drains waste and sludge into the water body.

These impacts are considered to be moderate but after mitigation measures, this effect is almost negligible.

4.4.3. Impacts on sensitive works

The construction of different subproject items may affect some sensitive works located near the construction sites, including the inconvenience of the people when they want to move to the that areas; Exhaust gases and dust can become a nuisance for local residents and cultural activities; Traffic safety and accident-related risks during the construction. The survey shows that the subproject construction may not only affect the workers and neighboring communities, but also affect some sensitive structures on the transportation routes of materials. The magnitude of impact is assessed as medium, temporary and mitigable. Details of the works within a radius of 200 - 500 m around the subproject area are described as follows:

Table 75: Impacts on sensitive works

Sensitive works	Characteristics of works	Impacts
1. Construction of Southnorth road & Huong Thuong bridge: There are two sensitive works		
Huong Thuong commune kindergarten 	- Located at the end of Southnorth road, Huong Thuong bridge, about 230m from the end point of the road. - The kindergarten serves for about 300 children in Huong Thuong commune. - Studying time takes place from Monday to Friday, starting time: 7h-8h and ending time 16h30 - 17h30.	- Dust, exhaust gases. - Noise, vibration. - Traffic jam at time after school from Monday to Friday, starting time from 7 - 8 am and the ending time from 16h30 - 17h30 - Potential risk of traffic accidents at time taking children to the school and time after school due to transportation of construction materials. - Affect health of children and teachers due to uncollected domestic waste and waste water. - Affect recreation and entertainment activities of children.

Sensitive works	Characteristics of works	Impacts
Water pumping station near Huong Thuong bridge 	- Located at downstream of Huong Thuong bridge under the works of Southnorth road, Huong Thuong bridge. - This pumping station takes water directly from Cau river to irrigate for the fields in Huong Thuong commune with area more than 80 hectares. - The pumping station operates intermittently due to depending on the seasons, mainly in the dry season (from January to April). The operation frequency is about 7 days to timely catch up with the cultivation progress.	- Interruption of water pumping for irrigation of 80 ha of fields in Huong Thuong commune - Impacts on development of plants, reducing productivity of rice, leading to affecting income of people - Transportation can damage equipment of the pumping station. - Affect period of water irrigation for agricultural production activities. - Potential risks of landslide and erosion during the construction.
2. Construction of Huong Thuong – Chua Hang road: There are 5 sensitive works		
Linh Trung communal house 	- Situated along Huong Thuong – Chua Hang road (Km0+800). - There is no land occupation under this works. - The worship activities are mainly on the 1st and 15th of the months (lunar calendar). There is only one day for god worship in Linh Trung cultural house.	- Dust, exhaust gases. - Noise, vibration. - Dropped solid waste will affect the spiritual and social activities of local people when going to the communal house. - Restrict people's access to Linh Trung communal house. - Risks of community conflicts.
Thong hamlet lake 	- Located along Huong Thuong – Chua Hang road (Km1+700). - This is a large lake with area of about 2.5 ha, which stores and supplies water for farming and aquaculture for the whole surrounding area.	- Wastwwater, solid waste and hazardous waste dropped into the lake causes death of fishes - Affect economy of fishery household - Affect lake water quality. - Conflicts between workers and local people
Nam Son hamlet church 	- Located about 70m (Km2+400) away from Huong Thuong – Chua Hang road. - Area of the works is about 2,000m^2. - Local people often go to the church at the weekend and on 24 December every year.	- Dust, exhaust gases. - Noise, vibration. - Traffic jams and accidents - Conflicts between workers and local people. - Restrict people's access to the church.
Cemetery in Chua Hang ward	- Located about 80m away from the end point of Huong Thuong – Chua Hang road. - Area of the works is about 1.0	- Solid waste dropped will affect environmental sanitation of the area. - Restrict people's access to

Sensitive works	Characteristics of works	Impacts
	ha. - Worship activities are not continuous and mainly on Qingming festival, 15th July (lunar calendar) and tending graves at the end of Lunar year.	the cemetery. - Affect the activities of tending graves - Conflicts between workers and local people.
Monument to War Heroes and Martyrs in Chua Hang ward 	Located about 120m away from the end point of Huong Thuong – Chua Hang road. - Area of the works is about 6,400 m^2. - - Worship activities are not continuous, mainly on 27th July every year.	- Solid waste dropped will affect environmental sanitation of the area. - Restrict people's access to the cemetery. - Affect the activities of tending and worship. - Conflicts between workers and local people.
3. Upgrading and construction of Dong Bam road: There are two sensitive works		
Cemetery in Nhi Hoa village 	- Located about 130m away from the road passing Dong Bam residential site. - Area of the works is about 1.0 ha. - Worship activities are not continuous and mainly on Qingming festival, 15th July (lunar calendar) and tending graves at the end of lunar year.	- Solid waste dropped will affect environmental sanitation of the area. - Restrict people's access to the cemetery. - Affect the activities of tending graves. - Conflicts between workers and local people.
Cemetery near Dong Bam residential area 	- Located about 50m away from the road passing Dong Bam residential site. - Area of the works is about 1,000 m^2. - Worship activities are not continuous and mainly on Qingming festival, 15th July (lunar calendar) and tending graves at the end of lunar year.	
4. Upgrading of Dan bridge: No sensitive works		
5. Upgrading and Construction of Le Huu Trac road: There is one sensitive works		
Thai Nguyen Provincial Mental Hospital 	- Located about 90 away from the starting point of Le Huu Trac road. - Area of the works is about 3,000 m^2. - No. of staff: 50 persons - No. of patients: 8,500 persons	- Dust, exhaust gas. - Noise, vibration. - Solid waste. - Wastewater - Affect the examination and treatment of diseases. - Traffic jams and accidents. - Conflicts with workers. - Restrict access.

Sensitive works	Characteristics of works	Impacts
6. Construction of Huong Son kindergartens: There is no sensitive works		
7. Upgrading of Phan Dinh Phung kindergarten: There is no sensitive works		
8. Rehabilitation of Xuong Rong drainage ditch: There is no sensitive works		
9. Rehabilitation of Mo Bach stream drainage ditch: There is one sensitive works		
Thai Hai Primary school and Kindergarten 	- Located about 30m away from Mo Bach drainage ditch. - Area of school campus is about 7,200m^2 with 24 classes including kindergarten and primary classes. The school has about 50 teachers and over 350 pupils/children. - Studying time takes place all days in a week, starting time 6h30 – 7h30, 13h-14h and the ending time: 11h-12h, 16h30-17h30.	- Dust, exhaust gas. - Noise, vibration. - Solid waste. - Wastewater - Odor from dredging - Traffic jams and accidents. - Restrict parents' and teachers' access. - Community conflicts. - Affect outdoor activities.

Generally, impacts caused by the Subproject construction on the sensitive works are assessed as LOW because: The construction time at these locations is not long (about 1 – 2 months); (ii) Impacts are localized and gradually decrease by distance. These impacts are mitigable.

4.5. Impacts and risks during the operation phase

Construction of roads, bridges, rehabilitation of drainage ditches and construction of kindergartens will contribute to improving infrastructure, environmental sanitation, improving living conditions, boosting trade and services exchange and connect to the areas of the city and surrounding areas. When puting operation, the subproject works will not affect sensitive works; However, in the operation phase, the following impacts should be considered:

1. Changes in topography and flow of Xuong Rong and Mo Bach ditches

The area of Xuong Rong and Mo Bach ditches is expanded with the width of B = 8 - 25m and dredged with an average depth of 0.8m, while along 02 banks will be reinforced with concrete. As a result, Xuong Rong and Mo Bach ditches have changes in flow (changes in hydrological and hydraulic regime). The realignment and expansion of the route will facilitate the flow, ensuring the drainage during the rainy and flooding season and ensuring the stability of the works; however, there will be potential risks of landslide, affecting the production and daily living activities of the people living along the two ditches. However, the impacts caused by changes in flow are assessed as LOW because the condition of topography of the two sides of the canal has been changed from earth banks into concrete ones. This reduces landslide and erosion into the land area of people, gradually ensuring the stability of people's lives.


Figure 46: Image of embanked Mo Bach ditch section

2. Road safety during the operation of 04 roads and Dan bridge

Road safety is one of main impacts during the operation of the roads of the Southnorth, Huong Thuong - Chua Hang, Dong Bam, Le Huu Trac and the bridges of Huong Thuong, Mo Linh 1, Mo Linh 2 , Dan and NH3 overpass. In the early years when the transportation by non-motorized vehicles (bicycles, ox-carts) has been combined with the transportation by motorized vehicles (cars, motorcycles, trucks, etc.) and the level of traffic accidents can increase. Experience showed that this situation can be managed by raising community's awareness of the road rules and practices as well as monitoring and enforcing the speed and behaviors of road users. In the long-term, when traffic flow is high, the emission of dust, exhaust gases, noise and vibration can become a matter to be taken into account but mitigable by the long-term plan.

Figure 47: Traffic image on Viet Bac – Thai Nguyen road

3. Change of the ecological landscape and land use purposes

When the two works of Xuong Rong and Mo Bach ditches are put into operation, the ecological landscapes along the two ditches will be improved because: (i) the flow will be widened, reducing flooding in case of heavy rains or floods in the construction site; (ii) Domestic wastewater from households will not be directly discharged into 02 ditches but collected by the drainage sewer system; (iii) dredging of canals and ditches will reduce malodors, thereby improving environmental sanitation. These impacts are assessed as positive and HIGH, changing living environment conditions of the local people in a positive way, gradually contributing to stabilizing people's lives.

The agricultural land areas along the two sides of the Southnorth road, Huong Thuong - Chua Hang road, Dong Bam road, Le Huu Trac road, Xuong Rong ditch, Mo Bach ditch tend to convert into urban residential land, reducing the area of agricultural land, affecting the production of foods and foodstuffs in the subproject area. However, the conversion of land use purpose into residential land will increase the value of the current land plot and increases the value of adjacent land plots. The impacts are assessed as positive and HIGH, which will change in regional socio-economic conditions and stimulate the development of trade and services.

However, many social impacts may occur due to changes in land use and/or associated development (increased volume of solid waste, illegal use of right of way (ROW)); however, this can be a long-term problem. In the early years, these impacts are assessed as LOW, However, improvement of knowledge of socio-economic development opportunities and risks associated with social issues can help mitigate potential negative impacts on the local people.

Change in ecological landscape after completion of ditch embankment (the embanked Mo Bach ditch section)

Change in land use purposes in two sides of road (illustrative image of Viet Bac – Thai Nguyen city road)

Figure 48: Image of ecological landscape and land use purpose change after putting the works into operation

4. Impacts of wastewater and waste during the operation of kindergartens

When two kindergartens of Huong Son and Phan Dinh Phung are put into operation, they will be concentrated by 1000 people. Namely: (i) Huong Son kindergarten has 550 people (50 teachers and 500 pupils); (ii) Phan Dinh Phung kindergarten has 450 people (50 teachers and 400 pupils). This is the emission source of domestic wastewater and waste.

- Domestic wastewater: It is estimated that volume of domestic wastewater generated at Huong Son and Phan Dinh Phung pre-schools is 27.5 m^3/day and 22.5 m^3/day, respectively. As a rule, wastewater from 02 kindergartens will be pre-treated before being discharged into the common drainage system of Thai Nguyen city. The load of pollutants after preliminary treatment will reduce by 30-40% (BOD_5/COD).
- Domestic waste: Estimated amount of domestic waste generated at Huong Son and Phan Dinh Phung kindergartens is 165 kg/day and 135 kg/day, respectively. The amount of domestic waste will be collected and treated on daily basis by Thai Nguyen Urban Environment Joint Stock Company.

Therefore, the impacts of domestic wastewater and wastes during the operation phase of two kindergartens are assessed as LOW because: (i) the amount of domestic wastewater and waste generated is not much and localied only at the schools; (ii) the amount of wastewater is preliminarily treated before being discharged into the environment; (iii) the amount of waste is collected on daily basis by the local functional units.

5. Falling down from height

❖ ***Risks of falling into rivers, streams and drowning***

These cases are alerted when walking up or down the walkways under the embankment or at the sewers along the embankment of the two ditches Xuong Rong and Mo Bach or the means of transport fell to Cau river, Mo Linh stream, Ho Nui Coc diversion canal when traveling on the route. Although the embankments have some sections designed with gray electric-static steel handrails at the embankment peak with a height of 80 - 90 cm, children and the elderly are at risk of falling into rivers, canals and ditches due to slipping or drowning. In addition, in the rainy season, means of transport run on slippery roads can fall into rivers and streams. This will affect health, even life of road users. Specific technical measures need to be researched and supplemented in the subsequent phases and consulted with local communities. Design should be made to prevent threats to the community when using the works.

❖ ***Risk of falling into hard ground***

These situations are warned in case of moving on National Highway 3 overpass or at 02 works of Huong Son and Phan Dinh Phung kindergarten. Although the overpass of National Highway 3 or the second and third floors of the two kindergarten are arranged with concrete balcony with a height of 80-90cm, however, means of transportation or teachers, children can get the risks of falling into hard ground, which affects life and property damage. Specific technical measures need to be researched and supplemented in the next phases and there should be consulted with local communities. Design should be also carried out to prevent threats from the community when using the works.

6. Risks of landslide and subsidence

During the operation phase, there may be incidents, including: (i) embankment landslide and cracking or breaking in the two ditches of Xuong Rong and Mo Bach; (ii) landslide of bridge abutments in 5 bridges (Huong Thuong, Mo Linh 1, Mo Linh 2, Dan bridge, National Highway 3 overpass); (iii) landslides and subsidence of the Southnorth road, Huong Thuong - Chua Hang road, Dong Bam road, Le Huu Trac road or two kindergartens Huong Son and Phan Dinh Phung. These incidents will damage the embankments, bridges, roads, infrastructure, affecting lives and property for the surrounding people and road users. Causes of such incidents include: (i) prolonged natural disasters, floods and heavy rains; (ii) unqualified quality, specifications and materials during the construction process; (iii) overloaded means of transport on roads and bridges; (iv) inadequate and irregular operation and maintenance. Specific technical measures need to be researched and supplemented in the subsequent phases and consulted with local communities. Design should be made to prevent threats to the community when using the works.

7. Risks of flooding when formation of roads

When the roads are put into operation, they can disrupt the natural drainage direction in the area. The elevated roads can form the dyke to prevent inundation in case of heavy rains or in rainy season. The failure of drainage is likely to cause local flooding at some sites, affecting: (i) travel and daily living activities of local people; (ii) long-term flooding can cause environmental pollution, potential risks of epidemics, affecting the health of people in the area; (iii) affecting agricultural production activities, causing loss of property to the people.

To minimize impacts of inundation during the operation of the roads, the Subproject Owner arranged horizontal and vertical sewers along the roads:

- In the design of the roads, post-construction elevation has been taken into account to ensure drainage by the existing natural system.
- Arrange bridges passing through the intersections with the water body.
- Arrange horizontal sewer with sizes suitable with intensity of rain and flow of overflow rainwater over the subproject area.
- Regularly check the areas at risks of inundation to design additional horizontal sewers (if necessary).
- Consult with local authorities and people in the areas at risks of inundation in order to take addition measures in time.

However, specific technical measures need to be researched and supplemented in subsequent phases and consulted with the local communities. Design should be made to prevent threats to the local community when using the works.

8. Impacts at the disposal sites

During the operation phase, there is no impact if dumping at Da Mai disposal site but dumping at Tich Luong disposal site may have some impacts as: risk of traffic accidents, risk of sewage

sludge leak and infiltrate into the ground water, and rain water drains waste and sludge into the water body.

These impacts are considered to be small because the disposal site will be applied mitigation measures and the results of analysis of sediment samples showed that the sediment in Xuong Rong and Mo Bach stream have no pollution

CHAPTER 5. MITIGATION MEASURES

There are several strategies (avoidance, mitigation, rectification, and/or compensation) that have been applied to mitigate the potential negative impacts identified in CHAPTER 4. During the preparation of the subproject, great efforts have been made to avoid potential adverse impacts on resettlement and land acquisition by reducing scope and/or modification of the basic design of the investment subproject. Appropriate compensation plans and strategies have been incorporated to minimize the impacts of land acquisition. The proposed mitigation measures to reduce the impacts due to land acquisition and resettlement are described in the RAP and RPF.

This chapter identifies mitigation measures of the environmental and social impacts during the construction (which include site clearance, ground leveling, and construction) and operation phases. In CHAPTER 6 of this ESIA, Environmental Codes of Practice (ECOPs) have been indicated to mitigate generic impacts of the Subproject. These ECOPs will be incorporated in the Bidding documents and contract documents.

However, for Thai Nguyen City Subproject, there are site-specific impacts at the specific sites and impacts on sensitive works, which require site-specific measures (beside ECOPs) during the phases of the Subproject.

5.1. Mitigation measures in the pre-construction phase

Impacts in the pre-construction phase include (1) land acquisition; (2) Safety risk related to unexploded ordnance (UXO). As the sub-project is constructed according to successive method or due to the short preparation time, impacts from dismantling and site clearance, dredging, excavation, backfilling or workers camps preparation will occur during the construction phase. At the same time, there has no impact on sensitive works during the pre-construction phase.

1. Impacts mitigation measures by land acquisition, compensation and resettlement

Land acquisition and resettlement shall comply with the RPF under the Dynamic Cities Integrated Development Project. The Resettlement Action Plan (RAP) of the subproject will be prepared in accordance with the RPF.

- ***Technical measures are integrated in design to minimize the area, number of affected households and assets***

For roads: The roads are designed with surface water drainage system, roadside, traffic signs to ensure traffic safety in accordance with standards, slope stability along the access roads, if necessary and trees are planted along the roads. In the detailed design, the PMU will ensure requirements for completed drainage systems to avoid flooding during the construction and operation process and lighting systems for saving energy to ensure aesthetic.

For bridge construction: Design is based on hydrographic surveys (flood level, flow regime, etc), geological, terrain conditions of the area to ensure safety and efficiency for works operation.

For improvement of ditches and construction of embankments for Xuong Rong and Mo Bach ditches with the aim to limit site clearance for permanent houses owned by local people, it is necessary to ensure that embankments are built straightly along the ditch banks, or shaped, land acquisition is minimized at the lowest level by technical options and construction methods. Besides, there should ensure the form of embankments without curves, fracture, as well as drainage capacity and landslide prevention. In addition, consideration should be given to the following issues: (i) Stairs and balustrades are included in embankment design to maintain safe approach to river banks for local communities; (ii) Trees will be planted along the ditch banks to improve landscape.

For construction of kindergartens: The design process has been calculated based on general planning, socio-economic development planning, specific surveys on hydrological regimes,

terrain, geology, consultation with local authorities, people living in the subproject area to ensure safety, convenience and effective operation of the works.

The detailed design of the works should be clear in all aspects related to excavation and backfilling, management of dredged materials, transportation of dredged materials by covered trucks and leakage prevention equipment; Dredged materials should be treated at appropriate locations which are prepared in advance.

❖ ***Mitigation measures for livelihoods***

299 households are severely affected with agricultural production land (losing over 20% of production land area, or 10% or more of production land area for vulnerable households) by the subproject implementation, in addition to receiving compensation in accordance with the RPF's regulations, households are also involved in livelihood restoration programs, including:

- Vocational training program;
- Job creation program;
- Credit lending to develop household economy through various organizations;

Details of mitigation measures will be provided in the Resettlement Action Plan of the subproject.

❖ ***Mitigation measures for relocated households***

133 households have to relocate by the subproject implementation. Three proposed relocation options include: (i) On-site resettlement (on the remaining area of households); (ii) self-relocation for displaced persons who wish to find their new accommodation and (iii) Concentrated resettlement at resettlement site of the subproject. For the options (i) and (ii) affected households will receive compensation, assistances and arrange new accommodation themselves. For the option (iii) affected households will receive compensation for affected non-land assets and be considered for arranging resettlement in the following locations:

- Residential area 11 of Thinh Dan ward, which was built from end of 2016, has an area of 3ha with 88 plots varying from 150 to 200 m^2 of each plot. This residential area was invested with full infrastructure such as roads, drainage system, power system., etc.
- Dong Bam ward residential area has an area of 10ha with 147 plots varying from 120 m^2 to 180 m^2 of each. This residential area was invested with full infrastructure such as roads, drainage system, power system., etc.
- Tan Lap residential area is located in Tan Lap ward, has an area of 7.5ha with 120 plots varying from 150 m^2 to 200 m^2 of each. This residential area is being invested in construction of infrastructure. It is expected this residential area will be put into operation in Quarter II, 2018.
- The residential area in Tuc Duyen new urban area has an area of 10ha with 170 plots varying from 120 m^2 to 200 m^2. This residential area is being invested in construction of infrastructure. It is expected this residential area will be put into operation in Quarter II, 2018.

Details of mitigation measures are shown in the Resettlement Action Plan of the Subproject.

❖ ***Mitigation measures for affected business households***

74 households affected on business and production, in addition to cash compensation for affected land and assets, shall be provided with:

- Production and business stabilization assistance:
    + Businesses/households with business registration affected by the subproject will be compensated or supported. The maximum compensation/support is equal to

30% of after-tax income of 01 year based on their average annual after-tax revenue of the last three years which have been declared to the tax authorities;

+ Households without business license but who have met their tax obligations will be entitled to compensation equivalent to 50% of support level for registered businesses/households.

- Assistance for removing the production/business facilities: Organizations and PAPs that are leased land by the state or are lawfully using land and have to relocate their productive and/or business establishments are entitled to financial support for dismantling, relocating and re-installation of the establishments. Support levels will be determined by actual costs at the time of removal.
- Allowance for interrupted employment: Employees who are working for affected manufacturing facilities or businesses with labor contract and continuously contributed social insurance at the businesses shall be entitled to receive allowance equivalent to the minimum salary as per the regulations of government on affected employees during the transition period which can be for a maximum of 6 months as well as assistance in seeking job opportunity if needed.

Details of mitigation measures will be provided in the Resettlement Action Plan of the subproject.

❖ ***Mitigation measures for vulnerable households***

There are 73 vulnerable households affected by the subproject implementation. In addition to compensation provided according to the RPF's regulations, vulnerable households will receive additional allowance to facilitate for their lives early restoration. Details of mitigation measures will be provided in the Resettlement Action Plan of the subproject.

❖ ***Impacts mitigation measures by removal of graves***

58 graves (owned by 30 households) are affected and displaced. In addition to the subproject will support relocation costs in compliance with the RPF of the subproject, during the site clearance process, the Subproject Owner in cooperation with local authorities will hold a consultation meeting with 30 affected households so that they can understand desires of local people and make a final and reasonable decision about removal of graves and accordance with regional practices. Details of mitigation measures will be provided in the Resettlement Action Plan of the subproject.

❖ ***The compensation plan for the affected items by the subproject***

Generally, the compensation payment will be transparent and publicalized. Compensation rates will be disclosed at the head offices of the People's Committees of the subproject wards/communes. The budget for implementing the Resettlement Action Plan will be part of the government counterpart fund (budget from Thai Nguyen PPC). Thai Nguyen PPC will provide counterpart funds for the implementation of compensation and resettlement, which will be included in the total investment cost of the subproject.

The estimated cost of implementing the RAP for subproject works is **402,970,000,000** VND, (equivalent to **18,111,000** USD). Below is the compensation bill for the subproject. Detailes of mitigation measures due to land acquisition are indicated in the Resettlement Action Plan of the Subproject.

Table 76: The compensation plan for the affected items by the subproject

No	Item	Total amount	
		VND	USD
1	Compensation for land	212,962,655,396	9,571,355
2	Compensation for structures	82,406,017,141	3,703,641
3	Compensation for trees and crops	1,172,465,197	52,695
4	Compensation for graves	198,000,000	8,899
5	Assistances	54,200,087,438	2,435,959
6	Incentive bonus	2,694,000,000	121,079
7	Total 9 items	353,633,225,172	15,893,628
8	Management expense = 2% IX	7,072,664,503	317,873
9	Contingency (10% of total)	35,363,322,517	1,589,363
10	Other expense	6,901,332,252	310,172
	Independent monitoring = 1% IX	3,536,332,252	158,936
	Income restoration program (temporary)	2,765,000,000	124,270
	Replacement cost survey expense (temporary)	600,000,000	26,966
11	**Total**	**402,970,544,444**	**18,111,036**
	Rounding	**402,970,000,000**	**18,111,000**

Source: Resettlement Action Plan of the Subproject, 2017

2. Impacts by demining unexploded ordnance

Mines and unexploded ordnance should be cleared prior to carrying out construction activities. The steps of clearing unexploded ordnance should be strictly implemented. The Subproject Owner will contract with functional units to clear mines and unexploded ordnance within the subproject area. Clearance of unexploded ordnance is carried out by using a detector according to the following steps:

- Clearance on land:
  + Localizing the clearance areas, treatment of mines and unexploded ordnance;
  + Clearance of site;
  + Detecting to a depth of 0.3m;
  + Marking, excavating, testing and signal processing to a depth of 0.3m;
  + Detecting to a depth of 5m (machines are located at a high sensitivity level);
  + Excavating, inspecting and processing the signal to a depth of 5m.
- Clearance under water: for dredging of Xuong Rong and Mo Bach ditches:
  + Detecting to a depth of 0.5m from the bottom of water.
  + Marking the signal at the depth of 0.5m from the bottom of water.
  + Checking and excavating for processing the signal at depth of 0.5m from the bottom of water.
  + Detecting at depth from 0.5m to 3m or up to 5m from the bottom of water.
  + Marking the signal at a depth of 0.5m to 3m or up to 5m from the bottom of water.
  + Diving for testing, excavating for the signal processing at depth of over 0.5 m to 1 m from the bottom of water.
  + Preparing plan and excavating and processing of underwater signals at depth of

between over 1m and 3m or up to 5m from the bottom of water.

- In wet fields, ponds with a depth of <0.5m, it is necessary to embank banks to drain water, then clearance and processing of bombs and unexploded ordnance is carried out to avoid left them over. In case of clearing unexploded ordnance on land, dangerous warning signs should be placed and staff should be also arranged to prevent local people, animals and vehicles from passing through the construction area in order to avoid accidents.

Collection, classification, transportation management and destruction of unexploded ordnance should be carried out in accordance with safety standards on preservation, transportation and use of explosive materials QCVN 02: 2008/BCT National Technical Regulations on safety in preservation, transportation, use and destruction of industrial explosive materials, explosion regulations by the Ministry of Engineering Command, and other current regulations. The units implementing clearance of unexploded ordnance are responsible for reporting the Military Command in their localities about the situation of performing the task for necessary issues.

5.2. Mitigation measures during the construction phase

5.2.1. Generic mitigation measures

As part of the Environmental and Social Management Plan (ESMP) for the subproject these general measures have been translated into a standard environmental specification to be incorporated into bidding and contract documents. These are referred to as Environmental Codes of Practice (ECOPs), and will be applied to mitigate typical impacts of the subproject's civil works during the pre-construction and construction phase.

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. The measures identify typical mitigation measures for the following aspects:

(1) Impacts of dust;
(2) Air pollution;
(3) Noise and vibration;
(4) Water pollution;
(5) Solid waste;
(6) Hazardous wastes;
(7) Traffic management;
(8) Restoration of affected areas;
(9) Worker and public Safety;
(10) Communication with local communities about subproject environmental issues;
(11) Health and Safety for workers and the public;
(12) Chance finding procedures;
(13) Fire hazard due to accident.

5.2.2. Site specific mitigation measures

Table 77 presents site-specific impacts and mitigation measures for each work item of Thai Nguyen City subproject that are not addressed through the general measures in the ECOPs because of the severity or site-specific nature of the impacts and mitigation measures.

- **Mitigation measures when building bridges**

Construction of bridges will be planned to limit underwater construction in rainy season (from

May to September);

The Contractor shall prepare a specific Environmental, Health and Safety Plan (EHSP) prior to carrying out the demolition of the existing bridges and construction of new bridges. At least, the Environmental, Health and Safety Plan should meet the following requirements:

- Description of measures for spill prevention, sediment control, surface water flow change, restoration, etc should be implemented;
- Local residents will be informed at least two weeks in advance of blocking and dismantling Dan bridge;
- Signs and fences should be installed and maintained to prevent the two heads of the bridge from being safely approached. Staff are arranged to protect the construction site 24 hours a day. Light is adequately ensured at night;
- Instruction signs of traffic direction should be installed at two heads of each existing bridge before dismantling;
- Life jackets and protective equipment are provided for labor and compulsory use when working in water or on water, especially in the construction process of abutments with a depth of 2-3 m;
- Wastes is strictly controlled to limit the discharge or disposal of any wastewater, sludge, waste, fuel and oil into water. All these materials should be collected and treated on land at the bank area. Sludge and sediment are also pumped to the bank for treatment and discharging directly into the river is prohibited;
- Rehabilitation of waterway transport routes is implemented;
- After the bridge implementation, the work area will be restored to its original state;
- Do not mix concrete directly on the ground and only be implemented on non-permeable surface.
- All flows from concrete mixing areas should be strictly controlled, and water contaminated with cement will be collected, stored and treated in the approved area;
- Unused cement bags will be stored away from the overflow of rain water; Used (empty) cement bags will be collected and stored in weather-resistant containers to prevent dust from wind and water pollution;
- All excess concrete should be removed from the site upon completion of the concrete work and treatment. Not allowed to wash excess volume on the ground. All excess volume will also be eliminated;

➢ **Mitigation measures for the items of dredging, construction of embankment and roads and kindergartens**

It should avoid dredging during the rainy season, from May to September, to maintain drainage functions of the river;

The Contractor shall prepare the Contractor's Dredged Management Plan (CDMP) and submit it to the Supervision Consultant and the PMU for review and approval prior to commencement of construction. The dredging plan should clearly show the following contents:

- Scope of works in contract package, method and schedule of dredging,
- Water users may be affected by dredging and lining embankment.
- Volume of dredging, water quality and characteristics of dredged material; Especially water should be tested for pH, DO, TSS, BOD, salinity, etc; Heavy metals including pH, Hg, As, Cd, Cu, Pb, Zn and Cr, organic material and mineral oil should be tested for sediment. A sample of water and a sediment sample should be taken and tested for each tender package.

- Procedures for temporary storage of dredged materials and on-site pollution control plans.
- Method of loading and unloading and transportation of materials to the final processing area: state the road of transportation from the dredging area to the dumping site, the operating time, the type of vehicles/trucks.
- Setting up schedule to inform nearby communities of the subproject, publicizing name and contact number so that complaints can be made if needed.
- Potential social and environmental impacts, including specific impacts and risks of dredging;
- Mitigation measures to address potential impacts and risks;
- Final disposal plan;
- Environmental monitoring plan.

In addition to the mitigation measures associated with normal construction impacts, the dredging plan should meet the following requirements:

- Cofferdams are constructed prior to dredging to isolate the construction site from the surrounding water body areas so that potential impacts on river/stream water quality can be minimized;
- Disturbance on the ground and under the riverbed is maintained at the lowest level; Regular monitoring will ensure that dredged material in temporary treatment areas will not contaminate or flood the surrounding area; Sediment traps are installed around temporary dumping sites;
- Waste water leaking from dredged material will flow back into the river;
- In case of typhoon forecast, dredging or embankment lining activities will be limited, field protection measures will be implemented; All construction activities will be stopped in the event of a storm;

Installation of warning signs in hazardous areas, including overflows, erosion, or deeply excavated areas; Specific safety devices have been identified including lifebuoys provided to workers and compulsory use when working in water. Observers are appointed during the work process for timely rescue in an emergency.

➢ **For construction of social infrastructure works**

- Parents whose children are learning in Phan Dinh Phung kindergarten will be notified at least one month in advance of the time, construction progress and new learning places for the children.
- Wastes are strictly controlled to limit the discharge or disposal of any wastewater, sludge, waste, fuel and oil into the water.
- Waste at foundation holes is strictly controlled and must be flew into the collection system, settling tank before
- Signs and fences must be installed and maintained to prevent access to the construction site
- No construction after 6 pm.
- Designing of kindergartens:
    + Design children-friendly buildings and classrooms (classrooms are beautifully decorated and attractive for children. Playgrounds have suitable, beautiful layout with green spaces for children).
    + Utilities are arranged suitably, easy to use and safe for children (toilets, faucets, sinks, power sockets and switches, etc.).
    + Classrooms are equipped with adequate ventilation system suitable for children.

+ Classrooms are designed to maximize natural light, thereby saving power.
+ Arrange water taps in appropriate locations, ensuring water saving.

Site-specific mitigation measure are presented in Table 77 below.

Table 77: Mitigation measures of site-specific impacts during the construction phase

Site-specific impacts	Mitigation measures
1) Impacts on water environment Two drainage ditches of Xuong Rong and Mo Bach; 04 bridges (Huong Thuong bridge, Mo Linh 1, Mo Linh 2, Dan bridge)	- The dredging operation is conducted only during the dry season; - Create sedimentation traps and maintain them periodically to ensure that most solids in surface runoff are retained in the traps before entering the existing drains or water sources surrounding the sites; - Leachate from sediments must be first deposited in sedimentation hole/trap before entering the river. - Strictly prohibit contractors to discharge waste into river - Collection of redundancy material on site is implemented daily. Upon forecasted stormy weather, suspend all the construction activities, tidy up the sites, brace and protect the materials and construction machines. - Do not gather construction materials as well as machinery and equipment near the river. Gathering small quantities of materials fit with the schedule. Materials must be covered with tarpaulin, avoiding the upwind location, near the river. - Strictly prevent hazardous waste, waste oils or particularly greasy rags from entering the flow. - Comply with QCVN 08-MT:2015/BTNMT, QCVN 14:2008/BTNMT, QCVN 18:2014/BXD.
2) Impacts caused by erosion, subsidence and damages to existing structures NH3 overpass, Xuong Rong ditch, Mo Bach ditch, Huong Son and Phan Dinh Phung kindergartens	- Before dredging, reinforcement will be conducted. This construction method must be proposed and submitted to the authorities concerned for approval by the construction contractors. - Ensure that land acquisition and house relocation at the site boundary is completed prior to commencing construction work. - Use appropriate construction methods with each construction site location. - Closely monitoring the vibration level - Construction of side slope is made in accordance with the design - Do not carry out dredging works in rainy season. - Do not place heavy machineries and transportation vehicles near the canals banks. Inspection and supervision on land subsidence risks must be taken regularly in order to prepare the appropriate reinforcement plans. - Ensure the constant presence of supervision consultants and contractors during construction to monitor the potential risk of erosion and landslides and if necessary take the appropriate action. - Comply with QCVN 18:2014/BXD.
3) Impacts on waterway transport on river Huong Thuong bridge and Cau river	- Coordinate with the local authority to inform local people of the construction plan prior to construction; - Coordinate with waterway management unit to flag the signal system on the inland waterway where means of transport will travel through; - Provide the workers with all appropriate PPE and ensure that life jackets are used in proximity to water. Safety staff must be available at all times for timely rescue in case of incidents. - Place warning boards along the construction route, both on land and water

Site-specific impacts	Mitigation measures
	surface (arrange the road and waterway traffic guide). - Comply with Law on inland waterway navigation No. 23/2004/QH11, the Law on amendment and supplement of a number of Articles of the Law on inland waterway navigation No. 48/2014/QH13 and guidelines on waterway safety of the Ministry of Transport.
4) Impacts on studying and teaching Phan Dinh Phung kindergarten when relocation to temporary place	- Inform pupils at least one month in advance of the estimated relocation schedule to temporary place. - Consult with parents on measures to minimize the psychological effects of children during the relocation process. - Ensure water supply, electricity supply and facilities at the temporary place of teaching and learning. - Notify the local community around the temporary place of teaching and learning of the teaching and learning plan of Phan Dinh Phung Kindergarten. - Relocate to a temporary place of learning and teaching nearby the current place of the kindergarten.
5) Impacts by malodor from dredged materials Xuong Rong and Mo Bach ditches	- Notify the construction progress of each section dredging for surrounding people. - Dredged materials are transported to the disposal site by specialized vehicles. - Do not gather dredged material along the ditches. - Use lime powder to limit malodor dispersion, if necessary. - Do not construct at the rest time, limit construction after 18h. - Consult closely with local people and communities for appropriate mitigation measures. - Provide adequate personal protective equipment for all workers. - Comply with QCVN 18:2014/BXD.
6) Leaking water from dredging 02 ditches of Xuong Rong and Mo Bach	- Dredging activities are only carried out in the dry season; - Water leaking from sediment must be deposited in settling tank/trap before discharging into river; - The process of transporting dredged materials must use specialized vehicles with containers. - No dredging at the time of water intaking for agricultural production activities of the local people. - Comply with QCVN 08-MT:2015/BTNMT, QCVN 14:2008/BTNMT, QCVN 18:2014/BXD.
7) Impacts on agricultural production The Southnorth road, Huong Thuong bridge, Huong Thuong – Chua Hang road, Dong Bam road, Le Huu Trac road, Xuong Rong and Mo Bach ditches	- Informing the community of the construction schedule at least two week before the construction. - Arrange drainage around the construction sites to prevent soil erosion and sedimentation into the rice fields and irrigation canals. - Regularly check the affected on-field irrigation canals to ensure they are not blocked by construction spoil or waste and if they are affected, provide alternative irrigation water from canals to the locations the local people request. - Immediately rehabilitate irrigation canals if they are damaged by construction activities to ensure that water supply for the rice fields is maintained. - Closely consult with the local community to ensure that suitable solutions to problems are taken and communities' concerns related to construction activities are addressed.

Site-specific impacts	Mitigation measures
8) Impacts on groundwater quality Construction sites of Huong Thuong bridge, Mo Linh 1, Mo Linh 2, Dan bridges, NH3 overpass or two ditches of Xuong Rong and Mo Bach	- Coordinate with the local authority to inform local people of the construction plan prior to construction; - Coordinate with the management unit of waterway to flag the signal system on the inland waterway the transport will travel through; - Provide the workers with all appropriate PPE and ensure that life jackets are used in proximity to water. Safety staff must be available at all times for timely rescue in case of incidents. - Place warning boards along the construction route, both on land and water surface (arrange the road and waterway traffic guide). - Comply with QCVN 09-MT:2015/BTNMT, QCVN 18:2014/BXD.
9) Impacts on traffic circulation at construction sites of bridges Dan bridge and NH3 overpass	- Ensure that the contract requires the contractor, before commencing work, to provide a construction plan with a detailed health, safety, environment and traffic management plan, which has to be provided to the local authorities and approved by CSC. - Inform local residents in advance (at least one week) of construction and work schedules, interruption of services, traffic routes. Inform the community of the planned night construction at least 2 days in advance. - Put and maintain bulletin boards at the construction site, containing the following information: full name and phone number of the Contractor, Site Manager, Supervision Consultants and Subproject Owner, duration and scope of work. - Contractors should provide lighting at all construction sites at night; security guard staff at construction sites to moderate vehicles entering and exiting the construction site; - Put road construction warning signs at the site and maintain them for the duration of the work. - Sediment shall be transported out of construction site or transfer site within the day. Do not transport sediment during rush hours; - Limit the construction area to that within the designated site boundary. - Assign staff to control traffic during transportation, loading and unloading, at construction sites and sediment transfer site. - The Subproject Owner and the Contractor will arrange signs and instructive signs in front of the construction site, speed limit signs when passing throught the construction site, and arrange attention signs, etc. These signs are arranged at appropriate distances of approximately 2 km from the construction site and repeated every 500m in both ways - The construction plan is publically informed to the local communities via the mass media such as television, broadcasting or newspapers, etc.; - The construction method is successive and the construction mainly takes place at nights with the sufficient provision of lighting system at the construction site and at instructive areas; - Close coordination with the highway authority will be made to have appropriate measures for traffic diversion and construction; - The Subproject Owner obtained the permission from the NH3 authority. - Comply with QCVN 18:2014/BXD.
10) Business interruption 74 business households	- Inform the street household businesses of the construction activities and their potential impacts such, waste, dust, and noise, traffic, and construction schedule at least 02 weeks before start of the construction. - Provide safe and easy access to the household businesses putting clean and

Site-specific impacts	Mitigation measures
	strong thick wood panels or steel plates over the open ditches or manholes. - Do not use machines generating loud noise and high vibration levels near the household businesses. - Spray sufficient water to suppress dust during dry and windy days at least three times a day at site that is near household businesses. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes, and to guard high risk operations. - Cleaning up construction areas at the end of the day, especially construction areas in front of business shops. - Manage the worker force to any avoid the conflict with the local people and household businesses. - Compensate goods, products damaged by construction activities of the subproject. - Immediately address any issue/problem caused by the construction activities and raised by the local household businesses.
11) Dust and exhaust gas from welding Dan bridge, Mo Linh 1 and Mo Linh 2, NH 3 overpass and Huong Thuong bridge	- Clearly notify the local community of the welding plan. - Do not weld in the head of wind direction, the area is easy to fire. - Provide labor protective equipment for workers. - Provide eye protection equipment for workers directly involved in the welding process. - Provide signboards or warning signs for the welding areas. - Comply with QCVN 18:2014/BXD.
12) Risks and unsafety during construction nearby the production forest Huong Thuong – Chua Hang road, Le Huu Trac road, Mo Bach ditch	- Coordinate with local authorities to inform people of construction plans at least two weeks before construction. - Provide labor protection equipment for workers. - Build regulations and rules on the construction site and disseminate to workers before carrying out construction activities. - Prohibit hunting of animals around the construction site - Prohibit burning, smoking and cooking near inflammable areas or production forests - Prohibit workers' cutting down trees outside the construction site. - Propangadize and raise workers' awareness of forest protection and development. - Provide medicine cabinets at the construction sites. - Comply with standard QCVN 18:2014/BXD.
13) Impacts at the disposal sites - Disposal site	- Covering waste during transportation - Do not transport waste during rush hours - Sludge will be transported out of the construction area at the end of day - Sludge are dump into separate area with waterproof canvas to lining. - Combination of lime in the discharge of sediment - Around the dumping area of sludge is covered with waterproofing canvas to limit rainwater washed away. - Analyzes show that the sediment in Xuong Rong and Mo Bach stream have no pollution.

5.2.3. Mitigation measures of impacts on sensitive works

The construction process may affect the operation of these facilities, including the safety of local people and access to these sites; Smoke and dust affect local people and cultural works may be affected by the subproject activities listed in Table 78.

Table 78: Mitigation measures of impacts on sensitive works

Sensitive works	Mitigation measures
1. Construction of Southnorth road & Huong Thuong bridge: There are two sensitive works	
Huong Thuong commune kindergarten 	- Inform the school management of the construction activities and their potential impacts such, waste, dust, and noise, traffic, and construction schedule at least two weeks before start of the construction - Install safety warning signs at around the school. - Spray sufficient water to suppress dust during dry and windy days at least two times a day on the route. - Arrange staff to guide the traffic during transportation of construction materials and wastes when pupils go to and leave the school. - Truck drivers shall restrict the use of horns close to the school location. - Limiting transporting on rush hours when pupils go to and leave the school (the studying time every weekday: 7h00-8h00; 16h30 - 17h30).
Water pumping station near Huong Thuong bridge 	- Informing the community of the construction schedule at least two week before the construction. - Arrange drainage system around the construction sites to prevent soil erosion and sedimentation into water collection points of Pumping station. - Regularly check the affected on-field pumping station to ensure they are not blocked by construction spoil or waste and if they are affected, provide alternative water collection points from the river to the locations the local people request. - Immediately rehabilitate water collection points if they are damaged by construction activities to ensure that water supply for the rice fields is maintained. - Closely consult with the local community to ensure that suitable solutions to problems are taken and communities' concerns related to construction activities are addressed.
2. Construction of Huong Thuong – Chua Hang road: There are 5 sensitive works	
Linh Trung communal house 	- Inform the Head of Linh Trung communal house of the detailed construction schedule, activities, and associated impacts at least one month before start of the construction. - Prepare a proper construction schedule to avoid negative impact on Linh Trung communal house's activities. - Stockpile of construction materials, storage of wastes and maintenance of construction equipment and machineries should be in places not affecting access to the cultural house. - Contractors will implement measures to mitigate dust, noise and vibration impacts on Linh Trung communal house. - Worker camps must be located at least 200 meters far from the communal house. - Workers are required to have a good behavior with local culture and

Sensitive works	Mitigation measures
	respect for local belief. - Vehicles passing through the sensitive areas have to reduce speed, do not honk and give way to local people.
Thong hamlet lake 	- During the construction process, if the dead fish is found and verified to be caused by the subproject construction, the Client shall compensate for local people and prepare plan to clean water of the lake. - Putting the provision of fishing ban at the lake into the internal rules, regularly check and have a punishment plan if workers violate. - If workers fish at the lake, the Client must have compensation plan for the local people
Nam Son hamlet church 	- Inform the Head of the church of the detailed construction schedule, activities, and associated impacts at least one month before start of the construction. - Vehicles passing through the sensitive areas have to reduce speed, do not honk and give way to local people. - Stockpile of construction materials, storage of wastes and maintenance of construction equipment and machineries should be in places not affecting access to the church. - Contractors will implement measures to mitigate dust, noise and vibration impacts on the church. - Worker camps must be located at least 200 meters far from the church. - Workers are required to have a good behavior with local culture and respect for local belief. - Limit transportation of construction materials on weekends. - No transportation of construction materials on weekends and festivals: Christmas (December 25); Easter (8 April 2018); Thanksgiving Holidays (23 Nov. 2017 & 22 Nov. 2018); Holy day (1 Nov.); All Souls day (2 Nov.); Feast day (8 Dec.);
Cemetery in Chua Hang ward	- Inform local people of the construction schedule - The vehicles passing through the sensitive area should reduce speed, do not honk and give way to local people. - Regularly collect waste and wastewater on the construction site to minimize impacts on the cemetery. - Close consultation with the local communities to ensure proper resolution of people's complaints related to construction acitivities. - Not cause noise and not construction at time of funeral at the cemetery.
Monument to War Heroes and Martyrs in Chua Hang ward 	- Inform local people of the construction schedule - No transportation of building materials on 26 – 27 July annually - The vehicles passing through the sensitive area should reduce speed, do not honk and give way to local people. - Drivers should limit honk when passing thorugh Chua Hang Monument to War Heroes and Martyrs. - Regularly collect domestic waste and construction waste around the Monument and transport to the stipulated place.
3. Upgrading and construction of Dong Bam road: There are two sensitive works	

Sensitive works	Mitigation measures
Cemetery in Nhi Hoa village 	- Inform local people of the construction schedule - The vehicles passing through the sensitive area should reduce speed, do not honk and give way to local people. - Regularly collect domestic waste and construction waste on the construction site to minimize impacts on the Cemetery. - Close consultation with the local communities to ensure proper resolution of people's complaints related to construction acitivities. - Not cause noise and not construction at time of funeral at the cemetery.
Cemetery near Dong Bam residential area 	
4. Upgrading of Dan birdge: No sensitive works	
5. Upgrading and Construction of Le Huu Trac road: There is one sensitive works	
Thai Nguyen Provincial Mental Hospisal 	- Inform the Head of Hospisal of the detailed construction schedule, activities, and associated impacts at least one month before start of the construction. - The vehicles passing through the hospital should reduce speed, do not honk and give way to people. - Stockpile of construction materials, storage of wastes and maintenance of construction equipment and machineries should be in places not affecting access to the hospital. - Contractors will implement measures to mitigate dust, noise and vibration impacts on the hospital. - Worker camps must be located at least 200 meters far from the hospital. - Workers are required to have a good behavior with local culture and respect for local belief.
6. Construction of Huong Son kindergartens: There is no sensitive works	
7. Upgrading of Phan Dinh Phung kindergarten: There is no sensitive works	
8. Rehabilitation of Xuong Rong drainage ditch: There is no sensitive works	
9. Rehabilitation of Mo Bach stream drainage ditch: There is one sensitive works	
Thai Hai Primary school and Kindergarten 	- Inform the school management unit of the construction activities and their potential impacts such, waste, dust, and noise, traffic, and construction schedule at least two weeks before start of the construction - When construction at this section, it is required to implement within a shortest time. - Limit transportation at time when pupils and children go to school and time after school (studying time on weekdays: 6h30 - 7h30, 11h - 12h, 13h - 14h and 16h30 - 17h30).

Sensitive works	Mitigation measures
	- At time after school, arrange the staff to guide traffic at the point of congestion. - Install fences and barriers. - Arrange lights at night. - Drivers should reduce honking when passing through the school - Increase the frequency of watering 4 times per day on less-rainy summer days.

5.3. Mitigation measures during the operation phase

Mitigation measures of site-specific impacts during the operation phase are shown in the table below:

Table 79: Mitigation measures of impacts during the operation phase

Site-specific impacts	Mitigation measures
1) Changes in topography and flow of Xuong Rong and Mo Bach ditch	- The Subproject Owner coordinates with local authorities, people in regularly checking the status of works to timely detect the risks of landslide, erosion by the flow. - Carry out periodical maintenance, arrange adequate budget for maintenance work.
2) Road safety during the operation of 04 roads and Dan bridge The Southnorth, Huong Thuong - Chua Hang, Dong Bam, Le Huu Trac and the bridges of Huong Thuong, Mo Linh 1, Mo Linh 2 , Dan and NH3 overpass	- Improving knowledge of local people on road use regulations and practices - Monitoring and enforcement of driver speed and behavior. - When traffic volume is high, generation of dust, exhausted gases, noise, and vibration could be an additional issue but this could be mitigated through long term planning.
3) Change of the ecological landscape and land use purposes The Southnorth road, Huong Thuong - Chua Hang road, Dong Bam road, Le Huu Trac road, Xuong Rong ditch, Mo Bach ditch	- Improving people knowledge on socio-economic development opportunity and risks related to social issues. - Coordinate with local authorities in management, migration and use of land on 02 sides of the roads and ditches. - Propagandize, raise awareness of people living near the subproject area about the sense of keeping environmental sanitation, ecological landscapes and protection of works.
4) Impacts of wastewater and waste during the operation of kindergartens Huong Son and Phan Dinh Phung kindergartens	- Raise awareness of kindergarten staff in saving water and limiting waste generation. - Arrange carbage bins at the kindergartens' campus. - Daily collect waste and hire functional units for disposal. - The technical design included construction of preliminary wastewater treatment system (3-compartment septic tanks). - Arrangement of toilets (one per classroom) to collect domestic wastewater and prevent wastewater from

Site-specific impacts	Mitigation measures
	overflowing into environment. - Periodically remove sludge from the septic tank of the kindergarten.
5) Risks of falling from height (into rivers, streams and drowning, falling into hard foundation) Two ditches Xuong Rong and Mo Bach, Cau river, Mo Linh stream, Ho Nui Coc diversion canal	- Design and erect fences or barrier gate at the up and down steps to the walking paths under the embankment, - Build handrail for bridge and high-rise buildings - Plug warning signs and install lighting system in the positions. - Place warning signs at high-rise areas and bridges - Take propaganda about this risk in the first operational phase for local people accustomed to this situation. - Taking first aids for persons who get accidents and transporting them to the nearest hospitals and health service units.
6) Risks of landslide and subsidence - (i) embankment landslide and cracking or breaking in the two ditches of Xuong Rong and Mo Bach; - (ii) Landslide of bridge abutments in 5 bridges (Huong Thuong, Mo Linh 1, Mo Linh 2, Dan bridge, National Highway 3 overpass; - (iii) Landslides and subsidence of the Southnorth road, Huong Thuong - Chua Hang road, Dong Bam road, Le Huu Trac road or two kindergartens Huong Son and Phan Dinh Phung	- Regularly check locations at risks of landslide, subsidence (bridge abutments, embankments, positions with soft and unstable soil ground). - Allocate funds for maintenance, carry out periodical maintenance. - Raise awareness of road users not allowed to carrying overload as stipulated. - Check the works before, during and after the rainy/storm season to take appropriate corrective measures. - Coordinate with authorities and people in protection of right of way.
7) Risks of flooding when formation of roads The Southnorth road, Huong Thuong – Chua Hang road, Dong Bam road and Le Huu Trac road	- Supplement horizontal sewers with sizes suitable for the intensity of rain and the flow of stormwater over the subproject area, if necessary. - Regularly check the areas at risk of flooding to design additional horizontal sewers (if necessary). - Consult with local authorities and local authorities in the areas at risk of flooding in order to take measures to supplement sewers in time. - Clear the flow at the places at risks of flooding before, during and after the rainy/storm season. - Regularly carry out maintenance of works, bridges and sewers.
8) Impacts at disposal sites - Disposal site	- Thường xuyên kiểm tra đê bao và bạt che mưa tại vị trí đổ thải trầm tích, đặc biệt trong mùa mưa bão. - Nếu phát hiện đê bao có dấu hiệu bị hư hỏng phải nhanh chóng đắp lại đê bao và thông báo cho chính quyền phường Tích Lương ngay lập tức. - Trước mùa mưa bão phải chuẩn bị sẵn một số các bao tải đất, cát để kịp thời đắp lại đê bao khi xả ra sự cố - Regularly check embankment and rainproof canvas at dumping area of slude, especially during rainy season. - If embankment are damaged, must be quickly repaired

Site-specific impacts	Mitigation measures
	and notified to the authorities of Tich Luong ward immediately. - Prior to the rainy season, sacks of sand and soil are ready to cover the embankment timely

CHAPTER 6. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

Based on the assessment of the potential negative impacts discussed in Chapter 4 and the mitigation measures proposed in the previous Chapter 5, this chapter presents the Environmental and Social Management Plan (ESMP) for subprojects of DCIDP. The ESMP identifies actions to be carried out under the subproject including the environmental monitoring program and the implementation arrangements, taken into account the need to comply with the Government's ESIA regulations and the World Bank (WB)'s safeguard policies, including those of the World Bank Group's Environmental, Health, and Safety Guidelines

6.1. Basic principles

As a part of the ESIA, an Environmental and Social Management Plan (ESMP) is a safeguards instrument that is typically used in many projects and which consists of information on and guidance for the process of mitigating and managing adverse environmental impacts throughout subproject implementation. Typically in Vietnam, an ESMP comprises a list of typical mitigation measures to be carried out by contractors, an environmental monitoring program, organization arrangements, and an estimated monitoring cost.

There is a comprehensive regulatory framework in Vietnam related to ESIA preparation, environmental standards, protection and management of forest and cultural property, and other aspects related to construction and operation of facilities and infrastructures in Vietnam. This ESMP in consistent with these regulations

To facilitate effective implementation of the ESMP, the PMU will: (a) Establish an Environment and Social Unit (ESU) responsible for ensuring timely implementation of the ESMP, including monitoring, reporting, and capacity building related to safeguards; (b) Assign the Construction Supervision Consultant (CSC) to also be responsible for supervision of the contractor's safeguard performance as part of the construction contract and this requirement will be included in the CSC's terms of reference; and (c) Hire qualified national consultants as the Independent Environmental Monitoring Consultant (IEMC) to assist the ESU in performing its task.

After completion of the subproject, Thai Nguyen People's Committee will assign the unit in charge of implementing mitigation measures during the subproject operation phase and these agencies will ensure the implementation of mitigation measures and provide fully budget. The Provincial Steering Committee (PSC), chaired by the Chairperson or Vice Chairperson of the Provincial People's Committee (PCP), will present overall policy guidelines and monitor the implementation of the subproject. The roles and responsibilities of the specialized agencies and Thai Nguyen Department of Planning and Investment, Thai Nguyen Department of Natural Resources and Environment (DONRE) are important.

In terms of laying out the mitigation measures of the ESMP, there are two fundamental parts to this ESMP. Firstly, the City has developed and will use Urban Construction Environmental Codes of Practice (ECOPs). These ECOPs outline typical generic low-level impacts that can be expected to occur in a wide range of construction activities of the subproject. They include mitigation measures for these impacts and a process for including them in the construction contracts of contractors. During the detailed design of technical specifications for each contract, the technical design consultant will incorporate into the contract the parts of the ECOPs specific to that contract, as well as the specific measures identified in the ESMP.

Secondly, all site-specific impacts that are either not covered in the general ECOPs or which are of an order of magnitude that require mitigation measures not covered in the ECOPs, are described in more detail in the ESMP. The mitigation measures are derived from the more detailed analysis.

Activities to be carried out to mitigate impacts due to land acquisition and resettlement are presented separately (RP and RPF) and they will be carried out and monitored separately.

6.2. Mitigation measures

6.2.1. Mitigation plan of generic impacts (ECOPs)

Below are the mitigation measures themselves. Types of impacts covered in this document are:(1) Impacts of dust; (2) Air pollution; (3) Noise and vibration; (4) Water pollution; (5) Solid waste; (6) Hazardous wastes; (7) Traffic management; (8) Restoration of affected areas (9) Worker and public Safety; (10) Communication with local communities about subproject environmental issues; (11) Health and Safety for workers and the public; (12) Chance finding procedures, (13) Fire hazard due to accident.

Table 80: Generic mitigation measures

Environmental and social issues	Mitigation measures	Applicable National Regulations, Standards	Responsibility	
			Implementation	Supervision
1. Impacts of dust	- The Contractor is responsible for ensuring compliance with relevant Vietnamese legislation with respect to ambient air quality. - The Contractor shall ensure that dust generation is mitigated and will not annoy local people and implement measures to control dust concentration in order to maintain safe working place and minimize disturbance to surrounding residences/houses. - Material loads shall be suitably secured during transportation to prevent the scattering of soil, sand, materials or dust. - Exposed soil and material stockpiles shall be protected against wind erosion and the location of stockpiles shall take into consideration the prevailing wind directions and locations of sensitive receptors - Dust masks should be used where dust levels are excessive.	- Decision No. 35/2005/QD-BGTVT on inspection of quality, technical safety and environmental protection - QCVN 05:2013/MONRE: National technical regulation on ambient air quality. - QCVN 18:2014/BXD National technical regulation on safety in construction. - EHS Guidelines.	Contractor	PMU, CSC
2. Air pollution	- All vehicles must comply with Vietnamese regulations controlling allowable emission limits of exhaust gases. - 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 (for example: asphalt, etc.) on site.	- Decision No. 35/2005/QD-BGTVT on inspection of quality, technical safety and environmental protection - QCVN 05: 2013/MONRE: National technical regulation on ambient air quality. - QCVN 18:2014/BXD National technical regulation on safety in construction. - EHS Guidelines.	Contractor	PMU, CSC
3. Noise and vibration	- The contractor is responsible for compliance with the relevant Vietnamese legislation with respect to noise and vibration. - All vehicles must have appropriate “Certificate of conformity from	- QCVN 26:2010/BTNMT: National technical regulation on noise	Contractor	PMU, CSC

Environmental and social issues	Mitigation measures	Applicable National Regulations, Standards	Responsibility	
			Implementation	Supervision
	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 through or processing material in community areas (like concrete mixing).	- QCVN 27:2010/BTNMT: National technical regulation on vibration. - QCVN 18:2014/BXD National technical regulation on safety in construction. - EHS Guidelines.		
4. Water pollution	- The Contractor must be responsible for compliance with the relevant Vietnamese legislation relevant to wastewater discharges into watercourses. - Portable or constructed hygienic 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 local 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. - Implement measure to collect, redirect or block municipal wastewater disposed from surrounding houses to properly dispose and ensure that local blocking or flooding are minimized. - 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.	- 14:2008/BTNMT: National technical regulation on domestic wastewater. - EHS Guidelines.	Contractor	PMU, CSC
5. Solid waste	- 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 commencement, the Contractor must prepare the	- Decree No. 38/2015/ND-CP on solid waste management. - EHS Guidelines.	Contractor	PMU, CSC

Environmental and social issues	Mitigation measures	Applicable National Regulations, Standards	Responsibility	
			Implementation	Supervision
	dredged material management plan. - Before construction, all necessary waste disposal permits or licenses must be obtained. - Measures shall be taken to reduce the potential for litter and negligent behavior with regard to the disposal of all refuse. At all places of work, the Contractor shall provide litter bins, containers and refuse collection facilities. - Solid waste may be temporarily stored on site in a designated area approved by the Construction Supervision Consultant and relevant local authorities prior to collection and disposal through a licensed waste collector, for example, local environment and sanitation companies. - Waste storage containers shall be covered, tip-proof, weatherproof and scavenger proof. - No burning, on-site burying or dumping 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.			
6. Hazardous wastes	- The removal of asbestos-containing materials or other toxic substances shall be performed and disposed of by specially trained and certified workers. - Used oil and grease shall be removed from site and sold to an approved used oil recycling company. - Used oil, lubricants, cleaning materials, etc. from the maintenance of vehicles and 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. - Unused or rejected tar or bituminous products shall be returned to the	- Decree No. 38/2015/NĐ-CP dated 24/04/2015 on waste and scrap management - Circular No. 36/2015/TT-BTNMT on management of hazardous substance. - EHS Guidelines.	Contractor	PMU, CSC

Environmental and social issues	Mitigation measures	Applicable National Regulations, Standards	Responsibility	
			Implementation	Supervision
	supplier's production plant. - Relevant agencies shall be promptly informed of any accidental spill or incident. - Appropriate communication and training programs should be put in place to prepare workers to recognize and respond to workplace chemical hazards. - Prepare and initiate a remedial action following any spill or incident. In this case, the contractor shall provide a report explaining the reasons for the spill or incident, remedial action taken, consequences/damage from the spill, and proposed corrective actions.			
7. Traffic management	- Before construction, carry out consultations with local government and community. - Significant increases in number of vehicle trips must be included in a construction plan before approved. Routings, especially of heavy vehicles, need 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 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 necessary.	- Law on traffic and transport No. 23/2008/QH12; - Decree 46/2016/ND-CP on administrative penalty for traffic safety violation - Law on construction No. 50/2014/QH13; - QCVN 18:2014/BXD National technical regulation on safety in construction.	Contractor	PMU, CSC
8. Restoration of affected areas	- Temporary acquired areas to make warehouse, cable pulling site, etc. are used for a short period of time, site facilities, workers' camps, stockpiles areas, working platforms and any areas temporarily occupied	- Decree No. 167/2013/ND-CP on administrative penalty for violations related	Contractor	Compliance reported by CSC

Environmental and social issues	Mitigation measures	Applicable National Regulations, Standards	Responsibility	
			Implementation	Supervision
	during construction of the subproject works shall be restored using landscaping, adequate drainage. - All affected areas shall be landscaped and any necessary remedial works shall be undertaken without delay. These works may be green-spacing, roads, bridges and other works to original existing etc. - Soil contaminated with chemicals or hazardous substances shall be removed and transported and buried in waste disposal areas in accordance with regulations; - Restore all roads caused by the subproject activities to their original state or better.	to social security, order and safety issues. - QCVN 18:2014/BXD National technical regulation on safety in construction.		
9. Worker and public Safety	- Contractor shall comply with all Vietnamese regulations regarding worker safety. - Prepare and implement action plan to cope with risk and emergency. - Preparation of emergency aid service at construction site. - Training workers on occupational safety regulations - If blasting is to be used, additional mitigation measures and safety precautions must be outlined in the ESMP. - 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 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	- Decree No. 167/2013/ND-CP on administrative penalty for violations related to social security, order and safety issues. - QCVN 18:2014/BXD National technical regulation on safety in construction. - EHS Guidelines.	Contractor	PMU, CSC
10. Communication with local communities about	- Maintain open communications with the local government and concerned communities; the contractor shall coordinate with local	- Decree No. 167/2013/ND-CP on administrative	Contractor	PMU, CSC

Environmental and social issues	Mitigation measures	Applicable National Regulations, Standards	Responsibility	
			Implementation	Supervision
subproject environmental issues	authorities (leaders of local wards or communes) for agreed schedules of construction activities at areas nearby sensitive places. - Copies in Vietnamese of these ECOPs and of other relevant environmental safeguard documents shall be made available to local communities and to workers at the site. - Disseminate subproject information to affected parties (for example local authority) through community meetings before construction commencement; - Provide a community relations contact from whom interested parties can receive information on site activities, subproject status and subproject 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 and elected officials through the preparation of fact sheets and disclosure, when major findings become available during subproject phase; - Monitor community concerns and information requirements as the subproject progresses; - Respond to telephone inquiries and written correspondence in a timely and accurate manner; - Provide technical documents and drawings to PC's community, especially a sketch of the construction area and the ESMP of the construction site; - Notification boards shall be erected at all construction sites providing information about the subproject, 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.	penalty for violations related to social security, order and safety issues. - EHS Guidelines.		
11. Health and Safety for workers and the public	- Training in HIV/AIDS within 2 weeks prior to the commencement of packages for construction items lasting at least 6 months. - Provide training in first-aid skill and first-aid kit to workers and site	- Directive No. 02 /2008/CT-BXD on labour safety and sanitation in construction	Contractor	PMU, CSC

Environmental and social issues	Mitigation measures	Applicable National Regulations, Standards	Responsibility	
			Implementation	Supervision
	engineer - Regularly exam worker's health to ensure occupational health - Provide workers with PPE such as masks, gloves, helmets, shoes/boots, goggles, safety belt, etc. and enforce wearing during working especially working at heights and in dangerous areas. - Limit or avoid working in extreme weather conditions, e.g. too hot, heavy rain, strong wind, and dense fog. - Provision of proper eye protection such as welder goggles and/or a full-face eye shield for all personnel involved in, or assisting, welding operations. Additional methods may include the use of welding barrier screens around the specific work station (a solid piece of light metal, canvas, or plywood designed to block welding light from others). Devices to extract and remove noxious fumes at the source may also be required. - Special hot work and fire prevention precautions and Standard Operating Procedures (SOPs) should be implemented if welding or hot cutting is undertaken outside established welding work stations, including 'Hot Work Permits, stand-by fire extinguishers, stand-by fire watch, and maintaining the fire watch for up to one hour after welding or hot cutting has terminated. Special procedures are required for activities on tanks or vessels that have contained flammable materials. - Safely install power lines at offices and in construction sites and do not lay connectors on the ground or water surface. Electric wires must be with plugs. Place outdoor electric panels in protection cabinets. - Limit vehicle speed at 5km/hour at construction site and 20km/h on transportation routes across local resident areas. - Install fences, barriers for dangerous warning/prohibition sites around the construction area which show potential danger to the public. - 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. - Provide sufficient lighting when carrying out construction activities at	agencies; - Circular No. 22/2010/TT-BXD on regulation on labour safety in construction - QCVN 18:2014/BXD: Technical regulation on safety in construction. - EHS Guidelines.		

Environmental and social issues	Mitigation measures	Applicable National Regulations, Standards	Responsibility	
			Implementation	Supervision
	night. - Locate noise-generating sources and concrete mixing plants far enough from and downwind of residential areas and camps. - Store fuels and chemicals in areas with impermeable ground, roofs, surrounding banks, and warning signs at least 50 m far from and downwind of residential areas and the camps. - Provide training in fire-fighting to workers and fire-extinguishers for the camps. - Prepare an emergency plan for chemical/fuel spill incident risk before construction begins. - Provide the camps with sufficient supplies of clean water, power, and sanitary facilities. There must be at least one toilet compartment for every 30 workers, with separate toilets for males and females. Workers' beds must be provided with mosquito nets so as to prevent dengue fever. Temporary tents will be unacceptable. - Clean camps, kitchens, baths, and toilets and sanitize regularly, and keep good sanitation. Provide dustbins and collect wastes daily from the camps. Clear drainage ditches around the camps periodically. - Stop all construction activities during rains and storms, or upon accidents or serious incidents.			
12. Chance finding procedures in case of finding objects with historical or cultural values	- 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 takes over; - Notify the Construction Supervision Consultant who in turn will notify responsible local or national authorities in charge of the Cultural	- Law on cultural heritage No. 28/2001/QH10; - Amended and supplemented Law on cultural heritage No. 32/2009/QH12; - Decree No 98/2010/ND-CP dated 21/09/2010 on guideline to implement Cultural Heritage Law.	- Contractor, supervising consultant cooperates to implement - Cultural Information Department	PMU, CSC

Environmental and social issues	Mitigation measures	Applicable National Regulations, Standards	Responsibility	
			Implementation	**Supervision**
	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 Subproject'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.		- Contractor, Owner and local Authority	
13. Fire hazard due to accident	- Comply with the national law and regulation on fire prevention and fight extinguishing. - Prepare an emergency preparedness plan for fire hazard control. - Equip the substation with enough number of fire extinguishers. - Frequently examine equipment to detect and repair fire hazard. - Train operation staff on fire prevention and fire control.	- Decree 46/2012/ND-CP. - QCVN 18:2014/BXD National technical regulation on safety in construction.	Contractor	PMU, CSC

6.2.2. Mitigation plan of site-specific impacts during the construction phase

Table 81: Mitigation plan of site-specific impacts during the construction phase

Site-specific impacts	Specific mitigation measures	Responsibility	Supervised
1) Impacts on water environment Two drainage ditches of Xuong Rong and Mo Bach; 04 bridges (Huong Thuong bridge, Mo Linh 1, Mo Linh 2, Dan bridge)	- The dredging operation is conducted only during the dry season; - Create sedimentation traps and maintain them periodically to ensure that most solids in surface runoff are retained in the traps before entering the existing drains or water sources surrounding the sites; - Leachate from sediments must be first deposited in sedimentation hole/trap before entering the river. - Strictly prohibit contractors to discharge waste into river - Collection of redundancy material on site is implemented daily. Upon forecasted stormy weather, suspend all the construction activities, tidy up the sites, brace and protect the materials and construction machines. - Do not gather construction materials as well as machinery and equipment near the river. Gathering small quantities of materials fit with the schedule. Materials must be covered with tarpaulin, avoiding the upwind location, near the river. - Strictly prevent hazardous waste, waste oils or particularly greasy rags from entering the flow. - Comply with QCVN 08-MT:2015/BTNMT, QCVN 14:2008/BTNMT, QCVN 18:2014/BXD.	Contractor	PMU, CSC
2) Impacts caused by erosion, subsidence and damages to existing structures NH3 overpass, Xuong Rong ditch, Mo Bach ditch, Huong Son and Phan Dinh Phung kindergartens	- Before dredging, reinforcement will be conducted. This construction method must be proposed and submitted to the authorities concerned for approval by the construction contractors. - Ensure that land acquisition and house relocation at the site boundary is completed prior to commencing construction work. - Use appropriate construction methods with each construction site location. - Closely monitoring the vibration level - Construction of side slope is made in accordance with the design - Do not carry out dredging works in rainy season. - Do not place heavy machineries and transportation vehicles near the canals banks. Inspection and supervision on land subsidence risks must be taken regularly in order to prepare the appropriate reinforcement plans.	Contractor	PMU, CSC

Site-specific impacts	Specific mitigation measures	Responsibility	Supervised
	- Ensure the constant presence of supervision consultants and contractors during construction to monitor the potential risk of erosion and landslides and if necessary take the appropriate action. - Comply with QCVN 18:2014/BXD.		
3) Impacts on waterway transport on river Huong Thuong bridge and Cau river	- Coordinate with the local authority to inform local people of the construction plan prior to construction; - Coordinate with management unit of waterway to flag the signal system on the inland waterway the transport will travel through; - Provide the workers with all appropriate PPE and ensure that life jackets are used in proximity to water. Safety staff must be available at all times for timely rescue in case of incidents. - Place warning boards along the construction route, both on land and water surface (arrange the road and waterway traffic guide). - Comply with Law on inland waterway navigation No. 23/2004/QH11, the Law on amendment and supplement of a number of Articles of the Law on inland waterway navigation No. 48/2014/QH13 and guidelines on waterway safety of the Ministry of Transport.	Contractor	PMU, CSC
4) Impacts on studying and teaching Phan Dinh Phung kindergarten when relocation to temporary place	- Inform pupils at least one month in advance of the estimated relocation schedule to temporary place. - Consult with parents on measures to minimize the psychological effects of children during the relocation process. - Ensure water supply, electricity supply and facilities at the temporary place of teaching and learning. - Notify the local community around the temporary place of teaching and learning of the teaching and learning plan of Phan Dinh Phung Kindergarten. - Relocate to a temporary place of learning and teaching nearby the current place of the kindergarten.	Contractor	PMU, CSC
5) Impacts of malodor from dredged materials Xuong Rong and Mo Bach ditches	- Notify the construction progress of each section dredging for surrounding people. - Dredged materials are transported to the disposal site by specialized vehicles. - Do not gather dredged material along the ditches. - Use lime powder to limit malodor dispersion, if necessary. - Do not construct at the rest time, limit construction after 18h. - Consult closely with local people and communities for appropriate mitigation measures. - Provide adequate personal protective equipment for all workers.	Contractor	PMU, CSC

Site-specific impacts	Specific mitigation measures	Responsibility	Supervised
	- Comply with QCVN 18:2014/BXD.		
6) Leaking water from dredging 02 ditches of Xuong Rong and Mo Bach	- Dredging activities are only carried out in the dry season; - Water leaking from sediment must be deposited in settling tank/trap before discharging into river; - The process of transporting dredged materials must use specialized vehicles with containers. - No dredging at the time of water intaking for agricultural production activities of the local people. - Comply with QCVN 08-MT:2015/BTNMT, QCVN 14:2008/BTNMT, QCVN 18:2014/BXD.	Contractor	PMU, CSC
7) Impacts on agricultural production The Southnorth road, Huong Thuong bridge, Huong Thuong – Chua Hang road, Dong Bam road, Le Huu Trac road, Xuong Rong and Mo Bach ditches	- Informing the community of the construction schedule at least two week before the construction. - Arrange drainage around the construction sites to prevent soil erosion and sedimentation into the rice fields and irrigation canals. - Regularly check the affected on-field irrigation canals to ensure they are not blocked by construction spoil or waste and if they are affected, provide alternative irrigation water from canals to the locations the local people request. - Immediately rehabilitate irrigation canals if they are damaged by construction activities to ensure that water supply for the rice fields is maintained. - Closely consult with the local community to ensure that suitable solutions to problems are taken and communities' concerns related to construction activities are addressed.	Contractor	PMU, CSC
8) Impacts on groundwater quality Construction sites of Huong Thuong bridge, Mo Linh 1, Mo Linh 2, Dan bridges, NH3 overpass or two ditches of Xuong Rong and Mo Bach	- Coordinate with the local authority to inform local people of the construction plan prior to construction; - Coordinate with the management unit of waterway to flag the signal system on the inland waterway the transport will travel through; - Provide the workers with all appropriate PPE and ensure that life jackets are used in proximity to water. Safety staff must be available at all times for timely rescue in case of incidents. - Place warning boards along the construction route, both on land and water surface (arrange the road and waterway traffic guide). - Comply with QCVN 09-MT:2015/BTNMT, QCVN 18:2014/BXD.	Contractor	PMU, CSC
9) Impacts on traffic circulation at	- Ensure that the contract requires the contractor, before commencing work, to provide a construction plan with a detailed health, safety, environment and traffic management plan, which has to be provided to the local authorities and approved by CSC.	Contractor	PMU, CSC

Site-specific impacts	Specific mitigation measures	Responsibility	Supervised
construction sites of bridges Dan bridge and NH3 overpass	- Inform local residents in advance (at least one week) of construction and work schedules, interruption of services, traffic routes. Inform the community of the planned night construction at least 2 days in advance. - Put and maintain bulletin boards at the construction site, containing the following information: full name and phone number of the Contractor, Site Manager, Supervision Consultants and Subproject Owner, duration and scope of work. - Contractors should provide lighting at all construction sites at night; security guard staff at construction sites to moderate vehicles entering and exiting the construction site; - Put road construction warning signs at the site and maintain them for the duration of the work. - Sediment shall be transported out of construction site or transfer site within the day. Do not transport sediment during rush hours; - Limit the construction area to that within the designated site boundary. - Assign staff to control traffic during transportation, loading and unloading, at construction sites and sediment transfer site. - The Subproject Owner and the Contractor will arrange speed limit signs when passing throught the construction site, and arrange attention signs, etc. These signs are arranged at appropriate distances of approximately 2 km from the construction site in both ways and repeated every 500m. - The construction plan is publically informed to the local communities via the mass media such as television, broadcasting or newspapers, etc.; - The construction method is successive and the construction mainly takes place at nights with the sufficient provision of lighting system at the construction site and at instructive areas; - Close coordination with the highway authority will be made to have appropriate measures for traffic diversion and construction; and - The construction activities will not be started until the Subproject Owner obtains permission from the NH3 authority - Comply with QCVN 18:2014/BXD.		
10) Business interruption 74 business households	- Inform the street household businesses of the construction activities and their potential impacts such, waste, dust, and noise, traffic, and construction schedule at least 02 weeks before start of the construction. - Provide safe and easy access to the household businesses putting clean and strong thick wood	Contractor	PMU, CSC

Site-specific impacts	Specific mitigation measures	Responsibility	Supervised
	panels or steel plates over the open ditches or manholes. - Do not use machines generating loud noise and high vibration levels near the household businesses. - Spray sufficient water to suppress dust during dry and windy days at least three times a day at site that is near household businesses. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes, and to guard high risk operations. - Cleaning up construction areas at the end of the day, especially construction areas in front of business shops. - Manage the worker force to any avoid the conflict with the local people and household businesses. - Compensate goods, products damaged by construction activities of the subproject. - Immediately address any issue/problem caused by the construction activities and raised by the local household businesses.		
11) Dust and exhaust gas from welding Dan bridge, Mo Linh 1 and Mo Linh 2, NH 3 overpass and Huong Thuong bridge	- Clearly notify the local community of the welding plan. - Do not weld in the head of wind direction, the area is easy to fire. - Provide labor protective equipment for workers. - Provide eye protection equipment for workers directly involved in the welding process. - Provide signboards or warning signs for the welding areas. - Comply with QCVN 18:2014/BXD.	Contractor	PMU, CSC
12) Risks and unsafety during construction nearby the production forest Huong Thuong – Chua Hang road, Le Huu Trac road, Mo Bach ditch	- Coordinate with local authorities to inform people of construction plans at least two weeks before construction. - Provide labor protection equipment for workers. - Build regulations and rules on the construction site and disseminate to workers before carrying out construction activities. - Prohibit hunting of animals around the construction site - Prohibit burning, smoking and cooking near inflammable areas or production forests - Prohibit workers' cutting down trees outside the construction site.	Contractor	PMU, CSC

Site-specific impacts	Specific mitigation measures	Responsibility	Supervised
	- Propangadize and raise workers' awareness of forest protection and development. - Provide medicine cabinets at the construction sites. - Comply with Standard QCVN 18: 2014/BXD.		

6.2.3. Mitigation Plan of Impacts on Sensitive Works during the construction phase

Table 82: Mitigation measures of impacts on sensitive works during the construction phase

Sensitive works	Impacts	Mitigation measures	Responsibility	Supervised
1. Construction of Southnorth road & Huong Thuong bridge: There are two sensitive works				
Huong Thuong commune kindergarten 	- Dust, exhaust gases. - Noise, vibration. - Traffic jam at time after school from Monday to Friday, starting time from 7 - 8 am and the ending time from 16h30 - 17h30 - Potential risk of traffic accidents at time taking children to the school and time after school due to transportation of construction materials. - Affect health of children and teachers due to uncollected domestic waste and waste water. - Affect recreation and entertainment activities of children.	- Inform the school management of the construction activities and their potential impacts such, waste, dust, and noise, traffic, and construction schedule at least two weeks before start of the construction - Install safety warning signs at around the school. - Spray sufficient water to suppress dust during dry and windy days at least two times a day on the route. - Arrange staff to guide the traffic during transportation of construction materials and wastes when pupils go to and leave the school. - Truck drivers shall restrict the use of horns close to the school location. - Limiting transporting on rush hours when pupils go to and leave the school (the studying time every weekday: 7h00-8h00; 16h30 - 17h30).	Contractor	PMU, CSC
Water pumping station near Huong Thuong bridge	- Interruption of water pumping for irrigation of 80 ha of fields in Huong Thuong commune - Impacts on development of plants, reducing productivity of rice, leading to	- Informing the community of the construction schedule at least two week before the construction. - Arrange drainage system around the construction sites to prevent soil erosion and sedimentation into water	Contractor	PMU, CSC

Sensitive works	Impacts	Mitigation measures	Responsibility	Supervised
	affecting income of people - Transportation can damage equipment of the pumping station. - Affect period of water irrigation for agricultural production activities. - Potential risks of landslide and erosion during the construction.	collection points of Pumping station. - Regularly check the affected on-field pumping station to ensure they are not blocked by construction spoil or waste and if they are affected, provide alternative water collection points from the river to the locations the local people request. - Immediately rehabilitate water collection points if they are damaged by construction activities to ensure that water supply for the rice fields is maintained. - Closely consult with the local community to ensure that suitable solutions to problems are taken and communities' concerns related to construction activities are addressed.		
2. Construction of Huong Thuong – Chua Hang road: There are 5 sensitive works				
Linh Trung communal house 	- Dust, exhaust gases. - Noise, vibration. - Dropped solid waste will affect the spiritual and social activities of local people when going to the communal house. - Restrict people's access to Linh Trung communal house. - Risks of community conflicts.	- Inform the Head of Linh Trung communal house of the detailed construction schedule, activities, and associated impacts at least one month before start of the construction. - Prepare a proper construction schedule to avoid negative impact on Linh Trung communal house's activities. - Stockpile of construction materials, storage of wastes and maintenance of construction equipment and machineries should be in places not affecting access to the cultural house. - Contractors will implement measures to mitigate dust, noise and vibration impacts on Linh Trung communal house. - Worker camps must be located at least 200 meters far from the communal house. - Workers are required to have a good behavior with local	Contractor	PMU, CSC

Sensitive works	Impacts	Mitigation measures	Responsibility	Supervised
		culture and respect for local belief. - Vehicles passing through the sensitive areas have to reduce speed, do not honk and give way to local people.		
Thong hamlet lake 	- Wastwwater, solid waste and hazardous waste dropped into the lake causes death of fishes - Affect economy of fishery household - Affect lake water quality. - Conflicts between workers and local people	- During the construction process, if the dead fish is found and verified to be caused by the subproject construction, the Client shall compensate for local people and prepare plan to clean water of the lake. - Putting the provision of fishing ban at the lake into the internal rules, regularly check and have a punishment plan if workers violate. - If workers fish at the lake, the Client must have compensation plan for the local people	Contractor	PMU, CSC
Nam Son hamlet church 	- Dust, exhaust gases. - Noise, vibration. - Traffic jams and accidents - Conflicts between workers and local people. - Restrict people's access to the church.	- Inform the Head of the church of the detailed construction schedule, activities, and associated impacts at least one month before start of the construction. - Vehicles passing through the sensitive areas have to reduce speed, do not honk and give way to local people. - Stockpile of construction materials, storage of wastes and maintenance of construction equipment and machineries should be in places not affecting access to the church. - Contractors will implement measures to mitigate dust, noise and vibration impacts on the church. - Worker camps must be located at least 200 meters far from the church. - Workers are required to have a good behavior with local culture and respect for local belief. - Limit transportation of construction materials on weekends. - No transportation of construction materials on	Contractor	PMU, CSC

Sensitive works	Impacts	Mitigation measures	Responsibility	Supervised
		weekends and festivals: Christmas (December 25); Easter (8 April 2018); Thanksgiving Holidays (23 Nov. 2017 & 22 Nov. 2018); Holy day (1 Nov.); All Souls day (2 Nov.); Feast day (8 Dec.);		
Cemetery in Chua Hang ward 	- Solid waste dropped will affect environmental sanitation of the area. - Restrict people's access to the cemetery. - Affect the activities of tending graves - Conflicts between workers and local people.	- Inform local people of the construction schedule - The vehicles passing through the sensitive area should reduce speed, do not honk and give way to local people. - Regularly collect waste and wastewater on the construction site to minimize impacts on the cemetery. - Close consultation with the local communities to ensure proper resolution of people's complaints related to construction acitivities. - Not cause noise and not construction at time of funeral at the cemetery.	Contractor	PMU, CSC
Monument to War Heroes and Martyrs in Chua Hang ward 	- Solid waste dropped will affect environmental sanitation of the area. - Restrict people's access to the cemetery. - Affect the activities of tending and worship. - Conflicts between workers and local people.	- Inform local people of the construction schedule - No transportation of building materials on 26 – 27 July annually - The vehicles passing through the sensitive area should reduce speed, do not honk and give way to local people. - Drivers should limit honk when passing thorugh Chua Hang Monument to War Heroes and Martyrs. - Regularly collect domestic waste and construction waste around the Monument and transport to the stipulated place.	Contractor	PMU, CSC
3. Upgrading and construction of Dong Bam road: There are two sensitive works				
Cemetery in Nhi Hoa village	- Solid waste dropped will affect	- Inform local people of the construction schedule	Contractor	PMU, CSC

Sensitive works	Impacts	Mitigation measures	Responsibility	Supervised
 Cemetery near Dong Bam residential area 	environmental sanitation of the area. - Restrict people's access to the cemetery. - Affect the activities of tending graves. - Conflicts between workers and local people.	- The vehicles passing through the sensitive area should reduce speed, do not honk and give way to local people. - Regularly collect domestic waste and construction waste on the construction site to minimize impacts on the Cemetery. - Close consultation with the local communities to ensure proper resolution of people's complaints related to construction acitivities. - Not cause noise and not construction at time of funeral at the cemetery.		
4. Upgrading of Dan birdge: No sensitive works				
5. Upgrading and Construction of Le Huu Trac road: There is one sensitive works				
Thai Nguyen Provincial Mental Hospisal 	- Dust, exhaust gas. - Noise, vibration. - Solid waste. - Wastewater - Affect the examination and treatment of diseases. - Traffic jams and accidents. - Conflicts with workers. - Restrict access.	- Inform the Head of Hospisal of the detailed construction schedule, activities, and associated impacts at least one month before start of the construction. - The vehicles passing through the hospital should reduce speed, do not honk and give way to people. - Stockpile of construction materials, storage of wastes and maintenance of construction equipment and machineries should be in places not affecting access to the hospital. - Contractors will implement measures to mitigate dust, noise and vibration impacts on the hospital. - Worker camps must be located at least 200 meters far	Contractor	PMU, CSC

Sensitive works	Impacts	Mitigation measures	Responsibility	Supervised
		from the hospital. - Workers are required to have a good behavior with local culture and respect for local belief.		
6. Construction of Huong Son kindergartens: There is no sensitive works				
7. Upgrading of Phan Dinh Phung kindergarten: There is no sensitive works				
8. Rehabilitation of Xuong Rong drainage ditch: There is no sensitive works				
9. Rehabilitation of Mo Bach stream drainage ditch: There is one sensitive works				
Thai Hai Primary school and Kindergarten 	- Dust, exhaust gas. - Noise, vibration. - Solid waste. - Wastewater - Odor from dredging - Traffic jams and accidents. - Restrict parents' and teachers' access. - Community conflicts. - Affect outdoor activities.	- Inform the school management unit of the construction activities and their potential impacts such, waste, dust, and noise, traffic, and construction schedule at least two weeks before start of the construction - When construction at this section, it is required to implement within a shortest time. - Limit transportation at time when pupils and children go to school and time after school (studying time on weekdays: 6h30 - 7h30, 11h - 12h, 13h - 14h and 16h30 - 17h30). - At time after school, arrange the staff to guide traffic at the point of congestion. - Install fences and barriers. - Arrange lights at night. - Drivers should reduce honking when passing through the school - Increase the frequency of watering 4 times per day on less-rainy summer days.	Contractor	PMU, CSC

6.2.4. Mitigation plan of site-specific impacts during the operation phase

Table 83: Mitigation plan of site-specific impacts during the operation phase

Site-specific impacts	Mitigation measures	Responsibility	Supervised
1) Changes in topography and flow of Xuong Rong and Mo Bach ditch	- The Subproject Owner coordinates with local authorities, people in regularly checking the status of works to timely detect the risks of landslide, erosion by the flow. - Carry out periodical maintenance, arrange adequate budget for maintenance work.	- Operation management unit - Local government	- PPMU
2) Road safety during the operation of 04 roads and Dan bridge The Southnorth, Huong Thuong - Chua Hang, Dong Bam, Le Huu Trac and the bridges of Huong Thuong, Mo Linh 1, Mo Linh 2 , Dan and NH3 overpass	- Improving knowledge of local people on road use regulations and practices - Monitoring and enforcement of driver speed and behavior. - When traffic volume is high, generation of dust, exhausted gases, noise, and vibration could be an additional issue but this could be mitigated through long term planning.	- Operation management unit - Local government	- PPMU
3) Change of the ecological landscape and land use purposes The Southnorth road, Huong Thuong - Chua Hang road, Dong Bam road, Le Huu Trac road, Xuong Rong ditch, Mo Bach ditch	- Improving people knowledge on socio-economic development opportunity and risks related to social issues. - Coordinate with local authorities in management, migration and use of land on 02 sides of the roads and ditches. - Propagandize, raise awareness of people living near the subproject area about the sense of keeping environmental sanitation, ecological landscapes and protection of works.	- Operation management unit - Local government	- PPMU
4) Impacts of wastewater and waste during the operation of kindergartens Huong Son and Phan Dinh Phung kindergartens	- Raise awareness of kindergarten staff in saving water and limiting waste generation. - Arrange carbage bins at the kindergartens' campus. - Daily collect waste and hire functional units for disposal. - The technical design included construction of preliminary wastewater treatment system (3-compartment septic tanks). - Arrangement of toilets (one per classroom) to collect domestic wastewater and prevent wastewater from overflowing into environment. - Periodically remove sludge from the septic tank of the kindergarten.	- Operation management unit - Local government	- PPMU
5) Risks of falling from height (into rivers, streams and drowning, falling into hard foundation)	- Design and erect fences or barrier gate at the up and down steps to the walking paths under the embankment,	- Operation management unit	- PPMU

Site-specific impacts	Mitigation measures	Responsibility	Supervised
Two ditches Xuong Rong and Mo Bach, Cau river, Mo Linh stream, Ho Nui Coc diversion canal	- Build handrail for bridge and high-rise buildings - Plug warning signs and install lighting system in the positions. - Place warning signs at high-rise areas and bridges - Take propaganda about this risk in the first operational phase for local people accustomed to this situation. - Taking first aids for persons who get accidents and transporting them to the nearest hospitals and health service units.	- Local government	
6) Risks of landslide and subsidence - (i) embankment landslide and cracking or breaking in the two ditches of Xuong Rong and Mo Bach; - (ii) Landslide of bridge abutments in 5 bridges (Huong Thuong, Mo Linh 1, Mo Linh 2, Dan bridge, National Highway 3 overpass; - (iii) Landslides and subsidence of the Southnorth road, Huong Thuong - Chua Hang road, Dong Bam road, Le Huu Trac road or two kindergartens Huong Son and Phan Dinh Phung	- Regularly check locations at risks of landslide, subsidence (bridge abutments, embankments, positions with soft and unstable soil ground). - Allocate funds for maintenance, carry out periodical maintenance. - Raise awareness of road users not allowed to carrying overload as stipulated. - Check the works before, during and after the rainy/storm season to take appropriate corrective measures. - Coordinate with authorities and people in protection of ROW	- Operation management unit - Local government	- PPMU
7) Risks of flooding when formation of roads The Southnorth road, Huong Thuong – Chua Hang road, Dong Bam road and Le Huu Trac road	- Supplement horizontal sewers with sizes suitable for the intensity of rain and the flow of stormwater over the subproject area, if necessary. - Regularly check the areas at risk of flooding to design additional horizontal sewers (if necessary). - Consult with local authorities and local authorities in the areas at risk of flooding in order to take measures to supplement sewers in time. - Clear the flow at the places at risks of flooding before, during and after the rainy/storm season. - Regularly carry out maintenance of works, bridges and sewers.	- Operation management unit - Local government	- PPMU

6.2.5. Management of Impacts on Physical Cultural Resources

Based on the ESIA study and the RAP preparation process, approximately 58 graves will be relocated for implementation of the subproject. The relocation of these 58 graves has been mentioned in the RAP.

Based on ESIA study and the RAP preparation process, no sensitive works (communal houses, historic sites, and nature reserves) is affected by land acquisition.

During excavation and dredging, specific procedures should be applied in the case of archaeological finds. Figure 49 below shows the steps to take. PMU will be responsible for overall coordination and reporting. Finding processes will be mentioned in all construction contracts and key personnel and contractors will be trained on how to implement these processes.

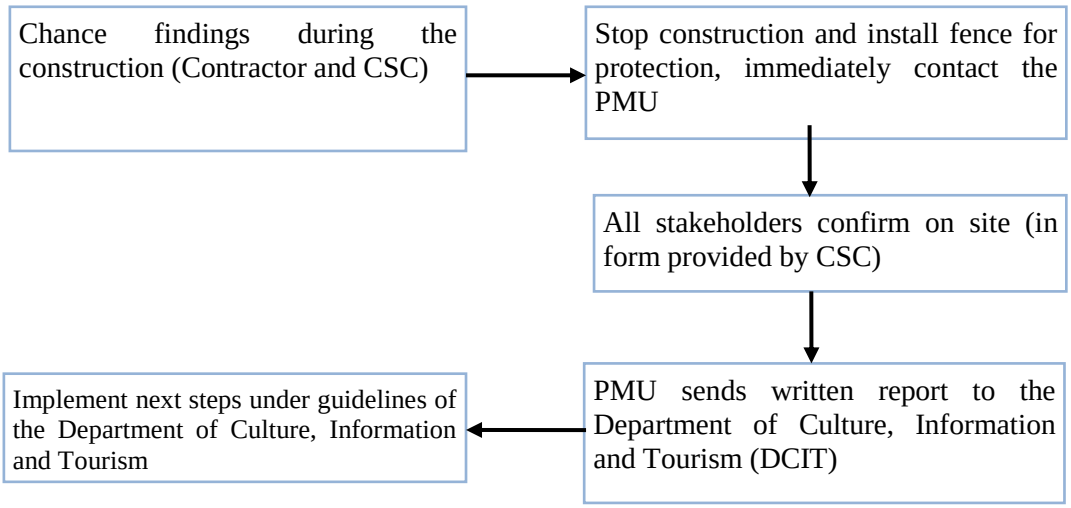


Figure 49: Procedures for chance findings during the construction phase

6.3. Environmental - social monitoring program

Environmental monitoring

It is necessary to design an environmental monitoring program and implement this program at an appropriate frequency to document the overall performance of the subproject's works as well as the short-term effects caused by the subproject's construction activities. The environmental monitoring program will be implemented during construction, at all 3 levels:

- *Monitor compliance with mitigation measures,*
- *Community-based monitoring, and*
- *Monitoring environmental parameters established in the ESIA for each works.*

6.3.1. Objectives of the environmental monitoring program

Implementation plan of monitoring program is divided into 2 phases: pre-construction phase and construction phase. Monitoring program in the pre-construction phase was shown in the section 3, this section will setup an environmental monitoring program for construction phase. Do not conduct environmental monitoring during subproject operation phase due to mostly positive impacts on this phase. Mitigation measures determined during subproject preparation must be completed by the designer before construction. The proper design results must be included into the contractor's bids.

During construction phase, some mitigation measures must be carried out before construction such as training for contractor and Construction Supervision Consultant. The detailed implementation plan for mitigation measures must be given out to be applied at site on commencement date. Such requirement is also available in the Bidding Documents and such

plan shall be inspected by PPMU

6.3.2. Review of contractor's documents

ESMP's Implementation Plan must be prepared by the contractor and inspected by PPMU before the Bids are submitted. All documents submitted by the contractor are appraised in accordance with the subproject requirements are submitted PPMU and CSC to ensure that no works are undertaken unless the supervising engineer/supervision consultant is satisfied that the contractor has suitable proposals for managing the E&S risks of the activity in accordance with the employers requirements. Any changes in documents must be accepted by the environmental officer and CSE. Such documents must be continuously updated.

6.3.3. Environmental monitoring criteria

6.3.3.1. Environmental monitoring plan

During subproject preparation and construction, the environmental monitoring is carried out by the Subproject Owner, concretely:

Table 84: Location, parameters and frequency of monitoring program

No	Monitored items	Construction phase
I	**Monitoring of air quality, noise, vibration**	
1	Monitoring parameters	TSP, CO, NO_2, SO_2, L_{eq}, vibration
2	Monitoring frequency	06 month/time x 4 times
3	Applied Regulation	QCVN 05:2013/BTNMT, QCVN 06:2009/BTNMT; QCVN 26:2010/BTNMT; QCVN 27:2010/BTNMT
4	Monitoring locations	9 locations

Table 85: Estimated cost for sampling and sample analysis

No.	Indicators	Frequency	Quantity	Total samples	Unit price (VND)	Total amount (VND)
1	Quality of air, noise and vibration	Every 6 months	9	36	2,176,100	78,339,600
	Total					**78,339,600**

6.3.3.2. Social monitoring plan

Social monitoring plan during construction is shown in the Table 86.

Table 86: Social monitoring plan during construction

No.	Form	Site	Frequency	Basis
I	OSH monitoring			
1	Environmental hygiene	- Construction site - Worker camping area - Material mobilization areas	3 months/ time	- Quantity and conditions of cleaning tools - First aid box - Medical works - Number of infectious and contamination cases - Communication plan on community health
2	Labor safety	- Construction site - Worker camping	3 months/ time	- PPEs - Safety signs

No.	Form	Site	Frequency	Basis
		area - Material mobilization areas		- Number of accidents

Because construction time is about 24 months for each work item, the social monitoring will be executed about 8 times at each site.

The supply of data on environmental monitoring at the construction site by contractors is considered a quantitative assessment tool for environmental quality around the construction site. Since then, construction supervision consultants have requested to add or change the construction methods and mitigation measures to minimize the social and environmental impact.

6.3.4. Monitoring implementation of Dredged Material Management Program (DMMP)

In order to ensure that dredging, transportation and disposal activities do not cause negative impacts on the local population and environment, a guideline for preparation and monitoring of the dredged materials management plan is presented in the box below. Accordingly, the detailed design will include a DMMP Basic Testing and Development Program that reflects the guidelines below as appropriate.

Guidelines for preparation and management of DMMP

Major environmental and social issues related to contaminated dredged materials include: (a) Pollution during transport of dredged materials from the dredging site to the disposal site; (b) increased turbidity and water pollution in lakes and canals during the dredging; (c) other incidents, malodors and disturbances to residents; (d) Possible misuse of contaminated dredged materials for household and public infrastructure. To assist in the preparation of a DMMP due to activities undertaken in urban areas or existing water bodies that may also be used by other users, the following issues should be considered:

- *Assessment of sediment load.* This assessment is to confirm whether the sediments contain large amounts of environmentally hazardous materials such as heavy metals and other toxins. If these substances are found to be greater than the permitted thresholds in the national environmental standard, a special discharge plan will be prepared in conjunction with a monitoring plan. This discharge plan will also establish a program to ensure that local residents do not use dredged materials for house construction or gardening. Sludge and sediment samples will be taken for analysis of major pollution indicators. Sampling and analysis must comply with the government regulations while sampling sites depend on the level of risk for each specific site.

Volume in cubic meter	No. of sediment sample
Up to 25,000	3
25,000 to 100,000	4-6
100,000 to 500,000	6-10
500,000 to 2,000,000	10-20
For each 1,000,000 above 2,000,000	Additional 10

- *Identification of available disposal site of dredged materials.* The plan should also mention public land and private land that can be used with the permission of the affected households. Also, it should identify appropriate disposal sites for dredged materials

suitably with the level of risk associated with them. For the areas of public land, land for building rural roads, the works where level of risks from dredged sludge is high, this dredged sludge must be disposed at the sanitary disposal sites that are currently operating.

- *Preparation for dredging and transportation plan of dredged materials/sludge.* The waste sludge dredging and transport plan should outline: (a) dredging methods (using pipeline, pumping water before excavation and so on) and loading sludge to the disposal site or onto the transport vehicles or to the temporary disposal site. If the trucks are used, the transport route from the dredging site to the disposal site should be indicated, (b) the dredging time, (c) the type of vehicles and proposed measures to reduce the leakage of dredged materials from vehicles, (d) the contractor's responsibility for clearing roads and taking remedial actions, if necessary, and (e) communication plans for neighboring communities, including phone numbers in case of any complaints.
- *Temporary storage for non-contaminated sludge and sediments.* Since the dredged materials will firstly be in a slurry state with suspended particles within 24-48 hours, all water drained from the temporary sludge storage site will be drained into the drainage ditch and discharged into the canal/lake. For the sites highly contaminated with organic matters and malodor, dredged materials must be removed in sealed containers out of the site as quickly as possible. In case bottom sludge is contaminated with organic matters, the dredged sludge will be transported to the suitable storage site which is design with appropriate location and size. A monitoring program for dumping of heavily contaminated dredged materials will also be prepared.
- *Identification of areas/main objects (such as business establishments, schools, public services, etc.) that is sensitive to dredging and transportation activities.* The DMDP will cover an overall analysis of affected local business activities, limited access to water sources and traffic situation (affected by dredging), and provide a plan to minimize/compensate for obstructions. The plan should also include all possible measures to minimize impacts on local traffic and water supply.
- *Identification of main users of other water sources.* The water sources from dredged lakes/rivers can be used by other objects, thus dredging can affect them. A water quality monitoring plan with specific stations and parameters should be prepared to monitor potential impacts on the users. Priority is given to monitoring areas sensitive to water quality changes (high suspended solids, low pH, high BOD and COD, high salinity, etc.), especially where water is used as a source of domestic and agriculture production purposes. In areas where dredging activities may have negative impacts on water users, the subproject owner must inform and consult with these users and take actions to address their concerns, incorporate implementation of water quality monitoring in the DMMP.

6.3.5. Monitoring efficiency of ESMP implementation

The ESU with the support from the IEMC, will monitor the implementation of the ESMP during the bidding / detailed design stages as well as during the construction and first-year operation to ensure that (a) dredging and sludge treatment is made in accordance with the DMMP, (b) Other impacts included in ESMP are effectively managed and mitigated; and (c) traffic management is appropriate and the extent of impact is within acceptable limits (no complaints or unresolved cases). The results are kept strictly in the subproject documents for consideration by the PMU and the World Bank. The PMU will be responsible for payment of monitoring costs.

6.4. Roles and responsibilities for ESMP implementation

6.4.1. Institutional Arrangement

Table 87 and Figure 50 indicating that ESMP during construction requires the involvement of

several stakeholders and agencies, each with different roles and responsibilities including, PPMU, DONRE (Thai Nguyen Department of Natural Resources and Environment), the Contractors, the Construction Supervision Consultant (CSC), Detailed Technical Design, and local communities.

To ensure effective implementation of the ESMP, the following actions will be carried out during the implementation of the subproject:

During the detailed design and tender documentation making

- During the detailed design and preparation of bidding/ contractual documents for each package, the detailed technical design consultant will incorporate the mitigation measures and monitoring responsibilities provided in the ESMP and Environmental, Social, Health and Safety (ESHS) requirements into the detailed technical designs and standard procurement documents and contractual documents
- PMU make effort to inform thebidders/contractors about the subproject safeguard requirements and request them to commit to comply.

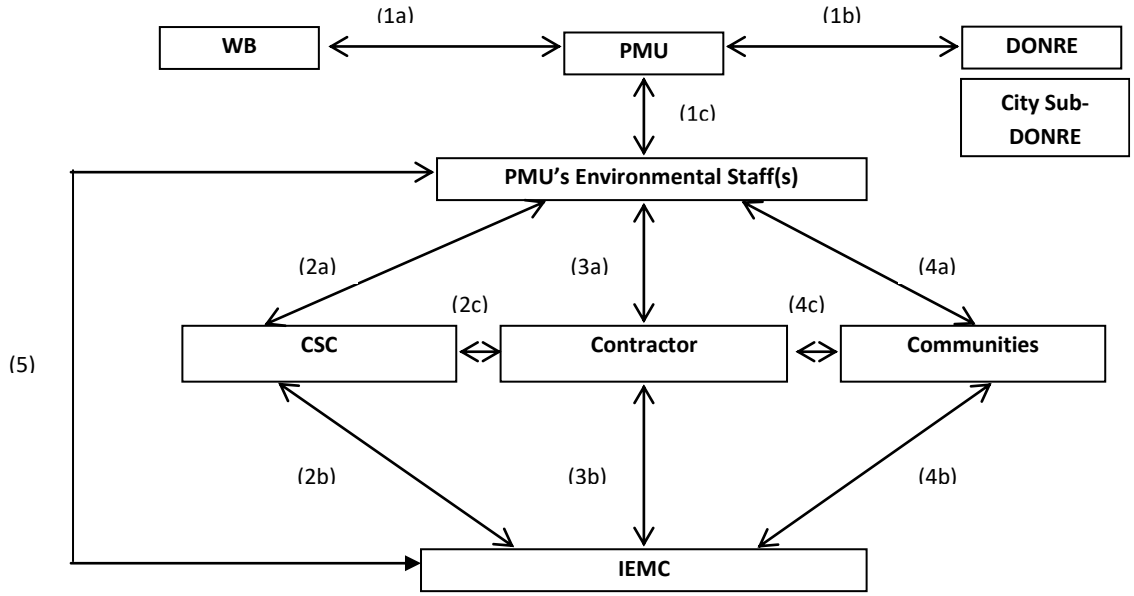


Figure 50: ESMP implementation structure

Table 87: Environmental protection responsibilities

Community/ Agencies	Responsibilities
PPMU	PPMU will be responsible for monitoring the overall subproject implementation, including environmental compliance of the subproject. PPMU will have the final responsibility for ESMP implementation and environmental performance of the subproject during the construction and operational phases. Specifically, the PPMU will: (i) closely coordinate with local authorities in the participation of the community during subproject preparation and implementation; (ii) monitor and supervise ESMP implementation including incorporation of ESMP into the detailed technical designs and bidding and contractual documents; (iii) ensure that an environmental management system is set up and functions properly; (iv) be in charge of reporting on ESMP implementation to the DONRE and the World Bank.

Community/ Agencies	Responsibilities
	In order to be effective in the implementation process, PPMU will assign Environmental Staff(s) (ES) to help with the environmental aspects of the subproject.
PPMU Environmental and Social Staff(s) (ES)	The ES is responsible for monitoring the implementation of the subproject ESMP. Specifically, ES will be responsible for: (i) helping PPMU incorporate ESMP into the detailed technical designs and civil works bidding and contractual documents; (ii) helping PPMU incorporate responsibilities for ESMP and supervision into the TORs, bidding and contractual documents for the Construction Supervision Consultant (CSC) and other safeguard consultant (IEMC) as needed; iii) providing relevant inputs to the consultant selection process; (iv) reviewing reports submitted by the CSC and safeguard consultants; (v) conducting periodic site checks; (vi) helping the PPMU on solutions to handle social issues of the subproject; and vii) preparing environmental and social performance section on the progress and review reports to be submitted to the DONRE and the World Bank.
Construction Supervision Consultant (CSC)	The CSC will assign Environmental and Social Staff(s) and will be responsible for routine supervising and monitoring all construction activities and for ensuring that Contractors comply with the requirements of the contracts and the ECOP. The CSC will engage sufficient number of qualified staffs (e.g. Environmental Engineers) with adequate knowledge on environmental protection and construction subproject management to perform the required duties and to supervise the Contractor's performance. The CSC will also assist the PPMU in reporting and maintaining close coordination with the local community. Arrange, implement training on HIV/AIDS awareness rising for all workers, the local community, CSC team and PPMU staff. The cost for this training included in the consulting service contract.
IEMC	IEMC supports PMU/ESU to implement the ESMP 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 subproject to be implemented by CSC at key 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
Contractor	The contractor will assign Environmental and Social Staff(s) to carry out Environmental and Social mitigation measures proposed in ESMP. Based on the approved environmental specifications (ECOP) in the bidding and contractual documents, the Contractor is responsible for establishing a Contractor ESMP (CESMP) for each construction site area, submit the plan to PPMU and CSC for review and approval before commencement of construction. In addition, it is required that the Contractor get all permissions for construction (traffic control and diversion, excavation, labor safety, etc. before civil works) following current regulations. The Contractor is required to appoint a competent individual as the contractor's on-site Safety and Environment Officer (SEO) who will be responsible for monitoring the contractor's compliance with health and safety requirements, the CESMP requirements, and the environmental specifications (ECOP).

Community/ Agencies	Responsibilities
	Take actions to mitigate all potential negative impacts in line with the objective described in the CESMP. Actively communicate with local residents and take actions to prevent disturbance during construction. Ensure that all staffs and workers understand the procedure and their tasks in the environmental management program. Report to the PPMU and CSC on any difficulties and their solutions. Report to local authority and PPMU and CSC if environmental accidents occur and coordinate with agencies and keys stakeholders to resolve these issues.
Local community	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 the PPMU. If unexpected problems occur, they will report to the CSC and PPMU.
Thai Nguyen People's Committees, DONRE	Oversee implementation of subproject under recommendations of DONRE and PPMU to ensure compliance of Government policy and regulations. DONRE is responsible for monitoring the compliance with the Government environmental requirements.

6.4.2. Environmental Compliance Framework

(i) Environmental Duties of the Thai Nguyen PMU/Detail Design Consultants

During the preparation of TORs for consulting services and construction bidding documents, Thai Nguyen PMU will also work closely with the consultants to ensure that: i) contract packaging and cost estimations includes ESMP implementation, including the services on independent safeguard monitoring, environmental sampling/monitoring and compliance supervision, reporting etc.; ii) ECOPs and relevant common as well as site-specific mitigation measures are incorporated into the bidding documents; iii) environmental supervision and training are included in the scope of works assigned to the construction supervision consultant.

At feasibility study/detail engineering design stage, Thai Nguyen PMU shall work closely with the feasibility study consultants and detail design engineers to ensure that the greening/landscaping, environmental friendly solutions and relevant mitigation measures proposed in the ESIA/ESMP are considered and incorporated into the engineering design as appropriate.

During construction phase, Thai Nguyen PMU shall work closely with the supervision consultant to monitor the compliance of contractors and report to relevant authorities. Thai Nguyen PMU will also direct the supervision consultant and contractors on the actions to be undertaken in case when issues are arisen, incidents or accidents etc.

Thai Nguyen PMU will assign at least one staff with suitable qualifications to be Environmental Officer (EO) throughout project implementation. The EO will oversee environmental issues and monitor safeguard compliance of the subproject. The EO will be supported by the Independent Monitorign Consultant, the Environmetnal Officers of the construction supervision team as well as the contractors.

(ii) Environmental Duties of the Contractor

The contractor firstly shall adhere to minimize the impact that may be result of the project construction activities and secondly, apply the mitigation measures under ESMP to prevent harm and nuisances on local communities and environment caused by the impacts in construction and operation phases.

Prior to construction, the contractor will be required to prepare and submit a contractor's site-specific Environmental and Social Management Plan (Contractor's SEMP) to the CSC and PMU based on the ESMP of the project and requirement in the Specification of Bidding Document. The CESMP shall be certified by the CSC with subsequent submission to the PMU for approval. No construction activity should be implemented before approval of the CESMP.

Remedial actions that cannot be effectively carried out during construction should be carried out on completion of the works (and before issuance of the acceptance of completion of works).

The duties of the Contractor include but not limiting to:

- Compliance with relevant legislative requirements governing the environment, public health and safety;
- Work within the scope of contractual requirements and other tender conditions;
- Organize representatives of the construction team to participate in the joint site inspections undertaken by the Environmental Staffs of the CSC;
- Carry out any corrective actions instructed by the Environmental Staffs of the PPMU and CSC;
- In case of non-compliances/discrepancies, carry out investigation and submit proposals on mitigation measures, and implement remedial measures to reduce environmental impact;
- Stop construction activities, which generate adverse impacts upon receiving instructions from the Environmental Staffs of PPMU and CSC. Propose and carry out corrective actions and implement alternative construction method, if required, in order to minimize the environmental impacts; Non-compliance by the Contractor will be cause for suspension of works and other penalties until the non-compliance has been resolved to the satisfaction of the ES of PPMU and CSC.
- In case the contractor proposes to use source of raw materials that have not been covered in subproject ESIA, the contractor will report to the CSCs and PMUs and coordinate with them in carrying out due –diligence environmental review of these materials sources to assess their compliance to national environmental requirements. Only complied sources can be used under DCIDP.
- The contractor shall be responsible for implementation of corrective measures at his costs. The contractor shall also be responsible for paying the costs of damages caused by non-compliance to ESMO and/or applicable environmental regulations.

(iii) Contractor's Environmental and Social Management Plan

After contract signing, based on the ESIA and contractual conditions, the contractor will prepare a CESMP for each contract package and submit to the CSC and PMU for review and approval.

The objective of the Contractor Environmental and Social Management Plan (CESMP) is to provide information for environmental management during the proposed works/activities on site of Hai Duong subproject. This is to ensure that the Contractor (and any subcontractors) have minimal impact on the environment. The CESMP will detail how the contractor will mitigate construction impacts and documents the contractor's response to inspecting, monitoring, verifying, internal auditing and correcting or improving environmental performance. The CESMP must be site-specific and should include details of control measures

that will be implemented on site to minimize any potential environmental impacts from the proposed works/activities. If the proposed works/activities contained within the CESMP are altered during the Contract, the CESMP will be required to be modified by the Contractor to reflect these changes or modifications. The CESMP shall include the following contents:

(1) A statement of policy, providing a definition of the Contractor's environmental policy and an indication of commitment to the execution of its Site Environmental Management Plan.

(2) A brief document description; Date of issue; Revision status; Distribution list; and preparation personnel details and signoff.

(3) Applicable laws and regulations associated with the requirements in the subproject ESMP.

(4) Identification of the contractor licenses, permits and approval associated with the CESMP.

(5) Details on how the environmental impacts identified in the subproject ESIA will be managed on site, including: 1) the site-specific measures to mitigate impacts during construction (pages 184-191); 2) ECOPs (pages 198-208); 3) site-specific EMP (pages 208-213); and 4) the Contractor's Dredging Management Plan that the contractor is required to develop (page 259-265).

(6) Contractor's plan to carry out self-monitoring of implementation of the CESMP.

(7) Detailed environmental training that all site contractor personnel (including subcontractors) are required to undertake. As a minimum all contractor personnel working at the subproject sites must: i) be familiar and understand the CESMP for the works; ii) be aware of their environmental responsibilities and legal obligations on site; and iii) undertake health and safety and emergency response training.

(8) Specific capabilities, support mechanisms and resources necessary to satisfactorily implement the CESMP. Detailed environmental responsibilities of all contractor personnel including subcontractors working on site with appropriate knowledge, skills and training for specific tasks shall be identified.

(9) The contractor shall be responsible for preparing monthly environmental reports, as a section within the Progress report required in the bidding document, including accidental report if any, for submitting to the subproject owner. The contents of these reports may include following details:

- Implementation of the Contractor's CESMP complying with the agreed program;
- Any difficulties encountered in the implementation of the CESMP and recommendations for remedying them for the future;
- The number and type of non-compliances and proposed corrective actions;
- Reports from the Subcontractors involved in the implementation of the CESMP, including minutes of meetings and discussions held by the Contractor;
- Minutes of meeting from discussions held with the subproject owner regarding implementation of the CESMP.

(iv) Contractor's Safety, Social and Environmental Officer (SEO)

The contractor shall be required to appoint competent staff(s) as the Contractor's on-site safety, Social and environmental officer (SEO). The SEO must be appropriately trained in environmental management and must possess the skills necessary to transfer

environmentalmanagement knowledge to all personnel involved in the contract. The SEO will be responsible for monitoring the contractor‘s compliance with the ESMP requirements and the environmental specifications. The duties of the SEO shall include but not be limited to the following:

- Carry out environmental site inspections to assess and audit the contractors' site practice, equipment and work methodologies with respect to pollution control and adequacy of environmental mitigation measures implemented;
- Monitor compliance with environmental protection measures, pollution prevention and control measures and contractual requirements;
- Monitor the implementation of environmental mitigation measures;
- Prepare audit reports for the site environmental conditions;
- Investigate complaints and recommend any required corrective measures;
- Advise the contractor on environment improvement, awareness and proactive pollution prevention measures;
- Recommend suitable mitigation measures to the contractor in the case of non-compliance. Carry out additional monitoring of noncompliance instructed by the ES of PPMU and CSC
- Inform the contractor and ES (of PPMU and CSC) of environmental issues, submit contractor’s ESMP Implementation Plan to the ES of PPMU and CSC, and relevant authorities, if required;
- Keep detailed records of all site activities that may relate to the environment.

(v) Independent Environmental Monitoring Consultant (IEMC)

The IEMC will be responsible for assisting the PMU in ESMP 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 subproject activities to ensure that unified environmental protection policies of the Government and World Bank are applied and supervised during subproject 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 ESMP implementation of the contractor; (2) ensure active participation of the local communities and schools in the subproject areas, (3) monitor environmental parameters to assess the overall impacts of the subproject, and (4) establish environmental training program.

Specifically, the IEMC’s responsibilities include:

- Ensuring that the approved ESMP and all subproject loan agreements related to environmental safeguards are fully applied and complied during subproject 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 ESMP performance during subproject 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 subproject 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.

(vi) Environmental and Social Supervision during Construction (CSC)

During construction phase, a qualified CSC reporting to the PPMU shall carry out the environmental supervision. The CSC will assign environmental and social staff(s), will be responsible for inspecting, and supervising all construction activities to ensure that mitigation measures adopted in the ESMP are properly implemented, and that the negative environmental impacts of the subproject are minimized. The CSC shall engage sufficient number of Environmental Supervision Engineers with adequate knowledge on environmental protection and construction subproject management to perform the required duties and to supervise the Contractor's performance. Specifically ES of CSC will:

- Review and assess on behalf of the PPMU whether the construction design meets the requirements of the mitigation and management measures of the ESMP,
- Supervise contractor's implementation of its CESMP including their performance, experience and handling of site environmental issues, and provide corrective instructions;
- Review the ESMP implementation by the contractors, verify and confirm environmental supervision procedures, parameters, monitoring locations, equipment and results;
- Arrange, implement training on HIV/AIDS awareness rising for all workers, the local community, CSC team and PPMU staff.
- Report ESMP implementation status to PPMU and prepare the environmental supervision statement during the construction phase;

(vii) Compliance with Legal and Contractual Requirements

- The constructions activities shall comply not only with the general contractual condition on environmental protection and pollution control requirements in the bidding document, the subproject ESMP, and the CESMP, but also with environmental protection and pollution control laws of the Socialist Republic of Viet Nam.
- All the works method statements submitted by the Contractor to the CSC and PMU for approval to see whether sufficient environmental protection and pollution control measures have been included.
- The CSC and PMU shall also review the progress and program of the works to check that relevant environmental laws have not been violated, and that any potential for violating the laws can be prevented.
- The Contractor shall copy relevant documents to the SEO and the ES of CSC and PMU. The document shall at least include the updated work progress report, the updated work measure, and the application letters for different license/permits under the environmental protection laws, and all the valid license/permit. The SEO and the ES shall also have access, upon request, to the Site Log-Book.
- After reviewing the documents, the SEO or the ES shall advise the PMU and the contractor of any non-compliance with the contractual and legislative requirements on

environmental protection and pollution control for them to take follow-up actions. If the SEO or the ES concludes that the status on license/permit application and any environmental protection and pollution control preparation works may not comply with the work measure or may result in potential violation of environmental protection and pollution control requirements, they shall advise the Contractor and the PMU accordingly.

(viii) Environmental Claims and Penalty System

- In the compliance framework, if non-compliance with the Contractor's ESMP and environmental regulations are discovered by CSC/ES/IEMC/PMU during the site supervision, 2% values of interim payment of the contractor of this month will be held back. The Contractor will be given a grace period (determined by CSC/PMU) to repair the violation. If the Contractor satisfactorily performs the repairs within the grace period (confirmed by CSC/PMU), no penalty is incurred and the uphold money will be paid to the contractor. However, if the Contractor fails to successfully make the necessary repairs within the grace period, the Contractor will pay the cost for a third party to repair the damages (deduction from uphold money).
- In case of IEMC/CSC/PMU not detected of non-compliance with environmental regulations of the contractor, they will be responsibility payment to repair the violation.

(ix) Reporting Arrangement

ESMP monitoring and reporting requirements are summarized in Table 88 below

Table 88: Regular reporting requirements

No.	Report Prepared by	Submitted to	Frequency of Reporting
1	Contractor to the Employer	PPMU	The Contractor is obliged to report (immediately of certain aspects and monthly with respect to a wider range of aspects) to the CSC
2	Construction Supervision consultant (CSC)	PPMU	The CSC is required to report to the employer every weekly and monthly
4	Community Monitoring	PPMU	When the community has any complaint about the subproject safeguards implementation
5	PPMU	DONRE	PPMU is required to report to DONRE every six-month in accordance with Gov's regulations
6	PPMU	WB	PPMU is required to report to WB every six-month in accordance with the Section II of the Loan Agreement

6.5. Capacity building program

6.5.1. Technical Assistance support for the safeguard implementation

An assessment of safeguards implementation capacity of existing PPMU staffs indicate that PPMU 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 subproject implementation of safeguards requirements contained in the ESMP 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 PPMU during the implementation of the safeguards requirements. The technical assistance will provide the

necessary technical support the PPMU in its work with contractors as well as other entities involved in the implementation of the ESMP.

This technical assistance must be made available at an earlier stage to ensure that the ESMP is properly and appropriately translated into the bidding (and subsequent contract) documentation. The technical assistance should be undertaken by appropriately skilled and experienced personnel, and be undertaken in accordance with a Terms of Reference that includes specific reference to developing effective Employers Requirements sections of the standard Procurement Documents (SPDs).

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 subproject as well as training that covers both specific knowledge on safeguard procedures and requirement for the subproject staffs, 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 PPMU (environmental staffs and coordinators of packages) to do their tasks. It would also include assisting the PPMU's environmental staffs with the review of contract documents on the bidding packages for construction items of the subproject to ensure compliance with environmental protection policies and impact mitigation and monitoring requirements as well as provide general environmental guidance as requested by the PPMU to enhance overall subproject 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 2 times (one on pre-construction phase and another on construction phase). The WB safeguard specialists will participate in the capacity building in particular in the training activities as appropriate

6.5.2. Training programs

❖ *Training program in environmental management and monitoring*

Table 89 below provides examples of the basic trainings for safeguards during subproject implementation. The training programs will be developed and delivered by the Technical Assistance team for the implementation of safeguards for the PPMU training. The PPMU 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 PPMU and the Technical Assistance team for the implementation of safeguards during subproject implementation based upon a reassessment of needs and the status of safeguards implementation.

- *Target groups for the training:* include PPMU staffs, ESU staffs, field engineers, CSC, construction contractors, local authorities, and community representatives in the subproject 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 sub subproject/contracts.

Training frequency: The basic training programs proposed in Table 89 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 PPMU staffs will continue until year three of implementation.

Table 89: Training programs for capacity building

I. Objects	**Provincial Subproject Management Unit (PPMU)**
Training course	Environmental supervision, monitoring and reporting
Participators	Environmental staffs and technical staffs
Training Frequency	Soon after subproject effectiveness but at least 1 month before the construction of the first contract. The follow-up training will be scheduled as needed.
Time	Four days of training twice a year to be repeated on a yearly basis until year three of implementation
Content	- General environmental management relating to subproject including requirements of WB, DONRE, cooperating with relevant enterprises - Requirements on 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	PPMU, with support of the Technical Assistance team for the implementation of safeguards
II. Objects	**CSC, contractor, commune/wards authorities, community representatives**
Training course	Implementation of mitigation measures
Participators	CSC; on-site construction management staffs; environmental staffs of contractor; commune/ward/group authorities
Training frequency	After bidding, update based on requirements
Time	Three days of training for CSC and contractors and two days of training for other also to be repeated twice a year on an annual basis depending on needs
Content	- Overview of environmental monitoring; - Requirements of environmental monitoring; - Role and responsibilities of contractors and CSC - Content and methods of environmental monitoring; - Response and risk control; - Propagate monitoring forms and guide how to fill in the forms and risk report; - Training in HIV/AIDS; - Other areas to be determined; - Preparation and submission of report
Responsibilities	PPMU with support of the Technical Assistance team for the implementation of safeguards
III. Objects	**Communities and workers**
Training course	Environmental sanitation and safety
Participators	Representatives of community and/or worker leaders (as appropriate)
Training frequency	As appropriate
Time	One-day presentation and one-day on-the job training twice a year to be repeated on a per needs basis
Content	- Preliminary presentation on environmental protection and environmental overview

	- Key issues that require community and workers attention to minimize safety risks (roads, equipment, machines, etc.) as well as reduce pollution (dust, fume gases, oil/grease spill, waste management, etc.) - Management of environmental safety and sanitation in work sites and worker camps; - Mitigation measures at construction site and work camps; - Safety measures on electricity, mechanical, transportation, air pollution; - Other areas to be determined; - Procedures to deal with emergency situation
Responsibilities	Contractor, PPMU

❖ ***Training program in HIV/AIDS***

To minimize and address the HIV/AIDS-related risks (especially in women), the HIV/AIDS communication and information dissemination should be carried out by the Subproject. The HIV/AIDS training program includes campaigns of raising awareness of workers and communities at construction sites will be conducted by CSC under the supervision of the community, ward/commune WU and PPMU. Funds for HIV/AIDS training are as follows:

Table 90: Cost estimate of HIV/AIDS training

Training objects	Quantity (1 course /ward/commune)	Unit price (VND)	Total amount	
			VND	USD
Construction supervision consultant (CSC)	14 courses	20,000,000	280,000,000	12,302
Contractor's workers				
Local officials and community				
PPMU's staff				

6.6. Estimated cost of environmental and social management plan

Expenditure for implementing ESMP includes the main financial resources, covering the environmental monitoring expenses and expenses for implementing the mitigation measures. The expenses of implementing the mitigation measures have been included into the expenditure for implementing construction subprojects on environmental protection works and measures.

According to the unit price of environmental monitoring in the locality, the estimated cost for environmental quality monitoring of the Subproject is stated in the table below.

Table 91: Estimated cost for ESMP (million USD)

	Cost (USD)	Funding source
(a) Mitigation during construction	**Part of contracts**	WB
(b) Supervision of safeguards during construction	**Part of CSC costs**	WB
(c) Environmental Safeguards unit (ESU) of PMU	**Part of PMU costs**	Counterpart fund
(d) Environmental quality monitoring	**3,441**	WB
(e) Independent Environmental Monitoring Consultant (IEMC)	**98,629**	WB
(f) Safeguards capacity building program	**20,000**	WB
(g) Training program in HIV/AIDS	**12,302**	WB

Table 92: Estimated cost for the IEMC

No.	Content	Unit	Quantity	Price (VND)	Total (VND)	Total (USD)
1	Specialist salary (I)	Month	8	40,000,000	320,000,000	14.060
2	Specialist salary (II)	Month	24	30,000,000	720,000,000	31.634
3	Specialist salary (III)	Month	16	15,000,000	240,000,000	10.545
4	Local stays and allowance	Day	720	520,000	254,800,000	11.195
5	Traveling expenses	Turn-person	90	3,000,000	420,000,000	18.453
6	Training course	Overall	8	10,000,000	120,000,000	5.272
7	Office supply	Overall	18	12,000,000	120,000,000	5.272
8	Office and communication	Overall	18	5,000,000	50,000,000	2.197
	Total					**98.629**

6.7. Grievance redress mechanism (GRM)

The contractors must indicate contact for any complaints when the contractors announce construction schedule to local communities

Complaints relating to any subproject's problems will be solved through negotiations to achieve the consensus. A complaint will go through three Stages before it can be transferred to the court. The enforcement unit will pay all administrative and legal fees relating to the acceptance of complaints. This cost is included in the subproject budget.

Complaint procedures and resolution will be performed as follows:

The first level People's Committee of ward/commune. An affected household is to take his/her complaint to any member of the People's Committee of the ward/commune, through the ward head or directly to People's Committee of ward, in written or oral form. The said member(s) of the People's Committee will inform the People's Committee of the ward on the complaint. The People's Committee of Ward will work directly in person with the said affected household and will decide on the settlement of the complaint 5 days after receiving such complaint. The Secretariat of the People's Committee of the relevant ward is responsible for documenting and recording all the complaints that it is handling.

After the Ward People's Committee issues its decision, the relevant household can make an appeal within 30 days. In case a second decision has been issued but the said household is still not satisfied with such decision, such household can appeal to the municipal (city) People's Committee (CPC).

The second level the CPC. Upon receiving a complaint from a household, the CPC will have 15 days after receiving the complaint to resolve the case. The CPC is responsible for filing and storing documents on all complaints that it handles.

When the CPC has issued a decision, the household can make an appeal within 30 days. In case a second decision has been issued and the household is still not satisfied with such a decision, they can appeal to the Hanoi People's Committee.

The third level The Thai Nguyen People's Committee (PPC). Upon receiving a complaint from the household, the PPC will have 30 days after receiving the complaint to resolve the case. The PPC is responsible for filing and storing documents for all complaints to be submitted.

After the HPC has issued a decision, the household can appeal within 45 days. In case a second decision has been issued and the household is still not satisfied with such decision, they can appeal to the court within 45 days. The HPC will then have to pay the compensation into an account.

The Forth Level Provincial Court. In case a complainant brings his/her case to a provincial court and the court rules in favor of the complainant, the provincial authorities will have to

increase the compensation up to such a rate as may be ruled by the court. In case the court's ruling is in favor of the HPC, the complainant will be refunded the amount of money that has been paid to the court.

The decision ruling the settlement of complaints will have to be sent to complainants and concerned parties, and shall be publicly posted at the headquarters of the People's Committee of the relevant level. The complainant will receive such ruling three days after the result of complaint resolution at the ward/commune/town level has been decided upon and 7 days at the district or provincial level.

Personnel: The environmental staffs chosen by the PPMU will design and maintain a database of the subproject-related complaints from affected households, including information such as: the nature of the complaint, the source and date of receipt of the complaint, the name and address of the complainant, action plan, and current status.

For oral complaints, the receiving/mediator board will record these requests in a complaint form at the first meeting with the affected person. Contractor and Construction Supervision Consultant:

During construction, the GRM will also be managed by the contractors under supervision of the CSC. The contractors will inform the affected communities and communes about the GRM availability to handle complaints and concerns about the subproject. This will be done via the community consultation and information disclosure process under which the contractors will communicate with the affected communities and interested authorities on a regular basis. Meetings will be held at least quarterly, monthly information brochures will be published, announcements will be placed in local media, and notices of upcoming planned activities will be posted, etc. The contractors should indicate contact for any complaints when the contractors announce construction schedule to local communities.

All complaints and corresponding actions undertaken by the contractors will be recorded in subproject safeguard monitoring reports. Complaints and claims for damages could be lodged as follows:

- Verbally: direct to the CSC and/or the contractors' safeguard staffs or representatives at the site offices.
- In writing: by hand-delivering or posting a written complaint to specified addresses.
- By telephone, fax, e-mails: to the CSC, the contractors' safeguard staffs or representatives.

Upon receipt of a complaint, the CSC, the contractors' safeguard staffs or representatives will register the complaint in a complaint file and maintain a log of events pertaining to it thereafter, until it is resolved. Immediately after receipt, four copies of the complaint will be prepared. The original will be kept in the file, one copy will be used by the contractor's safeguard staffs, one copy will be forwarded to the CSC, and the fourth copy to the PPMU within 24 hours since receipt of the complaint.

Information to be recorded in the complaint log will consist of:

- The date and time of the complaint.
- The name, address and contact details of the complainant.
- A short description of the complaint.
- Actions taken to address the complaint, including contact persons and findings at each step in the complaint redress process.
- The dates and times when the complainant is contacted during the redress process.
- The final resolution of the complaint.

- The date, time and manner in which the complainant was informed thereof.
- The complainant's signature when resolution has been obtained.

Minor complaints will be dealt with within one week. Within two weeks (and weekly thereafter), a written reply will be delivered to the complainant (by hand, post, fax, e-mails) indicating the procedures taken and progress to date.

The main objective will be to resolve an issue as quickly as possible by the simplest means, involving as few people as possible, and at the lowest possible level. Only when an issue cannot be resolved at the simplest level and/or within 15 days, will other authorities be involved. Such a situation may arise, for example, when damages are claimed, the to-be-paid amount cannot be resolved, or damage causes are determined.

World Bank Grievance Redress Mechanism: Communities and individuals who believe that they are adversely affected by a World Bank (WB) supported subproject may submit complaints to existing subproject-level grievance redress mechanism or the WB's Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed in order to address subproject-related concerns. Subproject affected communities and individuals may submit their complaints to the WB's independent Inspection Panel which determines whether harms occurred, or could occur, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the WB's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit www.worldbank.org/grs. For information on how to submit complaints to the World Bank Inspection Panel, please visitwww.inspectionpanel.org

CHAPTER 7. PUBLIC CONSULTATION AND INFORMATION DISLCOSURE

7.1. Objectives and basic principles

7.1.1. Objectives of public consultation

The subproject's public consultation required during ESMP was implemented. The community involvement and consultancy meetings were carried out to: Provide the useful information and better understand about the subproject and its potential impacts and improve the subproject as necessary; Allow the controversy issues to appear early; Facilitate to quickly solve the problems; Facilitate to set up the transparent procedures to implement the proposed subproject and create the accountability and awareness on local ownership during subproject performance. The affected groups and local NGOs were notified in accordance with WB's action policy (OP 4.01) on ESIA; the involvement was required during subproject preparation to some extent and regularly recommended as a part of implementation

7.1.2. The basic principles of public consultation

Facilitate the participation of local people and authorities in subproject area as soon as possible;

The public consultation needs to be conducted with two rounds:

- The first round: As soon as environmental screening is completed and before TOR for ESIA report is finalized.
- Second round: After the first draft of EIA report is prepared

7.2. Implementation methods

Thai Nguyen city Subproject will carry out two rounds of public consultation during the environmental and social impact assessment. Technical consultants and environmental consultants collaborated closely with PMU, local authorities and community in affected areas to perform these two public consultations in order to meet the WB’s requirement.

7.2.1. The first public consultation

To implement the EIA report, on July 27, 2017, the PMU sent the Dispatch No. 1169/UBND-WB to the Subproject wards/towns/communes. From August 01 to August 14, 2017, the PMU held meetings to collect opinions about the Subproject from the local people and people’s committees of 14 wards/communes in Thai Nguyen city. The meetings aims to introduce the subproject, identify the zone/population group in the subproject area, collect information about the status of environmental sanitation at the locality, discuss potential environmental impacts and mitigation measures as well as coordinate with the local authorities in holding public consultation in the subproject area. Simultaneously, the PMU also sent the dispatches to the relevant agencies for consultation about the Subproject.

Before consulting at wards, the ODA-PMU held general meetings at each ward to introduce about the subproject and collect opinions for the subproject.

The schedule of the first consultation with the people’s committees of the subproject wards/communes has been implemented as Table 93. Results of the 1st consultation are shown in Table 95.

Table 93: The first consultation with People’s Committees of the subproject wards/communes on environmental impact assessment

No.	Time	Ward/commune	Quantity	Participants
1	1 August 2017	Huong Son	31	• Representatives of local authorities and relevant agencies: - Farmers’ Union, - Women’s Union,
2		Phan Dinh Phung	29	
3	2 August 2017	Quang Trung	43	
4		Linh Son	61	

No.	Time	Ward/commune	Quantity	Participants
5	3 August 2017	Chua Hang	49	- Fatherland Front, - Youth's Union. • Representatives of Affected households • Representatives of households surrounding the subproject area • Representatives of the PMU • Representatives of Consultants
6		Thinh Dan	45	
7	4 August 2017	Gia Sang	94	
8		Tan Thinh	38	
9	5 August 2017	Quang Vinh	38	
10	7 August 2017	Tuc Duyen	41	
11		Tan Lap	67	
12	8 August 2017	Huong Thuong	62	
13	11 August 2017	Dong Bam	46	
14	14 August 2017	Hoang Van Thu	62	

7.2.2. The second public consultation

The 2nd public consultation is conducted upon completion of the draft ESIA report. This consultation was implemented from Nov 14th 2017 to Nov 18th 2017 in 14 wards/communes. PPMU has sent written requests for consultation to local authorities and non-governmental organizations about the ESIA report in line with the Government's Decree No. 18/2015/ND-CP dated 14 February 2015 on environmental protection planning, strategic environmental assessment, environmental impact assessment and environmental protection plan and Circular No. 27/2015/TT-BTNMT of the MONRE on strategic environmental assessment, environmental impact assessment and environmental protection plan.

Content of the 2nd consultation includes a summary of ESIA report, main impacts and objects to be affected as well as mitigation measures to be implemented in each specific subproject ward so that the communities and representatives of local authorities, unions, and associations can provide responses. The schedule of the second consultation with the people's committees of the subproject wards/communes has been implemented as Table 94. Results of the 2nd consultation are shown in Table 96.

Table 94: The second consultation with People's Committees of the subproject wards/communes on environmental impact assessment

No.	Time	Ward/commune	Quantity	Participants
1	14 Nov 2017	Chua Hang	36	• Representatives of local authorities and relevant agencies: - Farmers' Union, - Women's Union, - Fatherland Front, - Youth's Union. • Representatives of Affected households • Representatives of households surrounding the subproject area • Representatives of the PMU • Representatives of Consultants
2	14 Nov 2017	Dong Bam	44	
3	14 Nov 2017	Gia Sang	37	
4	15 Nov 2017	Hoang Van Thu	70	
5	15 Nov 2017	Huong Son	28	
6	15 Nov 2017	Huong Thuong	61	
7	16 Nov 2017	Linh Son	25	
8	16 Nov 2017	Phan Đình Phung	21	
9	16 Nov 2017	Quang Trung	30	
10	17 Nov 2017	Quang Vinh	39	
11	17 Nov 2017	Tan Lap	68	
12	17 Nov 2017	Tan Thinh	34	
13	18 Nov 2017	Thinh Dan	37	
14	18 Nov 2017	Tuc Duyen	67	

7.3. Results of public consultations

Local authorities and people of ward/commune in the subproject area totally agreed with the implementation because it will bring many socio-economic and environmental benefits. However, it was required to ensure environmental sanitation during construction process, particularly prevention from dust, gas, damage of roads and construction needs to be fast to ensure scheduled progress. The results of public consultation in 14 wards/communes/town are showed in the Table below:

Table 95: Results of the first public consultation

Comments	Responses from the Client
GENERAL COMMENTS	
- Local government and people strongly agreed on the subproject and expected the subproject to be implemented soon. - Ensure construction schedule for the subproject implementation to be in accordance with the regulations to stabilize lives of local people. - Ensure that the subproject is implemented on schedule, avoiding hanging the subproject - Ensure traffic safety. - Implement the compensation policy mechanism, it is necessary to study closely with the real market (price) from time to time to compensate local people affected by the subproject. - In the process of implementing the subproject, it is necessary to coordinate closely with the localities to ensure the situation and security of the area. Registration of temporary residence or temporary absence in localities is in accordance with regulations; Priority for recruiting local workers. - Ensure environmental quality, not affect the health of people in the subproject area. - Work with local people to prepare the time and plan for relocation of the grave resonably with the aim to ensure affected households. The Client shall be responsbilities for all these costs. - Construction material trucks should have loads of ≤10 tons. - In case of damage to the roads or surrounding works, the Client shall have to compensate and repair immediately. - Install instruction signs, signal lights at night.	- The Client will ensure construction time and progress. - Price and compensation plan will be implemented according to the policy framework of the subproject, in accordance with the regulations of the WB, Vietnam and Thai Nguyen province in particular. - For cases where the grave must be relocated, the Client will coordinate with the affected households to select the time, place and plan of relocation in accordance with local customs and habits. The implementation cost will be paid by the Client. - The Client will consider other comments and commit to implement these mitigation measures to ensure that the construction will have the smallest impact on the environment and society.
SEPERATE COMMENTS OF LOCAL PEOPLE AND PEOPLE'S COMMITTEE OF EACH COMMUNE/WARD	
Tuc Duyen ward	
- The People's Committee of Tuc Duyen ward agrees with the environmental mitigation measures outlined in the summary, and these measures should be more clarified. - It is recommended that the Client ensure absolute safety related to labor safety, covering the works during the process of construction. Ensure traffic safety in the process of transporting construction materials to the construction site,	- The Client will consider opinions and include these contributions in the ESIA report and commit to implement mitigation measures in the report.

fire fighting and prevention and control security at the construction site. - It is recommended that the Client strictly comply with commitments on treatment measures in order to prevent and minimize negative impacts on the environment. - In case of dredging ditches, there should take environmental protection measures, not more than 2 days for sludge collection.	
Huong Thuong commune	
- In case the road goes through paddy fields and causes impacts on cultivation or damage to the trees of local people, the Client shall compensate local people. - For intersection roads with the existing roads, it is necessary to build temporary roads for residents. - Regularly water, limit dust, noise during construction, especially during rush hours. - During the construction process of Huong Thuong bridge, there should install a system of warning signs and lights and fences to prevent the construction site from the surrounding areas and protect them from serious accidents. - In the process of relocating Huong Thuong pump station, it is necessary to provide water for local people - The Client should manage workers not to catch without permission in the fish farming area at xom Thong Village Lake.	- If the construction affects cultivation or damage to crops, the Client will compensate local people. - The Client will coordinate with the authorities and local residents to select the time for relocation of the pump station so that cultivation of local people can not be affected. - The Client ensures that the workers will strictly observe the rules of labor and workers camp, do not allow catching fish without permission and affect the security and order of the area. If this situation happens, the Client will have penalties for the offending employees and adequate compensation for local people. - The Client will seriously consider other comments.
Gia Sang ward	
- The Client have to prepare detailed plans for dredging Xuong Rong ditch and inform local people of the construction time and plans. - Dredged material should be dumped in prescribed places. - The Client should dredge all ditch branches of the Xuong Rong drainage ditch to ensure better drainage. - Safety for resident should be ensured. It is necessary to cover sections under construction and install lights, signs and manholes. - The Client should inform and cooperate with local people in case of connecting general water drainage system together with the water drainage pipe of each household.	- In the course of construction, the Client shall coordinate with local authorities to announce the construction plan to local residents before 1-2 weeks. - Dredged materials will be dumped at Da Mai and Tich Luong landfills after each day. - Other comments will be considered and included in the ESIA report by the Client.
Chua Hang ward	
- It is recommended that the Client ensure absolute safety related to labor safety, covering the works during the process of construction. Ensure traffic safety in the process of transporting construction materials to the construction site, fire fighting and prevention and control security at the construction site. - In case construction causes damage to cultivation of local residents, causing death of rice and crops, the Client shall be	- The Client will compensate damages caused by the construction. - Other comments will be considered and included in the ESIA report by the Client.

responsible for compensating. - Transportation of construction materials is not allowed at time after school at the road passing Huong Thuong school.	
Dong Bam ward	
- The Client should regularly inform of details of the subproject implementation progress and coordinate with the local authorities in implementing the subproject. - It is requested that the Client should ensure the schedule, the absolute construction quality on labor safety and covering the works in the process of construction. - The Client should pay attention to environmental impacts during the construction process related to waste including: domestic waste of workers, hazardous waste of works under construction. - When constructing at Dong Bam intersection, there should install signs, fences and signal lights to avoid accidents. - Manholes should be covered and installed signal lights.	- In the course of construction, the Client shall coordinate with local authorities to announce the construction plan to local residents before 1-2 weeks. - The Client commits to ensure the construction process without hanging or delay the subproject. - At traffic intersections, staff will be arranged to regulate transport during rush hours. - Other comments will be considered and included in the ESIA report by the Client.
Linh Son commune	
- In case the road goes through paddy fields and causes impacts on cultivation or damage to the trees of local people, the Client shall compensate local people. - The Client should take measures to manage the workers so as not to cause loss of security and order in the locality.	- The Client will compensate damages caused by the construction. - The Client will regularly monitor implementation of the rules of workers at the construction site and camp.
Thinh Dan ward	
- The Client should complete the temporary bridge prior to demolishing the existing Dan bridge. - Install adequate signs - Do not litter into the ditch which takes water from Nui Coc Lake	- The temporary bridge will be completed prior to demolition of the existing Dan bridge. - Other comments will be considered and included in the ESIA report by the Client.
Tan Lap ward	
- Compensation should be carried out publicly and transparently. - The Client should take measures to ensure the safety of traffic participants on National Highway 3 during the construction process of the overpass. - The Client should ensure that the proposed road plan is the most reasonable plan in terms of site clearance to limit the case of complaining.	- Compensation plan and compensation rate will be posted at the notice board of wards/communes. Compensation and assistance will be made publicly and transparently in accordance with the policy of the subproject. - The selected option is entirely based on the criteria of planning, technology, environment, society, compensation and so on. Therefore, the proposed plan is the most suitable one. The Client commits that there has no shaping alignment for the individual benefits. - Other comments will be considered and included in the ESIA report by the Client.

Huong Son ward	
- It is recommended that the subproject shoud be implemented soon - Do not construct after 7pm - Do not transport construction materials during rush hours - Waste water and pump water from worker activities should be managed. Do not let water overflow over the road.	- Water from foundation hole will be flew into the ditch and manholes and then flowing into the general drainage system of the area. The Client commits not to let wastewater overflow the road, causing environmental sanitation. - Other comments will be considered and included in the ESIA report by the Client.
Phan Dinh Phung ward	
- It is recommended that the subproject shoud be implemented soon. - Do not construct after 7pm - Ensure safety of adjacent works. In case of damage, compensation should be paid. - Waste water and pump water from worker activities should be managed. Do not let water overflow over the road.	- Construction will be finished after 7pm to ensure no noise disturbs resting of local people. - Other comments will be considered and included in the ESIA report by the Client.
Quang Trung ward	
- The Client have to prepare detailed plans for dredging the ditch and inform local people of the construction time and plans. - Dredged material should be dumped in prescribed places. - There should prepare reasonable construction methods to connect existing embankments with newly built embankment. - It is necessary to ensure safety for local people. Covering sections under construction, installing lights, signs and manholes. - The Client should inform and cooperate with local residents when constructing connection of the general water drainage system together with the water drainage pipe of each household. - The Client should clear the bushes around the subproject to ensure the safety and landscape of the works. - Facilitate households to transport excess land, dredged material for leveling.	- In the course of construction, the Client shall coordinate with local authorities to announce the construction plan to local residents before 1-2 weeks. - The Client shall install the full system of fences, signs, signal lights. - The Client will create favorable conditions for households to have their own transportation of soil, stone and dredged materials for leveling. However, the means of transportation of local people should ensure that the material is not dropped, affecting the environment. - Other comments will be considered and included in the ESIA report by the Client.
Tan Thinh ward, Quang Vinh ward and Hoang Van Thu ward	
- Dredging should ensure environmental hygiene. - In the subproject area, many low-lying areas should be leveled, thus the Client coordinates to create conditions for local people to transport excavated soil, dredged materials for leveling during the construction process. - The worker camps adjacent to the ditch, thus, the Client should take measures to spray mosquitoes, mosquitoes so as not to spread the disease. - The Client should inform and cooperate with local people when constructing connection of the general water drainage system together with the water drainage pipe of each household.	- The Client will announce the construction plan to local people before 1-2 weeks and work with people on the connection plan of wastewater drainage system. - The Client will coordinate with the wards health care to spray mosquito and flies at the workers camp and drainage ditch to avoid spreading the disease. - The Client will install the full system of fences, signs, signal lights. - The Client will facilitate households

	to have their own transportation of soil, stone and dredged materials for leveling. However, the means of transportation of local people should ensure that the material is not dropped, affecting the environment. - Other comments will be considered and included in the ESIA report by the Client.

Generally, through the public consultations at the subproject area, the authorities and local people supported the subproject and desired the subproject to be implemented early. Some consultation opinions are summarized as follows

- All local people agreed with the subproject implementation, however, they request the construction to be carried out rapidly, limit delays and ensure environmental cleanliness as well as compliance with tasks and ensuring quality of works.
- To mitigate potential impacts on the community and living conditions of the local people, the subproject components must be implemented. The construction on main roads of the city must be carried out in a systematic manner, and ensure labor and traffic safety for local people.
- Request the contractor to comply with commitments to mitigating negative environmental impacts caused by the subproject.
- For impacts on land acquisition and resettlement, the subproject general principle is that design alternatives should be studied to avoid any resettlement impacts. If it is not avoidable, the subproject should put into good account of all resettlement and income rehabilitation matters, to ensure that the local people's livelihood and living condition will be, at least restored, or improve to pre-subproject implementation. The local people also requested the local authorities and the subproject to make proper compensation and arrange resettlement for them in accordance with their expectations.
- People's Committees of the wards/communes enthusiastically supported the subproject implementation. When the subproject is completed, the local people will have great benefits on living places and fresh environment.
- The local authorities will facilitate and support for implementation of the subproject, especially issues related to the land acquisition for the subproject implementation through site clearance and construction of work items.
- People's Committees of the wards/communes agreed with contents of the ESIA report. Negative environmental impacts caused by the subproject are minor; however, it is essential to take mitigation measures of adverse environmental impacts.
- Agree with the mitigation measures of environmental pollution as mentioned in the report;
- Request the Client to commit to strictly implementing the mitigation measures of potential negative impacts such as environmental management and environmental quality monitoring.
- People's Committees of the wards/communes and representatives of people in the subproject area will jointly discuss and solve issued raised during the subproject implementation.

Chua Hang ward

Hoang Van Thu ward

Huong Son ward

Xã Huong Thuong

Xã Linh Son

Phan Dinh Phung ward

Quang Trung ward

Tuc Duyen ward

Figure 51: Some pictures of public consultations 1

Table 96: Summary of opinions in the 2nd public consultation

Comments	Responses from the Client
GENERAL COMMENTS	
- 1. It requires a policy of adequate compensation for the people, early measurement of site clearance and compensation payment for people to stabilize their lives early - 2. The resettlement area must not be far from the city center, and must be accessible to social security services - 3. Vehicles of transporting constructional materials must be not greater than 10 tons - 4. Water spray to reduce dust generation - 5. Do not work at rest time - 6. Installation of signal lights at night - 7. Install the sheets around the construction site - 8. Installation of signs at the construction site - 9. Force workers not to cause disorder in the area - 10. Employ local laborers - 11. Compensate or repair in case of causing damages to the roads	- 1. The compensation and support will be implemented in accordance with the policy framework of the subproject. - 2. The relocated households will relocate to Dong Bam resettlement site, located about 3km from the city center with convenient transportation, easy access to social security services. - 3. The Client will use vehicles with load not greater than 10 tons - 4. The Client will spray water twice a day on unrainy days and 4 times a day on the roads passing the pagodas and churches on festivals. - 5. The Client will not execute work items that might cause noise after 18h. - 6 & 7 & 8. The Client will install signal lights, signs, wire rope, install sheets around the construction site - 9 & 10. The Client will develop rules and regularly check so workers do not cause security disorder. The Client will also conduct temporary residence registration for workers. In addition, the Client will utilize local laborers to create jobs for them - 11. The Client will repair the roads if the construction damages the roads.
SEPERATE COMMENTS OF LOCAL PEOPLE AND PEOPLE'S COMMITTEE OF EACH COMMUNE/WARD	
1. Chua Hang	
- Inform the local people of the compensation plan - The compensation work must be clear and timely implemented in order to stabilize people's lives. - The construction route must comply with the design, not occupying more land of the people. - Not affect the quality and traffic at the existing Huong Thuong bridge	- The Client will quickly prepare the compensation plan and carry out compensation payment one time for people to stabilize their lives - The compensation rates will comply with the policy framework of the subproject to ensure entitlements for affected people - The works will be implemented in compliance with the design. Land acquisition will be implemented in accordance with the planning - The Client committed not to affect the traffic at the existing Huong Thuong bridge - The new Huong Thuong bridge is located 50m away from the existing bridge, so the construction will not affect the quality of the existing Huong Thuong bridge. In case of unfortunately damaged, the Client will be responsible for compensation.
2. Dong Bam	
- Provide specific construction schedules for dissemination to the people - Develop suitable electricity/water supply	- The Client will announce the construction schedule to people before 1-2 weeks. - The Client will announce the cut-off schedule of

plans for people to avoid sudden disruption, affecting the lives of people. - Relocate electric poles quickly to avoid affecting the lives of people	electricity, internet, water and so on to people and quickly overcome to minimize relevant impacts on people.
3. Gia Sang	
- Inform the local people of the compensation plan - The compensation work must be clear and timely implemented in order to stabilize people's lives. - The compensation payment must be made publicly and paid once, not delay for a long time - When dredging and breaking mosquito drives, it is required to arrange sanitation teams for preventing epidemic and spraying pesticide to minimize epidemics. - In dredging, keep environmental sanitation. - Pay attention to social security disorder at the locality. - Malodor raised from sludge need measures to minimize and outbreak sterilizing measures.	- Compensation, support will be made publicly, transparently and comply with the policy framework of the subproject. - In the rainy season, the Client will coordinate with the Thai Nguyen Preventive Medicine Center to spray insecticides at the construction sites and workers' camps related to the item of dredging Mo Bach ditch. - Dredged sludge will be transported to the dumping site each day. - The Client will make temporary residence registeration for workers. At the workers' camps and construction sites, worker administration rules will be disclosed. The Client will regularly visit (once a month) to check the compliance with rules of workers. - Leverage local laborers and coordinate with the civil defense forces to reduce conflicts between workers and local people.
4. Hoang Van Thu	
- Inform the local people of the compensation plan - The compensation payment must be made publicly and paid once, not delay for a long time - In dredging, keep environmental sanitation. - Make temporary residence registeration for workers - Take measures to minimize malodor and sterilizing measures. - Frequently spray insecticides to avoid the emergence of diseases, especially dengue fever and malaria.	- Compensation, support will be made publicly, transparently and comply with the policy framework of the subproject. - In the rainy season, the Client will coordinate with the Thai Nguyen Preventive Medicine Center to spray insecticides at the construction sites and workers' camps related to the item of dredging Mo Bach ditch. - Dredged sludge will be transported to the dumping site each day. - The Client will make temporary residence registeration for workers. At the workers' camps and construction sites, worker administration rules will be disclosed. The Client will regularly visit (once a month) to check the compliance with rules of workers. - Leverage local laborers and coordinate with the civil defense forces to reduce conflicts between workers and local people.
5. Huong Son	
- Because the subproject is located in the residential area, there must be a plan to ensure traffic during peak hours to ensure safety and avoid traffic jams. - The Client must preapre a treatment plan of wastewater from workers to prevent	- The Client will assign staff to conduct traffic diversion during peak hours. - The Client will rent mobile toilets for workers's use. Dig drainage ditches for water around the construction site and water settling in the settling pond before discharging into the common drainage

wastewater from discharging into the surrounding environment.	system of the area
6. Huong Thuong	
- Inform the local people of the compensation plan - The compensation payment must be made publicly and paid once, not delay for a long time - When construction of Huong Thuong bridge, not affect travel of people on the existing Huong Thuong bridge.	- The Client will quickly prepare the compensation plan and carry out compensation payment one time for people to stabilize their lives soon. - The compensation rates will comply with the policy framework of the subproject to ensure entitlements for affected people - The Client committed not to affect the traffic at the existing Huong Thuong bridge - The new Huong Thuong bridge is located 50m away from the existing bridge, so the construction will not affect the quality of the existing Huong Thuong bridge. In case of unfortunately damaged, the Client will be responsible for compensation.
7. Linh Son	
- Inform the local people of the compensation plan - The compensation work must be clear and timely implemented in order to stabilize people's lives.	- The Client will quickly prepare the compensation plan and carry out compensation payment one time for people to stabilize their lives soon. - The compensation rates will comply with the policy framework of the subproject to ensure entitlements for affected people
8. Phan Dinh Phung	
- Because Phan Dinh Phung kindergarten is located in the alley of 6m wide, so it requires to have a suitable traffic diversion scheme and arrange personnel for traffic diversion, not transport construction materials during peak hours to avoid congestion. - Take appropriate construction methods so as not to affect the quality of works of the grade 4 or 1-storey accoomdation block for leasing behind the school. - Early complete the works for the pupils to stabilize their studying.	- The Client will assign staff to conduct traffic diversion during peak hours. - Regarding the accommodation block behind the school, the Client will prepare suitable construction plans so as not to affect the quality of the works. If the construction damages to the buildings or household furnitures, the Client will make adequate compensation (rebuilding, or compensation in cash) - The Client will focus on construction immediately after the pupils to be moved to new studying places to ensure progress.
9. Quang Trung	
- Create favorable conditions for people to use sludge to fill the lowland areas - Build a temporary bridge before dismantling the existing bridge - Diversing traffic flow suitably, especially during peak hours, to avoid congestion; Assign staff to conduct traffic diversion during peak hours - When dredging Mo Bach ditch, mosquito drives, it is required to arrange sanitation teams for preventing epidemic and spraying pesticide to minimize epidemics.	- The Client will facilitate households in need of exhaust soil and sludge for levelling ground. - Before destroying Dan bridge, the Client will build a temporary bridge and arrange staff to diverse traffic, install instruction signs and signals and warning signs to ensure traffic safety. - In the rainy season, the Client will coordinate with the Thai Nguyen Preventive Medicine Center to spray insecticides at the construction sites and workers' camps related to the item of dredging Mo Bach ditch. - Dredged sludge will be transported to the dumping site each day.

- In dredging, keep environmental sanitation.	
10. Quang Vinh	
- Diversing traffic flow suitably, especially during peak hours, to avoid congestion; Assign staff to conduct traffic diversion during peak hours - When dredging Mo Bach ditch, mosquito drives, it is required to arrange sanitation teams for preventing epidemic and spraying pesticide to minimize epidemics. - Ensure workers not to affect the regional security	- The Client will assign staff to diverse traffic during peak hours - In the rainy season, the Client will coordinate with the Thai Nguyen Preventive Medicine Center to spray insecticides at the construction sites and workers' camps related to the item of dredging Mo Bach ditch. - The Client will make temporary residence registeration for workers. At the workers' camps and construction sites, worker administration rules will be disclosed. The Client will regularly visit (once a month) to check the compliance with rules of workers. - Leverage local laborers and coordinate with the civil defense forces to reduce conflicts between workers and local people.
11. Tan Lap	
- Inform the local people of the compensation plan - The compensation work must be clear and timely implemented in order to stabilize people's lives. - Compensation payment must be made publicly and paid once, not delay for a long time	- The Client will quickly prepare the compensation plan and carry out compensation payment one time for people to stabilize their lives soon. - The compensation rates will comply with the policy framework of the subproject to ensure entitlements for affected people - The compensation payment must be publically. The compensation rates and payment schedule are disclosed at the bulletin boards of the communes/wards people's Committees and inform to the people.
12. Tan Thinh	
- During the constructing, if it requires demolition of local bridge, there must be a compensation plan and ensure the movement of people during the construction period. - When dredging and breaking mosquito drives, it is required to arrange sanitation teams for preventing epidemic and spraying pesticide to minimize epidemics. - In dredging, keep environmental sanitation. - Pay attention to social security disorder at the locality. - Malodor raised from sludge need measures to minimize and outbreak sterilizing measures.	- The Client will rebuild or repair the bridge or embankment to be damaged by the construction activities. - In the rainy season, the Client will coordinate with the Thai Nguyen Preventive Medicine Center to spray insecticides at the construction sites and workers' camps related to the item of dredging Mo Bach ditch. - Dredged sludge will be transported to the dumping site each day. - The Client will make temporary residence registeration for workers. At the workers' camps and construction sites, worker administration rules will be disclosed. The Client will regularly visit (once a month) to check the compliance with rules of workers.
13. Thinh Dan	
- Inform the local people of the compensation plan - The compensation payment must be clear	- The Client will quickly prepare the compensation plan and carry out compensation payment one time for people to stabilize their lives soon.

and timely implemented in order to stabilize the people's lives - The compensation payment must be made publicly and paid once, not delay for a long time - Build a temporary bridge before dismantling the existing Dan bridge - Diversing traffic flow suitably, especially during peak hours, to avoid congestion; Assign staff to conduct traffic diversion during peak hours	- The compensation rates will comply with the policy framework of the subproject to ensure entitlements for affected people - The compensation payment must be publically. The compensation rates and payment schedule are disclosed at the bulletin boards of the communes/wards people's Committees and inform to the people. - Before destroying Dan bridge, the Client will build a temporary bridge and arrange staff to diverse traffic, install instruction signs and signals and warning signs to ensure traffic safety.
14. Tuc Duyen	
- Timely and adequate compensation for the people - The dredging must ensure the general hygiene - Ensure drainage during the construction period - Inform the people of the construction schedule and the drainage system connection schedule	- The compensation payment will comply with the subproject policies - The Client committed to ensuring environmental sanitation during the dredging - The Client will use the method of retaining dyke to ensure drainage during the dredging - The construction schedule will be notified to the local people prior to 2 weeks. The Client will coordinate with local people in connection of the wastewater drainage system into the general drainage system.

Generally, the communities actively expressed their opinions about the subproject. They were aware of positive impacts that subproject brings and desired the subproject to be early implemented. However, the residents also desired that during the subproject implementation, especially the construction, the subproject owner and construction contractors should pay attention to following outstanding problems:

- Disseminate information about the progress at the locality for residents to arrange their works and daily life to minimize conveniences during the construction. An incremental construction method should be preferred to avoid spreading construction across the whole area, and to narrow radius of influence;
- Provide the Community Monitoring Committee with the training program to exactly understand their functions and tasks. At the same time, there should be funding for maintaining and supporting members of the Community Monitoring Committee in implementing tasks;
- Provide necessary assistances for households affected on livelihoods during the construction;
- Minimize delay of construction progress to avoid direct impacts on income and daily life of households;
- Minimize dust and noise during the transportation of materials gathered from the construction site;
- Ensure existing drainage system for residents during the improvement/upgrading of drainage system, avoid water run-off over the road pavement, causing environmental pollution and urban unaesthetic;
- The road pavement should be returned in aesthetic condition as original status and minimize repetition of road excavation on a same route.

The subproject owner will be present at the construction site to closely manage activities of the construction contractors and ensure focals so that residents can contact in case of emergency.

Quang Vinh ward

Tan Thinh ward

Gia Sang ward

Thinh Dan ward

Dong Bam ward

Tan Lap ward

Figure 52: Some pictures of public consultations 2

7.4. Information disclosure

The first draft ESIA in Vietnamese had been published at the offices of 14 communes/ward and the Thai Nguyen PPMU on July and August, 2017 for public consultation. Basing themselves on the contents of the ESMP, the local people could get the Subproject information and contribute their opinions/comments on environmental issues of the Subproject. The final draft ESIA in Vietnamese language was published at the offices of 14 communes/ward and the Thai Nguyen PPMU on November 24th, 2017. The final draft ESIA in English was disclosed at the World Bank's internal and external websites on November 28th, 2017.

CONCLUSIONS, RECOMMENDATIONS AND COMMITMENT

1. Conclusion

The Subproject implementation will conform to the master plan for socio-economic development in Thai Nguyen as well as other plannings issued by the Government of Vietnam. The ESIA report is prepared to identify all positive and negative impacts on the local natural environment, economic and social conditions.

➢ Environmental aspects

Assessment of potential negative impacts as identified in the report, including impacts in general and specific impacts of each works. These impacts are assessed by different phases of the Subproject, including the pre-construction phase, the construction phase and the operation phase.

During the pre-construction phase, negative impacts are identified mainly involved in land acquisition, compensation, and resettlement and demining.

During the construction phase, environmental impacts are mainly involved in dust, exhaust gases from dredging, excavation, transportation and operation of machines, equipment and vehicles or construction wastewater, workers' domestic wastewater, domestic and construction solid waste. To mitigate these impacts, the proposed mitigation measures in combintation with ECOPs will be incoporated in the Contracts of the Construction Contractor and Construction Supervision Consultant (CSC).

In addition to generic environmental impacts, a number of site-specific environmental impacts have been identified and are mainly related to the work items of the Southnorth road, Huong Thuong bridge, Huong Th uong - Chua Hang road, Dong Bam road and dredging of Mo Bach ditch. These include impacts on water environment, infrastructure degradation, waterway and roadway, relocation of children from Phan Dinh Phung kindergarten to other place, dredging of Mo Bach ditch and so on. With each impact, the ESIA report recommended appropriate mitigation measures. For example:

- Building temporary bridges to ensure traffic circulation during demolition of old bridges for building new ones.
- Taking flow diversion measures to dredge the structures to ensure drainage capability of drainage ditches.
- Dredged materials are dewatered and transported to Da Mai and Tich Luong ward disposal sites.
- Avoiding transportation of dredged materials through the roads in densely populated areas.
- Avoiding construction during rainy season and cultivation period.

An environmental monitoring program has been proposed that is appropriate to the scale of the Subproject and the GoV's and WB's regulations on environmental monitoring during the subproject implementation, clearly identified responsibilities of each competent agencies. Monitoring results will be submitted to the Vietnamese environmental agencies and World Bank on a regular basis.

ESIA has been also disclosed to the local authorities and people in the subproject area and get constructive and positive comments from the consulted stakeholders.

➢ Social aspects

The Subproject will bring positive environmental and socio-economic impacts during the operation, including: (i) Improved infrastructure of Thai Nguyen city; (ii) Improved environmental sanitation, contributing into reducing inundation in Thai Nguyen city; (iii)

Contributing into reducing pressures of kindergarten education demands.

The design alternatives have been carefully considered; However, resettlement is unavoidable. It is estimated that 1,347 households might be affected by the Subproject implementation, of which 133 households have to be relocated and 30 households are affected on graves (58 graves to be affected and relocated). No ethnic minority is affected by the Subproject.

2. Recommendations

To ensure the Subproject to be put into operation quickly, the Subproject Owner suggests the WB to review and approve the ESIA report so that the Subproject Owner can continue to implement next steps of the subproject and ensure investment progress of the subproject.

The Subproject Owner suggests the functional agencies to coordinate with Subproject Owner to monitor and solve environmental issues arising during the construction and operation of the subproject to ensure environmental safeguard and promote economic benefits of the subproject.

The local authorities coordinate together in the propaganda and maneuver local people to support the subproject and raise community's awareness of environmental protection during the implementation and after the completion of the subproject.

3. Commitments

❖ ***General Commitments***

The Subproject Owner and PPMU commit to complying with Vietnam Laws on Environmental protection: Law on Environmental protection 2014, Laws and legal documents (Decree No. 18/2015/ND-CP dated 14 February 2015 of the Government on environmental protection assessment, strategic environmental assessment, environmental impact assessment and environmental protection plan; Decree No. 38/2015/ND-CP dated 24 April 2015 on management of waste and scrabs; Decree No. 88/2007/ND-CP dated 28 May 2007 of the Government on urban drainage and urban areas, etc.) and WB's safeguard policies during the subproject implementation.The Subproject Owner commits to complying with the mitigation measures of adverse impacts of the Subproject on environment during the construction preparation, construction and operation according to contents as mentioned in Chapter 6 of this Report.

Subproject's activities shall be under the inspection of the competent authorities in charge of environmental management of DONRE of Thai Nguyen city and relevant functional agencies to ensure the subproject development and environmental protection

The Subproject Owner commits to disclose contents of approved ESIA report approved at the subproject locality to monitor the compliance with environmental protection commitments in the approved ESIA report.

❖ ***Commitment To Complying With Environmental Standards And Regulations***

The Client commits to complying strictly with environmental standards and regulations:

- Exhaust gas: In accordance with Vietnam standard QCVN 05:2013/BTNMT – National technical regulation on ambient air quality;
- Waste water: Commit to implementing mitigation measures and operation of waste water treatment system to ensure waste water treatment according to QCVN 14:2008/BTNMT (column B): National technical regulations on domestic waste water quality;
- Noise: Control noise in accordance with QCVN 26:2010/BTNMT – National technical regulation on noise.
- Solid waste: Solid waste will be collected and treated properly to ensure not drop down and exposure to ambient environment to ensure requirements for environmental

sanitation and regulations in Decree No.59/2007/ND-CP dated 09 April 2007 of the Government on solid waste management.

- Hazardous waste: Commit to complying with Circular No. 12/2011/TT-BTNMT dated 14 April 2011 of MONRE on hazardous waste management.

❖ ***Commitment To Management And Control of Environmental Pollution***

The environmental management and control of environmental pollution will be given top priority during the construction and operation;

The Subproject Owner commits to coordinating with the functional agencies during designing, construction and operation of the treatment system and environmental protection;

During the operation, the Client commits to implementing the environmental pollution management and control program in the subproject area as mentioned in this report and periodically reporting to the DONRE of Thai Nguyen city.

The Subproject Owner commits for compensation and remedy of environmental pollution in case of environmental incidents and risks due to the subproject implementation;

The Subproject Owner commits to completing planned works, especially completion of the environmental treatment works after the ESIA report is approved./.

REFERENCES

1. Feasibility Study and Basic Design of the Subproject "Dynamic Cities Integrated Development Project – Thai Nguyen City Subproject".
2. Planned route direction drawings of the proposed subproject works.
3. Topographic map 1/25.000 ratio of the studied area.
4. Description report on adjustment of overall planning of Thai Nguyen city, Thai Nguyen province up to 2035.
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7. Assessment on sources of air, water and land pollution - Environmental Technology Handbook, Volume 1, Geneva, 1993.
8. Environment, Health, and Safety Guidelines of International Monetary Fund.
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10. Air environment, Pham Ngoc Dang, Science and Technics Publishing House, 1997.
11. Statistical Yearbook of Thai Nguyen city 2016.
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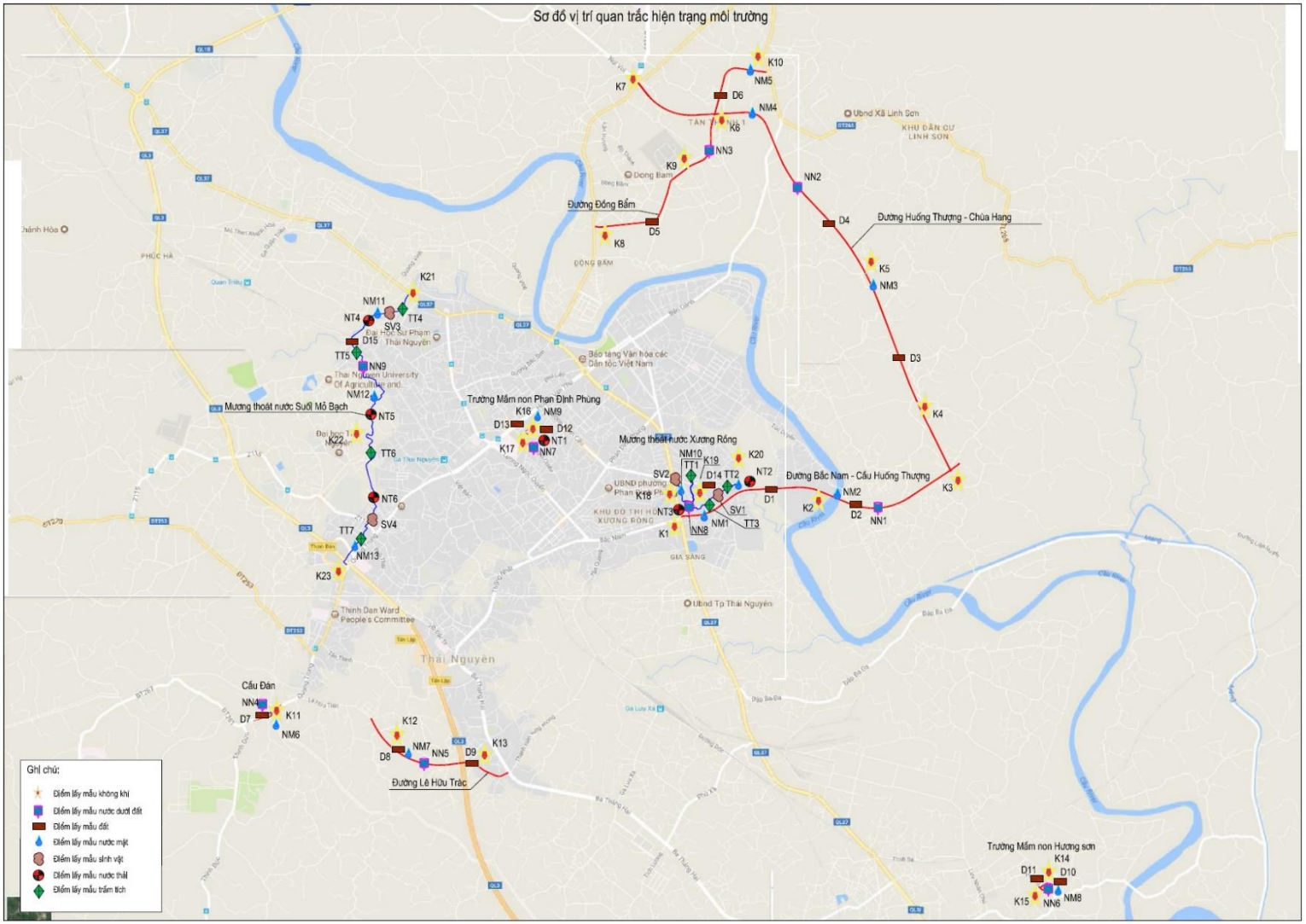
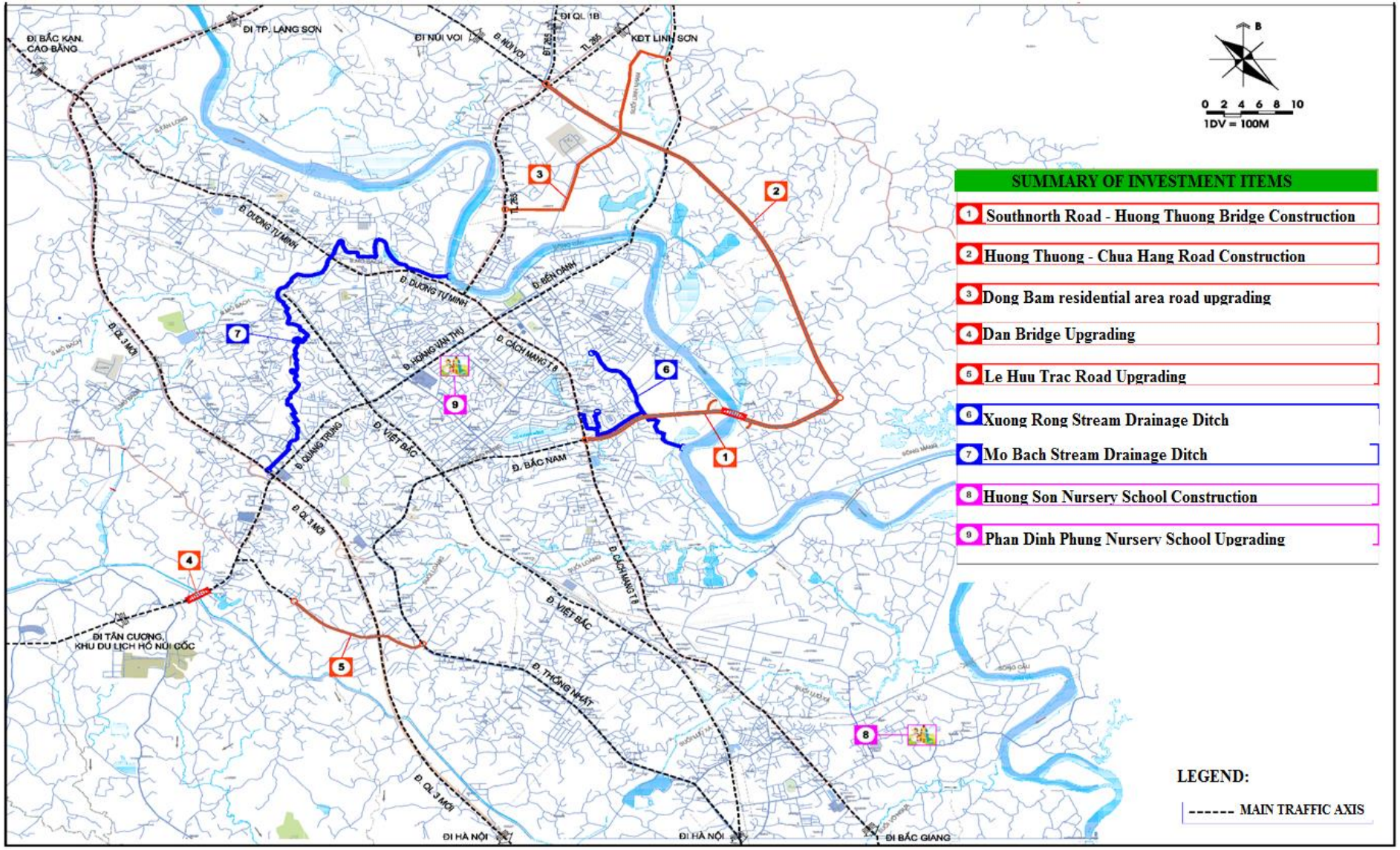
13. Guide to Sustainable Transportation Performance Measures, United States Environmental Protection Agency, August 2011.
14. US Federal High way Administration, Roadway construction noise handbook, 1/2006.
15. WHO - Assessment of sources of air, water, and land pollution, A guide to rapid source inventory techniques and their use in formulating environmental control strategies. Part 1: Rapid Inventory Techniques in Environmental Pollution. Geneva, Switzerland, 1993.

APPENDIX

Appendix 1: Environmental monitoring locations of the Subproject area during the ESIA pre-construction



Appendix 2: Tentative air monitoring locations during the construction phase

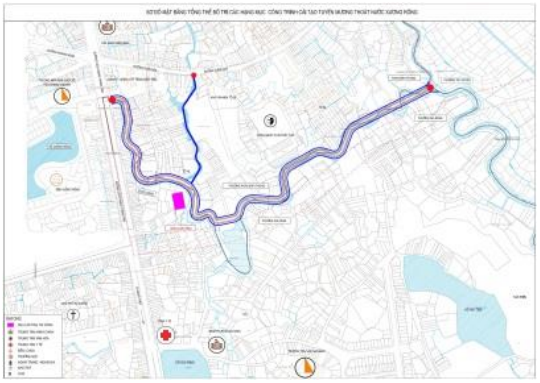


Appendix 3: Dredged Material Management Plan of the Subproject

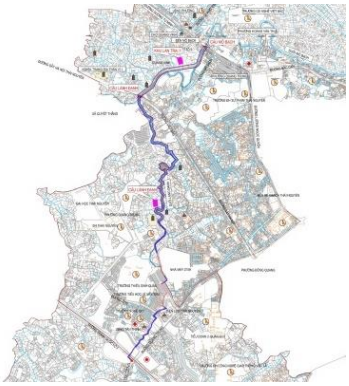
1. Location, volume and characteristics of dredged materials

The proposed project covers rehabilitation of two ditches of Xuong Rong and Mo Bach (dredging and embankment construction). The Contractors shall conduct underwater dredging and embankment backfilling. Scope of works is as follows:

- Xuong Rong ditch will be dredged with the length of L = 3,200m, B = 8 -25m and average dredging depth of 0.8m. Total dredged mud volume is 5,650 m^3.
- Mo Bach ditch will be dredged with the length of L = 3,854m, B = 8 -25m, and average dredging depth of 0.8m. Total dredged mud volume is 24,400 m^3.



Dredging location of Xuong Rong ditch



Dredging location of Mo Bach ditch

The analysis results of sediment mentioned in Chapter 2 (Table 25) show that all the analysis indicators of heavy metal in the sediment samples of the two ditches of Xuong Rong and Mo Bach are both below the permitted level (QCVN43:2012/ BTNMT). As a result, dredged material from two ditches can be used to leveling the lowland area for planting trees or to be disposed at two disposal sites of Da Mai and Tich Luong.

2. Final disposal sites

Total volume of dredged materials of 02 ditches of Xuong Rong and Mo Bach is 30,050 m^3. This amount of dredged materials will be transport to two disposal sites which have been licensed by Thai Nguyen City People's Committee:

- (i) Da Mai disposal Site is located in Tan Cuong Commune, 15km away from Thai Nguyen city center with an area of 25ha, with an estimated reserve of 1,000,000m^3 from the beginning of 2017.
- (ii) The second disposal site is located in group 1, Tich Luong ward, Thai Nguyen city, 5km away the center. The area of disposal site is 10ha, the permitted volume is 40,000 m^3.

Therefore, the capacity of to disposal sites fully meets volume of waste materials and solid waste from the work items. Details of the transportation routes from the construction site to Da Mai disposal site and Tich Luong ward disposal site are shown in table below.

Table 97: Transportation route to Da Mai disposal site and Tich Luong disposal site

No.	Work items	Transportation route	Distance (km)
1	Southnorth road & Huong Thuong bridge	Inter-commune road – Tich Luong ward disposal site	2-5
2	Huong Thuong - Chua Hang road	Inter-commune road – Tich Luong ward disposal site	2-5
3	Dong Bam	Inter-commune road – Tich Luong ward disposal site	5 – 7

No.	Work items	Transportation route	Distance (km)
	residential area road		
4	Dan bridge	Quang Trung - provincial road DT267 - Da Mai disposal site	8.5
5	Le Huu Trac road	Quang Trung – provincial road DT267 – Da Mai disposal site	10
6	Xuong Rong drainage ditch	Xuan Hoa – Tuc Duyen road – inter-commune road – Tich Luong ward disposal site	3-5
7	Mo Bach stream drainage ditch	Quang Trung – provincial road DT267 – Da Mai disposal site	11
8	Huong Son kindergarten	Huong Son road - Luu Nhan Chu – NH 37 – Gang Thep road – road 3/2 – NH 3 - Quang Trung – provincial road 267 – Da Mai disposal site	20
9	Phan Dinh Phung kindergarten	Hoang Van Thu - Quang Trung – provincial road267 – Da Mai disposal site	12

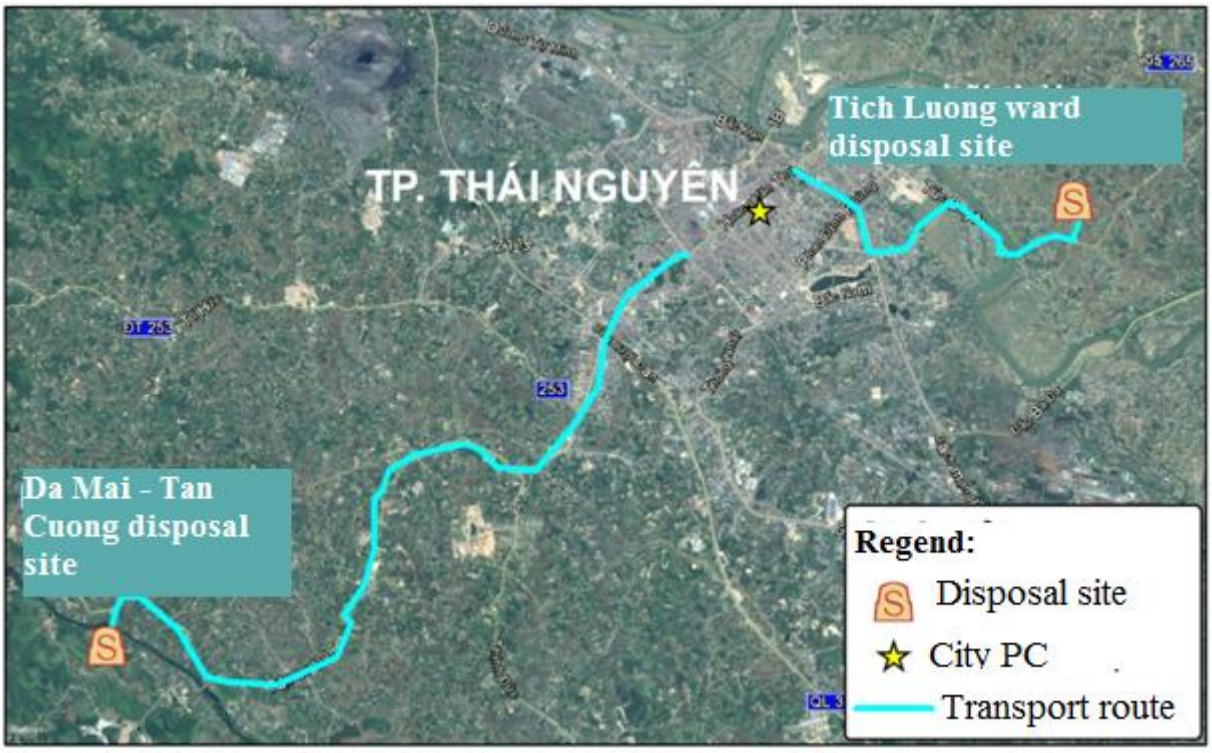


Figure 53: Map of location and distance from Thai Nguyen city center to Da Mai disposal site and Tich Luong ward disposal site

3. Contractor's Dredging Management Plan

The Contractor is required to prepare a Contractor's Dredging Management Plan (CDMP) and submitted to the Environmental Consultant of the Construction Supervision team and the PMU Environmental Officer for review and approval. The CDMP will include, but not limited to the followings:

- The Scope of Works in the Contract package, construction method and schedule
- Volume and quality of water quality and sediment quality in the dredging area covered by the contract
- Water users that may be affected by the dredging and embankment lining
- Materials uploading and transportation method: indicate proposed route of the transport

from the dredged site to the disposal area, time of operation, type of vehicles/trucks and proposed measures to reduce the leakage of the dredged materials from the transport trucks,

- Schedule to inform the nearby communities about the project, disclosure of name and contact number for possible complaints.
- Potential social and environmental impacts, including the site-specific impacts and risks.
- Mitigation measures to address the potential impacts and risks. The mitigation measures should be proposed based on ESIA/ECOP, ESMP, SEMP, the potential impacts and mitigation measures presented in Section 4 and 5 of this Plan and the following requirements:
  + Environmental Quality Monitoring plan carried out by the contractor (particularly pH, DO, TSS, BOD,... for water and heavy metals including As, Cd, Cu, Pb, Zn and Cr, Organic Materials and Mineral Oils for sediments and soil
  + For soil and sediment: The number of samples taken will follow the following guidelines.

Table 98: The number of Sediment samples

Volume of dredged (m^3)	No of Sediment Samples
Up to 25,000	3
25,000 to 100,000	4-6
100,000 to 500,000	6-10
500,000 to 2,000,000	10-20
For each 1,000,000 above 2,000,000	Additional 10

At least one water, soil and sediment sample must be taken for each contract package

- Consultation with affected community about the draft CDMP

Excavated soil are separated from dredged materials from source. Excavated soils will be reused on-site and off-site as much as possible and transported to the nearest disposal site appraised under ESIA, or identified and approved during detail engineering design or construction phase;

The mitigation measures are adequate to address the potential social and environmental impacts associated with various steps and activities, areas of influence and receptors of dredging, temporary storage, transportation and final disposal of the dredged materials.

Field survey are carried out by the Contractor during the preparation of the CDMP in order to identify if there are additional sensitive receptors not identified previously under CCSEP and proposed additional site-specific mitigation measures accordingly.

Contractor's environmental monitoring plan are included

Commitments to carry out corrective actions when excessive pollution is determined, or when there are complaints about environmental pollution, social impacts from any stake holders

4. Potential Impacts and Mitigation Measures for Dredging

The typical potential impacts and risks related to dredging together with mitigation measures are listed in the Table 4 below.

Table 99: Typical Socio Environmental Impacts and Risks

Impacts and Description	Mitigation Measures
AT DREDGING and TEMPORARY LOADING AREAS	

Impacts and Description	Mitigation Measures
Interruption to drainage and irrigation service Irrigation service may be disrupted if the existing irrigation ditch is blocked during the dredging and embankment lining	- Inform community at least two weeks before dredging - Dredging half width of the canal each time, retain the other half for drainage and irrigation function
Odor and air pollution, nuisance Decomposition of organic matters under anaerobic conditions generates strong odor-generated gases such as SO_2, H_2S, VOC etc. When the mud are disturbed and excavated, these gases are released much faster into the air. Exposure to odor pollution affect the health of workers, local residents and cause public nuisance	- Inform the community at least one week before dredging is started - Minimize the duration of temporary loading of dredged materials on-site - temporary loading materials must be transported to the disposal site within 48 hours - Load the materials on-site tidily - Do not load the materials temporarily outside the construction corridor determined for each canal section - Avoid loading the sludge in populated residential areas or near public buildings such as kindergarten. Load the sludge as far from the houses and buildings as far as possible - Cover the temporary sludge loads when loading near sensitive receptors or longer than 48 hours unavoidable
Dust and nuisance Temporary loading of sludge at the construction site cause nuisance to the public Dry and wet mud may be dropped along the dredging area and on transportation route causing nuisance to the public and traffic safety risks	- Avoid temporary loading of dredged materials on-site - Dredged materials must be transported to the final disposal sites earliest possible and no later than 48 hours from dredging. - Use truck with water-tight tank to transport wet/damp dredged materials; - All trucks must be covered tightly before leaving construction site to minimize dust and mud dispersion along the road
Traffic Disturbance The placement and operation of dredging equipment and construction plants on the ground, temporary loading of the dredged materials may obstruct or disturb traffic and cause safety risks for the people travelling on the canal-side road, particularly on canal-crossing bridges which are usually very narrow	- Place “road work” and “slow down” signboards at the populated or near residential areas. - Clean up and rehabilitate the disturbed areas as soon as possible.
Social Disturbance Concentration of workers and equipment, construction plants, temporary loading of materials and wastes, traffic disturbance, dusts and odor pollution etc. will disturb daily activities and the lives of local residents Conflicts may also be arisen if workers, waste, materials, equipment etc. are present outside the construction corridor	- Inform the community at least one week before construction is started - Monitor to ensure that physical disturbances are within the construction corridors only - Contractor recruit local labors for simple works, brief them about project environmental and safety requirements before started working - Contractor register the list of workers who come from other localities to the commune at the construction site - Led the water leaked from wet/damp dredged materials going back to the river, not to affect garden or agricultural land

Impacts and Description	Mitigation Measures
	- Keep the areas to be disturb minimal - Enforce workers to comply with codes of conducts
Landslide and soil subsiding risks at dredging area Relative deep excavation or cut and fills on the embankments that create slopes may lead to landslide and soil subsiding at the slops or excavated areas, particularly in rainy weather Deep excavation also cause risks to the existing buildings nearby, particularly the weak structures or located too close to the deep excavation area.	- During field survey for the preparation of CDMP, the contractor in coordination with the Environmental Officer of PMU and the Environmental Consultant of the CES identify weak structures that may be at risk and determine appropriate mitigation measures accordingly - Consider and select appropriate dredging method that allow minimizing soil subsiding risks, for example carry out stepped excavation, stabilize slops in parallel to dredging - Apply protective measures such as sheet piles at risky locations
Water Quality Degradation Turbidity in water will be increased when the mud is disturbed; Water leaked from dredged material and suface runoff through disturbed ground also contain high solid contents. Muddy water entering irrigation ditch will cause sedimentation. Aquatic livest in the canal would also be affected by turbid water.	- Build coffer dams surrounding the dredging area and pump the water out before starting dredging - If dredging is carried out directly onto the water, dredge at intervals to allow suspended materials to resettle before continuing. Observe water color at 20 m upstream and stop dredging when water color there started to change
Increased Safety risk for the Public	- Place stable barriers along the construction corridor boundary to separate the site with nearby structures - Place warning signs and reflective barriers along the construction area, at dangerous locations and within sensitive receptors - Ensure adequate lighting at
Health and Safety risk to the workers The health of workers may be affected due to exposure to odor and other contaminants from sludge Risk of being drown	- Within two weeks before dredging is started, the contractor will coordinate with local authority to identify good swimmers or those who can dive in the locality, and hire at least one of them at each canal construction site deeper than 3 m and there are workers working on or near water surface. - Provide and enforce the workers to use masks. If and when working in the water, protective cloths, rubber boots, gloves and hats must be wore.
Others	- Other relevant measures specified in ECOP or proposed by the contractors as necessary
MATERIAL LOADING AND TRANSPORTATION	
Dust and nuisance, traffic safety risks Dust or wet materials may be dropped along the transportation route	- Use water-tight tank trucks for transporting wet/dam materials - Cover the materials tightly before leaving the construction site - Do no overload material on the trucks
AT FINAL DISPOSAL SITE	
Landslide and soil subsiding risks at final Disposal site	- Level the materials after being disposed off - Slopes of the dumps will not be steeper than 45^o

Impacts and Description	Mitigation Measures
Landslide and subsiding risk may happen on slopes created at the final disposal site of dredged materials if the slopes created are too high, steep or unstable	- Build/create the walls to protect slopes - Create and maintain drainage at the foot of each dump higher than 2 m
Disturbance to existing drainage Unloaded dredged and excavated materials may disturbed, damage or block the existing drains causing localised flooding	- Dispose of the materials at designated areas only - Clean up or repair existing drains if blockage or damages are the contractors' faults. Clean up and repair will be at cost of the contractors

5. Specific Guidance for Dredging at Xuong Rong and Mo Bach canal

Identifying the available land for disposing the dredged materials. The plan should also identify the possible lands to be appropriated for the disposal of dredged materials. Public land, land for construction of rural roads, public works, private land, etc. may be used, with an agreement with the project affected households. It should also meet local plans for land use.

Preparing for a transportation plan. In case, the dredge disposal area is far away from the dredged sites, the DMP shall set out a transportation plan including: (a) methods of transportation (pipeline, barges, hopper barges) and uploading to the disposal area. If trucks are used, indicate proposed route of the transport from the dredged site to the disposal area, (b) time of operation, (c) type of vehicles/trucks and proposed measures to reduce the leakage of the dredged materials from the transport trucks, (d) contractors' responsibilities for cleaning the roads and carry out remedial works if necessary, and (e) a communication plan for the nearby communities including contact number for possible complaints.

Plan for managing the disposal areas including: (a) plan for reducing the drainage, (b) construction of the perimeter dykes, (c) construction of sub-containment area, if applicable, (d) planned thickness of the dredged materials (typically less than 1.5 meters), (e) any measures to protect ground water and soils (e.g., installation of PVC membrane).

Designing the Draining for Disposal lands. As the dredged materials are in the state of mud at first and soil particles are suspended for 24 to 48 hours. All drainage water from disposal land shall be driven to the drains and discharged back to the river. In order to limit the negative impacts of mud (produced by dredging) on the environment as well as the water quality of the canals, the dredged sediment will be transported to a containing area which is appropriately located and properly design with an adequate size. The dredged spoil will be pumped to the disposal land and then overflow to a settlement pond, where turbidity and total suspended solids are settled. After some time, effluent is returned to the river. A typical design of the dike around each disposal may be as follows: Height: 2m, Footing width: 5 m, and Surface width: 1m. The plan should set out a basic layout.

Monitoring the Disposed Dredged Materials. A plan for monitoring the dredged materials as well as water quality of effluent would be required. As stated before, an intensive monitoring would be required if the dredged materials contains higher content of the heavy metals and other harmful materials than the national thresholds.

In order to mitigate the issue of turbidity during dredging operation, the DMP shall set out dredging equipment and/or techniques suitable to the particular site. On laying dredging machines on a barge, contractors can use a proper mud –stopping net for enclosing the dredging site and keeping back mud on land, not to let it goes back to the canal. If the disposal site for dredge materials is located far away from the dredger, a suction dredger should be used to transfer all the mud and soil in water to the disposal sites. The length of dredging sections should be limited less than 1 km and the dredging should be done one by one.

At the completion of the contract, carry out an assessment on dredged materials, and determine the use of the dredged materials for activities such as: (a) construction (roads and dykes), (b) basis for individual houses, and (c) gardening.