

**MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT
AGRICULTURE PROJECT MANAGEMENT BOARD**

**SUSTAINABLE FISHERY DEVELOPMENT PROJECT
AT MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT, FUNDED BY
WORLD BANK**

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

**Project location: 05 city/provinces: Hai Phong, Thanh Hoa,
Binh Dinh, Khanh Hoa and Kien Giang**



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ABBREVIATIONS AND ACRONYMS

APMB	Agricultural Projects Management Board
COC	Codes of Conduct
COVID- 19	Coronavirus Disease 2019
CPC	Commune/ward/People's Committee
CPMU	Central Project Management Unit
CSC	Construction Supervision Consultant
DARD	Department of Agriculture and Rural Development
D-Fish	Directorate of fishery
DMDP	Dredged Material Disposal Plan
DOCST	Department of Culture, Sport and Transportation
DOF	Department of Finance
DOLISA	Department of Labors, Invalids and Social Affairs
DONRE	Department of Natural Resource and Environment
DPC	District People Committee
DPI	Department of Planning and Investment
E&S	Environmental and Social
ECOP	Environmental Code of Practices
EEZ	Exclusive Economic Zone
EIA	Environmental Impacts Assessment (required by GoV)
EM	Ethnic Minority
EMDP	Ethnic Minority Development Plan
EMPF	Ethnic Minority Policy Framework
EPP	Environmental Protection Plan
ESA	Environmental and Social Assessment
ESCP	Environmental and Social Commitment Plan
ESF	Environment and Social Framework (of WB)
ESHGs	World Bank Group's Environmental Social and Health Guidelines
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESS	Environmental and Social Standards (of WB)
FS	Feasibility study
GAP	Good Aquaculture Practices
GBV	Gender - Based Violence

GIIP	Good International Industry Practices
GoV	Government of Vietnam
GRM	Grievance Redress Mechanism
ha	Hectare
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
IoT	Internet of Things
IPM	Integrated Pest Management
IPMP	Integrated Pest Management Plan
IUU	Illegal Unreported and Unregulated
LMP	Labor Management Procedures
MARD	Ministry of Agriculture and Rural Development
MOF	Ministry of Finance
MOLISA	Ministry of Labor Invalids and Social Affairs
MONRE	Ministry of Natural Resources and Environment
MPI	Ministry of Planning and Investment
MSC	Monitoring, Control and Surveillance
OOG	Office of the Government
OSH	Occupational Safety and Health
PPC	Provincial People's Committee
PPMU	Provincial Project Management Unit
PSC	Project Steering Committee
RAP	Resettlement Action Plan
RPF	Resettlement Framework
SEA	Sexual Exploitation and Abuse
SEF	Stakeholder Engagement Framework
SFDP	Sustainable Fishery Development Project
TOR	Terms of Reference
TWG	Technical Working Group
VAC	Violence against Children
VWU	Vietnam Women's Union
WB	The World Bank
M	Million
\$	US Dollar
m	Meter
km	Kilometer
ha	Hectare

EXECUTIVE SUMMARY

Project Background

The Ministry of Agriculture and Rural Development (MAE) proposed the Sustainable Fishery Development Project (SFDP) to the Government of Viet Nam, focusing on investments in seafood exploitation infrastructure, brackish water shrimp farming, brood-stocking and technological innovation in order to improve fishery exploitation and aquaculture development. The project proposal was approved by the Prime Minister in document No. 192/TTg-QHQT dated February 2, 2021. Under this project, seafood exploitation infrastructure will be invested, such as building and upgrading dynamic fishing ports, fishing ports, and storm shelters for regional fishing vessels, facilitating fishing activities, particularly offshore exploitation. This helps increase exploitation efficiency, reduce losses after planning and protect the environment. The "Sustainable Fishery Development Project at the Ministry of Agriculture and Rural Development (financed by WB)" includes 06 subprojects divided into 3 components (all 6 subprojects which are managed by MARD¹) as follows:

Component 1: Structural investments (06 subprojects) serving sustainable fisheries development: (i) building 02 new dynamic fishing ports in major fishery centers in Khanh Hoa and Kien Giang; (ii) upgrading and repairing 04 grade I fishing ports and/or storm shelters: storm shelter on Bach Long Vi island - Hai Phong city; Lach Hoi fishing port, Thanh Hoa province; Lach Bang fishing port, Thanh Hoa province; and regional storm shelter in Tam Quan region - Binh Dinh province.²

The investments under this component include 06 Subprojects:

- (i) Upgrading and expanding Lach Hoi fishing port, Thanh Hoa province;
- (ii) Upgrading and expanding Lach Bang Fishing Port, Thanh Hoa province;
- (iii) Upgrading and expanding Tam Quan regional-level storm shelter, Binh Dinh (recently merged with and renamed Gia Lai) province;
- (iv) Construction of Khanh Hoa major fishery Center, Khanh Hoa province;
- (v) Construction of Kien Giang Major Fishery Center, Kien Giang (recently merged with and renamed An Giang) province
- (vi) Upgrading of Bach Long Vi Storm Shelter, Hai Phong city.

Component 2: Non-structural investments: (i) Improving seafood exploitation management capacity against illegal, unreported and unregulated fishing (IUU); (ii) application of advanced technology in the production of marine and shrimp breeds; (iii) application of advanced technology in commercial shrimp farming; (iv) Upgrade and complete the national database system on fisheries; (v) Support the management and reduction of plastic waste in exploitation

¹ Effective July 1, 2025, the Ministry of Agriculture and Rural Development (MARD) was merged with the Ministry of Natural Resources and Environment to establish the Ministry of Environment and Agriculture (MAE). For consistency with the Government of Vietnam's approval documents for the feasibility studies and Environmental Impact Assessment, the former name (MARD) is retained throughout this document

² The provinces covered under MAE's managed component include Hai Phong (retaining its name after merging with Hai Duong); Thanh Hoa; Gia Lai (newly named after merging with Binh Dinh), Khanh Hoa (maintaining its name after merging with Ninh Thuan); and An Giang (newly named after merging with Kien Giang). As the Feasibility Studies and the Environmental Impact Assessment were approved by MARD and MONRE prior to the merger date (01 July 2025), the original names of the provinces are used in this ESIA to ensure consistency with the approved documents.

and aquaculture.

Component 3: Project management.

Legal and technical basis for ESIA

The environmental assessment carried out during project preparation confirmed that the project's environmental risks were classified as **Substantial**. The environmental and social standards (ESS) applied to the project are as follows: ESS 1: Assessment and management of environmental and social risks and impacts; ESS10: Staholder Engagement and and Information disclosure; ESS2: Labor and working conditions; ESS3: Resource Efficiency and and pollution prevention and management; ESS4: Community health and safety; ESS5: Land acquisition, restrictions on land use and involuntary resettlement; ESS6: Biodiversity Conservation and Sustainable management of living natural resources; ESS8: Cultural heritage. The Environmental and Social Impact Assessment (ESIA) document is prepared in accordance with the ESF and national legislation. ESIA includes the proposed works for Component 1 of the project.

Project description

The scope of physical investment for the six sub-projects is summarized in the Table below.

No	Name of subproject	Scope of investment
1	Lach Hoi fishing port – Thanh Hoa province	Upgrade and expand Lach Hoi Fishing Port from type II with an area of 4.5 ha (ha) to type I with an area of 7.65 ha. The upgraded port will be able to accommodate 120 vessel visits per day, with the largest vessel capable of docking having capacity of 800CV.
1.1	Port area	Upgrade and construct the port facilities: - Upgrade the area for mooring fishing vessels >150CV: The length is 180m (keeping 75m of the existing dock and constructing 105m of new dock), width 10m, dock elevation +3.1m, and bottom elevation - 4.8m. - Construct a new area for mooring fishing vessels <150CV: The length is 189m, width 10m, dock elevation +3.1m, and bottom elevation - 3.6m. - Build a new storage area on pile foundation: The area is 6,517m², with a protective embankment behind the storage area extending 408m. - Design the navigation channel with a width of 42m, a turning radius of 250m, and a turning basin diameter of D=120m.
1.2	Logistics facilities	- Upgrade and construct reception and sorting buildings: 03 single-floor buildings, with a total area of 2,829m². - Construct a new waste collection house with an area of 76m². - Build 08 new operational bridges. - Install a shelter over the docking area with an area of 3,023m², 10m wide along the length of the dock.
1.3	Technical infrastructure	- Upgrade the internal traffic road behind the pile foundation area, covering an area of 5,658m². - Upgrade Tran Hung Dao street, approximately 417m in length and 14m in width, with a total area of 5,850m². - Construct a new wastewater treatment plant (WWTP) with a capacity of 300m³/day, using biological treatment technology. The treated wastewater will meet the requirements of column B, QCVN 11-MT:2015/BTNMT – wastewater from seafood processing before being

No	Name of subproject	Scope of investment
		discharged into the Ma River. - Build the technical infrastructure to serve the project, including electricity supply, drainage, and water supply systems.
2	Lach Bang fishing port – Thanh Hoa province	The project will invest in upgrading the Grade III port works on the area of Hai Thanh fishing port with 40.6 ha, and the existing Hai Binh fishing port with 2.75 ha. Fishing port scale: It will accommodate 150 vessel arrivals per day, with the largest vessel capable of docking being 40m in length; the port will handle 45,000 tons of seafood annually
2.1	Facilities for Hai Binh port	Upgrading and constructing port facilities include: - Install the roof for the wharf: with an area of 4,020m², the average width is 9.5m along the wharf length. - Upgrading the sorting house with an area of 1,672m²: the existing sorting house is about 950m², and the renovation will add an additional 722m². - Constructing a solid waste collection house: with an area of 76m². - Upgrading the internal traffic road to the Hai Binh area. - Building a new WWTP with a capacity of 300m³/day, applying biological treatment technology. The treated wastewater quality will meet Column B requirements of QCVN 11-MT:2015/BTNMT – seafood processing wastewater before being discharged into the Lach Bang river.
2.2	Facilities for Hai Thanh port	Upgrading Hai Thanh Port: + Rehabilitating the existing wharf for ship docking in Hai Thanh Ward, which has deteriorated, and extending it to the north (utilizing the area for port yard space). + Constructing a new wharf following the current wharf line, extending towards the front. The new wharf will be 180m long, with a width of 10m (the same as the existing wharf), wharf top elevation of +2.25m, and wharf bottom elevation of -4.5m. - Installing a roof on the wharf with an area of 1,407m², with an average width of 9.5m along the wharf length. - Upgrading the internal traffic road in Hai Thanh over an area of 2,513m², including: + Demolishing the old damaged concrete road surface in the port area, repaving with a new cement concrete layer to restore the surface. + For the extended yard area: constructing a new surface using cement concrete on a sand foundation. - Constructing a 3-floor operation building with an area of 565 m². - Constructing public restrooms with an area of 60 m². - Building technical infrastructure systems: power supply, lighting, drainage, water supply, etc.

No	Name of subproject	Scope of investment
3	Tam Quan Regional Storm Shelter and Anchorage Area in Tam Quan, Hoai Nhon District, Binh Dinh Province will be newly constructed on an area of approximately 115 ha in Tam Quan Commune. Scope: The project involves repairing and upgrading the existing storm shelter and anchorage area in Tam Quan to a regional-level storm shelter, accommodating 1,200 vessels of up to 400CV, in conjunction with the Tam Quan fishing port.	
3.1	Facilities for the storm shelter	The construction works include: - Dredging of the storm shelter covering 32.5 ha, with an expected dredging volume of 523,224 m³. - Construction of new coastal protection embankments (5 sections) with a total length of 2,494 meters (m). - Installation of a communication system and signaling buoys. - Construction of a two-floor healthcare facility with accommodation, covering an area of 260 m².
4	Dynamic fishing port for Khanh Hoa major fishery center – Khanh Hoa province The subproject will invest in the construction of a Grade III maritime structure at the existing Da Bac fishing port, which has an area of 9.66 ha, and will expand the total area to 15.7 ha (ha) (6.5 ha of land and 9.2 ha of water). The scale of the project will accommodate up to 250 visits per day by vessels capable of docking at the port with a maximum length of 40 m. The seafood throughput at the port is expected to reach 100,000 tons per year. The storm shelter area will be designed to accommodate up to 2,000 fishing vessels (with engines of up to 1,000 horsepower).	
4.1	Port area	Upgrade and construction of port facilities, including: - Construction of a new jetty with a length of 122m, width of 29m, wharf deck elevation at +2.0m, and wharf bottom elevation at -4.5m. - Upgrade of the existing wharf with a length of 200m, width ranging from 9.5m to 29m, wharf deck elevation at +2.0m, and wharf bottom elevation ranging from -3.7m to -5.7m. - Construction of a new logistics service wharf with a length of 60m, width of 4.0m, wharf deck elevation at +2.0m, and wharf bottom elevation at -2.9m. - Construction of a new community wharf with a length of 60m, width of 5m, wharf deck elevation at +2.0m, and wharf bottom elevation at -2.9m. - Construction of a 140m-long shore protection embankment. - Upgrade of the access bridge with a length of 24.5m. - Dredging of the water area in front of the wharfs: the water area width ranges from 15m to 30m, and the dredged bottom elevation ranges from -2.9m to -5.7m. The estimated dredging volume is 69,332 m³. - Arrangement of the shipping channel with a width of 60m (main channel) and 32m (branch channel for the community wharf); the curve radius of the channel is 400m. The turning basin radius for the jetty is D=90m, the upgraded existing wharf is D=120m, the service wharf is D=45m, and the community wharf is D=72m.
4.2	Logistics facilities	- Construction of a new 2-floor office building with a floor area of 1,600 m². - Construction of a new 1-floor seafood reception and sorting house with

No	Name of subproject	Scope of investment
		a floor area of 4,500 m ² . - Construction of a new solid waste collection house with a total area of 96 m ² . - Construction of public restrooms with an area of 87 m ² . - Dock canopy: Installation of a canopy on the dock with a total area of 2,481 m ² .
4.3	Technical infrastructure	- Upgrade of internal traffic roads and yard roads within the port, covering an area of 0.9 ha. - Construction of a new yard for the office area with a size of 3,991 m ² . - Construction of a new WWTP with a capacity of 600 m ³ /day and night, using the Activated Sludge (AO) treatment technology. The treated wastewater quality will meet the requirements specified in Column B, QCVN 14:2008/BTNMT – National Technical Regulation on Domestic Wastewater before being discharged into Cam Ranh Bay. - Construction of technical infrastructure systems to support the facilities, such as power supply, drainage, and water supply systems.
5	Dynamic fishing port for the Kien Giang major fishery center - Kien Giang province. The subproject will invest in the construction of a Grade III maritime structure on a total area of 31.27 ha (11.27 ha of land and 20 ha) at Tay Yen A Commune, An Bien District, Kien Giang Province. The scale includes: 100,000 tons of seafood throughput at the port per year; a capacity up to 180 vessel visits per day, with fishing vessels having a maximum length of 40 ms.	
5.1	Site leveling	- Totally earthwork is approximately 163,338 m ³ . The lowest fill elevation is +1.8m (NDL - National Vertical Datum). Before filling, the site will be cleared, and organic soil will be excavated with an average thickness of 30cm. - Sand will be used as the filling material and transported to the site via barges, then pumped into the reclamation area.
5.2	Port area	Construction of port facilities, including: - Construction of a new dock for vessels <24m: length of 240m, width of 15m, wharf bottom elevation at -3.5m. - Construction of a new dock for vessels from 24-40m: length of 120m, width of 15m, wharf deck elevation at +2.0m, wharf bottom elevation at -5.5m. - Construction of a new export-import seafood dock with length of 60m, width of 15m. - Construction of a new service wharf: Length of 120m, width of 15m. - Shore protection (dock underside protection) with a length of 540m. - Dredging of the water area in front of the wharf: The water area width in front of the wharf is 36m, with dredged bottom elevation at -5.5m. The estimated dredging volume is 5,432 m ³ . - Arrangement of the shipping channel with a width of 60m. The curve radius of the channel is 400m. The turning radius for the wharf is D=120m.
5.3	Logistics facilities	- Construction of a new 3-floor control building with a floor area of 1,800 m ² . - Construction of a new 1-floor sorting and classification building with

No	Name of subproject	Scope of investment
		a floor area of 4,225 m². - Construction of a new solid waste collection station with a total area of 96 m². - Construction of a new staff parking lot with an area of 120 m² and a height of 3.85m. - Construction of a new port gate, guardhouse, and fence. - Canopy on the wharf: The canopy will be installed along the length of the fishing port, with a width of 12m.
5.4	Technical infrastructure	- Construction of a new internal yard road with an area of 48,882 m². - Construction of a new general cargo yard with an area of 3,552 m². - Construction of a new WU^{TP} with a capacity of 600 m³/day and night, using the Activated Sludge (AO) treatment technology. The treated wastewater quality will meet the requirements specified in Column A, QCVN 40:2011/BTNMT – National Technical Regulation on Industrial Wastewater before being discharged into the Nga Ba Canal, which flows into the Cai Lon River. - Construction of technical infrastructure systems to support the facilities, such as power supply, drainage, and water supply systems.
6	Bach Long Vi fishing port and storm shelter subproject in Hai Phong City Investing in upgrading and building new tertiary maritime works with a scale of 29.48 ha on Bach Long Vi Island District, Hai Phong City. Scale of fishing port: To become a type I fish tank, meeting the needs of 405 ships of all types for storm shelter, with the largest ship having a length of 35m; the amount of seafood passing through the port is expected to reach 10,000 tons per year. The storm shelter anchorage has a regional scale, with a capacity of 1,000 units and a length of up to 35m..	
6.1	Upgrading and constructing port works including:	- Upgrading and constructing port works including: - Maintaining the existing small wharf, continuing to use it with a total length of about 175m - Constructing a new wharf >15m: length 80m, width 20m, wharf top elevation +5.0m, wharf bottom elevation -3.4m - Upgrading the existing western breakwater with a total length of 500m, dimensions BxH=1.5x2m - Dredging the storm shelter anchorage area with an area of 10.2ha, dredged bottom elevation from -1.1 to -2.9m; the shipping channel and turning area with an area of 3.3m, the bottom elevation of the shipping channel is -2.9m. The total estimated dredging volume is 51,550 m³
6.2	Technical infrastructure	- Upgrade the anchor system, storm shelter buoys (116 sets). - Install 2.4m diameter buoys, 9m long D44mm chain, 53T at the anchorage area <15m - Install 2.4m diameter buoys, 10m long D44mm chain, 53T at the anchorage area >20m

Social and environmental baseline

In order to assess the baseline environmental quality in the project area, the project owner coordinated with the environmental monitoring unit, the Center for Analysis and Technology Transfer in Environmental Engineering under the Institute of Agricultural Environment (certified by VIMCERTS 082), to conduct surveys, measurements, and sample collection for

baseline environmental analysis in the sub-project area. The environmental sampling was carried out on January 15, 2024. Results of field surveys and environmental monitoring show that:

a. Current air quality and noise levels

The results of ambient air quality monitoring in the subproject area show that all indicators are within the allowable limits of QCVN 05:2023/BTNMT – National Technical Regulation on Ambient Air Quality (one-hour average). The noise levels in the project area comply with QCVN 26:2010/BTNMT – National Technical Regulation on Noise.

These results indicate that the ambient air quality in the project implementation areas remains relatively good, with no signs of pollution.

b. Current groundwater quality

The analysis results show that the groundwater quality in the subproject areas is relatively good, with no signs of pollution. At the sampling locations, the analyzed indicators are within the permissible limits of QCVN 09:2023/BTNMT – National Technical Regulation on Groundwater Quality. However, at Tam Quan fishing port, chloride levels in groundwater two analysed samples were elevated— 1.3 and 1.6 times higher in the two analyzed samples —due to saltwater intrusion from the nearby East Sea and shallow borewell depths.

c. Current surface water quality

Lach Hoi subproject:

The monitoring results of the Ma River's surface water quality in the subproject area show that most indicators at all monitoring points are below the allowable limits set by QCVN 08:2023/BTNMT (Column A). However, certain indicators—specifically Total Suspended Solids (TSS), ammonium, and surfactants—exceed the allowable thresholds, with levels ranging from 1.3 to 2.64 times higher for TSS, 1.3 to 1.4 times for ammonium, and 3.28 to 4.8 times for surfactants.

These elevated concentrations are primarily attributed to the influence of activities at the existing Lach Hoi fishing port, which is currently affected by operations such as fishing vessel movements, fish sorting, and other port-related activities. In addition, the absence of a wastewater treatment facility at the existing port contributes to the degradation of water quality.

Lach Bang subproject:

02 samples of surface water were taken in Lach Bang river, in existing fishing port. According to the monitoring results, at all monitoring points, almost all parameters are lower than permissible limits according to the QCVN 08:2023/BTNMT (Column A), excepting TSS (from 2.72 to 3.5 times), surfacants (from 3.24 to 3.32 times) exceeding allowable limits according to QCVN 08:2023/BTNMT (column A). NM1 and NM2 samples have higher TSS and surfactant levels than the allowable limit because this is the existing Lach Bang Fishing Port, currently affected by activities such as boats, fishermen, fish sorting activities, etc., and there is no wastewater treatment facility in the Port.

Tam Quan subproject:

The sub-project monitored 04 surface water quality locations at the storm shelter anchorage and Tam Quan fishing port. According to the results of surface water quality monitoring, most of the parameters in the surface water samples are within the permissible limits of QCVN 08:2023/BTNMT (specified in Table 1 and Table 2 - column A). However, the TSS parameter in surface water samples exceeded from 1.27 to 1.88 times because at the time of sampling the storm shelter anchorage area, there were many activities of ships; the nitrite parameter in

surface water samples exceeded from 2.04 to 2.72 times because there are still many aquaculture activities in the storm shelter anchorage area.

Kien Giang subproject:

In this area, there is no activity of extracting surface water from the Cai Lon River for domestic water supply purposes. According to the surface water quality monitoring results, at all monitoring points, most values are lower than the permissible limits according to QCVN 08:2023/BTNMT (column A), except for the TSS slightly higher (from 1.1 to 1.2 times) than the permissible limit. At the sampling time, the water in the Cai Lon River appeared turbid due to a high amount of sediment.

d. Current seawater quality

Khanh Hoa subproject:

According to seawater quality monitoring results, most observed values at all monitoring points are below the allowable limits of QCVN 10:2023/BTNMT - National Technical Regulation on Seawater Quality. However, ammonium ($\text{NH}_4^+\text{-N}$) exceeds the standard (3.92 times at sample NB1, 4.48 times at sample NB2, and 3.36 times at sample NB3) compared to the permissible limit. Overall, the seawater quality in the area is considered relatively clean.

Bach Long Vi subproject:

Three seawater samples around the Fishing Port area – where the project construction works are taking place) to analyze parameters including pH, TSS, Ammonium ($\text{NH}_4^+\text{-N}$), Nitrite (NO_2^-), CN^- , Cu, Pb, Cd, As, Total Chromium, Total oil and grease, Total phenol, Surfactants, Chlorine-based organic pesticides (Heptachlor, Dieldrin), Phosphorus-based organic pesticides (Chlorpyrifos, Diazinon).

The analysis results show that most parameters are within the allowable limits set by QCVN 10:2023/BTNMT – National Technical Regulation on Seawater Quality. However, the Ammonium ($\text{NH}_4^+\text{-N}$) parameter exceeded the standard in two samples, with levels ranging from 1.4 to 2.2 times above the permissible limit. Total mineral oil concentrations in two samples were at the allowable threshold (0.5 mg/l). Overall, the seawater quality in the area is considered relatively clean.

e. Current wastewater quality

Lach Hoi subproject:

The results of household wastewater monitoring in some residential areas near the project show that most wastewater parameters are within the permissible limits, except for some indicators such as TSS, Ammonium, and Surfactants, which exceed the standard limits from 1.4 to 9.2 times of QCVN 14:2008/BTNMT – National Technical Regulation on Domestic Wastewater (Column B). The wastewater samples at Lach Hoi fishing port contain high levels of TSS, Ammonium, and Surfactants due to the lack of a wastewater treatment system. Domestic wastewater from fishermen operating at the port is only treated through septic tanks and has not been fully treated.

Lach Bang subproject:

04 samples were taken in wastewater culvert in some residential areas along seawater prevention dike in Lach Bang Fishing Port. The monitoring results show that most of the parameters are lower than allowable limits, except TSS (exceed 1.84 – 7.02 times), Ammonium (exceed 9 times) exceeding allowable limits according to 14:2008/BTNMT, Column B. The wastewater samples in the Lach Bang port area all have higher levels of TSS, Ammonium, and surfactants than the allowable limit because the fishing port currently does not have wastewater

treatment facility. The domestic wastewater from the fishermen operating in the port is only treated through septic tanks and has not been thoroughly treated.

Tam Quan subproject:

Most measured wastewater parameters are within the permissible limits of QCVN 14:2008/BTNMT, Column B – National Technical Regulation on domestic wastewater. However, some parameters exceed the standards: total suspended solids (TSS) are about 4.2 to 5.6 times higher, ammonium is about 1.6 times higher, and surfactants are about 1.23 times higher than the allowable limits. In the Tam Quan fishing port area, wastewater has not been fully collected and treated, resulting in these exceedances.

Khanh Hoa subproject:

The results of wastewater monitoring in some residential areas of the project site indicate that most parameters are within the allowable limits, except for TSS (exceed 9.25 – 16.2 times) and ammonium (exceed 1.36 – 1.48 times), which exceed the standard limits under QCVN 14:2008/BTNMT, Column B.

Bach Long Vi subproject:

The project conducted monitoring and analysis on three wastewater samples taken from the Bach Long Vi Fishing Port area. The analysis results show that the wastewater parameters, such as pH, TSS, total oil and grease, ammonium, nitrate, lead (Pb), cadmium (Cd), arsenic (As), copper (Cu), zinc (Zn), manganese (Mn), total chromium (Cr), total phenols, and surfactants, all fall within the allowable limits according to QCVN 14:2008/BTNMT - National Technical Regulations on Domestic Wastewater Quality, Column B. For the Cyanide (CN-) parameter, sample NB1 showed 0.007mg/l; NB2 < 0.001mg/l, and NB3 showed 0.009mg/l, all of which are well below the allowable limits (0.01mg/l).

f. Current soil quality

The analysis results of soil quality in the Lach Hoi Subproject expansion area show that heavy metal indicators comply with QCVN 03:2023/BTNMT – National Technical Regulation on Soil Quality. This indicates that the soil quality in the project area remains relatively good, with no signs of pollution. During project construction, the topsoil will be removed, and the reuse or disposal of excavated soil will depend on its properties. Therefore, the excavated soil from construction areas can be reused for purposes such as leveling or disposed of as general waste.

g. Sediment quality

Tam Quan subproject:

Surface sediments: The analysis results show that the concentrations of heavy metals in the sediments are much lower than the permissible limits specified in the National Technical Regulation on Sediment Quality (QCVN 43:2017/BTNMT). Therefore, the surface sediments dredged from the sub-project area are non-hazardous and not contaminated with heavy metals.

Dredged material: The sub-project monitored and analyzed 24 samples of dredged material along the Tam Quan storm shelter anchorage (from Con Ro area to the mouth of the storm shelter). The analysis results show that the dredged material consists mainly of poorly mixed sandy soil with a loose structure. The concentrations of heavy metals and pesticides in the dredged material are within the permissible limits of QCVN 43:2017/BTNMT – National Technical Regulation on Sediment Quality. Therefore, the dredged material in the sub-project area is still of acceptable quality, with no signs of pollution.

Khanh Hoa subproject:

Surface sediments: Analysis results show that heavy metal concentrations in sediments within the project area are significantly lower than the permissible limits set in QCVN 43:2017/BTNMT - National Technical Regulation on Sediment Quality. Therefore, the dredged sediment from the subproject is classified as non-hazardous and free from heavy metal contamination. The dredged material can be used for planting perennial trees, landscaping, or site leveling, depending on local needs. If not reused, the dredged material will be collected, transported, and disposed of at designated temporary disposal sites approved by local authorities.

Dredged material: The analysis results of dredged material show that heavy metal indicators comply with the permissible limits under QCVN 43:2017/BTNMT - National Technical Regulation on Sediment Quality. This confirms that the dredged material in the project area remains in good condition with no signs of contamination. As a result, the dredged material can be used for planting perennial trees, urban landscaping, or site leveling, depending on local demand. Otherwise, it will be collected, transported, and disposed of at temporary storage areas approved by local authorities.

Kien Giang subproject

Surface sediment: The analysis results show that the concentrations of heavy metals in the sediments in the subproject area are much lower than the permissible limits specified in the National technical regulation on sediment quality (QCVN 43:2017/BTNMT). Therefore, the volume of sediments dredged from the subproject component is non-hazardous and not contaminated with heavy metals. The measured salinity ranged from 0.63‰ to 0.68‰, which are within the low threshold and do not affect crops, including rice and vegetables

Dredged material: The analysis results of three dredged material samples (at depths of 20cm to 50cm) show that the heavy metal parameters are all within the permissible limits according to QCVN 43:2017/BTNMT - National technical regulation on sediment quality. The results indicate that the quality of the dredged material in the subproject area is still quite good, with no signs of pollution. Therefore, the volume of dredged sediments from the subproject component is non-hazardous and not contaminated with heavy metals.

. The investments will be located in existing or planned areas for fishing ports, storm shelters, mostly on the mainland in modified habitats or areas already affected by human activities. The project will not affect IUCN-listed Endangered or Critically Endangered species, nor significantly impact critical or natural habitats. The exception pertains to the investment in upgrading fishing port and storm shelter, located on Bach Long Vi island, which is within the development area of the Bach Long Vi protected marine area (MPA). The project sites are accessible via roads and/or waterways. The existing systems at the fishing ports are generally poorly managed, including improper management of solid waste and the discharge of untreated wastewater into the environment. The project areas are all vulnerable to climate change and natural disasters, albeit at varying levels. The project subject some sensitive receptor including graves, schools temples etc, which will be temporarily impacted during construction However, no cultural heritage is affected by the project.

Analysis of Alternatives

The report compared “with the Project” and “without project” scenarios, compared the options on the selection of the technical designs for each subproject, including ancillary items such as the dredging method/material storage sites. Specifically:

For the Tam Quan subproject: Based on the analysis of alternative wave regime modeling scenarios in the subproject area, which informed the layout and design of coastal protection structures, the option “Dredging the storm shelter anchorage area without dredging Ro Islet” has been selected. This option ensures minimal impact on the local community - no resettlement

is required and counterpart funding is secured for implementation - while also providing better protection of water quality and aquatic life in the Tam Quan River.

For the Bach Long Vi subproject: Based on the analysis of alternative options and stakeholder consultations—particularly with the Management Board of the Bach Long Vi Marine Protected Area (MPA) and the Department of Agriculture and Environment of Hai Phong City, the option “Using three smaller disposal sites to minimize impacts on intertidal ecological resources” was selected. This approach aims to reduce environmental disturbance while ensuring alignment with local conservation priorities and stakeholder recommendations.

Analysis of Dredging Method Selection: For the dredged works, the analysis for dredging method selection was Based on the following conditions: (1) Dredging activities are carried out in actively used navigation channels; (2) The channels are currently narrow and shallow; (3) The distance to the dredged material disposal sites must be considered; It is necessary to ensure safe operating conditions for both dredging vessels and commercial traffic, and to organize dredging fleets efficiently to achieve maximum productivity

Analysis of Dredging Method Selection. The selection of the dredging method was based on the following conditions: (i) dredging activities will be carried out in actively used navigation channels; (ii) these channels are currently narrow and shallow, requiring careful guiding; (iii) the distance to designated dredged material disposal sites must be considered. To ensure safe operating conditions for both dredging vessels and commercial traffic, the method must allow for efficient fleet organization and maximum productivity. These factors guided the technical analysis and informed the final approach to dredging operation

Environmental and Social Impacts and Risks

The ESIA has identified the potential negative impacts and risks of the project across the pre-construction, construction, and operation phases. The impacts during construction are temporary, localized, and reversible, due to the medium-scale nature of the works. In contrast, the operational phase may involve long-term impacts that are generally moderate and reversible. These impacts can be effectively mitigated through the application of appropriate design solutions, sound construction and management practices, and effective operational procedures.

a. In the pre-construction phase:

Lach Hoi subproject

Impacts due to land acquisition: The existing Lach Hoi fishing port, which has an area of 3.61 ha, will be upgraded and expanded to a total area of 7.65 ha. The expanded land area of 4.04 ha covers 2.18 ha of land for public purposes - currently serving as a transportation area in front of the port; 0.33 ha for commercial production (11 kiosks of single story, with an average area of about 50 m² per kiosk, which the Lach Hoi Fishing Port Management Board is renting out to some households for business); and 1.52 ha of the Ma River water surface.

Safety risks related to unexploded ordnaces (UXO): The Lach Hoi subproject will be upgraded and expanded on the existing Lach Hoi fishing port. UXO will be cleared for the expansion area of 4.04 ha.

Lach Bang subproject:

Impacts due to land acquisition: The construction and upgrading activities under the Lach Bang subproject are located within the existing Lach Bang fishing port, which spans two areas: one on the Hai Thanh ward side and the other on the Hai Binh ward side. The total land area to be acquired for the port expansion is 2.62 ha, comprising:

- The expansion area on the Hai Thanh ward side covers 0.53 ha: 0.28 ha of transportation land (managed by Hai Thanh ward People's Committee) and 0.06 ha haof non-agricultural production and business land (managed by Lach Bang Port Management Board); 0.19 ha of Lach Bang river water surface area (managed by Hai Thanh ward People's Committee);
- The expansion area on the Hai Binh ward side covers 2.09 ha, including: 2.0 ha of non-agricultural production and business land (15 kiosks rented by 15 households from the Lach Bang Port Management Board; and 01 petrol business facility); 0.04 ha haof Lach Bang river water surface area; and 0.05 ha of unused land managed by Hai Binh ward People's Committee.

Safety risks related to UXO: The total area to be acquired for the expansion of Lach Bang fishing port is 2.62 ha. If the subproject does not conduct unexploded ordnance (UXO) clearance, it may pose risks of explosion of mines remaining from the war during the construction of the main subproject items.

Tam Quan subproject:

Impacts due to land acquisition: The area designated for the Tam Quan subproject construction covers 109.13 ha, of which the majority consists of riverbed soil with an area of 97.64 ha (surface water of Tam Quan River), aquaculture land with an area of 3.71 ha, and land for specialized use with an area of 2.64 ha

Safety risks related to UXO: The Tam Quan Subproject is a completely new construction investment, so the mine clearance activities will be carried out over the entire construction area of the subproject (about 114.77 ha).

Khanh Hoa subproject:

Impacts due to land acquisition: The upgraded construction area within the existing Da Bac Port includes an expansion of 9.66 ha, which is part of the available land within the port. Specifically: 9.64 ha of public-use land, 0.02 ha of non-agricultural production and business land.

Safety risks related to UXO: The Khanh Hoa Subproject involves the renovation and upgrading of the existing Da Bac fishing port. Since UXO clearance activities have already been carried out, there are no potential safety risks related to unexploded ordnance for the subproject.

Kien Giang subproject:

Impacts due to land acquisition: The total area to be acquired for implementation of the Kien Giang subproject is approximately 15.78 ha, of which: (i) The area for construction of work items is 11.27 ha including: 1.83 ha of wet rice farming land; 5.52 ha of perennial cropland (fruit trees such as mango, pomelo, orange, jackfruit, etc.); 1.68 ha of rural residential land; 0.14 ha of non-agricultural production and business land; 2.09 ha of land for public purposes; (ii) The land area planned to build a resettlement site for households who are subject to relocation due to construction of the subproject is 4.51 ha , including: 4.45 ha of wet rice farming land and 0.06 ha of specialized land (transportation land).

Safety risks related to UXO: unexploded ordnance clearance will be carried out in entire the construction area and resettlement area of Kien Giang subproject (about 15.78 ha)

Bach Long Vi subproject

Impacts due to land acquisition: The subproject is planned with a total area of 32.15 ha, including: 26.35 ha of non-agricultural land (comprising 0.42 ha of special-use land for public purposes and 25.94 ha of special-use water surface land); 5.8 ha of unused land. In addition, to serve construction activities, the subproject will use 03 disposal sites with a total area of 5.13

ha as dumps for dredged materials (according to Decision No. 2397/UBND-MT dated October 30, 2024, by the Hai Phong City People's Committee approving the location for dumping dredged materials). The total reception capacity of these 03 disposal sites is 76,000 m³.

Safety risks related to UXO: Although the Bach Long Vi subproject is implemented within the existing fishing port land and storm shelter area for ships, the possibility of UXO remaining in the subproject area is considered to be very low. However, due to dredging activities in the fairway, turning basin, and storm shelter anchorage, the subproject will still carry out mine clearance over the entire planned area of 32.15 ha.

b. Impacts and risks during the construction phase:

✓ Generic impacts during construction

The generic impacts during construction include dust, exhaust gas, noise, vibration, wastewater, and solid waste result from construction activities and the daily life of workers. These impacts can be considered low to moderate for each facility and can be minimized. Construction activities will cause general environmental and social impacts such as air pollution from dust and emissions; noise and vibration impacts; generation of wastewater; generation of solid waste; decreased water quality; impacts on aquatic life; erosion, sedimentation, and local flooding; increased safety risks and traffic disruption; potential damage to existing infrastructure due to embankment works and the transport of construction materials and machinery; occupational health and safety risks for workers; safety risks for the local community; social impacts due to labor migration; and impacts on cultural resources.

✓ Site-specific impacts during construction

For the Lach Hoi subproject, the site-specific impacts during construction include loss of coastal vegetation in the port expansion area; disturbance to the operation of fishing vessels entering and exiting the Lach Hoi fishing port; impact on several neighboring aquatic enterprises/processing establishments; impact on a number of sensitive receptors.

For the Lach Bang subproject, the site-specific impacts during construction include: disruption to the operation of the existing Lach Bang fishing port; interference with the operation of the Duy Xuyen ferry terminal, posing safety risks for ferry passengers; increased pollution, potentially affecting the production and business activities of some local aquatic and seafood processing establishments and fishery logistics operations; impacts on aquaculture activities in the Bang river.

For the Tam Quan subproject, the site-specific impacts during construction of the subproject identified as follows: disturbance to the operation of the existing Tam Quan fishing port; impacts on aquatic life and deterioration of water quality due to dredging; impacts on waterway traffic activities on the Tam Quan River within the project area; environmental pollution risks at dredged material storage sites; impacts on sensitive receptors; impacts on aquaculture activities in the project area; Risk of embankment subsidence due to extreme weather.

For the Khanh Hoa subproject, the site-specific impacts during construction include disturbance on the operation of Da Bac fishing port (ships, seafood processing business); impact on aquatic life and deterioration of water quality due to dredging; safety and disturbance of waterway traffic; impacts and risks of environmental pollution at dredged material storage sites; Impact on aquaculture activities; Impacts on sensitive receptors.

For the Kien Giang subproject, the site-specific impacts during the construction of the subproject are as follows: impact on aquatic life and deterioration of water quality due to dredging activities; environmental pollution risks and impacts at the dredged material storage sites; impacts on sensitive receptors, including physical cultural resources (PCR).

For the Bach Long Vi subproject, the specific impacts of the construction activities in the subproject are as follows: impacts of construction and dredging activities on the existing fishing port and anchorage area; impacts and risks to biological resources in the Bach Long Vi Marine Protected Area (MPA); site-specific impacts and risks at disposal site No. 1, located approximately 80–150m from the tidal flat.

Impacts on sensitive structures: the project implementation will affect nearby sensitive structures (such as memorial area, schools, pagodas, parish, temples): Dust, noise, vibration, traffic accidents during the construction process will affect the learning, teaching and transportation of students. In addition, spiritual cultural activities of local people in the community hall, pagodas and cemeteries will be affected, especially the risk of conflict between workers and local residents. This impact is assessed to be temporary, small to medium, and mitigable.

c. Impact during in the operation phase

The general impacts and risks during the operation phase of the project include: generation of dust and air emissions; noise; discharge of wastewater; generation of solid waste; potential impacts on aquatic life and deterioration of surface water quality in rivers and coastal areas; traffic-related risks (both waterway and roadway); occupational health and safety risks and incidents; environmental risks and incidents; impacts on aquaculture activities; and potential effects on the marine ecosystem within the Bach Long Vi MPA.

Regular dredging activities to maintain the shipping channel and storm shelter may cause the following impacts and risks: air quality deterioration due to the operation of dredging vehicles and machinery; decreased surface water quality due to dredging activities (increased turbidity, TSS, oil and grease, etc.); impact on the aquatic ecosystem in the area

d. Cumulative impacts

The cumulative impact assessment (CIA) for the Project evaluates the incremental environmental and social risks arising from interactions between SFDP subprojects and other past, ongoing, or foreseeable development activities in the same regions. The assessment covers six geographically dispersed subprojects across five provinces, focusing on valued environmental and social components (VECs) such as air and water quality, aquatic ecosystems, traffic safety, and coastal livelihoods. Spatial cumulative impacts are primarily localized due to the lack of direct interconnection between subproject areas.

During the construction phase (2026–2028), potential cumulative impacts include increased dust, emissions, noise, and waterway traffic density, especially in areas where other infrastructure or tourism projects are active. Social pressures may also arise from labor influx and overlapping land use. These impacts are assessed as low to moderate and manageable through coordinated scheduling, local stakeholder engagement, and mitigation measures outlined in the ESMP.

In the operation phase (from 2029 onward), cumulative impacts may include increased vessel traffic, wastewater discharge, and solid waste generation at fishing ports and storm shelters. These could affect water quality, aquatic life, and coastal resource use. Climate change risks such as sea level rise and storm intensity may further compound these impacts. However, with proper planning, adaptive design, and decentralized management, these cumulative effects are considered minor to moderate and controllable, ensuring long-term sustainability of the project.

Environmental and Social Management Plan

The ESMP outlines detailed procedures for implementation, monitoring, supervision, and reporting to ensure effective management of these impacts. It also includes a capacity building program to strengthen the skills and knowledge of relevant stakeholders, as well as a

comprehensive cost estimate for all proposed measures. The main components of the ESMP include: mitigation measures for environmental and social risks and impacts; implementation arrangements; the project compliance framework; environmental monitoring program; capacity-building activities; cost estimation; and a grievance redress mechanism

Mitigation measures

Mitigation measures for the project's environmental and social (E&S) impacts are designed to address risks across all phases of the project—feasibility study, detailed design, site preparation, construction, and operation. These measures are developed and implemented in accordance with the World Bank's mitigation hierarchy, which prioritizes avoidance, minimization, mitigation, and compensation or offset of adverse impacts.

Mitigation measures during detailed design

Mitigation measures for the detailed design phase of all subprojects are presented in Section 5.1.1. In short, during the detailed design phase, mitigation measures will be implemented to address environmental and social risks associated with dredging works, fishery logistics and port infrastructure, and wastewater and solid waste management.

For dredging activities, stakeholder consultations will guide the selection of appropriate locations, timing, and techniques, while waterway safety signage and channel alignments will be planned to minimize disruptions to local communities and aquatic livelihoods. Environmentally safe methods will be developed for sedimentary rock removal, particularly in sensitive areas such as Bach Long Vi, to protect underwater ecosystems.

For port infrastructure, comprehensive geological and hydrological surveys will inform resilient designs, with attention to sediment dynamics, durable materials, and embankment engineering to withstand subsidence and storm surges. Port facilities will incorporate wastewater collection, drainage systems, and green spaces, while minimizing vegetation clearance and promoting energy-efficient building designs.

Wastewater and solid waste management facilities will be sited away from vulnerable areas, designed for operational efficiency and compliance with national standards, and equipped with appropriate treatment technologies and odor control measures. Qualified personnel will manage operations, with reinforced excavation pits and robust emergency response planning to address potential risks at fishing ports.

Mitigation during preparation period

Section 5.1.2 outlines the mitigation measures to be implemented during the preparation period.

To address the impacts due to land acquisition, During the preparation phase, the project developed a Resettlement Plan (RP) outlining compensation, assistance, and livelihood restoration measures for project-affected persons (PAPs), based on full replacement cost principles and inclusive consultations. The RP also includes a grievance redress mechanism (GRM), preliminary cost estimates, and culturally sensitive procedures for grave relocation, ensuring that all mitigation actions are aligned with World Bank ESSs and local customs.

To address risks from UXO, the project will conduct clearance activities prior to any land leveling or dredging works at six subproject sites. UXO clearance will be carried out by authorized agencies, with public notification and no construction permitted until sites are certified safe and handed over. A total budget of approximately VND 24.7 billion has been allocated for UXO clearance across the Lach Hoi, Lach Bang, Tam Quan, Khanh Hoa, Kien Giang, and Bach Long Vi subprojects.

Mitigation measures for the impacts during the construction phase

Mitigation measures for E&S risks and impacts during construction are outlined in section 5.1.3. Regarding the layout of mitigation measures during construction, there are two fundamental parts to this ESMP. Given that most key impacts will occur due to civil works and the transportation of construction and waste materials, a range of potential negative impacts on the physical, biological, and social environments – such as noise, dust, water pollution, waste generation, and social disturbances, worker and community health and safety- could be addressed through a set of general measures typically applied to construction projects. Within the project's ESMP, these general measures have been translated into standard environmental and social specifications, namely the Environmental and Social Codes of Practice (ESCOPs). The ESCOPs are designed to mitigate typical impacts associated with civil works across all subprojects and will be incorporated into all construction contracts. Details of the ESCOPs are provided in Section 5.1.3.1.

In addition to these general measures, each of the six subprojects present site-specific impacts that require site-specific measures during construction. Sections 5.1.3.2 through 5.1.3.8 describes the site-specific measures to be implemented during construction for each subproject, where additional actions are required beyond those covered by the ESCOPs. All site-specific construction measures will also be included in the relevant construction contracts.

Mitigation measures during the operation phase

Similarly, Section 5.1.4 details the mitigation measures to be implemented during the operational phase. This section is organized into two subsections: Section 5.1.4.1 describes the measures applicable to the operation of all subprojects, while Section 5.1.4.2 presents the site-specific operational measures for each individual subproject.

Mitigation measures addressing general impacts during the operational phase of the six subprojects include: control of dust and air emissions; management of noise; treatment and discharge of wastewater; handling of solid waste; prevention of environmental risks and incidents; mitigation of traffic-related impacts and risks (for both waterways and roadways); protection against surface water quality degradation; and reduction of adverse effects on aquatic life.

Site-specific mitigation measures for the operational phase, applicable to the Bach Long Vi subproject, include: (a) measures to mitigate impacts on the marine ecosystem within the Bach Long Vi Marine Protected Area (MPA); (b) measures to address impacts on aquatic species; and (c) measures to manage sedimentation in the harbor basin during operation.

Minimize cumulative impact

To address cumulative environmental and social impacts from SFDP subprojects and regional development, mitigation measures are implemented at subproject, project-wide, and inter-regional levels, tailored to each project phase. Design integrates climate adaptation and environmental protection through elevated site planning, permeable infrastructure, green materials, and robust water management, while policy-level planning ensures climate risks are systematically addressed.

During construction and operation, coordinated scheduling, traffic regulation, and stakeholder engagement minimize emissions and social disruption. Regional coordination, independent monitoring, and digital tools help manage overlapping activities and risks. Investments in social infrastructure, livelihood support, and ongoing community feedback ensure inclusive, adaptive governance and long-term sustainability across coastal regions.

Community Engagement: Develop feedback systems for addressing public concerns, improve access to public services, and organize training on environmental protection, waterway safety, and disaster risk management

Public consultation and Information dissemination

Public consultation: Direct consultation with the Commune/Ward People's Committee, communities and stakeholders is carried out from December 2023 to February 2024 including the following main contents: Overall introduction of the project, investment items of the project, identification of residential quarters/groups in the project area; Introduction to the basic requirements of the World Bank's ESF; Existing status of environmental hygiene of works in wards and outstanding issues; Potential environmental and social impacts and risks of the project on local communities; Solutions proposed by the community to limit environmental impacts and issues in the course of project implementation; Comments for the construction of the works.

Dissemination of information: The first draft of the ESIA, SEP, LMP, and ESCP in Vietnamese will be disclosed locally in the communes within the project area and at the Project Management Unit, expected in December 2023 and February 2024, for public consultation. Based on the ESIA content, local residents can access project information and provide their feedback/comments on environmental and social issues. The final draft of the ESIA and the final drafts of the SEP, LMP, and ESCP in English will be published on the WB's external website, expected in September 2025, for public consultation. The final ESIA in both Vietnamese and English will be disclosed locally at project sites and on the WB website.

OVERVIEW

I.1. PROJECT BACKGROUND

I.1.1. Project overview

The marine economy is playing an increasingly important role, becoming a driving force for the country's development. Sustainable development of the marine economy is associated with ensuring national defense and security, maintaining independence, sovereignty and territorial integrity, strengthening foreign affairs and international cooperation on the sea, contributing to maintaining a peaceful and stable development for the country, which are the central goals in the "Vietnam's Strategy for sustainable development of marine economy to 2030, vision to 2045". To that end, one of the priorities is to focus on infrastructure investment and promote sustainable offshore seafood exploitation; to build connections between sea and coastal areas, coastal areas and inland areas, coastal and landlocked localities, and between sectors and fields in a synchronous manner, etc. Without proper investment, Viet Nam still has a poor infrastructure for the fisheries industry, posing many limitations, difficulties and challenges for sustainable development of the marine economy. Marine economic development has not been linked with social development and environmental protection. Marine environmental pollution in many places is still serious, plastic waste pollution has become an urgent problem; Marine ecosystems and marine biodiversity are reduced; some marine resources are overexploited; Response to climate change, sea level rise, and sea erosion still has many limitations and inadequacies. Science and technology, basic surveys, and marine resource development have not become key factors in sustainable development of the marine economy. International cooperation on the sea is not effective. Investment in scientific research, basic surveys, and marine resource development is still limited; Training, vocational training, and job change support for people living in coastal areas have not met the needs.

Therefore, the Ministry of Agriculture and Rural Development (MARD)³ proposed the Sustainable Fishery Development Project to the Government of Viet Nam, focusing on investments in seafood exploitation infrastructure, brackish water shrimp farming, broodstocking and technological innovation in order to improve fishery exploitation and aquaculture development. The project proposal was approved by the Prime Minister in document No. 192/TTg-QHQT dated February 2, 2021.

Under this project, seafood exploitation infrastructure will be invested, such as building and upgrading dynamic fishing ports, fishing ports, and storm shelters for regional fishing vessels, facilitating fishing activities, particularly offshore exploitation. This helps increase exploitation efficiency, reduce losses after planning and protect the environment. The "Sustainable Fishery Development Project at the Ministry of Agriculture and Rural Development (financed by WB)" includes 06 subprojects divided into 3 components (all 6 subprojects which is managed by MARD) as follows:

Component 1: Structural investment (06 subprojects) serving sustainable fisheries development: (i) building 02 new dynamic fishing ports in major fishery centers in Khanh Hoa and Kien Giang; (ii) upgrading and repairing 03 grade I fishing ports and combined fishing ports on Bach Long Vi island - Hai Phong city; Lach Hoi fishing port, Thanh Hoa province, Lach Bang fishing port, Thanh Hoa province; (iii) upgrading 01 storm shelter in Tam Quan

³ Effective July 1, 2025, the Ministry of Agriculture and Rural Development (MARD) was merged with the Ministry of Natural Resources and Environment to establish the Ministry of Environment and Agriculture (MAE). For consistency with the Government of Vietnam's approval documents for the feasibility studies and Environmental Impact Assessment, the former name (MARD) is retained throughout this document

region - Binh Dinh province.

Under this component, investments include: (i) Subproject on Upgrading and Expanding Lach Hoi Fishing Port, Thanh Hoa province; (ii) Subproject on Upgrading and Expanding Lach Bang Fishing Port, Thanh Hoa province; (iii) Subproject on Construction of Tam Quan Regional Storm Shelter, Binh Dinh province; (iv) Subproject on Construction of Khanh Hoa Major Fishery Center, Khanh Hoa province; (v) Subproject on Construction of Kien Giang Major Fishery Center, Kien Giang province and (vi) Subproject on Construction and Upgrading of Bach Long Vi Fishing Port and Storm Shelter, Hai Phong city.

Component 2: Non-structural investments: (i) Improving seafood exploitation management capacity against illegal, unreported and unregulated fishing (IUU); (ii) application of advanced technology in the production of marine and shrimp breeds; (iii) application of advanced technology in commercial shrimp farming; (iv) Upgrade and complete the national database system on fisheries; (v) Support the management and reduction of plastic waste in exploitation and aquaculture.

Component 3: Project management.

1.1.2. SFDP's Consistency with Other Plans and Development Projects

The project complies with the Construction Law, Decree No. 56/2020/ND-CP dated May 25, 2020 of the Government on the management and use of official development assistance (ODA) capital and concessional loans from foreign donors, as well as Government's policies on priority areas for using official development assistance capital and concessional loans.

The project complies with Law on Public Investment No. 39/2019/QH14; Resolution No. 973/2020/UBTVQH14 July 8, 2020 of the National Assembly Standing Committee on stipulating principles, criteria and norms for allocating public investment capital from state budget capital in the 2021-2025 period;

In addition, the project complies with Directive No. 18/CT-TTg dated June 29, 2019 of the Prime Minister on strengthening management and improving the efficiency of using ODA loans and foreign concessional loans in the new situation when borrowings are for development investment expenditures, not for recurrent expenditure.

- ***Consistence with National Fisheries Development Strategies***

In Decision No. 339/QĐ TTg dated March 11, 2021 of the Prime Minister on approving the fisheries industry development strategy to 2030 and vision to 2045, it was determined: Investment project to upgrade infrastructure fisheries infrastructure, making investments to synchronously upgrade infrastructure systems and seafood logistics services to meet the seafood supply chain. The project includes investment in major fishery centers, grade I fishing ports, storm shelters for fishing vessels, shrimp farming, and aquaculture areas, concentrated industrial fisheries, marine aquaculture infrastructure, cold storage, and database construction are identified as priority projects for implementation in 2021-2030.

- ***Consistence with Sectoral and Local Planning***

Fishing ports and storm shelters: 02 major fishery centers in Khanh Hoa and Kien Giang; 06 Grade I fishing ports: Lach Hoi fishing port (Thanh Hoa), Lach Bang fishing port (Thanh Hoa; 04 regional storm shelters: Tam Quan (Binh Dinh), storm shelters and Bach Long Vi fishing port and storm shelter (Hai Phong); which are all parts of fishing port and storm shelter for fishing vessels planned to 2020 with an orientation to 2030 approved by the Prime Minister in the decision No. 1976/QĐ-TTg dated November 12, 2015.

In addition to the existing ports that have been implemented according to the plan, , Tam Quan port have made a 1/2000 scale planning Khanh Hoa, and Kien Giang fishing ports have been

planned at a scale of 1/500. The remaining fishing ports and storm shelter anchorage areas that have been proposed by the locality to be implemented above have the department to allocate space to develop the project in accordance with the local development planning. Specifically, the fish pond and storm shelter anchorage of Bach Long Vi are built and upgraded in full accordance with Decision No. 232/QĐ-TTg dated March 30, 2023 on approving the adjustment of the General Plan of Hai Phong city to 2040 with a vision to 2050 and Decision No. 1516/QĐ-TTg dated December 2, 2023 of the Prime Minister on approving the planning of Hai Phong city in the 2021-2030 period, with a vision to 2050; land use planning of Bach Long Vi district.

- ***Consistence with the National Environmental Protection Strategy***

Locations for the implementation of the Project's works/investment items are in line with the National Environmental Protection Strategy to 2030, with a vision to 2050 according to Decision No. 450/QĐ-TTg dated April 13, 2022. The project with investment items that do not pose a potential risk of pollution to environmental quality, do not affect the health of the community, towards the goal of sustainable socio-economic development, adaptation and response to climate change through works and non-construction items for sustainable development of the fisheries sector and response to with local climate change to minimize damage caused by natural disasters and climate change for fishermen in the project area.

I.2. LEGAL BACKGROUND

The project in general and the sub-project in particular will fully comply with the current environmental and social laws of Vietnam and the World Bank's Environmental and Social Safety Framework (ESF). Environmental and Social Assessments are conducted in accordance with the Environmental and Social Standards (ESSs) according to the ESF and Vietnam's requirements.

I.2.1. Legal documents and technical basis of the Government of Vietnam

- ✓ ***Law***

- The Law on Environmental Protection No. 72/2020/QH14 was approved by the XIV National Assembly on November 17, 2020, and takes effect from January 1, 2022. This Law provides for environmental protection activities; policies, measures, and resources for environmental protection; rights and obligations of organizations, households and individuals in environmental protection.
- Land Law No. 31/2024/QH15 was approved by the National Assembly on January 18, 2024, and takes effect from January 1, 2025. The Law provides for the regime of land ownership, the powers and responsibilities of the State on behalf of the owners of the whole people in charge of land and the uniform management of land, the regime of land management and use, the rights and obligations of citizens and land users with respect to land in the territory of the Socialist Republic of Vietnam.
- The Law on Natural Disaster Prevention and Control No. 21/VBHN-VPQH dated August 2, 2023, effective from July 1, 2024, stipulates natural disaster prevention and control activities, rights and obligations of agencies, organizations, households and individuals participating in natural disaster prevention and control activities, state management and resources to ensure the implementation of natural disaster prevention and control. against natural disasters.
- The Law on Water Resources No. 28/2023/QH15 was approved by the National Assembly on November 27, 2023, and takes effect from July 1, 2024. This Law provides for the management, protection, regulation, distribution, restoration, development, exploitation and use of water resources; prevention, combat and remedy of harm caused by water in the territory of the Socialist Republic of Vietnam Law on Public Investment No.

39/2019/QH14 promulgated by the National Assembly of Vietnam on January 1, 2020.

- Law on Cultural Heritage No. 45/2024/QH15 was approved by the National Assembly on 23/11/2024. This Law provides for cultural heritage, activities of management, protection and promotion of cultural heritage values, rights, obligations and responsibilities of agencies, organizations, communities and individuals in the management, protection and promotion of cultural heritage values of the Socialist Republic of Vietnam.
- Law on Gender Equality No. 73/2006/QH11 of the National Assembly of Vietnam dated 29 June 2006 and is currently being updated.
- The Law on Biodiversity No. 20/2008/QH12 passed by the National Assembly on November 13, 2008, stipulates the conservation and sustainable development of biodiversity, rights and obligations of organizations, households and individuals in the conservation and sustainable development of biodiversity.
- Forestry Law No. 16/2017/QH14 passed by the National Assembly on November 15, 2017 regulating the management, protection, development and use of forests, processing and trading of forest products.
- The Fisheries Law No. 18/2017/QH14 approved by the National Assembly on November 21, 2017, regulates fisheries activities, rights and responsibilities of individuals and organizations engaged in fisheries activities and the state management of fisheries.
- The Law on Marine and Island Resources and Environment No. 82/2015/QH13 passed by the National Assembly on June 25, 2015, stipulates the integrated management of natural resources and environment, rights, obligations and responsibilities of agencies, organizations and individuals in general management and protection of natural resources and environment in Vietnam.
- The Law on Construction No. 50/2014/QH13 passed by the National Assembly on June 18, 2014, stipulates the rights, obligations and responsibilities of agencies, organizations, individuals and state management in construction investment activities.
- The Law on Complaints No. 02/2011/QH13 of the National Assembly of Vietnam dated November 11, 2011, provides for complaints and settlement of complaints, management and monitoring of complaint settlement.
- Law on Fire Prevention and Fighting and Rescue No. 55/2024/QH15 was approved by the National Assembly on November 29, 2024; Law on Occupational Safety and Health No. 84/2015/QH13 promulgated by the National Assembly on 25/06/2015;
- The Electricity Law No. 28/2004/QH11 of December 14, 2004, provides for planning and investment in the field of electricity; electricity saving; electricity market; rights and obligations of organizations and individuals in using electricity; protection of electrical equipment and works; electricity safety.
- Law on Road Traffic No. 23/2008/QH12 dated 13/11/2008 Law on Inland Waterway Navigation No. 23/2004/QH11 dated June 15, 2004, and Law No. 48/2014/QH13 on the adjustment and supplementation of a number of articles of Law No. 23/2004/QH11
- Labor Law No. 45/2019/QH13 dated 18/06/2012 was approved by the National Assembly of the Socialist Republic of Vietnam XIII on 01/01/2021.
- Children's Law No. 102/2016/QH13 was approved by the 13th National Assembly of the Socialist Republic of Vietnam on April 5, 2016
- Irrigation Law No. 08/2017/QH14 was approved by the National Assembly of the Socialist Republic of Vietnam XIV on June 19, 2017, and took effect on July 1, 2018.

✓ **Decree**

- Decree No. 80/2014/ND-CP dated August 6, 2014, of the Government regulating water drainage and wastewater treatment.
- Decree No. 39/2015/ND-CP dated April 27, 2015, of the Government on support policies for ethnic minority women and poor women complying with population policies. Decree No. 67/2018/ND-CP dated May 14, 2018, of the Government detailing a number of articles of the Law on Irrigation.
- Decree 100/2019/ND-CP of the Government dated December 30, 2019, stipulating penalties for administrative violations in the field of roads and railways.
- Decree No. 39/2015/ND-CP dated April 27, 2015, of the Government on support policies for ethnic minority women and poor women complying with population policies.
- Decree 26/2019/ND-CP dated March 08, 2019, of the Government detailing a number of Articles and measures to implement the Law on Fisheries.
- Decree No. 06/2024/ND-CP dated January 25, 2024, of the Government amending and supplementing a number of articles of the Government's Decree No. 08/2021/ND-CP dated January 28, 2021 regulating the management of inland waterway activities.
- Decree 37/2024/ND-CP dated April 04, 2024, of the Government stipulating amendments and supplements to a number of articles of the Government's Decree No. 26/2019/ND-CP dated March 8, 2019, detailing a number of articles and measures to implement the Law on Fisheries.
- Decree 38/2024/ND-CP dated 05/4/2024 of the Government regulating sanctioning administrative violations in the field of fisheries.
- Decree No. 08/2022/ND-CP dated January 10, 2022, of the Government detailing a number of articles of the Law on Environmental Protection
- Decree No. 05/2025/ND-CP dated January 6, 2025, of the Government on amendments and supplements to a number of articles of the Government's Decree No. 08/2022/ND-CP dated January 10, 2022, detailing a number of articles of the Law on Environmental Protection
- Decree 06/2022/ND-CP regulating greenhouse gas emission mitigation and protection of the ozone layer.
- Decree No. 02/2023/ND-CP of the Government dated February 1, 2023, detailing the implementation of a number of articles of the Law on Water Resources.
- Decree 53/2020/ND-CP dated 05/5/2020 of the Government regulating environmental protection fees for wastewater.
- Decree No. 40/2020/ND-CP dated April 6, 2020, of the Government guiding the implementation of a number of articles of the Law on Public Investment.
- Decree No. 57/2024/ND-CP dated May 20, 2024, of the Government on dredging activities in seaport waters and inland waterway waters.
- Decree No. 71/2024/ND-CP dated June 27, 2024, of the Government regulating land prices.
- Decree No. 88/2024/ND-CP dated July 15, 2024, of the Government regulating compensation, support and resettlement when the State recovers land
- Decree No. 101/2024/ND-CP dated July 29, 2024, regulating land basic survey; registration and grant of certificates of land use rights, ownership of land-attached assets

and land information systems.

- Decree No. 45/2022/ND-CP dated 07/07/2022 of the Government stipulates the sanctioning of administrative violations in the field of environment.
- Decree No. 156/2018/ND-CP dated November 16, 2018, of the Government detailing the implementation of a number of articles of Forestry Law
- Decree No. 10/2023/ND-CP dated April 3, 2023, of the Government amending and supplementing a number of articles of decrees guiding the implementation of the Land Law
- Decree No. 10/2023/ND-CP dated April 3, 2023, of the Government amending and supplementing a number of articles of decrees guiding the implementation of the Land Law
- Decree No. 102/2024/ND-CP dated July 30, 2024, of the Government detailing the implementation of a number of articles of the Land Law.
- Decree No. 123/2024/ND-CP dated October 4, 2024, stipulating penalties for administrative violations in the field of land.
- Decree No. 23/2024/ND-CP dated November 26, 2024, of the Government regulating techniques for establishing water source protection corridors.
- Decree No. 88/2024/ND-CP dated July 15, 2024, of the Government regulating compensation, support and resettlement when the State recovers land
- Decree No. 27/2024/ND-CP dated 06/3/2024 amending and supplementing a number of articles of the Government's Decree No. 156/2018/ND-CP dated November 16, 2018 ,detailing the implementation of a number of articles of the Forestry Law
- Decree No. 06/2021/ND-CP dated January 26, 2021, of the Government detailing a number of contents on quality management, construction and maintenance of construction works.
- Decree No. 15/2021/ND-CP dated March 3, 2021, of the Government detailing a number of contents on management of construction investment projects.
- Decree No. 114/2021/ND-CP dated December 16, 2021, of the Government guiding the management and use of official development assistance (ODA) and concessional loans of foreign donors.
- Decree No. 79/2021/ND-CP dated 16/0 and 8/2021 of the Government amending and supplementing a number of articles of Decree No. 97/2018/ND-CP dated 30/06/2018 on on-lending ODA loans and foreign concessional loans of Government;
- Decree 114/2021/ND-CP dated 16/12/2021 on the management and use of official development assistance (ODA) and concessional loans of foreign donors.
- Decree No. 136/2020/ND-CP dated 24/11/2020 of the Government detailing a number of articles and measures to implement the Law on Fire Prevention and Fighting and the Law amending and supplementing a number of articles of the Law on Fire Prevention and Fighting.
- Decree No. 124/2020/ND-CP dated October 19, 2020, of the Government detailing a number of articles on measures to implement the Law on Complaints.

✓ **Circular**

- Circular No. 02/2022/TT-BTNMT dated January 10, 2022, of the Ministry of Natural Resources and Environment detailing the Law on Environmental Protection.
- Circular No. 07/2025/TT-BTNMT dated February 28, 2025, of the Ministry of Natural Resources and Environment on amendments and supplements to a number of articles of

- Circular No. 02/2022/TT-BTNMT dated January 10, 2022, of the Ministry of Natural Resources and Environment detailing the Law on Environmental Protection;
- Circular No. 01/2022/TT-BTNMT dated January 07, 2022, of the Ministry of Natural Resources and Environment detailing the implementation of the Law on Environmental Protection on response to climate change.
 - Circular No. 01/2023/TT-BTNMT dated March 13, 2023, of the Ministry of Natural Resources and Environment promulgating 5 national technical regulations on the quality of the surrounding environment.
 - Circular No. 19/2016/TT - BYT dated June 30, 2016, of the Ministry of Health guiding the management of occupational hygiene and employee health.
 - Circular No. 08/2017/TT-BXD dated 16/5/2017 of the Ministry of Construction regulating the management of construction solid waste.
 - Circular No. 04/2017/TT-BXD dated 30/3/2017 of the Ministry of Construction regulating occupational safety management in construction.
 - Circular No. 80/2017/TT-BTC dated 02/8/2017 of the Organizing Committee guiding the determination of the value of land use rights and land-attached assets when the State recovers land and manages compensation for assets managed by the State and supports in cash when the State recovers land without having to pay compensation for land.
 - Decision No. 3733/2002/QĐ-BYT dated October 10, 2002: Promulgating 21 occupational hygiene standards, 05 principles and 07 occupational hygiene measurements.

✓ ***Applicable Standards and Regulations***

- QCVN 01-1:2018/BYT- on the quality of clean water used for domestic purposes.
- QCVN 03:2023/BTNMT - National technical regulation on soil quality
- QCVN 05:2023/BTNMT- National Technical Regulation on Air Quality
- QCVN 07:2009/BTNMT: National technical regulation on hazardous waste threshold
- QCVN 50:2013/BTNMT - National Technical Regulation on hazard thresholds for sewage sludge from wastewater treatment
- QCVN 07:2016/BXD - National Technical Regulation on "Technical infrastructure works"
- QCVN 01:2021/BXD - National technical regulation on construction planning
- QCVN 08:2023/BTNMT - National technical regulation on surface water quality
- QCVN 09: 2023/BTNMT - National technical regulation on groundwater quality
- QCVN 14:2008/BTNMT National Technical Regulation on Domestic Wastewater
- QCVN 10:2023/BTNMT - National Technical Regulation on seawater quality
- QCVN 17:2011/BGTVT - National technical regulation on regulations on prevention of pollution caused by inland waterway vehicles
- QCVN 18:2021/BXD - National Technical Regulation on Safety in Construction
- QCVN 26:2010/BTNMT - National technical regulation on noise
- QCVN 27:2010/BTNMT - National technical regulation on vibration.
- QCVN 43:2017/BTNMT- National technical regulation on sediment quality.
- QCVN 02-15:2009/BNNPTNT - National Technical Regulation on mitigating measures for food safety, biosafety and environment for aquatic breed activities;

- QCVN 26/2018/BGTVT: National technical regulation on marine pollution prevention systems of ships;TCVN 7222:2002 - on general environmental requirements for centralized domestic wastewater treatment stations.
- TCVN 7957:2008 - Drainage - Networks and external works - Design standards; TCVN 3890:2023: Fire prevention and fighting - Fire prevention and fighting equipment for houses and works - Equipment, layout.
- TCXDVN 33:2006 - Water supply - Pipeline network and design standards; Industry Standard 20TCN 33-85: Water supply and drainage, external networks and works.

✓ ***Legal documents related to the project***

- Decision No. 1976/QD-TTg dated 12/11/2015 of the Prime Minister approving the system of fishing ports and storm shelter anchorages for fishing vessels by 2020, with a vision to 2030
- Document No. 4586/BNN-HTQT dated 08/7/2020 of the MARD Proposing a Sustainable Fisheries Development Project, borrowing from the World Bank
- Document No. 76/BNN-HTQT dated 07/01/2021 of the Ministry of Agriculture and Rural Development finalizing the proposal for the Sustainable Fisheries Development Project, borrowing from the World Bank, the work part carried out by the Ministry of Agriculture and Rural Development
- Document No. 192/TTg-QHQT dated 17/02/2021 of the Prime Minister approving the project proposal "Sustainable fisheries development" - Component project at the Ministry of Agriculture and Rural Development, loan from the World Bank
- Decision No. 802/QD-BNN-HTQT dated 01/03/2021 of the Ministry of Agriculture and Rural Development assigning tasks in the stage of preparing the pre-feasibility study report, the project "Sustainable fisheries development", borrowing from the WB - Component project at the Ministry of Agriculture and Rural Development.
- Decision No. 339/QD-TTg dated March 11, 2021, of the Prime Minister approving the fishery development strategy to 2030 with a vision to 2045
- Document No. 1060/UBND-KT dated 23/3/2021 of the People's Committee of Thai Binh Province V/v Proposing the Thuy Tan Fishing Port project to participate in the "Sustainable Fisheries Development" Project with a loan from the World Bank
- Document No. 2994/BNN-HTQT dated May 24, 2021 , of the MARD Proposing investment in the construction of storm shelter anchorage for fishing vessels in Cua Lap, Ba Ria - Vung Tau province to participate in the project "Sustainable fisheries development", borrowed from the WB, the work part is carried out by the MARD.
- Document No. 4521/UBND-TL dated 08/7/2021 of Hai Phong City People's Committee proposing to add the Project to upgrade fishing ports and storm shelter anchorages for Bach Long Vi fishing vessels to the Project: Sustainable Fisheries Development" with a loan from the World Bank (WB).
- Document No. 4511/BNN-HTQT dated 20/7/2021 of the Ministry of Agriculture and Rural Development Proposing investment in upgrading fishing ports and storm shelter anchorages for Bach Long Vi fishing vessels
- Pursuant to the Prime Minister's Decision No. 1664/QD-TTg dated October 4, 2021, approving the project on development of marine aquaculture to 2030, with a vision to 2045
- Decision No. 592/QD-TTg dated May 30, 2023, of the Prime Minister deciding on the investment policy of the Sustainable Fisheries Development Project at the Ministry of

Agriculture and Rural Development, borrowing from the World Bank.

1.2.2. World Bank policies and guidelines on environmental and social safety

The project will apply the World Bank's Environmental and Social Framework (ESF) 09 Environmental and Social Standards (ESSs) from ESS1 to ESS10, except ESS9. and The project will also comply with the Bank's operational policies on international waterways (OP/BP 7.50);

The scope of application of social support institutions is discussed below.

ESS1: Assessment and Management of Environmental and Social Risks and Impacts

ESS1 requires borrowers to assess, manage and monitor relevant environmental and social risks and impacts at each stage of sub-projects/projects funded by the Bank of China in order to achieve consistent environmental and social outcomes with social institutions.

Overall, the project proposes to bring many potential environmental benefits such as positive impacts on waste/wastewater management through investment, implementation of better management regulations, minimization of storm damage and through effective management of post-harvest loss reduction. Overall, the risks and negative impacts on the environment and social environment caused by the project are considered significant for the following reasons:

- In terms of society, key risks and impacts will include loss of land, land assets, livelihoods and other assets due to temporary and permanent land acquisition and relocation; disruption of livelihood activities of farmers and fishermen (due to upgrading/building and operating fisheries infrastructure and improving operational capacity dynamic); occupational safety and health; gender-based violence and abuse of sexual exploitation by migrant workers and risks related to public health and safety; increasing conflicts on water use between brackish water aquaculture and freshwater rice cultivation; the inadaptability of farmers to new livelihood models; risks due to the failure of livelihood models have a negative impact on the welfare of households benefiting from the project; uneven access to project benefits among disadvantaged groups such as the poor, ethnic minorities and women heads of households. Although the impact risks are quite numerous, all are manageable and can be mitigated through feasible environmental and social impact mitigation and assessment plans that will be developed during the preparation and implementation of the project/sub-project.
- The main environmental risks and impacts during project implementation include (i) safety risks associated with unexploded ordnance; (ii) environmental pollution due to the generation of dust, waste, wastewater and dredged materials; (iii) degradation of water quality and impacts on aquatic ecosystems and aquatic species due to embankment and dredging; (iv) the risk of infrastructure cracking, erosion and subsidence during construction; (v) impacts on natural habitats and altered habitats during the construction of embankments, harbors and storm shelter anchorages; (vi) loss of few protection mangrove shrubs; (vii) Operational and Community Health and Safety.
- Major environmental risks and impacts during operation include: (i) soil erosion and embankment subsidence; (ii) potential soil and water pollution due to the operation of ships entering and exiting the port and sheltering from storms; (iii) air pollution and noise caused by the operation of fishing vessels and road and waterway vehicles; (iv) water pollution and disturbance of aquatic life due to improper waste management, oil leaks, periodical maintenance dredging; (v) risk of land salinization and water pollution from saline shrimp farms; and (vi) occupational and community health and safety risks during port operation. These impacts are long-term, reversible, and can be mitigated through appropriate design and management practices

- Based on the type and location of the project proposing investment, the sensitivity of the project and the capacity of the project implementation and management agency, the risks and potential negative impacts on environmental and social protection due to the project are assessed Substantial and controllable level.

Although Viet Nam has an advanced social and environmental framework, some differences between domestic and international E&S assessment regulations and practices still exist. A discussion of the project's application of ESS is described below, while Table 3.3 below describes the key differences between the country's social security assessment requirements and the WB's ESSs.

ESS2: Labor and Working Conditions

ESS2 recognizes the importance of job and income creation in the pursuit of poverty reduction and inclusive economic development. The project can promote a healthy relationship between workers and management and enhance the development of project interests by treating workers in the project with equality and providing safe, secure and healthy working conditions.

With the initial project design, the project/sub-project owner is expected to use labor (mostly from local sources) to support the management of the project/ sub-project and carry out the construction/renovation/upgrade of existing fishing ports, storm shelters, and large fisheries centers. With the existing design, most of the upgrading and construction of fishing ports can be medium-scale and a few are larger-scale with the number of workers at each subproject is estimated at 50-120 people (a total of 6 subprojects is about 430 people) and most of them are recruited from the locality. Most other risks associated with construction activities include occupational safety and health (OHS), gender-based violence (GBV), sexual abuse and exploitation (SEA) due to construction investment activities such as fishing ports, large fisheries centers, storm shelters can occur at medium risk levels.

In line with ESS2 requirements, as part of the environmental assessment process, a labor management plan (LMP) has been developed as part of the Environmental and Social Management Plan (LMP). LMP provides a way to manage project workers in compliance with the provisions of the National Law and ESS2.

ESS3: Resource Efficiency and Pollution Prevention and Management

ESS3 acknowledges that economic activity, agricultural and fishery production, and widespread urbanization often cause air, water and land pollution, and consume finite resources that may threaten people, ecosystem services, , and the environment at the local, regional, and global levels. ESS3 sets out requirements to address resource efficiency and pollution prevention and management throughout the project life cycle.

Given the type and scale of the project investment, the project is expected to use a large amount of resources and construction materials, the risks and negative impacts on human health and the associated environment are expected to be moderate. Risks and impacts related to waste/wastewater arising from the operation of Class I fishing ports, major fisheries centers and resource efficiency will be assessed, and impact management and mitigation measures will be proposed during the preparation of the project as part of the Environmental and Social Assessment (ESA) .

Dredged materials from ports, creeks, fishing ports, storm shelters may contain organic pollutants or some other toxic substances. The adverse impacts and risks associated with dredging, storage, transportation and handling of dredged material will be identified during the development of the environmental and social impact assessment (ESIA). Guidelines for the Preparation of a Dredging Material Management Plan (DMMP) have been prepared and included in the ESMP and it will be used to guide contractors to develop specific DMMP for dredged works during project implementation.

During the implementation process, if it is determined that the construction or operation of the project has the potential to significantly emit greenhouse gas emissions, the project will immediately carry out an inventory of emissions and apply appropriate control and mitigation measures. The project will apply the measures, specified in the World Bank Group's Environmental, Health, and Safety Guidelines (WBG EHS) and Good International Industry Practice (GIIP), to efficiently use raw materials and optimize energy use to a technically and financially feasible level.

ESS4: Community Health and Safety

ESS4 addresses the risks and impacts to the health, safety, and security of project-affected communities, and outlines the Borrower's responsibility to avoid, minimize, or mitigate such risks and impacts, with particular attention to individuals who, due to their specific circumstances, may be vulnerable. Given the nature and scale of the project, it is not expected to discharge large volumes of hazardous or dredged materials without proper management that could adversely affect community health. The project is also not expected to expose local communities to high or substantial risks related to waterway and road traffic accidents, electricity use, or social disturbances due to labor. The project does not involve the construction or rehabilitation of dams, nor does it depend on water supply from existing dams.

Community health and safety risks and impacts are likely from construction noise, vibration, air pollution, inappropriate management of construction waste and dredging materials, movement of heavy vehicles in congested and other restricted areas. In addition, there is also risk related to unexploded ordnance (UXO) left from the war which ended in 1975.

Therefore, the standard measures outlined in the Environmental, Health and Safety (EHS) Guidelines to ensure public health and community safety during the construction and operation of project-funded infrastructure are sufficient. The guidance covers general measures in design and operation, communication and training, and measures to address physical, chemical, occupational protective equipment, special hazardous environment and monitoring risks. These measures have been tailored and incorporated into the project's Environmental and Social Management Plan (ESMP).

In addition, measures to prevent Gender-Based Violence (GBV), Sexual Exploitation and Abuse (SEA), and Sexual Harassment (SH) will be implemented, including requiring workers to sign a Code of Conduct and establishing a Grievance Redress Mechanism (GRM) capable of receiving and referring SEA/SH-related

ESS5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement

ESS5 recognizes the adverse impact of the project/sub-project on local people, especially those who are considered vulnerable or disadvantaged. Involuntary resettlement will be avoided. In the event that involuntary resettlement is unavoidable, mitigation measures and the implementation of appropriate measures to minimize the negative impact on displaced persons (and for host communities hosting displaced persons) should be taken.

Given that most of the works of the project will be carried out within the scope of existing infrastructure/aquatic works (fishing ports, storm shelter anchorages) for renovation/upgrading. However, the construction/upgrading of infrastructure for 2 major fishery centers (regional fishing ports) in Cam Ranh (Khanh Hoa province) and An Bien (Kien Giang province) and other type I fishing ports that meet the standard scale, can recover land for the project. That may lead to relocation and resettlement and affecting people's activities and livelihood opportunities. There may also be land recovery requirements related to dumping, sludge treatment from the upgrading/construction of fishing ports, storm shelter anchorages leading to permanent recovery of land and land-attached assets. Using a decentralization system of

mitigation, analysis of alternatives during the project design phase has been carried out to avoid or reduce land acquisition and land use restrictions as much as possible to minimize the negative impacts of land acquisition and socio-economic of local people, especially vulnerable people, and develop a Resettlement Plan (RP) that complies with the ESS5.

ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

ESS6 recognizes that the protection and conservation of biodiversity and the sustainable management of living natural resources are fundamental to sustainable development. It emphasizes the importance of maintaining the core ecological functions of habitats - including forests, riparian zones, coastal and marine areas - and the biodiversity they support. ESS6 also addresses the sustainable management of primary production and harvesting of living natural resources and acknowledges the need to consider the livelihoods of project-affected parties, including local communities and ethnic minorities, whose access to or use of biodiversity or living natural resources may be affected by the project.

The project's activities will be carried out in existing canals, rivers, or coastal areas and bays that have been used as waterways for fishing, storm shelter purposes. These water bodies can be considered as aquatic ecosystems supporting aquatic species; however, they are but are mostly situated in areas designated for fishing ports and storm shelters, and not within critical habitats or high biodiversity areas. One exception is the subproject on upgrading the storm shelter in Bach Long Vi island. The subproject investments and the 03 disposal sites are located within the development zone of the Bach Long Vi Marine Protected Area (MPA). The upgrading of Lach Hoi Port will require the removal of approximately 0.15 ha of black mangrove shrubs, which, although not part of a designated protection forest, provide important ecological functions such as bank stabilization and erosion control

The ESA confirms that the project will not cause significant impacts and risk to the MPA or any other critical and natural habitat. Mitigation measures incorporated in the ESMP, will be implemented to protect or minimize adverse impacts on aquatic ecosystems during construction and operation including managing increased water turbidity, preventing pollution from building material spills, and controlling grease leaks

ESS7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities

ESS7 aims to ensure that the development process encourages full respect for the human rights, dignity, aspirations, identities, cultures and natural resource-based livelihoods of ethnic minorities (definition equivalent to Indigenous Peoples). ESS7 also means that in order to avoid the adverse impacts of sub-projects, or when it cannot be avoided, mitigation measures applied to mitigate and/or offset those impacts should be implemented.

The social assessment indicates that the project investments take place within existing fishing ports and storm shelter anchorages where the majority of Kinh people live in coastal areas. The project is expected not to cause any significant negative impacts on the socio-economic and cultural aspects of ethnic minorities. Therefore, this standard is not relevant.

ESS8: Cultural Heritage

ESS8 defines cultural heritage as a continuity of tangible and intangible forms between the past, present and future. It sets out measures designed to protect cultural heritage throughout the life of the project.

Given the nature, scale and location of the project, the project will not cause significant negative impact on tangible or intangible cultural heritage. While no tangible cultural sites are affected by land acquisition, some may experience temporary, moderate construction-related

impacts and risks, including increased dust, noise and vibration, temporary waste storage nearby, and restricted access. The ESMP includes measures to mitigate these impacts. The ESMPs also include a chance find procedure to ensure appropriate handling of any unexpected discoveries of tangible cultural heritage during implementation.

ESS10: Stakeholder Engagement and Information Disclosure

ESS10 recognizes the importance of open and transparent participation between project owners and project stakeholders as an essential element of Good International Practice. Effective stakeholder engagement can improve the environmental sustainability of projects, increase project acceptance, and contribute significantly to the successful design and implementation of projects. For the SFDP Project, the main stakeholders are the communities and households that benefit, those affected by the project, implementing agencies at the national level (Ministry of Agriculture and Environment, Ministry of Finance), local governments of the provinces participating in the project (including Provincial People's Committees, Department of Agriculture and Environment), Department of Finance and relevant commune-level People's Committees, Management Board of existing ports).

During the identification of sub-projects and the preparation of the E&S documents, the project owner has been prepared a Stakeholder Engagement Plan (SEP) for the project. This is to ensure transparency and meaningful consultation with affected parties and interested parties in the project. Stakeholder engagement and consultation has been conducted throughout the project/sub-project lifecycle. This will include discussions on the design of the sub-project and the impact among potential beneficiary communities as well as discussions with provincial stakeholders on environmental and social issues during the project preparation phase. The identification of individuals or groups affected by the sub-project as "disadvantaged or vulnerable" during the identification and analysis of stakeholders should be given special attention. The SEP, along with other environmental and social tools, has been introduced during the public consultation and project information disclosure process as required by the ESS10 and will be considered as a living document that needs to be updated regularly during the implementation of the project.

(b) Other applicable policies

This policy is activated for the project because some construction activities in some provinces may affect the basin of international waterways such as the Ma River and the Mekong River. These international waterways are shared by countries including China, Myanmar, Laos, Thailand, Cambodia, and Vietnam

Among the 05 project provinces, Thanh Hoa in the Ma River basin, and Kien Giang in the Mekong River basin. The Ma River is an international waterway that flows from Vietnam, through Laos and back to Vietnam. The Mekong River is an international waterway originating from the Tibetan Plateau, flowing through China's Yunnan Province, Myanmar, Laos, Thailand, Cambodia, and Vietnam. The two tributaries of the Mekong River split in Cambodia, becoming the Tien River and the Hau River. Then it passes through Vietnam and runs through the provinces of Soc Trang, Bac Lieu, Ca Mau, and Kien Giang connecting with the Hau River through a system of small rivers and canals. Vietnam is the country with the lowest river downstream among these international rivers.

The determination of the notification exemption or notice that is being discussed and acted upon correctly will be done prior to the project due diligence.

The Bank's policy on access to information⁴. The World Bank's Access to Information Policy aims to ensure that people and groups affected by the project are informed about the project's goals and impacts, and are consulted throughout the project to ensure that their interests are represented. Locally published E&S documents in project areas and the Bank's internal and external websites provide the public with access to information about the Bank's projects and programs/projects.

The WBG's policy requires that during the ESA process, the Government conducts meaningful consultations with stakeholders such as groups affected by the project and local NGOs on the environmental and social aspects of the project, and considers their views when designing the project. All draft E&S tools are published locally in an accessible place and in a form and language that is understandable to key stakeholders and in English at the Bank's internal and external websites prior to project appraisal.

Health and environmental safety guidelines⁵. Projects funded by the World Bank should also refer to the World Bank Group's Environmental, Health and Safety (WBG ESHG) Guidance (known as the "EHS Guidance") and the relevant environmental and social health and safety (ESHS) of the World Bank on aquaculture, ports, and ⁶harbors. The EHS Guide is a general as well as specific technical reference according to Good International Practice in the Field of Specialization (GIIP). The extent and measures to be implemented in accordance with the Guidelines are generally accepted by the WB Group and can be achieved in the construction of new buildings at a reasonable cost using existing technology. The environmental assessment process may propose levels of implementation or alternative measures (higher or lower), if accepted by the WB, and will become specific requirements at specific project sites. The EHS guidance applicable to the project outlined in the Environmental Code of Practice (ECOP) will be integrated into the construction contract.

1.2.3. Relevant International Treaties and Agreements

Government of Vietnam has signed a number of international agreements and conventions relating to environmental management, community rights and ethnic minorities. The international treaties are not always adopted to be national legislation. Some of the key agreements are listed in the following table.

Table 0.1. International Agreements/convention/treaties Relevant to the project

Agreements/Conventions	Status	Objectives/Relevance
A. ENVIRONMENT		
United Nations Convention on Biological Diversity, 1992	Signed in May 1993	Promotes development of national strategies for the conservation and sustainable use of biological diversity. Often seen as the key document regarding sustainable development.
Convention on Wetlands of International Importance	Joined in 1989	The conservation and sustainable utilization of wetlands, i.e. to stem progressive encroachment on

⁴ Details of the Bank's policies on Access information on the <http://www.worldbank.org/en/access-to-information> website

⁵Environmental safety guidance on the www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines website.

⁶<https://www.ifc.org/wps/wcm/connect/9237a8dd-de88-4b3c-a55b-552d9361c91f/Final%2B-%2BAquaculture.pdf?MOD=AJPERES&CVID=jqes4FP>

https://www.ifc.org/wps/wcm/connect/ddfac751-6220-48e1-9f1b-465654445c18/20170201-FINAL_EHS+Guidelines+for+Ports+Harbors+and+Terminals.pdf?MOD=AJPERES&CVID=ID.CzO9

Agreements/Conventions	Status	Objectives/Relevance
especially as Waterfowl Habitat (Ramsar Convention), 1982		and loss of wetlands now and in the future, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value.
Convention on the International Trade of Endangered Species of Wild Fauna and Flora (CITES), 1973	Joined in 1994	To ensure that international trade in specimens of wild animals and plants does not threaten their survival and it accords varying degrees of protection to more than 33,000 species of animals and plants.
Cartagena Protocol on Bio-safety	Jointed in 2004	To ensure an adequate level of protection in the field of the safe transfer, handling and use of living modified organisms resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity and risks to human health.
United Nations Convention on the Law of the Sea (UNCLOS)	Jointed in July 1994	Promotes the peaceful use of the seas and oceans, facilitates international communications, enables equitable and efficient utilization of ocean resources, protects marine environment and promotes maritime safety.
MARPOL International Convention for the Prevention of Pollution from Ships	Signed in August 1991	Achieves the complete elimination of intentional pollution of the marine environment by oil and other harmful substances and the minimization of accidental discharge of such substances.

B. SOCIAL AND CULTURAL

UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage, 1972 (World Heritage Convention)	Joined in 1987	Promotes cooperation among nations to protect heritage from around the world that is of such outstanding universal value that its conservation is important for current and future generations.
Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) 1979	Signed in July 1980	The Convention defines what constitutes discrimination against women and mandates actions on a national level to put an end to discrimination.
International Covenant on Economic, Social and Cultural Rights (ICESCR)	Joined in 1982	This could protect the rights of minority ethnic groups

A number of certain ILO Conventions has been signed by the Government of Viet Nam, of which the details are provided in the table below. Viet Nam, which has now ratified 6 out of the 8 ILO Fundamental Conventions, becomes the 167th ILO Member State to ratify the Convention No.98 and the 20th State in the participating Asia and Pacific Region.

Table 0.2. Vietnam Ratification to ILO Conventions

Convention	Date	Status
C029 - Forced Labour Convention, 1930 (No. 29)	05 March 2007	Effective
C098 - Right to Organise and Collective Bargaining Convention, 1949 (No. 98)	05 June 2019	Effective

Convention	Date	Status
C100 - Equal Remuneration Convention, 1951 (No. 100)	07 October 1997	Effective
C111 - Discrimination (Employment and Occupation) Convention, 1958 (No. 111)	07 October 1997	Effective
C138 - Minimum Age Convention, 1973 (No. 138) Minimum age specified: 15 years	24 June 2003	Effective
C182 - Worst Forms of Child Labour Convention, 1999 (No. 182)	19 December 2000	Effective
C155 - Occupational Safety and Health Convention, 1981 (No. 155)	3 October 1994	Effective

I.2.4. Gap Analysis between the GoV's regulations and WB's ESF

The application of environmental assessment policies in Vietnam, as well as various efforts directed to policy harmonization between GoV and donors, has gradually narrowed the gap between the two systems. However, starting October 2018, the WB applies the Environment and Social Framework (ESF) to all WB-financing projects. The ESF describes the WB E&S policy to ensure that all WB's financing investment projects will meet the 10 Environmental and Social Standards (ESSs) which were designed to avoid, minimize, reduce or mitigate the adverse E&S risks and impacts of projects. These ESSs are:

- ESS1 - Assessment and Management of Environmental and Social Risks and Impacts;
- ESS2 - Labor and Working Conditions;
- ESS3 - Resource Efficiency and Pollution Prevention and Management;
- ESS4 - Community Health and Safety;
- ESS5 - Land Acquisition, Restrictions on Land Use and Involuntary Resettlement;
- ESS6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- ESS7 - Indigenous Peoples;
- ESS8 - Cultural Heritage;
- ESS9 - Financial Intermediaries; and
- ESS10 - Stakeholder Engagement and Information Disclosure

The WB will classify projects/subprojects into one of the four classifications: high risk, substantial risk, moderate risk or low risk and will disclose the project's classification and the basis for that classification on the WB's website and in project documents.

In late 2018 - early 2019, the WB team conducted a full Country System Framework Assessment for Vietnam to identify key gaps between the country legal system and the ESSs and priority needs to ensure full compliance of the ESSs. The conclusion is that Vietnam has a comprehensive regulatory framework that in many cases meets the requirements of the 10 ESSs and key issues are more associated with implementation and the different capacity between the central and provincial project management units and between the provinces. There are opportunities to accelerate implementation of recent improvements in the country system, especially on labor, community safety and stakeholder engagement.

Initial screening of the proposed Project suggested that the E&S risks and negative impacts of the proposed Project activities can be classified as **Substantial**, however, the FSs for possible medium-scale investments (provincial or inter-provincial) may result in moderate to substantial risks while high risks is not anticipated. In this context, it is expected that the national regulations and relevant requirements of the ESSs will be applied to the most of the proposed investment while specific attention and capacity building will be given to ensure that contractors adequately address the issues related to contract management, safety of local communities and workers. **Table 0.3** below summarizes key differences between the WB's ESA process and GoV's EIA requirements and action to be adopted by the proposed Project.

Table 0.3. Summary of the World Bank (WB) ESA and National EIA Processes and proposed gap mitigation for the project

ESA Stage	WB (stipulating in the ESF and ESSs)	Viet Nam (stipulating in Decree 08/2022/NĐ-CP, amended and supplemented in Decree 05/2025/ND-CP; Circular 02/2022/TT-BTNMT, amended and supplemented in Circular 07/2025/TT-BTNMT)	Gap filling measures for this project
Objective	The ESF includes 10 ESSs which are designed to assess and manage negative E&S risks and impacts of projects towards sustainable development.	LEP and related laws, decrees, standards and regulations on environmental protection. This law is supplemented and supported by the legal system and legal documents related to natural resource management, labor, construction management, etc. The following comparison focuses on the LEP 2020 No. 72/2020/QH14 and directives for implementation (Decree No. 08/2022/ND-CP, amended and supplemented in Decree 05/2025/ND-CP; Circular No. 02/2022/TT-BTNMT, amended and supplemented in Circular 07/2025/TT-BTNMT)	The ESF of the WB is applied to projects financed by WB
ESA instrument	- Tools developed under the ESSs may include ESMF, ESIA, ESMP, regional & local ESIA; SESA, LMP assessing a hazard or a risk; ES audit. - Based on the information provided by the Borrower, the WB evaluates E&S instruments of proposed projects intended to be financed by the WB - The Borrower prepares, submits, and discloses all the E&S documents (including Environmental and Social Commitment Plan (ESCP) and Stakeholder Engagement Plan (SEP), LMP, ESIA/ESMP, EMDP RP) for the WB before the appraisal.	Environmental assessment tools such as SEA, EIA, Environmental licenses, and environmental registration are decided based on Appendices I to V of Decree 08/2022/ND-CP, amended and supplemented in Decree 05/2025/ND-CP.	ESIA/ESMP, ESCP, SEP, EMDP, RP, and LMP meet the ESSs 1, 2, 3, 4, 5, 6, 8 and 10; EIA meets the requirements of Vietnam.
Scope and clearance	- The Borrower conducts an ESIA for the project. The level of assessment depends on the level of environmental and social risks of the Project. - If the Borrower and the WB propose to apply part or all of the country's Socioeconomic development plant	Usually, after consulting with the local DAE or MAE, if the project is listed to require an EIA report, the project owner will prepare the EIA report.	Preparation of ESIA/ESMP, ESCP, SEP, EMDP, RP, LMP and Gender Plan for the Project will be in accordance with the ESSs. These

ESA Stage	WB (stipulating in the ESF and ESSs)	Viet Nam (stipulating in Decree 08/2022/ND-CP, amended and supplemented in Decree 05/2025/ND-CP; Circular 02/2022/TT-BTNMT, amended and supplemented in Circular 07/2025/TT-BTNMT)	Gap filling measures for this project
	(SEDP), the WB will evaluate that legal framework to ensure the Project meets the objectives under ESSs (paragraph 20, ESS1) - The Borrower manages environmental and social impacts and risks throughout the entire project cycle, from preparation to construction and operation. - WB reviews the E&S documents before evaluating the project. - Mitigation measures are considered in the steps of project location, design, construction, and operation. Contractor and worker management requirements. - There are E&S assessments required for main suppliers.	- Submit preliminary EA with PFS and EIA report with FS report. - There are regulations on labor management and construction management in several relevant legal documents but there is no strict regulation on the management of environmental and social requirements in the bidding documents like the WB. - There are legal regulations on the management of mines and borrow pits. Functional agencies will monitor and inspect environmental compliance (DAE) and labor (Department of Labor, Invalids and Social Affairs, now the Department of Home Affairs).	documents will be submitted to the WB prior to project appraisal. - Preparation of EIA and submission to PPC or MAE with the FS. - Requirements for measures to minimize the environmental impacts are included in the bidding documents and supervised throughout the project implementation.
Public consultation, stakeholder engagement, and grievance redress mechanism (GRM)	- The Borrower shall consult the stakeholders of the project and the ones who are interested in the project. - The Borrower shall prepare a SEP, including defining stakeholders, consultation, information disclosure, establishment, and operations of a GRM. - ESS2 also requires the preparation of the labor management procedures (LMP) and the establishment and operation of a GRM for project workers. - If the ethnic minority is present and is adversely affected, free, prior, and informed consent (FPIC) is required. - Consultation with affected people including vulnerable people throughout project implementation. - For informed consent, the Borrower provides relevant project documents promptly before consultation in a	Pursuant to Article 33 of Law 72/2020/QH14 (stipulated in Article 26 of Decree 08/2022/ND-CP regulating consultation in environmental assessment, amended and supplemented in Clause 8, Article 1 of Decree No. 05/2025/ND-CP) as follows: When assessing environmental impact, the project owner must consult the following two groups of subjects: a) Residential communities and individuals directly affected by the project's environmental impact, specifically: - Residential communities and individuals living, producing and doing business in land, water surface, water surface land and sea areas appropriated for project investment. - Residential communities and individuals within the direct impact of wastewater, exhaust gas, dust, noise, solid waste, and hazardous waste caused by the project.	Consultation in accordance with the ESS10. Consultation results shall be included in ESIA/ESMP, ESCP, SEP, EMDP, RP, LMP and Gender Plan.

ESA Stage	WB (stipulating in the ESF and ESSs)	Viet Nam (stipulating in Decree 08/2022/NĐ-CP, amended and supplemented in Decree 05/2025/ND-CP; Circular 02/2022/TT-BTNMT, amended and supplemented in Circular 07/2025/TT-BTNMT)	Gap filling measures for this project
	form and language that are understandable and accessible to the group being consulted. - Minutes of the public meetings are included in the reports.	- Residential communities and individuals affected by subsidence, landslides, riverbank and coastal sedimentation caused by the project. - Other affected communities and individuals, identified through the environmental impact assessment process. b) Agencies and organizations directly related to the investment project include: - People's Committee at commune/ward level, Vietnam Fatherland Front Committee at commune/ward level where the project is implemented. - Management board, investor in construction and business of infrastructure of production, business, concentrated service zones, industrial clusters where the project is located within the management boundary. - State agencies managing irrigation works for projects that discharge wastewater into irrigation works or occupy irrigation works. - State management agencies assigned to manage areas with environmentally sensitive factors (if any). - Ministry of National Defense, Ministry of Public Security or Provincial Military Command, Provincial Police for projects related to security and defense factors (if any). The project owner sends the EIA report to the People's Committee of the commune/ward level of the relevant unit (as if above) along with a written request for comments. Within 15 working days from the date of receiving the EIA. Within 15 working days from the date of receipt of the EIA,	

ESA Stage	WB (stipulating in the ESF and ESSs)	Viet Nam (stipulating in Decree 08/2022/NĐ-CP, amended and supplemented in Decree 05/2025/ND-CP; Circular 02/2022/TT-BTNMT, amended and supplemented in Circular 07/2025/TT-BTNMT)	Gap filling measures for this project
		the W/CPCs send their responses if they do not approve the project.	
Disclosure	- WB requires to disclose E&S documents to the local authority before project appraisal. - The WB will make the E&S documents of substantial, high-risk, and moderate-risk projects available to the public before project appraisal.	After the EIA report is approved, the project owner proceeds with the necessary procedures to make the EIA publicly available at the W/CPC's office in the project area, in which consultation of the community is made for people's information, examination, and oversight (Article 26, Decree No. 08/2022/ND-CP, amended and supplemented in Clause 8, Article 1 of Decree No. 05/2025/ND-CP).	ESIA/ESMP, ESCP, SEP, EMDP, RP, LMP and Gender Plan will be publicly disclosed as per requirements on the ESS 10 and EIA by the GoV.
Independent Expert	For high-risk and complex projects, the Borrower may be required to retain independent ESA experts not affiliated with the project to carry out ESA.	The project owner shall prepare or contract an institution meeting the conditions of the current relevant Law on Enterprise.	The risk of the project is moderate. The project will not require independent experts.
Clearance procedure	The WB screens and categorizes the project's risks and the documents are reviewed and approved at different levels	- The MAE shall appraise and approve EIA reports for projects specified in Appendix III to these Decree, except for projects dealing with national defense and security. - PPCs appraise and approve EIA reports for projects in the province, except for projects specified above.	- The WB will review ESIA/ESMP, ESCP, SEP, EMDP, RP, LMP, and Gender Plan before project appraisal. In general, the documents will be finalized before the end of the appraisal. - MAE province will approve all E&S documents of the project.
Content of ESIA /EIA report	- According to the ESS1 - Due attention will be given address labor and working conditions as well as community health and safety	EIA report should be in line with Circular No. 02/2022/TT-BTNMT, amended and supplemented in Circular 07/2025/TT-BTNMT.	Structure of the ESIA is in harmony with requirement of the WB and GoV.

ESA Stage	WB (stipulating in the ESF and ESSs)	Viet Nam (stipulating in Decree 08/2022/NĐ-CP, amended and supplemented in Decree 05/2025/ND-CP; Circular 02/2022/TT-BTNMT, amended and supplemented in Circular 07/2025/TT-BTNMT)	Gap filling measures for this project
ESIA/EIA supervision	During project implementation, the WB supervises the implementation of environmental and social commitments in accordance with the approved documents.	- The DAE is entrusted to supervise the environmental compliance of the subproject. - In the event of a safety or environmental incident, management agencies usually establish an inspection team (typically with all relevant parties involved) to assess, conclude, and require corrective actions to resolve the issue.	Follow the ESCP and the approved ESIA/ESMP, RP, Gender Plan, SEP, EMDP, and LMP; EIA of the project.

1.3. ESIA PREPARATION METHOD

In the process of preparing the ESIA report, the consultant uses a combination of the following research methods:

Listing method: widely applied to identify research areas, sampling sites, identify areas of impact/impact, sensitive areas that may be affected by project activities in the previous stage, during construction and when put into operation. At the same time, the method is also used to list information about the natural, environmental, and social conditions as well as listing the environmental impacts this generates.

Rapid assessment method: Method of using emission coefficients that have been researched, announced and applied to calculate emissions and dust emissions (TSP); forecasting noise and vibration pollution in areas where construction activities are carried out etc.... From there, the possibility of environmental impacts by polluting sources is forecasted. The rapid assessment method is used as a basis for rapid assessment of pollutant loads and assessment of impacts by project activities.

Environmental modeling method: The construction area of the project items is located in coastal areas, due to the impact of the tide, so the running of the model to forecast the level of rise and fall due to the tide has been calculated and forecasted. MIKE21 model combined with flow modules (MIKE21HD FM); The spectrum module (MIKE21 SW FM) and the sand transport module (MIKE21 ST FM) are used by the capability and reliability level that has been widely recognized nationally and internationally. The results of the model will be the basis for assessing the impact on the level of tidal control as well as the impacts on the marine current ecosystem in the pre- and post-construction periods. In addition, the report also uses models to forecast the spread of dust pollution and emissions during construction according to different construction items. Details of this section are assessed in the environmental impact assessment chapter of the report

Expert method: This method is implemented with the knowledge and experience of experts, related to the survey of the project implementation area, including: location, socio-economic development, people's lives, cultural and religious assets; natural environment (existing status of basic air quality conditions, water and soil); regional and local climatic characteristics such as hydrometeorology, geology, geography, linkage structures and landscapes; and ecology (animal and plant characteristics); ... In addition, in the process of implementing the ESIA report, the report also uses experienced experts to interview experts who are knowledgeable about the region, experts in local management.

Comparative Methods: The results of the natural environment survey and laboratory analysis are compared with the national technical regulations on physical environmental components to assess the basic conditions of the environment in the project area.

GIS mapping method: Using GIS, in coordination with existing maps (such as topographic maps) and special software (such as MapInfo, AutoCAD) to create comprehensive maps for the ESIA process, including: maps of sampling sites for flora surveys; maps of sampling sites for air quality and surface water quality.

Field surveys and surveys: Based on existing environmental data and maps (topographic maps, existing land use maps of districts/cities in the project area, etc.), the implementation of on-site measurements, sampling, surveys, and field surveys on natural environmental components (air, water, soil and flora and fauna) in the project area conducted throughout the year in the dry and rainy seasons.

Environmental monitoring and analysis methods: In order to assess the current state of environmental quality in the region, the project has carried out activities to monitor, sample and analyze environmental parameters (soil, water, air and sediment environment in the subproject construction area). The methods of monitoring and sampling at the site are then brought back to the laboratory for analysis according to Vietnamese standards. All monitoring and analysis equipment is calibrated to ensure high accuracy and in accordance with regulations.

Public consultation: Public consultation is used to help identify opportunities and risks, improve sub-project design and execution, and increase sub-project ownership and sustainability. Public consultation is specifically required by the World Bank's environmental and social policies. A meaningful public opinion will be used. It is a two-way process in which beneficiaries provide advice and input on the design of the proposed sub-project that affects their lives and the environment, fostering dialogue between governments, communities and implementing agencies to discuss all aspects of the proposed sub-project. Feedback from stakeholders during the consultation process is synthesized and integrated into the subproject design and serves as the basis for the Environmental and Social Impact Assessment (ESIA). Those affected by the sub-project include those who are living and working directly or indirectly at the project area. In particular, stakeholder involvement has been carried out during the ES assessment process to meet the requirements of ESS10.

Disclosure: Disclosure of information on the project as well as environmental and social issues stated in this ESIA report will be widely disseminated to the locality where the project is implemented, the management agency (Ministry of Environment and Agriculture) and the World Bank. This disclosure is required under the World Bank's Environmental and Social Framework (ESF). All E&S documents will be made publicly available in both the local language and English, in-country and through the World Bank's external disclosure platform.

Data processing and statistics: All data and documents collected during the implementation of project preparation, preparation of EIA reports, ESIA are statistically processed. Statistical data are systematized over time and content to serve the determination of the existing status and developments of natural, environmental and socio-economic conditions.

I.4. LIST OF ESIA PREPARATION EXPERTS

List of experts involving in preparation of this ESIA is presented in the following table.

Table 0.4. ESIA preparation expert list

No.	Full name	Qualification	Responsible for	Signature
I. Project owner's representative				
1.	Ton That Son Phong	Deputy Head of the PMU		
II. Consulting team's members				
2.	Ngo Huy Toan	Master of Environmental Science	Leading the team for the preparation of ESIA Providing general management of report preparation, existing status survey and assessment of environmental impacts, proposals	

No.	Full name	Qualification	Responsible for	Signature
			for mitigation measures, consolidation of ESIA contents	
3.	Doan Manh Hung	Master of Environmental Science	Major environmental expert – Participating in management of report preparation, existing status survey and assessment of environmental impacts, proposals for mitigation measures, consolidation of ESIA contents.	
4.	Le Quang Hai	Master of Environmental Hydrology	Hydrological expert – Participating in surveys on hydrological conditions and assess hydrological impacts; Participating in preparation of Chapters 2 and 3	
5.	Pham Anh Tuyet	Master of Environmental Science	Public consultation expert - Participating in public consultation and impact assessment due to land acquisition and site clearance; Participate in writing Chapters 3 and 5.	
6.	Nguyen Thi Thuy	Master of Environmental Science	Supporting staff	
7.	Nguyen Van Bang	Bachelor of Economics	Supporting staff	
8.	Truong The Anh	Master of Natural Resources and Environment management	Supporting staff	

CHAPTER 1. PROJECT DESCRIPTION

1.1 Project Information

- ✓ **Project's name:** *Sustainable Fishery Development Project at MARD (funded by WB).*
- ✓ **Executive agency:** *Ministry of Agriculture and Rural Development*
 - + Address: No. 2, Ngoc Ha, Ba Dinh, Hanoi.
 - + Phone No.: (024) 3734.1635.
- ✓ **Project owner:** *Agriculture Project Management Board (APMB)*
 - + Address: 9th floor, intercom building 2, 16 Thuy Khue, Tay Ho district, Hanoi.
 - + Phone No.: 04.37286163

1.2 Project's Objectives and Components

Project's general objectives: To strengthen management of the fisheries industry and increase product value through upgrading "smart" infrastructure.

Project's specific objectives: (i) Investing in infrastructure to serve exploitation of aquatic product, including building and upgrading dynamic fishing ports in national major fishery centers and grade I fishing port; modern and complete storm shelter for regional fishing vessels, creating motivation to support exploitation of aquatic product, especially offshore exploitation, improving the efficiency of exploitation of aquatic product and reducing downstream losses; (ii) Build infrastructure and equipment for the fisheries inspection industry to serve the sustainable and effective exploitation and protection of seafood resources; (iii) Upgrading and completing essential infrastructure and equipment to serve the selection of broodstock shrimp breeds and the production of marine breeds (marine fish, oysters, seaweed...) to proactively produce domestically with high quality, disease-free; (iv) Strengthen management capacity of production organizations to combat illegal, unreported and unregulated (IUU) fishing, and sustainably manage aquatic resources; (v) Reduce losses after exploitation of aquatic product, reduce pandemics, improve productivity, quality, value of farmed shrimp products, protect the environment and adapt to climate change; (vi) Improve management capacity of the fisheries sector.

Project's Components:

Component 1: Structural investment (06 subprojects) serving sustainable fisheries development: (i) building 02 new dynamic fishing ports in major fishery centers in Khanh Hoa and Kien Giang; (ii) upgrading and repairing 04 grade I fishing ports and/or storm shelter: Storm shelter on Bach Long Vi island - Hai Phong city; Lach Hoi fishing port, Thanh Hoa province; Lach Bang fishing port, Thanh Hoa province; Regional storm shelter anchorage area in Tam Quan region - Binh Dinh province.

For this section, described it as: (i) Subproject on Upgrading and Expanding Lach Hoi Fishing Port, Thanh Hoa province; (ii) Subproject on Upgrading and Expanding Lach Bang Fishing Port, Thanh Hoa province; (iii) Subproject on Construction of Tam Quan Storm Shelter, Binh Dinh province; (iv) Subproject on Construction of Khanh Hoa Major Fishery Center, Khanh Hoa province; (v) Subproject on Construction of Kien Giang Major Fishery Center, Kien Giang province and (vi) Subproject on Construction and Upgrading of Bach Long Storm Shelter, Hai Phong city.

Component 2: Non-structural investments: (i) Improving seafood exploitation management capacity against illegal, unreported and unregulated fishing (IUU); (ii) application of advanced

technology in the production of marine and shrimp breeds; (iii) application of advanced technology in commercial shrimp farming; (iv) Upgrade and complete the national database system on fisheries; (v) Support the management and reduction of plastic waste in exploitation and aquaculture.

Component 3: Project management.

1.3 Project locations

The SFDP project managed by MARD including 6 subprojects will be implemented in 5 provinces/cities namely: Hai Phong, Thanh Hoa, Binh Dinh (currently merged to Gia Lai), Khanh Hoa and Kien Giang (currently merged to and is under An Giang Province)⁷

No.	Subproject name	Subproject location
I	Construction, upgrading the grade I Fishing ports	
1	Upgrading and Expanding Lach Hoi Fishing Port	Quang Tien Ward, Sam Son city, Thanh Hoa province
2	Upgrading and Expanding Lach Bang Fishing Port	Hai Thanh ward and Hai Binh ward, Tinh Gia district (now renamed Nghi Son town), Thanh Hoa province
II	Construction, upgrading the Major Fishery centers	
3	Construction of dynamic fishing port for Khanh Hoa Major Fishery Center	Cam Linh ward, Cam Ranh city, Khanh Hoa province
4	Construction of dynamic fishing port for Kien Giang Major Fishery Center	Tay Yen A commune, An Bien district, Kien Giang province
III	Construction the Regional Storm Shelters	
5	Construction of Tam Quan Storm Shelter	Tam Quan Bac Ward, Hoai Nhon town, Binh Dinh province
6	Upgrading Bach Long Vi Storm Shelter	Bach Long Vi island, Bach Long Vi district, Hai Phong city

Locations of subprojects are presented in the following Figure:

⁷ The provinces covered under MAE's managed component include Hai Phong (retaining its name after merging with Hai Duong), Thanh Hoa, Gia Lai (newly named after merging with Binh Dinh), Khanh Hoa (maintaining its name after merging with Ninh Thuan), and An Giang (newly named after merging with Kien Giang). As the Feasibility Studies and the Environmental Impact Assessment were approved by MARD and MONRE prior to the merger date (01 July 2025), the original names of the provinces are used in this ESIA to ensure consistency with the approved documents.

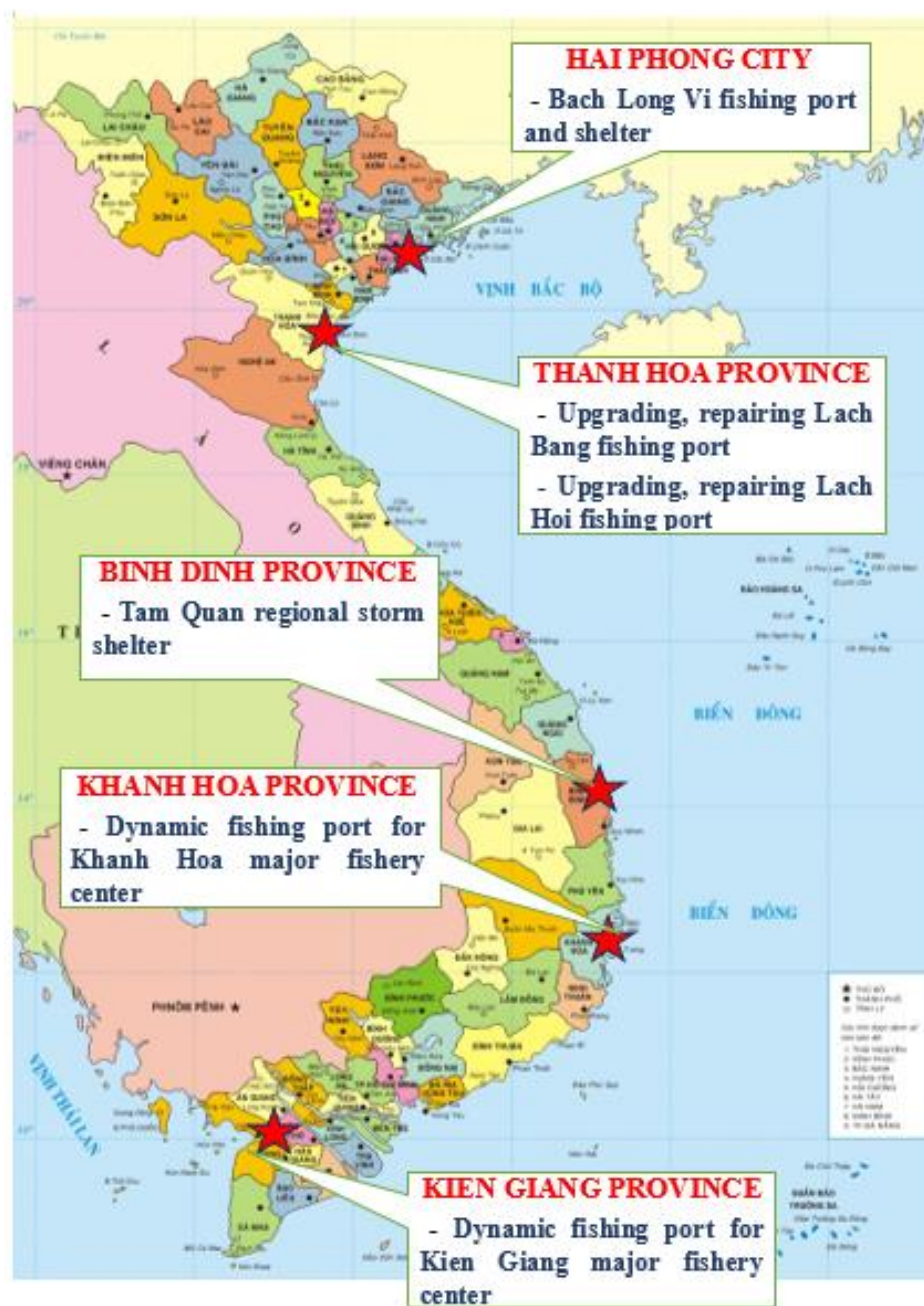


Figure 1.1. Location of Subprojects on the Map

The location of each subproject is as described below:

1. Lach Hoi Fishing port upgrading and expansion subproject

Boundary: Lach Hoi fishing port bordering the Ma River in the north; the residential area of Quang Tien Ward in the south, east, and west.

Current land use status: The upgrade area is within Lach Hoi Fishing Port. The existing port, covering 3.61 ha, will be upgraded and expanded to a total area of 7.65 ha.

Existing infrastructure: The site is accessible via a 9-meter-wide asphalt concrete road and Tran Hung Dao Road, which is 16 meters wide and connects to Lach Hoi Fishing Port. The port area has an electricity supply, water supply, and a drainage system discharging into the Ma River.

Distance to the nearest residential area: The densely populated residential area of Quang Tien Ward is located 80-100 m from the project site. Within the upgrade area, there are scattered

mangrove trees (su and vet) growing on the port development land, which is not classified as protective forest land.

Project construction area: The existing Lach Hoi Fishing Port (3.61 ha) will be upgraded and expanded to a total area of 7.65 ha. The expansion area of 4.04 ha includes: 2.18 ha of public land, currently used as transportation land in front of the port, 0.33 ha of production and business land (kiosks) owned by several households, 1.52 ha of Ma River water surface.

Number of households affected by land acquisition: 11 single-floor level-4 kiosks, where households rent kiosks from the fishing port and land from the communal People's Committee.

Sensitive receptors: 20 m from memorial stele for southern compatriots migrating north, 20m from Thanh Binh Trading JSC seafood processing plant, 150 m from Southern compatriots memorial site, Quang Tien Secondary School and Quang Tien Kindergarten, located 20-50 m from Tran Hung Dao Road (the main transportation route).



Figure 1.2. Lach Hoi fishing port and storm shelter

2. Lach Bang Fishing port upgrading and expansion subproject

Boundary:

+ Lach Bang Fishing Port area (Hai Binh Ward) is located: to the north, it borders Lach Bang River; to the south, it borders the residential area of Hai Binh Ward; to the east, it borders the port entrance channel; to the west, it borders the road leading to Lach Bang 2 Bridge.

+ Lach Bang Fishing Port area (Hai Thanh Ward) is located: to the north, it borders Lach Bang River and the residential area of Hai Thanh Ward; to the south and east, it borders the residential area of Hai Thanh Ward; to the west, it borders the port entrance channel.

Current land use status: The area for upgrading is within the existing Lach Bang Fishing Port. The port will be renovated and upgraded, which will temporarily affect the activities of fishermen during the construction process.

Existing infrastructure: Access road to Lach Bang Fishing Port (Hai Binh Ward): a 6-meter-wide concrete anti-salinity dike, and a 23-meter-wide asphalt road running along the west side of the port.

Access road to Lach Bang Fishing Port (Hai Thanh Ward): a 9-meter-wide asphalt road. The fishing port has electricity supply, water supply, and a drainage system discharging into the Lach Bang River.

Distance to the nearest residential area: The densely populated residential areas of Hai Thanh and Hai Binh Wards are located 20-50 meters from the project site.

Distance to the nearest aquaculture area: Shrimp, fish, and oyster cages on the Lach Bang River are located 2400-500 meters away, toward Lach Bang Bridge.

Project construction area: The construction will take place within the existing Lach Bang Fishing Port, which consists of two sections:

- + The port at the side of Hai Thanh Ward covering 2.75 ha, will be upgraded on the existing wharf platform and extended by 0.53 ha. The extension area includes: 0.28 ha of transportation land, 0.06 ha of non-agricultural business land, and 0.19 ha of water surface in Lach Bang River.
- + The section at the side of Hai Binh Ward covering 8.7 ha, will be upgraded on the existing wharf platform and extended by a total of 2.09 ha. The extension area of 2.09 ha includes: 2 ha of non-agricultural business land, 0.04 ha of water surface in Lach Bang River, and 0.05 ha of unused land.

Number of households affected by land acquisition: 15 households affected by non-agricultural business land acquisition.

Sensitive receptors:

- + Hai Thanh Ward: Du Xuyen ferry terminal, 100 meters away; Hai Thanh Ward gas station, 80 meters away; fish processing factory, 50 meters away.
- + Hai Binh Ward: gas station, 20 meters away; Long Hai Seafood Processing and Transportation Trading Co., Ltd., 150 meters away



Figure 1.3. Lach Bang fishing port

3. Tam Quan regional storm shelter

Location: Tam Quan Bac Ward, Hoai Nhon Town, Binh Dinh Province. To the north and west, it borders the residential area of Tam Quan Bắc Ward; to the south, it borders an aquaculture pond; to the east, it borders the Thien Chanh residential area.

Current land use status: The area of the sub-project is primarily located on the Tam Quan River.

Existing infrastructure: The area has several concrete roads providing access to Tam Quan fishing port. The waterway along the Tam Quan River has a relatively high traffic density. The port area is also equipped with electricity supply, water supply, and a drainage system discharging into the Tam Quan River.



Figure 1.4. Tam Quan storm shelter and fishing port

4. Subproject on upgrading of Khanh Hoa Major fishery center

Location: Cam Linh Ward, Cam Ranh City, Khanh Hòa Province. To the north and east, it borders the aquaculture ponds of households in Cam Linh Ward; to the south, it borders the industrial workshops of Da Bac Port; to the west, it borders Cam Ranh Bay.

Current land use status: The construction area is located within the existing Da Bac Fishing Port. The area currently houses over 30 households engaged in marine farming (mainly breeding lobster and fish). However, the farming activities are spontaneous and not located in the designated aquaculture zone for the project. When the project is implemented, it will be necessary to develop a support plan to help these households transition to other occupations, as they have invested in aquaculture before the project's investment plan was approved.

Existing infrastructure: There is a 6-meter-wide asphalt road (3/4) and an 8-meter-wide Nguyen Trai Road providing access to Da Bac Fishing Port. The port area also has a system of electricity supply, water supply, and a drainage system discharging into Cam Ranh Bay.



Figure 1.5. Khanh Hoa major fishery center

5. Subproject on Kien Giang Major fishery center construction investment Subproject

Boundary: To the north, it borders the Cai Lon River and Canal 40; to the south and west, it borders agricultural land in Tây Yên A Commune; to the east, it borders the Cai Lớn River.

Current land use status: The project will occupy part of the Cai Lon River's surface, with the remaining area being built on residential and agricultural land of households in Tây Yên A Commune, An Bien District, Kien Giang Province.

Existing infrastructure: There is an asphalt road (about 3 meters wide) providing access, along with a system of electricity, water supply, and drainage discharging into the Cai Lon River and Canal 40.

Distance from the nearest residential area: The residential area in Tây Yên Commune is within the project area (143 households), with an average population density.

Construction area: A new construction will take place, with a total land area to be acquired of 15.78 ha, including: primarily rice-growing land (6.29 ha), land for perennial crops such as coconuts and fruit trees (5.52 ha), rural residential land (1.68 ha), non-agricultural production and business land (0.14 ha), and public land (2.15 ha).

Number of households affected by land acquisition: 102 households, including 68 households losing residential land and requiring relocation, 1 household losing agricultural land, 1 household losing non-agricultural production land, and 26 households affected by non-agricultural production and business. Additionally, the project impacts 41 level IV houses, approximately 2.5 km of asphalt road, 1.5 km of water supply pipeline, and 60 graves.

Sensitive receptors: Ba Nga Bat temple is located 100 meters away, and Ong Bon temple is located 180 meters away.



Figure 1.6. Kien Giang major fishery center

6. Upgrading Bach Long Vi storm shelter subproject

Subproject on upgrading of Bach Long Vi storm shelter will be implemented in the southern area of Bach Long Vi island district, Hai Phong city.

The subproject is bordered to the north by the residential area of Bach Long Vi island, to the south by the ship channel to the island, to the east by vacant land and the Gulf of Tonkin, and to the west by Bach Long beach and the Gulf of Tonkin.



Figure 1.7. Location map of Bach Long Vi storm shelter subproject

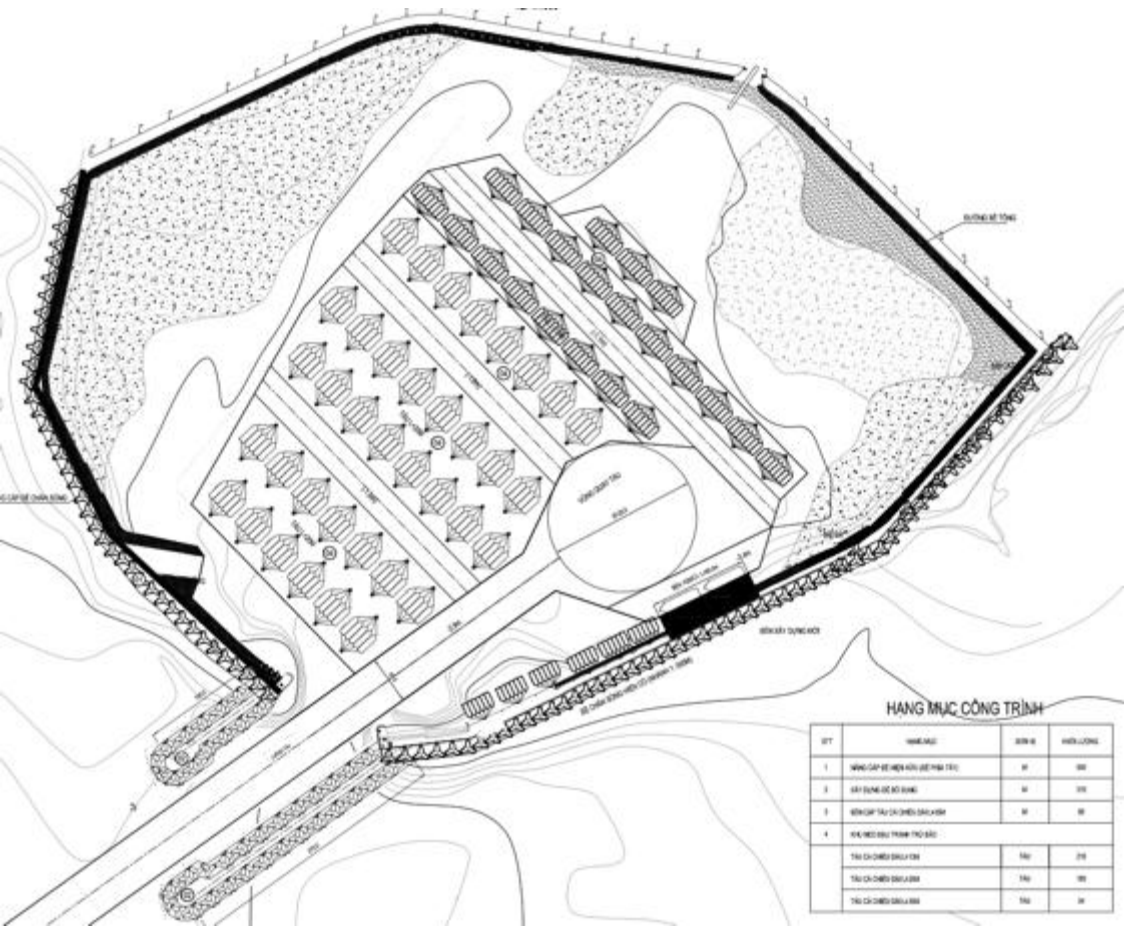


Figure 1.8. Bach Long Vi subproject layout

In addition, the subproject also uses 3 areas as gathering places for dredged materials (which have been licensed by the MARD to dump dredging waste for the project⁸ and approved by the Hai Phong City People's Committee for the disposal site⁹), specifically:

Site 1: located in the east of the island, is an open land sandwiched between the road surrounding Bach Long Vi island and a small part of the tidal flats in the east of the island, about 200m from the dredging area, located outside the sea dike with an area of 4.0 ha. The plan is to pour 1.5m higher than the current ground level, with the volume of dredged material that can be received estimated at about 55,000 m³. This land currently has a terrain about 1.2m–1.5m lower than the natural ground on the island and is being managed by the People's Committee of Bach Long Vi district.



Figure 1.9. Location of disposal sites

Site No. 2: This is an empty land area located in the northwest of the island, outside the sea dike, next to the southern slope of the embankment in the port area, about 1,300 m from the dredging area, with an area of about 0.48 ha. The plan is to pour 2.5 m higher than the current ground level, and the volume of dredged materials it can receive is about 12,000 m³. This land currently has a terrain about 0.5 m lower than the natural ground on the island and is being managed by the People's Committee of Bach Long Vi district.

Site No. 3: located near the stadium, next to the island's domestic garbage dump, about 700 m from the dredging area, with an area of about 0.65 ha (land managed by the People's Committee of Bach Long Vi island district). The dumping area is planned to be 1.5 m higher than the current ground level, with the volume of dredged materials it can receive being about 9,000 m³.

Thus, with the 03 planned storage sites, the total amount of dredged materials that can be received is 86,000 m³.

⁸ Document No. 8049/BNN-HTQT dated 25/10/2024 on the licensing of dredging disposal sites for the subproject of upgrading and repairing fishing ports in combination with anchorage for storm shelter for fishing vessels on Bach Long Vi island.

⁹ Document No. 2397/UBND-MT dated 30/10/2024 of Hai Phong City on approving the location of the disposal site for dredged materials for the subproject of upgrading and repairing fishing ports combined with storm shelter anchorages for fishing vessels on Bach Long Vi island.

* Existing status of land use and regional infrastructure

The construction area of the subproject work items is planned with a total area of 34.52 ha, of which 29.48 ha are for the construction of subproject works (land managed and used by the Bach Long Vi Port and Mooring Area Management Board) and 5.13 ha for 3 disposal sites (managed by the People's Committee of Bach Long Vi district).

The land area planned for the construction of subproject work items is currently non-agricultural land (of which the special-use land used for public purposes is 0.42 ha, the rest is water surface land exclusively used as ports, entrances, exits, anchorages, and storm shelters for ships, etc. Around this area are breakwaters and fairways for boats).

Existing infrastructure conditions: Around the port, there is currently a concrete road (about 2.5m-3.5 m wide) surrounded by embankments, with a breakwater inside and outside.

On the island, there is currently a clean water supply project to meet the living needs of people on the island. Electricity is supplied from the power supply stations of Bach Long Vi district by solar power and diesel generators with a capacity of 5MW, which is enough for production and daily activities of people on the island.

There is also a full drainage system for rainwater and domestic wastewater in the existing subproject area. Rainwater is designed to drain directly into the sea, and domestic wastewater, after passing through the system of septic tanks of the Port Management Board, will be discharged into the general drainage system of the area and poured into the sea.

Bach Long Vi district has built a concentrated landfill in the central area of the district, where all waste generated from the port area and households on the island is now collected and brought to this landfill for disposal.

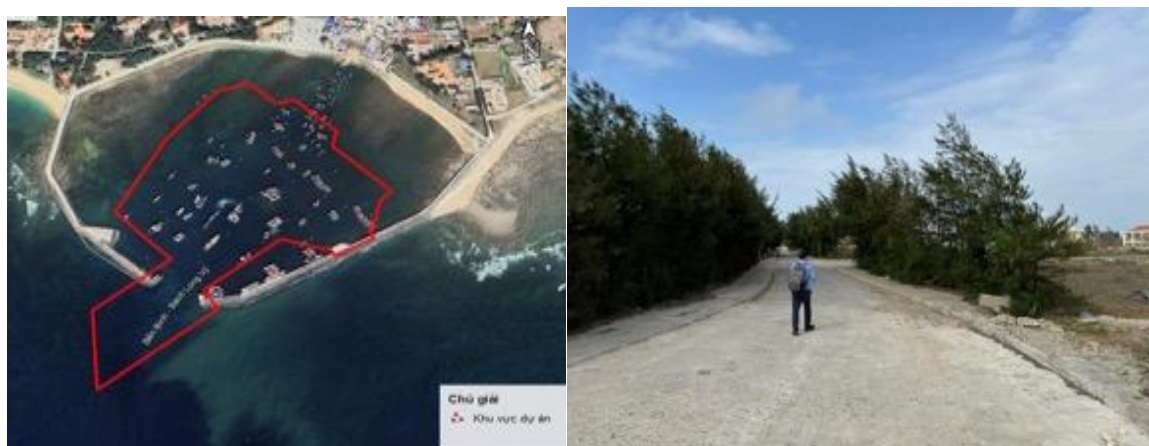


Figure 1.10. Fishing port and storm shelter anchorage for Bach Long Vi fishing boats and concrete roads surrounding the island.

1.4 Scope of Works under the Project

1.4.1. Scope of Works under the project

The scope of investment in construction and upgrade of the facilities for the 6 sub-projects is summarized in the table below.

Table 1.1. Scope of investment under the six subprojects

No	Name of subproject	Scope of investment
1	Lach Hoi fishing port – Thanh Hoa province - Upgrade and expand Lach Hoi Fishing Port from type II with an area of 4.5 ha to type I with an area of 7.65 ha. The fishing port's capacity will accommodate 120 vessel visits per day, with the largest vessel capable of docking being 800CV.	
1.1	Port area	Upgrade and construct the following port facilities: - Upgrade the area for mooring fishing vessels >150CV: The length is 180m (keeping 75m of the existing dock and constructing 105m of new dock), width 10m, dock elevation +3.1m, and bottom elevation -4.8m. - Construct a new area for mooring fishing vessels <150CV: The length is 189m, width 10m, dock elevation +3.1m, and bottom elevation -3.6m. - Build a new storage area on pile foundation: The area is 6,517m², with a protective embankment behind the storage area extending 408m. - Design the navigation channel with a width of 42 m, a turning radius of 250m, and a turning basin diameter of D=120m.
1.2	Logistic facilities	- Upgrade and construct reception and classification buildings: 03 single-floor buildings, with a total area of 2,829 m². - Construct a new waste collection building with an area of 76m². - Build 08 new operational bridges. - Install a shelter over the docking area with an area of 3,023m², 10m wide along the length of the dock.
1.3	Technical infrastructure	- Upgrade the internal traffic road behind the pile foundation area, covering an area of 5,658m². - Upgrade Tran Hung Dao street, approximately 417m in length and 14m in width, with a total upgraded road area of 5,850m². - Construct a new WWTP with a capacity of 300m³/day, using biological treatment technology. The treated wastewater will meet the requirements of column B, QCVN 11-MT:2015/BTNMT – wastewater from seafood processing before being discharged into the Ma River. - Build the technical infrastructure to serve the project, including electricity supply, drainage, and water supply systems.
2	Lach Bang fishing port – Thanh Hoa province The project will invest in upgrading the Grade III maritime works on the area of Hai Thanh fishing port with 40.6 ha, and the existing Hai Binh fishing port with 2.75 ha. Fishing port scale: It will accommodate 150 vessel arrivals per day, with the largest vessel capable of docking being 40m in length; the port will handle 45,000 tons of seafood annually	
2.1	Facilities for Hai Binh port	Upgrading and constructing port facilities include: - Arranging the roof for the wharf: with an area of 4,020m², the average width is 9.5m along the wharf length. - Upgrading the sorting house with an area of 1,672m²: the existing sorting house is about 950m², and the renovation will add an additional 722m².

No	Name of subproject	Scope of investment
		- Constructing a solid waste collection house: with an area of 76m². - Upgrading the internal traffic road to the Hai Binh area. - Building a WWTP with a capacity of 300m³/day, applying biological treatment technology. The treated wastewater quality will meet Column B requirements of QCVN 11-MT:2015/BTNMT – seafood processing wastewater before being discharged into the Lach Bang river.
2.2	Facilities for Hai Thanh port	Upgrading Hai Thanh Port: - Rehabilitating the existing wharf for ship docking in Hai Thanh Ward, which has deteriorated, and extending it to the north (utilizing the area for port yard space). - Constructing a new wharf following the current wharf line, extending towards the front. The new wharf will be 180m long, with a width of 10m (the same as the existing wharf), wharf top elevation of +2.25m, and wharf bottom elevation of -4.5m. - Installing a roof on the wharf with an area of 1,407m², with an average width of 9.5m along the wharf length. - Upgrading the internal traffic road in Hai Thanh over an area of 2,513m², including: + Demolishing the old damaged concrete road surface in the port area, repaving with a new cement concrete layer to restore the surface. + For the extended yard area: constructing a new surface using cement concrete on a sand foundation. - Constructing a 3-floor operation building with an area of 565m². - Constructing public restrooms with an area of 60m². - Building technical infrastructure systems: power supply, lighting, drainage, water supply, etc.
3	Tam Quan Regional Storm Shelter and Anchorage Area in Tam Quan, Hoai Nhon District, Binh Dinh Province will be newly constructed on an area of approximately 115 ha in Tam Quan Commune. Scope: The project involves repairing and upgrading the existing storm shelter and anchorage area in Tam Quan to a regional-level storm shelter, accommodating 1,200 vessels of up to 400CV, in conjunction with the Tam Quan fishing port.	
3.1	Facilities for the storm shelter	The construction works include: - Dredging of the storm shelter covering 32.5 ha, with an expected dredging volume of 523,224 m³. - Construction of new coastal protection dikes (5 sections) with a total length of 2,494 meters. - Installation of a communication system and signaling buoys. - Construction of a two-floor healthcare facility with accommodation, covering an area of 260 m².
4	Dynamic fishing port for Khanh Hoa major fishery center – Khanh Hoa province The subproject will invest in the construction of a Grade III maritime structure at the existing Da Bac fishing port, which has an area of 9.66 ha, and will expand the total area to 15.5 ha (6.5 ha of land and 9.2 ha of water).	

No	Name of subproject	Scope of investment
		The scale of the project will accommodate 250 visits per day with vessels capable of docking at the port with a maximum length of 40 meters. The seafood throughput at the port is expected to reach 100,000 tons per year. The storm shelter area will be designed to accommodate 2,000 fishing vessels (up to 1,000 horsepower)
4.1	Port area	Upgrade and construction of port facilities, including: - Construction of a new jetty with a length of 122m, width of 29m, wharf deck elevation at +2.0m, and wharf bottom elevation at -4.5m. - Upgrade of the existing wharf with a length of 200m, width ranging from 9.5m to 29m, wharf deck elevation at +2.0m, and wharf bottom elevation ranging from -3.7m to -5.7m. - Construction of a new logistics service wharf with a length of 60m, width of 4.0m, wharf deck elevation at +2.0m, and wharf bottom elevation at -2.9m. - Construction of a new community wharf with a length of 60m, width of 5m, wharf deck elevation at +2.0m, and wharf bottom elevation at -2.9m. - Construction of a 140m-long shore protection embankment. - Upgrade of the access bridge with a length of 24.5m. - Dredging of the water area in front of the wharfs: the water area width ranges from 15m to 30m, and the dredged bottom elevation ranges from -2.9m to -5.7m. The estimated dredging volume is 69,332.5m³. - Arrangement of the shipping channel with a width of 60m (main channel) and 32m (branch channel for the community wharf); the curve radius of the channel is 400m. The turning radius for the jetty is D=90m, the upgraded existing wharf is D=120m, the service wharf is D=45m, and the community wharf is D=72m.
4.2	Logistic facilities	- Construction of a new 2-floor office building with a floor area of 1,600 m². - Construction of a new 1-floor seafood reception and sorting building with a floor area of 4,500 m². - Construction of a new solid waste collection station with a total area of 96 m². - Construction of public restrooms: Building public restrooms with an area of 87 m². - Dock canopy: Installation of a canopy on the dock with a total area of 2,481 m².
4.3	Technical infrastructure	- Upgrade of internal traffic roads and yard roads within the port, covering an area of 0.9 ha. - Construct a new yard for the office area with a size of 3,991 m². - Construction of a new WWTP with a capacity of 600 m³/day and night, using the Activated Sludge (AO) treatment technology. The treated wastewater quality will meet the requirements specified in Column B, QCVN 14:2008/BTNMT – National Technical Regulation on Domestic Wastewater before being discharged into Cam Ranh Bay. - Construction of technical infrastructure systems to support the

No	Name of subproject	Scope of investment
		facilities, such as power supply, drainage, and water supply systems.
5	Dynamic fishing port for Kien Giang major fishery center - Kien Giang province. The subproject will invest in the construction of a Grade III maritime structure on a total area of 31.27 ha (11.27 ha of land and 20 ha of water) at Tay Yen A Commune, An Bien District, Kien Giang Province. The scale includes: 100,000 tons of seafood throughput at the port per year; capacity: 180 visits per day, with fishing vessels having a maximum length of 40 meters	
5.1	Site leveling	- Totally earthwork is approximately 163,338 m³. The lowest fill elevation is +1.8m (NDL - National Vertical Datum). Before filling, the site will be cleared, and organic soil will be excavated with an average thickness of 30cm. - Sand will be used as the filling material and transported to the site via barges, then pumped into the reclamation area.
5.2	Port area	Construction of port facilities, including: - Construction of a new dock for vessels <24m: Length of 240m, width of 15m, wharf bottom elevation at -3.5m. - Construction of a new dock for vessels from 24-40m: Length of 120m, width of 15m, wharf deck elevation at +2.0m, wharf bottom elevation at -5.5m. - Construction of a new export-import maritime seafood dock: Length of 60m, width of 15m. - Construction of a new service wharf: Length of 120m, width of 15m. - Shore protection (dock underside protection) with a length of 540m. - Dredging of the water area in front of the wharf: The water area width in front of the wharf is 36m, with dredged bottom elevation at -5.5m. The estimated dredging volume is 5,432 m³. - Arrangement of the shipping channel with a width of 60m. The curve radius of the channel is 400m. The turning radius for the wharf is D=120m.
5.3	Logistic facilities	- Construction of a new 3-floor control building with a floor area of 1,800 m². - Construction of a new 1-floor sorting and classification building with a floor area of 4,225 m². - Construction of a new solid waste collection station with a total area of 96 m². - Construction of a new staff parking plot with an area of 120 m² and a height of 3.85m. - Construction of a new port gate, guardhouse, and perimeter fence. - Canopy on the wharf: The canopy will be installed along the length of the fishing port, with a width of 12m.
5.4	Technical infrastructure	- Construction of a new internal yard road with an area of 48,882 m². - Construction of a new general cargo yard with an area of 3,552 m².

No	Name of subproject	Scope of investment
		- Construction of a new WWTP with a capacity of 600 m³/day and night, using the Activated Sludge (AO) treatment technology. The treated wastewater quality will meet the requirements specified in Column A, QCVN 40:2011/BTNMT – National Technical Regulation on Industrial Wastewater before being discharged into the Nga Ba Canal, which flows into the Cai Lon River. - Construction of technical infrastructure systems to support the facilities, such as power supply, drainage, and water supply systems.
6	Bach Long Vi fishing port and storm shelter subproject in Hai Phong City Investing in upgrading and building new tertiary maritime works with a scale of 29.48 ha on Bach Long Vi Island District, Hai Phong City. Scale of fishing port: To become a type I fish tank, meeting the needs of 405 ships of all types for storm shelter, with the largest ship having a length of 35m; the amount of seafood passing through the port is expected to reach 10,000 tons per year. The storm shelter anchorage has a regional scale, with a capacity of 1,000 units and a length of up to 35m..	
6.1	Upgrading and constructing port works	- Upgrading and constructing port works including: - Maintaining the existing small wharf, continuing to use it with a total length of about 175m - Constructing a new wharf >15m: length 80m, width 20m, wharf top elevation +5.0m, wharf bottom elevation -3.4m - Upgrading the existing western breakwater with a total length of 500m, dimensions BxH=1.5x2m - Dredging the storm shelter anchorage area with an area of 10.2ha, dredged bottom elevation from -1.1 to -2.9m; the shipping channel and turning area with an area of 3.3m, the bottom elevation of the shipping channel is -2.9m. The total estimated dredging volume is 51,550 m³
6.2	Technical infrastructure	- Upgrade the anchor system, storm shelter buoys (116 sets). - Install 2.4m diameter buoys, 9m long D44mm chain, 53T at the anchorage area <15m - Install 2.4m diameter buoys, 10m long D44mm chain, 53T at the anchorage area >20m

Detailed investment scale of each subproject as follows.

1.4.1.1. Lach Hoi Fishing port upgrading and expansion subproject

The subproject for upgrading and repairing Lach Hoi fishing port includes the following groups of works: (i) construction of the fishing port; (ii) construction of fishery logistics facilities and administrative-service area; (iii) construction of technical infrastructure works. The overall layout of the construction components of the Lach Hoi Fishing port upgrading and expansion subproject is shown in the image below.



Figure 1.11. General layout of Lach Hoi fishing port

The scale of the construction works for the Lach Hoi Fishing port upgrading and expansion subproject is summarized in the table and described in detail in the technical specifications below

No	Work item	Scale, quantity
A	Port area	
1	Upgrading and expanding the docking berth for fishing vessels over 150CV	- Upgrading the existing berth with a length of 180m (including retaining 75m up to the existing pier and constructing a new 105m pier), a width of 10m, a top elevation of +3.1m, and a bottom elevation of -4.8m. - Constructing a new berth with a length of 189m, a width of 10m, a top elevation of +3.1m, and a bottom elevation of -3.6m
2	Constructing a yard on a piled foundation	An area of 6,517 m ² , with a 408m-long revetment protecting the shore behind the yard on a piled foundation
5	Installing a roof over the pier	An area of 3,023 m ² , with a width of 9.5m along the berth length.
6	Upgrading the reception and sorting house	Three single-floor buildings with a total area of 2,829 m ² .
7	Constructing a waste collection house	An area of 76 m ² , one-floor high, with a structure of steel columns and reinforced concrete columns.
8	Constructing a service bridge.	Eight service bridges.
B	Infrastructure	
1	Upgrading internal and connecting roads	Area 5,658 m ² .

No	Work item	Scale, quantity
2	Upgrading Tran Hung Dao road surface	A length of approximately 417m, a width of 14m, with a total area of 5,850 m ² .
3	Upgrading the power supply and lighting system	Constructing a new 35(22)/0.4kV substation to supply power for the operation area, technical infrastructure, sorting house, greenery, and lighting.
4	Upgrading the water supply system	- 547m of HDPE pipes for fire protection water supply, 375m of HDPE pipes for domestic water supply, 375m of HDPE D63 pipes, 3 outdoor fire hydrants D100, a water storage system, 1 main meter manhole, and 6 outdoor fire hydrants D100 - One water storage tank with a capacity of 415 m³ for port water supply and the fire protection system of the sorting house
5	Upgrading the rainwater drainage system separately from the wastewater system	- 371m of D1200 culvert with H30-XB80 load capacity, 13 D1200 catch basins, 1 D600 connection manhole, 1 connection manhole BXH = 1000x1000, and 1 D1200 culvert outlet.
6	Constructing a separate wastewater collection and treatment system	- 350m of HDPE D315-PN12.5 culvert, 11 wastewater drainage manholes. - Construction of a new WTP with a capacity of 300 m³/day using biological treatment technology. The treated wastewater meets the requirements of Column B, QCVN 11-MT:2015/BTNMT – wastewater from seafood processing before discharge into the Ma River.

a. Port area

- ❖ **Ship channel and turning basin:** The ship channel has a width of 42m, a turning radius of 250m, and a turning basin diameter of D=120m.
- ❖ **Berthing area:** The total length of the berthing area is 369m, consisting of two sections: (i) berthing area for fishing vessels >20m and (ii) berthing area for fishing vessels <20m.
 - Upgrading the berthing area for fishing vessels >20m: Includes 22 berths with a capacity of 85 vessels/day, a length of 180m (retaining 75m up to the existing pier and constructing a new 105m pier), a width of 10m, a berth crest elevation of +3.1m, and a berth bottom elevation of -4.8m. The entire existing U-shaped pier and access bridge will be demolished due to the deterioration of the pile system and incompatibility with the new port design. The existing 300 CV berth upstream will be repurposed, with surface improvements to connect to the newly planned infrastructure.
 - Constructing a new berthing area for fishing vessels <20m: Includes 6 berths with a capacity of 15 vessels/day, a length of 189m, a width of 10m, a berth crest elevation of +3.1m, and a berth bottom elevation of -3.6m. The berth structure consists of a reinforced concrete beam-slab system on driven reinforced concrete piles (40x40cm, 22m long), including vertical and inclined piles (6:1) to resist impact and tensile forces from vessels.
 - Constructing a new yard on a piled foundation: The area from the pier to the crest of the existing revetment will be developed as a yard on a reinforced concrete pile foundation (35x35cm driven piles, 22m long). Pile spacing will range from 3.5 to 4.0m depending on the area to avoid existing removed piles. The structure includes transverse and longitudinal

beams of in-situ cast reinforced concrete M300, with a beam cross-section of $b \times h = 40 \times 80 \text{ cm}$. The deck slab is in-situ cast reinforced concrete M300, with a thickness of 25cm.

- Constructing a 408m-long revetment protecting the shore behind the yard: The revetment will use a reinforced concrete L-shaped wall on a piled foundation, combined with a rock embankment at the base to protect the revetment foot.

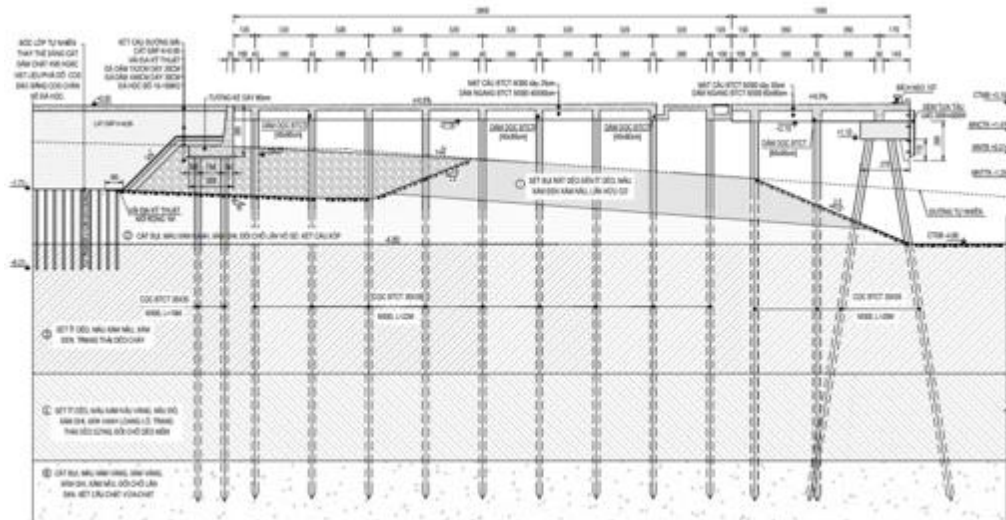


Figure 1.12. Typical cross section for design of Lach Hoi fishing port

b. Logistics facilities

- ❖ **Reception and sorting houses:** Three seafood reception and sorting houses will be constructed, with a total floor area of 2,836 m², including auxiliary facilities such as restrooms and ice storage. The structure consists of columns placed on beams over a piled foundation. The roof frame is made of hot-dip galvanized steel, covered with composite tile sheets. The floor is coated with epoxy.
- ❖ **Operation house:** The existing operation house will remain unchanged without repairs or upgrades.

c. Technical infrastructure

- ❖ **Traffic system:**
 - Upgrading Tran Hung Dao Road in front of the port and the piled yard area based on the existing road foundation, with a carriageway width of $4 \times 3.5 \text{ m} = 14.0 \text{ m}$ and a sidewalk width of 2.5m (on the right side of the route). The pavement structure consists of 5cm-thick asphalt concrete (AC).
 - Constructing new sections for the widened road and the road behind the piled yard with a 5cm-thick AC pavement. The sidewalk and wharf yard surfaces will be paved with 5cm-thick artificial stone concrete bricks on a cement concrete base, with natural stone curbs. Grass will be planted in designated green areas, along with shade trees suitable for the coastal soil and climate, such as Casuarina, Millettia, and Sea Grape.
- ❖ **Water supply system:** a water supply system including 547 m of HDPE pipes for fire protection, 375 m of HDPE pipes for domestic use, 375 HDPE D63 pipes, 3 D100 outdoor fire fighting posts, one water tank for domestic use and indoor fire fighting (400 m³, one master meter pit, 6 D100 outdoor fire fighting posts). The water source will be connected to Sam Son city's common clean water supply.

The water storage system includes one existing 200m³ tank serving the outdoor fire protection system and one newly constructed 415m³ tank supplying water for the port and the fire protection system for the sorting houses

- ❖ **Power supply system:** construction of a new 35(22)/0.4kV substation supplying the operating area, technical infrastructure, sorting house, trees and public lighting. The 35kV medium voltage power source is taken from the medium voltage compartment of the area's existing substation. The 35kV medium voltage power grid supplies power to the newly constructed substation. The cable route from the existing substation to the new substation will be underground when going from the existing substation to the construction site.
- ❖ The boat dock canopy has an area of 3,180 m², a width of 10 m along the length of the dock, and is constructed with a combination of steel and reinforced concrete columns. The roof structure consists of hot-dip galvanized steel frames, covered with eco-friendly plastic roofing sheets. The floor surface is coated with epoxy for enhanced durability and hygiene.
- ❖ **Other auxiliary works:** construction and installation of communication systems, traffic safety systems (signs, buoys...), drainage outlet, gates, fences ...

d. Waste treatment and environmental protection works

- ❖ **Solid waste storage facility:** A waste collection house will be built with a total area of 72 m². The structure consists of steel and reinforced concrete columns on single concrete foundations. The floor is made of concrete with an epoxy coating, while the walls are built with bricks and finished with ceramic tiles. The roof is covered with eco-friendly green plastic sheets on hot-dip galvanized purlins.
- ❖ **Rainwater collection and drainage system:** Designed based on the principle of gravity flow, ensuring the drainage slope follows the formula $I_{min} \geq 1/D$. The rainwater drainage system is entirely separate from the wastewater drainage system. Collected rainwater is discharged into the Ma River through two existing outlets. The system includes: 371 m of D1200 culverts with H30-XB80 load capacity; 13 D1200 collection manholes; 1 D600 connection manhole; 1 BXH = 1000x1000 connection manhole; 1 D1200 culvert discharge outlet
- ❖ **Wastewater collection and drainage system:** Completely separate from the rainwater drainage system. The system includes: 350 m of HDPE D315-PN12.5 pipes; 11 wastewater manholes; 1 WWTP with a capacity of 300 m³/day, utilizing biological treatment technology; 139 composite grating panels (2440x850 mm), with a load capacity of 25 tons; 350 D315 stainless steel (Inox 304) pipe clamps, spaced at 1 m per clamp.

The WWTP 300m³/day is built on an area of about 230 m² with biological treatment technology, will collect (i) Production wastewater generated from activities of fish sorting, washing berths, washing vessel holds and (ii) Domestic wastewater generated from people's activities at the port after being preliminarily treated by septic tanks. The quality of treated wastewater meets the requirements in column B, QCVN 11-MT:2015/BTNMT - National technical regulations on seafood processing wastewater before being discharged into Ma River

The details of the construction items for the WWTP (01 module - Capacity 150 m³/day) are presented in the table below:

No	Work item	Description/specification
1	Collection tank	LxWxH = 4x3x4.5
2	Equalization tank	LxWxH = 5x3.0x4.5
3	Physicochemical tank	LxWxH = 3x1.5x2.5
4	Primary sedimentation tank	LxWxH = 3x3x4.5
3	Anoxic tank	LxWxH = 4.5x3x4.5
4	Aerobic tank	LxWxH = 5 x3x4.5
5	Sedimentation tank	LxWxH = 3 x3x4.5
6	Disinfection and intermediate tank,	LxWxH = 3x1.5x4.5
7	Sludge storage tank	LxWxH = 3x1.5x4.5
8	Operation building,	Area: 15m ²
9	Chemical mixing house and chemical storage.	Area: 12m ²

1.4.1.2. Lach Bang Fishing port upgrading and expansion subproject

The Lach Bang Fishing port upgrading and expansion subproject includes the following of works: (i) construction of the port berth area; (ii) construction of fishery logistics facilities and administrative-service areas; (iii) construction of technical infrastructure works; (iv) construction of waste treatment and environmental protection works. The overall site plan of the construction items in the Lach Bang Fishing port upgrading and expansion subproject is shown in the figure below



Figure 1.13. Overall layout for upgrading and expanding Lach Bang fishing port (Hai Binh ward



Figure 1.14. Overall layout for upgrading and expanding Lach Bang fishing port (Hai Thanh ward)

The scale of the investment works in the Lach Bang Fishing port upgrading and expansion subproject is summarized in the table and detailed technical description below:

Table 1.2. Investments under Lach Bang fishing port upgrading and expansion subproject

No	Work item	Scale, quantity
A	The port at the side of Hai Binh ward	
1	Canopy on the pier	Area of 4,020 m ² , width 9.5m, length approximately 400m, height 7.4m.
2	Upgrade of the sorting house	The existing sorting house with an area of 950 m ² is upgraded to an area of 1,672 m ² , with a height of 1 floor.
3	Construction of solid waste collection house	Area of 76 m ² , dimensions 6.22m x 12.22m.
4	Upgrade of the water supply system	- Use of 01 existing water tank with a capacity of 400m³ - Installation of 320m of HDPE pipes D110, 88 HDPE pipes D63 - 03 fire hydrant columns D100 for the existing water supply system
5	Upgrade of the wastewater collection and treatment system, completely separate from the rainwater system	- 449m of HDPE pipes D315-PN12.5 - 01 type 1 dirty water manhole; 14 type 2 dirty water manholes, 01 manhole for elevation change - 01 WWTP with a capacity of 300m³/day, using biological technology - 425m of drainage channel for surface water at the port
6	Upgrade of the rainwater drainage system	- 505m of B600 reinforced concrete drainage channel for surface water collection, 57m of B400 reinforced concrete drainage channel for surface water collection, 18 manholes for B600 drainage channels, 2m of HDPE pipe D630.

No	Work item	Scale, quantity
7	Upgrade of the internal port traffic road system	- Upgrade of the internal port traffic road system with an area of 298.32 m ² .
B	Fishing port at the side of Hai Thanh ward	
1	Construction of a new dock	- Length 180m, width 10m, dock top elevation +2.25m, dock bottom elevation -4.5m
2	Construction of an operations building	- 3 floors, area 565 m ² , structure made of reinforced concrete frame
3	Construction of a canopy on the pier	- Area 1,407 m ² ; average width 9.5m; length approximately 180m; height 7.4m
4	Upgrade of the internal traffic road system	- Upgrade of the internal port traffic road system with an area of 2,513 m ²
5	Construction of public restrooms	- Area 60 m ²
6	Construction of an operations building	- 3 floors, total area 565 m ²
7	Upgrade of the electrical supply and lighting system	- Installation of a new 180 KVA transformer to replace the damaged existing transformer - Placement of 17m high light poles at the central island (access road) of the subproject, with an average distance of 30m between poles - Installation of a new electrical cabinet at the transformer station of the area
8	Upgrade of the water supply system	- Upgrade of the pumping station & water tank: equip 01 mobile fire pump; use the existing water tank with a capacity of 50m ³ . - Additional installation of 143m of HDPE pipe D110, 304 HDPE pipes D50, 1 fire hydrant column D100.
9	Upgrade of the rainwater drainage system	- 173m of B600 reinforced concrete drainage channel for surface water collection, 07 manholes for B600 drainage channels - 10m of HDPE pipe D630 (discharge outlet), 01 HDPE D630 flip valve
10	Upgrade of the wastewater collection and treatment system	- Construction of 01 WWTP with a capacity of 60m ³ /day, using BASTAF tank technology - 10m of HDPE pipe D200 (from the drainage and discharge system) - 1 HDPE D200 flip valve

Below is the detailed technical description of the investment works in each area of the port:

(i) Construction works at the Hai Binh Port Area:

a. Port Wharf Area

- The layout of the vessel channel and turning basin includes a channel width of 30m, a turning radius of 200m, and a turning basin with a diameter of 120m.
- The Hai Binh fishing port pier, measuring 400m in length and 10m in width, remains in good condition and will be retained as is. Only a canopy will be added to the pier, and the port surface will be raised to create a slope that directs wastewater toward the inner

edge of the port, ensuring proper environmental sanitation. The pier edge elevation (on the outer side of the port) is +2.30m.

b. Construction works

❖ Reception and sorting house

Hai Binh port sorting house will be rehabilitated and expanded with an area of 1,672 m² (current sorting house area is about 950 m², additional area: 722 m²). The existing house will be added with auxiliary works such as offices to serve port officials, monitoring and traceability of fish origin, areas for storing sorting tools, water supply and drainage systems, lighting power supply and will be added an area of 722 m² (replacing a temporary kiosk made of corrugated iron to hold fish sorting tools and other functions serving port management and operations). The house structure is a single foundation, reinforced concrete columns, roof, and exterior decoration system made of steel lamella.

❖ Wharf roof:

The wharf is equipped with a roof cover with an area of 4,020m² on the Hai Binh side. The average width is 9.5m along the length of the wharf. The structure consists of steel columns combined with reinforced concrete on the wharf surface. The sloping roof is made of reinforced concrete covered with green glazed tiles, and the floor is coated with epoxy.

c. Infrastructure Works

❖ Traffic system

Comply with the current structure of the yard, only repairing and reinforcing the existing surface layer to align with the drainage direction. The road surface structure is reinforced with construction volume as follows:

Table 1.3. Traffic system and yard under proposed Lach Bang fishing port (Hai Binh side)

Construction and rehabilitation of traffic system	Unit	Quantity
Surface of road and sidewalk, and yards are paved with bricks/fake stone tiles	m ²	298.32
C12.5 asphalt layer on the port surface is 5cm thick	m ²	1,6638.11
Replacing 25cm thick M250 concrete of road and yard surface	m ²	873.64
Paving new M250 concrete on road and yard surface	m	423.00
Curbing 18X22 cement concrete	pcs	17.00
Plant tank size 1.6x1.6	m ²	1,023.61
Vegetation (Casuarina tree, Poplar tree, sea grape...)	m	31.00

❖ Water supply system

The water storage system at the Hai Binh port area includes one existing tank with a capacity of 400m³, serving both the fire-fighting system and domestic water supply. Therefore, it is not necessary to construct an additional facility.

The project owner will invest in the installation of 320m of HDPE pipe D110, 88 pipes of HDPE D63, and 03 D100 fire hydrants.

d. Waste treatment and environmental protection works**❖ Solid waste collection house:**

A solid waste collection house with an area of 76m² will be constructed, featuring a roof and a foundation with anti-seepage reinforcement. The dimensions are 6.22m x 12.22m, with a steel column and reinforced concrete column structure on a single reinforced concrete foundation. The facility will include areas for general waste, household waste, and hazardous waste.

❖ Rainwater collection and drainage system:

A separate rainwater collection and drainage system will be built for the Hai Binh fish port area, including 505m of B600 concrete gutters for surface water collection, 57m of B400 concrete gutters for surface water collection, 18 B600 gutter chambers, 2m of HDPE D630 pipes (discharge outlets), and 1 HDPE D630 flap valve. Rainwater will be collected and discharged into the Lach Bang River.

❖ Wastewater collection and drainage system:

The wastewater collection system for the subproject will be entirely separate from the rainwater collection and drainage system: 449m of HDPE D315-PN12.5 pipes, 1 type 1 wastewater discharge chamber, 14 type 2 wastewater discharge chambers, 1 sewage lift station chamber, 1 WWTP with a capacity of 300m³/day, and 425m of port surface water collection gutters (located on the pipeline).

The WWTP with a capacity of 300m³/day will be built on an area of approximately 230m², comprising 2 modules, each with a capacity of 150m³/day, using biological treatment technology. The collected wastewater consists of: (i) production wastewater generated from fish sorting, dock washing, and ship hull cleaning, and (ii) domestic wastewater from port workers, which will be pre-treated in septic tanks.

The treated wastewater quality will meet the requirements specified in Column B, QCVN 11-MT:2015/BTNMT – National technical regulations for wastewater from seafood processing before being discharged into the Lach Bang River. The scale of the Lach Bang WWTP is summarized in the table below.

No	Work item	Specification (m)
1	Collection tank	LxWxH = 4x3x4.5
2	Equalization tank	LxWxH = 5x3.0x4.5
3	Chemical and physical treatment tank	LxWxH = 3x1.5x2.5
4	Primary settling tank	LxWxH = 3x3x4.5
3	Anaerobic tank	LxWxH = 4.5x3x4.5
4	Aerobic tank	LxWxH = 5 x3x4.5
5	Settling tank	LxWxH = 3 x3x4.5
6	Disinfection and intermediate tank	LxWxH = 3x1.5x4.5
7	Sludge storage tank	LxWxH = 3x1.5x4.5
8	Operations building	Area: 15m ²
9	Chemical preparation building and chemical storage warehouse	Area: 12m ²

(ii) Construction of works at the Hai Thanh port area**a. Port area****❖ Docking area:**

The existing dock at the Hai Thanh fishing port will be renovated due to its deteriorating condition. The northern part of the dock will be repurposed as a foundation for the port area, and a new dock will be constructed along the current dock line, extending forward. The new dock will have a length of 180m, with the same width as the existing dock (10m). The elevation at the top of the dock will be +2.25m, and the bottom elevation will be -4.5m. A roof system will be added over the entire length of the 180m dock. The new dock structure will consist of a reinforced concrete slab beam supported by bored pile foundations.

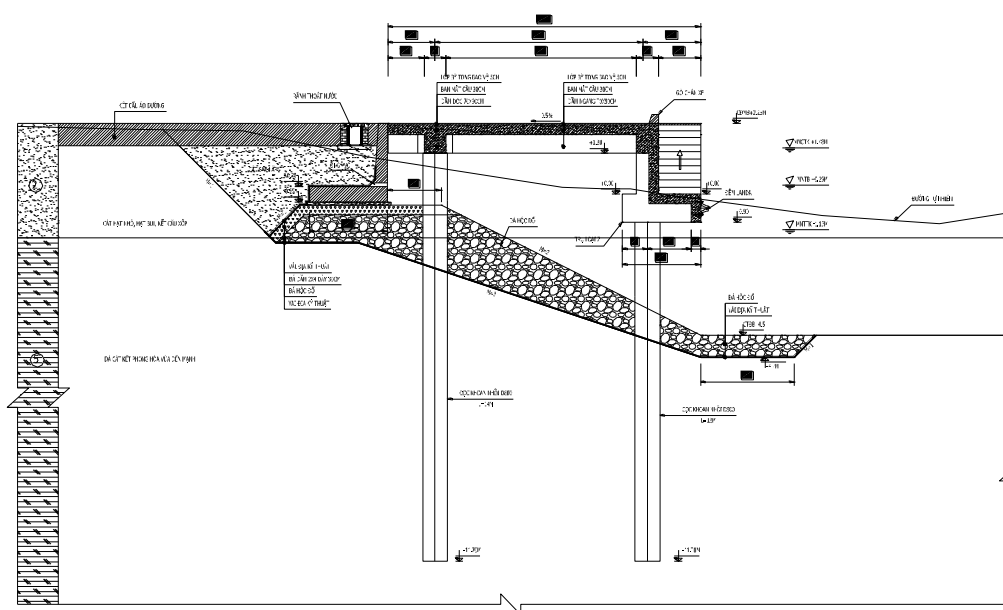


Figure 1.15. Cross section of Hai Thanh port under Lach Bang subproject

b. Architectural works**❖ Administration building:**

A three-floor administration building will be constructed on an area of 565 m² with a reinforced concrete frame structure on piles, and walls made of masonry combined with glass panels. This building will accommodate 21 staff members working at the port. It will include functional rooms such as offices, a break room, a medical room, a guest room, a system management room, a meeting room, a conference room, a kitchen, and a dining hall. The building will be equipped with an electrical system, lighting, water supply, and other necessary utilities.

❖ Dock roof:

A roof with an area of 1,407 m² will be installed on the dock. The average width will be 9.5m along the length of the dock. The structure will consist of steel columns combined with reinforced concrete on the dock slab, with a sloping reinforced concrete roof covered in green glazed tiles. The floor will be coated with epoxy.

❖ Public restrooms

A public restroom building will be constructed with an area of 60m², featuring a reinforced concrete column structure on a single reinforced concrete foundation, and walls made of non-

fired brick. The roof will be a concrete slab with tile finishing. The restroom will be equipped with an electrical lighting system, water supply, and drainage.

c. Technical infrastructure work

❖ Transportation system

For the existing road area: The old damaged concrete surface will be demolished, and the foundation will be compacted. A new M300 cement concrete layer, 25cm thick, will be poured to restore the surface. For the expanded yard area: The surface structure will be newly built. The construction volume is as follows:

Table 1.4. Road and yard system under Lach Bang subproject (at Hai Thanh ward side)

Construction, rehabilitation of road	Unit	Quantity
Sidewalks, roads, and paved areas with bricks/stone-like bricks	m ²	390.10
Replace the concrete road surface and M250 yard with a thickness of 25cm.	m ²	1,293.60
New M250 concrete for the sidewalk and road surface	m ²	1,220.21
18x22 cm M250 cement concrete curb.	m	160.00
Planting beds with dimensions 1.6x1.6m	item	19.00

❖ Water supply system

The current water supply for the Hai Thanh fishing port comes directly from the clean water pipeline to a 50m³ tank on the port for domestic water use. For fire fighting water supply outside the buildings, due to insufficient space for a tank, it is recommended to purchase a portable fire pump that uses water directly from the river. The subproject will invest in the installation of 143m of HDPE pipe D110, 304 HDPE pipes D50, and one D100 fire hydrant.

❖ Power supply system:

The power supply for the area is connected from the existing substations. A new 180 KVA transformer will be installed to replace the damaged one.

Public lighting system: Install 17m high light poles at the central island (entrance road) of the subproject, with an average distance of 30m between poles. A new electrical cabinet will be installed at the substation location of the area.

d. Waste treatment and environmental protection work

❖ Rainwater collection and drainage system:

Since the wastewater drainage system is combined with the rainwater drainage system, the project will install a float valve to regulate the water flow from the rainwater collection ditch into the existing wastewater treatment tank. When the rainfall exceeds the treatment capacity, the valve will automatically close, and the rainwater will be discharged through the common outlet.

❖ Wastewater collection and drainage system:

The wastewater will be collected to the 60 m³/day WWTP using the BASTAF tank technology. The treated wastewater will be connected to the project's rainwater drainage system.

The wastewater drainage system includes: one 60m³/day WWTP (WWTP), 10m of HDPE D200 pipe (from the drainage ditch and waste discharge road), and one HDPE D200 flap valve. The wastewater will be collected to the 60m³/day WWTP using BASTAF tank technology. The treated wastewater will be connected to the project's rainwater drainage system.

The 300m³/day WWTP, built on an area of approximately 230 m², will collect (i) production wastewater from the process of cleaning the dock, washing ship holds, and (ii) domestic wastewater from the activities of port residents. The treated wastewater quality will meet the requirements of column B, K=1.2, QCVN 11-MT:2015/BTNMT - National technical regulations on wastewater from seafood processing before being discharged into the Lach Bang River. The treatment tank dimensions are LxWxH = 9.8x4.8x2.85m.

1.4.1.3. Tam Quan storm shelter upgrading investment subproject

The Tam Quan storm shelter subproject will invest in the following works: (i) Dredging the storm shelter and channel covering 32.5ha; (ii) Constructing 5 protective embankment sections with a total length of 2,487m; (iii) Building a communication system, signal buoys, and marking buoys; (iv) Constructing a medical facility combined with accommodation.



Figure 1.16. General layout of investments under Tam Quan subproject

The scale of the investment works for the Tam Quan storm shelter anchorage area combined with Tam Quan fishing port is summarized in the table and detailed technical description below:

Symbol	Subproject	Unit	Quantity
1	Dredging of the anchorage area and channel	ha	32.5
2	Shore protection embankment	m	2,494
	Shore protection embankment section K1	m	1,069
	Shore protection embankment section K2	m	166
	Shore protection embankment section K3	m	308
	Shore protection embankment section K4	m	362
	Shore protection embankment section K5	m	582
4	Communication system	HT	01
5	Anchor buoy	Set	7
6	Signal buoy, warning signs	set	19
7	Medical and accommodation building, 2 floors high	m2	260

❖ **Dredging the anchorage area and ship channel:** Dredging of the anchorage and channel with an area of 32.5ha includes:

- **Dredging of the anchorage area:** Divided into 3 dredging zones, including:
 - + Anchorage for ships with a length of 24-35m, channel width B=40m, dredging depth at -4.5m;
 - + Anchorage for ships with a length of 20-24m, channel width B=35m, dredging depth at -3.7m;
 - + Anchorage for ships with a length of 17-20m, channel width B=30m, dredging depth at -3.2m.
- **Dredging the approach channel to the anchorage area:**
 - + The section outside the sea gate: length 1200m, channel width B=50m, dredging depth at -5.0m;
 - + The section inside the river B=40m, dredging depth at -4.5m, minimum curve radius R=200m. Channel slope ratio m=7.

The total dredging volume for the anchorage and channel is approximately 523,224m³.

❖ **Coastal Protection Embankment:**

Construction of a coastal protection embankment with a total length of 2,494m, including 5 embankment sections, with crest elevation ranging from +2.2m (sections K1, K2, K5) to +2.5m (sections K3, K4). The embankment sections are:

- + Section K1: Length 1,069m, including 2 subsections: K1B (953m) from the foot of the wave breaker at the entrance to the end of the shoreline of zone E, and K1A (116m) from the shoreline of zone E to the end of the anchorage area.
- + Section K2: Along the C shoreline, length 166m;
- + Section K3: Along the existing Dinh Thanh residential area, length 308m;
- + Section K4: Along the existing Cong Thanh residential area and resettlement zone, length 362m;
- + Section K5: Along the shipbuilding zone B, length 582m.

Embankment structure: Vertical wall suitable for the limited space, docking with a large number of ships ensuring fire safety and rescue when necessary. Crest elevation ranges from +2.2m to +2.5m depending on the position. The structure uses SW350A sheet piles with a length of 9-10m, SW400A sheet piles with a length of 11m, and M400 concrete walls above, with a reinforced concrete pile row of 40x40cm, pile spacing 2m, pile length 7m. Horizontal drainage pipes are arranged for rainwater drainage.

❖ **Communication System:**

Investment in communication equipment, including 1 HF radio, 1 VHF radio, and loudspeakers for storm, flood warnings, and anchorage management. The operation center of Tam Quan fishing port will manage the anchorage area, and the communication system will be located at the port's operation center in zone D.

❖ **Mooring Posts and Buoys:**

Mooring posts:

- (i) Invest in 44 mooring posts for fishing boats with a length of 17-24m using M400 gravity concrete blocks with dimensions of 2.3m in length, 2.3m in width, and 2.2m in height.
- (ii) Invest in 2 mooring posts for fishing boats with a length of 24-35m using M400 gravity concrete blocks with dimensions of 2.7m in length, 2.3m in width, and 2.2m in height. The mooring posts will have a top elevation between +2.2m and +2.5m (NN system), matching the embankment's crest elevation; the bottom elevation of the posts will be at +0.00m (NN system). Each mooring post will be equipped with a 20T mooring flange.

Buoys: Invest in 7 sets of mooring buoys, anchor turtles in the anchorage areas. Use steel buoys with a diameter of 2.4m, 44mm diameter chains, and concrete anchor turtles measuring 4.7x4.7x1.2m weighing 53 tons. The buoy chains will be coated with 3 layers of anti-corrosion paint, and the turtle anchors will be buried 0.8m in the ground.

Buoy and Signage System:

Arrange a system of marker buoys indicating the entrance channel, storm shelter anchorage area, and anchorage zones to ensure easy access for vessels to the port and anchorage areas, in compliance with QCVN20:2015/BGTVT on maritime signaling. It is planned to deploy 12 new channel marker buoys and 7 new anchorage zone signs.

❖ **Healthcare and Accommodation Building:**

The healthcare and accommodation building has 2 floors and a total floor area of 260m² (including 1 healthcare room, 5 accommodation rooms, a sanitation area, and a lobby). The structure will consist of a foundation using single foundation piles reinforced with reinforced concrete piles, with columns, beams, and slabs made of solid reinforced concrete. The roof will be constructed with galvanized steel box trusses and covered with metal sheets.

❖ **Wastewater Treatment Facility:**

Tam Quan subproject does not invest in a WWTP as the project only focuses on the storm shelter anchorage area.

1.4.1.4. Khanh Hoa major fishery center construction & upgrading investment Subproject:

This subproject will invest in the following facilities: (i) Construction of the port terminal area; (ii) Construction of fisheries logistics and administrative service buildings; (iii) Construction of technical infrastructure and waste treatment facilities. The overall layout of all subprojects under the Khanh Hoa subproject is shown below.

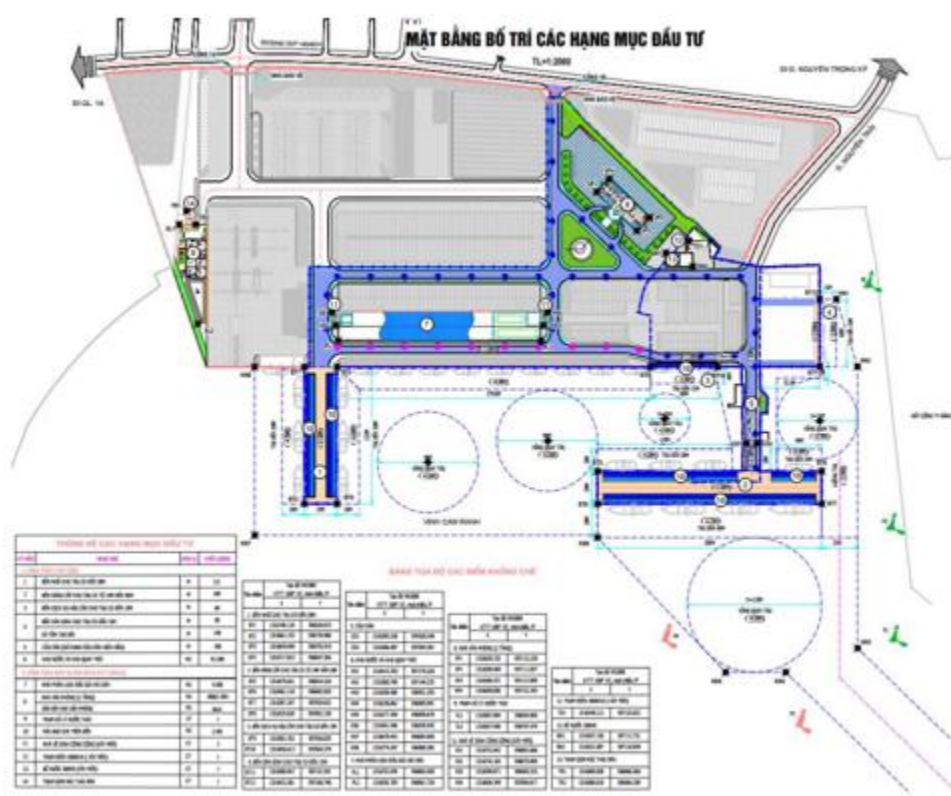


Figure 1.17. General layout of investments under Khanh Hoa subproject

The scale of the investment works for the Khanh Hoa subproject is summarized in the table and detailed technical description below:

Table 1.5. Description of investments under Khanh Hoa subproject

No	Subproject	Scale and quantity
A	Port facilities	
1	Construction of a new protruding pier	Length 122m, width 29m, pier top elevation +2.0m; pier bottom elevation -4.5m.
2	Upgrade of the existing fishery pier	Length 200m, width from 9.5m to 29m, pier top elevation +2.0m; pier bottom elevation from -3.7m to -5.7m.
3	Construction of a new logistics service pier	Length 60m, width 4.0m, pier top elevation +2.0m; pier bottom elevation -2.9m.
4	Construction of a new community pier	Length 60m, width 5m, pier top elevation +2.0m; pier bottom elevation -2.9m.
5	Shore protection embankment	Length 140m.
6	Upgrade of the existing ramp	Upgrade of the existing ramp with a length of 24.5m, using a beam system and reinforced concrete slab on the foundation of the old bridge deck.
7	Dredging of the water area, turning basin, and vessel channel	- The dredging volume is 69,332.5 m³. - The width of the water area in front of the pier ranges from 15m to 30m, with the dredging depth ranging from -2.9m to -5.7m. The vessel channel is arranged with a width of

No	Subproject	Scale and quantity
		60m (main channel) and 32m (for the branch channel leading to the community pier).
B	Architectural works	
1	Construction of a sorting and seafood auction house	The building floor area is 4,500m ² , with 1 floor.
2	Construction of an office building	The floor area is 1,600m ² , with 2 floors.
3	Canopy on the pier	Total area of 2,481m ² on the pier.
4	Construction of a solid waste collection station	Total area of 96m ² .
5	Construction of public restrooms	Area of 87m ² , with 1 floor.
C	Technical infrastructure	
1	Construction of the office area yard	Area 3,991m ²
2	Upgrade of the internal traffic roads and yard roads in the port with an area of 0.9ha	- Road No. 1 is the existing Nguyen Trai Road. - Road No. 2 has a length of 109.42m, width of 13m, with 2 lanes. - Road No. 3 has a length of 238.92m, width of 13m, with 2 lanes. - Road No. 4 has a length of 384.37m, width of 10-13m, with 2 lanes. - Road No. 5 has a length of 158m, width of 20m, with 4 lanes. - Road No. 6 has a length of 90.55m, width of 9m, with 2 lanes. - The new access road has a length of 25.01m, width of 15-16m, with 2 lanes.
3	Electrical supply system	Arrangement of street lighting along the right side of the sidewalk. Construction of a new 1000 kVA transformer station to supply electricity to the fishing center. Yard lighting system: lights powered by solar energy, with a light pole height of 6.2m.
	Upgrade of the water supply system	Including an existing tank with a capacity of 200m ³ , plus the construction of an additional tank with a capacity of 300m ³ ; a pumping station and water tower to supply water for domestic use and fire protection.
4	Construction of a rainwater drainage system separate from the wastewater system	Includes: 44 manholes for D400 pipes, 8 manholes for D600 pipes, 15 manholes for D800 pipes, 293m of reinforced concrete D400 pipes, 372m of reinforced concrete D600 pipes, 302m of reinforced concrete D800 pipes.
5	Construction of a wastewater collection system and treatment station separate from the rainwater system	- 33 manholes, 230m of B300 drainage ditches, 802m of HDPE pipe D315, 836m of HDPE pipe D250, 10m of HDPE pipe D180, 46m of HDPE pipe D110.

No	Subproject	Scale and quantity
		- Construction of a new WWTP (TXLNT) with a capacity of 600m ³ /day, using AO technology. The quality of the treated wastewater meets the requirements according to Column B, QCVN 14:2008/BTNMT – National technical regulation on domestic wastewater before discharging into Cam Ranh Bay.
6	Installation of the fire protection system (PCCC)	Integrated fire protection system for all structures.

Details description of investments under the subproject include:

a. Port Area

- ❖ **Dredging of the water area in front of the dock:** The width of the water area in front of the dock for ships <15m, ships <24m, and ships from 24–40m are respectively: 15m, 20m, and 30m. The dredging depth ranges from -2.6m to -5.7m. The proposed dredging slope near the dock is m=1.5, and the slope outside the water area is also m=1.5.

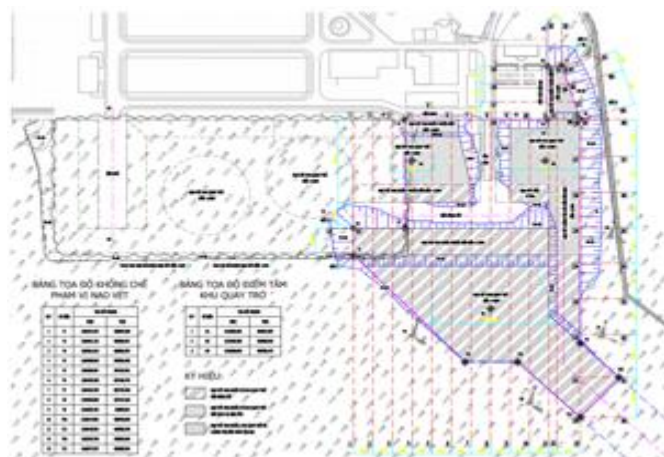


Figure 1.18. Typical dredging layout of works under Khanh Hoa subproject

- ❖ **Ship Channel and Turning Basin:** The channel width for ships is 60m (main channel) and 32m (branch channel for the community dock), with a dredging depth of -4.50m and a turning radius of 400m. The diameter of the turning basin for the jetty is D=90m, the upgraded existing dock is D=120m, the service dock is D=45m, and the community dock is D=72m.
- ❖ **Dredging Material Volume:** The estimated dredging volume for the water area in front of the dock, the ship channel, and the turning basin is 69,332.5 m³.
- ❖ **Number of Docks**
 - + Number of fishing vessel docks: 13 docks (12 docks for vessels under 24m; 1 dock for vessels 24m and above).
 - + Number of logistics docks: 03 docks.
- ❖ **Land Reclamation:** The land area for the community dock is reclaimed to a height of +2.00m (National Datum), with the reclamation plan as follows:

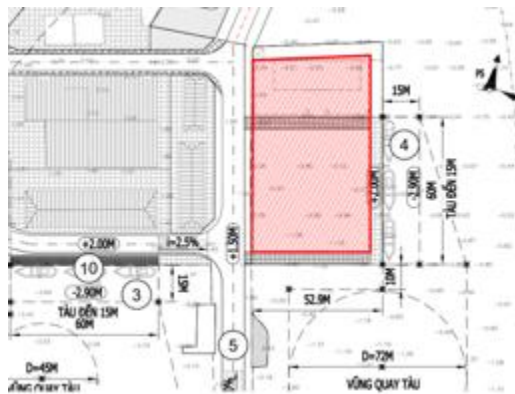


Figure 1.19. Land reclamation layout

❖ **Dock Roof:** The roof dimensions are 12.2m in width, with a total construction area of 2,481m². The structure of the roof includes galvanized steel load-bearing columns, connected to the dock structure by pre-installed bolts; the roof material is a corrosion-resistant composite sheet.

❖ **Ship Anchorage Area:**

Existing Upgraded Dock:

The existing pier at Da Bac Fish Port is being upgraded and expanded, with the deck width varying from 9.5m to 29m, and a length of 200m (divided into 3 sections: section 1 is 85m, section 2 is 60m, and section 3 is 55m).

The upgraded dock will retain the 200m length, and the width will increase from 19.5m to 29.0m; the dock top elevation is +2.0m; the bottom elevation of the dock ranges from -3.7m to -5.7m.

Overhead on the dock, roofs will be installed on both sides, running along the dock's length, with dimensions of 12.6x115.65m, 12.6x187.2m, and 12.6x36.4m. Ladders will be installed for ease of access to ships for loading and unloading. The dock structure is made of reinforced concrete, with bored pile foundations of D800mm diameter; the average length of the piles is expected to range from 17.5m to 26.4m.

- + Section 1, 3: The horizontal framework includes 5 rows of bored piles with a D800mm diameter. The pile spacing in the horizontal direction is 29m. The longitudinal framework for section 1 has 17 rows of piles, with a longitudinal pile spacing of 84.99m; section 3 has 11 rows of piles, with a longitudinal pile spacing of 54.99m.
- + Section 2: Section 2 is divided into two parts: new construction and upgrading of the old dock.

The new construction includes a system of longitudinal and transverse beams made from reinforced concrete M400 with dimensions of 70x90cm, and the deck thickness is 30cm, also made from M400 concrete. A 10cm layer of M200 concrete will be applied to the deck surface. This section has a horizontal framework with 4 rows of bored piles with a D800mm diameter and a pile spacing of 19m. The longitudinal framework for section 2 has 14 rows of piles, with a longitudinal pile spacing of 59.98m.

The upgrade of the existing dock includes transverse and longitudinal beams with dimensions of 70x50cm (beam height includes the 30cm deck thickness), poured on the old deck after it has been roughened. The deck thickness is 30cm, made of M400 concrete, with a 10cm M200 concrete layer on top. Along the approach to the bridge, edge beams of 30x50cm will be installed. The transverse beams and the deck will be poured together with the new construction portion of this section.

Approach Bridge: The approach bridge will be upgraded using a system of beams and reinforced concrete decks on the old deck surface. The dimensions of the longitudinal and transverse beams are 70x50cm, and the deck is made from M400 concrete with a thickness of 30cm. A 10cm layer of M200 concrete will be applied on top. The beam spacing in the horizontal direction is 16m, and in the longitudinal direction, it is 24.5m. Edge beams of 30x50cm will be installed at the approach to the main dock. The junction between the approach bridge and the access road will be poured with M300 concrete, sloped at 2% from +2.0m to +1.50m.

Newly Built Jetty: The deck width is 29m, the length is 122m (divided into 2 sections of 61m each), with the top elevation at +2.0m, and the bottom elevation at -4.5m. Two roof sections of the same size (12.6x108.7m) will be installed. Each dock section will have working platforms (ladders) 14.90m long and 1.35m wide, for easy access for people when the water level changes. The dock structure is a pier with a floating platform on a foundation of bored piles with a D800mm diameter, with an average pile length expected to range from 14.5m to 19m. The pile tips will reach the hard rock layer.

The upper structure includes a system of longitudinal and transverse beams made from reinforced concrete M400 with dimensions of 70x90cm, and a 30cm deck made of reinforced concrete. A 10cm layer of M200 concrete will be applied to the deck surface. The dock will be equipped with 20T mooring flanges, LAMDA300H-L2000 type rubber fenders, and other auxiliary equipment.

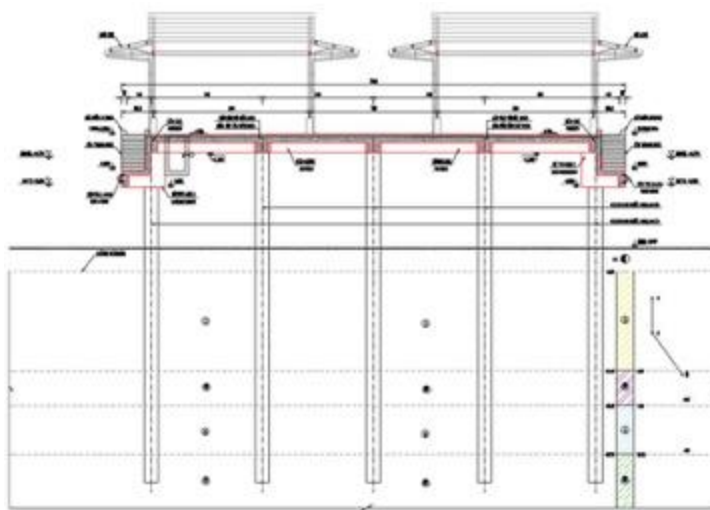


Figure 1.20. Typical design cross section of jetty under Khanh Hoa subproject

- Logistics Service Dock:

This dock is built with a width of 4m and a length of 60m, with the top elevation at +2.0m and the bottom elevation at -2.9m. A roof with dimensions of 5.75x59.25m is installed above. It is designed for fishing vessels up to 15m in length. The dock structure consists of reinforced concrete beams on the existing dock surface, combined with a bored pile of D800mm diameter and 20m length at the dock corner, with the pile tip reaching the hard rock layer. Due to the curved section where the dock meets the tuna dock, a bored pile is required at this position. The upper structure includes a system of longitudinal and transverse beams made from reinforced concrete M400 with dimensions of 50x50cm, and the deck thickness is 25cm, made of reinforced concrete. A 5cm layer of M200 concrete will be applied on top of the deck. The dock

will be equipped with 10T mooring flanges, D-shaped rubber fenders, and other auxiliary equipment.

- Civil wharf:

This wharf will be arranged at the area east of the Fisheries Center, with 5m wide surface, 60m long, crest +2.0m; depth -2.9m, accomodating fishing vessels up to 15m in size. The wharf structure is a 10m long SW350A pile wall structure, anchored with a 10m long PHC D400 pile system with a slope of 1:6, the anchor bars are M400 reinforced concrete beams with dimensions $xh = 35 \times 50$ cm at beam crest +0, 00m with anchor step of 3.5m, connection between piles using M400 reinforced concrete longitudinal beam 35×50 cm.

- Protection embankment:

The seawall for the residential dock area has a length of 140m with a vertical wall structure made of reinforced concrete piles type SW350A, each pile measuring 10m. The pile cap is made of reinforced concrete M400 with a cross-section of 100×90 cm. The elevation of the pile cap is +1.50m. The concrete curb is cast integrally with the pile cap, with a height of 80cm and a width of 30cm. The elevation of the curb is +2.30m. The piles are anchored using connections with round concrete piles type PC D300, each 11m long, with a pile spacing of 2.2m.

b. Architectural Works:

❖ **Seafood Sorting and Auction House:** The seafood sorting house has a single floor with a total floor area of $4,500\text{m}^2$ (including restroom, seafood sorting area, and seafood auction area). Structure: The building has a frame structure, cast-in-place with reinforced concrete beams, columns, and floors. The roof is made of corrosion-resistant composite panels with galvanized purlins placed on galvanized trusses. The floor foundation consists of 20cm thick M300# concrete, a layer of oil paper, and 15cm of type 2 crushed stone. The foundation is a pile system connected by reinforced concrete beams.

❖ **Office Building:** A two-floor office building with a total floor area of $1,600\text{m}^2$ (including a kitchen, dining room, restroom, conference room, etc.). The foundation elevation is +0.00m, designed to be 45cm above the finished ground surface. The structure is a two-floor reinforced concrete frame, with 220mm thick brick walls and cement mortar M50#. The roof is made of M350# reinforced concrete, and the floor is made of ceramic tiles. The restroom floors are laid with anti-slip 20×20 cm ceramic tiles. The foundation is reinforced concrete M350# on pile foundations.

c. Technical Infrastructure:

❖ **Traffic System:** The total area of roads and yards in the port is approximately 0.9ha. The entire port yard will be elevated to an average elevation of +2.0m. The project will invest in the construction of the internal port traffic system, which includes:

Road No. 1: Existing Nguyen Trai road.

Road No. 2: Length 109.42m, width 13m, 2 lanes.

Road No. 3: Length 238.92m, width 13m, 2 lanes.

Road No. 4: Length 384.37m, width 10-13m, 2 lanes.

Road No. 5: Length 158m, width 20m, 4 lanes.

Road No. 6: Length 90.55m, width 9m, 2 lanes.

New access road: Length 25.01m, width 15-16m, 2 lanes.

The road surface and yard in the port will be divided into sections, using the following main construction materials: 24cm thick M350 concrete for the road surface; 50mm thick Terrazzo tiles for sidewalks; and green plants for separation.

- ❖ **Water supply system:** The fishery center is still using water from Cam Phuoc Tay water plant with current capacity of 16,000m³/day, in the long term the water plant will increase capacity to 30,000m³/day. In the port, a tank system of about 500m³ (an additional tank with capacity of 300m³ and an existing tank with capacity 200m³), a pumping station, and a water tower will be built to proactively supply water for daily life and fire prevention. The water supply system in the port area, office area, sorting house... connecting to the tank 300m³ through pipeline.
- ❖ **Power supply system:** at present, the subproject area is still using existing power source from 22kV line 474-F9 on Nguyen Trai street. In the future, the power supply for the Fishery Center will be connected to the 22KV medium voltage line expected along the road bordering the Northeast of the planning area (sourced from the 110KV Cam Ranh station). Lighting system will be arranged along the right side of the sidewalk. Constructing a new 1000 kVA substation to supply power for the fisheries center. The road lighting system will be equipped with solar-powered lamps, with a lamp height of 6.2m
- ❖ **Public Restrooms:** Construct public restrooms with a total area of 87m² (two restrooms, each with an area of 43.5m²). The public restrooms will be located at two positions at the ends of the fish sorting and auction house. The building structure will be a reinforced concrete frame on a single concrete foundation, with walls made of non-fired solid bricks, and a concrete roof covered with tiles.

d. Waste Treatment and Environmental Protection Works:

- ❖ **Solid Waste Collection Station:** Construct a solid waste collection station with a total area of 96m². The roof will extend 0.5m on each side, with a slope of $i = 0.5\%$. The roof will have 100mm thick brick walls around the perimeter, with a wall height of 0.2m above the roof surface.
- ❖ **Rainwater collection and drainage system:** The rainwater collection and drainage system is separate from the wastewater collection and drainage system: The system includes: 44 D400 sewer manholes, 8 D600 sewer manholes, 15 manholes of sewer D800, 293m of reinforced concrete sewer D400, 372m of reinforced concrete sewer D600, 302m of reinforced concrete sewer D800. Rainwater is collected and then drained into Cam Ranh Bay.
- ❖ **Wastewater collection and drainage system:** The project's wastewater collection system is completely separate from the rainwater collection and drainage system: 33 manholes, 230m of B300 ditch, 802m of HDPE D315 pipes, 836m of pipes HDPE D250, 10m HDPE D180 pipe, 46m HDPE D110 pipe.
- ❖ **WWTP** with capacity of 600m³/day using "AO technology" treatment technology, will collect (i) Production wastewater arising from the process of fish washing, fish sorting, washing berths, and from wholesale market and auction area and (ii) Domestic wastewater generated from people's activities at the port after preliminary treatment by septic tanks. The quality of treated wastewater meets the requirements in column B, QCVN 14: 2008/BTNMT- National technical regulations on domestic wastewater before being discharged into Cam Ranh Bay at 01 discharge point

1.4.1.5. Kien Giang Major fishery center construction & upgrading investment Subproject

The work items of the Kien Giang Major fishery center construction investment Subproject include the following project groups: (i) construction of the port area; (ii) Construction of fisheries logistics works and administrative and service areas; (iii) Construction of technical infrastructure projects; (v) Construction of waste treatment and environmental protection works. Overall plan of project items of Kien Giang Major fishery center construction investment Subproject below.

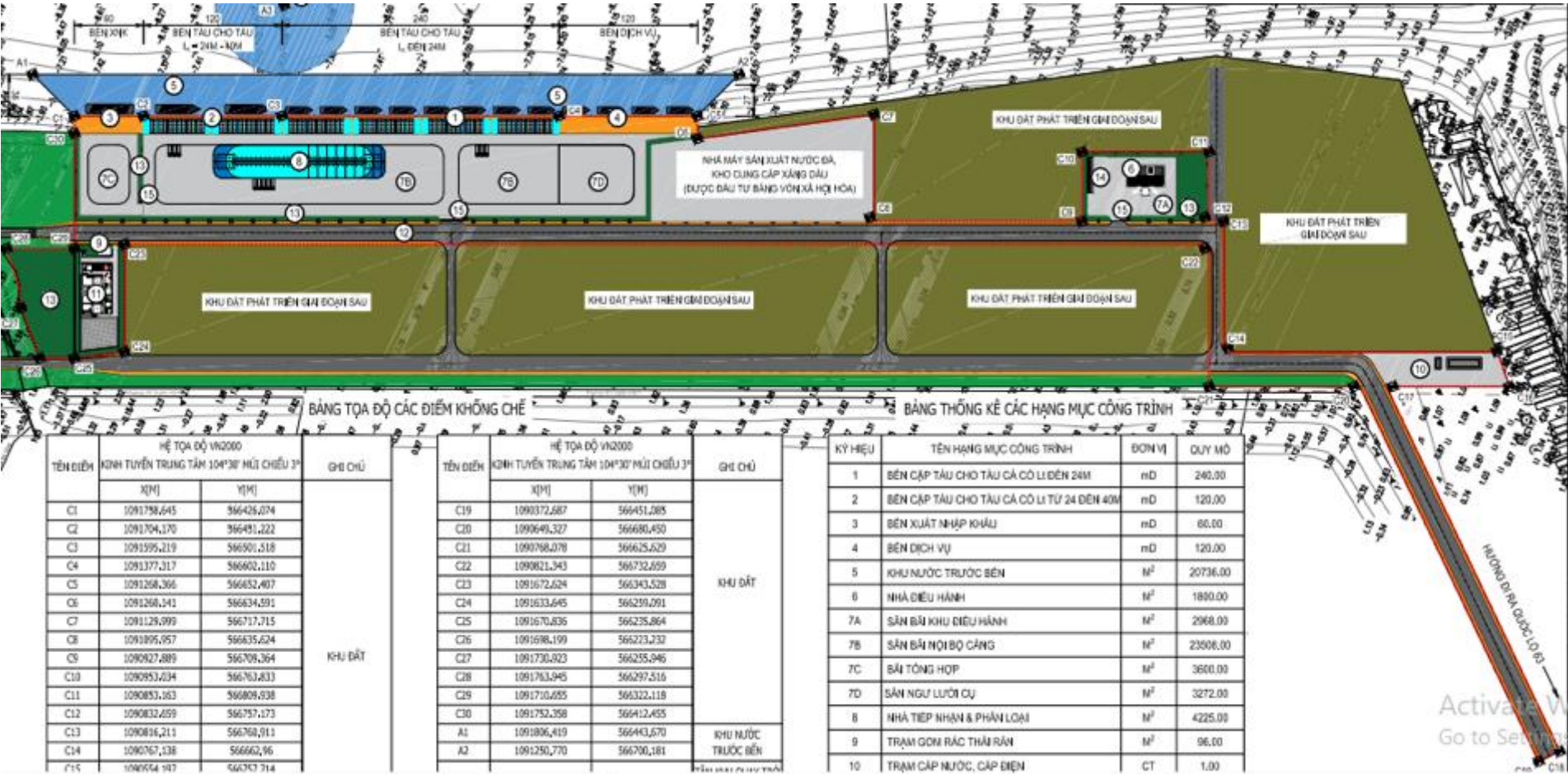


Figure 1.21. Overall layout of work items under Kien Giang Major fishery center construction investment Subproject

The scale of the investments under Kien Giang subproject is summarized in the table and detailed technical description below

Table 1.6. Description of investments under Kien Giang subproject

	Subproject	Quantity
A	Ground leveling	
1	Ground leveling	The filling volume is approximately 163,338 m ³ . The lowest leveling elevation is +1.8m. The material used for leveling is sand.
B	Port facilities	
1	Construction of a docking pier for vessels <24m	Length 240m, width 15m, pier bottom elevation -3.5m
2	Construction of a docking pier for vessels from 24m to 40m	Length 120m, width 15m, pier top elevation +2.0m; pier bottom elevation -5.5m
3	Construction of a seafood import/export pier	Length 60m, width 15m
4	Construction of a service pier	Length 120m, width 15m
5	Dredging of the water area in front of the pier	Width 36m, dredging depth -5.5m. The estimated dredging volume is 5,432 m ³
6	Construction of a protective embankment (under-pier embankment)	Length 540m
C	Architectural works	
1	Construction of an operations building	Floor area of 1,800m ² , 3 floors
2	Construction of a sorting and seafood trading house	Floor area of 4,225m ² , 1 floor
3	Construction of a new solid waste collection house	Total area of 96m ² , 1 floor
4	Construction of a new staff parking building	Area of 120m ² , 1 floor
D	Technical infrastructure	
1	Construction of internal yard roads	Area of 48,882m ² , including: - Road 01+01B: length 506.62m, width 20m, 4 lanes. - Road No. 02: length 123m, width 13m, 2 lanes. - Road No. 03: length 989.5m, width 20m, 4 lanes..
2	Construction of a general cargo yard	Area 3,552 m ²
3	Construction of the electrical supply system	03 transformer stations 22/0.4kV within the project area to supply power to the distribution boards for electrical power and lighting for the structures in the port.
4	Construction of the water supply system	01 storage tank with a capacity of 1,600m ³ ; HDPE water supply pipes, enclosed in protective steel pipes at locations where the pipes pass through roads.

	Subproject	Quantity
5	Rainwater drainage system	Reinforced concrete circular pipes with dimensions D400-D1 and box culverts with dimensions BxH = 1800x1800, with a distance between manholes ranging from 30m to 50m.
6	Construction of WWTP	The treatment capacity is 600m ³ /day, with the treatment technology being "AO technology." The quality of the treated wastewater meets the requirements of Column A, QCVN 40:2011/BTNMT – National technical regulation on industrial wastewater.

Description of work items under the subproject include:

a. **Ground leveling**

The leveling volume is approximately 163,338 m³. The leveling elevation is +1.8 m NDL. Before leveling, the site will be cleared, and organic soil will be excavated with an average thickness of 30 cm. The leveling solution is chosen using the pumping method. The sand will be pumped from barges to the leveling area, from the shore towards the sea.

b. **Port area**

❖ **Dredging of the area in front of the dock:**

The width of the area in front of the dock is 36 m, and the dredging elevation is -5.50 m. The estimated dredging volume is approximately 5,432 m³, with a dredging slope ratio of m = 3.

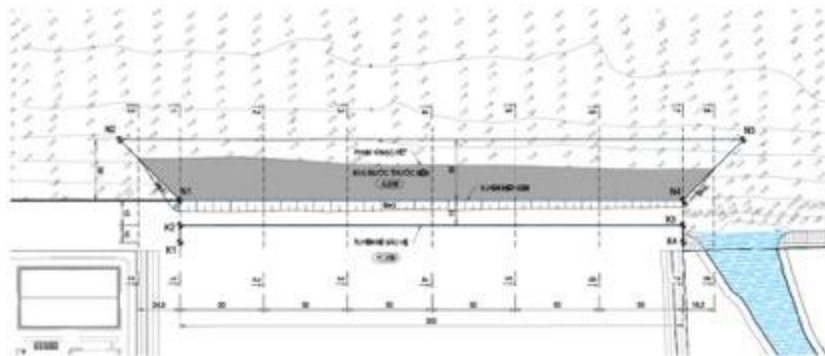


Figure 1.22. Dredging work under Kien Giang subproject

❖ **Number of docks**

- + The number of fishing boat docks is 22 docks (19 docks for boats under 24m; 03 docks for boats 24m and above).
- + The number of logistics boat docks is 08 docks.

❖ **Docking area for moored boats:**

The fishing boat dock for boats ranging from 24 to 40m in length has a length of 120m, width of 15m, with an elevation of +2.5m at the dock top and -5.5m at the dock bottom. The structure consists of reinforced concrete beams on a foundation of prestressed concrete piles, using 308 PHC D500C piles, 90mm thick, with an estimated length of about 25m.

The fishing boat dock for boats under 24m in length has a total length of 400m (divided into 4 sections, each 100m long), with a width of 15m, an elevation of +2.5m at the dock top, and

-3.5m at the dock bottom. The structure consists of reinforced concrete beams on a foundation of prestressed concrete piles, using 903 PHC D500C piles, 90mm thick, with an estimated length of about 25-30m.

The import-export dock for seafood products is 60m long, serving the import and export of seafood products, and also supports the transport of heavy equipment for service boats and fishing boats.

The logistics service dock is 120m long, equipped with a fuel supply system and a conveyor belt for loading ice onto the boat.

❖ **Protection embankment**

The shoreline protection dike for the project has a total length of 540 meters. The dike structure consists of a corner wall foundation on piles, with a sloped stone layer in front. The elevation of the dike crest is set at +2.5m along the entire length.

A total of 288 PHC piles, 500mm in diameter, 90mm thick, and 25m long, are used. Of these, 144 piles are driven vertically and 144 piles are inclined. The concrete corner wall is 2.5m high and 2.5m wide. The base slab is 0.5m thick, the wall slab thickness ranges from 0.3m to 0.5m, and the wing slab is 0.4m thick, with a spacing of 3.9m between them. The front barrier slab is 0.35m thick and 1.5m deep. Behind the wall, a high-strength geotechnical mesh is installed to enhance the stability of the dike slope. The sloped surface in front of the corner wall is structured in two layers: Layer 1: D300 rubble stone, 0.6m thick. Layer 2: 4x6 crushed stone, 0.2m thick. A geotextile fabric with a tensile strength of 14 kN/m is placed in between. The slope is designed with a gradient of $m = 3$

c. Functional areas

- ❖ **Reception and sorting house:** The seafood sorting facility is a single-floor building with a total area of 4,225 m². Inside the building, there are several areas: public restrooms, offices, tool storage room, fish trays, sorting area, cooling room, and a high-value seafood auction area. The foundation is a pile foundation, and the load-bearing columns are made of steel profiles, connected to the foundation structure using pre-installed bolts. The roof structure is a steel frame, consisting of vertical and horizontal steel elements. The roofing material is a 3mm thick eco-friendly green plastic.
- ❖ **Operation house:** The operation house is three-floors with total floor area of approximately 1,800m². The first floor includes areas such as office rooms, dining room, and business/service rooms. The second floor includes office spaces for various departments. The third floor is conference room. The house has pile foundation, and the superstructure consists of a beam-column system made of reinforced concrete (RC). The external walls are brick masonry
- ❖ **Roof for the dock:** The roof is located along the fishing dock, with a width of 12m. The supporting columns for the roof structure are steel profiles, connected to the RC columns using pre-installed bolts. The columns, rising from the dock to an elevation of 1.25m, are covered with stainless steel to prevent corrosion from saltwater. The roof is a steel frame, consisting of vertical and horizontal steel elements, with an eco-friendly 3mm thick green plastic roofing material.
- ❖ **Staff parking garage:** The staff parking garage covers an area of 120m², with dimensions of 30m x 4m, and a height of 3.85m. The foundation consists of individual footings, each measuring 1.5m x 1.5m. The columns are I-shaped steel. The roof structure consists of a truss system, purlins, and a 3mm thick eco-friendly green plastic roofing material

- ❖ **Solid Waste Collection Station:** A solid waste collection station will be built with a total area of 96m². The roof is made of reinforced concrete, with a waterproof layer on top. The waterproof mortar extends 0.5m on each side, with a slope of $i=0.5\%$. The roof has a 100mm thick brick wall surrounding it, with the brick wall's height being 0.2m above the roof surface. The foundation consists of reinforced concrete, and the walls are made of 200mm thick brick.
- ❖ **Port Gate:** The main entrance is for vehicles, with a steel box gate measuring 5.1m in width and 2.2m in height, sliding on a rail system. The auxiliary entrance is a swing gate with a width of 1.4m and a height of 2.2m.
- ❖ **Guard House:** Located on the roadside, the roof is made of heat-resistant corrugated metal. The building has a footprint of 3.3m x 3.3m and a height of 4.3m. The foundation is made of reinforced concrete columns, and the walls are constructed of 20cm thick brick.
- ❖ **Fence:** The port fence surrounds the boundary of the port with a height of 2.5m. The fence walls are made of non-fired bricks with a grade 100 mortar and cement mortar of grade 75. The structure includes a simple foundation and reinforced concrete columns. The foundation for the fence is built with stone blocks, with PVC pipes for drainage arranged at the base.

d. Technical Infrastructure

- ❖ **Road System:** The road system includes:

- + Road 01+01B: length of 506.62m, width of 20m, 4 lanes.
- + Road 02: length of 123m, width of 13m, 2 lanes.
- + Road 03: length of 989.5m, width of 20m, 4 lanes.

The internal areas, including roads and yards, are paved with M300 cement concrete, 2x4 stones with a thickness of 200mm, with a waterproof oil-paper layer, crushed stone type II with a thickness of 150mm, compacted soil (K98) with a thickness of 300mm. The sidewalks are made of 3cm thick Terazzo tiles with 2cm thick cement mortar, 8cm thick BTMX stone 2x4 B7.5, a layer of waterproof oil-paper, and compacted soil or sand achieving K95.

- ❖ **Water Supply System:** A water reservoir with a capacity of 1,600m³ will be built to meet the maximum daily water demand of the center. The water supply system will be connected to the water pipeline along National Highway 63, supplying water to the entire An Bien district and extending to the project. The maximum daily water demand for the port in phase 1 is approximately 731m³/day, with a fire-fighting water demand of approximately 839m³/day. The water supply pipes will be made of HDPE, and in areas where they cross roads, the pipes will be encased in protective steel tubes.
- ❖ **Electricity Supply System:** The power supply will be connected to the 22kV power line along National Highway 63 from the 110kV Minh Phong substation. Three 22/0.4kV substations will be built in the project area to supply power for the electrical and lighting systems of the port facilities. New solar panels will be installed on the sorting building roofs to supply power for the common systems when weather conditions are favorable.

e. Environmental Protection Works

- ❖ **Garbage Collection House:** The garbage collection house has an area of 96m². The foundation consists of D300mm reinforced concrete piles. The beams are made of reinforced concrete with cross-section dimensions of 200x300mm, resting on 200x200mm reinforced concrete columns. The structure is enclosed by 200mm thick brick walls, and the roof is made of reinforced concrete.
- ❖ **Rainwater Collection and Drainage System:** The rainwater collection and drainage system

is separate from the wastewater collection and drainage system. Rainwater will be collected and discharged into the Cai Lon River. The system uses round reinforced concrete pipes with diameters ranging from D400 to D1500 and box culverts with cross-section dimensions of BxH=1800x1800, capable of withstanding H30 loads. The distance between manholes is from 30 to 50 meters.

- ❖ **Wastewater Collection and Disposal System:** The wastewater collection system for the project is completely separate from the rainwater collection system. A new WWTP with a capacity of 600m³/day will be constructed, using AO treatment technology. The system will collect (i) wastewater generated from fish washing, freezing, sorting, wholesale markets, and auctions, and (ii) domestic wastewater generated by port residents after preliminary treatment in septic tanks. The treated wastewater will meet the quality standards of column A, QCVN 40:2011/BTNMT – National Technical Regulation on Industrial Wastewater before being discharged into the Nga Bat canal and then flowing into the Cai Lon River.

1.4.1.6. Bach Long Vi Storm shelter upgrading subproject

The subproject of investment in the fishing port and storm shelter anchorage for Bach Long Vi fishing vessels will invest in works including:

No	Work items	Scale and volume
A	Port area	
1	Ship fairway and turnaround area	- Dredging of ship fairway and turnaround area: area of 3.3 ha, with the bottom of the fairway at a depth of -2.9m
2	Dock upgrades and construction	- Maintain the existing status of the small pier, continuing to use it with a total length of about 175m. - Construction of a new wharf: for ships >15m to dock, with a length of 80m, a width of 20m, the height of the top of the wharf at +5.0m, and the height of the bottom of the wharf at -3.4m
3	Upgrading breakwaters	- Upgrading the current western breakwater with a total length of 500m and dimensions B x H = 1.5 x 2m.
4	Dredging the storm shelter anchorage	- Dredging the storm shelter anchorage area with a total area of 10.2 ha; the dredging depth ranges from -1.1m to -2.9m. - The total dredging volume is expected to be 51,550 m ³ (including the dredging volume of the fairway and turnaround area).
B	Technical infrastructure	- Construct and upgrade the system of anchor pillars and storm shelter mooring buoys.
1	Mooring area <15m	- Install mooring buoys with a diameter of 2.4m, D44mm chains 9m in length, and 53T turtles for the <15m mooring area.
2	Ship mooring area >20m	Install mooring buoys with a diameter of 2.4m, D44mm chains 10m in length, and 53T turtles for the >20m mooring area. The total number of mooring buoy sets is 116 (covering both <15m and >20m mooring areas)

The overall ground plan of the subproject in Bach Long Vi is presented in Figure 1.9.

❖ Ship fairway and turnaround area

Dredging of the channel and the turnaround area with a scale of 3.3 ha; the dredged bottom elevation of both the fairway and turnaround area is -2.9m, ensuring safe navigation for fishing vessels with lengths of up to 35m, and accommodating anchorage for 405 vessels of all types, with the largest vessel being 35m in length.



Figure 1.23. Cross-section of dredging for the Bach Long Vi subproject

❖ Docking Stations

- Maintain the current small pier for continued use with a total length of approximately 175m.
- Construction of a new pier for ships >15m with a length of 80m, a width of 20m, a height of +5.0m at the top of the wharf, and a height of -3.4m at the bottom of the wharf. Structure: flat box stone foundation with a minimum thickness of 1m; stacking blocks including prefabricated M400 concrete hollow blocks, box stone poured wharf; the wharf surface is 0.3m thick, poured on-site with M400 concrete; at the bottom is a layer of flattened crushed stone laid over a dehydration-resistant nylon sheet; bumpers are M400 concrete, 30cm high; the ridge has a trapezoidal cross-section with a bottom of less than 30cm and a top of more than 20cm, cast together with the wharf; ship mooring flange: the wharf is equipped with 30-ton mooring flanges and rubber fenders fixed to pre-installed anchor hooks..

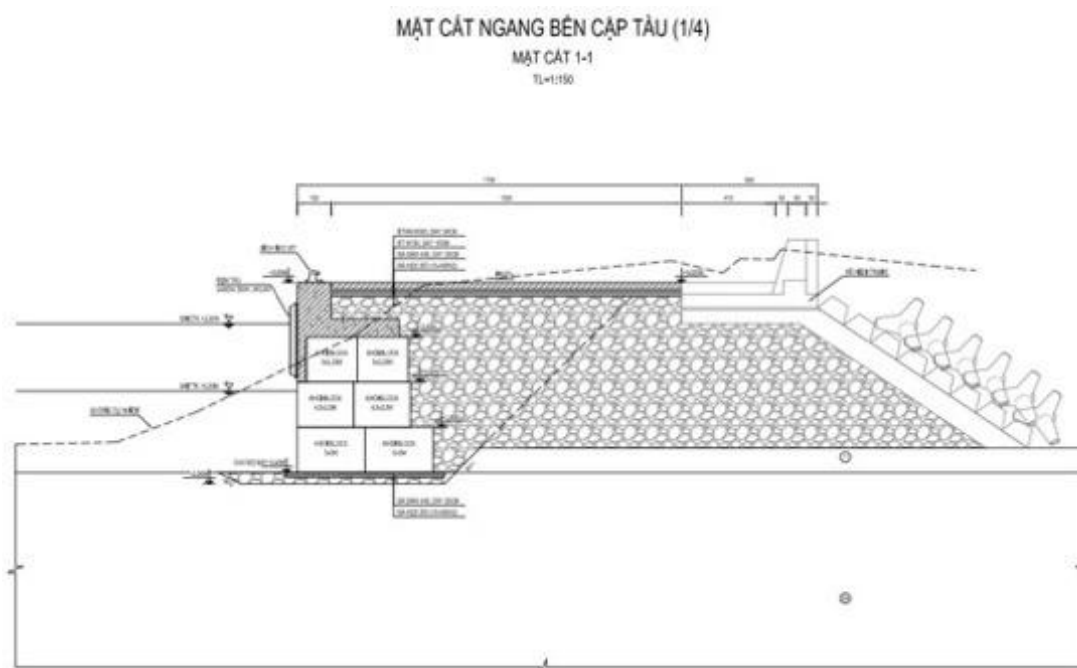


Figure 1.24. Typical cross-section of the berth in the Bach Long Vi subproject:

❖ Upgrading breakwaters

- Upgrading the breakwater in the west with a length of 500m: construction of a dike crest block with dimensions $B \times H = 1.5 \times 2\text{m}$. The connection between the newly constructed dike crest block and the existing dike will be implemented by steel implant drilling.

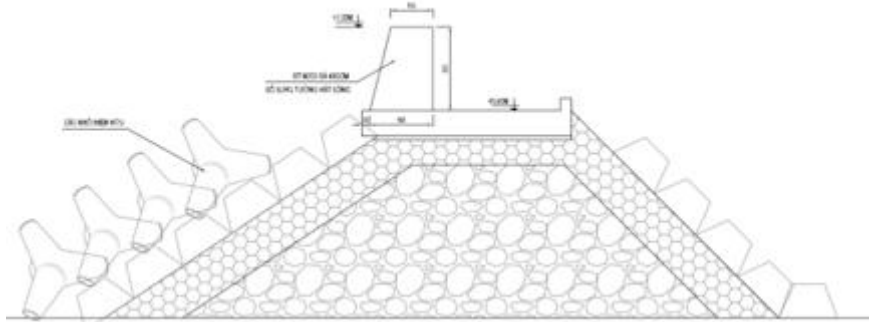


Figure 1.25. Typical cross-section of breakwater upgrade

❖ **Storm shelter anchorage:**

- Dredging the storm shelter anchorage area with a total area of 10.2 ha, with the dredged bottom elevation ranging from -1.1m to -1.6m depending on the specific location. The dredging slope is $m=1$. The expected total dredging volume is 51,550 m^3 .
- The storm shelter anchorage is divided into two areas: one area designed to accommodate the largest ships with lengths up to 35m, and one area designated for ships of 20m and less than 15m in length.

❖ **Mooring buoy:**

- **Ship mooring area <15m:** Install 2.4m diameter mooring buoys, D44mm chains with a length of 9m, and 53T concrete sinkers.
- **Ship mooring area >20m:** Install 2.4m diameter mooring buoys, D44mm chains with a length of 10m, and 53T concrete sinkers.

❖ **Existing status of infrastructure in the port area:**

The port and Bach Long Vi anchorage were constructed under Decision No. 1689-QD/XDCB dated 12/10/1995 of the People's Committee of Hai Phong City. In 2001, the project was accepted, handed over, and put into use. The existing status of the project is as follows:

- **Breakwater route:** The breakwater system consists of the eastern and western dikes, forming locks. The total length of the dike is approximately 1150m, with the western dike being 500m long and the eastern dike 650m long. The dike surface is a 5-7m wide road, with the surface height ranging from +4.5m to +5.0m. The interior of the embankment is made of concrete and stone.

+ **Eastern breakwater:** The concrete dike surface is 4.5-6.0m wide. A breakwater wall is positioned at the top of the dike, with the height of the wall ranging from +6.5m to +7.0m. The breakwater is equipped with a berth for fishing boats, tourist ships, and emergency rescue operations. Behind the dock area, there is a traffic system connecting to the island, as well as electricity and water supply lines running along the road to the outside of the wharf.

+ **Western breakwater:** The concrete dike surface is 2-3m wide. A breakwater wall in the form of a comb structure is in place, though waves can still overflow the dike and enter the lock area. Within the breakwater, an inclined berth has been arranged for military ships.

On the dike surface outside the sea, a breakwater wall extends from the end of the dike to the inclined wharf. The remaining section does not have a breakwater.

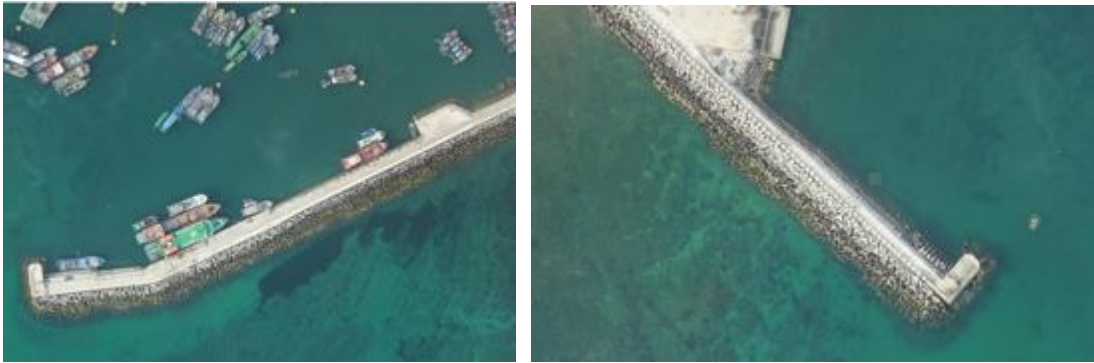


Figure 1.26. Existing status of breakwaters in the East and West

- Service area behind the port: total area of about 2000 m², housing area of about 274 m², working area of 193.5 m².



Figure 1.27. Existing status of the service area behind the port

- The ship mooring area has an area of 28 ha (of which 7.4 ha is useful), with an average depth of 3.5 m; it serves as an anchorage for about 200-300 fishing boats to shelter from the wind. The capacity is for 20-300 vessels ranging from 1000CV to 400CV. The rest of the area is unusable (because it is shallow stone and needs to be dredged to increase the useful area for mooring ships).

- At present, on average, each year the number of ships entering and docking is about 8,000 to 9,000 units/year. Vessels entering and exiting the anchorage area for anchorage and storm shelter include fishing vessels, military vessels, coast guard vessels, and cargo ships. On the mooring area, there is a sloping wharf for transporting civilian and military goods.

- The average volume of goods passing through the port per year is 15,000 tons - 20,000 tons (including seafood and other goods).

Waste treatment works:

The project area currently does not have a wastewater treatment system; all visitors entering and exiting the port use the existing septic toilet system of the Bach Long Vi Port Management Board. The solid waste generated in the port area is collected and taken to the general landfill of Bach Long Vi District.

According to the subproject plan, Bach Long Vi will invest in additional wastewater and solid waste treatment works. During the construction process, the contractor will arrange to install 02 portable septic toilets for workers to use. Once the project is operational, visitors entering and exiting the port will continue to use the existing toilet system with septic tanks of the Bach Long Vi Port Management Board.

1.4.2. Fishing Port Exploitation Technology

1.4.2.1. Fishing Port Exploitation Process

The Fishing Port exploitation process (used at the Lach Hoi, Lach Bang, Khanh Hoa, Kien Giang, and Bach Long Vi subprojects) is as follows:

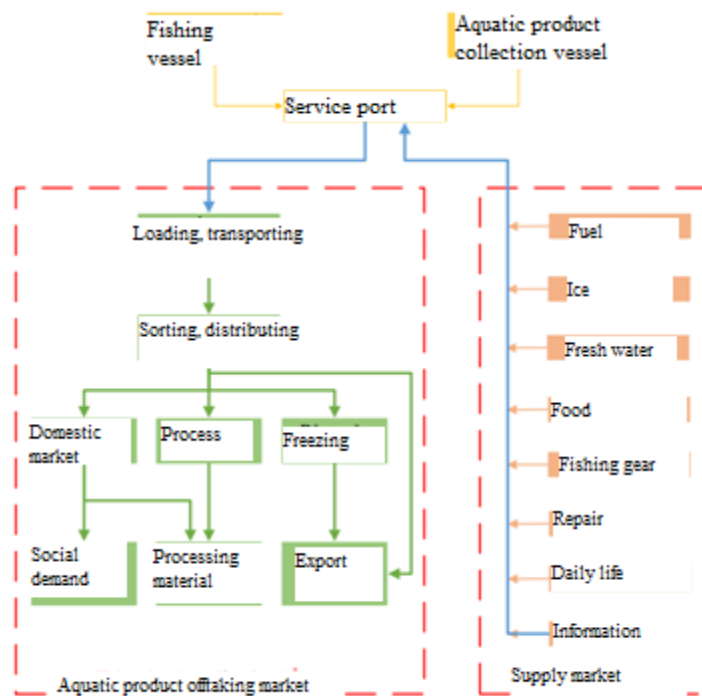


Figure 1.28. Fishing port exploitation diagram

1.4.2.2. Fishing port exploitation equipment

Exploitation equipment used at the Lach Hoi, Lach Bang, Khanh Hoa, Kien Giang, and Bach Long Vi subprojects is as follows:

- Loading and unloading equipment from fishing boats to the wharf and the sorting reception house includes:
 - Crane (mobile crane, wheel-mounted crane): for transporting fishery products in crates from the ship to the wharf.

- Conveyor belt: for transporting fishery products in bags, which need to be torn open.
- Transport equipment from the wharf to the sorting reception house and from the sorting reception house to processing plants includes: forklifts, conveyor belts, trucks, and refrigerated trucks.
- Transport equipment from the factory to the consumer market includes: trucks and refrigerated trucks.
- Transport equipment from port services to fishing boats includes:
 - Fuel (gasoline and oil): using direct pumping pipelines.
 - Ice: using conveyor belts.
 - Freshwater: using direct pumping pipelines.

1.4.2.3. Seafood Reception Diagram via the Port

❖ Lach Hoi Subproject

Seafood is brought through the port to the shore, part of it is directly exported to the market, and part is processed through the reception and sorting house. In the reception house, sorting processes are carried out for preliminary processing, refrigeration, and further processing of the seafood. Afterward, the products are sent out to the market. The diagram of seafood reception at the port is shown below:

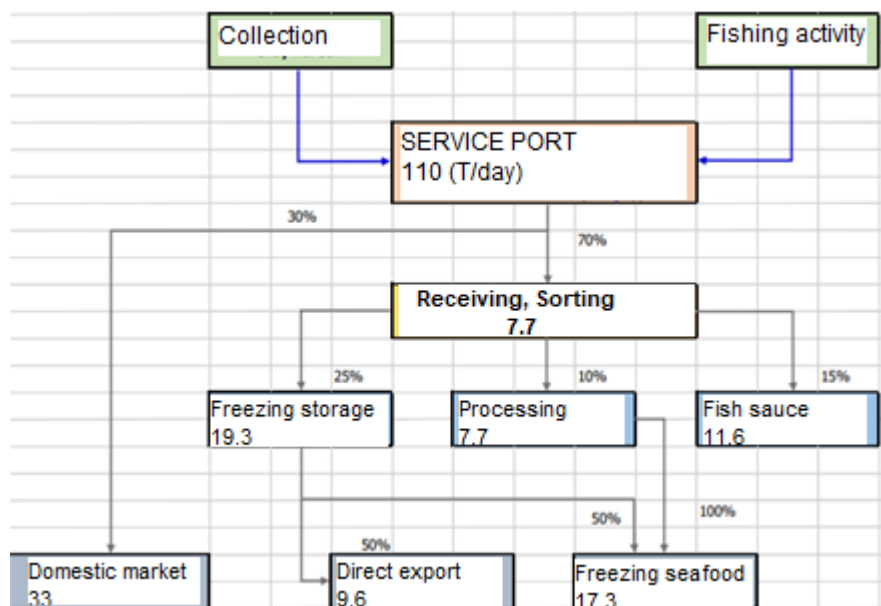


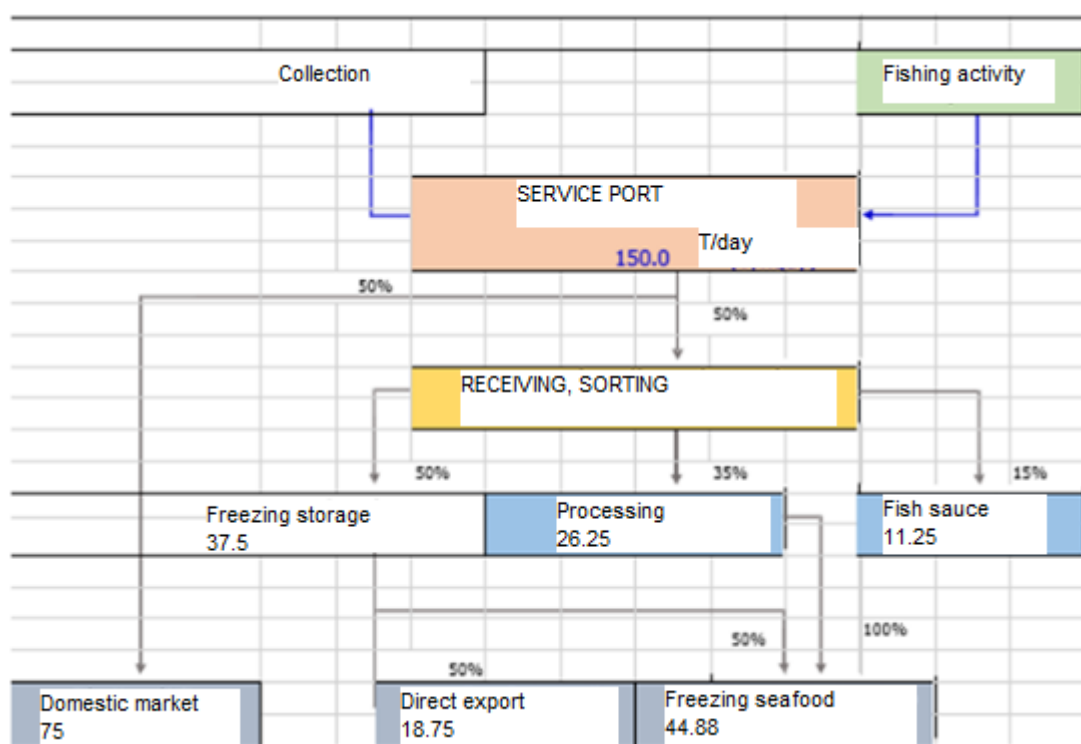
Figure 1.29. Diagram of seafood reception at Lach Hoi port

Table 1.7. Operational capacity of Lach Hoi fishing port

No.	Work item	Unit	Throughput demand
1	Fish reception and sorting area	Ton/day	77.0
2	Cold storage warehouse	Ton/day	19.3
3	Preliminary processing area	Ton/day	7.7
4	Ice production workshop	Ton/day	52.8

❖ Lach Bang Subproject

Seafood is unloaded from the port to the shore, with part of it being directly exported to the market, while the other part goes through the reception and sorting house. At the reception house, the sorting process is carried out for preliminary processing, cold storage, and further processing of the seafood. Afterward, the products are exported to the market. The diagram of seafood reception through the port is shown below.

**Figure 1.30. Diagram of aquatic products reception at Lach Bang port****Table 1.8. Operational capacity scale of Lach Bang fish port**

No	Work item	Unit	Throughput demand
1	Fish receiving and sorting facility	Tons/day	75.0
2	Cold storage warehouse	Tons/day	37.5
3	Pre-processing area	Tons/day	26.25
4	Ice production workshop	Tons/day	150.0

❖ **Khanh Hoa subproject**

Aquatic products unloaded at the port are partially delivered directly to the market, while the rest are sent to the receiving and sorting facility. At the facility, they undergo a classification process for pre-processing, cold storage, and processing. The final products are then distributed to the market.

Table 1.9. Operational capacity scale of Khanh Hoa major fishery center

No	Type of vessel	Capacity to meet %Qn	Value	Unit	Note
0	Peak daily cargo volume through the port (Qn)		600	T/day	
1	Demand for fish washing and sorting area	90%	540	T/day	10% sorted at sea
2	Weighing and sorting area	100%	600	T/day	
3	Wholesale market	70%	420	T/day	70% of daily seafood volume
4	Cold storage and freezing facility	30%	180	T/day	30% of daily seafood volume
5	Ice demand after sorting	70%	840	Tons of ice/day	2T of ice per 1T of fish
6	Parking demand (5T) - 2 trips/day	100%	240	Slots	5T per vehicle

❖ **Kien Giang subproject**

Aquatic products unloaded at the port are partially shipped directly to the market, while the rest are sent to the receiving and sorting facility. At the facility, they undergo a classification process for pre-processing, cold storage, and processing. The final products are then distributed to the market.

Table 1.10. Operational capacity scale of Kien Giang major fishery center

No	Type of vessel	Capacity to meet %Qn	Value	Unit	Note
0	Peak daily cargo volume through the port (Qn)		360	T/day	
1	Demand for fish washing and sorting area	100%	360	T/day	
2	Weighing and sorting area	100%	360	T/day	
3	Wholesale market	70%	252	T/day	70% of daily seafood volume
4	Cold storage and freezing facility	30%	108	T/day	30% of daily seafood volume

No	Type of vessel	Capacity to meet %Qn	Value	Unit	Note
5	Ice demand after sorting	70%	504	T of ice/day	2T of ice per 1T of fish
6	Parking demand (5T) - 2 trips/day	100%	72	Slots	5T per vehicle

❖ Bach Long Vi subproject

Seafood is exported directly to the consumption market, with part of it going through receiving and sorting houses. At the receiving house, the sorting process takes place for preliminary processing, cold storage, and seafood processing. The product is then put on the market. The diagram of receiving seafood through the port is shown below:

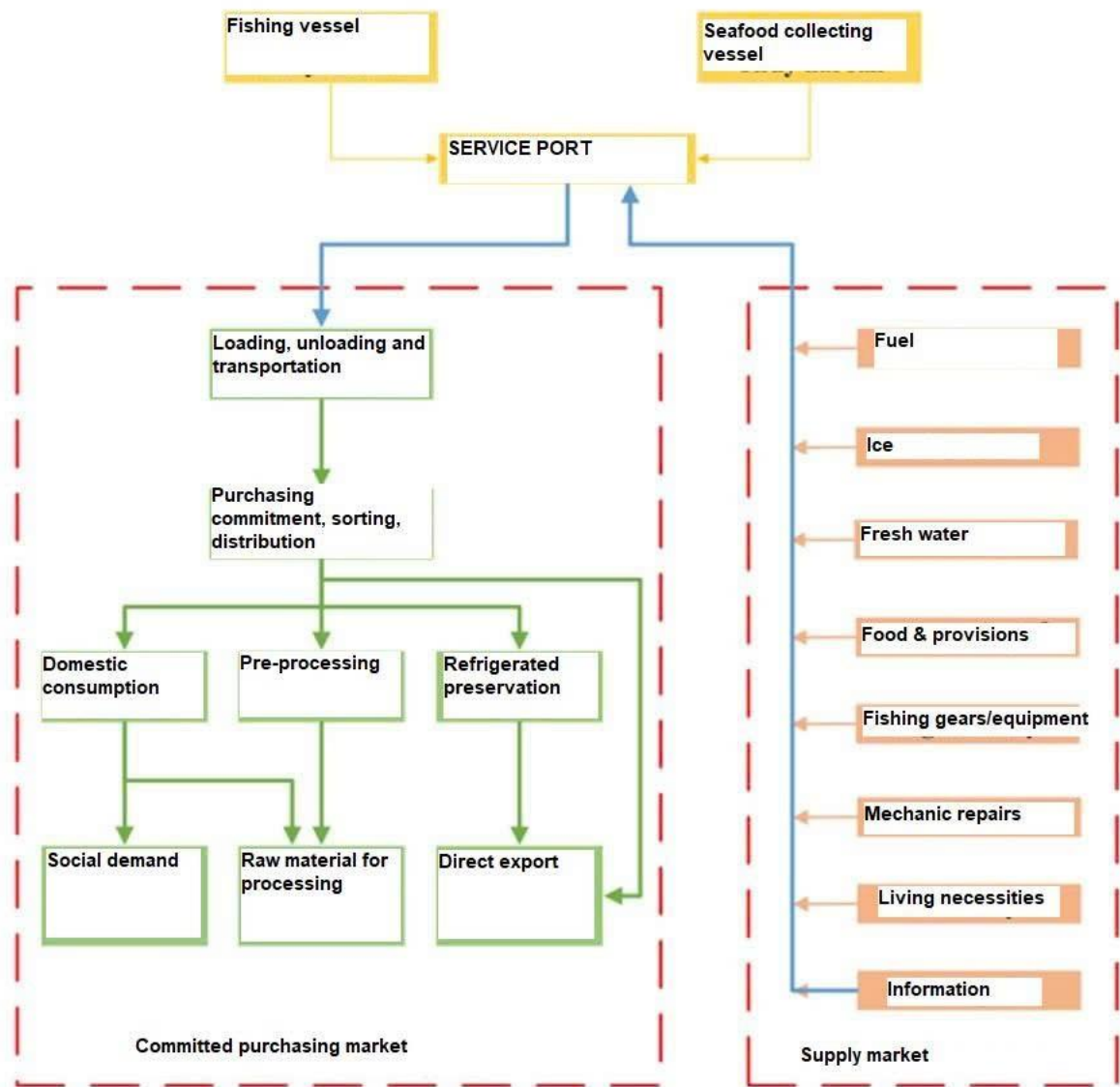


Figure 1.31. Diagram of receiving seafood through Bach Long Vi port

The scale of the port and the ability to receive ships into the storm shelter anchorage area in Bach Long Vi are as follows:

Table 1.11. Scale of receiving ships anchored for storm shelter in Bach Long Vi

No.	Category	Unit	Amount
1	The ship has a length of <15m	Ship	216
2	Ships with a length of 15-24m	Ship	185
3	Ships with a length of 24-35m	Ship	04
	Total	Ship	405

Source: Project Base Design Report, 2024

1.5 List of Construction Equipment and Machinery

The tables below provide a list of key equipment deployed for construction work. Depending on the nature of the work, the contractor's capacity, and weather conditions, the use of equipment at each subproject may vary.

Table 1.12. List of Construction Equipment and Machinery under Lach Hoi subproject

NO.	Machinery and equipment	Quantity (item)	NO.	Machinery and equipment	Quantity (item)
1	30-ton floating crane	1	13	Air hammer - air consumption: 3m3/ph	1
2	Speedboat	1	14	Rubber-tired crane – lifting capacity: 16T	1
3	Excavator	2	15	Crawler crane	1
4	Diesel air compressor	2	16	Crawler crane – lifting capacity: 16,0 T	2
5	Generator	1	17	Concrete pump - capacity: 40 - 60 m3/h	1
6	Bulldozer	2	18	Rebar cutting and bending machine – capacity: 5 kW	5
7	Truck	8	19	Concrete vibrator, plate type	1
8	Barge	6	20	Roller	1
9	1,200 HP dredging vessel	1	21	Front shovel excavator – bucket capacity: 1,25 m3	1
10	Tugboat	3	22	Piling vessel - hummer weight: 3,5 T	1
11	3T electric winch	1	23	Concrete mixing plant - capacity: 50 m3/h	1
12	AC welding transformer – power: 23 kW	3			

(Source: Cost estimate for project basic design, 2024)

Table 1.13. List of Construction Equipment and Machinery under Lach Bang subproject

NO.	Machinery and equipment	Quantity (item)	NO.	Machinery and equipment	Quantity (item)
1	Speedboat	1	10	Crawler crane	2
2	Excavator	1	11	Crawler crane – lifting capacity: 16,0 T	1
3	Generator	1	12	Concrete pump - capacity: 40 - 60 m3/h	3
4	Bulldozer	1	13	Rebar cutting and bending machine – capacity: 5 kW	1
5	Truck	2	14	Concrete vibrator, plate type	6

NO.	Machinery and equipment	Quantity (item)	NO.	Machinery and equipment	Quantity (item)
6	Barge	6	15	Roller	1
7	Tugboat	2	16	Front shovel excavator – bucket capacity: 1,25 m ³	1
8	AC welding transformer – power: 23 kW	1	17	Concrete mixing plant - capacity: 50 m ³ /h	1
9	Rubber-tired crane – lifting capacity: 16T	1			

(Source: Cost estimate for project basic design, 2024)

Table 1.14. List of Construction Equipment and Machinery under Tam Quan subproject

NO.	Machinery and equipment	Quantity (item)	NO.	Machinery and equipment	Quantity (item)
1	Speedboat	2	10	Tugboat 150CV	2
2	Sand pump with 350 HP diesel engine	1	11	Tugboat 360CV	2
3	Sand pump with 1216 CV diesel engine	3	12	Boat (40T) equipped with a pump	1
4	Water pump with 30 HP diesel engine	3	13	Boat (5T) equipped with a pump	3
5	Water pump with 40CV diesel engine	1	14	Poker-type vibrator – 1.5 kW	3
6	Cable-operated excavator – bucket capacity: 2.3 m ³	4	15	Welding machine – 23 kW	4
7	Barge 200T	8	16	Boat (5T) equipped with a pump	3
8	Barge 250T	4	17	Diving station	4
9	Barge 400T	6			

(Source: Cost estimate for project basic design, 2024)

Table 1.15. List of Construction Equipment and Machinery under Khanh Hoa subproject

NO.	Machinery and equipment	Quantity (item)	NO.	Machinery and equipment	Quantity (item)
1	Speedboat	1	13	Bulldozer 110CV	2
2	Barge 200T	4	14	10T crane	1
3	Barge 400T	4	15	16T crane	1
4	Tugboat 150CV	4	16	25T crane	1
5	Tugboat 360CV	4	17	5T crane	1
6	Poker-type vibrator – 1.5 kW	4	18	50T crane	1

NO.	Machinery and equipment	Quantity (item)	NO.	Machinery and equipment	Quantity (item)
7	Welding machine – 23 kW	10	19	Excavator – bucket capacity: 1.25 m ³	1
8	Diving station	1	20	Excavator – bucket capacity: 0.5 m ³	1
9	Concrete mixing plant 25m ³ /h	1	19	10.7 m ³ concrete mixer truck	2
10	Drilling machine 80KNm - 125KNm	2	20	1,200 HP dredging vessel	1
11	Drilling machine >200KNm - 300KNm	1	21	Concrete pump 50m ³ /h	2
12	Piling vessel 3,5T	1	22	Rebar cutting and bending machine – power: 5 kW	5

(Source: Cost estimate for project basic design, 2024)

Table 1.16. List of Construction Equipment and Machinery under Kien Giang subproject

NO.	Machinery and equipment	Quantity (item)	NO.	Machinery and equipment	Quantity (item)
1	30-ton floating crane	1	11	Barge	5
2	Speedboat	1	12	1,200 HP dredging vessel	1
3	Sand pump with 1216 CV diesel engine	2	13	Tugboat 360CV	1
4	Water pump with 30 HP diesel engine	2	14	Tugboat 150CV	2
5	25T crane	5	15	16T road roller	3
6	Electric welding machine	10	16	25T road roller	1
7	50T crane	5	17	Rebar cutting and bending machine	10
8	Generator	1	18	Concrete vibrator	10
9	Piling vessel	2	19	Clamshell dredger	2
10	10-ton dump truck	10	20	Tugboat 1200CV	3

(Source: Cost estimate for project basic design, 2024)

Table 1.17. List of construction equipment and machinery of Bach Long Vi subproject

No.	Machines/Equipment	Quantity (pcs)	No.	Machines/Equipment	Quantity (pcs)
1	30 Ton Floating Crane	1	8	360CV Tugboat	1
2	Canoe	1	9	150CV Tugboat	1
3	25T Crane	3	10	Bending Cutter	5
4	Electric Welding Machine	5	11	Concrete Compressor	5
5	50T Crane	3	12	Grab bucket digger	1
6	10 ton dump car	5	13	1200CV Tugboat	1
7	Barge	5			

(Source: Project Basic Design Estimate, 2024)

1.6 Demand for construction materials and labors**1.6.1. Material used and supply source****✓ Demand for material**

According to the project's feasibility study report, the demand for input construction materials is estimated as follows:

Table 1.18. Quantity of main construction material for subprojects

No	Material	Unit	Quantity (m3)	Conversion coefficient	Volume (ton)
I	Lach Hoi subproject				
1	Sand	m ³	12,998	1.3	16,897
2	Stone	m ³	20,447	1.6	32,715
3	Steel	Ton	795	-	795
4	Cement	Ton	2,983	-	2,983
II	Lach Bang subproject				
1	Sand	m ³	8,321	1.3	10,817
2	Stone	m ³	15,169	1.6	24,270
3	Steel	Ton	920	-	920
4	Cement	Ton	2,144	-	2,144
III	Tam Quan subproject				
1	Sand	m ³	4,918	1.3	6,393
2	Stone	m ³	75,216	1.6	120,345
3	Steel	Ton	1,331	-	1,331
4	Cement	Ton	3,646	-	3,646
5	Geotextile	m ²	77,437	-	-
IV	Khanh Hoa subproject				

No	Material	Unit	Quantity (m3)	Conversion coefficient	Volume (ton)
1	Cement	ton	9,616	-	9,616
2	Sand	m ³	12,325	1.3	16,022
3	Stone	m ³	23,036	1.6	36,857
4	Steel	Ton	5,113	-	5,113
5	Geotextile	m ²	1,907	-	-
6	Paint	Ton	0.13	-	0.13
7	Backfill soil (leveling)	m ³	7,973	2.4	19,135
8	Geotube	md	127	-	-
V	Kien Giang subproject				
1	Sand	m ³	339,005	1.3	440,706
2	Stone	m ³	24,545	1.6	39,272
3	Steel	Ton	1,770	-	1,770
4	Cement	Ton	10,099	-	10,099
5	Geotextile	m ²	84,517	-	-
6	Backfill soil (leveling)	m ³	163,338	2.4	392,001
VI	Bach Long Vi subproject				
1	Cement	Ton	3,409	-	3,409
2	Sand	m ³	4,620	1.3	8,346
3	Stone	m ³	22,832	1.6	36,531
4	Steel	ton	219	-	219

(Source: Cost estimate for project basic design, 2024)

✓ **Source of supply for materials, construction materials, and main transportation route**

- Materials such as sand, soil materials, stone, and gravel will be purchased from supply units in the area, districts within the subproject region in the province/city, or neighboring provinces and cities. For the Kien Giang subproject (requiring approximately 163,338 m³ of embankment soil), it is expected to source from licensed quarries in Kien Giang province, such as the quarry of Ly Tuc Bach One-Member Limited Liability Company in Thuan Yen commune, Ha Tien city.
- Steel, cement: Steel will be purchased from supply units in the district within the subproject region in the province or neighboring provinces and cities. For Bach Long Vi subproject, construction materials such as steel, cement, sand, and stone are purchased by contractors from suppliers in Hai Phong city and then transported by sea from Dinh Vu port (Hai Phong city) to the island, which is about 170 km away. The transportation of raw materials from the mainland to the island will be carried out by the supplier and is not within the scope of the project.

The project (all 6 subprojects) does not include any items related to the exploitation of sand, stone, and soil materials; therefore, there is no requirement to open any new quarries. No quarries are exclusive sources for the project. All materials will be quality-checked and have

their prices published by the Departments of Construction in each project province/city to ensure that the material sources are legally licensed for exploitation.

A summary of material sources and main transportation routes for the six subprojects is described in the table below.

Table 1.19. Source of materials and main transportation route for Lach Hoi Fishing port upgrading and expansion subproject

Location	Material used	
	Backfill material	Construction material (Bricks, cement, sand, stone, and other materials)
Nghi Son town – Thanh Hoa province	Not use	Use supply sources from suppliers in Thanh Hoa province: • Bim Son cement • Tan Thanh 9 bricks • Thai Nguyen steel, Hoa Phat steel • Sand from the sand mine in Cam Ngoc commune, Cam Thuy district, with an area of 21.6 ha; sand and gravel mines licensed by the Thanh Hoa Provincial People's Committee, mainly concentrated along the Chu River and Ma River.

Main transportation route:

- The road transport route includes National Highway 47, Nam Song Ma Boulevard, Tran Hung Dao Street, and Au Co Street.

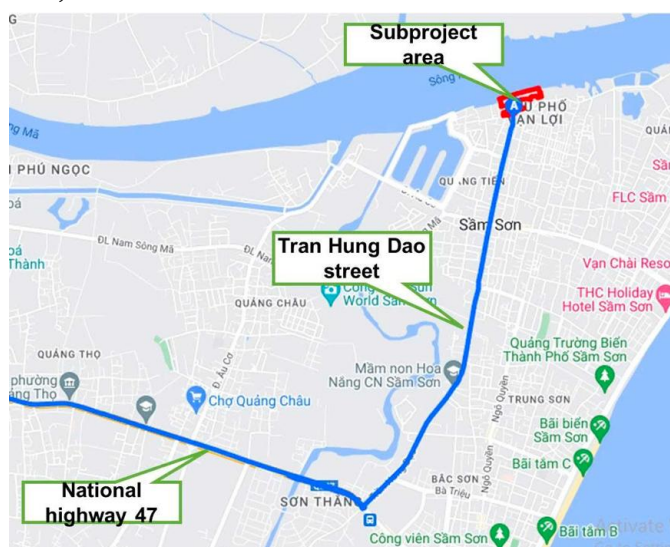


Table 1.20. Source of materials and main transportation route for Lach Bang Fishing port upgrading and expansion subproject

Location	Material used	
	Backfill material	Construction material (Brick, cement, sand, stone and other materials)
Nghi Son town – Thanh Hoa province	Not use	Use supply sources from suppliers in Thanh Hoa province: • Bim Son cement • Tan Thanh 9 bricks • Thai Nguyen steel, Hoa Phat steel • Sand from the sand mine in Cam Ngoc commune, Cam Thuy district, with an area of 21.6 ha; sand and gravel mines licensed by the Thanh Hoa Provincial People's Committee, mainly concentrated along the Chu River and Ma River

Main transportation route:

The road transport route includes National Highway 1A, the coastal road, and the saltwater prevention dike

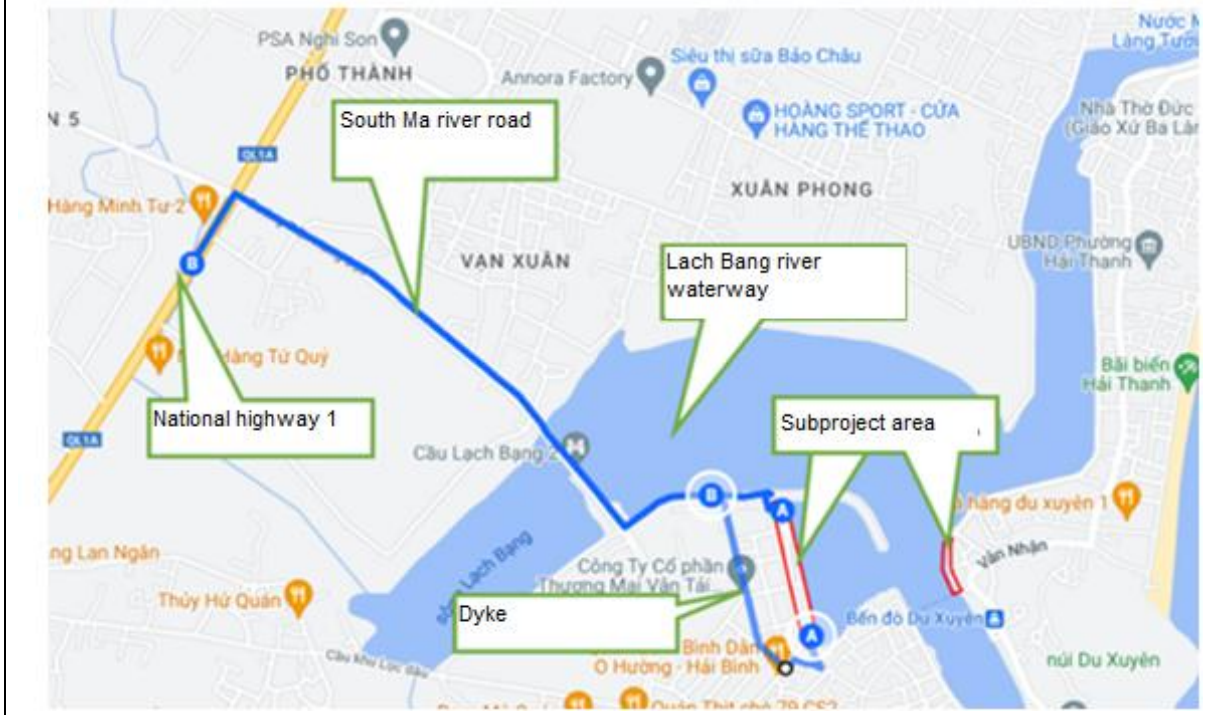


Table 1.21. Source of material and main transportation route for Tam Quan subproject

Location	Material used	
	Backfill material	Construction material (Brick, cement, sand, stone and other material)
Hoai Nhon town-Binh Dinh province	Utilize a portion of the dredged materials from the project.	Use supply sources from suppliers in Binh Dinh province: • Dong Lam cement, Nghi Son cement • An Nhon sand and stone, Nhon Hoa... • Song Dinh sand mine, Village 4, An Trung commune, with a reserve of 88,500 m³ • Lien Hoi sand mine, Kim Son River, Xuan Son village, An Huu commune, Hoai An district, with a reserve of 139,000 m³...

Main transportation route:

- The road transport route includes provincial road 638, Tran Quoc Toan Street, and Thong Nhat Street.

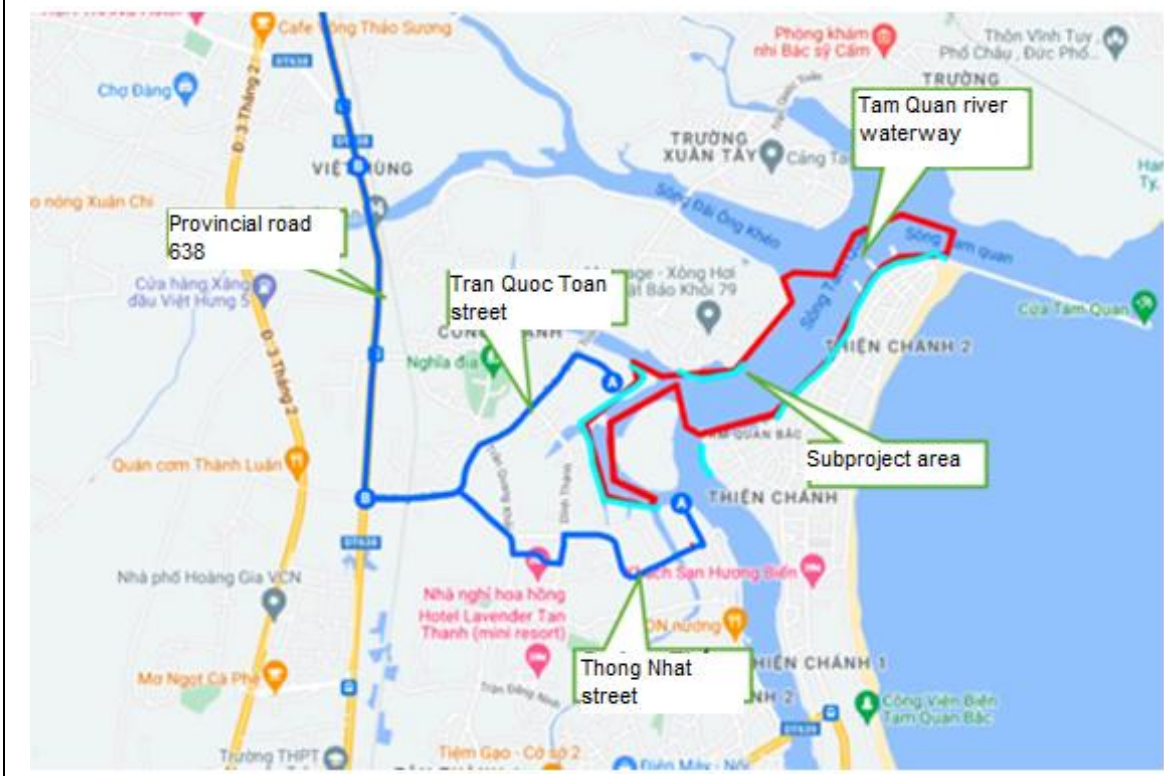


Table 1.22. Source of material and main transportation route for Khanh Hoa subproject

Location	Material used	
	Backfill material	Construction material (Brick, cement, sand, stone and other material)
Cam Ranh – Khanh Hoa	Utilize dredged materials from the project	Use supply sources from suppliers in Khanh Hoa province: • Song Gianh cement • Nui Sam stone mine • Hoa Phat steel • Sand from two mines in Dien Lam and Dien Xuan (Dien Khanh district).

Main transportation route:

- The road transport route includes National Highway 1A, Nguyen Trong Ky Street, Nguyen Trai Street, and March 3rd Street.



Table 1.23. Source of material and main transportation route for Kien Giang subproject

Location	Material used	
	Backfill material	Construction material (Brick, cement, sand, stone and other material)
An Bien district – Kien Giang province	Utilize dredged materials from the project and material mines within the province and nearby areas (expected from licensed soil mines in Kien Giang province, such as the soil mine of Ly Tuc Bach One-Member Limited Liability Company in Thuan Yen commune, Ha Tien city)	Use supply sources from suppliers in Kien Giang province: • Ha Tien cement • Hon Soc stone mine • Mien Nam steel • Sand mines in Chau Thanh district, Cho Moi... • Hoa Hung - 4 leveling sand mine (Hoa Hung commune, Cai Be district, Tien Giang province) operated by Hoang Hai Joint Stock Company, with a total water surface area of 23.2238 ha and an approved mineral extraction volume of 1,858,031 m³.

Main transportation route:

- Roads including NH63, NH61, NH80.



Table 1.24. Source of materials and main transportation routes of Bach Long Vi subproject

Location	Materials used	
	Leveling Materials	Building Materials (Brick, cement, sand, stone and other materials)
Hai Phong city through Dinh Vu port to Bach Long Vi island	Do not use	Materials will be bought from suppliers on the mainland and transported by sea from Dinh Vu Port (Hai Phong) to Bach Long Vi Island. The distance from Dinh Vu Port to Bach Long Vi Island is 171 km. The means of transport will be ships

The main material transportation route is according to the following diagram:



Diagram of the route for transporting materials from the mainland to the project area

✓ Supply of electricity, water and energy

- Water supply: Water for construction and daily use by staff and workers will be sourced from the available clean water supply in each project area.

For Kien Giang subprojects, groundwater from drilled wells is expected to be used for construction water supply.

For Bach Long Vi subproject, although it is located outside the island, because the construction area is within the scope of Bach Long Vi Fishing Port, this place has a source of clean water and electricity supplied by the Power Company and Bach Long Vi District Clean Water Company, so the construction process and when the project is put into operation, the current electricity and water supply for fishing ports will continue to be used by the subproject.

- Electricity demand: Electricity will be sourced from the existing low-voltage power grid near each subproject site.
- Fuel (diesel and gasoline): Construction machinery will be powered by fuel supplied by local petroleum companies. With the existing distribution network, fuel supply for each subproject is relatively convenient.
- Particularly for Bach Long Vi subproject, the petroleum distribution network will be more difficult, but currently, there is a petroleum retail store of Ha Thinh Co., Ltd. on the island, so it is expected that the subproject will also use this supply. To ensure fire and explosion safety, the project will strictly prohibit contractors from storing petrol and oil in the construction area, with the principle being to buy there at a petrol retail store.

1.6.2. Other auxiliary works

❖ Worker demand and temporary worker camp

During the construction of work items under each subproject, temporary worker camps are expected to be built. The estimated total workforce for the entire project is around 420 workers, with the number of workers at each subproject site ranging from approximately 50 to 120. The projected workforce for each subproject is detailed in the table below

Table 1.25. Expected number of workers at each subproject

No	Subproject	Number of workers (people)	Expected construction time (month)
1	Lach Hoi subproject	60	36
2	Lach Bang subproject	50	36
3	Tam Quan subproject	80	36
4	Khanh Hoa subproject	100	36
5	Kien Giang subproject	120	36
6	Bach Long Vi subproject	20	18
	Total	420	

(Source: Cost estimate for project basic design, 2024)

The estimated timeline includes:

- Clearing/demolition for site preparation: 1 – 6 months, depending on the subproject.

- Ground leveling: 1 – 6 months (Khanh Hoa subproject: 1 month; Kien Giang subproject: 6 months).
- Dredging works: 6 – 24 months (Tam Quan subproject: 24 months; Khanh Hoa subproject: 12 months; Kien Giang subproject: 6 months; Bach Long Vi subproject: 18 months).
- Construction of other project components: 12 – 24 months.

❖ **Access Roads**

All six subprojects do not require the construction of access roads for construction purposes, as existing roads provide convenient access to the project areas.

❖ **Workforce Requirements for the Operation Phase**

During the operation phase, management, operation, and maintenance will be handled by the Project Management Units (PMUs) of each subproject. The estimated number of staff and workers required for operation at each subproject is as follows:

Table 1.26. Number of staff/officer of each subproject in operation phase

No	Description	Number of staff/officers for operation (expected)
1	Lach Hoi subproject	30
2	Lach Bang subproject	30
3	Tam Quan subproject	20
4	Khanh Hoa subproject	75
5	Kien Giang subproject	75
6	Bach Long Vi subproject	20
	Total	250

1.7 Waste Disposal and Temporary Storage Requirements

1.7.1. *Volume of Demolition, Excavated soil, and Excess Dredged Materials from the Project*

Solid waste generated during the construction phase that needs to be treated includes dredged biomass material, soil from excavation for the construction of subprojects, household waste from worker camps, and debris from demolishing existing structures. The table below lists the volume for each subproject:

Table 1.27. Demolition, Earthwork, and Dredged Material Volumes from Project

No.	Subproject	Demolition/clearance volume (m³)	Excavated soil volume (m³)	Dredged volume (m³)	Backfill volume (m³)	Excavated soil volume reused for on-site filling (m³)	Excavation volume, material to be disposed of (m³)
		1	2	3	4	5	6=2+3-5
1	Lach Hoi subproject	1,285	16,040	0	0	0	16,040
2	Lach Bang subproject	900	14,914	0	0	0	14,914
3	Tam Quan subproject	0	119,653	523,224	0	334,406	308,471
4	Khanh Hoa subproject	0	7,973	69,333	7,973	6,012	71,294
5	Kien Giang subproject	2,500	12,459	5,432	163,338	12,459	5,432
6	Bach Long Vi subproject	4,278	0	51,000	0	0	51,000
	Total	8,963	171,039	648,989	171,311	352,877	467,151

(Source: Cost estimate for project basic design, 2024)

1.7.2. Dredged material disposal sites

Debris from demolishing existing structures and the plant biomass from land clearing will be collected and disposed of at the designated waste disposal sites in coordination with local authorities.

The volume of excavated soil and surplus dredged material generated during the construction will be taken to waste disposal/disposal sites to avoid environmental impacts and to facilitate future resource utilization. Based on considerations such as the volume of materials, characteristics/contents, transport distance, and the current state of the project area, the disposal sites for the excavated soil and surplus materials for each subproject have been selected as follows:

Table 1.28. Disposal sites for excavated soil and surplus materials for each subproject

No.	Subproject	Volume of excavated soil and surplus materials to be disposed of (m ³)	Area of the disposal site (ha)	Capacity (m3)	Transportation distance (Km)
2	Lach Hoi subproject	16,040	The volume to be disposed of primarily consists of excavated soil and construction debris. Therefore, these two subprojects will contract with the relevant authorities to collect, transport, and process the materials.		
3	Lach Bang subproject	14,914			
4	Tam Quan subproject, site 1	308,471	2.47	130,000	0.4
	Tam Quan subproject, site 2		2.4	120,000	0.5
5	Khanh Hoa subproject, site 1	71,294	2.64	52,800	0.5
	Khanh Hoa subproject, site 2		0.5	12,000	0.3
6	Kien Giang subproject	5,432	Utilize the land within the port area of the project (for later phase).		
7	Bach Long Vi subproject, site 1	55,828	4.0	55,000	0.5
	Bach Long Vi subproject, site 2		0.48	12,000	1.3
	Bach Long Vi subproject, site 3		0.65	9,000	0.7

The table below lists and describes the existing status of the temporary disposal sites for each subproject.

Table 1.29. Temporary disposal sites for excavated soil and dredging materials by subprojects

Name, capacity of the site	Location	Description of existing status
1. Lach Hoi subproject: There is no disposal site as there is no dredging activity.		
2. Lach Bang subproject: There is no disposal site as there is no dredging activity.		
3. Tam Quan subproject		
Tam Quan Disposal Site 1 - Area: 2.47 ha - Capacity: 100,000 m ³	- Location: Dong-Tay Cong Stone Area, Tam Quan Bac Ward, Hoai Nhon Town, Binh Dinh Province - Adjacent areas: Bordered by Cong Thach residential area (north and west), and Tam Quan River with Dinh Thach–Cong Thach Road (south and east). - Transport distance: 0.4 km from the construction site to the disposal area.	- The site consists of agricultural land, mainly aquaculture ponds, in the densely populated Cong Thach residential area. - According to the planning by the PC's of Hoai Nhon District, the disposal site area Tam Quan planned for fishing infrastructure; land acquisition is underway. - The area includes abandoned rice fields and ponds (2–3m deep), to be filled and raised by 1–2m.  location of the dredged material disposal site.  Existing status of the dredged material disposal site
Tam Quan 2 disposal site - Area: 2.4ha - Capacity: 120,000 m ³	- Location: Cong Thach neighborhood, Tam Quan Bac Ward, Hoai Nhon Town, Binh Dinh Province. - Adjacent areas: Bordered by Tran Quoc Toan Street (north and west), Tam Quan River (south), and Cong Thach residential area (east).	- The site includes abandoned and active aquaculture ponds in Cong Thach residential area. - As per Hoai Nhon District PC's planning, the area is designated for a resettlement zone linked to the fishing port (Zone B); land acquisition is underway.

Name, capacity of the site	Location	Description of existing status
	Transport distance: 0.5 Km from construction site to disposal area	Ponds are 2–3m deep; after filling, elevation will be raised by 1–2m above current ground level.  location of the dredged material disposal site  Existing status of the dredged material disposal site
4. Khanh Hoa subproject		
- Khanh Hoa 1 disposal site - Area: 2.64 ha - Capacity: 52,800m³	- Location: Within Da Bac Port, Cam Linh Ward, Cam Ranh City, Khanh Hoa Province. - Adjacent areas: Bordered by household fish ponds (north and east, separated by port fence), Vinh Khuong shipbuilding workshop and Da Bac port warehouses (south), and an empty plot within the port (west). - Transport distance: 0.5 Km from construction site to disposal area	- The site currently includes an unused fish farming pond; land recovery is completed, and the area has been used to store dredged materials from Da Bac Port. - Located within Da Bac Port, the temporary disposal site poses no risk of dredged material dispersal outside the port area. - The site is planned for future infrastructure development under the Khanh Hoa large-scale fisheries center. Ponds are 2–3m deep and will be filled to match the current surface level.  Location of the disposal site

Name, capacity of the site	Location	Description of existing status
		 Existing status of the disposal site
- Khanh Hoa Disposal Site 2 - Area: 0.5 ha - Capacity: 12,000m ³	- Location: Within Da Bac Port, Cam Linh Ward, Cam Ranh City, Khanh Hoa Province. - Adjacent areas: Bordered by Nguyen Trai Street and port warehouses (north); the access channel into Da Bac Port surrounds the site on the south, east, and west. - Transport distance: 0.3 Km from construction site to disposal area	- Current status: The water surface lies within Da Bac Fishing Port and is used to store dredged materials from the water area, turning basin, and service wharf channel. The area will be leveled to match the existing elevation after filling. - Future use: Once filled, the temporary disposal site is planned for development into facilities such as parking areas and service buildings for the Khanh Hoa Major Fisheries Center.  Location of the site  Existing status of the site
6. Kien Giang subproject		
Kien Giang Disposal site - Area: 0.6 - Capacity: 12,000 m ³	Location: Nga Bat Hamlet, Tây Yên A Commune, An Biên District, Kiên Giang Province.	The location is within the Kien Giang subproject area (land reserved for later development)

Name, capacity of the site	Location	Description of existing status
	Transport distance: Within the project's land area; no external transport required.	phase).  Existing status of the site
6. Bach Long Vi subproject		
Disposal site No. 01: - Area 4.0 ha (length 433 m, width, average 100 m). - Capacity: 55,000m3	• Location: Near the concrete road encircling Bach Long Vi Island, including part of the eastern tidal flats adjacent to the sea. • Transport distance from project area: about 0.5 km. • Transport route: Materials will be moved by 10-ton trucks via a 3.5-meter-wide concrete road around the island, suitable for such vehicles (see image below).  (photographed at the location of the disposal site 01)	• Current condition: The area consists of exposed base rock with no vegetation and lies 1.2–1.5 meters below the dike road surface. It is not regularly flooded, except during high tides or extreme weather. • Planning and approval: The site lies between the island's coastal development zone and the ecological restoration zone of the Bach Long Vi MPA. It has low conservation value and is designated for commercial service use in the island's sea reclamation plan, approved by the MARD and Hai Phong City People's Committee¹⁰.  Location of disposal site No. 01 Bach Long Vi Island has not yet determined the average tidal line, so approximately 20% of the reservoir area may fall within the tidal flat zone.

¹⁰ Document No. 2397/UBND-MT dated 30/10/2024 of Hai Phong City approves the location for dumping dredged materials for the subproject of upgrading and repairing fishing ports combined with storm shelter anchorages for fishing vessels on Bach Long Vi Island.

Name, capacity of the site	Location	Description of existing status
		 Status of disposal site area No. 1

1.8 Construction method

With the characteristics of the project, it is the construction of items to serve the construction of fishing ports and some works are combined places for ships to take shelter from storms. The construction sites of subprojects are mostly located close to the sea. Therefore, other construction methods are similar between subprojects.

1.8.1. Lach Hoi Fishing Port upgrading and expansion subproject

❖ Wharf Construction

- Prepare the construction site, clear obstacles within the construction area, and establish control points for the project;
- Conduct pilot piling for the wharf structure, with the piling equipment possibly being a piling barge;
- Once the official pile length is decided, proceed with the mass piling;
- Install reinforcement and pour concrete to form the pile head connections;
- Install formwork, reinforcement, and pour concrete for the wharf's horizontal and vertical beams;
- Assemble precast panels, install reinforcement, and pour concrete for the bridge deck;
- Pour concrete for the deck surface and create the slope for the wharf;
- Install anchor flanges, fender pads, and gangways. Apply anti-corrosion paint on steel details and paint vehicle barriers.

❖ Shore Protection Revetment:

- Set out the project alignment;
- Dredge the foundation of the revetment;
- Construct the stone base of the revetment using a crane mounted on a barge combined with a stone-carrying barge. This section does not require piling as the current shoreline foundation is stable, so only stone cages need to be dropped to protect the natural slope;
- Lay geotextile fabric using machinery combined with manual labor;
- Install stone revetment slopes using a crane on a barge with a stone-carrying barge;
- Install the surface cover for the revetment using a crane mounted on a barge, combined with divers;
- Build the concrete structure for the revetment top road.

❖ Architectural Works:

- Construction of architectural structures: administration building, specialized warehouses, transit warehouses, seafood sorting and storage facilities, etc., with the construction process proceeding from foundation work to walls, roofing, plastering, wall painting, and door installation.
- Excavation for foundation pits: Excavation is done to the specified depth as shown in the drawings, with measures for foundation pit support to ensure the safety of workers and the structure.
- After completing the excavation, the pouring of concrete base and foundation or masonry

work will commence.

- Pouring in-situ reinforced concrete (RCC) structures must ensure the integrity of the concrete.
- Construction of frame beams, roof framework, and roof covering.
- Finishing works: plastering, painting, door installation, basic interior fittings.

❖ **Technical Infrastructure Systems:**

- The technical infrastructure includes the following facilities: power supply & lighting, water supply & drainage, wastewater drainage, and WWTP.
- Power supply & lighting: Electrical equipment must be calibrated and tested by a qualified body before installation and trial operation. All lamp posts must be grounded, with the grounding resistance value below 10Ω during construction. If the required grounding resistance is not met, additional grounding rods must be installed. The work must comply with technical standards and industry regulations for electrical systems.
- Water drainage and wastewater treatment system: Drainage system construction is combined with site leveling; pipes and trenches are installed according to the drawings. Wastewater is conveyed to the treatment plant via gravity pipes or pumps; after treatment at the plant, it is returned to the general drainage system.
- Water supply system: All water supply pipelines must undergo pressure testing, leakage inspection, and flushing after construction.
- Pay attention to the intersections of systems according to the priority of the design.

1.8.2. Lach Bang Fishing port upgrading and expansion subproject

Lach Bang subproject will build the shore protection revetment, architectural works, technical infrastructure systems. These items have similar construction solutions to the Lach Hoi subproject above. The items with different construction solutions of the Lach Bang sub-project are as follows.

❖ **Site Levelling for the Port (Hai Thanh Ward Port):**

- Marking and setting up reference piles at control points for site levelling;
- Backfill material for site levelling is either purchased or sourced from dredged material from the water area if it meets quality standards;
- The site foundation is levelled while also constructing the drainage system;
- Construction proceeds from the inside out, with equipment including bulldozers and rollers/compactors.

❖ **New Wharf Construction (Hai Thanh Ward Port):**

- Site preparation, demolition of unsuitable existing structures, clearing obstacles in the construction area, and setting control points for the construction of the wharf;
- Excavating the wharf foundation pit with a grab dredger, loading onto barges, and transporting it to temporary storage areas via waterways;
- Construction of a stone bedding layer and crushed stone base under the foundation;
- Placement of prefabricated concrete blocks for the lower part of the wharf structure;
- Installation of formwork for pouring concrete for the upper part of the wharf structure;
- Pouring stone behind the prefabricated blocks and anti-scouring stone using a 25T crane on

- a 400T barge;
- Installing geotextile fabric behind the stone fill to relieve pressure and proceed with site levelling behind the wharf;
- Installing a geotextile layer up to the wharf surface and crushed stone;
- Installing additional accessories such as fender pads, anchor flanges, etc., and completing the handover of the wharf.

1.8.3. Tam Quan storm shelter upgrading investment subproject

Tam Quan subproject will build the shore protection revetment, architectural works, technical infrastructure systems. These items have similar construction solutions to the Lach Hoi sub-project above. The items with different construction solutions of the Tam Quan sub-project are as follows.

❖ *Sloped Shore Protection Revetment:*

- Excavation of the underwater revetment with a bucket dredger, combined with a backhoe to adjust the revetment slope;
- Installing geotextile fabric;
- Pouring a reverse filtration crushed stone layer;
- Pouring large stones on the revetment slope;
- Constructing corner walls;
- Installing reverse filtration layers after the corner walls;
- Site restoration after the revetment;
- Construction of access roads behind the revetment;
- Final inspection, acceptance, and handover.

❖ *Dredging of Ship Channel and Water Area:*

- Prior to dredging, conduct a survey and clear any mines and obstacles;
- Define the dredging area using buoys;
- Depending on the geological conditions of the dredging area, select the appropriate construction method: suction dredgers or bucket dredgers combined with barges to transport the dredged materials to a designated collection point. The collection point must be precisely identified to ensure compliance with environmental requirements;
- The process of dredging and transporting materials is closely monitored and complies with legal regulations to ensure the material is deposited in the approved location;
- Construction methods at the dredged material storage area: The dredged material storage area will be enclosed with sandbags (or a geotube structure) and/or dredged sand, with the embankment height at the approved design level; primary sedimentation pits and water collection pits will be created during the filling process. The water drained from the dredged material will flow through temporary drainage channels to the sedimentation pit before being released into the receiving water body.

1.8.4. Khanh Hoa Major fishery center construction & upgrading investment Subproject

Khanh Hoa subproject will build the wharf construction shore protection revetment, architectural works, technical infrastructure systems. These items have similar construction

solutions to the Lach Hoi sub-project above. The items with different construction solutions of the Khanh Hoa sub-project are as follows.

❖ **Site Levelling for the Port:**

- Marking and setting up reference piles at control points for site levelling;
- Backfill material for site levelling is either purchased or sourced from dredged material from the water area if it meets quality standards;
- The site foundation is levelled while also constructing the drainage system;
- Construction proceeds from the inside out, with equipment including bulldozers and rollers/compactors.

1.8.5. Kien Giang major fishery center construction & upgrading investment subproject

Kien Giang subproject will build the wharf construction shore protection revetment, architectural works, technical infrastructure systems. These items have similar construction solutions to the Lach Hoi sub-project above. The items with different construction solutions of the Kien Giang sub-project are as follows.

❖ **Clearing and Land Acquisition Measures:**

The clearing process is carried out in the following steps: (i) preparation for cutting, defining boundaries, and preparing the site; (ii) mobilizing machinery, tools, and labor to the site; (iii) cutting and trimming trees; (iv) removing, transporting, and handling biomass material from clearing.

- Preparation for cutting: Notify the local government and surrounding communities about the clearing at least two weeks before beginning the clearing process. Define the boundaries of the area to be cleared based on existing stakes and markers to precisely identify the area to clear.
- Marking the clearing boundaries: The proposed method will combine machinery and manual labor, so machinery, tools, and labor will be mobilized to the site, including barriers, flags, whistles, ropes, various saws, crowbars, wedges, knives, hammers, hoes, shovels, pull cables, and trucks for transporting the cleared material/waste.
- Cutting or digging tree stumps: The process involves cutting branches from the bottom up, lowering the trunks from top to bottom, and only performing this if the tree's height is no more than 3-4 meters. Determine the fall area, the direction of the tree's fall, the length and width of the fall zone, and a convenient place to transport logs and firewood. If there is no wide enough space to drop the tree, cut the trunk into shorter sections to ensure safety.
- Cleaning up branches and digging out stumps: All objects such as trees, tree stumps, roots, grass, debris, and other obstacles must be dug out, cleaned, and removed from the site and then reused or discarded at a designated location. The stumps and roots within the embankment area should be removed to a depth of at least 50 cm from the natural ground surface. For the roadbed area, all tree roots and trunks should be removed to a depth of at least 50 cm below the foundation layer of the road structure.
- Loading, transporting, and stockpiling clearing material: Materials obtained from the site preparation process, which can be reused for other tasks or sold to recycling facilities (such as tree trunks and branches), must be stockpiled at a designated area on-site. Waste materials and hazardous substances should be transported and disposed of at approved disposal sites.

❖ **Port area backfilling work**

- Position and stake out reference points for the embankment filling area.

- Use backfill material purchased or sourced from dredged materials from water areas, if they meet quality requirements.
- Fill the embankment area while installing drainage systems.
- Work in an outward direction from the center, using bulldozers, rollers, and compactors.

1.8.6. Bach Long Vi Storm Shelter upgrading and construction subproject

With the characteristics of the project, it is the construction of items to serve the construction of fishing ports and some works are combined places for ships to take shelter from storms. The construction sites of subprojects are mostly located close to the sea. Therefore, the construction measures are similar between subprojects.

For the subproject fishing port and storm shelter anchorage area for Bach Long Vi fishing vessel, construction measures for specific work items are as follows:

❖ Construction of a new pier >15m, 80m long, 20m wide

The construction method is applied sequentially according to the following steps:

- Preparation of construction sites: clearing and clearing obstacles in the construction area, locating control points in the construction area;
- Casting blocks stacked on the temporary yard;
- Remove the cushion and install the stacking blocks, then pour the back box stone wall;
- Erecting formwork and reinforcement to pour concrete on the wharf;
- Pouring bridge deck overlay concrete and creating a wharf slope;
- Installation of anchor flanges, ship cushions, and ladders up and down. Carry out anti-rust coating for steel details and car barrier ledge paint;

❖ Upgrading the current western breakwater with a total length of 500m:

- Applying the cover of the dike roof with a crane placed on the buoy;
- Construction of concrete structures on the top of the dike.

❖ Dredging of storm shelter anchorage (area of 10.2ha) and fairway (area of 3.3ha), bottom elevation from -1.1m to -2.9m (expected dredging volume of 51,550m³):

- Perfect inspection, clearance, clearance of bombs and mines and obstacles;
- Locate the dredging range with a buoy;
- Depending on the geology of the dredging area, select a suitable construction plan: Use a rock breaker combined with a barge for dredging and then use a car to transport it to the planned dumping sites for dredged materials (yards No. 01, 02, and 03);
- The supervision of the construction process and transportation of dredged materials complies with the provisions of law; ensure the gathering at the right assigned location and in accordance with the process prescribed by the law.

1.9 Total Investment, Project Implementation Schedule:

- The total investment : VND 2,682,533,761,000, equivalent to 115.60 million USD.
- Financial Mechanism of the Project:
 - IBRD loan from the World Bank: VND 1,938,464,489,000, equivalent to 83.6 million USD.

- Counterpart funding: VND 703,819,272,000, equivalent to 30.4 million USD.
- Non-refundable aid from donors: VND 40,250,000,000, equivalent to 1.61 million USD.

The total investment for each subproject is summarized in the table below.

Table 1.30. Total investment of each subproject

No	Subproject	Investment fund (VND)
1	Subproject for “Construction of Thuy Tan fishing port – Thai Binh province”	280,515,687,730
2	Subproject for Lach Hoi fishing port upgrading and expansion subproject	310,915,535,521
3	Subproject for Lach Bang fishing port upgrading and expansion subproject	132,315,941,534
4	Subproject for “Construction of Tam Quan fishing port and storm shelter”	221,508,860,014
5	Subproject for “Construction of Khanh Hoa major fishery center”	439,726,000,000
6	Subproject for “Construction of Kien Giang major fishery center”	180,000,000,000
7	Subproject for “Construction and upgrading Bach Long Vi fishing port and storm shelter”	470,734,221,000

Expected project implementation timeline: 2025 – 2030

- 2023 and 2024: Conduct legal preparation tasks for the project.
- 2025 to 2030: Design detailed plans and implement construction for the subprojects within the scope of the project.
- Q4/2030: The project will be put into use.
- For Bach Long Vi subproject, the total construction time is expected to be 18 months.

1.10 Project implementation arrangement

Project managing agency: Ministry of Environment and Agriculture (MAE) Investor: Project Management Board of Agricultural Projects.

- Form of project implementation management: The investor directly manages the project.
- The project managing agency is the MMA The investor of the project is the Project Management Board of Agricultural Projects. The Project Management Board of Agricultural Projects will directly coordinate with relevant agencies and departments (departments under the MAE, relevant ministries and local agencies, etc.).
- There is a group of officials in charge of the project's environment.

a. Preparation and construction phase

Supervision during the construction phase: The project owner will hire an independent supervision consultant before construction to supervise the construction and another independent consultant to supervise the safety of the social field at the sub-projects. The supervision period is from the start of construction to the time the project is put into operation.

The independent monitoring consultancy unit on environmental safety will carry out supervision at all 6 subprojects with the support for the project owner, the Agricultural Project Management Board, to supervise the entire environmental and social safety of the project, ensure that issues of environmental safety, occupational safety and health, social issues as well

as compensation and resettlement of the project are fully implemented by the project owner. Independent supervision consultants will carry out on-site supervision activities on environmental safety, occupational safety and health on a regular basis every 3 months; supervise social issues, compensation and resettlement work on a periodic basis every 6 months. Before conducting supervision activities, the independent supervision consultant is responsible for developing a detailed implementation plan and submitting it to the Management Board of Agricultural Enterprises and the World Bank for approval of 01 start-up report. After each periodic monitoring at the site, the consultant will make 01 report on the monitoring results to be submitted to the Management Board of Agricultural Enterprises and before the end of the consultation, there will be 01 report summarizing the monitoring results and at the same time giving recommendations for the project when it is put into operation so that environmental safety is fully implemented. Details of the work of the independent environmental and social monitoring consultant will be described in the environmental management and monitoring plan chapter of this report.

When the project is put into operation: Environmental and social safety monitoring activities will be carried out by the operation management unit.

In addition, at each sub-project, construction contractors and construction assassination consultants will also be required to have full-time staff to supervise and carry out daily environmental safety work at the construction site.

The organizational diagram in the construction phase is shown in the following figure:

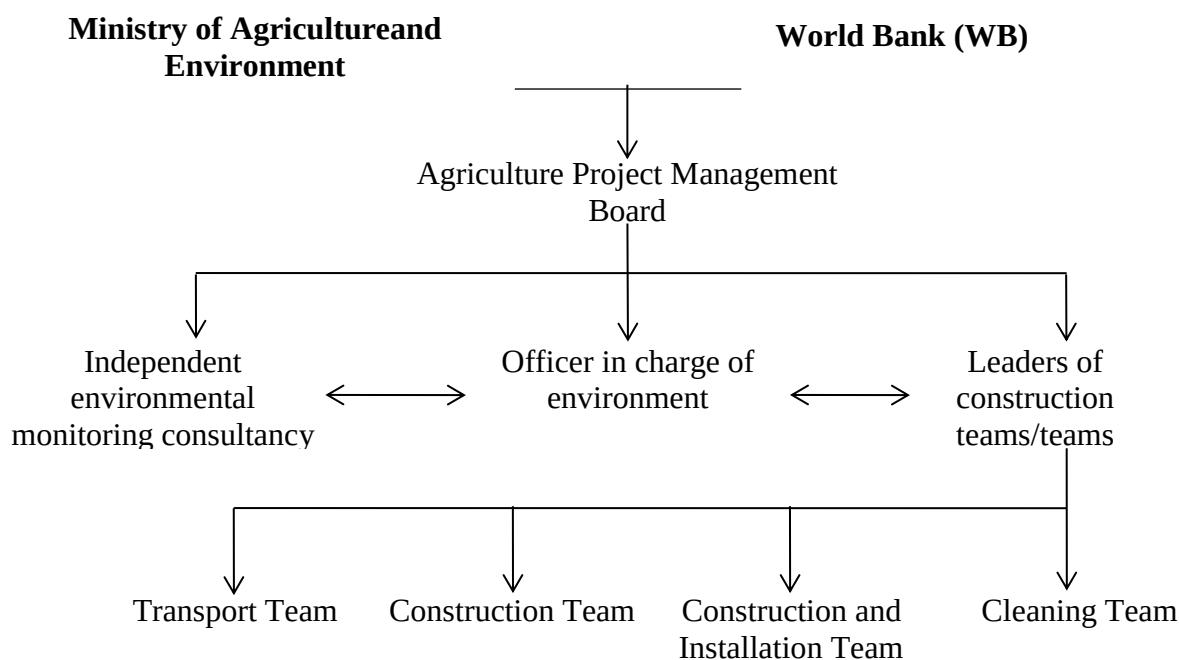


Figure 1.32. Management organization chart in the construction stage

b. Operational Phase

When the project is put into operation, the project owner will hand over the project to the Management Board of Fishing Ports, anchorages and large fishery centers at each subproject for direct operation and management.

- The PMU shall also establish an environmental team or have professional environmental officers to carry out the environmental protection work of the project.

- Annually, PMU shall make periodic reports on the implementation of environmental protection of sub-projects under their management and submit them to management agencies in accordance with regulations.

The units that manage, operate and maintain the works are expected to be listed in the table below:

Table 1.31. Expected management unit of each subproject

No	Name of subproject	Unit for management, operation and maintenance
1	Subproject for Lach Hoi fishing port upgrading and expansion subproject	Thanh Hoa fishing port management board
2	Subproject for Lach Bang fishing port upgrading and expansion subproject	
3	Subproject for “Construction of Tam Quan storm shelter”	Hoai Nhon Town Fishing Port and Urban Services Management Board
4	Subproject for “Upgrading and Expanding of Khanh Hoa major fishery center”	Khanh Hoa Fisheries Infrastructure Management Center
5	Subproject for “Construction and Upgrading of Kien Giang major fishery center”	Kien Giang Fishing Port Management Board
6	Subproject for “Upgrading Bach Long Vi storm shelter”	Bach Long Vi Port and Storm shelter Management Board

CHAPTER 2. NATURAL, ENVIRONMENTAL AND SOCIAL CONDITIONS

2.1 LACH HOI FISHING PORT UPGRADING AND EXPANSION SUBPROJECT

2.1.1. Natural condition

2.1.1.1. Geography

Quang Tien is a ward located at the western end of Sam Son city, with the advantage of exploiting seafood. Quang Tien Ward has the following geographical location:

- Bordering Quang Cu ward in the East;
- Trung Son ward in the South;
- Quang Chau ward in the West;
- Ma River, Hoang Chau commune, Hoang Phu, Hoang Hoa district in the North



Figure 2.1. Location Map of Lach Hoi subproject in Quang Tien ward, Sam Son city

2.1.1.2. Topography

The work items for the subproject will be constructed on the Ma River bank, about 4 km from the Lach Hoi estuary. The Ma River in the study area has a width ranging from 350 to 600 meters, with a steep slope, and the riverbed is about 20 meters from the shore, with an average wave depth of -4.30m. The waterway into the Lach Hoi estuary is part of the Le Mon – Thanh Hóa maritime route. According to Maritime Notice No. 244/2021/TBHH/TCTBĐATHHMB dated August 31, 2021, from the Viet Nam Maritime Safety -North regarding the technical specifications of the Le Mon – Thanh Hoa maritime route:

- The section from buoy 0 to buoys 7 and 8: The maritime channel bed width is 50m, marked and guided by the maritime signaling system, with a depth of 0.3m (zero point three meters).
- The section from buoys 7 and 8 to Le Mon port: The maritime channel bed width is 50m, marked and guided by the maritime signaling system, with a depth of 3.0m (three meters).

2.1.1.3. Geology

According to the geological survey results conducted by the jointventure contractor of Port And Waterway Engineering Consultant Joint Stock Company (Tediport) and IDIC Joint Stock Company, 12 boreholes were drilled in December 2023. The survey showed that the project area has a complex stratigraphy, formed by the river and marine sedimentation process, resulting in significant variations in both surface area and depth. Specifically:

- Layer 1: Silty clay, dark gray, ash gray, flowing. This layer is widespread across the project area, with thickness varying from 0.6m (borehole LK12) to 2.5m (borehole LK7). This is a weak soil layer, requiring consideration during the design phase.
- Layer 2: Sandy silt, gray, gray-green, loose and water-saturated. This layer is not evenly distributed and appears only at borehole locations LK1, LK2, LK3, LK4, LK8, LK9, and LK10, with thickness varying from 0.6m (LK9-LK10) to 5.4m (LK3).
- Layer 3: Clay, gray, yellow-brown, dark gray, soft, plastic, and flowing. This layer is widespread throughout the project area, with thickness ranging from 1.5m (LK8) to 7.3m (LK1). This is a weak soil layer.
- Layer 4: Clay, mottled (yellow, reddish-brown, off-white), firm to semi-firm. This is a relatively good soil layer with substantial thickness, ranging from 1.5m (LK3) to 6.7m (LK2). This layer is not present at boreholes LK5, LK6, LK7, LK9...LK12.
- Layer 5: Clayey sand, light gray, pale gray. This layer is unevenly distributed and appears only at boreholes LK2, LK3, LK4, with thickness varying from 1.4m (LK2) to 4.5m (LK3). This is a weak soil layer.
- Layer 6: Sandy silt, occasionally mixed with gravel, light gray-yellow, light brown. This layer is located deeper and appears only at borehole locations LK1, LK2, LK3, and LK4, with depth ranging from -17.3m (LK1) to -21.4m (LK2). This is a good soil layer.

2.1.1.4. Climatic and meteorological conditions

Temperature: With its favorable geographical location, Thanh Hoa's climate is characterized by high humidity and a tropical climate. The average temperature is around 23-25°C throughout the year, with the lowest in December and the highest in July. Temperature varies with altitude; in highland areas, the average temperature is around 17-19°C, while in the plains and coastal areas, it is higher, reaching about 26-27°C.

Humidity: Humidity is another factor influencing Thanh Hoa's climate. The city of Thanh Hoa has an average humidity of 70-80% throughout the year, highest in July and lowest in December. During the rainy season, humidity tends to be higher, while in the dry season, it decreases significantly. Humidity also varies across different regions, with lowland and coastal areas generally experiencing higher humidity than the plains.

Rainfall: Thanh Hoa experiences a rainy season from April to October, receiving approximately 1,900 to 2,300mm of rainfall annually, particularly in coastal areas such as Hau Loc, Hai Ha, Hai Tien, Nghi Son, and Hoang Hoa. Additionally, typhoon-related rain and wind often occur in coastal regions.

Winds: Thanh Hoa is situated in a maritime wind region, experiencing winds from the west and northwest. The winter monsoon winds come from the north, helping to lower temperatures, while the summer monsoon winds come from the southeast, cooling the climate. Coastal areas are frequently affected by monsoons and typhoon winds. Overall, winds are weak, with average speeds ranging from 1.3 to 2 m/s. In coastal plains, wind speeds can vary, with some areas like the Lach Hoi fishing port experiencing average wind speeds of about 4 m/s during the typhoon season from June to November.

2.1.1.5. Hydrological regime

Thanh Hoa has five main river systems: the Hoat River, Ma River, Yen River, Lach Bang River, and Cha River. The network of rivers is quite dense, including inland rivers, with a river density of 2-3 km/km². The rivers are highly meandering, with an average meandering coefficient of 1.4. The rivers here have wide riverbeds, with an average width of 0.02 - 0.05m/km.

- **Hoat River:** The river originates from Hang Cua Mountain in the Yen Thinh area (Ha Trung), with a catchment area of 250 km² up to the Chinh Dai Bridge (13 km from the river mouth). The river is 55 km long, flowing through Ha Trung District, Bim Son Town, and along the boundary between Nga Son District and Kim Son District (Ninh Binh). Due to its location in an area with low rainfall (below 1,500 mm), and passing through many limestone regions, the river has very poor flow during the dry season and is strongly affected by tides. During the rainy season, due to the basin-like topography, the river drains slowly and frequently causes flooding in Ha Trung (Ha Bac, Ha Yen, Ha Giang, Ha Van) and Nga Son.
- **Ma River:** This is the largest river system in the province. The main river is 528 km long, originating from an altitude of 800 – 1,000 meters in the Dien Bien Phu region, flowing through Laos (118 km) before entering Thanh Hoa at the northern edge of Sop Sim (Muong Lat). The length of the Ma River in Vietnam is 410 km, with 242 km in Thanh Hoa. The total catchment area is 28,106 km², of which 7,913 km² is in Laos, 20,193 km² in Vietnam, and nearly 9,000 km² in Thanh Hoa. The Ma River has 89 tributaries, with the main tributaries in Thanh Hoa including: Sim Stream (40 km), Quanh Stream (41 km), Xia Stream (22.5 km), Luong River (102 km), Lo River (74.5 km), Hon Nua (25 km), Bui River (130 km), Cau Chay River (87.5 km), and Chu River (325 km).
- **Yen River:** Originating from Binh Luong commune (Nhu Xuan), at an elevation of 100 – 125 meters, it flows down to the Nong Cong and Quang Xuong plains before discharging into the sea at Ghép estuary. The river is 94.2 km long, with nearly 50 km in the mountainous region. The catchment area is 1,996 km². The Yen River has four main tributaries: Nhom River (66.9 km), Hoang River (81 km), Ly River (27.5 km), and Thi Long River (50.4 km).
- **Lach Bang River:** Originating from the Huon Mountains in Phu Lam commune (Tinh Gia), at an elevation of 100 meters, it flows through the Tinh Gia mountainous region, reaching Khoa Truong before descending to the plains and discharging into the sea at Bang estuary. The river is 34.5 km long, with 18 km in the mountainous region. The catchment area is 236 km².
- **Chang River:** This is the only river in the province that flows into another province (Nghe An). The Chang River is a tributary of the Hieu River (Nghe An). The catchment area of the river in Thanh Hoa is approximately 250 km².

In addition to these natural rivers, Thanh Hoa also has a system of artificial rivers, canals, and ditches. During the feudal period, there was the Le Dynasty's canal system. In modern times, there are canals from the Bai Thuong dam irrigation project, the North Ma River and South Ma River irrigation projects, and the Quang Chau River project, among others.

2.1.1.6. Natural resources

Water resources

Surface water resources: Thanh Hoa's water resources are quite abundant. The total amount of rainfall in Thanh Hoa each year is 19 billion cubic meters, with an average evaporation of 9 billion cubic meters. The remaining 9.7 billion cubic meters contribute to surface runoff, while 0.3 billion cubic meters form groundwater flow. Every year, the river system drains

approximately 20 billion cubic meters of water into the sea, with 9.7 billion cubic meters coming from Thanh Hoa, and the rest from the Northwest and Laos.

The average surface runoff modulus ranges from 20.4 to 38 liters per second per km². The plains region varies between 20 to 30 liters per second per km², while the mountainous areas exceed 30 liters per second per km², with the highest being 38 liters per second per km² in the Am River basin. The quality of surface water is generally good, except in the lower reaches during dry seasons due to tidal influences.

The groundwater flow modulus ranges from 2 liters per second per km² to 20 liters per second per km². The middle section of the Ma River basin has a groundwater flow modulus of over 20 liters per second per km². Generally, the groundwater quality is good, except in some peripheral areas of Thanh Hoa City and Sam Son Town, where the surface water has been contaminated. Coastal and river estuary areas are affected by salinity in the groundwater.

Groundwater resources: Thanh Hoa has abundant groundwater resources both in terms of quantity and variety, with groundwater found in a wide range of geological formations including sedimentary, metamorphic, igneous, and volcanic rocks. Thanh Hoa has the following types of groundwater:

- *Pore water:* Found in mountain rock formations, created by marine and riverine sedimentary sources of Holocene age (QIV), distributed in flat plain areas at altitudes of 7 to 15 meters, and depths ranging from 0 to 35 meters. Additionally, there is pore water in sedimentary formations of Pleistocene age (QI-III), which lies beneath or is exposed in some foothill areas. These water-bearing layers have low water storage capacity, with a discharge rate ranging from 0.2 to 11 liters per second per meter. These layers are hydraulically connected to surface water. The total mineralization ranges from 0.1 to 5 g/liter, and in many places, the water is saline. As a result, it can only meet small-scale needs for domestic use and production.
- *Fracture water:* Found in hard, fractured rocks with various compositions, distributed in the mountainous areas. The water quality is good with a total mineralization of less than 1 mg/liter but is highly complex in distribution, depending on the geological structure of each area. Currently, exploration in these areas is quite limited.

Mineral resources:

Thanh Hoa is one of the few provinces in Vietnam with a rich and diverse range of mineral resources. There are 296 mining sites and mineral points, with 42 different types, many of which have significant reserves compared to the national total, including: granite and marble (2-3 billion cubic meters), limestone for cement production (over 370 million tons), clay for cement (85 million tons), chrome (approximately 21 million tons), iron ore (2 million tons), serpentine (15 million tons), dolomite (4.7 million tons), as well as gold placer deposits and other minerals such as kaolin, white clay, sand, stones, lime, etc.

Marine tourism resources:

Thanh Hoa city has been building and developing many new tourism products, such as the Love Festival – Hon Trong Mai, the mural village, water motor services, pedestrian streets, and night markets. Particularly, the Sam Son beach tourism festival features many exciting activities, such as the light festival and the street carnival. However, the area where the Lach Hoi fishing port is being upgraded is located about 4-5 km from Sam Son city, with a separate access road. The implementation of this project will not affect the development of tourism activities or intangible cultural resources in the region.

Biological resources

a. Forest resources

Thanh Hoa has a very diverse plant system, and its forests include several characteristic vegetation types:

Tropical forests in lowland areas: These forests are found at elevations typically below 500 meters and cover the largest area in the province. The species composition is very rich, with dominant tree species belonging to families like legumes, dipterocarps, Meliaceae, and Sapindaceae, among others. There are almost no gymnosperms (cone-bearing trees) in the lowland areas.

Subtropical forests on mountains: These forests are found at altitudes ranging from 500 meters to 1,600 meters (also known as lowland tropical forests).

Planted forests: Planted forests in Thanh Hoa have been a focus for development for a long time.

Thanh Hoa's forests are predominantly broadleaf evergreen forests, with a rich and diverse flora, including many tree species. Valuable timber species include rosewood, pomu, and agarwood. Group II timber species include sa mu, green ironwood, teak, and various hardwoods. Group III and IV timber species include redwood, michalia (dổi), moraceae (đề), and *Parashorea chinensis* (chò chí). Species from the bamboo family include *Dendrocalamus* (luồng), *Gigantochloa* (nua, vau, giang, buong, and tre. In addition, there are species of rattan, sedge, medicinal plants, and red ants.

Protected forest areas (the nearest area to the Lach Hoi subproject is about 6 km away): According to national standards, Thanh Hoa has several protected forests, including: Ben En National Park (16,000 ha, located in the districts of Nhu Xuan and Nhu Thanh), Cuc Phuong National Park (part in Thanh Hoa, including Thach Lam and Thanh My communes, Thach Thanh District), a 300-hectare protected area for ironwood trees in Tam Quy Commune, Ha Trung District, Pu Luong Nature Reserve, Xuan Nha. In addition, there are genetic reserves associated with historical-cultural sites, such as: Lam Kinh area (for preserving ironwood forests), the Ba Trieu Temple area with its pine forests (Trieu Loc Commune, Hau Loc District), Ham Rông park and botanical gardens in Sam Son Town.

Thanh Hoa also has several major animal communities, including: animal communities in plains and lowland fields, animal communities in bamboo, reed, and other lowland forests, animal communities in shrub forests and grasslands, animal communities in woodlands and tree groves, freshwater animal communities.

However, many species of wildlife have been recorded in the Red Book within national parks and nature reserves, including:

Endangered species: Mammals: white-headed langur, red-shanked douc, black langur, silvered leaf monkey, black bear, Asiatic black bear, clouded leopard, tiger, elephant, sambar deer, gaur, wild goat, wild buffalo, wild boar. Birds: pheasant, wild turkey. Reptiles and amphibians: king cobra.

Vulnerable species: Mammals: small loris, red-faced monkey, macaque, pig-tailed macaque, gray langur, fire leopard, clouded leopard, southern cheo cheo, pangolin, flying squirrel. Birds: spoonbill, roseate spoonbill. Reptiles and amphibians: water monitor, lizard, buffalo snake, box turtle, yellow-headed turtle, water snake. Invertebrates: ear-shaped freshwater clam, water bug. Mammals: civet, fritter bats, flying squirrels. Birds: grey-footed pelican, yellow-legged red-shanked pheasant, black-headed gull. Invertebrates: Kim Boi crabs, Cuc Phuong crabs.

Some other species, such as geckos, cobras, and king cobras, have also been heavily hunted, causing their numbers to decrease rapidly.

In general, the national parks and nature reserves mentioned above are all more than 20 km away from the Lach Hoi subproject area, with the only exception being the botanical garden in Sam Son Town, which is located about 6 km from the area.

b. Marine biological resources

Sam Son has a coastline of 9 km from Cua Hoi to Vung Tien (Vung Ngoc). The coastal waters around Sam Son are rich and diverse in marine resources, giving Sam Son a significant advantage in seafood exploitation. The main fishing grounds include:

- Offshore fishing grounds from Nghe An to the north with an estimated stock of around 12,000 – 15,000 tons, primarily consisting of anchovies and sardines (40 – 50%), with the remainder made up of mackerel, anchovy, and other fish species. The annual catch potential is about 6,000 – 7,000 tons.
- The Lach Hoi – Southeast of Hon Me fishing grounds with a stock of 15,000 – 20,000 tons, mainly anchovies, sardines, and mackerel (60 – 70%), with the rest made up of tuna and other species. The annual catch potential is about 7,000 – 10,000 tons.
- Bottom fishing grounds from the South of Hòn Me Island to Lach Ghep and Lach Hoi – Southeast of Hòn Me.

Shrimp: There are two main shrimp grounds: The Hòn Nẹ – Lach Ghep shrimp grounds and the Lach Bang – Lach Quen shrimp grounds, both of which have high shrimp stocks in the Gulf of Tonkin. The annual catch potential is about 1,000 – 1,300 tons, primarily consisting of *Penaeus monodon* and *Penaeus vannamei* shrimp, along with over 7,000 tons of sea shellfish.

Squid: The Thanh Hoa coastal waters and its surrounding areas have a rich squid resource, with an estimated stock of 13,000 – 14,000 tons. The annual catch potential is about 5,000 – 6,000 tons, of which around 3,000 – 4,000 tons are *Loligo* squid and 1,500 – 2,000 tons are *Sepia* squid. In addition, there are many other high-value marine products popular in both domestic and international markets, such as *strombus* (conch), jellyfish, lobsters, crabs, and other shellfish.

Aquaculture: Sam Son has over 158.7 ha of water surface suitable for aquaculture, primarily located in Quang Cu (138.7 ha) and partially in Quang Tien (20 ha). All of this area lies within the embankment of the Ma River, forming ponds and marshes that can cultivate various high-value aquatic species like shrimp, crabs, lobsters, and seaweed.

Phytoplankton: Phytoplankton species recorded in the area belong to six phyla, including Heterokontophyta, Chlorophyta (green algae), Cyanobacteria, Euglenozoa (Euglenoids), and Dinoflagellata. In the lower Ma River, 117 species and subspecies from 2 classes, 2 orders, 12 families, and 26 genera of green algae were identified, with the most common families being *Scenedesmaceae* (39 species, 33.3% of total species), followed by *Hydrodictyaceae* (17 species, 14.5%), and *Cosmariaceae* (16 species, 13.6%). The most abundant genera include *Scenedesmus* (36 species), *Pediastrum* (17 species), and *Staurastrum* (10 species). Notably, the diversity of green algae is highest at the confluence of the Ma and Chu rivers, where 75 species and subspecies were recorded, while only 48 species were found at the Lach Hoi estuary, reflecting the ecological preference of green algae for freshwater.

Zooplankton: Approximately 15-35 species and groups of zooplankton were identified, including: *Copepoda* (water fleas), *Cladocera* (branchiopods), *Rotatoria* (rotifers), Two groups of larvae species. The species composition shows that most are common species found widely in northern Vietnam and across various water bodies in the country, such as *Diaphanosoma sarsi*, *Mesocyclops woutersi*, *Thermocyclops crassus* (Copepoda); *Bosmina longirostris*, *Moina dubia* (Cladocera), and *Asplanchna sieboldi* (Rotifera). Some species that thrive in eutrophic

organic environments, such as *Asplanchna sieboldi* and *Brachionus calyciflorus*, appear less frequently, with low densities.

Some species from the *Calanoida* group of copepods, typically found in slow-moving or stagnant water bodies such as rivers and lakes in the plains, include *Neodiaptomus schmackeri* and *Phyllodiaptomus tunguidus*.

c. Biological resources in Lach Hoi subproject area

Using the location screening tool for the project's area in comparison to protected areas/biosphere reserves/high biodiversity zones available at [IBAT Alliance](#), the report confirms that the expansion area for the Lach Hoi fishing port is located more than 20 km away from any National Parks or Nature Reserves in the province and surrounding areas. The only exception is the **Sam Son botanical garden**, which is located 6 km from the project area.

The expansion of the Lach Hoi fishing port covers an area of 4.04 ha, including: 2.18 ha of public land, which is currently used for transportation access to the port, 0.33 ha of commercial land (used by a few households for kiosks), 1.52 ha of water surface area in the Ma River.

Within the port expansion area, there are a few patches of mangrove plants (such as *Sonneratia* and *Avicennia*) growing sporadically along the Ma River bank. These plants are naturally occurring and are not part of a designated forest for environmental protection.

Surveys of the project's site and consultations with local residents indicate that the terrestrial wildlife in the area consists of common species such as reptiles (snakes, geckos), birds from agricultural lands, and some domesticated animals like cattle, dogs, chickens, and cats. No rare or endangered terrestrial species were found in the project's sub-area.



Figure 2.2. Existing status of some *Sonneratia* mangrove clusters within the Lach Hoi sub-project expansion area

Aquatic organisms in the project area: The aquatic species in the Ma River include various types of natural fish, such as carp, goby, tilapia, catfish, etc. The plankton in the area mainly consists of copepods, cladocerans, and rotifers. The benthic organisms are primarily clams, snails, oysters, mussels, worms, eels, shrimp, and crabs. The aquatic plants in the area are mainly aquatic grasses and algae. Phytoplankton recorded in the area belongs to six major groups: Heterokontophyta, Chlorophyta (green algae), Cyanobacteria, Euglenozoa (euglenoid algae), and Dinoflagellata. Zooplankton includes copepods, cladocerans, rotifers, and several groups of larvae. There are no rare or endangered aquatic species found in the sub-project area.

In conclusion, there are no rare or endangered species listed in the Red Book within the Lach Hoi sub-project area.

2.1.1.7. Natural disaster

The coastal plain area of Thanh Hoa Province experiences frequent storms, which can have a significant impact on the coastal districts from July to November every year. The most common natural disasters are storms, storm surges, heavy rainfall causing flooding, and concentrated floods, which typically occur in September. Droughts and severe cold spells last from December to February. In addition, tornadoes, waterspouts, and hailstorms can occasionally occur in the region, though with low frequency.

According to the annual disaster prevention report of Thanh Hoa Province, in recent years, an average of 30 natural disasters have occurred and impacted the province, including 3 storms, 1 tropical depression, 8 heavy rain events, 5 occurrences of windstorms and lightning, 4 landslides, 6 heat waves, and 3 cold spells. Some notable disasters include the following:

- + *HeaVi rainfall*: On May 5-6, June 6-10, June 25, July 7-10, August 26-28, September 7-9, September 13-15, and September 24-27, causing 1 death; damage to 23 houses, 202 ha of rice, 398 ha of crops, 587 ha of annual crops, and 13 ha of forest; 9 livestock and 55 poultry were killed; and 247 road locations were affected by landslides, with approximately 59,000 m³ of soil displaced, along with other assets.
- + *Windstorms, lightning, and rain*: On May 3, May 9, May 13, July 29, and September 5, in the districts of Nhu Xuan, Quan Hoa, Nhu Thanh, and Thuong Xuan, resulting in 2 deaths (due to lightning); damage to 5 houses, 43 ha of rice, 5 ha of forest, 1 hectare of annual crops, and other assets.
- + *Heatwaves*: From April 20-22, May 9-23, May 26-31, June 14-30, July 1-4, and July 25-31, there were severe heatwaves with temperatures ranging from 37°C to 41°C, and humidity levels dropping to between 40% and 55%.

Storm No. 2: Due to the influence of Storm No. 2, from the night of June 11 to the morning of June 13, 2021, Thanh Hoa Province experienced rainfall, with total rainfall ranging from 30-80mm, peaking at 108mm at the Ngoc Tra station, Quang Xuong. The storm caused damage to 9 houses, 2 ha of rice, 63 ha of crops, 90 ha of vegetables, and 224 locations of landslides with approximately 17,280 m³ of displaced soil.

Storm No. 8: From October 13 to October 16, due to the combined effects of Storm No. 8 and cold air, heavy rain occurred, with total rainfall ranging from 80-140mm, and up to 190mm in some lowland districts. The storm led to 1 house needing emergency evacuation, 7 houses affected by landslides, 3 schools impacted, and damage to 2 ha of rice, 90 ha of crops, 31 locations of landslides with around 6,530 m³ of displaced soil.

Disaster damage in 2021: In 2021, natural disasters caused significant losses in terms of human lives, assets, production, and infrastructure. The damages included 3 deaths, 1 injury, 39 damaged houses, 5 houses needing emergency evacuation, 33 houses affected by landslides, 260 ha of rice, 2 ha of seedlings, 552 ha of vegetables, 590 ha of annual crops, 9 livestock, 55 poultry, and damaged roads (on National and Provincial routes) with a total of 651 locations affected, displacing approximately 182,610 m³ of soil. The total estimated damage was about 66.5 billion VND.

2.1.2. Existing baseline environmental condition

In order to assess the baseline environmental quality in the project area, the project owner coordinated with the environmental monitoring unit, the Center for Analysis and Technology Transfer in Environmental Engineering under the Institute of Agricultural Environment (certified by VIMCERTS 082), to conduct surveys, measurements, and sample collection for baseline environmental analysis in the sub-project area. The environmental sampling was carried out on January 15, 2024. The information about the monitoring points within the Lach Hoi sub-project area is as follows

Table 2.1. Sampling locations for Lach Hoi subproject

No	Samples	Number of sample	Parameters	Sampling location/symbol
1	Air, noise	01	CO, SO ₂ , NO ₂ , TSP, Pb, noise, temperature, humidity, wind speed, wind direction	Measured at Lach Hoi Port Area Symbol: TH1-KXQ
2	Surface water	02	pH, TSS, Ammonium (NH ₄ ⁺ -N), Nitrite (NO ₂ ⁻ -N), Cyanide (CN ⁻), Copper (Cu), Lead (Pb), Cadmium (Cd), Arsenic (As), Total Chromium (Cr), Total Oil and Grease, Total Phenol, Surfactants, Organochlorine Pesticides (Heptachlor, Dieldrin), Organophosphorus Pesticides (Chlorpyrifos, Diazinon).	Ma River, Lach Hoi Port Area Symbol: from TH1-NM1 to TH1-NM2
3	Groundwater	01	pH, TSS, Ammonium (NH ₄ ⁺ -N), Nitrate (NO ₃ ⁻ -N), Chloride (Cl ⁻), Copper (Cu), Lead (Pb), Cadmium (Cd), Arsenic (As), Total Chromium (Cr).	Well water at Lach Hoi Port; Symbol: TH1-NN1
4	Wastewater	04	pH, TSS, Total Oil and Grease, Ammonium (NH ₄ ⁺ -N), Nitrate (NO ₃ ⁻ -N), Lead (Pb), Cadmium (Cd), Arsenic (As), Copper (Cu), Zinc (Zn), Manganese (Mn), Total Chromium (Cr), Total Phenol, Surfactants.	Wastewater at Lach Hoi Port Area Symbol: from TH1-NT1 to TH1-NT4
5	Soil	01	Arsenic (As), Cadmium (Cd), Lead (Pb), Chromium (Cr), Copper (Cu), Zinc (Zn).	Lach Hoi Fishing Port Area; Symbol: from TH1-D

Sampling locations for baseline environmental quality in the Lach Hoi Subproject area as shown below:



Figure 2.3. Sampling locations for baseline environmental quality in the Lach Hoi Subproject area

The detailed monitoring results of environmental quality components will be presented in Appendix 3. Below is a summary of the environmental quality assessment results in the Lach Hoi Subproject area.

a. Current air quality and noise levels

The results of ambient air quality monitoring in the subproject area show that all indicators are within the allowable limits of QCVN 05:2023/BTNMT – National Technical Regulation on Ambient Air Quality (one-hour average).

The noise levels in the project area comply with QCVN 26:2010/BTNMT – National Technical Regulation on Noise.

These results indicate that the ambient air quality in the project implementation areas remains relatively good, with no signs of pollution.

b. Current groundwater quality

The analysis results show that the groundwater quality in the subproject area is relatively good, with no signs of pollution. At the sampling locations, the analyzed indicators are within the permissible limits of QCVN 09:2023/BTNMT – National Technical Regulation on Groundwater Quality.

c. Current surface water quality

The monitoring results of the Ma River's surface water quality in the subproject area show that most indicators at all monitoring points are below the allowable limits of QCVN 08:2023/BTNMT (Column A), except for some parameters such as TSS, Ammonium, and Surfactants, which exceed the standard limits of QCVN 08:2023/BTNMT (Column A).

Specifically:

- At sampling point NM1: TSS exceeds by 1.48 times; Ammonium exceeds by 1.4 times; Surfactants exceed by 3.28 times.
- At sampling point NM2: TSS exceeds by 2.64 times; Ammonium exceeds by 1.3 times; Surfactants exceed by 4.8 times.

The reason for the high levels of TSS, Ammonium, and Surfactants at NM1 and NM2 is that this area is the existing Lach Hoi fishing port, which is currently affected by port activities such as fishing boats, fishermen, fish sorting operations, etc. Additionally, Lach Hoi fishing port currently lacks a wastewater treatment facility.

d. Current wastewater quality

The results of household wastewater monitoring in some residential areas near the project show that most wastewater parameters are within the permissible limits, except for some indicators such as TSS, Ammonium, and Surfactants, which exceed the standard limits of QCVN 14:2008/BTNMT – National Technical Regulation on Domestic Wastewater (Column B). Specifically:

- At sampling point NT1: TSS exceeds by 4.6 times; Ammonium exceeds by 9.2 times.
- At sampling point NT2: TSS exceeds by 2.8 times; Ammonium exceeds by 4.5 times; Surfactants exceed by 1.3 times.
- At sampling point NT3: TSS exceeds by 1.85 times; Ammonium exceeds by 1.4 times.
- At sampling point NT4: TSS exceeds by 1.9 times; Ammonium exceeds by 1.4 times.

The wastewater samples at Lach Hoi fishing port contain high levels of TSS, Ammonium, and Surfactants due to the lack of a wastewater treatment system. Domestic wastewater from

fishermen operating at the port is only treated through septic tanks and has not been fully treated.

e. Current soil quality

The analysis results of soil quality in the Lach Hoi Subproject expansion area show that heavy metal indicators comply with QCVN 03:2023/BTNMT – National Technical Regulation on Soil Quality. This indicates that the soil quality in the project area remains relatively good, with no signs of pollution. During project construction, the topsoil will be removed, and the reuse or disposal of excavated soil will depend on its properties. Therefore, the excavated soil from construction areas can be reused for purposes such as leveling or disposed of as general waste.

2.1.3. Socio-economic condition

The study area is located in Quang Tien Ward, Sam Son City, Thanh Hoa Province. The subproject does not involve land acquisition from households; therefore, no households will be relocated or resettled. Below are the socio-economic conditions of the subproject area:

2.1.3.1. Economic Development Conditions

Quang Tien is a ward located in the westernmost part of the city, with advantages in marine and aquatic exploitation. The ward's economic structure is dominated by agriculture, forestry, and fisheries (46.3%), followed by services and small-scale industries (41.9%), while industry and construction account for the smallest proportion (11.8%). The average per capita income in 2023 reached VND 6.6 million/person/month, higher than the provincial average in Thanh Hoa (VND 4.3 million/person/month). The percentage of poor households, based on the multidimensional poverty standard, is 1.39% (68 households), while near-poor households account for 3.61% (176 households).

2.1.3.2. Social Development Conditions

- Population: According to statistical data from Quang Tien Ward, as of December 31, 2023, the ward had a population of 21,567 people (10,760 males and 10,807 females) with 4,598 households, resulting in a population density of 6,555 people/km².
- Ethnic composition: 100% of the ward's population belongs to the Kinh ethnic group, and there are no ethnic minorities residing in the project area.
- Education: Quang Tien Ward has an educational system covering all levels from preschool to lower secondary school, including one preschool, two primary schools, and one lower secondary school.
- Healthcare: The ward has one health station providing primary healthcare services for local residents. The proportion of people with health insurance coverage reaches 95%.

2.1.3.3. Survey Results of Affected Households

Quang Tien Ward currently has 234 fishing vessels with a total capacity of 82,826 CV. The port area has four seafood processing enterprises employing 500-600 workers, as well as several small-scale business establishments (e.g., lubricants trading, fresh seafood sales, maritime equipment trading). Additionally, 11 households renting kiosks from the Lach Hoi Port Management Board are affected. Lach Hoi Fishing Port provides employment for over 1,700 workers, with an average monthly income ranging from VND 7-9 million from seafood trading and business activities.

2.1.4. Current Technical Infrastructure of the Subproject Area

a. Transportation System

Road Transport:

The project site is adjacent to the Sam Son Beach tourist area, approximately 4-5 km from the Lach Hoi subproject area, benefiting from a highly convenient external road transport network, including provincial roads.

Coastal Road: Constructed to grade III plain road standards, 12 m wide with four lanes and a design speed of 80 km/h. The project is developed under the PPP model through a BOT contract (Build-Operate-Transfer). The Thanh Hoa coastal road from Nga Son to Nghi Son is 96.2 km long, of which 18 km overlaps with the pre-invested Nghi Son Economic Zone road, while 78.2 km is newly constructed across districts, towns, and cities including Nga Son, Hau Loc, Hoang Hoa, Sam Son, Quang Xuong, and Nghi Son.

National Highway 47: The highway runs 138.5 km from Lach Hoi Port to Kheo Border Gate. The section from Thanh Hoa City to Tho Xuan Airport has been upgraded to four lanes, while the Thuong Xuan-Kheo Border Gate section meets at least grade IV standards with two lanes. A 17 km section from Xuan Thang Junction (Km53+800, QL47) to Thuong Xuan Town has been realigned and upgraded to grade III standards with two lanes.

Nam Song Ma Boulevard:

- This boulevard is planned as the largest main axis connecting Thanh Hoa City with Sam Son City along the coastal direction, driving breakthrough development.
- The boulevard spans 14.6 km, with an initial phase completed, allowing traffic flow at a speed of 60 km/h, reducing travel time from Thanh Hoa City Center to Sam Son to just 10 minutes.

Waterway Transport:

- Lach Hoi River estuary connects to the Gulf of Tonkin, providing convenient access for offshore fishing vessels and serving as a safe storm shelter.
- The inland waterway route along the Ma River from Lach Hoi estuary to Ham Rong spans approximately 19.5 km and is one of the 10 major inland water transport routes in the central region.

Internal Transport:

- The main city axis road in Sam Son – Tran Hung Dao Street – terminates at Lach Hoi Fishing Port. The road is asphalt-paved, 8 m wide, and approximately 5-6 km long, with sidewalks on both sides. Traffic density is high due to the movement of trucks and motorbikes transporting freshly caught seafood and providing port logistics services, especially during peak hours coinciding with school and office commuting times (7-8 AM and 4-6 PM).

b. Water Supply System

The clean water supply is sourced from the existing water supply system serving Quang Tien Ward, ensuring convenient connections for the project.

c. Solid Waste Collection and Treatment

The Lach Hoi subproject area has an integrated system for collecting household solid waste.

d. Power Supply and Telecommunications

Lach Hoi Port, situated within the densely populated center of Quang Tien Ward, has a complete power supply and street lighting infrastructure.

e. Drainage and Wastewater Treatment

The existing drainage system relies on natural flow into the Ma River. The project area currently lacks a separate centralized wastewater collection and treatment system.

f. Fishing Port Operations and Storm Shelter Area

Thanh Hoa Province has eight fishing ports, four designated storm shelters for fishing vessels, nine naturally sheltered anchorages in operation, and 35 shipbuilding and repair facilities. Among these, 10 facilities meet the required standards for building, upgrading, and modifying fishing vessels.

❖ Fishing Ports and Wharves

Lach Hoi Fishing Port is a grade II fishing port with a planned area of 4.5 ha, a wharf length of 263 meters, and the capacity to accommodate vessels up to 1,000 horsepower.

Lach Bang Fishing Port consists of two component ports: Hai Thanh Port and Hai Binh Port. Hai Binh Port is a grade I port with a planned area of 40.6 ha and a 400-meter wharf, capable of receiving vessels up to 400 horsepower. Hai Thanh Port is a grade II port with a planned area of 2.75 ha, featuring a 140-meter wharf (90 meters at Hai Thanh Wharf and 50 meters at Dao Me Wharf), along with other technical and auxiliary infrastructure.

Hoa Loc Fishing Port is a grade II port with an area of 3.5 ha. The storm shelter area has a total area of 19.5 ha, ensuring safe anchorage for vessels up to 400 horsepower.

Quang Nham Fishing Port is a grade III port with a 50-meter wharf but lacks auxiliary facilities. Approximately 300 fishing vessels from Quang Nham Commune and other communes of Quang Xuong District frequently operate there, handling more than 7,000 tons of products annually.

Hoang Truong Fishing Port has undergone embankment investment, while Hoang Phu and Hai Chau Fishing Ports have received investments in embankments, wharves, operation buildings, and roofing structures. However, they lack auxiliary facilities and do not fully support loading and unloading activities for fishing vessels.

❖ Storm Shelter Areas

Lach Hoi Shelter Area in Sam Son City has a capacity for 1,000 vessels, accommodating ships up to 600 horsepower.

Lach Bang Shelter Area in Nghi Son Town has a capacity for 800 vessels, accommodating ships up to 400 horsepower.

Lach Truong Storm Shelter for fishing vessels in Hau Loc District can accommodate 700 vessels with a capacity of up to 350 horsepower.

The storm shelter areas at Ly River Estuary in Quang Xuong District and Lach Trao in Hoang Hoa District are under construction, with a capacity for 300 vessels up to 200 horsepower.

❖ Lach Hoi Fishing Port

Lach Hoi Fishing Port has a planned area of 45,000 square meters, comprising 30,000 square meters of land and 15,000 square meters of water for vessel anchorage. The port was constructed and put into operation in 2003 and underwent a third-phase upgrade in 2005, with an investment of VND 25 billion. The total wharf length is 262 meters, including a 75-meter dock for 400-horsepower vessels, three U-shaped piers of 26 meters each, and a 110-meter pier upgraded from a 33-horsepower dock, running along a 372-meter embankment. The port can accommodate vessels of up to 1,000 horsepower, with a handling capacity of 400 tons of fish per day, servicing 20 vessels per session and 300 vessels for regular anchorage.

Additionally, Lach Hoi Fishing Port houses various businesses providing fishery logistics services, including: Five seafood processing and trading facilities; Five ice production and

supply facilities; One fuel supply station; Four essential goods supply businesses; Three seafood purchasing establishments within the port...Notably, several seafood processing enterprises, such as FXPT Import-Export Co., Ltd. and Thanh Binh Trading Joint Stock Company, are located 20–100 meters from the existing port.

❖ **Lach Hoi Storm Shelter Area**

The Lach Hoi Storm Shelter Area was constructed in 2007 and completed in 2010, with a total investment of VND 98.5 billion. Its purpose is to provide safe anchorage for 700 fishing vessels with a capacity of up to 60 horsepower operating in Thanh Hoa waters and neighboring provinces during storms. The shelter area includes:

- + Basin No. 01: 70,036 square meters, bottom elevation (-3.80 meters), accommodating vessels under 300 horsepower.
- + Basin No. 02: 68,137 square meters, bottom elevation (-3.80 meters), accommodating vessels under 300 horsepower.
- + Basin No. 03: 76,523 square meters, bottom elevation (-3.80 meters), accommodating vessels under 300 horsepower.
- + Entrance Basin: 100,693 square meters, bottom elevation (-4.30 meters), accommodating vessels of 300 horsepower and above (based on the national elevation system).

2.1.5. Environmental and Social Conditions in the Subproject Area and Sensitive Receptors

The existing Lach Hoi Fishing Port, covering 3.61 ha, will be upgraded and expanded to a total area of 7.65 ha. The expansion area of 4.04 ha includes: 2.18 ha of public land, currently used as a traffic area in front of the port; 0.33 ha of commercial production land (kiosks) owned by several households; 1.52 ha of river water surface from the Ma River.

At the subproject location, the Ma River is approximately 550–600 meters wide, while the river segment near the estuary (4 km away) is wider, reaching 700–900 meters. The river's water quality is relatively good, and waterway traffic is high, with many large vessels seeking shelter during storms. Within the construction area for the Lach Hoi Fishing Port upgrade, scattered patches of mangrove trees (sua and vet trees) are found along the Ma Riverbank. These trees naturally grow on the land designated for port expansion and are not part of a protective forest plantation. They will be cleared to prepare the construction site.

Quang Tien Ward's residential area, located approximately 80–100 meters from the port expansion site, is densely populated with around 200 households. Additionally, within 20–100 meters of the existing port, several seafood processing businesses, such as FXPT Import-Export Co., Ltd. and Thanh Binh Trading Joint Stock Company, operate.

Thanh Hoa City has been developing and promoting various new tourism products, including the Love Festival at Trong Mai Islet, mural villages, water sports services, pedestrian streets, and night markets. Notably, the Sam Son Beach Tourism Festival features captivating activities such as the Light Festival and the Street Carnival. However, the Lach Hoi Fishing Port upgrade site is located 4–5 km from Sam Son City and has a separate access route. Thus, the project implementation will not affect tourism development activities or intangible cultural heritage resources in the area.

Within and around (within a 200-meter radius) the subproject area, there are cultural and sensitive sites, including the Memorial for Southern Compatriots who migrated to the North and other sensitive locations such as schools. The characteristics of these sites and other sensitive areas will be detailed in the following sections. A map depicting the project area and affected entities is shown in the following figure.



Ma River and the construction and upgrading area.



Existing port wharf.



Memorial area for Southern compatriots who gathered in the North.



Mangrove tree cluster.



Mangrove tree cluster.



Thanh Binh Trading Joint Stock Company's seafood processing factory.

Sensitive receptors and distance to the project site are presented in the following table:

Table 2.2. Sensitive receptors under Lach Hoi Fishing port upgrading and expansion subproject

No	Sensitive receptors and distance to the project site	Description

I	Lach Hoi fishing port	
1	The memorial stele for Southern compatriots who gathered in the North, 20 meters away 	- Right at the Lach Hoi port construction site - Memorial site for Southern compatriots who gathered in the North
2	The seafood processing factory of Thanh Binh Trading Joint Stock Company, 20 meters away 	- The processing workshop located within the Lach Hoi port area has an approximate area of 300m², with around 40 workers working daily. Its main activities include processing, trading, and exporting frozen seafood (such as shrimp, squid, etc.).
3	The memorial site for Southern compatriots who gathered in the North, 150 meters away. 	- Near the construction area of Lach Hoi Port - The area of 15,500 m² is under construction, including the Gathering Ship Monument, an exhibition hall, a large arc-shaped relief, auxiliary structures, and simulated works.
II	Main transportation route (Tran Hung Dao Street)	
5	Quang Tien Secondary School, 20m away 	- The school is located on Tran Hung Dao Street, the main transportation route for raw materials leading to the existing Lach Hoi fishing port. - The school's campus covers an area of approximately 9,000 m², with around 50 teachers and over 900 students. - Students attend classes from Monday to Saturday, with arrival and departure times between 6:30 – 7:30, 11:00 – 12:00, 13:00 – 14:00, and 16:30 – 17:30.

6	Quang Tien Kindergarten, located 50 meters away. 	- The kindergarten is located on Tran Hung Dao Street, the main transportation route for raw materials leading to the existing Lach Hoi fishing port. - The kindergarten's campus covers an area of approximately 2,500 m², with around 50 teachers and over 800 students. - Students attend classes from Monday to Saturday, with arrival and departure times between 6:30 – 7:30, 11:00 – 12:00, 13:00 – 14:00, and 16:30 – 17:30.

2.2 LACH BANG FISHING PORT UPGRADING AND EXPANSION SUBPROJECT

2.2.1. Natural conditons

2.2.1.1. Geography

The Lach Bang fishing port upgrading and expansion subproject subproject is located in Hai Thanh ward and Hai Binh ward, Nghi Son town, Thanh Hoa province with the following geographical location:

- Hai Binh ward is located in the east of Nghi Son town, the East borders the East Sea and Hai Thanh ward, the West borders Truc Lam ward and Xuan Lam ward, the South borders Tinh Hai ward and the North borders Binh Minh ward.
- Hai Thanh ward is more than 4km to the southeast of Nghi Son town, the North and West border Binh Minh Ward, the South borders Hai Binh Ward and the East is the sea.



Figure 2.4. Map of Lach Bang Subproject location in Nghi Son Town

2.2.1.2. Topography

Based on the results of the topographic survey carried out by the joint contractor of Port and Waterway Engineering Consultant Joint Stock Company and IDIC Joint Stock Company. The subproject area is Lach Bang river bank, about 1 km from Lach Bang mouth. Lach Bang River in the study area has a width of 110 ~ 200m and with the topography as follows:

- Channel section from buoy 0 to pair of buoys 7 and 8: Within the bottom of the 50m wide navigational channel, limited and guided by the marine signaling system, depth reaches: 0.3m.
- Channel section from pair of buoys No. 7, 8 to Le Mon port: Within the bottom of the 50m wide navigation channel, limited and guided by the marine signal system, depth reaches: 3.0m.

The terrain of the Lach Bang estuary area is relatively flat and shallow, gradually sloping from the shore. The natural elevation within the project construction area ranges approximately from -1.85 to -4.8m (national elevation system). The terrain inside the Lach Bang estuary is relatively flat, with a deep channel close to the Hai Thanh side (old port side). The natural elevation throughout the entire area mainly ranges from -1.85 to -3.85m, with some places reaching -4.8m.

2.2.1.3. Geological Conditions

According to the results of a geological survey of the subproject area with 19 boreholes conducted by the joint venture contractor of Port – Waterway Engineering Consultant Joint Stock Company and IDIC Joint Stock Company in December 2023, the construction area of upgrading and expanding Lach Bang fishing port has quite complex stratigraphy, the geological strata are formed by the alluvial process - river and sea sediment so there is a large change in both area and depth of distribution. As follows:

- Layer 1: Clay mixed with dust, dark gray, ash gray, flowing. Locally distributed layer, only found at borehole LK2, this layer has a determined thickness of 0.7m (borehole location LK2). This is a weak soil layer, so when designing, it is necessary to pay attention to this layer.
- Layer 2: Sand and dust, gray gray, blue gray, porous - saturated with water. The grade is widely distributed throughout the survey area. This layer has a thickness varying from 0.8m (LK6) to 6.7m (LKTD7).
- Layer 3: Mixed clay, gray, dark brown, soft, flexible. Locally distributed layer, only appearing in borehole LK9; LK10, with thickness varying from 1.2m (LK9) to 2.3m (LK10). This is a weak soil layer.
- Layer 4: Clay, variegated color (yellow, reddish brown, gray-white), hard plastic - semi-hard. The distribution of the layer is uneven, only appearing in drill holes LK2; LK3; LK4 and LK8; LK9; LK10. This is a fairly good soil layer and has a large thickness with thickness varying from 2.3m (LK4) to unknown at drill holes LK8; LK9; LK10.
- Layer 5: Sandstone, yellow-gray, white-gray, gray-gray. The grade is widely distributed throughout the survey area. This is very good soil.

2.2.1.4. Climatic and Meteorological Conditions

The subproject area has climate and meteorological conditions consistent with those of Thanh Hoa Province and has been detailed in the aforementioned Lach Bang fishing port upgrading and expansion subproject subproject.

2.2.1.5. Tidal Regime

Nghi Son Town is located between the Yen River and the Lach Bang River, and is therefore affected by the hydrological regime of these two rivers. The rivers and streams in the area are short and steep, originating from the west and flowing into the sea. When nearing the sea, most of them are blocked by sand dunes running parallel to the coast, making the drainage difficult

during the flood season and causing flooding in coastal communes. The river system in the project area includes:

Yen River originates from Binh Luong commune (Nhu Xuan), at an altitude of 100 - 125m, flows down to Nong Cong and Quang Xuong plains and empties into the sea at Lach Ghep. The river is 94.2km long with nearly 50km in mountainous areas. The basin area is 1,996km². Yen River has 4 tributaries: Nhom River (66.9km), Hoang River (81km), Ly River (27.5km) and Thi Long River (50.4km). The basin area of the Yen River is 1,996* km² (with 49.5% plains and midlands, and 45.2% forested mountains). The total flow volume of the Yen River is 961 x 10⁶ m³ in flood season and 185 x 10⁶ m³ in the dry season.

Lach Bang River (known as Bang river) originates from the Huon mountains, Phu Lam ward (Nghì Son town), flows through the Du Xuyen mountain, reaches Khoa Truong, starts down the plain and flows into the sea at Bang mouth in the area between Hai Binh ward and Hai Thanh ward (the subproject area). The river is 34.5km, of which 18km in mountainous area, the basin area of 236 km². The section of the Lach Bang River has a greater natural depth, with a natural elevation ranging from -1.85m to -2.85 m. The total surface flow rate of the Bang River averages from 20.4 to 38 liters/second/km², and the basin area of the Bang River is 236 km².

Lach Bang estuary connects to the sea in a northwest-southeast direction. To the north of the Lach Bang estuary is shielded by the Mui Tron (Mui Rong) mountain, and the south is an open sandy beach.

The Lach Bang subproject area is located at the end of the Bang River, with the river section in the subproject area about 1 km from the Lach Bang estuary. The Bang River in the subproject area has a width of about 150-250 m, the river section near the estuary being wider at 200-300 m. The water quality of the river is quite good, and waterway traffic in this area is quite busy.

2.2.1.6. Natural resources

Natural resources

Surface water and groundwater resources in Thanh Hoa province and were presented in the Lach Hoi fishing port upgrading and expansion subproject mentioned above.

Mineral resources

Mineral resources in Thanh Hoa province and were presented in the Lach Hoi fishing port upgrading and expansion subproject mentioned above.

Biological resources

a. Forest resources

The forests and nature reserves mentioned above are all located over 30 km away from the subproject areas. In addition, in Nghì Son town (previously was Tinh Gia district), there is Lam Dong mountain protection forest in the three communes/wards of Truc Lam, Phu Lam and Phu Son, about 10 km to the west of the subproject areas, with an area of about over 5 thousand ha, the density of forest coverage is low.

Particularly in the coastal area to the north, about 4-5km away from the subproject area (Hai Hoa beach), there is production forest land with mainly casuarina and acacia trees grown for timber. Currently, the land has been allocated to local people. Tree density is average, trees are about 3-4m tall, trunks are 10 - 15cm in diameter and are periodically harvested when reaching growth to get wood for business and production. There are no mangrove forests in the subproject area

b. Marine Resources

Nghi Son Town is located in the southernmost part of Thanh Hoa province, bordering Nghe An province. It has a 42 km-long coastline and three estuaries: Lach Bang, Lach Ghep, and Lach Ha Nam. The coastal and adjacent sea areas of Nghi Son town have quite abundant and diverse marine resources, giving the town a significant advantage in seafood exploitation.

Floating fishing ground along the coast from Nghe An to the North have reserves of about 12,000 - 15,000 tons, mainly *Spratelloides* and herring (accounting for 40 - 50%); The remaining are *Decapterus*, anchovies, flat fish... Exploitation capacity is about 6,000 - 7,000 tons/year.

Bottom fishing ground south of Hon Me island to Lach Ghep and Lach Hoi - Southeast of Hon Me.

Sea shrimp: There are two main shrimp grounds: Hon Ne - Lach Ghep and Lach Bang - Lach Quen which have high reserves in the Gulf of Tonkin region. The annual exploitation capacity is about 1,000 - 1,300 tons, of which mainly shrimp, Spear shrimp and more than 7,000 tons of *Sergestidae*

Squid: Thanh Hoa and surrounding waters have very rich squid resources with reserves of 13,000 - 14,000 tons; The annual exploitation capacity is about 5,000 - 6,000 tons, including about 3,000 - 4,000 tons of squid and 1,500 - 2,000 tons of cuttlefish. In addition, the sea and coastal areas also have many other seafood specialties that have high economic value and are very popular in domestic and foreign markets such as Spotted Babylon snails, jellyfish, lobsters, sentinel crab, etc.

Regarding aquaculture: As of July 30, 2024, the total number of spontaneously farmed cages and rafts in Nghi Son town was 4,441 (including 2,479 cages and 1,962 rafts) and 73 households farming shrimp, mainly in the communes and wards: Hai Thanh, Hai Binh, Binh Minh, Xuan Lam, Hai Ha, Nghi Son, Hai Chau, Hai Hoa, Ninh Hai, Hai Yen, Tinh Hai... The town has 800 ha of aquaculture, of which 500 ha are brackish water aquaculture, 230 ha are freshwater aquaculture, and the remaining area is clam farming.

c. Biological resources in the project area.

When screening the project location from conservation areas/biosphere reserves/high biodiversity areas, the screening tool of <https://app.ibat-alliance.org/> is used. After screening, the location for upgrading and expanding Lach Bang Fishing Port is determined in the area of more than 30 km away from national parks/nature reserves within the province and neighboring areas.

The expanding area on Hai Thanh ward side is 0.53ha, covering: 0.28 transport land, 0.06ha of production, business and non-agricultural land and 0.19ha of surface water of Lach Bang river; the area on Hai Binh ward side has an area of 2.09ha, including: 2ha of production, business and non-agricultural land; 0.04ha of surface water area of Lach Bang river and 0.05ha of unused land.

By field survey and consultations with local residents, species of organisms in the project area include:

Terrestrial biological resources:

Most of the subproject areas have vegetation mainly garden ecosystems and agricultural ecosystems. The garden ecosystem has plant species such as jackfruit, longan, pomelo, grapefruit, banana and some shade trees such as eucalyptus, casuarina, etc. Agricultural ecosystems include corn, peanuts, potatoes, etc.

The terrestrial fauna in the Subproject area does not include any species listed in the red book. Amphibians and reptiles are commonly found in the area, with a relatively high species

composition and number of individuals. Additionally, there are domestic animals (buffaloes, cows, pigs, goats, etc.) and poultry (chickens, geese, ducks, etc.) raised by local households.

The Mammalia class in the project area does not include any rare species; it primarily consists of rodents such as field mice (*Muscaroli*) and large field rats (*Rattus argentiventer*); carnivores such as shrews (*Suncus murinus*); bats (*Chiroptera*); and bird.

Overall, there are **no** rare or endangered animals listed in the Red Book found in the Lach Hoi subproject area.

Aquatic species resources:

Aquatic animals include species such as shrimp, herring, anchovy, and lizardfish.

Planktonic flora: Regarding species composition, in the Bang River (Lach Bang) area and aquaculture ponds, the planktonic flora includes: diatoms, cyanobacteria, euglenoids, and dinoflagellates. The subproject area has a more diverse variety of algae compared to the aquaculture ponds.

Zooplankton: The zooplankton composition includes the following groups: Protozoa; Copepoda, Cladocera, Rotatoria, Ostracoda and Larvae. In the zooplankton composition, the Rotatoria group has a higher number of species, followed by the Cladocera group.

According to the *Report on the results of the General survey and assessment project suitable for coastal mangrove areas to serve the sustainable development strategy of Thanh Hoa province for the period up to 2020* by Prof. Dr. Pham Ngoc Ho, the amount of plankton and benthic animals in Bang river estuary include:

Table 2.3. Plakton and benthic animals in Bang River estuary

Phylum	Species	Unit	Quantity
Algae	<i>Bacillario phyta</i>	10 ³ cell/litre	74
	<i>Dino phyta</i>		36
	<i>Chloro phyta</i>		8
	Total		118
Zooplankton	<i>Naplius</i>	Individual/m ³	15.000
	<i>Copepoda</i>		57.500
	<i>Rotatoria</i>		7.500
	Total		48.750
Toxic algae	<i>Dinophysis caudata</i>	Cell/litre	100
	<i>Prorocentrum micans</i>		150

(Source: *Report on the results of the General survey and assessment project of coastal mangrove areas to serve the sustainable development strategy of Thanh Hoa province in the period up to 2020*)

The quantification of zooplankton, phytoplankton, and benthic animals in the Lach Bang estuary area is as follows:

Table 2.4. Zooplankton in the Bang River estuary

No	Zooplankton	Result (individual/m ³)		
		M ₁	M ₂	M ₃
	Rotatoria			
	<i>Class Monogononta</i>			
1	Order Ploimida	132.100	196.100	254.100
	Arthropoda			
	<i>Crustacea</i>			
2	Cladocera	261.100	285.100	103.100
3	Copepoda	428.100	389.100	295.100
	Total	821.100	870.100	652.100

(Source: Center for Environmental Research and Technology Transfer Vietnam Association for the Protection of Nature and Environment - October 2016)

In general, benthic animals are concentrated at the Lach Bang estuary and the coastal tidal area. The density tends to decrease gradually from the shore, with abundant of Bivalvia and Polychaeta, creating a source of bivalve mollusk seedlings for seafood farming and a valuable food base for many other seafood species. No rare or endangered aquatic species are recored in the project area.

2.2.1.7. Natural area

Lach Bang subproject area is also the coastal area of Thanh Hoa province where many storms occur and can significantly impact the coastal districts of the province from July to November each year. Natural disasters commonly include storms, storm surges, and heavy rains causing waterlogging, floods, and inundations, which are concentrated in September each year. Droughts and prolonged cold spells occur from December to February. Additionally, tornadoes, waterspouts, and hail can occur in this region with low frequency. Details have been presented in the Lach Hoi fishing port upgrading and expansion subproject.

2.2.2. Existing status of environmental parameters

To assess the quality of the baseline environment in the subproject area, the project owner coordinated with environmental monitoring unit, which is the Center for Environmental Analysis and Technology Transfer under the Institute of Agricultural Environment (certified by VIMCERTS 082), to conduct surveys, measurements, and baseline environmental sampling in the subproject area. The environmental sampling was carried out on January 15, 2024. Information about the monitoring points within the Lach Bang subproject area is as follows:

Table 2.5. Information about monitoring points in Lach Bang subproject

No.	Parameters	Quantity (sample)	Monitoring parameters	Description of monitoring location/Sign
1	Air, noise	01	CO, SO ₂ , NO ₂ , TSP, Pb, Noise, temperature, humidity, wind speed, wind direction.	At Lach Bang port (Hai Binh ward); Sign: TH2-KXQ

No.	Parameters	Quantity (sample)	Monitoring parameters	Description of monitoring location/Sign
				QCVN 05:2023/BTNMT: National technical regulation on ambient air; QCVN 26:2010/BTNMT- National technical regulation on noise.
2	Surface water	02	pH, TSS, Ammonium (NH ₄ ⁺ -N), Nitrite (NO ₂ ⁻ -N), Cyanide (CN ⁻), Copper (Cu), Lead (Pb), Cadmium (Cd), Arsenic (As), Total Chromium (Cr), Total Oil and Grease, Total Phenol, Surfactants, Organic Chlorine Pesticides (Heptachlor, Dieldrin), Organic Phosphorus Pesticides (Chlopyrifos, Diazinon)	TH2-NM1: Near salt prevention dike, Lach Bang estuary TH2-NM2: Near Ne beach, Lach Bang Estuary QCVN 08:2023/BTNMT – National technical regulation on surface water quality.
3	Groundwater	01	pH, TSS, Amonium (NH ₄ ⁺ -N), Nitrate (NO ₃ ⁻ -N), Chloride (Cl ⁻), Copper (Cu), Lead (Pb), Cadimium (Cd), Asenic (As), Total Chromium (Cr)	Well water in Lach Bang fishing port; Sign: TH2-NN1 QCVN 09:2023/BTNMT National technical regulation on groundwater
4	Wastewater	04	pH, TSS, Total Oil and Grease, Ammonium, Nitrate, Lead (Pb), Cadmium (Cd), Arsenic (As), Copper (Cu), Zinc (Zn), Manganese (Mn), Total Chromium (Cr), Total Phenol, Surfactants	Wastewater in the drainage culvert seawater prevention dike, Lach Bang estuary. Sign: from TH2-NT1 to TH2-NT4 QCVN 14:2008/BTNMT – National techncial regulation on domestic wastewater
5	Soil	01	Asenic (As), Cadimium (Cd), Lead (Pb), Chromium (Cr), Copper (Cu), Zinc (Zn)	Lach Bang fishing port area (on Hai Binh ward side); Sign: from TH2-D QCVN 03:2023/BTNMT – National technical regulations on soil quality

The diagram of the baseline environmental quality monitoring points in the Lach Bang Subproject area is shown below:

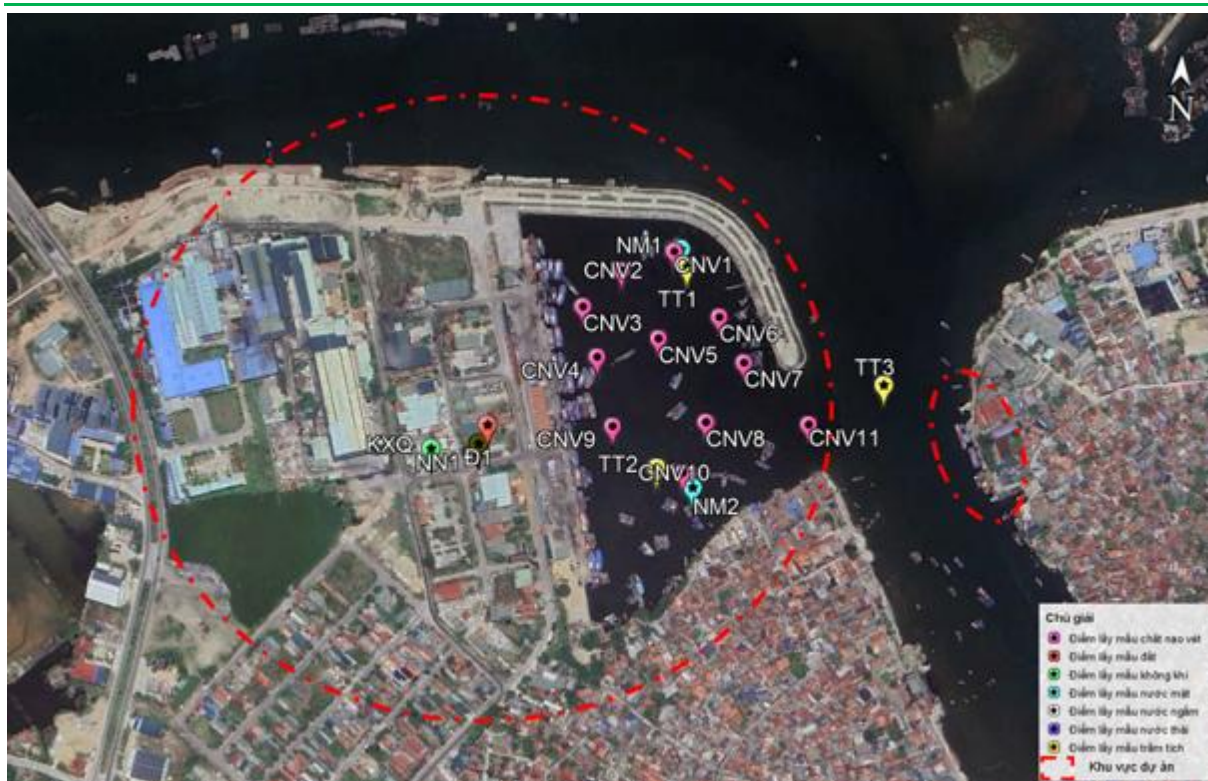


Figure 2.5. Map of baseline environmental quality monitoring points in the Lach Bang Subproject area

Environmental quality monitoring results will be presented in Appendix 3. Below is a summary of the results of environmental quality assessment in the Lach Bang subproject area.

a. Existing status of air quality and noise levels

01 sample in the construction area of the Lach Bang Fishing Port (on the Hai Binh ward side) was monitored. The results of the ambient air quality monitored in the subproject area show that all parameters are within the permissible limits of QCVN 05:2023/BTNMT: National technical regulation on ambient air (average one hour). The noise parameters in the subproject area are within the permissible limits according to QCVN 26:2010/BTNMT: National technical regulation on noise.

These results indicate that the ambient air quality and noise levels in the subproject areas are still relatively good, with no signs of pollution.

b. Existing status of groundwater quality

01 groundwater sample was taken from wells of households in Lach Bang Fishing Port. The monitoring results show that all parameters meet the permissible standards of QCVN 09:2023/BTNMT, except chloride exceeding 1.9 times compared to allowable limit. This explains for the reason that this coastal area has a chloride salt content in the seawater that permeates into the groundwater, increasing the chloride concentration in the groundwater.

c. Existing status of surface water quality

02 samples of surface water were taken in Lach Bang river, in existing fishing port. According to the monitoring results, at all monitoring points, almost all parameters are lower than permissible limits according to theo QCVN 08:2023/BTNMT (Column A), excepting TSS, surfacants exceeding allowable limits according to QCVN 08:2023/BTNMT (column A). Specifically:

- At the sampling point NM1 (near the seawater prevention dike, Lach Bang eastury): TSS

exceeding by 2.72 times; Surfactants exceeding by 3.24 times.

- At the sampling point NM2 (near Ne beach, Lach Bang eastury): TSS exceeding by 3.5 times; Surfactants exceeding by 3.32 times.

NM1 and NM2 samples have higher TSS and surfactant levels than the allowable limit because this is the existing Lach Bang Fishing Port, currently affected by activities such as boats, fishermen, fish sorting activities, etc., and there is no wastewater treatment facility in the Port.

d. Existing status of wastewater quality

04 samples were taken in wastewater culvert in some residential areas along seawater prevention dike in Lach Bang Fishing Port. The monitoring results show that most of the parameters are lower than allowable limits, except TSS, Amonium exceeding allowable limits according to 14:2008/BTNMT, Column B. Specifically:

- At NT1 sampling point: TSS exceeding by 3.52 times.
- At NT2 sampling point: TSS exceeding by 4.33 times;
- At NT3 sampling point: TSS exceeding by 7.02 times; Amonium exceeding over 9 times; Surfacants exceeding by 1.96 times;
- At NT4 sampling points: TSS exceeding by 1.84 times.

The wastewater samples in the Lach Bang port area all have higher levels of TSS, Ammonium, and surfactants than the allowable limit because the fishing port currently does not have wastewater treatment facility. The domestic wastewater from the fishermen operating in the port is only treated through septic tanks and has not been thoroughly treated.

e. Existing status of soil quality

01 soil sample was taken in the Lach Bang Fishing Port expanding area (on the Hai Binh side). The analysis results of soil quality show that the heavy metal parameters are all within the permissible limits according to QCVN 03:2023/BTNMT - National technical regulation on soil quality. This indicates that the soil quality in the subproject area is still quite good, with no signs of pollution. Therefore, the soil excavated during the construction of the subproject can be reused for various purposes such as land leveling... or can be disposed of as regular waste.

2.2.3. Socio-economic conditions

The Upgrading and Expanding of Lach Bang Fishing port upgrading and expansion subproject area is located between Hai Thanh and Hai Tien wards, Nghi Son town, Thanh Hoa province. The subproject will not acquire land, so there will be no household affected or relocated. The socio-economic conditions of two subproject wards are presented in the following part.

2.2.3.1. Economic development conditions

❖ Hai Thanh ward

According to Hai Thanh ward socio-economic report, the ward's economy relies on industrial and services development (making up 47.6%), followed by forestry- agricultural section (accounting for 33.3%), service and handicarf represents the smallest proportion with 19%. Details are as follows:

- Fishery and aquatic production: There are totally 291 means of exploitation and purchasing of seafood in the entire ward; catching output estimated at 8,100 tons, earning an estimated income of VND 270 billion.

- Regarding industry – construction, services, and trading: The entire ward has 10 fish drying facilities; 02 fish meal processing facilities; 68 companies and businesses in the fields of fishery logistics services, seafood processing, general commerce, passenger and cargo transportation vehicles, and specialized vehicles; 08 seafood purchasing vessels, and 05 oil vessels. The estimated seafood purchasing service volume at sea is 30,000 tons. The estimated revenue from business services is VND 430 billion.

The average per capita income reached VND 49,000,000 per person per year. The poverty rate of the ward in 2023 decreased to 1.8% (84 households), and the near-poor household rate is 6.99% (325 households).

❖ **Hai Binh ward**

Hai Binh Ward is located in the east of Nghi Son town, and adjacent to the sea, it has an advantage in developing the agriculture, forestry, and fisheries sector, which accounts for 52% of its structure. The service and small industry sectors account for 30%, and the construction industry only makes up 18%. The economic sectors of the ward in 2023 are as follows:

- Fishery: In 2023, the total production of fishing and aquaculture reached 25,000 tons; the total purchasing volume was 85,000 tons; and the total processing volume was 17,145 tons.
- Livestock farming and gardening: The total number of livestock and poultry is 2,564 (including 235 pigs, 1,853 poultry, and 476 other livestock such as buffaloes and cows). Additionally, households have also improved garden land to grow various vegetables to meet the needs of local residents, contributing to increased income.

Income per capita of the ward in 2023 reached VND 55 million per person per year. This living standard has been increasingly improved. The rate of poor households has decreased to 0.95% (30 households); and the figure of near poor households was 2.48% (78 households).

2.2.3.2. Socio-economic development conditions

❖ **Hai Thanh ward:**

Population: As of 31/12/2024, total population of Hai Thanh ward was 19,440 people, equivalent to 4,282 households, in which 9,603 male and 9,837 female. The population density reached 7,818 person/km².

Education: The ward has a system of schools from preschool to secondary school. In the 2022-2023 school year, the ward successfully mobilized 100% of children to attend kindergarten at the correct age as stipulated.

The ward has one health station that performed well in providing initial medical care to the residents throughout the year. The total number of medical examinations and treatments was 5,645 visits; 118 children received full vaccinations; and there were 238 prenatal check-ups.

❖ **Hai Binh ward:**

Population: As of December 31, 2024, the total population of Hai Binh ward is 14,774 people, with 7,357 males and 7,417 females. The population density is 1,549 /km².

Education: Hai Binh Ward has an education system from preschool to secondary school (01 secondary school, 01 primary school, 02 kindergartens).

Healthcare: The ward has one health station that performed well in providing initial medical care to the residents throughout the year. It ensured health care for the people, developed a comprehensive environmental sanitation plan, and took disease prevention

measures, especially for dengue fever and other seasonal epidemics that have the potential to outbreak.

2.2.3.3. Results of surveys on affected households

Hai Binh ward currently has 200 vehicles, including 70 fishery logistics service vessels, providing jobs for about 1,300 workers with an average income of VND 6 - 7 million/person/month. On average, the fishery logistics service fleet of Hai Binh ward purchases about 100 thousand tons of seafood at sea annually, supplying raw materials for more than 30 purchasing and processing facilities in the area. Additionally, the fishery logistics service vessels also supply millions of liters of gasoline, oil, ice, and other essential items to fishermen for offshore fishing activities.

Hai Thanh ward currently has approximately 283 fishing vessels and 8 seafood purchasing vessels, with around 230 households engaged in fishery logistics services, providing income for about 400-500 workers. The average income for these workers is approximately VND 7-9 million/month.

Regarding the 78 fishery logistics service vessels, they concentrate in two wards: Hai Binh (70 vessels) and Hai Thanh (8 vessels). In addition to purchasing hundreds of thousands of tons of seafood at sea annually, this fleet also supplies fuel, equipment, and other essential items to offshore fishing vessels. During the subproject implementation, fifteen households renting kiosks from the Lach Bang Port Management Board for seafood and fishery services at the port will be affected. The average income of these service households is about VND 8-10 million /month.

2.2.4. Existing status of infrastructure in subproject area

a. Transport system

❖ Road transportation

Currently, the main roads connecting the northern area of Hai Binh ward with National Highway 1 in the East-West direction include:

- The East-West Road 1 is approximately 1.35 km long, with a road width ranging from 5.5m to 10.5m, and structured of asphalt concrete.
- The East-West road 2 is approximately 1.18 km long, with a main road width of 15.0m x 2, side access roads of 3.5m x 2, a central divider of 5.0m, side dividers of 2.5m x 2, and sidewalks of 5.0m x 2. The road is structured of asphalt concrete.
- The North-South road 2 is approximately 5.96 km long, with a road width of 7.5m x 2, and a central divider of 10.0m. The road is structured of asphalt concrete. This is the main connection road in the North-South direction, linking National Highway 1 with the Lach Bang fishing port area.

The road along the Than canal passes through several communes to the east of Nghi Son town, providing access to the subproject area in Hai Thanh ward. This newly constructed road is 3.2 km long, 7.5m wide, with sidewalks ranging from 2.0m to 4.0m. The road has a cement concrete pavement structure of good quality and a moderate traffic volume.

❖ Waterway traffics

The Lach Bang river mouth connects to the Gulf of Tonkin, making it convenient for boats to the sea, as well as providing a safe shelter during storms. Currently, waterway traffic on the Bang River in the Lach Bang port area is quite busy (about 30 vessels per port call, with around 400 vessels regularly anchored). The subproject does not use waterway transportation to carry construction materials. However, there will be some construction machinery on the

water such as canoes, 30T floating cranes, barges, pile-driving vessels, etc. that needs to be transported to the construction site by waterway.

❖ *Inland roads:*

On Hai Binh ward side:

Road 7 is the main route for the current residential area in Hai Binh ward, running in the North-South direction. It is approximately 2.0 km long, with a road width ranging from 3.5m to 5.0m, and a roadbed width ranging from 10.0m to 12.0m.

The roads in the resettlement areas which are newly built in Hai Binh ward can access the subproject area. Most of these roads are asphalt concrete with a road width ranging from 7.5m to 10.5m, and sidewalks ranging from 3.0m to 5.0m, well meeting the travel needs of residents.

The seawater prevention dike in Hai Binh ward, which can access the subproject area, is currently a grade IV dike, with a length of 3.1 km. The road along the dike is 5.0m - 7.0m wide, and the sidewalks are 3.0m - 5.0m wide, with cement concrete structure.

On Hai Thanh ward side:

The Van Nhan road is the main road accessing the Lach Bang fishing port area in Hai Thanh ward. This road is 2.73 km long and 5.0m - 6.0m wide, with an asphalt concrete pavement structure. It is the main route connecting the subproject area with the center of Nghi Son town through Do Be bridge. The traffic density on this route is quite high due to trucks and motorcycles entering and leaving the existing port to transport seafood caught by fishermen and provide port logistics services. Especially, the road will be busier during peak hours of some schools with school start time (7-8 am) and end time (4-6 pm) daily and office headquarters.

b. Other infrastructure systems

Water supply system: The clean water is supplied from the existing residential water sources in Hai Binh and Hai Thanh wards.

Wastewater collection and treatment: The project area (Lach Bang port in Hai Binh and Hai Thanh wards) does not yet have a centralized wastewater collection and treatment system. The existing drainage system flows naturally and discharges into the Lach Bang River.

Solid waste collection and treatment: The subproject area (Lach Bang port in Hai Binh and Hai Thanh wards) already has a household solid waste collection system.

Electricity and communication system: Lach Bang Port in Hai Binh and Hai Thanh wards is a densely populated residential area, so the infrastructure system for electricity, lighting, and communication is complete.

f. Existing status of Lach Bang Fishing Port

Lach Bang Fishing Port include 02 components: Hai Thanh Port and Hai Binh Port with specific description as follows:

- Fishing port on Hai Thanh ward side: is grade-II fishing port with total planned land area of 2.75 ha, planned water surface area of 1.75 ha, with 90m of wharf, technical infrastructure and other auxiliary works. It was constructed in November 1998 and was put into operation in January 2004. At present, the port accommodates 4-5 vessels docking per day. The seafood throughput at the current port is 50 tons per day.
- Fishing port on Hai Binh ward side is the grade I port, was invested in construction and put into operation in 2003, with a planned area of 41.6 ha, including the wharf area and terrestrial logistics area of 8.7 ha; The shipping channel and the water surface in front of the wharf is 31.9 ha, with more than 400m of wharf designed for vessels up to 400CV to

anchor; The port is currently operating with 20 vessels docking per call, and 200 vessels regularly anchored at the port. The seafood throughput at the current port is 170 tons per day. Currently, it has been degraded, the anchor pillars are broken, the outdated design does not meet the needs of large capacity vessels docking at the port, the anchor pillars have been broken, the wastewater and plastic waste systems do not satisfy the standard and there is no communication and fishing vessel control system.



Image. Fishing port on Hai Thanh side



Image. Fishing port on Hai Binh side

2.2.5. Socio-environmental conditions in the subproject area and sensitive receptors

The existing Lach Bang fishing port is approximately 0.5 km from the river mouth and comprises two ports: one in Hai Thanh ward and the other in Hai Binh ward.

- The existing port in Hai Thanh ward covers an area of 2.75 ha and will be upgraded to a total area of 3.28 ha. The expansion of 0.53 ha includes: 0.28 ha of transportation land within the port, 0.06 ha of non-agricultural production and business land, and 0.19 ha of water surface area on the Lach Bang River.
- The existing port in Hai Binh Ward covers an area of 8.7 ha and will be upgraded to a total area of 10.79 ha. The expanded land covers an area of 2.09 ha, including 2 ha of non-agricultural production and business land, 0.04 ha of water surface area on the Lach Bang River, and 0.05 ha of unused land (open land reserved for port expansion as planned).

The Lach Bang River in this area has a width of approximately 170m to 200m (in the subproject area, about 1km from the Lach Bang river mouth). The river's width near the river mouth is larger, around 200m to 300m. The water quality is quite good, and waterway traffic in this area is quite busy. Currently, waterway traffic on the Bang River in the Lach Bang port area is quite busy (about 30 vessels per port call, with around 400 vessels regularly anchored). The shipping channel to the fishing port has a width of 30-45m and a depth of 3.5-4m.

The residential areas in Hai Thanh and Hai Binh wards are densely populated and adjacent to the port area (about 20-50m from the subproject area). Additionally, there are several existing seafood processing plants and some cages for shrimp, fish, and oyster farming on the Lach Bang River, located about 400-500m from the port area towards Lach Bang Bridge 2¹¹).

Within and around a 300m radius of the subproject area, there are no PCR objects (temples, pagodas, shrines, graves, churches). The sensitive structures that may be affected by the

¹¹ Lach Bang 2 Bridge is part of the North-South 2 road project within the Nghi Son Economic Zone, located in Hai Binh ward. The bridge is 330m long, 29m wide, and consists of 8 spans, 7 piers, and 2 abutments.

subproject include: Du Xuyen ferry terminal, petrol station, oyster farming area on the river. Details are presented in the table below.

Map of project location and sensitive receptors are displayed in the following image:

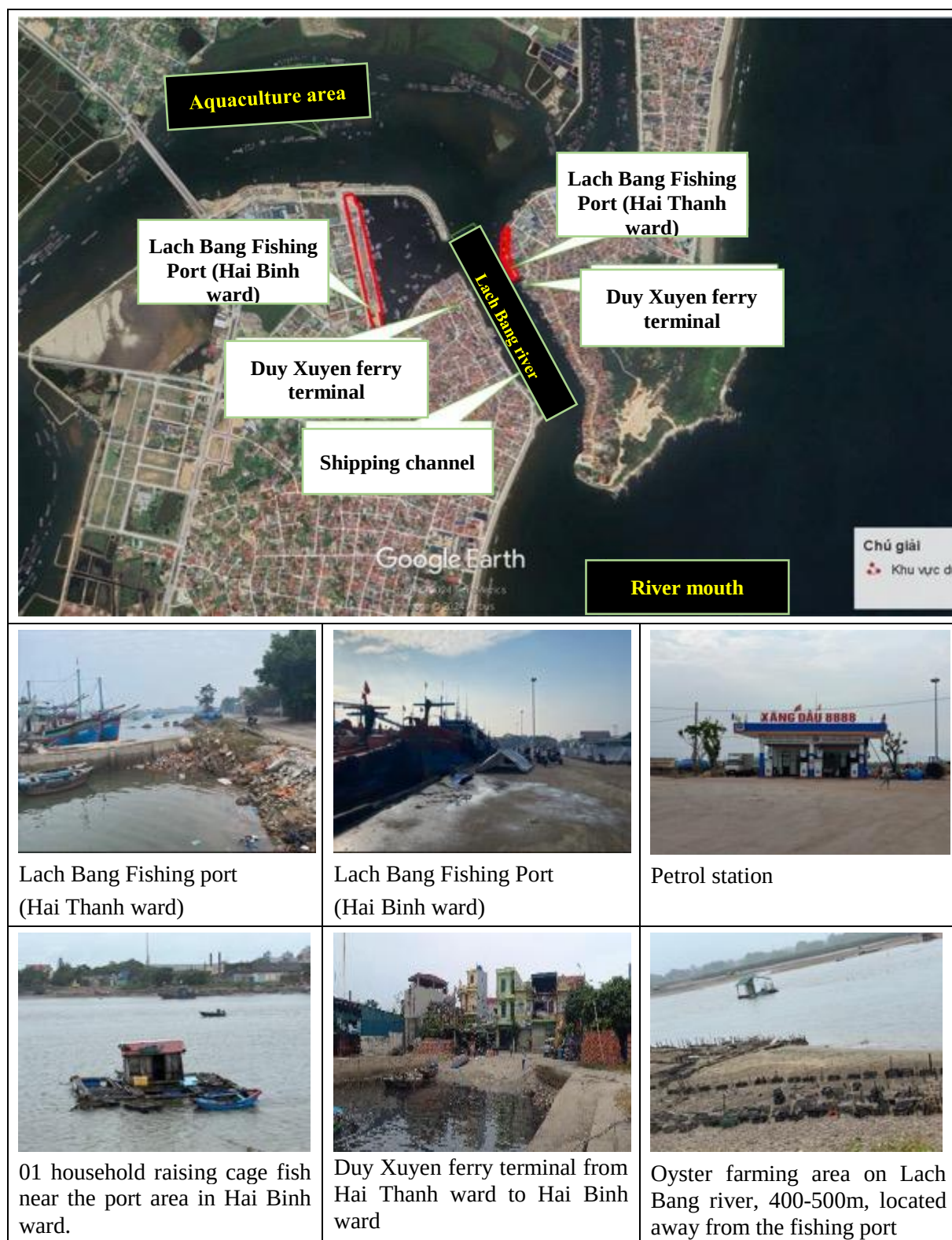
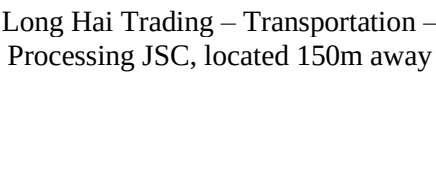


Figure 2.6. Location of Lach Bang subproject area and sensitive receptors

Table 2.6. Sensitive receptors under Lach Bang subproject

No.	Sensitive receptors and distance to the fishing port	Description
I	Fishing port on Hai Thanh ward side	
1	Duy Xuyen ferry terminal, located 100m away 	- Located near Lach Bang fishing port (Hai Thanh ward). - The ferry route across the Lach Bang River serves the transportation needs of residents in Hai Thanh and Hai Binh wards, as well as the surrounding area. - On average, there is a ferry trip every 30 minutes, and the ferry terminal operates from 5 a.m. to 10 p.m. daily.
2	Petrol station in Hai Thanh ward, located 80m away 	- Located near Lach Bang fishing port (Hai Thanh ward). - The area near the Lach Bang River, primarily selling petrol and oil, mainly serving the residents of Hai Thanh ward.
3	Fishing processing plant, located 50m away 	- The processing plant is located about 50m from the port and employs approximately 20-30 workers daily. Its main activities include fish processing and the business and export of frozen seafood (such as shrimp, squid, etc.).
II	Port on Hai Binh ward side	
1	Petrol station, located 20m away 	- Located next to the Lach Bang fishing port (Hai Binh Ward). - The area near the Lach Bang River, primarily selling petrol and oil, mainly serving the residents of Hai Binh ward and the fishing port.
2	Long Hai Trading – Transportation – Processing JSC, located 150m away 	- The company's seafood processing and fish meal production plant is located about 150m from the Lach Bang port area in Hai Binh ward, covering an area of approximately 200 m². The plant employs about 30 workers daily.

No.	Sensitive receptors and distance to the fishing port	Description
		

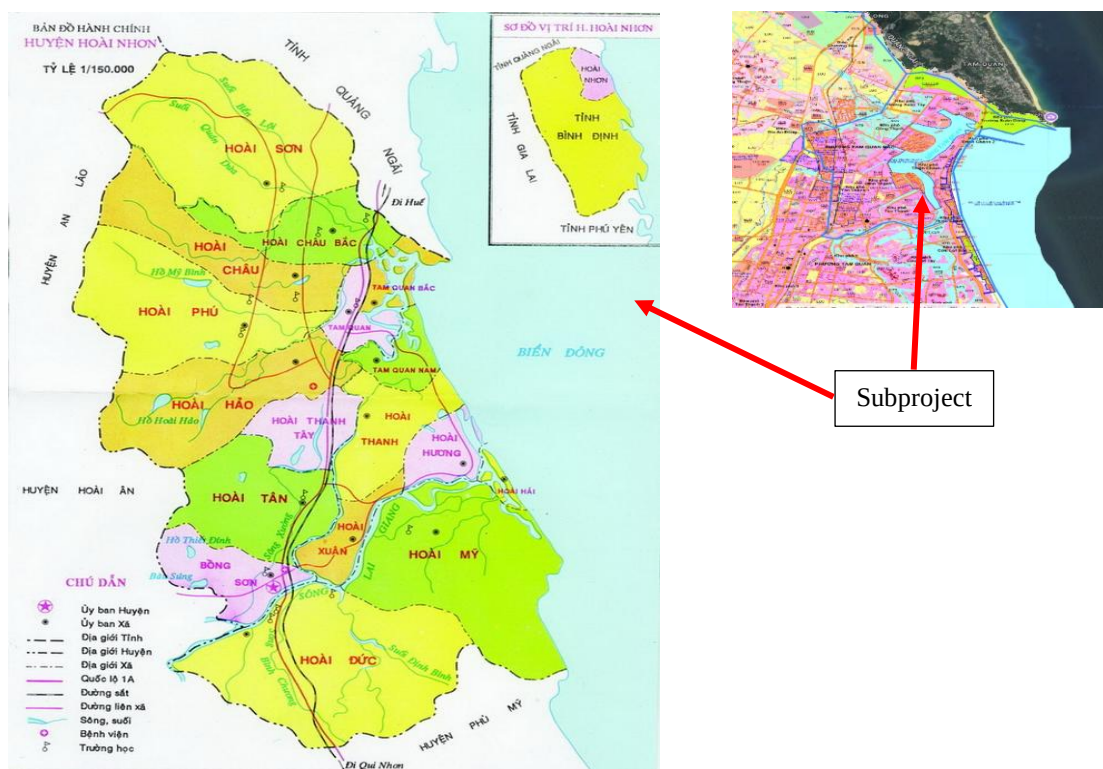
2.3 TAM QUAN STORM SHELTER UPGRADING AND CONSTRUCTION SUBPROJECT

2.3.1. Natural conditions

2.3.1.1. Geography

The subproject is located in Tam Quan Bac ward, Hoai Nhon town, Binh Dinh province. Hoai Nhon town is located in the north of Binh Dinh province, 87 km from Quy Nhon city where there are National Highway 1A and the North-South railway passing through; it serves as an important gateway for economic exchange in the northern part of Binh Dinh province and a key transportation hub connecting to Hoai An and An Lao districts.

The subproject is located in the lower reaches of the Tam Quan River, about 2.2 km from the river mouth, which connects to the East Sea through the Tam Quan estuary. The specific boundaries of the subproject are as follows: The North borders the Dai Ong Keo River; The East borders the residential areas of Thien Chanh 1 and Thien Chanh 2 villages and the planned land of seafood processing enterprises; The South borders the Tam Quan River, Tam Quan fishing port in Zone D, and the residential cluster of Dinh Thanh village; The West borders the residential cluster of Cong Thanh village.



Form 2.7. Location of Tam Quan subproject in Hoai Nhon town

2.3.1.2. Topography

The topography of Hoai Nhon town tends to slope downward towards the Northeast and is divided into 2 main types of terrain:

- Plain terrain: Surrounded by mountain ranges like a valley enclosed on three sides (North, West, South), with an average elevation of 8–10 m; the highest areas bordering the mountains reach 25 m, while the lowest areas near the sea are about 1 m.
- Low hilly terrain: The mountains are connected in an arc-shaped range, with an average elevation of 400 m, the lowest about 100 m, and the highest up to 725 m. In general, these two types of terrain have distinct characteristics that dominate the town's agricultural and forestry production.

The Tam Quan fishing port area is located downstream of the Tam Quan River, about 2.2 km from the estuary, where it converges with tributaries of the Quy Thuan River, the Nom River to the west, and the Thien Chanh River to the south. The entire catchment basin area up to the mouth of the Tam Quan River covers 265 km². The mouth of the Tam Quan River belongs to the typical estuary type of the South Central coastal area, consisting of a single creek flowing into the sea, shielded by mountains protruding into the coastline, and accompanied by arrow-shaped sand dunes running along the shore, strongly influenced by tides.

The final section of the Tam Quan River, from Thien Chanh Bridge to the estuary, is nearly 3 km long, flowing in a south–north direction almost parallel to the eastern sand dunes. Approaching the estuary, the riverbed widens, with small hills and dunes scattered in the middle of the stream.

The topography of the Tam Quan riverbed can be divided into 3 distinct sections:

- The section from downstream of Thien Chanh Bridge to the end of Go Dai: the river runs fairly straight, with an average width of 100–150 m, an average riverbed elevation of (-0.50) ÷ (-1.50) m, a gentle cross-sectional slope, and the main current flowing close to the right bank.
- The curved section near Con Ro (Ro island): the river bends with a small radius of $R = 100$ m. The protruding Con Ro bank extends into the middle of the stream, narrowing the riverbed abruptly to only about 70 m, with the deep current flowing close to the left bank. To the west of the Con Ro area, there is a small creek that serves as the outlet of a branch of a drainage canal from the south. Along both banks of this canal and around Con Ro, there are many shrimp ponds.
- The section from Go Xom 5 in the Cong Thanh area to the river mouth (border guard post): the river flows straight, then turns about 110° to connect with the navigation channel running along the southern sand barrier embankment and the northern Truong Xuan mountain range.

Along both sides of the river are dense residential clusters, concentrated particularly in Thien Chanh 1 and Thien Chanh 2 (east), Truong Xuan and Truong Xuan West (north), Cong Thanh, Dinh Thanh, Tan Thanh 1, Tan Thanh 2 (west), and Cuu Loi Bac (south).

2.3.1.3. Geology

According to the feasibility study report of the Project, the geology of the subproject on investment in the construction of storm shelter anchorage in the Tam Quan region, Binh Dinh province, consists of the following soil layers:

- Layer D: Soil infill (rocks, broken bricks, gravel, and sand, etc.). This is the surface layer of the terrain with mixed composition, insignificant in terms of construction.

- Layer 1: Poorly graded sand, yellow-gray to grayish-gray, loose structure (SP). This layer has weak to medium load-bearing capacity.
- Layer 2: Clayey sand, grayish-gray to dark gray, very loose texture (SC). This is a weak soil layer with low load-bearing capacity and high settlement compressibility.
- Layer 3a: Poorly graded sand, yellow-gray, grayish-gray, brown-gray, loose texture (SP). This layer has weak to medium load-bearing capacity.
- Layer 3b: Poorly graded sand, yellow-gray to dark gray, medium-dense structure (SP). This layer has relatively good load-bearing capacity.
- Layer 3c: Poorly graded sand, golden-gray to light gray, dense structure (SP). This layer has good load-bearing capacity.
- Layer 4a: Low-plasticity clay/low-plasticity silt, grayish-gray to dark gray, in a soft, flowing state (CL, ML). This is a weak soil layer with low load-bearing capacity and high settlement compressibility.
- Layer 4b: Clayey sand, yellow-gray, bluish-gray, light gray, loose texture (SC). This layer has weak to medium load-bearing capacity.
- Layer 5: Poorly graded sand/poorly graded silty sand, brown-gray, grayish-gray to light gray, medium-dense structure (SP, SP-SM). This layer has relatively good load-bearing capacity.
- Layer 6a: Low-plasticity clay, yellowish-brown to reddish-brown and light gray, stiff plastic state (CL). This layer has average load-bearing capacity.
- Layer 6b: Low-plasticity clay, yellowish-brown to reddish-brown, yellowish-gray to light gray, semi-hard to hard state (CL). This layer has good load-bearing capacity.
- Layer 6c: Low-plasticity silt, yellowish-gray to light gray, soft plastic state (ML). This layer has average load-bearing capacity.
- Layer 7a: Clayey sand, yellow-gray, dark gray to brownish-gray, loose to medium-dense texture (SC). This layer has average load-bearing capacity.
- Layer 7b: Poorly graded sand, gray-white, dense structure (SP). This layer has good load-bearing capacity.
- Layer 8a: Low-plasticity silt, yellowish-gray to light gray, stiff to semi-hard plastic state. This layer has relatively good load-bearing capacity.
- Layer 8b: Clayey sand, grayish-gray, brown-gray to light gray, dense to very dense structure (SC). This layer has very good load-bearing capacity.
- Layer 9a: Granite, highly weathered, strongly fractured, brown-gray to grayish-gray, light gray. This layer has very good load-bearing capacity.
- Layer 9b: Granite, moderately weathered, strongly fractured, grayish-gray to bluish-gray. This layer has very good load-bearing capacity.
- Lens: Low-plasticity clay, grayish-gray to bluish-gray, soft state (CL). This layer has average load-bearing capacity.

For the embankment works: During construction, attention should be paid to soil layers No. 2 and 4a. These are weak but locally distributed soil layers. Layer No. 2 is thin and located near the surface; it can be removed during construction.

In general, the geological conditions in the project area provide medium to good load-bearing capacity. The geological conditions ensure that construction activities of the subproject can be implemented smoothly, with minimal risks related to landslides during the construction process.

2.3.1.4. Climatic and meteorological conditions

- According to documents from Hoai Nhon Hydrometeorological Station, the climate in the project area is of a tropical monsoon type, divided into two distinct seasons: the dry season from January to August and the rainy season from September to December each year.
- The multi-year average temperature is 26.4°C; the highest monthly average temperature occurs in June at 29.6°C; the lowest monthly average temperature occurs in January at 22.5°C; the highest recorded air temperature is 40.5°C; the lowest recorded air temperature is 14.7°C.
- The multi-year average relative humidity is 82%; the lowest average air humidity recorded is 32%.
- The multi-year average rainfall is 2,164.6 mm; the average number of rainy days is 142 per year; the highest daily rainfall recorded is 318.6 mm; November has the highest average monthly rainfall at 560.2 mm, while March has the lowest at 15.3 mm.
- The prevailing wind direction in the subproject area is from the North; the maximum observed wind speed was 13 m/s from the North (N) on October 30, 2019.
- The multi-year average number of foggy days is 12 per year, with January having the highest occurrence at 4 days. Visibility on most days of the month ranges from 10 km to over 15 km.

2.3.1.5. Hydrographic/oceanographic condition

The hydrological regime of the sub-project area is directly influenced by the hydrological regime of the Tam Quan River. The Tam Quan River system includes the Go Gu Tai and Phung Du rivers in the upper reaches, which flow into the Tan My - Nom river - Tam Quan river system. Before discharging into the East Sea through the Tam Quan estuary, there is also a small tributary (Ong Kheo Dam river). The catchment area is about 217 km². Water flow is mainly concentrated in the four months of the rainy season (September to December), accounting for 70–75% of the total annual rainfall. During the flood season, the average discharge into the Tam Quan estuary is about 375 m³/s. The design flood discharge at 5% frequency reaches about 700 m³/s through the estuary gate, with a relatively strong flow velocity of about 2.27 m/s.

The mouth of the Tam Quan River lies on a coastal arc bounded by the Truong Xuan Mountains in the north and the Lo Dieu Mountains in the south, extending for about 15 km. Along this arc, there are two major estuaries: the Tam Quan estuary in the north and the Lai Giang River with the An Du estuary in the south. As these two rivers approach their estuaries, they encounter sandbars running perpendicular to the flow, forcing the river currents to turn parallel inside the dunes before breaking through narrower points of the sandbars to discharge into the sea (when the river's momentum overcomes the resistance of coastal currents). In the dry season, when river discharge decreases, coastal currents dominate and carry sand into these estuaries.

In addition, the hydrological regime of the project area is also influenced by other rivers in Binh Dinh province, specifically:

- Lai Giang River: Formed by the confluence of the Kim Son River (Hoai An) and the An Lao River (An Lao), this river flows through Hoai Nhon town and discharges into the sea at the An Du estuary (Hoai Huong). It is a large river in the south of the town,

with an average discharge of 58.6 m³/s, equivalent to an annual water volume of 1,844 million m³.

- **La Tinh River:** being the smallest of the four rivers in the province, it originates from mountainous forests at elevations of 400–700 m in the western part of Phu My and Phu Cat districts. The river flows northwest–southeast to Cay Gai dam, then turns west–east; at Cay Ke dam it changes course east–northeast, flowing into Nuoc Sap lagoon before discharging into the sea through the De Gi estuary.
- **Kon River:** being the largest river in the province, with a basin area of 3,067 km² and a length of 178 km, it originates in the Truong Son mountain range at elevations of 700–1,000 m. The river flows northwest–southeast to Thanh Quan–Vinh Phuc, then north–south to Binh Tuong, and further west–east to Binh Thanh, where it divides into two main branches: The Dap Da branch flows to the An Loi estuary and empties into Thi Nai Lagoon; The Tan An branch, joined by the Go Cham river about 2 km downstream from the junction, flows across the delta before merging with the Tan An river and discharging into Thi Nai Lagoon at the Tan Giang estuary. All tributaries of the Dap Da and Tan An rivers eventually enter the sea through the Quy Nhon estuary.
- **Ha Thanh River:** Originates from mountain peaks at about 1,100 m elevation in the southwest of Van Canh district, flowing southwest–northeast. At Dieu Tri, the river splits into two branches: the Ha Thanh branch and the Truong Au branch, both discharging into Thi Nai Lagoon through the Hung Thanh and Truong Au estuaries, and then out to sea via the Quy Nhon estuary. The total basin area is 539 km², with a river length of 58 km.

2.3.1.6. Biological resources

Typical ecosystems

According to the Report on the Current State of the Environment of Binh Dinh Province for the period 2016–2020, there are 08 main ecosystems in the province, including natural forests, secondary forests, bamboo forests, grasslands, shrubs, agricultural lands, inland waters, lagoons, coral reefs, as well as residential, urban, and industrial park ecosystems.

- **Natural forest ecosystem:** Defined based on rich forests with vegetation in the state of IIIA and IIIB. Natural forest ecosystems have high biodiversity and are less affected by economic development activities and direct human intervention. In Binh Dinh province, natural forests cover about 47,420 ha, distributed mainly in An Lao, Vinh Thanh, and Van Canh districts, and are represented by two main types: moist evergreen closed rainforests at elevations above 800 m, and tropical evergreen closed rainforests at elevations below 800 m.
- **Secondary forest ecosystem:** Includes degraded secondary forests corresponding to forest conditions at levels IIA and IIB. These forests regenerate after cultivation or deforestation. This ecosystem covers an area of 237,070 ha, accounting for 39.2% of the province's natural land area. Secondary forests are mainly distributed in Vinh Thanh, An Lao, Hoai An, and Van Canh districts, with scattered areas in Phu Cat and Phu My.
- **Bamboo forest, grassland, and shrub ecosystem:** Indirectly derived from tropical evergreen closed rainforests and directly resulting from cultivation or logging without reforestation. The forest condition is at levels IA, IB, and IC. However, in many areas, small patches of forest with scattered trees remain within bamboo forest areas. This ecosystem covers about 12,740 ha, accounting for 2.1% of the natural land area. Currently, this ecosystem type still has potential for forest restoration, as seed sources of tree species remain and soil conditions have not been significantly altered.

- **Agricultural ecosystem:** Covers an area of 280,100 ha, accounting for 46.3% of the natural land area, distributed mainly across Phu Cat, Phu My, Hoai Nhon, An Nhon, Tuy Phuoc, and Tay Son districts. This includes fields with diverse crops, low-yield or sparsely cultivated fields, and even abandoned farmland.
- **Freshwater ecosystem:** A typical ecosystem providing habitats for aquatic species including rivers, streams, lakes, and ponds. Inland water systems are classified based on natural features such as topography, geomorphology, substrate, and hydrological regime. Freshwater ecosystems cover 10,790 ha, accounting for 1.7% of the natural land area, mainly in An Lao, Tay Son, Vinh Thanh, and Van Canh districts, with scattered areas elsewhere. Freshwater bodies support a wide variety of fish, amphibians, invertebrates, aquatic plants, and microorganisms. They also provide essential regulating and maintenance services by transporting water, energy, nutrients, organisms, and sediments across landscapes and habitats, linking atmospheric, terrestrial, groundwater, and marine systems.
- **Lagoon ecosystem:** Binh Dinh province has a typical lagoon system of the South Central Coast, consisting of three large lagoons: Thi Nai Lagoon (5,060 ha), Tra O Lagoon (about 1,200 ha), and De Gi Lagoon (1,580 ha). Together, they cover about 8,000 ha, located in Quy Nhon City, Phu My District, and Phu Cat District.
- **Coral reef ecosystem:** Coastal coral reefs in Binh Dinh province are distributed from Hoai My (Hoai Nhon) to Quy Nhon. In particular, Quy Nhon Bay, with its many small islands and rocky outcrops, hosts a rich coral reef and seagrass ecosystem, concentrated along the coasts of Nhon Ly, Nhon Hai, Ghenh Rang, and Cu Lao Xanh (Nhon Chau) communes. These areas are also key locations for the province's economic and marine tourism development. Coral reefs are especially concentrated in the southern area within the triangle of Cu Lao Xanh, Hon Dat, and Hon Kho. The total area of coral reefs along the coast of Binh Dinh province is estimated at 108.69 ha, of which about 62 ha (54.7%) are concentrated around Hon Dat, Hon Kho, and Cu Lao Xanh.

According to IUCN (2018), Binh Dinh province has not established any marine or coastal protected areas. However, the province does have an inland water conservation area at Tra O Lagoon, located about 30 km south of the subproject site (construction and operation activities of the Tam Quan subproject will not affect this protected inland water area).

Biodiversity

According to the Report on the Current State of the Environment of Binh Dinh Province for the period 2016–2020, biodiversity in Binh Dinh in general, and in the sub-project area in particular, is as follows:

- **Species:** Binh Dinh is relatively rich and diverse, with 2,269 species of higher plants; 315 species of phytoplankton; 244 species of birds; 103 species of mammals; 45 species of amphibians; 95 species of reptiles; 353 species of insects; 281 species of fish; 160 species of zooplankton; and 210 species of benthic animals. At present, no new species have been recorded.
- **Genetic resources:** Binh Dinh Province has identified several rare and valuable genetic resources, including 222 species of higher plants (such as *Rauvolfia verticillata*, *Telectadium*, and *Stemona collinsiae*); 215 species of birds (*Lophura imperialis*, *Rheinardia ocellata*...); 92 mammal species (*Nomascus annamensis*, *Pygathrix cinerea*, *Panthera pardus*, *Viverra megaspila*, *Muntiacus truongsongensis*, *Manis javanica*...); 42 amphibian species (*Rhacophorus kio*, *Leptobrachium pullum*...); 56 reptile species (*Python molurus*, *Python reticulatus*, *Ophiophagus hannah*, *Cuora trifasciata*...); 8 insect species (*Troides helena cerberus* ...); and 114 fish species

(*Eleutheronema tetradactylum*, *Anguilla marmorata*, *Anguilla bicolor pacifica*, *Sardinella gibbosa*, *Chanos chanos*...). These species are listed among the rare and precious species in the International Union for Conservation of Nature (IUCN) Red List (2015) and the Vietnam Red Data Book (2006).

Biological resources in Tam Quan subproject implementation area:

The implementation area of the subproject is located more than 5 km away from the biodiversity conservation areas of Binh Dinh Province. Within and around the subproject area, there are no environmentally sensitive zones (no marine protected areas, wetlands, feeding or breeding grounds of marine mammals; and no truly rare or endangered species).

2.3.1.7. Natural disasters and abnormal weather phenomena

Drought: In the dry season in Binh Dinh, rainfall is very low, accounting for only 20–25% of the annual average. High temperatures combined with large and prolonged evaporation, along with steep terrain and short river basins, prevent rivers from retaining water during the rainy season, leading to severe droughts in the dry season that cause significant damage to production and daily life. The drought has reduced water levels in most irrigation reservoirs in the province below the dead storage level, cracked farmland, and left people without sufficient water for daily needs, making life extremely difficult. At the beginning of the dry season in 2024, the total storage of 164 irrigation reservoirs in Binh Dinh Province reached 489/683 million m³, equivalent to 71.7% of design capacity and 71% compared to the same period in 2023, with 22 reservoirs already depleted. Although there remains 489 million m³ of water in the reservoirs, forecasts indicate a rapid decline due to increased water demand, reduced monthly rainfall, and higher-than-average temperatures. For the summer–autumn crop in 2024, the province is expected to suspend production on 1,846 ha, including 1,191 ha zoned for suspension due to water shortage and 655 ha affected by the draining of 12 reservoirs under repair and upgrading during the season. Regarding domestic water supply, there are currently 131 centralized water supply facilities in rural areas serving 94,423 households, and 171,114 households relying on small-scale water sources (boreholes, dug wells). In 2024, under hot and dry conditions with no rainfall, approximately 6,069 households (24,276 people) are at risk of water shortage, specifically: Van Canh District: 2,061 households; Phu My: 1,695 households; Tay Son: 1,450 households; An Lao: 730 households; Tuy Phuoc: 60 households; and Phuoc My Commune (Quy Nhon City): 73 households.

Salinity intrusion: Salinity intrusion also occurs in the dry season. Salinity levels in estuaries, lagoons, and coastal waters increase rapidly, encroaching inland and altering freshwater ecosystems. Some farmland and freshwater aquaculture areas are affected by salinity contamination, making production impossible. Prolonged drought combined with high tides causes saltwater intrusion to spread rapidly over large areas, primarily in coastal localities. The most severe salinity intrusion occurred in 2016 and 2019, mainly affecting Hoai Nhon, Phu My, Quy Nhon City, and Tuy Phuoc. Salinity intrusion has left many ha of rice fields without irrigation water, leading to alum contamination, salinization, and crop failure.

Rain, storms, and flooding: Due to the impacts of climate change, Binh Dinh faces storms and floods during the rainy season (September–December). The number of storms affecting the province has been increasing over time. Heavy and prolonged rainfall during major floods in 2008, 2009, 2016, 2019, and 2021 made Binh Dinh one of the most severely flooded localities. Floodwaters inundated many residential areas in Tay Son, An Nhon, Tuy Phuoc, Phu Cat, Phu My, Hoai An, Hoai Nhon, and Quy Nhon. Many transport and irrigation works were severely damaged by landslides. According to the Damage Report and proposed remedial works due to natural disasters as of November 30, 2023, in Binh Dinh Province: 15 ha of crops were damaged (Hoai An District); reclamation land affected totaled 5.77 ha (2.80 ha in Hoai An District and 2.97 ha in Tuy Phuoc District); and 150 poultry were killed or swept away (Hoai An District).

In Hoai Nhon Town, key roads along My Binh Stream in My Binh 2 Village (Hoai Phu Commune, about 600 m) and Quan Dua Stream (Hoai Son Commune, about 1,000 m) were not reinforced, and prolonged heavy rainfall caused landslides that affected households and resulted in loss of production land. Estimated damages and remedial costs amount to about VND 252.3 billion.

Landslides: Climate change also exacerbates landslides. Increased river flow has eroded land, reducing agricultural and residential land areas, while cultural relics and riverbank protection structures have also been impacted. In Binh Dinh, landslides often occur in mountainous areas with steep slopes, weak geology, and thin soil layers (e.g., Van Canh and An Lao districts) or in coastal areas with fragile geological structures and strong erosion (e.g., Tuy Phuoc, Phu My, and Phu Cat districts). Landslides accelerate the leaching of pollutants from soil into water, disturb sediment layers, and directly affect water quality. During prolonged rainfall in November 2024, heavy rains triggered landslides on two talus slopes (about 30 m long) along the road from Village 4 (An Hung Commune, An Lao District) to Hoai Son Commune (Hoai Nhon Town). Large volumes of soil and rock fell onto the roadbed, blocking traffic and preventing people and vehicles from passing.

Natural disasters and abnormal weather phenomena in the subproject area:

The construction area of the subproject has not recorded any landslides due to its relatively flat terrain. However, as the subproject is located in a coastal area, it is annually affected by rainstorms, unusually strong winds, as well as drought and saltwater intrusion.

- Typhoons: Each year, the subproject area is typically impacted by 1–2 storms, bringing heavy rain and strong winds that affect both local livelihoods and construction activities. For instance, Typhoon Yagi caused heavy rainfall and strong winds, leading to damage to houses, crops, and infrastructure in Binh Dinh. Therefore, construction activities under the subproject need to take into account the potential impacts of storms and floods.

- Drought and saltwater intrusion: The most severe dry period usually occurs from March to September each year, when saltwater from the East Sea penetrates deep inland through the mouth of the Tam Quan River, significantly affecting freshwater sources for daily use and production. Drought and saltwater intrusion reduce the availability of fresh water in the Tam Quan River, creating difficulties for agriculture, aquaculture, and domestic water supply. Agricultural areas dependent on freshwater, particularly rice and fruit crops, are severely affected during periods of drought and salinity intrusion.

2.3.2. Baseline environmental condition

The environmental sampling and analysis were conducted on January 17, 2024, by the Center for Environmental Analysis and Technology Transfer under the Institute of Agricultural Environment (VIMCERTS 082 certificate). Information on the sampling locations of the Tam Quan subproject is as follows:

Table 2.7. Sampling locations under Tam Quan subproject

No.	Environmental component	Number of sample	Parameters	Description of sampling location/symbol/applied regulation
1	Air, noise	01	CO, SO ₂ , NO ₂ , TSP, Pb, Noise, temperature, humidity, wind speed, wind direction.	Measurement in the area of Tam Quan Fishing Port; Symbol: BD-KXQ1 QCVN 05:2023/BTNMT: National regulations on air quality;

No.	Environmental component	Number of sample	Parameters	Description of sampling location/symbol/applied regulation
				QCVN 26:2010/BTNMT- National technical regulation on noise
2	Surface water	04	pH, TSS, Ammonium (NH ₄ ⁺ -N), Nitrite (NO ₂ ⁻ -N), Cyanide (CN ⁻), Copper (Cu), Lead (Pb), Cadmium (Cd), Arsenic (As), Total Chromium (Cr), Total Grease, Total Phenol, Surfactants, Organic Chlorine Pesticides (Heptachlor, Dieldrin), Organic Phosphorus Pesticides (Chlpyrifos, Diazinon)	Tam Quan River at Tam Quan storm shelter anchorage and fishing port Symbol: from BD-NM1 to BD-NM4 QCVN 08:2023/BTNMT – National Technical Regulation on Surface Water Quality
3	Groundwater	02	pH, TSS, Ammonium (NH ₄ ⁺ -N), Nitrate (NO ₃ ⁻ -N), Chloride (Cl ⁻), Copper (Cu), Lead (Pb), Cadmium (Cd), Arsenic (As), Total Chromium (Cr)	Well water at Tam Quan fishing port; Symbol: from BD-NN1 to BD-NN2 QCVN 09:2023/BTNMT – National Technical Regulation on groundwater quality
4	Wastewater	03	pH, TSS, Total Grease, Ammonium, Nitrate, Lead (Pb), Cadmium (Cd), Arsenic (As), Copper (Cu), Zinc (Zn), Manganese (Mn), Total Chromium (Cr), Total Phenol, Surfactants	Wastewater in the Tam Quan fishing port area Symbol: from BD-NT1 to BD-NT3 QCVN 14:2008/BTNMT – National Technical Regulation on Domestic Wastewater
5	Soil	01	Arsenic (As), Cadmium (Cd), Lead (Pb), Chromium (Cr), Copper (Cu), Zinc (Zn)	Tam Quan Fishing Port area; Symbol: BD-D1 QCVN 03:2023/BTNMT – National Technical Regulation on soil quality
6	Sediment	03	Arsenic (As), Cadmium (Cd), Lead (Pb), Chromium (Cr), Copper (Cu), Zinc (Zn), Total N, Total Phosphorus, Organic Carbons, Organic Chlorine Pesticides, Organic Phosphorus Pesticides	Tam Quan River at Tam Quan storm shelter anchorage and fishing port; Tickets: from BD-TT1 to BD-TT3 QCVN 43:2017/BTNMT - National technical regulation on sediment quality
7	Dredging material	24	Arsenic (As), Cadmium (Cd), Lead (Pb), Zinc (Zn), Total Chromium (Cr), Copper (Cu), Total PCB, Organic Chlorine Pesticides, Organic	Tam Quan River at Tam Quan storm shelter anchorage and fishing port;

No.	Environmental component	Number of sample	Parameters	Description of sampling location/symbol/applied regulation
			Phosphorus Pesticides, Polycyclic Aromatic Hydrogen Compounds (PHA)	Symbol: from BÐ-CNV01 to BÐ-CNV24 QCVN 43:2017/BTNMT - National technical regulation on sediment quality

The map of sampling locations for baseline environmental quality monitoring in the Tam Quan subproject area is shown below:



Form 2.8. Map of baseline environmental sampling locations for Tam Quan subproject

The detailed tables of environmental quality monitoring results are provided in Appendix 3. A summary of the environmental quality assessment results for the Tam Quan Sub-project area is presented below.

a. Air quality

Air samples were taken from one location in the Tam Quan fishing port area. The results show that all air quality parameters are within the permissible limits specified in QCVN 05:2023/BTNMT – National Technical Regulation on Ambient Air Quality (1-hour average). This indicates that the ambient air quality in the sub-project area remains relatively good, with no signs of pollution.

Noise monitoring in the Tam Quan fishing port area also showed results within the permissible limits of QCVN 26:2010/BTNMT – National Technical Regulation on Noise.

b. Groundwater quality

Two samples of groundwater have been taken at borewells in the Tam Quan fishing port area which are used for the purpose of supplying water for activities at the fishing port. The analysis results show that most of parameters of the groundwater quality in the subproject area are within the permissible limits of QCVN 09:2023/BTNMT (National Technical Regulation on groundwater quality). However, the chloride parameter in the NN1 sample exceeded 1.6 times;

the NN2 sample exceeded 1.3 times compared to the permissible limit, because the area is relatively close to the East Sea, the depth of the borewells ranges from 20-30m, so it is affected by saltwater.

c. Surface water quality

The sub-project has monitored 04 surface water quality locations at the storm shelter anchorage and Tam Quan fishing port. According to the results of surface water quality monitoring, most of the parameters in the surface water samples are within the permissible limits of QCVN 08:2023/BTNMT (specified in Table 1 and Table 2 - column A). However, the TSS parameter in surface water samples exceeded from 1.27 to 1.88 times because at the time of sampling the storm shelter anchorage area, there were many activities of ships; the nitrite parameter in surface water samples exceeded from 2.04 to 2.72 times because there are still many aquaculture activities in the storm shelter anchorage area.

d. Wastewater quality

The sub-project monitors and analyzes 3 samples of domestic wastewater in the Tam Quan fishing port area. Most of the parameters measured in wastewater are within the permissible limits of QCVN 14:2008/BTNMT, Column B - National Technical Regulation on domestic wastewater. However, some parameters such as TSS exceeded about 4.24 - 5.55 times, ammonium exceeded about 1.58 times, and surfactants exceeded about 1.23 times compared to QCVN 14:2008/BTNMT, Column B. Wastewater in the Tam Quan fishing port area has not been collected and treated thoroughly, so some of the above parameters still exceed the permissible limits.

e. Soil quality

Soil sample was taken from the location in the Tam Quan fishing port area. The results of soil analysis show that the heavy metal parameters are all in permissible limit compared to QCVN 03:2023/BTNMT - National Technical Regulation on soil quality (Type 2). Thereby, it shows that the quality of the land in the project area is still good, there are no signs of pollution. Therefore, the amount of land from the excavation process at the sub-project can be reused for leveling purposes or can be disposed of as ordinary waste.

f. Sediment quality

Surface sediments

The sub-project monitored and analyzed three sediment samples in the Tam Quan storm anchorage and shelter area. The sediment samples were collected at the surface or at a depth of no more than 15 cm from the riverbed of the Tam Quan River. The analysis results show that the concentrations of heavy metals in the sediments are much lower than the permissible limits specified in the National Technical Regulation on Sediment Quality (QCVN 43:2017/BTNMT). Therefore, the surface sediments dredged from the sub-project area are non-hazardous and not contaminated with heavy metals.

Dredged material

The sub-project monitored and analyzed 24 samples of dredged material along the Tam Quan storm shelter anchorage (from Con Ro area to the mouth of the storm shelter). The analysis results show that the dredged material consists mainly of poorly mixed sandy soil with a loose structure. The concentrations of heavy metals and pesticides in the dredged material are within the permissible limits of QCVN 43:2017/BTNMT – National Technical Regulation on Sediment Quality. Therefore, the dredged material in the sub-project area is still of acceptable quality, with no signs of pollution.

However, since the sub-project area is located at the mouth of the Tam Quan River and close to the East Sea, the dredged material is more or less affected by salinity. Measures to minimize environmental impacts during the disposal of dredged material into storage sites should be carefully implemented to avoid affecting surrounding land areas.

2.3.3. Socio-economic conditions

2.3.3.1. Economic development conditions

The economy of Hoai Nhon Town has maintained steady growth, with each year higher than the previous one. While the agricultural sector continued to grow in absolute terms, its proportion gradually decreased, whereas the industry–construction and trade–services sectors grew significantly. In 2023, the economic structure of Hoai Nhon Town continued to shift in the right direction with notable changes: industry–construction accounted for 59.61%; trade–services 16.63%; and agriculture–forestry–fishery 23.76%.

- **Industrial production – handicrafts:** Focused on promoting the industrialization and modernization of agriculture and rural areas. Eight industrial clusters with a total area of 146.2 ha have been planned, of which six clusters are already in operation.
- **Trade – services:** Expanded and diversified distribution channels and product categories to meet consumer demand. Trade and service activities grew well, with total export turnover reaching USD 106.94 million (equivalent to VND 2,500 billion).
- **Agricultural sector restructuring:** Accelerated the implementation of the Agricultural Restructuring Scheme to develop commodity-oriented production and enhance added value. Concentrated production areas for rice, short-term crops, fruit trees, and aquaculture have been initially established. Many models linking production with product consumption along the value chain have emerged, contributing to improving agricultural production value. Mechanization in agriculture has reached over 90% of cultivated land.
- **Fisheries sector:** Promoted the implementation of Action Program No. 18-CTr/HU of the District Party Committee on marine economic development in association with the protection of sea and island sovereignty. Effectively implemented fisheries development policies, particularly oil subsidy support for offshore fishermen. The production value was estimated at VND 3,031 billion, with a total exploitation and aquaculture output of 49,247.8 tons, including 46,800 tons from seafood capture (of which ocean tuna accounted for 9,550 tons).

2.3.3.2. Social development conditions

Population: As of December 31, 2022, the population of Hoai Nhon Town was 210,295 people, with a population density of 499.8 people/km². Of this, males accounted for 49.7% (104,428 people) and females 50.3% (105,867 people). The urban population represented 74.1% (155,837 people), while 25.9% (54,458 people) lived in rural areas.

Education: Education and training continue to receive investment and development in both scale and quality. The town has 7 high schools, 17 secondary schools, 1 combined primary–secondary school, 25 primary schools, and 19 preschools and kindergartens.

Healthcare: Healthcare services for the population are given due attention, with improvements in medical facilities and equipment. The town has Bong Son Regional General Hospital, 1 district health center, and 17 commune health stations. These health units have performed well in providing healthcare, ensuring food hygiene, and maintaining safety.

2.3.3.3. Results of the socio-economic survey on affected households

According to the survey results of 23 households (all households have to be relocated by the project):

- Population: The 23 surveyed households have a total of 103 people, averaging 4–5 people per household. There are 2 households with only 2 members each, where the household heads are elderly. These are considered vulnerable households.
- Female-headed households: 10 households (43.4%) are headed by women. However, in most cases this is due to occupational characteristics of the area, as men typically go to sea while wives stay home to manage the family.
- Age of household heads: The average age is 53 years. Two household heads are elderly (84 and 88 years old).
- Ethnic composition: No ethnic minority households were identified in the survey.
- Education level: In general, the education level of the group of people directly affected by the project is relatively low. According to the survey results, out of a total of 23 household heads, the number with a high school education accounted for the highest proportion at 60%, followed by lower secondary education at 26%. None of the interviewed household heads had a college or university degree. The number of illiterate household heads (only able to sign their names) was 3, accounting for 14%.
- Information on educational attainment serves as one of the bases for orienting vocational transition support activities for working-age individuals in need. With the common education level being lower secondary and high school, stakeholders have also discussed and anticipated occupations that are truly suitable and can ensure employment opportunities for workers, in line with the locality's overall development strategy. However, the majority of respondents expressed no desire to change their occupations, preferring instead to continue with their traditional livelihood (fishing).
- Occupations of household heads:
 - + Fishery: 18 households (78.3%)
 - + Self-employed: 2 households (8.7%)
 - + Elderly (non-working): 2 households (8.7%)
- Household assets

The value of assets in each household depends largely on their economic conditions. Essential and valuable assets are less common in households with an average standard of living, while wealthier households tend to possess higher-value assets. Survey results show that color televisions are the most common means of mass communication (87%); followed by motorbikes (43.4%); and other assets such as refrigerators and freezers (35%).
- Household income and expenditure
 - + Collecting information on household income and expenditure often posed significant difficulties for surveyors, as respondents were generally reluctant to disclose their sources of income—this being a sensitive issue for many Vietnamese families. Therefore, the reported figures on income and expenditure should be considered as approximate.
 - + According to Government Decree No. 07/2021 dated January 27, 2021, on multidimensional poverty standards applied for the period 2021–2025, the average per capita monthly income is VND 2 million/person/month in urban areas and VND 1.5 million/person/month in rural areas. Survey results show that the average income

of the 23 surveyed households was VND 3.78 million/person/month. The highest was VND 5.63 million/person/month; the lowest was VND 0.83 million/person/month (the household of Mr. La Van Manh), which was also the only household with income below the poverty threshold.

- + On average, monthly household expenditure accounted for about two-thirds of total income. The average household income of the 23 surveyed households was about VND 45 million/household/month, with expenditures around VND 30 million/household/month. The main source of income was from fishing (85.3%), while other sources contributed only about 14.6%.
- Current situation of water supply and drainage
 - + *Water Supply:* The survey results indicate that the main water sources used by households in the project area are wells and rainwater storage tanks. 100% of households use drilled wells, while 14 households (60%) also use rainwater tanks.
 - + *Drainage:* Survey findings show that the drainage system in the project area remains poor and fragmented. As the roads in the Hon Ro area (the land acquisition site for the storm shelter anchorage area and fishing port) are unpaved, almost the entire residential area lacks a proper drainage system. To ensure environmental sanitation and reduce potential flooding, the resettlement area will be provided with a synchronous, concrete drainage system to ensure adequate rainwater runoff within the residential area.
- Household fuel use for cooking

Currently, households use a variety of fuels for cooking. The three main types of fuel used are: gas stoves (15/23 households, 65%), electric stoves (15/23 households, 65%), and firewood (1/23 households, 4.3%). Seven households reported using both electricity and gas for cooking.
- Household sanitation facilities

Survey results show that 100% of households are currently using septic toilets.
- Current land use status

Survey results indicate that 100% of surveyed households already possess land use right certificates.
- Gender issues
 - + The survey shows that men primarily go to sea for fishing, serving as the main income earners for their families. Women, however, bear greater responsibility for household tasks such as managing finances, household affairs, cooking, and cleaning. In many cases, women are identified as household heads. Economic circumstances, support programs, and family income management by women household heads need to be carefully assessed to ensure that female-headed households are not exposed to poverty risks or vulnerability during project implementation.
 - + During the preparation of the Resettlement Action Plan, the consultants organized focus group discussions specifically with female participants. In these meetings, women participated actively and expressed their personal expectations regarding the project. They suggested that the project provide opportunities for them to engage in simple jobs (such as cooking for workers' camps or cleaning contractors' offices) in order to earn additional income during the construction phase.

2.3.4. Technical infrastructure in the subproject area

a. Transportation system

Road traffic:

- The area around the port is connected by important transportation routes, facilitating both transportation and trade. One of the main routes is National Highway 1A, which passes through Hoai Nhon town and links the port with other provinces and cities.
- The coastal route (provincial road) 639 extends from Quy Nhon to Tam Quan, strengthening the connection between coastal areas and promoting socio-economic development.
- The western route of (provincial road) 638 runs through An Nhon town with a road width of 28 m, connecting An Nhon with Hoai An, Phu My, Phu Cat, and Tay Son districts.

These routes create favorable conditions for the operation of Tam Quan fishing port and promote trade and economic growth in the region.

Waterway traffic:

- Tam Quan Port is located on the central coastal strip, where an international maritime route passes by. From here, boats can access major fishing grounds such as Truong Sa, Hoang Sa, as well as coastal fishing grounds of Binh Dinh.
- The fishing port mainly serves offshore and nearshore fishing activities. From Tam Quan port, fishing boats can easily reach the waters of Phu Yen, Quang Ngai, and neighboring provinces.
- Tam Quan port can connect with larger seaports such as Quy Nhon port and Dung Quat port (Quang Ngai) through coastal waterways for cargo trading.
- Tam Quan River: This river flows into the sea near the port and functions as a small inland waterway for local transport, mainly serving fishing boats.

However, waterway traffic at Tam Quan port still primarily serves the seafood exploitation and processing sector, and has not yet developed significantly in terms of large-scale cargo transportation.

Road traffic around the Tam Quan subproject area is well connected by key transportation routes, providing favorable conditions for the transportation of raw materials, fuel, and waste disposal activities during the construction of the subproject's works.

b. Water supply system

Hoai Nhon town, Binh Dinh province, has implemented several clean water supply projects to meet the domestic needs of local residents.

My Binh Lake Clean Water Treatment Station (Hoai Phu commune): Provides domestic water for residents of Tam Quan Bac commune and nearby areas such as Hoai Hai, Hoai My, Hoai Huong, and Tam Quan Nam.

Hoai Nhon Water Supply Branch of Binh Dinh Water Supply and Sewerage Joint Stock Company is responsible for managing and operating the local water supply systems, ensuring clean water provision for wards and communes in Hoai Nhon town (including Tam Quan Bac ward).

In addition, the Thien Chanh River plays an important role in supplying water for both domestic use and agricultural activities in Tam Quan Bac ward. According to Resolution No. 21/2018/NQ-HDND on water resources planning of Binh Dinh province to 2025, with

orientation to 2035, the Thien Chanh River is identified as a key water source for Tam Quan town, Hoai Chau commune, Hoai Chau Bac commune, and Tam Quan Bac ward.

c. Electrical and communication systems

Tam Quan fishing port is located in Thien Chanh village, Tam Quan Bac ward, is a crowded residential area, so the infrastructure system of electricity supply, lighting, and communication is complete.

d. Water drainage, wastewater treatment, solid waste treatment

Wastewater collection and treatment: Wastewater in the port area is collected at the wastewater treatment station in Tam Quan Bac Concentrated Seafood Processing Zone for treatment before being discharged into the external environment.

Solid waste collection and treatment: The project area already has a domestic solid waste collection system. Domestic solid waste is classified and collected and taken to the solid waste treatment area of Hoai Nhon town for treatment according to regulations, ensuring landscape and environmental requirements.

e. Existing status of vessel anchorage and storm shelters

Existing status of Tam Quan fishing port: Tam Quan Fishing Port has been announced by the People's Committee of Hoai Nhon Town as a Class II fishing port under Decision No. 4954/QĐ-UBND dated December 13, 2021, with a design capacity of 40,000 tons/year. In addition, Binh Dinh Province also has Nhon Chau Fishing Port, which was completed and put into operation in 2000 under the East Sea – Islands Program. The port has a total wharf length of 85 meters and mainly serves local fishing vessels. However, over time, due to complex hydrometeorological conditions, the wharf has increasingly deteriorated.

Existing status of Tam Quan anchorage areas: The anchorage area covers 60 ha in Hoai Nhon Town, with a maximum capacity of 1,000–1,200 ships. Meanwhile, the total number of ships in Hoai Nhon Town has reached more than 2,300. In addition, during the rainy and stormy season, the anchorage area also accommodates about 250–300 vessels from Phu My District and Quang Ngai Province. This has led to an overload of the anchorage, compromising the safety of moored fishing vessels and increasing the risk of fire, explosion, and environmental pollution. The Tam Quan estuary channel remains narrow and prone to sedimentation, while offshore fishing vessels are becoming larger and more powerful, making navigation in and out of Tam Quan estuary increasingly difficult and unsafe.

2.3.5. Site-specific environmental and social conditions and sensitive receptors in the sub-project implementation area

2.3.5.1. Environmental and social conditions around the sub-project area

The Tam Quan storm shelter anchorage is located 2.2 km from the sea mouth. The SFDP subproject will be implemented on an area of 115 ha, aiming to develop Tam Quan storm shelter anchorage into a regional anchorage area, of which 10.74 ha is the existing land of Tam Quan fishing port, and the remaining 104.26 ha is expansion area. The expansion area includes: 97.09 ha of water surface of the Tam Quan River, 5.01 ha of unused land, 1.11 ha of public land (existing roads), and 0.93 ha of non-agricultural production and business land.

- The anchorage area is part of the lower reaches of the Tam Quan River.
 - + In this section, Tam Quan river width ranges from 250–450 m (about 2.2 km from the estuary), while near the estuary the width narrows to less than 150–200m.
 - + Monitoring results show that river water quality is generally good, ensuring conditions for aquaculture and water retention activities in the area.

- + Waterway traffic is dense, with more than 100 boats on average entering and leaving the storm shelter anchorage and Tam Quan fishing port. Boat traffic usually occurs when fishermen depart for offshore fishing (around 1:00–4:00 a.m.) or return to dock (around 6:00–9:00 a.m.), with a density of 30–50 boats/hour. During storms, the number of vessels rises sharply as many boats gather in the area for shelter.
- + The Tam Quan estuary channel remains narrow and frequently silted, making navigation in and out of the estuary difficult and unsafe.
- + Along both banks of the river, there are many densely populated households in Tam Quan Bac Ward. Near the sea mouth, one bank is reinforced with the Tam Quan embankment.
- + In addition, maintenance dredging is still carried out at Tam Quan General Port (located in the north of the project area, near the confluence of Tam Quan River and Dai Ong Kheo tributary). This port is separate from Tam Quan fishing port in the southeast of the project area. Dredged materials are transported by waterway to Tam Quan Port and are not deposited within the subproject area. Currently, these materials are reused for land leveling in other construction projects within Hoai Nhon Town.
- Tam Quan fishing port: Tam Quan fishing port was classified by the People's Committee of Hoai Nhon Town as a Class II fishing port under Decision No. 4954/QĐ-UBND dated December 13, 2021, with a design capacity of 40,000 tons/year. Main infrastructure includes seafood sorting facilities, port administration buildings, internal roads, rainwater and wastewater drainage systems, domestic water supply, lighting and fire protection systems. The solid waste collection system consists of several waste collection points and centralized storage areas, but these facilities are deteriorating. Several seafood processing factories are located within and around the port area.

The nearest residential area to the subproject site is Con Ro Island, with 23 households of Cong Thanh neighborhood, sparsely populated, located 20–50 m from the subproject boundary. Additionally, along both banks of the Tam Quan River, there are residential clusters in Truong Xuan Dong, Truong Xuan Tay, Cong Thanh, and Thien Chanh neighborhoods, located about 150–200 m from the subproject site, with relatively high density.

In the northern, western, and southwestern areas of the storm shelter anchorage, around 80 households are engaged in aquaculture, situated 30–100 m from the dredging area. Aquaculture mainly relies on natural water sources from the Tam Quan River or Dai Ong Khéo River.

Road access: The area is connected by Thong Nhat Road (about 17 m wide, asphalt concrete surface), and by several concrete roads (4–6 m wide) leading to the subproject site.

Waterway: Traffic density on the Tam Quan River is relatively high due to the large number of fishing vessels entering and leaving the storm shelter anchorage and fishing port. The Tam Quan fishing port area is equipped with power supply, water supply, and drainage systems discharging into the Tam Quan River.

Within a 300 m radius of the subproject site, there are no PCR (physical cultural resources such as communal houses, pagodas, shrines, cemeteries, or churches). Sensitive points include the residential area on Con Ro Island, the temporary bridge connecting the mainland to Con Ro, and the residential areas of Thien Chanh Commune, Cong Thanh, and Tam Quan Estuary.

The location map of the subproject area and details of affected objects are presented in the figure below.



Figure 2.9. Location of sub-project implementation and sensitive receptors

2.3.5.2. Subproject's dredged material disposal sites

The subproject will arrange two dredged material disposal sites to accommodate approximately 511,129 m³ of dredged material from the Tam Quan storm shelter anchorage.

- Existing status of Disposal site No. 1 (located about 0.4 km southwest of the subproject area, with an area of about 2.5 ha): The land is currently used mainly for agriculture, including rice fields, sedge cultivation, and some aquaculture ponds belonging to households in Cong Thach residential area. However, these areas are no longer under cultivation. Surrounding the disposal site are densely populated households in Cong Thach. According to the planning of the People's Committee of Hoai Nhon town, this site is designated for the development of the Tam Quan fishery infrastructure area. Therefore, the land acquisition process is being implemented by the local authorities (once land acquisition is completed, no rice fields will remain around the location of Disposal site No. 1).
- Existing status of Disposal site No. 2 (located about 0.5 km west of the subproject area, with an area of about 2.4 ha): The land consists of abandoned aquaculture ponds and several ponds still in use for aquaculture by households in Cong Thach residential area. According to the planning of the People's Committee of Hoai Nhon town, this site is designated for the Tam Quan Port resettlement area.

Main transport route for the dredged material: Subproject area → Tam Quan River → Disposal sites (0.4–0.5 km away). Accordingly, dredged materials will be transported entirely by waterway through pipelines pumping directly from the dredging area to the disposal sites (not transported by road). The arrangement of suction pump pipelines will not affect the activities of surrounding communities. The locations and current images of the dredged material disposal sites are presented below.



Table 2.8. Sensitive receptors under Tam Quan subproject

No.	Sensitive receptor	Description
1	Con Ro Island, 20m away 	There are 23 households on Con Ro island with sparse density. It is difficult to travel from Con to neighboring areas, mainly by boat/boat.
2	The temporary bridge connects Con Ro and the mainland, not within the dredging range of the storm shelter anchorage area 	The temporary bridge is made of wood with a width of about 1.5m and a length of about 60m. Con Ro people sometimes move through temporary bridges to enter the mainland. It is not necessary to dismantle the temporary bridge during the construction of the sub-project because the scope of dredging of the storm shelter anchorage does not affect this temporary bridge .
3	Residential area of Thien Chanh commune, Cong Thanh, 150-200m away 	The residential areas of Thien Chanh and Cong Thanh communes are located along 02 banks of the Tam Quan river(along the dredging range of the sub-project) about 150-200m from the project implementation area, the area has a dense population density.
4	Tam Quan estuary, 2.2km from Tam Quan fishing port area 	Tam Quan estuary is a regular entry and exit place for more than 1400 ships of Tam Quan fishing port and Tam Quan storm shelter anchorage. It is a waterway of fishing ships/boats entering and exiting the project area.
5	An Loc Temple, about 500m from the temporary disposal site No. 1 	Where locals often come to pray for peace and good luck. Ceremonies and prayers usually take place on the full moon days and the first day of the lunar month.

2.4 KHANH HOA MAJOR FISHERY CENTER UPGRADING INVESTMENT SUBPROJECT

2.4.1. Natural condition

2.4.1.1. Geography

The subproject "Upgrading and expansion of Khanh Hoa major fishery center" (hereinafter referred to as the Khanh Hoa Subproject) is located in Cam Linh Ward, Cam Ranh City, Khanh Hoa Province, approximately 2 km southeast of the Cam Ranh City center. Cam Linh Ward has a coastal terrain stretching along Cam Ranh Bay for about 1 km from north to south. It borders the sea to the southeast and southwest, Cam Thuan Ward to the northeast, and Cam Loi Ward to the northwest. The ward covers a total area of 1.881 km² and consists of nine residential groups: Linh Tan, Linh Xuan, Linh Trung, Linh Hoa, Da Bac, Linh Phu, Xom Con, Linh Van, and Linh Thuong.



Figure 2.11. Geographical Location of the Khanh Hoa Subproject

2.4.1.2. Topography

Based on the topographic survey documents of the TDA construction area (map at a 1/1000 scale prepared by the Port and Waterway Construction Consulting Joint Stock Company from November 11 to November 20, 2023), the TDA construction site has the following characteristics:

- The onshore area of the existing Da Bac fishing port has an elevation of +2.00m (State Datum). The existing wharf has an elevation ranging from +1.35m to +1.50m, while the elevations at the bridgehead range from +1.45m to +1.80m (State Datum).
- The water area at the existing wharf has a seabed elevation ranging from -3.40m to -3.80m (State Datum). The seabed elevation in the area of the existing revetment ranges from -3.00m to -3.20m (State Datum).
- Within the study area, aside from the existing wharf and fishing port area of Da Bac, there are: A ship repair and shipbuilding facility covering approximately 1.65ha, with an average ground elevation of +1.00m to +1.20m (State Datum). A seafood processing area covering about 1.62ha, with an average elevation ranging from +1.60m to +5.00m. Shrimp ponds with an average elevation of -0.50m to -0.80m (State Datum), which are currently still in use for aquaculture.

- The coastal water area is relatively shallow, with an average depth ranging from -0.60m to -1.20m, and scattered rocky reefs are present in the area.



Figure 2.12. Topographic map of the Khanh Hoa subproject area

2.4.1.3. Geology

Khanh Hoa subproject area a geotechnical survey was conducted on-site from November 8 to December 10, 2023, with 15 boreholes drilled in the project area, and laboratory testing was completed on December 22, 2023. Based on the collected geotechnical survey results, the stratigraphy of the subproject area is distributed as follows:

- Layer 1: Backfill material (clayey sand, sandy soil mixed with crushed stone and boulders, brownish-gray, yellowish-brown).
- Layer 2: Coral mixed with shell fragments and gravelly clayey sand, grayish-blue, gray (SC, SC-SM, GP-GC): Weak bearing capacity.
- Layer 3: Very plastic clay, low plasticity clay, very plastic silt, gray, grayish-blue, in a flowable to plastic-flowable state (CH, CL, MH): Very weak bearing capacity.
- Layer 4: Silty sand, clayey sand, sand mixed with silty clay, coral, and shell fragments, gray, ash-gray, porous structure (SM, SC, SC-SM): Relatively weak bearing capacity.
- Layer 5: Clayey sand, occasionally mixed with shell fragments, grayish-blue, grayish-white, porous structure (SC): Relatively weak bearing capacity.
- Layer 6: Poorly graded sand, well-graded sand mixed with clay and occasionally shell fragments, brownish-gray, gray, medium-dense to dense structure (SP, SW-SC): Good bearing capacity, but limited in distribution and thin.
- Layer 7a: Clayey sand, occasionally mixed with gravel (completely weathered granite), brownish-gray, yellowish-brown, grayish-blue, porous to medium-dense structure (SC): Fairly good bearing capacity.
- Layer 7b: Clayey sand, sandy silt, sand mixed with silt and occasionally gravel (completely weathered granite), yellowish-gray, grayish-blue, grayish-white, medium to dense structure (SC, SC-SM): Fairly good bearing capacity.
- Layer 8: Well-graded and poorly graded gravel mixed with silt, clay, silty sand, and clayey sand (weathered granite), yellowish-gray, yellowish-brown, very dense structure (GW-GM, GP-GC, SM, SC): Good bearing capacity.

- Layer 9a: Granite, yellowish-gray, grayish-white, grayish-blue, heavily weathered and highly fractured. Hardness grade IV-VI: Good bearing capacity.
- Layer 9b: Granite, yellowish-gray, grayish-white, grayish-blue, slightly weathered with moderate fracturing. Hardness grade IV-VI: Very good bearing capacity.

In general, the geological conditions in the subproject area range from very weak to very good bearing capacity. Very weak geological conditions were recorded in the surface soil layers (from layer 1 to layer 6); however, their distribution is limited and thin. Good to very good geological conditions were recorded from layer 7a to layer 9b, ensuring favorable conditions for the construction of embankments and piers under the subproject, with minimal risks of subsidence or landslides during both construction and operation. Therefore, pile foundation solutions are proposed:

- For the yard and revetment sections, pile foundation solutions should be used, with pile tips placed in Layer 7b or deeper. The length and size of the piles should be determined based on the calculated structural load.
- For the berth structure, pile foundation solutions should be used, with pile tips placed in Layer 9b or deeper. The length and size of the piles should be determined based on the calculated structural load.

2.4.1.4. Climatic and Meteorological Conditions

Khanh Hoa has a hot and humid tropical monsoon climate. The climate in Khanh Hoa is divided into two distinct seasons: the rainy season and the dry season. The rainy season usually starts in September and ends in December, characterized by heavy rainfall and limited sunshine; the dry season lasts from January to August, typically with plenty of sunshine, little rainfall, and particularly frequent heatwaves.

Air Temperature: The long-term average air temperature is 26.80°C. The average temperature from April to September is higher than from October to March, but overall, the temperature variation between months is not significant. During winter, temperatures do not drop too low. The highest recorded air temperature over the years was 39°C (August 1985), while the lowest recorded was 14°C (January 1992).

Humidity: The average annual relative humidity is 77%. The highest monthly relative humidity is mostly 100%, except for July, which is 99%. The lowest recorded relative humidity is 36%.

Rainfall: Annual rainfall in Khanh Hoa varies significantly by location and time of year. The difference between the areas with the highest and lowest rainfall ranges from 300 to 500 mm. The highest rainfall occurs mainly in the western and southwestern regions of the province, with annual precipitation typically between 1,700 and 1,800 mm. The lowest rainfall is observed in the southern coastal plains, where annual precipitation is approximately 1,200 to 1,300 mm. Rainfall distribution is uneven throughout the year, with about 80% of the total annual precipitation concentrated in the four months of the rainy season, while the remaining 20% falls during the eight-month dry season. Heavy rainfall events can reach 400–500 mm per day, such as in Cam Ranh on December 2, 1986 (470.8 mm), and in Ninh Hoa (486 mm). Intense rainfall is most common during the flood season, particularly in October and November.

Fog: The Cam Ranh Bay area is almost free of fog, so visibility is not restricted. Throughout the year, there are about 361 days with visibility greater than 10 km, and only 4 days with visibility below 10 km.

Wind: From October of the previous year to March of the following year, the prevailing wind directions are North and Northeast; from April to September, the prevailing winds are Southwest or Southeast. The maximum wind speed recorded over many years is 28 m/s (on December 9, 1993).

2.4.1.5. Hydrological regime

The Khanh Hoa region has a relatively dense river network, but its distribution is uneven. The terrain in the area varies, including mountainous regions, plains, and coastal sandy areas. The basin-shaped topography is favorable for receiving the northeast monsoon and weather disturbances from the East Sea, such as storms and tropical depressions.

The river network in the province is relatively dense, with an average river density of approximately 0.6–0.7 km/km². The large basin slopes enable rapid water concentration. The Cai Nha Trang River and Cai Ninh Hoa River have significant potential for hydropower, fisheries, and irrigation.

The flow distribution is uneven in both space and time. During the flood season, the flow accounts for about 75%, while in the dry season, it is only about 25%. The monthly flow distribution throughout the year is highly irregular, with the flood season lasting only 3–4 months but contributing nearly 70% of the total annual flow. Notably, around 50% of the total annual water volume is concentrated in October and November. Meanwhile, the dry season lasts for 8–9 months but accounts for only about 30% of the total annual water volume. According to collected data, the flow velocity in the port construction area is approximately 0.7–1.0 m/s.

The total annual flow volume reaches approximately 4.67 billion m³ of water. In high-flow years, the flow can be up to four times that of low-flow years. The annual flow distribution is uneven, with about 70% occurring during the four months of the flood season, while the remaining water is distributed over the eight dry months. A significant portion of flood season water is lost as it flows into the sea.

Tides: The Cam Ranh Bay area is directly influenced by a mixed tide regime with a diurnal tide tendency. The number of days with diurnal tides ranges from 18 to 22 days per month, and during neap tide periods, an additional small tide occurs. The tidal range during spring tides is between 1.50 and 2.0 meters.

Water Levels: The highest water level in the project area is +2.25m, the average is +1.30m, and the lowest is +0.80m (according to the Hydrographic Chart system). The elevation difference between the State system and the Hydrographic Chart system in the study area is 1.31m.

Waves: The wave regime in Cam Ranh Bay is generally mild. The port construction site is located deep inside the bay, well sheltered by the surrounding terrain, thus minimizing wave impact on the port. According to wave observation data from March 5 to March 20, 1995, the maximum observed wave height in the bay was less than 0.75m.

Sedimentation: Cam Ranh Bay is a sheltered bay. The amount of suspended sediment and silt carried by rivers into the bay is minimal, leading to high water stability. The geological conditions in the area consist of good-quality soil. If dredging is conducted, the risk of slope erosion is low. It is estimated that the sedimentation rate in the navigation channel and port water area after dredging will be approximately 0.10–0.20m per year. Consequently, the maintenance dredging requirement for the channel and water area is relatively low.

2.4.1.6. Natural resources

a. Biological resources

Khanh Hoa Province, located in the South Central Coast of Vietnam, is notable for its rich biodiversity, encompassing a variety of ecosystems and rare species of flora and fauna.

- **Flora diversity:** Khanh Hoa is considered a center of forest biodiversity with numerous rare plant species. Specifically, the province has about 1,035 plant species belonging to

559 genera and 161 families, many of which are either endemic or migrated from different regions.

- Fauna diversity: The forests of Khanh Hoa are home to many rare animal species, including mammals, birds, reptiles, and amphibians

b. Marine Biological Resources

Along the coast of Khanh Hoa, there are many beautiful beaches, such as Nha Trang Beach, located in the city center; Bai Tien Beach to the north of the city; Doc Let Beach in Ninh Hoa town, which stretches for 4 km; and Dai Lanh Beach in Van Ninh district, which is nearly 3 km long. Additionally, many large and small islands along the coast have the potential for tourism, scuba diving, and recreational activities. Notably, Hon Tre Island, the largest island, boasts year-round stunning beaches such as Bai Tru, Bai Tre, and Bich Dam.

Cam Ranh Bay is one of Vietnam's most beautiful and important natural bays, renowned for its rich biodiversity. This area encompasses a variety of ecosystems, including mangrove forests, tropical forests, and diverse marine zones, providing habitats for many rare species of flora and fauna.

- Coral reefs and seagrass beds: Cam Ranh Bay contains abundant coral reefs and seagrass beds, which play a vital role in sustaining fisheries resources and protecting the coastline.
- Thuy Trieu Lagoon: Located within Cam Ranh Bay, this lagoon is rich in aquatic resources and contributes significantly to the biodiversity of the region.

Despite its ecological richness, Cam Ranh Bay is facing numerous challenges such as over-exploitation and unplanned aquaculture, leading to environmental pollution that threatens ecosystems and fishery resources.

Biological resources in the area of the Khanh Hoa Subproject: The subproject area lies within Cam Ranh Bay but is not close to coral reefs or seagrass beds (at a distance of over 3 km). The area is mainly used for aquaculture and fisheries exploitation, resulting in low biodiversity. *Within and around the subproject area, there are no environmentally sensitive zones.*

2.4.1.7. Natural Disasters and Extreme Weather Events

Khanh Hoa Province, located in the South Central Coast region, is frequently affected by extreme weather events such as storms, floods, landslides, and droughts. In November 2021, Khanh Hoa experienced two heavy rainfall events with average precipitation ranging from 175–325 mm, causing flooding and significant damage. Approximately 36,000 people were affected, with total estimated losses of about VND 246 billion (mainly in irrigation, transportation, and agriculture).

In 2023 and early 2024, Khanh Hoa Province was impacted by storms, tropical depressions, and widespread heavy rains, resulting in damage to over 167 hectares of rice fields, the collapse of 270 meters of canals, and 500 meters of roads submerged, with total estimated damages of about VND 2.3 billion.

Given forecasts of complex weather conditions in the last months of 2024, Khanh Hoa Province has implemented disaster risk response plans, focusing on reviewing key areas and vulnerable locations, arranging safe evacuation sites for residents, and ensuring logistics, food supplies, and essential necessities.

In particular, the province has paid close attention to ensuring the safety of about 2,200 fish rafts with nearly 113,000 aquaculture cages operated by 6,100 fishermen, as well as approximately 27,300 people living in 216 landslide-prone areas—mainly concentrated in Nha Trang City, which has 130 locations and about 16,500 people requiring evacuation.

In the subproject area, no serious natural disaster events directly affecting the port have been recorded in recent years, and port operations have remained stable, contributing significantly to local economic development. However, in 2017, Typhoon No. 12 (Damrey) caused considerable damage in the area, with many fishing boats sunk or partially damaged by large waves.

2.4.2. Existing status of baseline environmental quality

Sampling for baseline environmental analysis was conducted on January 15, 2024, by the Center for Environmental Analysis and Technology Transfer under the Institute of Agricultural Environment (VIMCERTS 082 certificate). Information on the sampling locations of the Khanh Hoa subproject is as follows:

Table 2.9. Sampling locations for baseline environmental quality under Khanh Hoa subproject

No	Description	Number of sample	Parameters	Sampling location/symbol
1	Air, noise	02	CO, SO ₂ , NO ₂ , TSP, Pb, Noise, temperature, humidity, wind speed, and wind direction..	Da Bac fishing port area, front yard of the administrative building; Symbol: from KH-KXQ1 to KH-KXQ2
2	Coastal seawater	03	pH, TSS, Ammonium (NH ₄ ⁺ -N), Nitrite (NO ₂ ⁻ -N), Cyanide (CN ⁻), Copper (Cu), Lead (Pb), Cadmium (Cd), Arsenic (As), Total Chromium (Cr), Total Oil & Grease, Total Phenol, Surfactants, Organochlorine Pesticides (Heptachlor, Dieldrin), Organophosphorus Pesticides (Chlorpyrifos, Diazinon)	Da Bac fishing port area Symbol: from KH-NB1 to KH-KNB3
3	Wastewater	03	pH, TSS, Total Oil & Grease, Ammonium (NH ₄ ⁺ -N), Nitrate (NO ₃ ⁻ -N), Lead (Pb), Cadmium (Cd), Arsenic (As), Copper (Cu), Zinc (Zn), Manganese (Mn), Total Chromium (Cr), Total Phenol, Surfactants	Wastewater at the wastewater drainage culvert Symbol: from KH-NT1 to KH-NT3
4	Soil	02	Arsenic (As), Cadmium (Cd), Lead (Pb), Chromium (Cr), Copper (Cu), Zinc (Zn)	Da Bac Fishing Port area Symbol: from KH-Đ1 to KH-Đ2
5	Sediment	03	Arsenic (As), Cadmium (Cd), Lead (Pb), Chromium (Cr), Copper (Cu), Zinc (Zn), Total Nitrogen (Total N), Total Phosphorus (Total P), Organic Carbon, Organochlorine Pesticides, Organophosphorus Pesticides	Coastal waters in the Da Bac Fishing Port area Symbol: from KH-TT1 to KH-TT3
6	Dredged material	4	Arsenic (As), Cadmium (Cd), Lead (Pb), Zinc (Zn), Total Chromium (Cr), Copper (Cu), Total PCB, Organochlorine Pesticides, Organophosphorus Pesticides	Coastal waters in the Da Bac Fishing Port area Symbol: from KH-CNV01 to KH-CNV04

No	Description	Number of sample	Parameters	Sampling location/symbol
			Polycyclic Aromatic Hydrocarbons (PAHs)	

Diagram of baseline environmental quality monitoring locations in the Khanh Hoa Subproject area as shown below:



Figure 2.13. Map of sampling locations for baseline environmental quality in the Khanh Hoa Subproject

The detailed tables of environmental component quality monitoring results will be presented in Appendix 3. Below is a summary of the assessment results of environmental component quality in the Khanh Hoa Subproject area.

a. Current air, noise, and vibration quality

The results of ambient air quality monitoring in the project area show that all indicators are within the allowable limits of QCVN 05:2023/BTNMT - National Technical Regulation on Ambient Air Quality (one-hour average). These results indicate that the ambient air quality in the project implementation areas remains relatively good, with no signs of pollution.

b. Current seawater quality

According to seawater quality monitoring results, most observed values at all monitoring points are below the allowable limits of QCVN 10:2023/BTNMT - National Technical Regulation on Seawater Quality. However, ammonium (NH_4^+-N) exceeds the standard (3.92 times at sample NB1, 4.48 times at sample NB2, and 3.36 times at sample NB3) compared to the permissible limit. Overall, the seawater quality in the area is considered relatively clean.

c. Current wastewater quality

The results of wastewater monitoring in some residential areas of the project site indicate that most parameters are within the allowable limits, except for TSS and ammonium, which exceed the standard limits under QCVN 14:2008/BTNMT, Column B. Specifically:

- At sampling point NT1: TSS exceeds by 9.25 times; ammonium exceeds by 1.36 times.

- At sampling point NT2: TSS exceeds by 16.2 times.
- At sampling point NT3: TSS exceeds by 14.7 times; ammonium exceeds by 1.48 times.

d. Current soil quality

The results of soil quality analysis show that heavy metal indicators comply with the permissible limits under QCVN 03:2023/BTNMT - National Technical Regulation on Soil Quality. This indicates that the soil quality in the project area remains relatively good, with no signs of contamination. During project construction, the topsoil will be removed, and depending on its characteristics, it will either be reused or disposed of. Thus, the excavated soil from construction areas can be reused for purposes such as site leveling or disposed of as regular waste.

e. Current Status of Sediment Quality

Surface Sediment

The subproject conducted monitoring and analysis of three (03) sediment samples in the navigation channel and turning basin of Da Bac Fishing Port. The sediment samples were collected from the surface or at depths not exceeding 15 cm from the seabed surface. The analysis results show that the concentrations of heavy metals in sediments within the subproject area are significantly lower than the permissible limits specified in the National Technical Regulation on Sediment Quality (QCVN 43:2017/BTNMT). Therefore, the volume of surface sediment dredged from the subproject components is classified as non-hazardous and is not contaminated with heavy metals. Sediment in the subproject area can be reused for landfilling purposes or temporarily stored at the project's designated disposal sites (the local authorities will develop plans for reusing dredged sediment in provincial projects for landfilling purposes). Accordingly, dredged material may be used for perennial crop cultivation, urban landscaping, or land leveling, depending on the actual needs of the local community. If not reused, the dredged material from the subproject will be collected, transported, and disposed of at temporary disposal sites approved by the competent local authorities.

Dredged Material

The subproject conducted monitoring and analysis of four (04) dredged material samples from the water area in front of Da Bac Fishing Port. The analysis results indicate that:

- The dredged material mainly consists of sand, clayey silt, and clay, with a loose texture.
- Heavy metal parameters and pesticide residues in the dredged material are all within the permissible limits compared with QCVN 43:2017/BTNMT – National Technical Regulation on Sediment Quality.

Therefore, the dredged material in the subproject area remains relatively good, with no signs of contamination. The dredged material can be reused for leveling purposes or transported to the project's designated disposal sites (the local authorities will prepare plans for utilizing the dredged sediment in provincial projects for leveling purposes).

2.4.3. Socio-economic condition

In 2023, the Ward People's Committee implemented key tasks for synchronized socio-economic development, proposing solutions to accelerate economic growth while ensuring social welfare, political security, and public order in the area. The results are as follows:

2.4.3.1. Economic development condition:

- Trade and Services: There are 783 households engaged in commercial businesses, small-scale trading, and service activities in the area, of which 163 households involved in industrial and

service businesses fall under management oversight. Commercial activities remained vibrant, especially during the Lunar New Year, with stable prices for essential goods, diverse and abundant supplies, and no occurrences of shortages or sudden price spikes.

The ward implemented the joint plan of the City People's Committee and the Vietnam Fatherland Front Committee of the city to carry out Plan No. 50-KH/TU dated October 26, 2021, issued by the Standing Committee of the Khanh Hoa Provincial Party Committee, aimed at strengthening the Party's leadership in the campaign "Vietnamese people prioritize using Vietnamese goods" in the new context.

- **Fisheries:** The ward has a total of 89 fishing vessels of various types. The total seafood catch reached 3,750/3,500 tons, achieving 107.1% of the target, including contributions from vessels originating from other areas.
- **Aquaculture:** Currently, there are 6,743 lobster farming cages. The estimated harvest yield was 297/200 tons, reaching 148.5% of the plan. The selling prices of farmed seafood experienced an upward trend.

2.4.3.2. Social development condition

- **Population and Communities:** Cam Linh Ward has a relatively large population with diverse social groups, ranging from traditional fishermen to entrepreneurs and migrant workers. The local living environment is built upon neighborhood bonds, solidarity, and strong community cohesion.

- **Culture:** The cultural identity strongly reflects the characteristics of a coastal area. Traditional festivals such as the Cau Ngu Festival (Whale Worship Festival) and the Fishing Village Festival are held regularly, not only serving as occasions for residents to honor ancestors and deities but also as opportunities to strengthen community ties and promote local culture.

- **Education:** Summary of the 2022–2023 school year results: The percentage of students receiving awards at the preschool level was 40%, while at the primary level, it was over 59%. The promotion rate for primary school students was 100%, and the completion rate of the primary education program was also 100%. At the lower secondary level, the percentage of excellent students was 31%, and the promotion rate was 96.7%. Awareness campaigns were conducted to encourage parents to enroll their 5-year-old children in kindergarten and 6-year-old children in first grade, achieving a 100% enrollment rate.

- **Healthcare:** in 2023, the ward's health station provided primary healthcare services to 11,645 patient visits. The malnutrition rate among children under five was 3.06% for underweight cases and 4.59% for stunted growth. The universal health insurance coverage rate reached 98%.

2.4.3.3. Affected household consultation results

The subproject is implemented on the existing land area of Da Bac fishing port and does not occupy land or assets of local residents in the area.

2.4.4. Existing status of technical infrastructure in the subproject area

a. Transportation System

Roadway Transport

- **External Transportation:** The existing Da Bac Port connects to the external transportation network via Nguyen Trai Street, which links to Nguyen Trong Ky Street. According to

the planning, Nguyen Trai Street has a planned road width of 16m, with a carriageway width of 9m. However, the current road leading into the port is only about 6m wide.

- Internal Transportation: The internal roads within the port area have a carriageway width ranging from 3m to 9m.

Waterway traffic:

- The Da Bac fishing port area is connected to Cam Ranh Bay, making it convenient for ships and boats from the mainland to head out to sea, as well as a safe anchorage for storm shelter. Currently, waterway traffic at Da Bac fishing port is not heavy, with the density of vessels entering and leaving the port around 30-35 trips per day, primarily consisting of fishing boats and tourist vessels (wooden boats or canoes) operated by local residents. The project area does not use waterway transport for building material delivery. However, some construction machinery will need to be transported by water to the construction site, such as canoes, a 30-ton floating crane, barges, and piling ships.
- About 600 m to the southwest and south of the project area is the channel leading to the Cam Ranh asphalt plant, Ba Ngoi oil depot, and various local piers in Cam Loi ward, Cam Ranh city. The density of ships and boats on the channel is quite high (averaging around 100 trips per day), but vessels on this route do not pass through the sub-project area. The construction activities of the sub-project will also not affect traffic flow on this waterway route.

b. Water Supply System

- The existing Da Bac Port is connected to the D114 water supply pipeline on Nguyen Trai Street, supplied by the Cam Phuoc Tay Water Plant, with a capacity of 16,000m³/day.
- Within the port, there is a 200m³ water tank and a 20m³ elevated water tower to supply water to the office building and restrooms. Additionally, a 1HP pump is installed near the pier access road to supply seawater for fish washing.
- The office building is supplied by a D25 water pipeline, while the vessels and stone water production plant are supplied by a D60 water pipeline.

c. Solid Waste Collection and Treatment

The subproject area already has a domestic solid waste collection system (with garbage bins placed throughout the fishing port for waste collection). Domestic waste is then collected, transported, and treated by Cam Ranh Urban Joint Stock Company in accordance with regulations. However, this collection is not 100% effective, as many fishermen still have the habit of disposing of waste directly into the sea, which over time has created large garbage piles under the wharf.

d. Electricity and Telecommunications System

- The power supply for the existing Da Bac Port is drawn from the 22KV 474-F9 transmission line on Nguyen Trai Street. All electrical distribution lines within the port are installed underground; however, these existing cables have deteriorated due to saltwater intrusion.
- Currently, three pole-mounted transformer stations have been installed in the fishing port area, with capacities of 160KVA, 560KVA, and 750KVA.

f. Drainage and Wastewater Treatment

Rainwater and Wastewater Drainage System

The planned expansion area, including the existing Da Bac Port, does not yet have a synchronized wastewater collection and treatment system. Domestic wastewater is primarily

treated preliminarily through septic tanks before being discharged directly into the sea. The expanded area has a WWTP operated by Cafico Joint Stock Company. Wastewater from seafood washing activities at the pier is not collected but instead overflows onto the pier surface, carrying organic waste (fish scales, fish parts, etc.) before being discharged into the sea.

Fishing Ports

- Hon Ro Port (Nha Trang City): Classified as a level II port with a capacity of 25,000 vessel visits per year and a seafood throughput of 20,000 tons per year.
- Da Bac Port (Cam Ranh City): A small fishing port in Cam Ranh, Khanh Hoa, serving as a key gateway for tourists traveling to Binh Ba Island. It is located approximately 5km from Cam Ranh City and 15km south of Cam Ranh International Airport. The port has a capacity of 12,000 vessel visits per year, with a seafood throughput of 15,000 tons per year.
- Vinh Luong Port (Nha Trang City): Capacity of 8,000 vessel visits per year, with a seafood throughput of 14,000 tons per year.
- Dai Lanh Port (Van Ninh District): Capacity of 6,000 vessel visits per year, with a seafood throughput of 13,000 tons per year.

Storm Shelters

- Ninh Hai Storm Shelter (Ninh Hoa Town): Designed to accommodate 300 vessels.
- Hon Ro Port: Can receive 1,200 fishing vessels. Da Bac Port: Can accommodate 1,000 fishing vessels from the province and neighboring areas seeking shelter.
- Song Tac - Hon Ro Shelter (Nha Trang City): Can accommodate 1,200 vessels with capacities of 300CV.

In addition, within Khanh Hoa Province, there are other storm shelter anchorages of various scales.

- Vung Me Shelter (Nha Trang City): 700 vessels with 300CV capacity.
- Dam Mon Shelter (Van Ninh District): 300 vessels with 300CV capacity.
- Binh Tay Shelter (Ninh Hoa District): 300 vessels with 300CV capacity.
- Dai Lanh Shelter (Van Ninh District): 300 vessels with 300CV capacity.
- Cam Binh Shelter (Cam Ranh City): 300 vessels with 300CV capacity.
- Truong Sa Archipelago: Includes six docking areas: Truong Sa Lon, Song Tu Tay, Sinh Ton, Nui Le, Toc Tan, and Stone Tay. These docking areas are scheduled for modernization to accommodate thousands of vessels for storm sheltering. The docking areas can also provide maintenance services for vessels with capacities of 2,000DWT, allowing ships weighing 1,000–2,000 tons to dock, take shelter, and receive logistical and technical support.
- By 2020, the Truong Sa archipelago had six modern docking areas integrated with fishing ports at Truong Sa Lon, Sinh Ton, Stone Tay, Nam Yet, and Phan Vinh. The docking area at Song Tu Tay Island has been upgraded to accommodate 120–150 fishing vessels.

2.4.5. Social and environmental condition at the subproject area and sensitive receptors

2.4.5.1. Environmental and Social Conditions Surrounding the Subproject Area

The existing Da Bac Fishing Port in Cam Ranh Bay covers an area of 9.66 ha and is planned for expansion to 15.5 ha. The expanded area of 6.52 ha includes 6.5 ha of public land, which is

currently vacant within the fishing port and 0.02 ha of non-agricultural production and business land.

Current Status of Cam Ranh Bay near the Subproject Area:

Cam Ranh Bay in this area has a width of approximately 1.5 km. The water quality in the bay shows slight signs of pollution in terms of ammonium parameters (mainly due to aquaculture activities taking place around the subproject area).

Waterway traffic in Cam Ranh Bay near the subproject area is quite busy. About 600 m to the southwest and south of the subproject area is the navigation route to and from the Cam Ranh asphalt plant, the Ba Ngòi petroleum depot, and community ports in Cam Lợi Ward, Cam Ranh City. The traffic density on this waterway route is about 100 vessel movements per day. Waterway traffic usually occurs when fishing boats depart for offshore trips (around 1:00 a.m. to 4:00 a.m.) or when they return (around 6:00 a.m. to 9:00 a.m.). However, navigation activities on this route will not be affected by the construction activities of the subproject.

Currently, there are more than 30 households engaged in aquaculture (mainly lobster and fish farming) within the project area, located about 300 m north of the dredging site. However, these farming activities are spontaneous and not within the officially permitted aquaculture zones of the subproject area. During subproject implementation, it is necessary to develop support measures and create conditions for occupational transition for these households, as they had invested and conducted aquaculture activities prior to the project investment decision.

Existing status of Da Bac Port

Da Bac Fishing Port was upgraded and repaired in 2009, currently featuring structures such as a pier for fishing vessels, a seafood sorting facility, the port management office, service kiosks, an ice production facility, security stations, a fuel station, and guard posts. The shipyard area consists of one or two permanent structures, with the rest being temporary structures serving vessel repair activities. The planned expansion area includes approximately 1.62 ha designated for seafood processing, currently housing ice production plants, seafood processing facilities, wastewater treatment areas, administrative offices, and warehouses for seafood production and processing. Most structures in the port have deteriorated over time.

- Existing status of the Tuna Wharf: The tuna wharf is a shore-connected structure with a total length of 358.5 meters, divided into eight segments, each 44.8 meters long. The wharf features a slab structure without beams, supported by bored piles. Its components include a bottom slab, side slab, vehicle stop curb, and cast-in-place reinforced concrete (RC) M400 with 1x2 stone aggregate. The ship docking slab is made of prefabricated RC M400 elements.

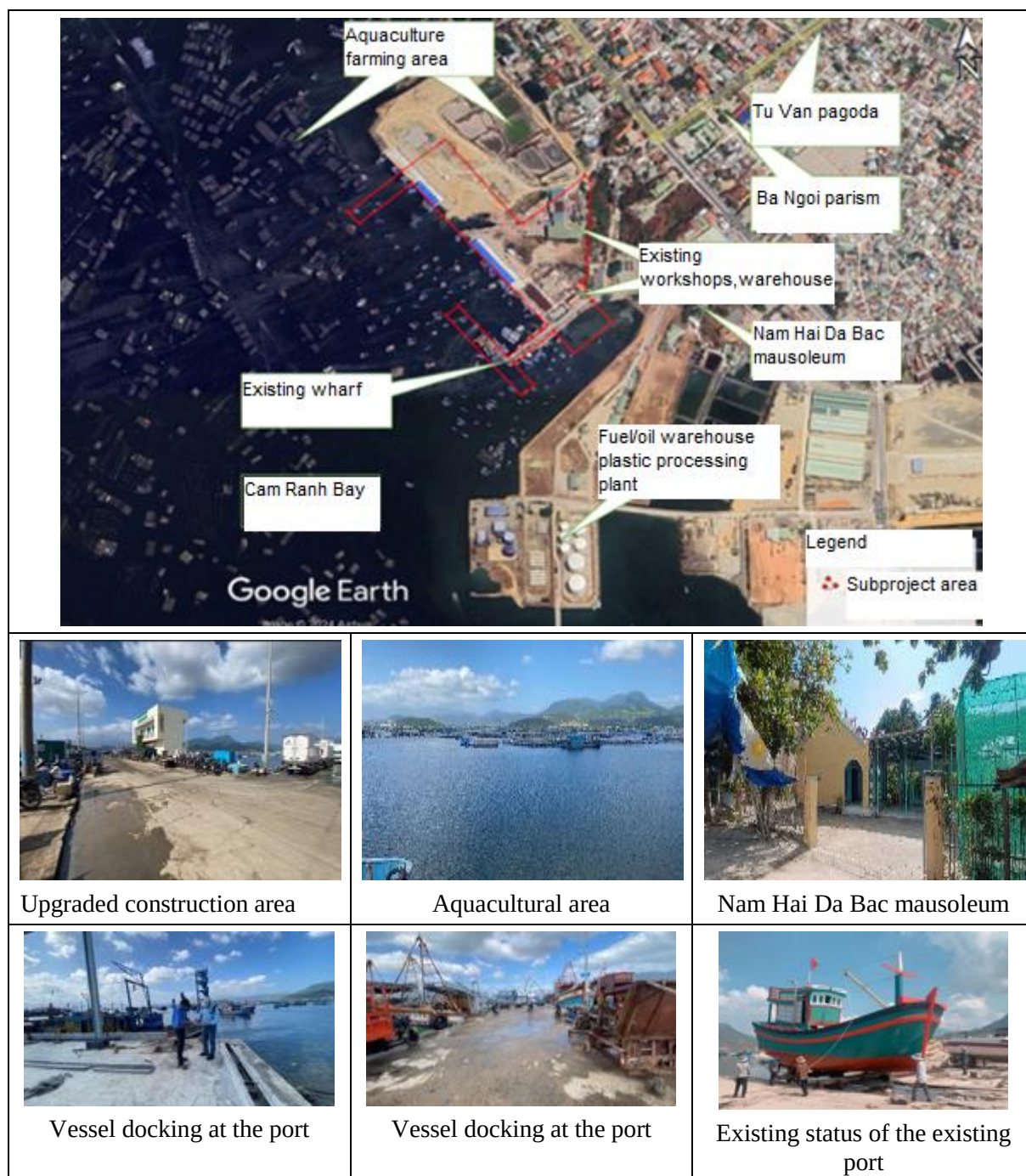
- Existing status of the service wharf: The logistics service wharf is a wharf-type structure with a length of approximately 80 meters, serving as a continuation of the tuna dock

- Existing status of Da Bac Fishing Port: The existing wharf is a soft jetty on a reinforced concrete pile foundation, consisting of a main pier and an approach bridge. The main pier has a length of 60 meters and a width of 9.5 meters. The approach bridge has a length of 24.5 meters and a width of 16 meters, connected to the main pier by an access road. Along the access road, there are facilities such as a fuel supply station, the Ba Ngòi border control station, and a vessel dispatching office.

Operations of the fishing port during upgrading and repair works: Under the current scale, there are about 30–35 vessel movements per day at the fishing port. Waterway traffic usually occurs when fishing boats depart for offshore trips (around 1:00 a.m. to 4:00 a.m.) or when they return (around 6:00 a.m. to 9:00 a.m.). The repair and upgrading works of the fishing port will be carried out in a phased manner, so vessel operations at the port will not be affected. Fishing boats will be alternately directed to the tuna wharf and the service wharf of the existing Đá Bạc fishing port when one of these wharves is under repair or upgrading.

The residential area of Cam Linh Ward is located approximately 70 meters from the project site and has a high population density. Additionally, several businesses and seafood processing facilities operate within the existing Da Bac Port, including Phuc Binh Seafood Company and Vinh Khuong Shipbuilding Workshop.

Along the project's main material transportation routes (Nguyen Trai Street and 30/4 Street), there are several culturally significant sites (temples, pagodas, shrines, graves, and churches), including Nam Hai Da Bac mausoleum, Tu Van Pagoda, and Ba Ngoi Parish. The characteristics of these sensitive sites will be detailed in the following section.



2.4.5.2. Dredged Material Disposal Sites of the Project

The subproject will arrange two dredged material disposal sites with a total area of approximately 3.1 hectares and a storage capacity of up to 60,000 m³, sufficient to accommodate the entire volume of dredged material from the subproject

Current status of Disposal Site No. 1 (about 0.5 km north of the dredging area): The disposal site covers an area of approximately 2.6 hectares and can accommodate over 50,000 m³ of material. The site is a former aquaculture pond that is no longer in use and has already undergone land acquisition. It has been previously used for storing dredged materials from maintenance dredging of the navigation channel and turning basin of Da Bac Fishing Port (Phase 1). Since the site is located within Da Bac Port, the transport of dredged materials does not pose any risk of spillage outside the port area. This disposal site is planned to be developed into infrastructure in the next phase of the Khanh Hoa Large-Scale Fisheries Center. The final elevation of the dredged material disposal site will be +21.05 m, consistent with the current technical infrastructure elevation of Da Bac Port.

- Current status of Disposal Site No. 2 (about 0.3 km east of the dredging area): The disposal site covers an area of approximately 0.5 hectares and can accommodate over 10,000 m³ of material. The site is currently a water surface area within the Da Bac Fishing Port boundary and has been used for disposing of dredged material from the basin, turning area, and access channel to the service berth. After backfilling, this disposal site is planned to be developed into facilities such as parking lots and service areas of the Khanh Hoa Large-Scale Fisheries Center. The final elevation of the dredged material disposal site will be +21.05 m, consistent with the current technical infrastructure elevation of Da Bac Port.

The dredged material will be pumped from the dredging area to the disposal sites via pipelines, part of which runs within Da Bac Port waters and part onshore within the Da Bac Fishing Port area. The layout of the pipeline will not affect surrounding community activities. The main route for dredged material disposal in this area follows: Project area → Disposal site (0.3–0.5 km away).





Figure 2.14. Location of disposal sites for the Khanh Hoa Major fishery center construction investment Subproject

2.4.5.3. Sensitive receptors of the subproject

Table 2.10. Sensitive receptors under Khanh Hoa subproject

No.	Sensitive receptors and distance to the site	Description
I	Da Bac fishing port	
1	 The aquaculture area on Cam Ranh Bay, 20 meters away	There are more than 30 households engaged in aquaculture in the area (mainly farming lobsters and fish). However, the farming area is spontaneous and not within the designated zone for aquaculture. After consulting with the local authorities, the City is implementing a program to help these households transition to alternative livelihoods
2	 Stores, 20m away	The area is home to various businesses operating within Da Bac port, with products sold including seafood, vegetables, and other goods
3	 Phuc Binh seafood company, 50m away	The seafood processing workshop is located right within the Da Bac port area, with approximately 20-30 workers operating daily. The main activities include processing, trading, and exporting frozen seafood (such as shrimp, squid, etc.)

No.	Sensitive receptors and distance to the site	Description
II	Main transportation route	
1	 Nam Hai Da mausoleum	The project is located along Nguyen Trai Street, which is the main transportation route for materials leading to the existing Da Bac fishing port. This area is a historical site frequently visited by people from Cam Linh Ward and the surrounding areas for sightseeing
2	 Tu Van pagoda, 80m away	The project is located along 3/4 Street, connecting to Nguyen Trai Street, which is the main transportation route for materials leading to the existing Da Bac fishing port. The pagoda area is a spiritual site regularly cleaned and visited by the people of Cam Linh Ward and the surrounding areas. Worship and ritual activities typically take place on the 1st or 15th day of the lunar month, as well as during holidays and festivals.
3	 Ba Ngoi parish, 60m away	The project is located along 3/4 Street, connecting to Nguyen Trai Street, which is the main transportation route for materials leading to the existing Da Bac fishing port. The church area is a spiritual site regularly cleaned and visited by the people of Cam Linh Ward and the surrounding areas. Worship and ritual activities typically take place on the 1st or 15th day of the lunar month, during holidays and festivals, with only one ceremonial day held annually at the church.
4	 Cam Linh primary school, 70m away	- The project is located along 3/4 Street, connecting to Nguyen Trai Street, which is the main transportation route for materials leading to the existing Da Bac fishing port. - The school covers an area of approximately 4,000 m², with about 30 teachers and over 220 students. Students' study hours are from Monday to Friday, with arrival and departure times between 6:30–7:30 AM, 11:00 AM–12:00 PM, 1:00–2:00 PM, and 4:30–5:30 PM
7		- "The project is located along 3/4 Street, connecting to Nguyen Trai Street, which is the main transportation route for materials leading to the existing Da Bac fishing port. - The school covers an area of approximately 6,500 m², with about 25 teachers and over 150 students. - Students' study hours are from Monday to Saturday, with arrival and departure times

No.	Sensitive receptors and distance to the site	Description
	Tran Hung Dao high school, 50m away	between 6:30–7:30 AM, 11:00 AM–12:00 PM, 1:00–2:00 PM, and 4:30–5:30 PM.
8	 Nguyen Trong Ky secondary school, 50m away	- The project is located along the 3/4 Street, connecting to Nguyen Trai Street, which is the main transportation route for materials leading to the existing Da Bac fishing port. - The school covers an area of approximately 1,200 m², with about 20 teachers and over 200 students. - The students' study hours are from Monday to Saturday, with arrival and departure times between 6:30–7:30 AM, 11:00 AM–12:00 PM, 1:00–2:00 PM, and 4:30–5:30 PM.

2.5 KIEN GIANG MAJOR FISHERY CENTER CONSTRUCTION & UPGRADING SUBPROJECT

2.5.1. Natural conditions

2.5.1.1. Geography

The construction location of Kien Giang Major fishery center construction investment subproject is located in Tay Yen A commune, An Bien district, Kien Giang province. It is located on the bank of Cai Lon river, about 10km from Rach Gia Bay estuary.

Tay Yen A has an area of 33.13 km², located in the south of Rach Gia city. The commune is located at coordinates 9°52'20"N 105°4'50"E with the North bordering Tay Yen commune, the East bordering the Cai Lon river, the South bordering Hung Yen commune and the West bordering Nam Yen commune.



Figure 2.15. Location of Kien Giang Subproject in Tay Yen A commune, An Bien district

2.5.1.2. Topography

Based on the 1/1,000 scale topographic survey documents of the construction area conducted by Minh Khai Company Limited from November 8 to 15, 2023, the survey scope is divided into two areas: above shallow and underwater. The terrestrial area in Tay Yen A commune was

surveyed from the bank of Xang Xeo Ro canal to Kinh 40 with a length of about 2.5km and a width of about 200m from the edge of Cai Lon river to the concrete road.

The terrain of the project implementation area is relatively flat: From the edge of the Cai Lon River, about 50m up, there is a newly built concrete road approximately 2m wide; From the edge of the road down to the river bank is land for growing nipa palms, and from the edge of the road inward to the border with the national defense dike is residential land, garden land, planted with perennial trees, of which most of the area is agricultural land and water surface aquaculture. Bordering the land is a national defense dyke, combined with an internal road with an elevation of 2.5m and a length of about more than 2km.

The area's terrain is divided into 2 parts by Nga Bat canal, the northern land from canal 40 to Nga Bat canal, the southern land from Nga Bat canal to Xeo Ro canal; The two areas are connected by a temporary iron bridge across the Nga Bat canal with a length of about 30m and a width of about 1m.

2.5.1.3. Geological Condition

According to the project geological survey report of the subproject area conducted by Minh Khai Company Limited from November 5 - 24, 2023, the location of 12 boreholes was surveyed for the project's geology. The stratigraphy of the survey area is divided into 10 soil and rock layers, from top to bottom as follows:

- Layer 1: Cultivated soil (Clay loam, gray brown, yellow brown). This is the layer right on the surface of the terrain, has a small thickness, and is of no significance in terms of construction.
- Layer 2: Very plastic clay/Very plastic dust, gray, blue gray, plastic (CH, MH). This is a weak soil layer. This layer has weak load-bearing capacity and high compressibility. When constructing a project, measures must be taken to handle this layer.
- Layer 3a: Very plastic clay/Less plastic clay, yellow-gray, brown-gray, light gray, hard plastic state (CH, CL). This layer has average load-bearing capacity.
- Layer 3b: Very plastic clay/Less plastic clay, yellow brown, light gray, semi-hard state (CH, CL). This layer has relatively good load-bearing capacity.
- Layer 3c: Very plastic clay/Less plastic clay, yellow brown, yellow gray, gray gray, hard state (CH, CL). This layer has good load-bearing capacity.
- Layer 4: Clayey sand/Sand mixed with clay, dust, gray-brown, yellow-gray, light gray, medium compact structure. This layer has relatively good load-bearing capacity.
- Layer 5a: Dusty sand/Sand mixed with clay, dusty, brownish gray, yellowish gray, light gray, medium compact texture (SM, SC-SM). This layer has a relatively good load-bearing capacity. Layer 5b: Clayey sand/Sand mixed with clay, dust, gray-brown, yellow-gray, light gray, medium-compact structure (SC, SC-SM). This layer has relatively good load-bearing capacity.
- Layer 6a: Less plastic clay, red brown, yellow gray, light gray, hard plastic state (CL). This layer has average load-bearing capacity.
- Layer 6b: Less plastic clay, red brown, yellow brown, gray gray, light gray, semi-hard - hard state (CL). This layer has good load-bearing capacity.
- Layer 7a: Clay sand, yellow-gray, light gray, medium compact structure (SC). This layer has relatively good load-bearing capacity.
- Layer 7b: Dusty sand/Sand mixed with clay, dusty, gray-brown, yellow-gray, medium-compact texture (SM, SC-SM). This layer has relatively good load-bearing capacity.
- Layer 8a: Less plastic clay, yellow brown, yellow gray, red brown, hard state (CL). This layer has good load-bearing capacity.
- Layer 8b: Less plastic clay, gray gray, yellow gray, light gray, semi-hard state. This layer has relatively good load-bearing capacity.

- Layer 9a: Dusty sand, gray-brown, yellow-gray, medium compact texture (SM). This layer has relatively good load-bearing capacity.
- Layer 9b: Sand and dust, yellow brown, yellow gray, tight - very tight texture (SM). This layer has very good load bearing capacity.
- Layer 10a: Less plastic clay, yellow brown, gray gray, green gray, semi-hard state (CL). This layer has relatively good load-bearing capacity.
- Layer 10b: Low-plastic clay, brownish-gray, gray-gray, blue-gray, hard state (CL). This layer has very good load bearing capacity.
- TK1 lens: Clay is less flexible, yellow brown, semi-hard state (CL). This lens has a relatively good load-bearing capacity.
- TK2 lens: Less plastic clay, yellowish gray, light gray, hard plastic state (CL). This lens has a medium load capacity.

According to the results of the site surey and geological survey in lab:

- For the Wharf and Access Bridge: Depending on the specific section of the wharf, driven piles can be used, and the pile tips should be placed in layers 3c, 5b, 6b, 8a, 9b, and 10b
- For the riverbank embankment and warehousing: During construction, attention must be paid to soil layer No. 2. This is a soft soil layer with an average thickness of 8.08 meters. Measures need to be taken for addressing, and cement-soil piles can be used.

2.5.1.4. Climatic and Meteorological Conditions

Kien Giang has a tropical monsoon climate, hot and humid all year round, typical of the Mekong Delta climate, with few natural disasters compared to other regions in the country. Kien Giang's climate is hot and humid all year round and has two distinct seasons: the dry season and the rainy season. The rainy season usually starts from May to November, the dry season starts from December to April of the following year. Kien Giang is not directly affected by storms, but rainwater volume accounts for a significant proportion, especially at the end of the rainy season.

Temperature: Kien Giang has high and fairly stable temperatures. Temperature characteristics data from three meteorological stations, Rach Gia, Phu Quoc and Tho Chu, show that the province has very small temperature variations over time and space. April and May are the two months transitioning from the dry season to the rainy season, with the highest temperature sometimes reaching 36 - 37°C while January and December are the two coldest months of the year with the lowest temperature possible. when down to 17 - 18°C. However, the average monthly highest temperature is only about 29 - 33°C, while the average monthly low temperature is 23 - 37°C.

Rainfall regime: Rainfall in Kien Giang is relatively large compared to the average in the Mekong Delta. Rainfall is uneven between districts and has large seasonal differences. The average annual rainfall is about 1,600 - 2,000 mm on the mainland and 2,400 - 2,800 mm on Phu Quoc island. Rainfall is strongly differentiated by season, with rainy season rainfall accounting for about 90% of the total rainfall falling in the rainy season from May to November. Rainfall distribution gradually decreases from west to east, Phu Quoc island has heavy rainfall. highest (in 2000 reached 4,165mm), followed by the western coastal areas of the province, commonly from 2,100 - 2,300mm, where the lowest rainfall is from 1,800 - 2,000mm.

Sunshine hours: Kien Giang has an average number of sunshine hours of 2,512.7 hours/year; The highest number of sunshine hours falls in March (291.2 hours/month) and the lowest in September (144.2 hours/month).

Air humidity: The average annual humidity in Kien Giang province is 80%, the highest is 85 - 86% usually falling in July and August, the lowest is 73% in February.

Wind regime: During the dry season, the prevailing wind regime is Northeast and East Northeast, and in the rainy season, the prevailing wind regime is West, West Southwest. The average wind speed is about 3.1 m/s (equivalent to level 2).

2.5.1.5. Hydrological network and regime

Hydrological network:

Kien Giang has a diverse hydrological network, including the West Sea and a rich network of rivers and canals. It can be said that almost the entire territory of Kien Giang is directly or indirectly influenced by the hydrological regime of the West Sea tide. Kien Giang's river system with a total length of rivers, canals and canals accounts for over 2,054.93 km, distributed almost throughout the territory. This system has a great influence on water regulation, soil properties and farming regimes throughout the Province. Natural rivers and canals include the following main rivers:

Cai Lon River: 60 km long, with an average surface width of 600 m and an average depth of 8-12 m. This river has tributary systems such as the Nga Ba Cai Tau River, the Nuoc Trong Canal, and the Cai Tu Canal. The Cai Lon River serves as a waterway for transportation and drainage during the rainy season but cannot be used for irrigation in the dry season due to saltwater intrusion. The central fishery location of Kien Giang is situated next to the Cai Lon River in the Nga Bat village, Tay Yen A commune, An Bien district, about 10 km from the Rach Gia Bay estuary.

Cai Be River: 92 km long; This river receives fresh water from the Thac Lac and Thi Doi canals; repel saline intrusion in the dry season.

Giang Thanh River: Originates from Cambodia and flows to the Gulf of Thailand in Ha Tien. In the dry season, this river is strongly influenced by the tides in the Gulf of Thailand, causing salinity. In the rainy season, this river drains the fields upstream.

In addition to the above natural rivers; there is also a canal system including main canals such as: Vinh Te canal; T3 channel; Tri Ton canal; Ba The canal; This canal system has the effect of draining flood water in the rainy season; Other channels such as: Cai San channel; Thot Not canal; Thi Doi Canal... has the effect of receiving fresh water from the Hau River to irrigate flood-affected areas; Rach Gia - Ha Tien Canal, in addition to draining flood water in the rainy season, also has the effect of regulating salt water flow in the dry season; Prevent saline intrusion deep into the interior of the field.

Tidal Regime:

The hydrological regime of Kien Giang province is governed by three factors: the tidal regime in the Gulf of Thailand (West Sea tide), the hydrological regime in the Hau River, and the inland tidal regime. These three factors combine to make the hydrological regime of Kien Giang province have two distinct seasons: the flood season and the dry season.

West Sea tide: With a mixed tidal regime favoring diurnal tides, tidal amplitude is 0.8-1m. In semi-diurnal tide mode, the two tidal peaks during the day are 0.5-0.7m different, but the two low tides are not significantly different. This type of tide is favorable for water drainage. The irregular diurnal tide regime of the Gulf of Thailand spreads from the west into the entire Kien Giang province and is itself influenced by the flow regime of the Hau River, through the trunk channels connecting the Hau River to the West Sea. The largest amplitude of the west sea tide at Rach Gia is 118cm in January and the smallest amplitude at Rach Gia is 2cm in October.

Hydrological regime of Hau River: Hau River section from Chau Doc to Can Tho is 120km long, 600-700m wide, 23 - 26m deep, average annual flow in Chau Doc is about 2,440m³/s, the smallest average monthly flow is 330m³/s in April sometimes down to 200m³/s. The largest average monthly flow in Chau Doc is 5,400m³/s in October. Hau River's hydrological regime

is strongly influenced by water flow upstream. From July to December there is almost no reverse flow. In late November and early December, due to the gradually decreasing upstream water volume, while the semi-diurnal tide in the East Sea becomes more active, the Hau River begins to have a reverse flow. The largest tidal amplitude in Chau Doc is 16 cm in October, 8 cm in November, gradually increasing to 101 cm in January and reaching 126 cm in May.

Inland rain regime: Strongly influenced by the flow regime in the region, it impacts on level of flooding and changes the acidity level in canals, the inland hydrological regime of Kien Giang province is very complex. , each region has a different flow regime.

Hydrological regime of the Cai Lon River (the subproject area):

The hydrological regime of the Cai Lon River is mainly influenced by the Hau River, rainfall, tides, and agricultural and aquaculture development activities in the area. The Cai Lon River receives water from the Hau River and nearby rivers and canals, while also being affected by regional rainfall. The flow of the Cai Lon River varies with the rainy season (May-November) and the dry season (December-April).

In the rainy season, the flow rate of the Cai Lon River increases significantly due to heavy rainfall and runoff from tributary rivers. The average flow rate can reach 200-300 m³/s in the main river sections during the rainy season. The peak flood occurs around September-October, with flow rates exceeding 400 m³/s during heavy rainfall periods. In the dry season, the flow rate decreases significantly, dropping to around 50-150 m³/s.

In addition, the Cai Lon River is affected by tides from the Western Sea (from Rach Gia Bay). The tidal range varies from 0.3 m to 1.2 m, affecting water flow and bidirectional currents on the river. The characteristic of the tides is an unequal semi-diurnal tide, with two high and low tides each day, but the tidal range is unequal. Tides play an important role in regulating water and influencing the salinity-freshness regime of the river. During the dry season, saltwater from the Western Sea intrudes deeply inland through the Cai Lon River mouth, significantly impacting the freshwater supply for domestic and production purposes; during the rainy season, abundant freshwater flow helps push saltwater far away, creating favorable conditions for agricultural production and freshwater aquaculture.

2.5.1.6. Natural resources

Water resources:

Surface water: The river and canal system in Kien Giang province, with a total length of more than 2000 km, includes natural rivers such as the Giang Thanh River, Cai Lon River, and Cai Be River, which are large rivers flowing into the Western Sea. They play a very important role in draining excess water and floodwater from fields to the Western Sea. Additionally, there is a network of interconnected canals, such as in the Long Xuyen Quadrangle region with canals like Vinh Te, Tam Ngan, Tri Ton, My Thai, Ba The, Kien Hai, Rach Gia-Long Xuyen, and Cai San. These canal sections all flow in a northeast-southwest direction, originating from the Hau River. The western Hau River region includes canal routes like KH1, Xang Tram Bau, Thot Not, KH6, KH7, and O Mon. The southwestern part of the province has a canal system including Can Gao, Trem Trem, Chac Bang, and Lang Thu Bay, originating from the Hau River and ending at the Cai Lon-Cai Be Rivers. These canals play a very important role in providing irrigation water and waterway transportation for the area.

Groundwater: In the province, seven aquifers and water-bearing zones have been identified through assessment: Permian – Lower Triassic fractured rock water-bearing zone (p-t₁), Upper Miocene porous aquifer (n₁³); Lower Pliocene porous aquifer (n₂¹); Middle Pliocene porous aquifer (n₂²); Lower Pleistocene porous aquifer (qp₁); Middle-Upper Pleistocene porous aquifer (qp₂₋₃); Upper Pleistocene porous aquifer (qp₃). Among them, four aquifers have been assessed for their extraction potential: (qp₃), (qp₂₋₃), (qp₁) and (n₂²). These aquifers can be exploited for

domestic and water supply purposes in the province. The total groundwater extraction capacity within the province is 1,322,417 m³/day. Of this, the static gravitational reserve is 1,317,474 m³/day, and the static elastic reserve is 4,944 m³/day. Groundwater in An Bien district originates from the sea at extraction depths of 80-130 meters, with a salinity of 0.9-1.2 grams/l, pH ranging from 6-8, and containing iron content.

Rainwater: Rainfall in Kien Giang is relatively high compared to the average rainfall in the Mekong Delta and is unevenly distributed over time. The annual average rainfall ranges from 1800mm to 2200mm, forming two seasons: the rainy season and the dry season. Rain is extremely important in agricultural production and in the daily lives of rural residents in Kien Giang province, especially in coastal areas far from freshwater sources.

Soil resources:

The total natural land area of Kien Giang is 634,852.67 ha, including: 458,159.01 ha agricultural production land, accounting for 72.17% of the natural area; 89,574.22 ha forestry land, accounting for 14.11% of the natural area; 28,378.93 ha aquaculture land, accounting for 4.47% of the natural area; 57.73 ha other agricultural land, accounting for 0.01% of the natural area.

Biological resources

According to *Environmental Status Report of Kien Giang Province for the period 2016-2020*, the biological resources and biodiversity of Kien Giang province are summarized as follows:

a. Forest resources

Kien Giang province has the Kien Giang World Biosphere Reserve, covering the districts of Phu Quoc, An Minh, Vinh Thuan, Kien Luong and Kien Hai. There are 3 core areas belonging to U Minh Thuong National Park, Phu Quoc National Park and Kien Luong - Kien Hai coastal protection forest. Kien Giang World Biosphere Reserve has six specific ecosystems, flora and fauna with about 2,340 species, of which 1,480 plant species with 116 rare species recorded in the red book and 57 endemic species; about 860 animal species with 78 rare species and 36 endemic species. This is also the area of the province containing 38 historical, cultural, and scenic relics recognized at the national and provincial levels. Kien Giang World Biosphere Reserve has great potential for developing ecotourism, while helping Kien Giang and Vietnam's coastal provinces strengthen their ability to respond to climate change.

The subproject area is over 10km away from the mentioned Kien Giang World Biosphere Reserve.

b. Marine Resources

Kien Giang's sea area is 63,290 km² wide, with more than 140 islands located in the Gulf of Thailand, bordering Cambodia, Thailand and Malaysia. This is the central point of Southeast Asia, and is also an ideal place to exploit tourism, especially international cruise tourism. Kien Giang sea has an average depth of 25 to 30 m, the deepest place is 50 m. This is a sea area with few large waves, the height of the largest wave is no more than 5 m and there are no underground waves. With the above natural conditions, Kien Giang sea is a favorable environment for seafood species to live and develop.

This is also a sea with many corals, about 9,720.4 ha and 12,000 ha of seagrass beds, which is the residence and food source of many species of marine fish and rare marine animals, creating a very diverse marine habitat. diverse and attractive for tourism exploitation. Seagrass beds in Kien Giang are quite rich and diverse, with up to 10 species out of 16 species announced in the entire sea area in Viet Nam. Coral in Kien Giang is very diverse in types, distributed in locations such as Phu Quoc, Nam Du and Tho Chu.

The subproject area is about 10km away Cai Lon estuary (discharge to Rach Gia Bay), this distance is quite far from the marine-resource areas in Kien Giang province - Nam Du archipelago, located about 100km away.

Freshwater fish in the Cai Lon River:

According to the *Study results on species composition and distribution characteristics of fish in the Cai Lon River basin*, Kien Giang province, 117 fish species have been identified, belonging to 91 genera, 50 families, and 16 orders. The fish fauna in the Cai Lon River basin is distributed according to the type of water body (still water, flowing water), the salinity of the water, and most fish species here are distributed year-round according to the rainy and dry seasons.

Regarding orders: in the study area, 16 orders have been identified, and their proportions are as follows: Perch-like fishes (Perciformes) have the most families with 24 families, accounting for 48.00%. Following is the Catfish (Siluriformes) with 6 families, accounting for 12.00%. Eels (Anguilliformes), Herrings (Clupeiformes), Carps (Cypriniformes), Needlefishes (Beloniformes), Swamp eels (Synbranchiformes), and Flatfishes (Pleuronectiformes) each have 2 families, accounting for 4.00%. The remaining 8 orders each have 1 family, accounting for 2.00%

Regarding family: In the study area, there are 50 families. The Carp family (Cyprinidae) has the most genera and species with 13 genera (14.28%) and 16 species (20.45%); followed by the White Goby (Gobiidae) with 8 genera (8.79%) and 9 species (7.69%); the Drums (Sciaenidae) with 5 genera (5.49%); the remaining families have 1-3 genera, accounting for 1.09% - 3.39% and have 1-4 species, accounting for 0.85% - 3.41%.

Regarding the species within orders: Among the 117 species belonging to different orders, 54 species (46.15%) belong to the Perch-like fishes (Perciformes); 19 species (16.23%) belong to the Carps (Cypriniformes), ranking second; 13 species (11.11%) belong to the Catfish (Siluriformes), ranking third. The Perciformes has the most species because they can adapt to various environments in the study area, such as freshwater, brackish water, and saltwater, and can be found in locations like rivers, canals, streams, ponds, lakes, and fields.

Plankton in the Cai Lon River:

According to research results, with a length of over 60 km, the Cai Lon River is home to many characteristic aquatic species such as flathead fish, goby, and naked catfishes, contributing to the biodiversity of the flowing water body. In addition to economically valuable aquatic species such as fish, large crustaceans, and mollusks, there is also a group of plankton.

A total of 105 species of plankton and 8 types of larvae (including Nauplius larvae, Veliger larvae (Bivalvia), Nematode larvae, Insect larvae, fish larvae, Gastropod larvae, Polychaete larvae, and Branchiopod larvae) were found in the Cai Lon River area, Kien Giang Province. Among them, Rotifera has the richest species diversity with 47 species, belonging to 12 genera and 10 families, followed by Copepoda with 23 species belonging to 15 genera and 11 families. The Protozoa group has 21 species, 7 families, and 8 genera. Cladocera has the lowest number of species, with 14 species belonging to 9 genera and 5 families.

The number of zooplankton species in the Cai Lon River area of Kien Giang province is quite diverse, with the main species belonging to Rotifera, Branchiopoda, and Copepoda. Notably, typical zooplankton species of Rotifera and Copepoda such as *Brachionus calyciflorus*, *B. falcatus*, *B. sericus*, *Polyarthra vulgaris*, *Paracalanus crassirostris*, and *Phyllognathopus viguieri* were found at most study sites during both the dry and rainy seasons. However, there are clear differences in species composition between the two main seasons of the year. The dry season has a richer species composition than the rainy season, with 95 species and 8 types of larvae. Dominant freshwater species are mainly Rotifera (36.84%) and Cladocera (14.74%)

(Table 2), this indicates that the Cai Lon River in Kien Giang province is less affected by salinity intrusion during the dry season. Many species only appear during the dry season. Representative species that appear at most sampling sites during the dry season include *Pseudosida bidentata*, *Ceriodaphnia laticaudata*, *Ceriodaphnia rigaudi*, *Philodina roscola*, *Keratella quadrata*, and *Trichocera rattus*. During the rainy season, 71 species of zooplankton and 2 types of larvae (*Nauplius larvae* and *D larvae*) were identified, fewer than in the dry season. The number of larvae decreases the most during the rainy season, as they are most affected by reproductive seasonality and water flow. Therefore, the number of identified species during the rainy season significantly decreases. However, some species only appear during the rainy season, such as *Philodina roseola*, *Filinia brachiata*, *F. opoliensis*, *F. longiseta*, *B. quadridentatus*, *B. pala*, *Keratella hiemalis*, and *Schmackeria gordioides*.

The phytoplankton species and subspecies recorded belong to various divisions such as: Heterokontophyta, Chlorophyta (Green Algae), Cyanobacteria, Euglenozoa (Euglenoids), and Dinoflagellata.

c. Biological resources in Kien Giang subproject

By using screening tool as <https://app.ibat-alliance.org/> to screen the subproject area from the protected areas/biosphere reserves/areas with high biodiversity, the report identified the location for constructing the Kien Giang subproject with an area of approximately 11.27 ha, more than 10km away from Kien Giang World Biosphere Reserve and 100km away from the marine protected area in the Nam Du Archipelago; and 10km away from the Cai Lon river mouth to Rach Gia Bay.

The current land status for constructing the Kien Giang major fishery center is mainly perennial crop land, such as coconut and fruit trees, a portion of rice fields, and residential land of 143 households. There are existing roads and small non-agricultural production business workshops. No forests (coastal protective forests or mangrove forests) are affected by the subproject activities

According to the results of the survey on the subproject area's existing status and consultations with local residents, the vegetation cover of the Kien Giang subproject area mainly includes perennial plants such as coconut and fruit trees, and wild plants growing along the river. Terrestrial animals in the subproject area include reptiles (snakes, geckos, etc.), field birds, and some domesticated animals such as dogs, chickens, and cats. There are **no** rare or endangered terrestrial plants and animal species within the subproject area.

Aquatic organisms in the subproject area: The aquatic organisms in the Cai Lon River include various natural fish species such as sea bass (Perciformes), catfish (Siluriformes), eels (Anguilliformes), herring (Clupeiformes), carp (Cypriniformes), halfbeak (Beloniformes), swamp eel (Synbranchiformes), and flounder (Pleuronectiformes). The zooplankton in the area mainly consist of Copepoda, Branchiopoda, and Rotifera families. The benthic animals primarily include clams, snails, mussels, oysters, trichobranchia, eels, and crabs. The aquatic vegetation is mainly comprised of water hyacinth (*Eichhornia crassipes*), water spinach (*Ipomoea aquatica*), and algae. There are **no rare or endangered aquatic species** within the subproject area.

In short, no **rare or endangered animals** listed in the Red Data Book are recorded in the Kien Giang subproject area.



Image. Existing status of some terrestrial plants and floating plant in Kien Giang Subproject

2.5.1.7. Natural disasters

Thunderstorms, storms, and tropical depressions in Kien Giang Province are recorded as follows:

Thunderstorms: On average, thunderstorms occur 25-30 days per year. Thunderstorms are more frequent in Kien Giang Province in general and Rach Gia in particular, compared to other provinces in the Southwestern subregion. Thunderstorms are usually accompanied by showers and strong winds, sometimes even hail, which can be very dangerous for people and structures.

Storm: In general, the seas of Kien Giang and the Gulf of Rach Gia rarely experience storms and tropical depressions compared to the coastal areas of Central and Northern Vietnam. However, the appearance of Typhoon No. 5 in November 1997, as well as some strong gusts and dangerous tornadoes in the Kien Giang, have highlighted the necessity of storm prevention measures for architectural structures.

Drought and Saline Intrusion: During the dry season (from December to April), saltwater from the Western Sea intrudes deep inland through the Cai Lon River estuary, significantly affecting the freshwater supply for daily life and production. The salinity concentration in the Cai Lon River can reach 4-10‰ during the dry season, depending on the distance from the estuary and hydrological conditions. During severe saline intrusion events such as in 2016 and 2020, salinity can exceed 10-15 ‰, causing significant damage to agriculture and aquaculture. Drought reduces the availability of freshwater in the Cai Lon River, creating difficulties for agricultural production, aquaculture, and the daily lives of local residents. Agricultural areas

dependent on freshwater, especially for rice cultivation and fruit trees, suffer heavily during drought periods.

2.5.2. Existing status of environmental parameters

To assess the quality of the baseline environment in the subproject area, the project owner has coordinated with environmental monitoring unit, which is the Center for Environmental Analysis and Technology Transfer under the Institute of Agricultural Environment (certified by VIMCERTS 082), to conduct surveys, measurements, and baseline environmental sampling in the subproject area. The environmental sampling was carried out on January 21, 2024. Information about the monitoring points within the Kien Giang subproject area is as follows:

Table 2.11. Information about monitoring points in Kien Giang subproject

No.	Parameters	Quantity (sample)	Monitoring parameters	Description of monitoring location/Sign/Comparison standard
1	Air, noise	01	CO, SO ₂ , NO ₂ , TSP, Pb, Noise, temperature, humidity, wind speed, wind direction.	Construction area of Kien Giang subproject; Sign: KG-KXQ QCVN 05:2023/BTNMT: National technical regulation on ambient air; QCVN 26:2010/BTNMT: National technical regulation on noise.
2	Surface water	03	pH, TSS, Ammonium (NH ₄ ⁺ -N), Nitrite (NO ₂ ⁻ -N), Cyanide (CN ⁻), Copper (Cu), Lead (Pb), Cadmium (Cd), Arsenic (As), Total Chromium (Cr), Total Oil and Grease, Total Phenol, Surfactants, Organic Chlorine Pesticides (Heptachlor, Dieldrin), Organic Phosphorus Pesticides (Chlopyrifos, Diazinon)	Cai Long river, in Tay Yen A commune Sign: from KG-NM1 to KG-NM3 QCVN 08:2023/BTNMT – National technical regulation on surface water quality
3	Groundwater	03	pH, TSS, Amonium (NH ₄ ⁺ -N), Nitrate (NO ₃ ⁻ -N), Chloride (Cl ⁻), Copper (Cu), Lead (Pb), Cadmium (Cd), Asenic (As), Total Chromium (Cr)	Well water of a household in Tay Yen A commune; Sign: KG-NN1 to KG-NN3 QCVN 09:2023/BTNMT – National technical regulation on groundwater
4	Wastewater	04	pH, TSS, Total Oil and Grease, Ammonium, Nitrate, Lead (Pb), Cadmium (Cd), Arsenic (As), Copper (Cu), Zinc (Zn), Manganese (Mn), Total Chromium (Cr), Total Phenol, Surfactants	Wastewater drainage culvert in residential area in Tan Yen A commune Sign: from KG-NT1 to KG-NT4 QCVN 14:2008/BTNMT – National technical regulation on domestic wastewater
5	Soil	01	Arsenic (As), Cadmium (Cd), Lead (Pb), Chromium (Cr), Copper (Cu), Zinc (Zn)	Garden land of a household in Tay Yen A commune; Sign: KG-Đ1 QCVN 03:2023/BTNMT – National technical regulations on soil quality
6	Sediment	03	Arsenic (As), Cadmium (Cd), Lead (Pb), Chromium (Cr), Copper (Cu), Zinc (Zn), Total N, Total Phosphorus, Organic Carbon, Organic Chlorine Pesticides, Organic Phosphorus Pesticides	Cai Lon river, in Tay Yen A commune; Sign: from KG-TT1 to KG-TT3 QCVN 43:2017/BTNMT – National technical regulation on sediment quality
7	Dredged materials	03	Arsenic (As), Cadmium (Cd), Lead (Pb), Zinc (Zn), Total Chromium	Cai Lon river, in Tay Yen A commune;

No.	Parameters	Quantity (sample)	Monitoring parameters	Description of monitoring location/Sign/Comparison standard
			(Cr), Copper (Cu), Total PCBs, Organic Chlorine Pesticides, Organic Phosphorus Pesticides, Polycyclic Aromatic Hydrocarbon Compounds (PHA)	Sign: from KG-CNV01 to KG-CNV03 QCVN 43:2017/BTNMT - National technical regulation on sediment quality

The diagram of the baseline environmental quality monitoring points in the Kien Giang Subproject area is shown below:

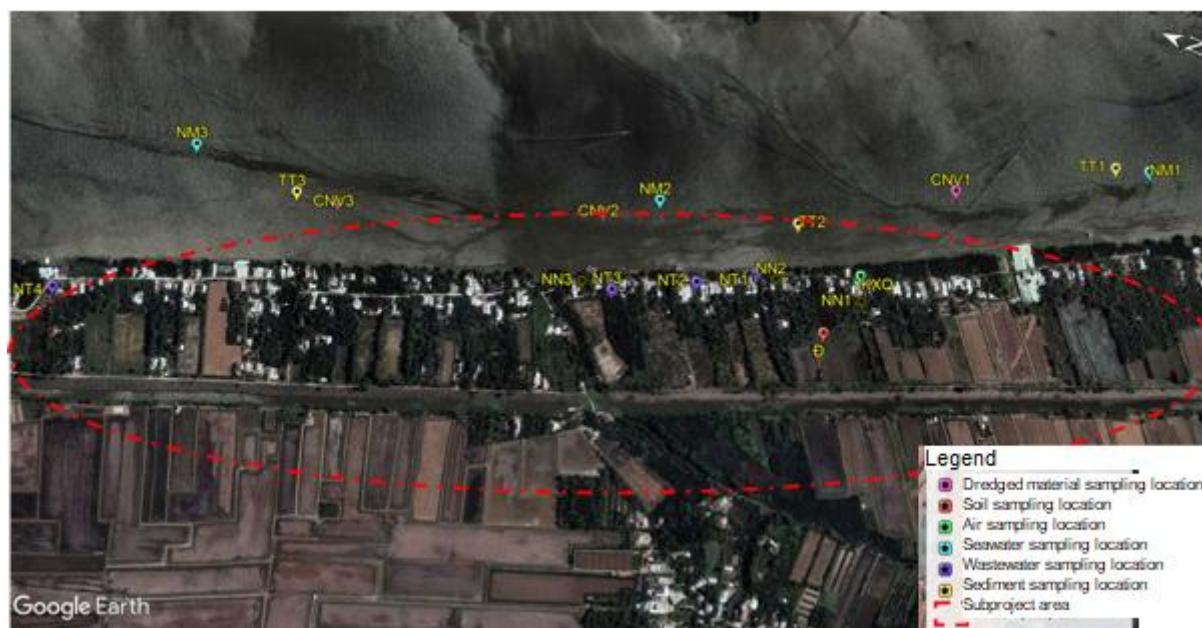


Figure 2.16. Map of baseline environmental quality monitoring points in the Kien Giang Subproject area

Environmental quality monitoring results will be presented in Appendix 3. Below is a summary of the assessment results of environmental quality in the Kien Giang subproject area.

a. Existing status of air quality and noise levels

01 sample in the construction area of the Kien Giang Major Fishery Center was monitored. The results of the ambient air quality monitoring in the subproject area show that all parameters are within the permissible limits of QCVN 05:2023/BTNMT: National technical regulation on ambient air (average one hour). The noise parameters in the subproject area are within the permissible limits according to QCVN 26:2010/BTNMT: National technical regulation on noise.

These results indicate that the ambient air quality and noise levels in the subproject areas are still relatively good, with no signs of pollution.

b. Existing status of groundwater

03 groundwater samples were taken from wells of households in Tay Yen A commune at a depth of approximately 30-50m. At the sampling points, all analyzed parameters meet the permissible standards of QCVN 09:2023/BTNMT. The analysis results indicate that the groundwater quality in the study area is relatively good, with no signs of pollution.

c. Existing status of surface water

03 samples were taken at the Cai Lon River in the Kien Giang subproject construction area. In this area, there is no activity of extracting surface water from the Cai Lon River for domestic water supply purposes. According to the surface water quality monitoring results, at all monitoring points, most values are lower than the permissible limits according to QCVN 08:2023/BTNMT (column A), except for the TSS (sample NM1 exceeding 1.2 times; sample NM3 exceeding 1.12 times) compared to the permissible limit. At the sampling time, the water in the Cai Lon River appeared turbid due to a high amount of sediment.

d. Characteristics of wastewater

04 wastewater samples were taken from the wastewater drainage systems in Tan Yen A commune. The monitoring results of the parameters in the domestic wastewater from the residential area in the subproject area show that the wastewater parameters are all within the permissible limits according to QCVN 14:2008/BTNMT - National technical regulation on domestic wastewater quality.

e. Existing status of soil quality

01 soil sample was taken at a depth of 20 cm at the Kien Giang subproject construction site. The results of soil quality analysis show that the heavy metal parameters are all within the permissible limits according to QCVN 03:2023/BTNMT - National technical regulation on soil quality. This indicates that the soil quality in the subproject area is still quite good, with no signs of pollution. Therefore, the soil excavated during the construction of the project components can be reused for various purposes such as land leveling or can be disposed of as regular waste.

f. Existing status of sediment quality

Surface sediment:

The subproject conducted 03 surface sediment samples at a depth of no more than 15 cm from the bottom surface of the water area in the Cai Lon River on the construction side of the Kien Giang Major Fishery Center. The analysis results show that the concentrations of heavy metals in the sediments in the subproject area are much lower than the permissible limits specified in the National technical regulation on sediment quality (QCVN 43:2017/BTNMT). Therefore, the volume of sediments dredged from the subproject component is non-hazardous and not contaminated with heavy metals.

Regarding salinity in the sediments, according to interviews with local residents, this area has not yet been affected by salinity. Additionally, two supplementary samples were collected (in December 2024) to measure salinity in the surface sediments of the Cai Lon River. The measured salinity ranged from 0.63‰ to 0.68‰, which are within the low threshold and do not affect crops, including rice and vegetables (*salinity levels from 0.75‰ to 1.5‰ can reduce the yield of salt-sensitive crops, from 1.5‰ to 3.5‰ can reduce the yield of many crops, and from 3.5‰ to 6.5‰ only salt-tolerant plants can survive*)¹².

Dredged material:

The dredged material from the Kien Giang subproject will include all the bottom sediments and the soil below the bottom sediment layer of the Cai Lon River. Within the project framework,

¹² The salt tolerance of crops, according to the Vietnam Academy of Agricultural Sciences. <http://www.vienmiaduong.vn/vi/detailkhoa.php?idTin=793>, accessed on November 30, 2017

the dredged material was taken from 03 samples of the geological survey (according to the geological survey report of the Kien Giang subproject, the geological survey samples were taken at the depth of 4m - 5m below the water surface according to the project design diagram).

The analysis results of three dredged material samples (at depths of 20cm to 50cm) show that the heavy metal parameters are all within the permissible limits according to QCVN 43:2017/BTNMT - National technical regulation on sediment quality. The results indicate that the quality of the dredged material in the subproject area is still quite good, with no signs of pollution. Therefore, the volume of dredged sediments from the subproject component is non-hazardous and not contaminated with heavy metals.

2.5.3. Socio-economic conditions

The subproject area for constructing the Kien Giang Major Fishery Center is located in Tay Yen A commune, An Bien district, Kien Giang province. There are 128 households affected by the project. Below are the socio-economic conditions of the subproject area and the households affected by the project:

2.5.3.1. Economic development conditions

According to the socio-economic report 2023 of Tay Yen A commune, the annual growth rate of the commune kept rising. The economic structure of the commune primarily focused on the agriculture, forestry, and fisheries sector, accounting for 76.7%; the industry and construction sector making up 13.6%, and the service and handicraft sector accounting for 9.7%. The average income per capita was 59 million VND per year. The poverty rate had decreased to 0.83% (22 households); the near-poor rate was 3.4% (90 households).

2.5.3.2. Social development conditions

Population: Tay Yen A commune has a natural area of 28.61 ha. As of December 31, 2024, the population was 10,602 people, including 5,259 males and 5,343 females. The population density was 371 people/km². Tay Yen A commune is divided into 6 villages: Muong Chua, Nga Bat, Ray Moi, Roc La. There are no ethnic minorities living in the subproject area.

Currently, Tay Yen A commune has all three levels of education (one kindergarten, one primary school, and one secondary school). In recent years, education has been a priority for development, with 100% of children attending school at the right age. The completion rate for all levels of education is 100%.

Healthcare: The commune has one health station with 12 beds and one doctor. In 2024, the health station successfully completed the primary healthcare tasks for local residents. The health insurance coverage rate among the population was 95.4%. The vaccination rate for children was 100%.

2.5.3.3. Socio-economic survey results of households affected by the Kien Giang subproject

✓ Household size:

Out of the total 128 households surveyed, with a total of 530 people, 13 households had only one member (10.2%); 16 households had 2 members (12.5%); and households with 4 or more members accounted for the highest percentage at 77.3% (99 households).

✓ Age of householder:

The average age of household heads was 52 years old; there were 30 household heads over the age of 60, indicating that the majority of household heads in the subproject area were still of working age.

✓ *Educational level:*

In general, the education level of the people directly affected by the project was relatively low. According to the survey results, among the total 128 household heads, the number of household heads with high school degrees only accounted for 29.6%; Secondary school level accounted for 24.2%. The majority of household heads only had primary school education (46%). No household head interviewed had a college or university degree.

✓ *Occupation*

The survey results on the main occupations of the household heads showed that they participated in three main groups of occupations: (i) Fisheries: 14 (10.9%); (ii) Agriculture: 27 (21.1%); and (iii) Freelancer: 73 (57%). Additionally, there was one household head who is a teacher (0.8%) and one household head who works as a mechanical repair technician (0.8%).

✓ *Household living standard*

The average income of the 128 households was 4.9 million VND/person/month (59.3 million VND per person per year). The main source of income for the households came from fishing activities (85.3%), while other sources accounted for 14.6%.

Household spending: The average expenditure of the affected households was 50 million VND per month, accounting for 2/3 of their income. Therefore, the accumulation level of the households affected by the project was not high.

According to Decree 07/2021 dated January 27, 2021 of the Government on multidimensional poverty standards applied for the period 2021-2025, poor and near-poor households were households with average income per capita/month at level of 1,500,000 VND or less and the household had a deficiency of 03 or more indicators which measure the level of basic social service deficiency. According to information provided by the commune, 17 out of 128 households were classified as poor and near-poor households.

✓ *Existing status of land use*

Survey results showed that 100% of surveyed households now had land use rights certificates. Residential land was provided with adjacent garden land for growing perennial crops. Rice land according to land records was actually being used by people to grow 1 rice crop and 1 shrimp crop.

✓ *Existing status of sanitation and environment*

Survey results show that 100% of households in the survey were currently using septic toilets

Water supply: the main water source used by households in the subproject area was tap water (water is supplied according to the centralized water supply system). 56 out of 128 households were using tap water (43.8%). 35/128 households used well water (27.3%) and 37 households had rainwater tanks (28.9%).

Drainage: Investigation results showed that the drainage system was built in sync with the concrete roads of the residential area. Most drainage lines had brick or concrete covers. To ensure environmental sanitation conditions as well as limit possible flooding problems, the resettlement site will have a consistent and concrete drainage system built to ensure water drainage in the residential area.

Energy: the survey results indicated that 100% households used electricity from the national grid for lighting. The main fuel sources households use for cooking were: 54/128 households (41.9%) of the surveyed households currently use gas for cooking; 59/128 households (45.7%) used electric stoves; 16/128 households (12.4%) still used charcoal and firewood.

✓ *Gender issue*

Labor distribution: through the survey, men mainly went to sea to catch seafood, workers in companies or freelance jobs. Women often worked in agriculture (growing rice, fruit trees, raising shrimp), and worked as hired labor (freelance). Women had more responsibility for household chores such as cooking and cleaning.

Gender-based violence: According to the survey results, there was currently no record of gender-based violence in the subproject area.

2.5.4. Existing status of infrastructure in the subproject area

a. Traffic system

External connection: National Highway 63 is the main foreign traffic axis. Currently, this National Highway is being upgraded under the Trans-Asia route project (Southern coastal corridor project) along with the bridge system across the Cai Be and Cai Lon rivers. In the district, there is also a project to build a dike on the Cai Lon River. In addition, in the planned area, there are a number of residential roads with cement concrete and gravel structures running along Cai Lon River and canal banks. In addition, waterway transportation has advantages with a large river system and deep ports (convenient for transporting goods from the Industrial Park to Can Tho and to Nam Du deep water port, Kien Luong).

Internal roads: Internal roads in the subproject area is mainly dyke roads and 2m-3m wide concrete roads. There is also a concrete bridge over Nga Bat canal.

During construction, the access to the subproject area is mainly by waterways. As mentioned above, the subproject area is adjacent to the Cai Lon River and about 10 km from the river mouth, so the transportation of materials is mainly by waterways through the Cai Lon River and the river mouth, which can conveniently connect with Rach Gia city and Ha Tien city. Transporting materials by waterways is also a common method in the Mekong Delta region and helps reduce the impact of air pollution, dust, and noise on residential areas near the project site, as well as minimizing the risk of traffic accidents and impacts on inter-village and inter-commune roads in the subproject area.

b. Water supply system

The main water supply source is groundwater and rainwater. Along National Highway 63, there is a water supply pipeline for the entire An Bien district.

The population in Tay Yen A commune mainly uses groundwater from drilled wells and rainwater stored in tanks, jars, palanquins and freshwater storage tanks.

c. Electricity and communication system

The 110KV Rach Gia - An Bien line runs through the planned area of Xeo Ro Industrial Park (located on the right side of Xeo Ro canal). In addition, along National Highway 63, there is also a 22kV power line supplying electricity to the entire district. There are also low voltage lines serving residential areas in the area.

d. Drainage, wastewater and solid waste treatment

Rainwater drainage: The current design area does not have a surface drainage system. Rainwater mainly flows down the slope into rivers, canals or seeps into the ground.

Wastewater treatment: The subproject area does not have a centralized wastewater treatment system. The drainage system in the planning area mainly drains water into existing canals, this is the main drainage system to Cai Lon river and Xeo Ro canal.

Existing status of solid waste collection and treatment:

The subproject area is a rural region, where the environmental conditions are mainly affected by agricultural production (use of fertilizers and chemicals) and the practices of livestock farming and building latrines along the river. Additionally, rural domestic waste is also a source of pollution for the soil, water, and natural landscape. Currently, there is no landfill or waste treatment facility. According to the *Existing status of Environment in Kien Giang province for the period 2016 – 2020*, the collection and treatment of solid waste in the communes and districts of the subproject area are as follows:

Currently, in the province, there is only one waste treatment plant in Soc Son town, Hon Dat district, operated by Tam Sinh Investment and Development Joint Stock Company, with a treatment capacity of 200 tons/day (currently treating waste from Rach Gia city; An Bien district (project area), Tan Hiep, Hon Dat, and Chau Thanh) and it is in the process of increasing its treatment capacity to 500 tons/day. Meanwhile, four other waste treatment plants are in the process of completing investment procedures and constructing plants. There are still 12 landfills in the province causing serious environmental pollution, and the Provincial People's Committee is mobilizing central and other funds to thoroughly rehabilitate and treat pollution at these 12 landfills, of which two severely polluted landfills in Tan Hiep and An Bien districts have been closed.

Household solid waste in the communes and towns of An Bien district is sorted at the source, then collected and transported to the waste treatment area in Soc Son town, Hon Dat district, for treatment. When the waste treatment plants in Long Thanh commune, Giong Rieng district, and Thanh Yen commune, U Minh Thuong district, come into operation, the waste will be transferred to these two plants for further treatment by incineration.

The volume of rural household solid waste generated is approximately 833 tons/day (equivalent to an average emission factor of 0.675 kg/person/day, roughly equal to the WHO estimated emission factor. Therefore, it can be said that the urban areas of the province have reached a developed living standard, while the rural areas are at a developing living standard). The volume of rural hazardous waste accounts for about 2.5%, equivalent to approximately 20.8 tons/day, and has not yet been separately collected and treated. The collection rate of rural household solid waste is low, generally only about 35%.

Tay Yen A commune – the area where the Kien Giang major fishery Center is being constructed, has established solid waste collection teams, mainly consisting of the women and idle workers. Household solid waste generated by residents is gathered at common collection points along the village, commune, and town roads; with a frequency of 2 - 3 times per week (in some places is once per week), sanitation workers in communes and towns organize the collection using hand carts, trailers, and motorbikes to temporary collection points, after which the waste is collected and transported to the waste treatment area.

e. Existing vessel mooring and storm shelter area

Kien Giang currently has 05 main fishing ports including: Tac Cau fishing port, An Thoi fishing port, Xeo Nhau fishing port, Nam Du fishing port, Tho Chau fishing port, of which 02 fishing ports Tac Cau and An Thoi are approved by the Ministry of Agriculture and for origin tracking of seafood for export.

Tac Cau fishing port: has been invested and put into use since 2003. Over a long period of use, many items show signs of serious deterioration such as traffic system being damaged a lot; The electrical system often has problems, the wastewater collection system is not thorough; Wastewater treatment is degraded, the entire port area is often flooded. Currently, the Department of Agriculture and Rural Development is implementing the investment project to upgrade and expand Tac Cau fishing port according to Decision 4461/QĐ-BNN-TCTS dated October 28, 2016. The project scale is to upgrade the existing wharf (600 CV and 45 CV) to 600 CV, upgrade internal roads and surface drainage system; wastewater collection and

treatment system; water supply system for domestic use and fire protection; product classification receptionist. Currently implementing phase II: Upgrading 45 CV port, internal roads and WWTP; Construction of the fire protection system has not yet been completed; the channel entering and exiting the port and the water area in front of the wharf.

An Thoi fishing port: was put into operation in 2001. Over time, many floors were degraded, and in 2012, it was invested in upgrading and expanding, including items: 600CV expansion bridge, combined embankment dock rate 45 - 90CV, product sorting house, water treatment system, fire protection system, water supply system; By July 2019, it will be completed and handed over to the Management Board. However, according to the current design, there is no system to collect wastewater from the wharf for treatment, so when cleaning the wharf, the water flows directly into the sea; The elevation of the old and newly upgraded wharves is much different, so the amount of wastewater collected at the treatment plant is very little. At the same time, the wharf does not have a roof system, so rainwater and wastewater are not clearly separated.

Tho Chau fishing port: put into use since the end of 1998 including items: Wharf, power plant, office building, road, sidewalk, drainage, water supply system, storage tank, embankment, embankment system. lighting system, leveling to create yards, and marker posts. Over time, most of the items have degraded, the wharf is cracked and the reinforced concrete is not guaranteed to be usable for loading and unloading goods. The existing status of infrastructure of the old Tho Chau Fishing Port only has the wharf, office building and internal roads. Currently, the project of storm shelter for fishing vessels is being implemented combined with upgrading and expanding Tho Chau island fishing port, Phu Quoc district according to Decision No. 2590/QĐ-UBND dated October 30, 2015 of the Provincial People's Committee. Kien Giang, with a total investment of 154 billion VND, including items: 1000 CV wharf, repair of existing wharf, embankment to protect the anchorage area, internal yard roads, sidewalks, drainage system Water - Fire protection, Electricity supply system, fishing port and anchorage management house, public toilet. The project is completing the 1000CV wharf, embankment and some auxiliary items.

Xeo Nhau fishing port: completed investment and handed over to the Management Board to receive from April 2013 including items: Dock, protection embankment, internal traffic, Drainage system, distribution reception house type, lighting system (no low voltage power source), drainage system (no water supply), office equipment. So far, some items have deteriorated: the security latch has sunk, the windows are damaged; The product sorting house is degraded, the panels and purlins are rotten by clay, the roadbed between the bridge and the house, the sidewalk corridor is sinking, the entrance and exit channels to the yard and the front water area are often silted up and need to be repaired. investment and upgrading.

Nam Du fishing port: Currently in the stage of transfer to the Kien Giang Provincial Department of Transport for management.

2.5.5. Socio-environmental conditions in the subproject area and sensitive receptors

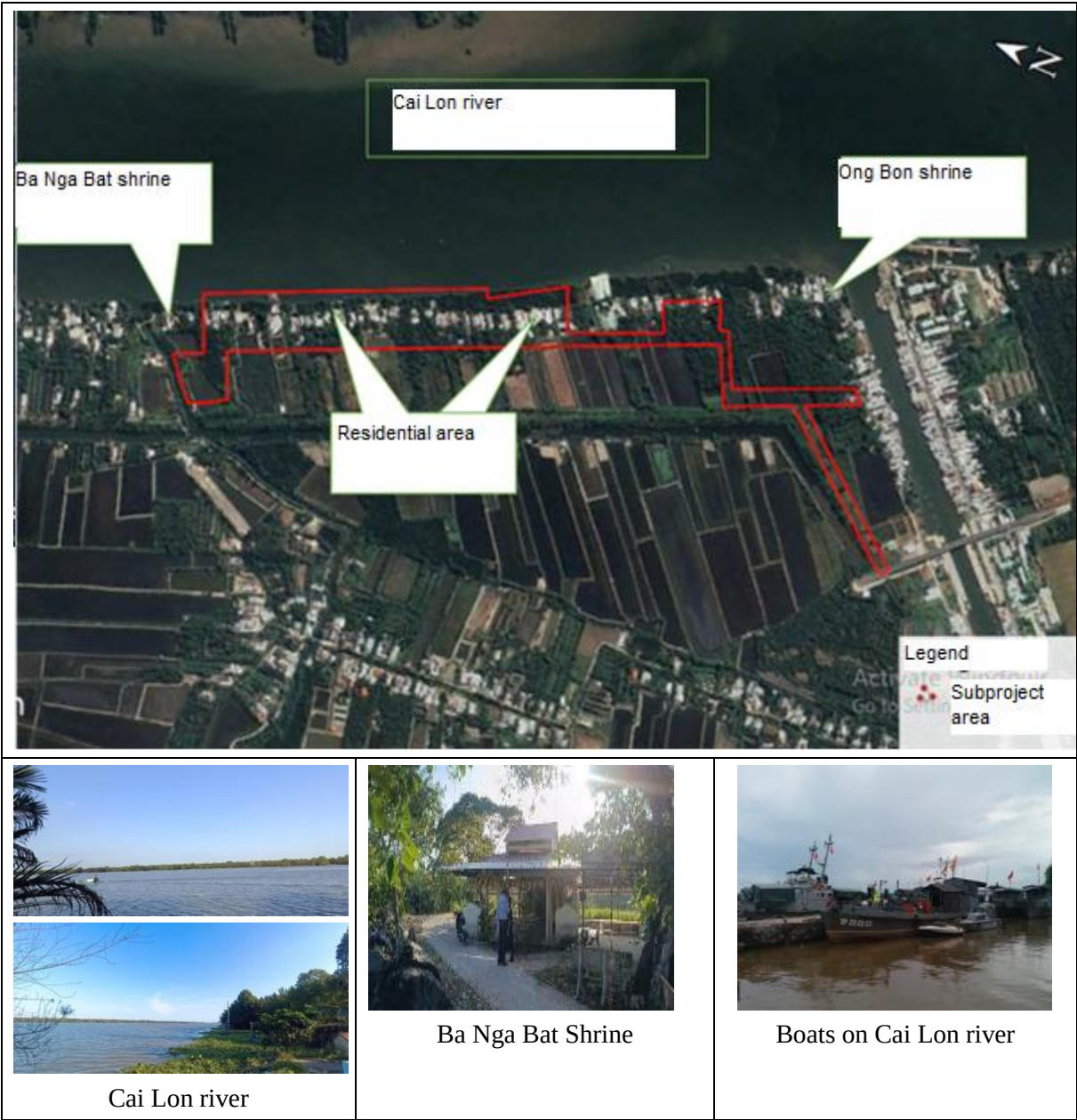
The Kien Giang Major Fishery Center will be newly constructed on an area of 11.27 ha, including: 1.83 ha of rice fields, 5.52 ha of perennial crops such as coconut and fruit trees, 1.68 ha of rural residential land, 0.14 ha of non-agricultural production and business land, and 2.15 ha of public land as village roads.

The Cai Lon River in this area has a width of about 500m-600m (the section at the subproject area, 8 km from the river mouth, the width of the river section near Rach Gia Bay is larger at 800-1000m. The water quality of the river is quite good, and the waterway traffic activity in this area is not high, with a concentration of large boats, mainly during storms.

The residential area of Tay Yen A commune, within the project implementation area (143 households), will be cleared for site preparation. The subproject construction will affect the livelihoods of 15 households (cultivated land will be used for building the resettlement area) and relocate 128 households. Around the subproject area, there are several residential areas interspersed with agricultural land, with a medium population density. The nearest residential area is scattered about 50 - 150 meters from the subproject.

Tay Yen A Secondary School is about 1 km away from the subproject area; Tay Yen A Primary School is also about 1 km away from the subproject area and is not located on the main transportation route of the project.

Within and around (within a 300m radius) the subproject area, there are PCRs (temples/shrines/graves/churches) including: Ba Nga Bat Shrine, Ong Bon Shrine, and about 60 graves scattered in the gardens of households (according to the local customs and practices). The sensitive points and their distances to the subproject are shown in the table below.



The disposal site for dredged material is arranged right within the premises of the Kien Giang subproject area (land fund serving the construction of the next phase).



Figure 2.17. Disposal site of materials dredged from the Kien Giang major fishery Center

Table 2.12. Sensitive receptors under Kien Giang subproject

No.	Sensitive receptors and distance to the construction site	Description
1	 Ba Nga Bat Shrine, located 100m away.	Ba Nga Bat Shrine is a spiritual place that the local people frequently clean and visit. Worship and ritual activities usually take place on the 1st or 15th day of the lunar calendar, as well as during holidays and festivals.
2	 Ong Bon Shrine (located at the intersection of Xeo Ro Canal and Cai Lon River), located 180m away.	Ong Bon Shrine is a spiritual place that the local people frequently clean and visit. Worship and ritual activities usually take place on the 1st or 15th day of the lunar calendar, as well as during holidays and festivals.

No.	Sensitive receptors and distance to the construction site	Description
	 Graves scattered in the gardens of households.	There are 60 graves scattered in the gardens of households (according to the local customs and practices). The families directly worship on death anniversaries, holidays, full moons, and the first day of the lunar month. All of these graves will have to be relocated for site preparation.

2.6 BACH LONG VI STORM SHELTER UPGRADING SUPROJECT

2.6.1. Natural condition

2.6.1.1. Geography

Bach Long Vi is the farthest offshore island of Vietnam, situated in the central part of the Gulf of Tonkin. The island is administratively part of Bach Long Vi District, Hai Phong City. It is positioned at geographical coordinates ranging from 20°07'35" to 20°08'36" North latitude and from 107°42'20" to 107°44'15" East longitude. The island lies 110 km from Hon Dau Island (Hai Phong), 70 km from Ha Mai Island, and 130 km from Ta Chiao Cape (Hainan, China). Bach Long Vi plays an essential role in Vietnam's maritime strategy, as it contributes to the expansion of territorial waters and serves as a key reference point in the delimitation of maritime boundaries within the Gulf of Tonkin. Furthermore, it is one of the eight major fishing grounds in the Gulf, holding strategic importance in the country's economic development as well as in ensuring maritime security and national defense.

The island has a triangular shape with a total perimeter of approximately 6.5 km. Its longest axis, running in the northeast-southwest direction, measures about 3 km. The width of the island varies, extending approximately 2 km in the northeast-southeast direction and around 1.5 km in the southeast-southwest direction. The land area of the island itself is about 2.5 km² and totally expands to approximately 4 km² if including the tidal flats that are exposed at low tide.



Figure 2.18. Location map of Bach Long Vi subproject on Bach Long Vi Island district

2.6.1.2. Topography

Bach Long Vi Island's terrain is relatively gentle compared to many other coastal islands. About 62.5% of the island's area has a slope of less than 5°, while the remaining areas mostly do not exceed 15°. The gentlest slopes are found at elevations of 2-5 meters, corresponding to marine accumulation terraces at the island's base, with slopes ranging from approximately 2-5°. Next are the hilltop surfaces at elevations of around 55-60 meters, with slopes of about 3-8°, representing an ancient peneplain. The steepest slopes, ranging from 25-50 meters in elevation, are found on the hillsides. As a gently sloping hill, Bach Long Vi is minimally dissected laterally and has very shallow vertical dissection, only about 5-10 meters per kilometer.

At the highest tide level, the island's area is 1.78 km². At the average sea level (0 meters relative to the mainland), the area is 2.33 km², and at the lowest tide level, it expands to 3.05 km². The island is a ridge-like hill with an absolute elevation of 61.5 meters and a relative height of approximately 90 meters, rising from the seabed at a depth of about 30 meters.

The emerged part of Bach Long Vi Island has a triangular shape with a perimeter of approximately 6.5 km. The island extends about 3 km in the northeast-southwest direction and has a width of around 1.5 km in the northwest-southeast direction. Surrounding the island are tidal flats and beaches covering an area of approximately 1.3 km², mainly composed of rocky terraces that have been eroded by waves over time. At the highest tide level, the island's land area is approximately 1.78 km², while at the lowest tide level, it expands to around 3.05 km² as the exposed tidal flats increase. The island's terrain is characterized by a gently sloping ridge, with 62.5% of its land area having a slope of less than 5°. Around the island, tidal flats and beaches form a surrounding zone of about 1.3 km², primarily made up of rocky terraces shaped by continuous wave erosion. In addition, there are numerous submerged rock formations and underwater trenches located close to the island's shore.

According to a 1/1,000-scale topographic survey conducted by Minh Khai Ownership Co., Ltd. in 2021, the planned location for the construction of the fishing port and storm shelter in the northwest of the island has the following key topographic features:

- Onshore area (from the waterline to the coastal road, including the island's shore and tidal zone): This area consists of rocky shores or sections covered by a thin sediment layer over bedrock, along with depositional shores made up of sand, cobbles, and gravel. The natural elevation in this area ranges from ±0.0 m to +2.5 m (HD). The elevation at the specific site planned for the subproject construction varies from +6.96 m in the northeast to +8.79 m in the northwest. Overall, the shoreline has a gentle slope.
- Underwater area: The seabed in this region slopes gently, with depths gradually increasing as the distance from shore extends (with a seabed slope of about 1-2°). The seabed primarily consists of rocky terraces that have been eroded by waves over time. The natural elevation within the designated storm shelter area varies from ±0.0 m to -4.5 m (HD). Further offshore, there are scattered submerged rock formations, some rising to an elevation of just -0.5 m below sea level.

2.6.1.3. Geology

The geology of the sea area and Bach Long Vi Island consists of the following layers:

- D1) Phu Thuy Chau Formation, Oligocene age (P3ptc), approximately 200 m thick;
- D2) Hoa Mi Formation, Middle Miocene to Pliocene age (N12N2hm), 55-60 m thick, located in the deeper parts;
- D3) Quaternary sediments, 0.5-1.5 m thick, mainly composed of marine-origin sand. Additionally, there are eluviations (on hilltops) and proluvium (on hill slopes);
- D4) Marine sediments composed of sand, gravel, pebbles, and biological debris, forming the high marine terraces at 10 m, 5 m, and 2-3 m, as well as modern beaches. Material composition includes sand (D4a) and boulder gravel (D4b);
- D5) Modern sediments consisting of coarse fragments and biologically derived materials (coral, mollusks, etc.). The coarse fragment group includes terrestrial deposits primarily originating from the destruction of the island's shore, composed of boulders and pebbles, distributed in the tidal zone. Carbonate coarse fragment sediments, including pebbles, gravel, sand, and coarse sand, are products of the destruction and re-deposition of biological sediments. These are distributed from the tidal zone down to depths of 10-15 m and form thin, discontinuous layers over the bedrock surface, concentrated in the southern and northwestern parts of the island.
- D6) From a depth of 25-30 m, marine sand predominates.

The geological survey results for the project construction area, conducted in 2023, show that the area's geology is divided into different layers, as follows:

- Layer 1: Gravelly sand with pebbles, grayish, light gray, very compact structure (SM);
- Layer 2a: Mudstone/sandstone, strongly weathered, especially cracked, grayish, dark gray, light gray, grade IV-VI stone;
- Layer 2b: Mudstone/sandstone, moderately to strongly weathered, heavily cracked, grayish, dark gray, light gray, grade IV-VI stone;
- Layer 2c: Mudstone/sandstone, moderately weathered, moderately to strongly cracked, grayish, dark gray, light gray, grade IV-VI stone.

Based on the survey results, it is shown that dredging in the project area will be relatively convenient, as layers 2a, 2b, and 2c have good bearing capacity. The structure ensures the feasibility for construction of work items under the subproject.

2.6.1.4. Climatic condition

The climate of Bach Long Vi Island represents the offshore region of the Gulf of Tonkin, characterized by two main seasons.

The rainy season lasts from May to September, with hot and humid weather and frequent rainfall. The southwest monsoon predominates, with a southerly direction occurring 74-88% of the time, and an average wind speed ranging from 5.9 to 7.7 m/s. The dry season runs from November to March of the following year, characterized by cold, dry weather with little rain. The predominant wind direction is from the northeast and east, accounting for 86-94% of the time, with an average wind speed of 6.5 to 8.2 m/s. April and October are transitional months.

The average annual air temperature is 23.3°C, with a maximum of 33.9°C and a minimum of 7.0°C. The highest temperatures typically occur in June, July, and August, while the lowest temperatures are found in January and February (16.6-16.8°C). The annual temperature range fluctuates between 9.6°C and 13.8°C, with a small diurnal temperature range, usually not exceeding 5°C.

The average humidity is 86%, with the highest levels occurring in March and April (92%) and the lowest in November (69%).

Sunshine and solar radiation: The total number of sunshine hours per year averages between 1,600 and 1,900 hours, with a fairly even distribution. The total annual radiation reaches 132.5 Kcal/cm², which is higher than that of the coastal islands (Cat Ba: 108.49 Kcal/cm²). The annual radiation balance ranges from 65 to 85 Kcal/cm² (with high radiation from April to October, peaking in May at 15.98 Kcal/cm², while the other months remain below 10 Kcal/cm², with the lowest radiation occurring in March at 7.18 Kcal/cm²).

Rainfall: The average annual rainfall is 1,031 mm, which is lower than that of the coastal areas of northern Vietnam. Rainfall is concentrated mainly from May to October, accounting for 83% of the total annual rainfall, with the heaviest daily rainfall reaching over 100 mm, the maximum recorded being 167.5 mm. From November to April, the monthly rainfall is consistently under 50 mm, with the lowest rainfall occurring in December. On average, there are 107.2 rainy days per year.

Fog: Fog is most common during the winter months, with an average of 24 days of fog per year (approximately 5-10 days per month).

2.6.1.5. Hydrological and oceanographic regimes

Bach Long Vi island is a small island located in the Gulf of Tonkin, and it does not have rivers, only small streams that form when it rains.

Oceanographic regime: With the characteristics of the Gulf of Tonkin, the tides in Bach Long Vi have a regular diurnal pattern, with an average water level of 1.42 meters. During the winter, the tide is relatively low (especially in February and March, where the high tide only reaches 3.0 meters), and it is higher in the summer (in September and October, the high tide reaches 3.76 meters). The lowest tidal level is 0.16 meters.

Waves and coastal currents: These are influenced by the wind direction. In the winter, the predominant wind direction is northeast (with a frequency of 37.9%), and in the summer, it is from the south and southeast (accounting for 22.9%). The average wave height is between 0.6 and 0.9 meters. During storm conditions, waves can reach 3-6 meters, with the maximum recorded wave height being 7 meters.

The coastal currents around the island are influenced by its shape. On the southwest side of the island, the current tends to flow southeast, southwest, and west. On the northeast side of the island, the current flows predominantly northeast, east, north, and west. The highest current speed is 0.65 m/s at the southeast of the island, with an average speed of 0.28 m/s. On the southwest and northeast sides, the current speeds are 0.58 m/s and 0.13 m/s, respectively.

The ocean currents around the island in the central Gulf of Tonkin follows a four-season pattern. During winter and spring, the current flows counterclockwise at an average speed of 0.3 to 0.6 nautical miles per hour. In summer and autumn, the current flows clockwise at an average speed of 0.4 to 0.8 nautical miles per hour.

Based on oceanographic data, the project has calculated and run simulation models to forecast the effects of tidal regimes under different scenarios. The research and calculations on design waves for the Bach Long Vi island area (carried out by the Institute of Structural Engineering) were done using simulations for waves with a 2% frequency; waves above level 12, and level 12, as follows:

**Design waves with 2% frequency:*

With waves coming from 90° from the east, the 2% frequency storm wave direction does not directly face the port entrance (project area), so the wave height in the harbor basin is smaller compared to cases where waves come directly into the harbor basin. The majority of the area in the harbor basin is suitable for storm sheltering, with approximately 90% of the basin area having wave heights less than 0.9 meters. When the 2% frequency storm wave direction gradually shifts south (at directions of 115°, 145°, 157°, 180°, and 225°), the wave height in the harbor basin tends to increase because the incoming wave angle directly faces the basin with less protection from the wave-breaker dikes on the north and south sides of Bach Long Vi Port. As the wave height increases in the harbor basin when the wave angle changes from east to south and southwest, the usable area in the harbor basin also tends to decrease according to the change in the incoming wave direction. Under 2% frequency storm conditions, with wave directions of 180° and 225°, wave heights in the harbor basin could exceed 1.0 meters, which would not ensure safe mooring for vessels.

Table 2.13. Extracting the Design Waves with a 2% Frequency, Existing Site Layout

Extracted point	90° direction		115° direction		135° direction		157° direction		180° direction		225° direction	
	Hs (m)	Tp (s)	Hs (m)	Tp (s)	Hs (m)	Tp (s)	Hs (m)	Tp (s)	Hs (m)	Tp (s)	Hs (m)	Tp (s)
P1	3,06	11,6	3,44	11,7	3,72	11,73	3,86	11,67	3,90	11,59	3,91	11,55
P2	2,88	11,7	3,18	11,8	3,35	11,82	3,42	11,74	3,48	11,68	3,44	11,61
P3	2,16	11,9	2,29	11,9	2,36	11,88	2,41	11,74	2,46	11,68	2,49	11,61
P4	1,80	11,9	1,86	12,0	1,90	11,87	1,93	11,71	1,97	11,66	2,02	11,59
P5	1,18	11,9	1,23	12,0	1,28	11,85	1,32	11,69	1,35	11,64	1,43	11,59
P6	3,18	11,6	3,55	11,8	3,83	11,77	4,00	11,72	4,07	11,63	3,96	11,57
P7	2,84	11,7	3,22	11,8	3,54	11,82	3,82	11,77	3,94	11,69	3,83	11,63
P8	2,30	11,8	2,39	11,9	2,45	11,89	2,48	11,84	2,49	11,75	2,40	11,69
P9	1,60	11,8	1,64	11,9	1,66	11,91	1,68	11,86	1,69	11,78	1,65	11,74
P10	1,26	11,8	1,27	11,8	1,28	11,87	1,27	11,89	1,26	11,86	1,23	11,87

* Storm waves above level 12 and level 12

Similar to the case of waves with a 2% frequency, under the conditions of storm waves above level 12 and level 12, the wave height within the harbor increases gradually as the waves shift from the eastward direction (90°) to the south (180°) and southwest (225°). This is because the storm waves from these directions can directly reach and penetrate the harbor basin through the entrance to Bach Long Vi Port.

Table 2.14. Extracting storm waves above level 12, existing site layout

Extracted point	90° direction		115° direction		135° direction		157° direction		180° direction		225° direction	
	Hs (m)	Tp (s)	Hs (m)	Tp (s)	Hs (m)	Tp (s)	Hs (m)	Tp (s)	Hs (m)	Tp (s)	Hs (m)	Tp (s)
P1	3,06	11,6	3,44	11,7	3,72	11,73	3,86	11,67	3,90	11,59	3,91	11,55
P2	2,88	11,7	3,18	11,8	3,35	11,82	3,42	11,74	3,48	11,68	3,44	11,61
P3	2,16	11,9	2,29	11,9	2,36	11,88	2,41	11,74	2,46	11,68	2,49	11,61
P4	1,80	11,9	1,86	12,0	1,90	11,87	1,93	11,71	1,97	11,66	2,02	11,59
P5	1,18	11,9	1,23	12,0	1,28	11,85	1,32	11,69	1,35	11,64	1,43	11,59
P6	3,18	11,6	3,55	11,8	3,83	11,77	4,00	11,72	4,07	11,63	3,96	11,57
P7	2,84	11,7	3,22	11,8	3,54	11,82	3,82	11,77	3,94	11,69	3,83	11,63
P8	2,30	11,8	2,39	11,9	2,45	11,89	2,48	11,84	2,49	11,75	2,40	11,69
P9	1,60	11,8	1,64	11,9	1,66	11,91	1,68	11,86	1,69	11,78	1,65	11,74
P10	1,26	11,8	1,27	11,8	1,28	11,87	1,27	11,89	1,26	11,86	1,23	11,87

Table 2.15. Extracted results of storm waves level 12, existing site layout

Extracted point	90° direction		115° direction		135° direction		157° direction		180° direction		225° direction	
	Hs (m)	Tp (s)	Hs (m)	Tp (s)	Hs (m)	Tp (s)	Hs (m)	Tp (s)	Hs (m)	Tp (s)	Hs (m)	Tp (s)
P1	3,07	10,91	3,46	11,04	3,73	10,99	3,86	10,94	3,89	10,66	3,89	10,66
P2	2,87	11,03	3,16	11,15	3,31	11,08	3,40	11,03	3,44	10,80	3,44	10,80
P3	2,13	11,17	2,25	11,25	2,32	11,13	2,38	11,04	2,44	10,76	2,44	10,76
P4	1,78	11,21	1,84	11,26	1,88	11,11	1,91	11,01	1,95	10,67	1,95	10,67
P5	1,17	11,22	1,22	11,25	1,27	11,08	1,31	10,98	1,35	10,65	1,35	10,65
P6	3,19	10,96	3,57	11,09	3,84	11,04	4,00	10,99	4,11	10,68	4,11	10,68
P7	2,84	11,03	3,23	11,14	3,56	11,09	3,83	11,03	3,96	10,79	3,96	10,79
P8	2,28	11,15	2,36	11,25	2,42	11,19	2,44	11,11	2,43	10,92	2,43	10,92
P9	1,58	11,16	1,62	11,25	1,64	11,22	1,65	11,15	1,65	11,01	1,65	11,01
P10	1,24	11,08	1,25	11,17	1,26	11,20	1,25	11,22	1,22	11,18	1,22	11,18

The calculation results for the water flow passing over the wave-breaking dike at points P1 to P10 along the dike's marine side, with the design wave values calculated using two sets of parameters: extreme waves corresponding to a 50-year return period (frequency P=2%) and simulated waves from a level 12 storm.

The wave overtopping level at the dike crest is established according to the conditions for assessing the impact on the port's water area and the safety conditions for the port's operations, including maintenance, repairs, and emergency situations. The calculation results indicate that when the dike crest elevation reaches the design height of +7.0m, the required overtopping flow rate is met, allowing ships to anchor and operate behind the wave-break dike. This safety value ensures that structures 5 to 10 meters behind the dike wall will not be damaged.

2.6.1.6. Natural resources

a. Water resources:

As an island in the Gulf of Tonkin, the fresh water supply is mainly provided by rainfall. According to the survey report by the National Water Resources Planning and Investigation Center in 2018, the natural conditions of Bach Long Vi Island are not favorable for forming freshwater on the island. The groundwater source is very poor due to the land and rocks' low water retention capacity. There are no rivers or streams with regular flow on the island. Survey results show that there are currently six small streams on the island, each less than 0.2 km in length. These streams flow from the steep slopes to the foot of the mountains, so they cannot retain water.

To store fresh water, a freshwater reservoir with an area of 40,000m² and a capacity of 60,000m³ has been built for Bach Long Vi district. This amount of fresh water meets the domestic water demand for the residents on the island. In 2022, Hai Phong City constructed and put into operation a clean water supply station on Bach Long Vi Island with a capacity of 15m³/hour, sufficient to provide fresh water for the residents on the island and partially for fishing vessels.



Figure 2.19. Freshwater reservoir with a capacity of 45,000 m³ and the water supply plant for the residents of Bach Long Vi Island with a capacity of 15m³/hour.

b. Mineral resources:

The mineral resources on the island have little exploitation value.

c. Biological resources:

The Bach Long Vi Marine Protected Area was established according to Decision No. 2630/QĐ-TTg, with a total area of 27,008.93 ha. This includes a strictly protected area of 2,570.15 ha, an ecological restoration area (buffer zone) of 4,599.96 ha, a development zone of 6,887.44 ha, the marine area outside the protected area of 9,673.55 ha, and a protective belt of 3,277.84 ha. The protected area encompasses the entire Bach Long Vi Island and extends into the surrounding marine area. The project area is located in the Bach Long Vi port area, and the three waste disposal sites fall within the development zone, approximately 50 to 100 meters from the marine ecological restoration area.

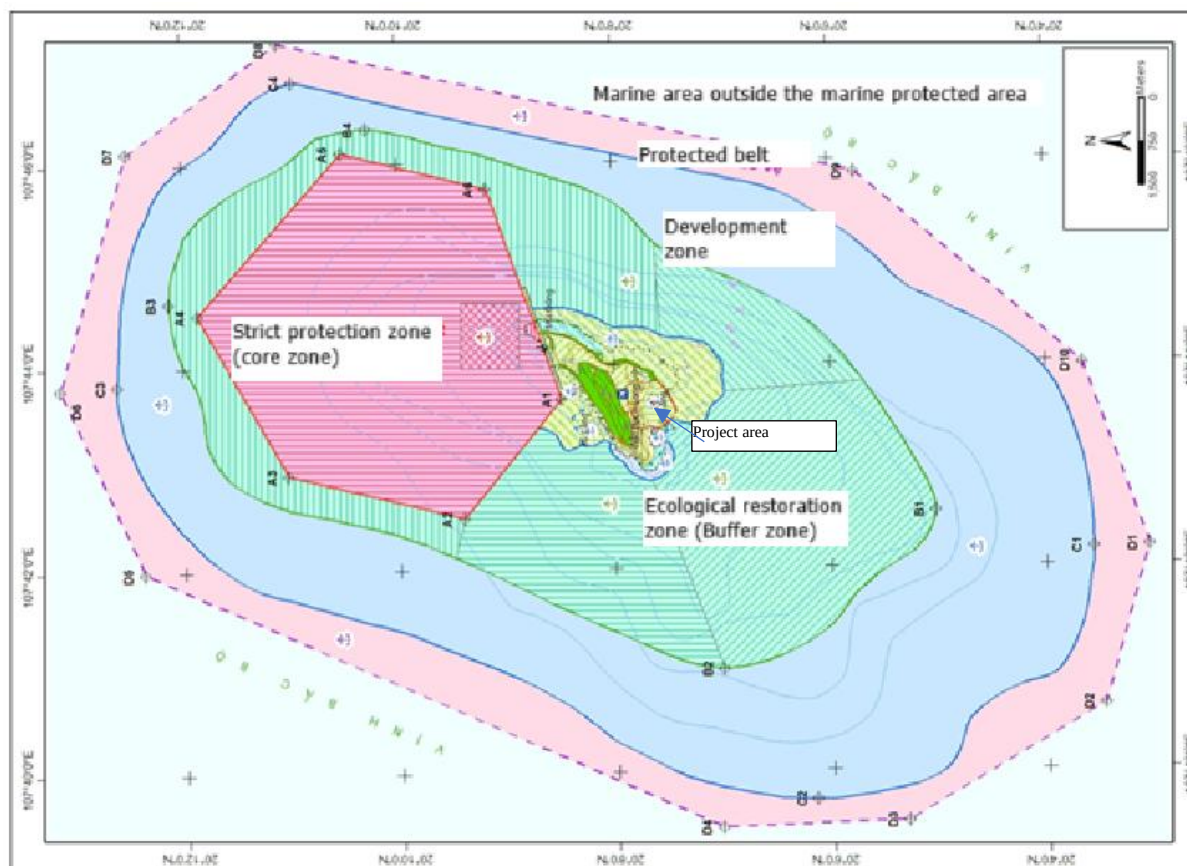


Figure 2.20. Map of the project location within the overall planning of the Bach Long Vi Marine Protected Area.

According to the study by authors Bui Duc Quang and Ha Quy Quynh on biodiversity on Bach Long Vi Island in 2013, there are three typical ecosystems on Bach Long Vi island: the island forest ecosystem, the intertidal zone ecosystem, and the subtidal ecosystem around the island.

- **Island forest ecosystem:** This ecosystem has a small area and is characterized by regenerating forests in the form of low shrubland and grassland, with small trees about 6-7m high, low density, and canopy coverage of 70-80%. The plant species on the island consist of 281 species from 229 genera and 111 families, with over 150 species being cultivated plants. The animal life on the island is limited due to its small size and geographic isolation, with 74 bird species, 16 mammal species, 15 reptile species, and 5 amphibian species.



Figure 2.21. Terrestrial ecosystem and intertidal zone around bach long vi island
(Source: <https://bachlongvy.haiphong.gov.vn/>)

- The intertidal zone ecosystem around the island includes the beach sand ecosystem, rocky intertidal ecosystem, and a relatively insignificant mangrove forest ecosystem. The groups of organisms distributed around Bach Long Vi Island include: floating plants, plankton, benthic animals, seaweed, corals, marine fish, mollusks, arthropods, echinoderms, sea cucumbers, and annelids.
 - + The sandy intertidal ecosystem is primarily inhabited by benthic animals (16 species), mollusks (4 species), and arthropods (12 species).



Figure 2.22. Sandy intertidal zone at bach long vi island

+ The Pebble intertidal ecosystem and the Rocky reef-coral ecosystem have a more diverse distribution of organisms, comprising 11 groups of species. In terms of aquatic biodiversity, the reef-coral ecosystem has a higher species diversity compared to the pebble-rock intertidal ecosystem (see the table below).

Table 2.16. Biodiversity of the intertidal zone ecosystem at Bach Long Vi island

Scientific name	Group of organisms	Sandy tidal flat		Cobble tidal flat		Coral reef tidal flat	
		family	species	family	species	family	species
Phytoplankton	Thực vật nổi (chi)	0	0	26	97	51	227
Zooplankton	Động vật nổi	0	0	12	30	33	110
Zoobenthod	Động vật đáy	8	16	26	49	60	132
Marine Algae	Rong biển	0	0	10	10	17	46
Anthozoa	San hô	0	0	0	0	12	94
Pisc	Cá biển	0	0	21	65	105	451
Mollusca	Thân mềm	2	4	12	31	40	97
Arthropoda	Chân khớp	6	12	7	15	10	22
Echinodermata	Da gai	0	0	2	2	5	7
Annelida	Giun đốt	0	0	2	2	4	5
Sipuncula	Sá sùng	0	0	1	1	1	1

Source: Biodiversity analysis report on Bach Long Vi Island, Journal of Biology, 2013



Figure 2.23. Rocky intertidal zone at bach long vi island, about 1 km from the project site

- The subtidal ecosystem: includes coral reefs, hard-bottom habitats, and soft-bottom habitats. Among these, coral reefs and hard-bottom ecosystems play a crucial role. The marine vegetation of Bach Long Vi Island consists of 274 species, with phytoplankton being the most abundant group, followed by seaweed. The marine animal ecosystem consists of 738 species, with fish being the most numerous, followed by benthic animals and plankton (110 species), and corals (94 species across 27 genera and 12 families). These organisms are primarily distributed in the northwest of the island (81 species), with a gradual decrease as you move towards the other sides of the island (the south side recorded only 16 species, covering just 2.6%). Many of these species hold significant economic value (especially species like abalones, whose production reached up to 50 tons in certain years, but has decreased to only a few tons in recent years due to overexploitation).

In addition to the classification based on ecosystem types, Bach Long Vi Island also contains some distinctive ecosystems, including:

- Coral reef ecosystems: The Bach Long Vi MPA is less affected by the mainland, which results in clear water. The seabed near the island mainly consists of rocks and sand, creating an ideal environment for the development of rich coral reefs with high coverage and large areas. These coral reefs serve as the habitat for many marine organisms, including crustaceans, mollusks, echinoderms, etc., many of which have economic value. These species are listed among the 22 rare and endemic species of Bach Long Vi MPA, such as: abalone, female and male top shells, sea cucumbers, squid, fish, lobsters, and especially the

Tectus pyramis, pearl oysters (*Pinctada martensii*), *Turbo marmoratus*, *Panulirus ornatus*, *Panulirus longipes*, and small *Ovula costellata*, which are included in the Red Book of endangered species. In addition, the coral reefs of Bach Long Vi also serve to protect and enhance the coastline and provide potential sites for future underwater ecological tourism.

- Recent research on the coral reef ecosystem around the island indicates the discovery of 94 species of hard corals from 28 genera and 12 families, which, although quite diverse, represent only about 47.2% of the coral species recorded in Vietnam.



Figure 2.24. Coral ecosystem in the waters around Bach Long Vi island
(Source: <https://bachlongvy.haiphong.gov.vn/>)

- Mangrove vegetation on Bach Long Vi Island consists of 17 species (salt-tolerant species) distributed in the high and intertidal zones, including inland groups (mangrove family, rice field family, sea spinach family) and some foreign species. The southern sandy bottom of the island is primarily covered with sea spinach and rice grass, while the western rocky ground has wild pineapples, cacti, and wild grass.

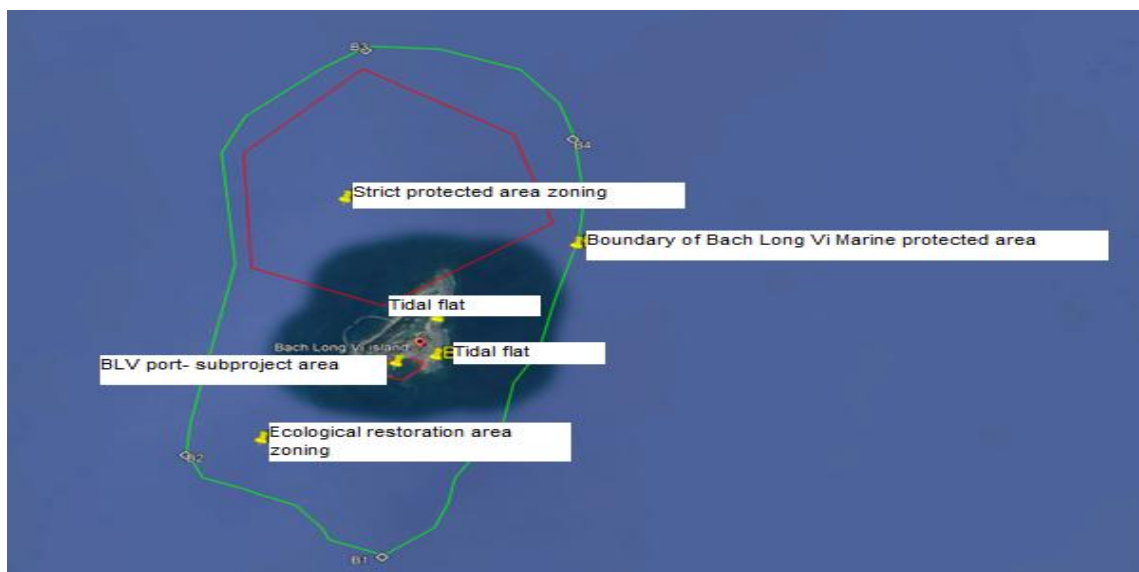
For the project construction area and the dredged material disposal sites 01 and 02 (located in the intertidal zone), the biodiversity of these ecosystems is as follows:

- Benthic animals: Surveys conducted in 2017 and 2018 recorded a total of 94 benthic species in the intertidal zone. The areas near dredged material disposal sites 1 and 2 recorded between 37 and 45 species. This area also hosts several species that are included in the conservation list, such as abalone, male and female top shells, sweet-scented top shell, and several other rare and valuable species.
- Plants: A total of 25 species of seaweed were recorded in the Bach Long Vi MPA, distributed across all intertidal zones. Among them, two species of seaweed are listed as endangered and need protection, such as *Caulerpa* and *Codium*, which are also found in areas near dredged material disposal sites 01 and 02.
- Coral: Research by the Bach Long Vi MPA Management Board has shown that coral diversity and coverage near the disposal sites are around 19%. Specifically, coral ecosystems near disposal site 01 recorded 40 species, with a coral cover of approximately 19%. Near disposal site 02, 39 coral species were recorded with a coral cover of around 27.5%.

Distance from ecosystems to the construction site locations:

The construction site for the fishing port and storm shelter for Bach Long Vi's fishing vessels, as well as the three planned disposal sites, are all located within the boundaries of the Bach Long Vi Marine Protected Area and within the development zone¹³. However, the construction areas and two dredged material disposal sites (01 and 02) are very close to the restoration zone. Therefore, the construction process may have an impact on the local ecosystems. The specific distances from these ecosystems to the construction sites are as follows:

- Forest ecosystem on the island: the distance from disposal site 2 to the island's forest ecosystem is about 10-20 meters (separated by 5A road).
- Sandy intertidal ecosystem: Disposal site 2 directly adjoins the sandy intertidal ecosystem on the west-northwest of the island. The sandy intertidal zone is approximately 50 meters wide along the coastline.
- Rocky intertidal ecosystem: Disposal site 1 is within the rocky intertidal zone, which is part of the Bach Long Vi Marine Protected Area's development zone. Disposal site 2 is about 50 meters away from the rocky intertidal ecosystem (separated by the sandy intertidal zone).
- Coral reef ecosystem: Disposal site 1 is about 150-200 meters away from the coral reef ecosystem, which is within the intertidal zone. Disposal site 2 is approximately 100 meters from the intertidal zone.



Therefore, to manage and minimize the impact on the ecosystem and local environment, the project owner and contractors must implement specific measures, which will be detailed in Chapter 4 of the report.

2.6.1.7. Natural disasters

Bach Long Vi Island, located in the Gulf of Tonkin, is directly affected by storms and tropical depressions from the East Sea (South China Sea) that make landfall in the Gulf of Tonkin.

¹³ According to Clause 9, Article 3 of Decree 26/2019/ND-CP, the ecological restoration zone of a marine protected area is defined as a sea, island, archipelago, or coastal area designated for the implementation of activities to restore and regenerate aquatic animal and plant species, as well as natural marine ecosystems.

On average, 1 to 2 storms pass over the island each year. The typhoon season usually begins in June and ends in October, with the highest frequency of storms occurring in July, August, and September. The strongest winds from these storms can reach up to 50 m/s. Thunderstorms occur an average of 2 to 3 days per month, mainly in August and September (with an average of 4 storms per month). Thunderstorms are absent in December.

The average number of foggy days is 24 days per year, concentrated in the winter season (5 - 10 days per month). Each winter, around 30 cold northeast monsoon periods pass through, with wind speeds reaching levels of 9 or 10 on the Beaufort scale. In some months, there are 3 to 5 such periods, with the highest occurring in months with 5 to 6 periods.

In 2024, Typhoon No. 3 made landfall and passed over Bach Long Vi Island, with winds reaching up to level 13, gusting to level 14. This caused damage to the island's infrastructure, with some trees being uprooted and several buildings sustaining roof damage, despite being securely tied down. During this typhoon, Bach Long Vi also sheltered 101 vessels from the storm.

2.6.2. Existing environmental quality in the subproject area

To assess the baseline environmental quality in the area, the project owner collaborated with the environmental monitoring unit, the Center for Analysis and Technology Transfer in Environmental Technology under the Institute of Agricultural Environmental Science (VIMCERTS 082 certification), to conduct surveys, measurements, and sample collection for environmental analysis in the project area. Environmental sampling took place on January 20, 2024. Information regarding the sampling locations within the subproject is as follows:

Table 2.17. Information on the monitoring locations within the Bach Long Vi subproject.

No	Environmental composition	Number of sample	Parameters	Symbol and description of sampling location
1	Air, noise	01	Carbon monoxide (CO), sulfur dioxide (SO ₂), nitrogen dioxide (NO ₂), total suspended particles (TSP), lead (Pb), noise, temperature, humidity, wind speed, and wind direction	Bach Long Vi Port Area Symbol: HP-KXQ
2	Sea water	03	pH, TSS, Ammonia (NH ₄ ⁺ -N), Nitrite (NO ₂ -N), Cyanide (CN ⁻), Copper (Cu), Lead (Pb), Cadmium (Cd), Arsenic (As), Total Chromium (Cr), Total Oil and Grease, Total Phenols, Surfactants, Organic Chlorine Pesticides (Heptachlor, Dieldrin), Organic Phosphorus Pesticides (Chlorpyrifos, Diazinon).	Sea water, fishing port area, storm shelter anchorage for fishing boats in Bach Long Vi Symbol: from HP-NB1 to HP-NB3
3	Groundwater	01	pH, TSS, Ammonia (NH ₄ ⁺ -N), Nitrate (NO ₃ -N), Chloride (Cl ⁻), Copper (Cu), Lead (Pb), Cadmium (Cd), Arsenic (As), Total Chromium (Cr).	Well water at Bach Long Vi Island; Symbol: HP-NN1.
4	Wastewater	03	pH, TSS, Total Oil and Grease, Ammonia, Nitrate, Lead (Pb), Cadmium (Cd), Arsenic (As), Copper (Cu), Zinc (Zn), Manganese (Mn),	Wastewater at the Bach Long Vi fishing port area Symbol: from HP-NT1 to

No	Environmental composition	Number of sample	Parameters	Symbol and description of sampling location
			Total Chromium (Cr), Total Phenols, Surfactants.	HP-NT3.
5	Soil	01	Arsenic (As), Cadmium (Cd), Lead (Pb), Chromium (Cr), Copper (Cu), Zinc (Zn).	Bach Long Vi Port area; Symbol: HP-D1.
6	Sediment	03	Arsenic (As), Cadmium (Cd), Lead (Pb), Chromium (Cr), Copper (Cu), Zinc (Zn), Total Nitrogen (N), Total Phosphorus (P), Organic Carbon, Organic Chlorine Pesticides, Organic Phosphorus Pesticides.	Fishing port area, storm shelter anchorage for fishing boats in Bach Long Vi; Symbol: from HP-TT1 to HP-TT3.
7	Dredged material	14	Arsenic (As), Cadmium (Cd), Lead (Pb), Zinc (Zn), Total Chromium (Cr), Copper (Cu), Total PCB, Organic Chlorine Pesticides, Organic Phosphorus Pesticides, Polycyclic Aromatic Hydrocarbons (PHA).	Fishing port area, storm shelter anchorage for fishing boats in Bach Long Vi; Symbol: from HP-CNV01 to HP-CNV03.

Map of sampling location for baseline environmental quality under Bach Long Vi subproject as follows:



Figure 2.25. Map of sampling location for baseline environmental quality under Bach Long Vi subproject

The results of the environmental quality monitoring are presented in Appendix 3.

The monitoring results are evaluated as follows:

2.6.2.1. Existing air quality and noise status

The project conducted air quality and noise monitoring at the Bach Long Viport area (1 sample), where the project construction works are being carried out. The results of the monitoring and analysis show that the monitored parameters, including CO, SO₂, NO₂, TSP, Pb, and noise, all fall within the allowable limits according to QCVN 05:2023/BTNMT: National Standards for

Ambient Air Quality (average over one hour). This result indicates that the surrounding air quality at the project site areas is still very good.

2.6.2.2. Existing ground water quality status

To assess the quality of underground water in the project construction area, the project carried out monitoring and took one groundwater sample from Bach Long Vi island. The analyzed parameters included: pH, TSS, NH₄⁺, NO₃⁻, Cl⁻, Cu, Pb, Cd, As, and Total Chromium.

The analysis results show that the analyzed parameters all fall within the allowable limits according to QCVN 09:2023/BTNMT. This indicates that the groundwater quality on the island is quite good.

2.6.2.3. Existing wastewater quality status

The project conducted monitoring and analysis on three wastewater samples taken from the Bach Long Vi Fishing Port area. The analysis results show that the wastewater parameters, such as pH, TSS, total oil and grease, ammonium, nitrate, lead (Pb), cadmium (Cd), arsenic (As), copper (Cu), zinc (Zn), manganese (Mn), total chromium (Cr), total phenols, and surfactants, all fall within the allowable limits according to QCVN 14:2008/BTNMT - National Technical Regulations on Domestic Wastewater Quality, Column B. For the Cyanide (CN⁻) parameter, sample NB1 showed 0.007mg/l; sample 1 < 0.001mg/l, and sample 33 showed 0.009mg/l, all of which are well below the allowable limits (0.01mg/l).

2.6.2.4. Existing seawater quality status

The project collected three seawater samples around the Fishing Port area (where the project construction works are taking place) to analyze parameters (pH, TSS, Ammonium (NH₄⁺-N), Nitrite (NO₂⁻), CN⁻, Cu, Pb, Cd, As, Total Chromium, Total oil and grease, Total phenol, Surfactants, Chlorine-based organic pesticides (Heptachlor, Dieldrin), Phosphorus-based organic pesticides (Chlorpyrifos, Diazinon)). The analysis results show that most of the parameters are below the allowable limits according to QCVN 10:2023/BTNMT - National Technical Regulations on Seawater Quality, except for the Ammonium (NH₄⁺-N) parameter, which exceeded the standard (sample NB1 exceeded by 1.43 times; sample NB3 exceeded by 2.23 times). The total mineral oil in samples sample NB1 and sample NB2 matched the allowable limits (0.5mg/l). The seawater quality in the area is considered quite clean.

2.6.2.5. Soil quality

With one soil sample taken from the Bach Long Viport area, the analysis of heavy metal parameters (As, Cd, Pb, Cr, Cu, Zn) shows that all of them fall within the allowable limits according to QCVN 03:2023/BTNMT - National Technical Regulations on Soil Quality. This indicates that the soil quality in the project area is still quite good, with no signs of contamination by heavy metals.

2.6.2.6. Existing sediment quality in the dredging area

As described, the project will dredge the sediment layer in the port area to create a shelter for boats and ships and to form the navigation channel for ships entering and leaving the port. Therefore, the project took 14 sediment samples from 14 different positions in the existing Fishing Port area to analyze environmental parameters: Arsenic (As), Cadmium (Cd), Lead (Pb), Zinc (Zn), Total Chromium (Cr), Copper (Cu), Total PCB, Chlorine-based pesticides, Phosphorus-based pesticides, Polycyclic Aromatic Hydrocarbon (PAH) compounds.

The analysis results show that the dredged sediment in the area is mainly composed of sedimentary rock and sand, resulting from the long-term sheltering activities of fishermen. The

analysis results show that the concentrations of heavy metals in the sediment in the area are much lower than the allowable limits specified in the National Technical Regulations on Sediment Quality (QCVN 43:2017/BTNMT). The dredged sediment is considered non-hazardous and free from toxic contamination such as heavy metals.

In addition, in March 2025, the project also collected two additional sediment samples from the Bach Long Vi port area and conducted supplementary analysis for cyanide parameters. The analysis results indicated that cyanide (CN⁻)^(a,b) was not detected in the analyzed samples.

Therefore, disposing of the dredged materials in disposal sites will not pose a significant risk of spreading pollutants to the surrounding environment. However, since the disposal sites are often affected by tides (sites 01 and 02), the project will implement specific measures, such as building embankments around the sites to prevent tidal water from washing materials out to sea, thus increasing turbidity and affecting marine life in the coastal area and the ecosystems within the Bach Long Vinature reserve.

2.6.3. Socio-economic conditions

2.6.3.1. Economic development conditions

a. Existing land use status

Bach Long Vi is the most remote island of Vietnam in the Gulf of Tonkin, with a total area of 307.02 ha. The land use structure is as follows:

- Agricultural land: 14.53 ha, accounting for 3.84%, of which 0.61 ha is land for other annual crops, 13.58 ha is protective forest land, and 0.33 ha is aquaculture land. There is no rice-growing land on the island.
- Non-agricultural land: 181.05 ha (60.05%), including 114.27 ha of defense land; 2.95 ha of non-agricultural production facilities; 29.11 ha for infrastructure development; 2.6 ha of rural residential land; 28.06 ha of specialized water land.
- Unused land: 111.44 ha, accounting for 36.11%

Currently, there is no rice cultivation land on Bach Long Vi island. The area for aquaculture at the beginning of 2024 is 0.33 ha, but according to the plan, by the end of 2024, there will be no aquaculture area remaining.

b. Economic development

According to the 2024 report on the implementation of socio-economic tasks, targets, and solutions for socio-economic development in 2025 by the People's Committee of Bach Long Vi District, the economic development results for 2024 are as follows:

*The total production value of all economic sectors in 2024 is estimated at 467.19 billion VND, an increase of 8.97% compared to the same period in 2023, broken down as follows:

- Industrial and construction sector: 178.05 billion VND, an increase of 5.23% compared to the same period. Construction projects and investment works in the district have been accelerated. Some local units have invested in building, repairing, and upgrading headquarters and defense-related facilities; electricity production has been promoted with diesel generators, wind energy, and solar power systems; the mechanical repair business has been maintained.
- Service sector: 276.6 billion VND, an increase of 11.67% compared to the same period. The total retail sales are estimated at 56.2 billion VND, achieving 107.66% of the annual plan, an increase of 11.51% compared to the same period, primarily driven by the revenue from seafood purchasing vessels, fishing services, essential goods services for

island residents, and offshore vessels; hospitality services' revenue is estimated at 9.87 billion VND, achieving 109.67% of the annual plan, up 13.45% compared to the same period.

- Agriculture and aquaculture sector: 12.54 billion VND, an increase of 5.91% compared to the same period. Agriculture contributed 3.77 billion VND, focusing on livestock and vegetable cultivation, providing basic food needs for officials, soldiers, and island residents; aquaculture contributed 8.77 billion VND, an increase of 4.4% compared to the same period.
- Tax revenue: The total tax revenue in 2024 is estimated at 1.408.85 billion VND, including 650 million VND from taxes, meeting 100% of the plan; 484.1 million VND from port and shelter service fees; and 274.75 million VND from 10 administrative penalty cases.

*The total investment capital attracted in 2024 is estimated at 158 billion VND, achieving 100.64% of the plan. The average income per person in the district is 112.394 million VND per year. The poverty rate in Bach Long Vi is 0%

2.6.3.2. Social development conditions

a. Population and residential status

According to the statistics from the People's Committee of Bach Long Vi district, in 2023, with a total area of 307.02 ha, the total population is 1,157 people, with 326 households, primarily engaged in fishing and fishing services. During stormy days, when boats seek shelter, the population on the island increases to 2,000-3,000 people.

The district's population structure is as follows: 662 males and 495 females, with a population density of 377 people per hectare. The population on the island is very young, with the average age of the residents in the district being under 40 years old.

b. Social and environmental development conditions:

The report on the implementation of socio-economic tasks in 2024, as well as the targets, tasks, and solutions for socio-economic development in 2025 by the Bach Long Vi District People's Committee, indicates that in 2024, the social-environmental indicators for the island district showed an increase compared to the same period in 2024. Specifically:

- The natural population growth rate is stable at 0.51%; there are no poor households, and 50% of the population participates in health insurance.
- Employment is maintained at 95%, with more than 90% of workers having received training.
- Currently, 100% of the residents on the island have access to hygienic water; the rate of collected and treated household waste reaches over 98%. The criteria for building the new rural district have been completed.

2.6.3.3. Survey Results of Affected Households:

As described in Chapter 1 of the report, the construction area of the Bach Long Vi sub-project is entirely within the boundary of the existing fishing port land, with no residents living within the port area. This indicates that no households are directly affected by the project construction activities, and therefore, no survey of affected households was conducted.

2.6.4. Technical infrastructure conditions in the subproject area:

2.6.4.1. Transport system:

The transport system on Bach Long Vi Island is relatively complete, with the central road of the island (administrative area) at an elevation of +18.0 to +22.0 m; it is 3,580 m long, with a road width of 6-7 m and sidewalks of 1-2 m. The coastal road around the island, including routes 5A, 5B, and 5C, has an elevation of +4.5 to +8.0 m, a total length of 6,280 m, a road width of 3.5 m, and a sidewalk width of 1.5 m, with a cement structure.

Additionally, there are connecting roads between the central axis and the coastal road, as well as internal roads in residential areas. The road sections have a width of 3.5 m, with sidewalks of 1.5 m, and the structure is made of concrete.

The 2024 report on the verification of the rural development standards for Bach Long Vi District shows that the total length of the district's roads is 16.69 km. 100% of the district's roads ensure year-round access for vehicles and connectivity to the district's administrative center. The percentage of paved and concrete roads is 100%, and the greenery along the roads covers 64.05% (10.69 km).

Regarding the transportation route for construction materials, due to the project's location on an island in the middle of the East Sea, the contractor will purchase materials from suppliers based in Hai Phong City and transport them by sea from Dinh Vu Port (Hai Phong City) to the island, covering a distance of approximately 170 km. Transportation will be carried out by ship or barge and managed by the supplying unit.

2.6.4.2. Water supply system:

The water supply for the island currently relies mainly on rainwater and a newly built freshwater reservoir on the island. To provide drinking water for the residents, Hai Phong City has built a water supply system with a capacity of 300m³/day, sufficient for the entire population. The complete water supply system includes a raw water extraction station, a clean water treatment station, a network of water pipes to households, and services for the fishery sector on the island.

The water supply pipes are installed from pumping stations to various facilities and households. The main water supply pipes are combined with fire-fighting pipes, installed along the sidewalks at an average depth of 1 m. Fire hydrants are placed at road intersections.

Currently, 100% of the households on the island have access to clean water from the centralized supply system.

2.6.4.3. Solid waste collection and treatment system:

- Solid waste collection and transportation system: The district has established and maintained an effective waste collection team for residential areas, with one team and one collection vehicle. The formation and effective operation of these teams in residential areas, along with the mobilization of the entire population to participate in environmental protection and cleaning activities during major holidays and industry anniversaries, has been successful. Since 2024, the district has implemented a model for waste segregation at the source and converting organic waste into compost at the household level, expanding the model throughout the district. As of now, the generated solid waste is 1,642 tons/year, and the collected and treated waste is 1,609 tons/year, achieving a rate of 98%.

- Waste segregation at the source: According to the statistics from the Bach Long Vi District People's Committee, in 2024, the district conducted training and deployed a waste segregation model, and currently, 54.55% of households (126/231) practice waste segregation at the source. The district is continuing efforts to raise awareness among residents to increase the percentage of households participating in waste segregation.

- Plastic waste collection model: The district has also launched a plastic waste and recyclable material collection model, aiming to generate funds for local organizations and schools.

Through this model, the amount of plastic waste generated in the area has significantly increased in terms of collection, reuse, recycling, and processing according to regulations. Currently, 98.29% of the plastic waste (about 468 tons/year) generated in the district is collected, reused, recycled, or processed according to regulations.

-Waste treatment: The waste generated after segregation is collected and transported to the district landfill for disposal by landfilling. The landfill is located far from residential areas and covers 5,000 m². It is enclosed with walls and planted with green trees to limit environmental impacts. The site is treated weekly with deodorizing chemicals and insecticides, and it is leveled and covered with soil twice a month to ensure hygiene and compliance with regulations.

2.6.4.4. Electricity and communications system:

According to the 2024 report on the verification of rural development standards for Bach Long Vi District, Hai Phong City, the electricity and communications system on Bach Long Vi Island has been developed according to planning and meets the technical requirements of the system, supplying power for all production and daily activities of the island residents. Specifically:

-Electricity supply: In 2020, the Northern Power Corporation invested in a wind power system with a capacity of 1 MW and a solar power farm with an installed capacity of 504 kWh. It also installed 2 new 1,000 KVA generators, 1 containerized battery storage system of 504 kVA/2000 kVAh, new 0.4 kV distribution cabinets, and a microgrid system. The entire system was put into use at the end of 2021 and the beginning of 2022, managed by Hai Phong Power Corporation, and ensures that it meets the needs of residential, service, and production activities on the island, supporting the development of light industries, fisheries, and tourism.

-Statistical results show that currently, 100% of the households on the island are connected to the electricity grid and use electricity regularly from the island's system.

During the construction and operation of the Bach Long Vy subproject " electricity supply will also be sourced from the existing power system on the island.

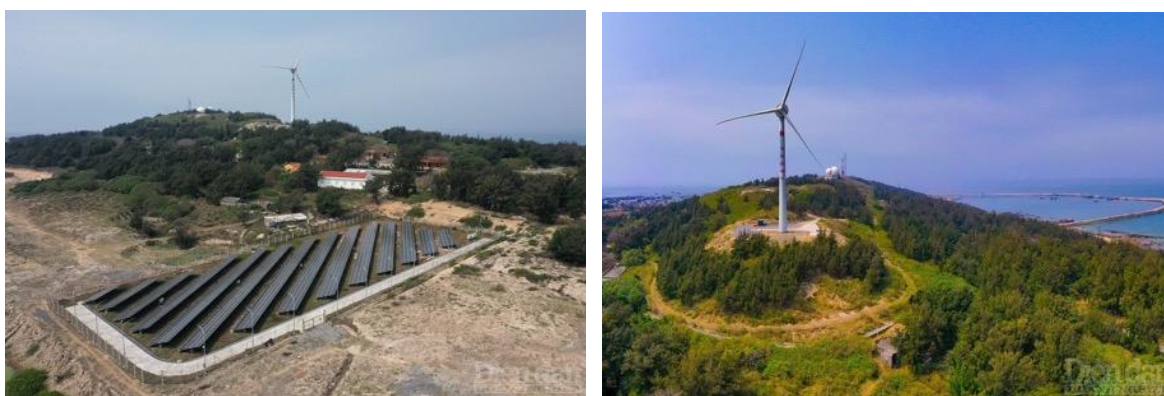


Figure 2.26. Solar and wind power facilities installed on the island

2.6.4.5. Drainage and Wastewater Treatment Conditions

The drainage system on the island was constructed using a combined drainage system (for both rainwater and wastewater) and is divided into two drainage basins: the Northeast basin and the Southwest basin.

- Northeast basin: The drainage system has been constructed, including two wastewater treatment tanks, a drainage channel with manhole covers in the central district area, the fishing logistics area, and residential areas. These areas are connected to the two treatment tanks and

the water is then discharged into the sea. In some areas outside the central district and residential zones, drainage systems have not yet been built. Rainwater flows naturally along the roadsides at the foot of the mountains, either infiltrates into the ground or flows into the sea.

- Southwest basin: Rainwater is collected through the drainage system and directly discharged into the sea.

For domestic wastewater, all wastewater generated from households and government agencies in the district is treated using septic tanks at the household level and then flows into the area's combined drainage system, which eventually leads to the sea. In the near future, the People's Committee of Bach Long Vi district will continue to invest in, improve, and upgrade the collection and drainage system. At the same time, the application of centralized and decentralized domestic WWTP and methods will be encouraged for better efficiency.

2.6.4.6. Existing status of Bach Long Vi port and storm shelter

The existing Bach Long Vi Port and storm shelter were built according to Decision No. 1689-QĐ/XDCB dated October 12, 1995, by the People's Committee of Hai Phong City. In 2001, the construction was completed, inspected, and handed over for use.

- The dock area (docking zone) is 7.4 ha in size, with an average depth of 3.5 meters; it serves as a shelter for about 200-300 fishing boats to avoid storms. The capacity is 20-300 boats up to 1000CV.
- Currently, approximately 8,000 to 9,000 ship arrivals and docking events are organized annually.
- The average annual cargo throughput at the port is between 15,000 and 20,000 tons. The port generates fees ranging from 450 million to 500 million VND annually.

In addition, the existing fishing port also serves as a shelter for boats during storms, and according to the planning, it is classified as a type 1 fishing port, while the docking area is planned as a regional-level docking area. However, the water depth, wave conditions within the dock, as well as the anchorage points and mooring buoys, mean that the current Bach Long Vi docking area cannot ensure safety for vessels seeking shelter during storms with winds exceeding level 8 (boats are required to move to land or the Cat Ba docking area to shelter). Therefore, the area does not meet the requirements for a regional-level fishing boat docking shelter and a type 1 fishing port.

The total area of the docking basin within the quay is about 28.5 ha, but the area suitable for docking ships of 90CV and above is only about 7.4 ha (26% of the total area), concentrated near the entrance of the dock. As a result, the number of ships and their docking capacity is limited, and the utilization of the dock is low. The dock has about 180 meters of quay (equivalent to approximately 4-5 ship docks) and one inclined quay. These quays serve fishing vessels, passenger ships, and naval vessels, so they do not meet the planned cargo volume requirements (fishing vessels up to 1,000 CV cannot dock; the docking capacity is insufficient for 100 ship movements per day and 10,000 tons of seafood per year).

The mooring buoys are few and mostly concentrated in the waters near the entrance to the dock, where the water depth is sufficient for mooring. The capacity for mooring ships is still limited, and some of the buoys are deteriorating.

The southeastern breakwater has a crest elevation of approximately +6.9m, with the top surface at around +4.70m. The southwestern breakwater crest elevation is +4.7m (nautical chart datum). Combined with the gate opening directly facing the sea, during storms—especially when accompanied by rising water levels and high tides—waves can overflow the breakwater crest and enter the harbor basin. Waves also pass through the gate into the basin (due to lack of

shielding), resulting in significant wave activity inside the basin, posing danger to vessels anchored for storm shelter. Therefore, when strong storms above level 8 occur, vessels are required to relocate to the mainland for safe anchorage.

2.6.5. Site-specific environmental and social conditions

The subproject is planned with a total land area of 34.61 ha, of which 29.48 ha will be used for the construction of subproject’s investments, and 5.13 ha are designated for three waste disposal sites.

- The land allocated for the construction of subproject investments (29.48 ha) is currently non-agricultural land (including 0.42 ha for public use, with the rest being water area used as a port, access areas, mooring, and storm shelter for ships, surrounded by a wave barrier and a ship entrance channel). The basin (docking area) is about 150-800m wide, and the entrance channel is approximately 80m wide. The basin is surrounded by a protective embankment, with a concrete road on top. Since the port and docking area have been in use since 1992, the docking basin has suffered from serious sedimentation and needs to be upgraded and dredged to facilitate safe and efficient passage for ships seeking shelter during storms. The entire area is within the jurisdiction of the Bach Long Vi fishing port and the docking area for fishing boats and is managed by the Bach Long Vi Port Management Board, so no households need to be relocated or displaced.

The Bach Long Vi island residential area is not within the project area and is about 80 meters away from the project site.

- As for the three waste disposal sites covering an area of 5.13 ha (managed by the People's Committee of Bach Long Vi district and approved by Hai Phong City People's Committee for waste disposal according to Decision No. 2397/UBND-MT dated October 30, 2024), site No. 01 is 4.0 ha, located between the coastal road of Bach Long Vi island and a small part of the tidal sand beach to the East of the Island, adjacent to the sea. The disposal site No. 02 covers 0.48 ha and is located to the Southwest between the coastal road and the planting area. Disposal site No. 03, covering 0.65 ha, is located in the center of the island.

 <i>Location of residential area adjacent to the subproject construction area and material transportation route from construction site to the disposal site No. 01</i>	 <i>Port entrance</i>



Figure 2.27. Diagram of the location of residential areas, the port, and the dike surrounding Bach Long Vi port.

The entire construction area of the project is within the Bach Long Vi port area and the three waste disposal sites currently planned, all of which are part of the development zone of the Bach Long Vi MPA. Among them, disposal site No. 01 and 02 are located close to the tidal flats, about 50 to 200 meters away from the marine ecological restoration area.

- Disposal site No. 01: Located next to the road on the east side of the island towards the sea, it is in the pebbly tidal zone with a bedrock foundation, no vegetation cover, and is 1.2 to 1.5 meters lower than the road level. It only floods during high tide. This area has low conservation value due to infrequent flooding and the lack of vegetation. Thus, the use of dredged waste from the fishing port, mostly weathered rock, to raise the current ground level is in line with the planning. Raising the ground level in this area will also expand the protective corridor for the residential area and the headquarters of the agencies and units on the island from the impact of waves during high tide or storms.
- Disposal site No. 02: Located outside the sea dike, next to the southern dike slope, approximately 800 meters away from the project site, covering an area of about 0.48 ha. This area is less affected by tidal flooding (only floods during high tide) and is about 100 meters away from the regularly flooded tidal zone. Waste Disposal Site No. 01 is directly adjacent to the sandy tidal flat (about 50 meters wide along the coastline), and outside the sandy tidal flat is a rocky tidal zone.
- Site No. 03 is a vacant land area of 0.65 hectares, located in the central part of the island, near the stadium and the district's centralized domestic waste landfill, approximately 0.7 km from the dredging area

According to the Bach Long Vi Marine Protected Area Management Board, the strictly protected area of the Bach Long Vi Marine Protected Area is located in the northern sea area of Bach Long Vi island. However, the project area is situated in the southwest of the island, about 2 kilometers away from the strictly protected area. In the strictly protected area, vessels are not allowed to anchor, and fishing activities are prohibited (see Figure 2.3).

2.6.6. Sensitive receptors under the subproject area

The survey results for the project area show that sensitive receptors (PCR: temples, shrines, graves, churches) within and around (300-meter radius) the project area include: Bach Long Vi Pagoda, Tran Hung Dao Temple, Whale Temple, and the Memorial to Fallen Soldiers. The locations of these PCR points are illustrated in the figures and tables below.



Figure 2.28. Diagram of the location of PCR points around the subproject area

Table 2.18. Sensitive receptors around the Bach Long Vi subproject area

No.	Sensitive receptor	Description
1	The tidal flat is located about 500 meters from the fishing port area and approximately 20 meters from disposal site 1. 	- The tidal flat is regularly submerged during high tide and exposed during low tide. - It is located approximately 500 m from the fishing port and 20 m from Disposal Site No. 01. - The flat has an average width of 30 m and stretches along the island's coastal road from the port toward the northern part of the island.
2	Bach Long pagoda, 180m from the subproject area 	- Bach Long Pagoda covers an area of 1,000 m² and was built in 2008 as a spiritual site for island residents. - It is frequently visited by locals and tourists, especially on the 1st and 15th days of the lunar month and during holidays. - The pagoda is located about 180 m from the port and lies next to the transport route for dredged materials to Disposal Site No. 02. - Transport activities may generate dust and noise, potentially disrupting worship and visitation during key lunar days.
3	Tran Hung Dao temple, 50m from the subproject area	The temple was built in 2012 and serves as a spiritual site frequently visited by island residents and tourists.

No.	Sensitive receptor	Description
		- Worship activities take place on the 1st and 15th days of the lunar month, during holidays, and once a year for the temple's main ceremonial event. - About 50 m distance from the port, near the transport route for dredged materials from the subproject to Disposal Site No. 02. - Material transport may generate dust and noise, affecting worship and visitation during key lunar days.
4	Whale shrine is about 50m from the subproject area 	- The shrine is located next to the Tran Hung Dao Temple, about 50 meters from the subproject site. - Locate near the concrete road surrounding Bach Long Vi port, which also serves as the transport route for dredged materials from the project site to Disposal Site No. 02. - Transport activities may generate dust and noise, potentially affecting the shrine's surroundings.
5	The beach, about 120m from the subproject area 	- The beach is a natural swimming area used by locals and tourists, especially during the summer season (June–August). - It is located approximately 120 meters from the port area. - The port is protected by a breakwater, which minimizes potential project-related impacts. - Project impact on the beach is considered low.

2.7 CLIMATE CHANGE AND RESPONSE SCENARIOS OF THE PROJECT PROVINCE/CITY

2.7.1. Climate change in Viet Nam

From 1958 to 2018, the temperature showed an increasing trend at most monitoring stations. On average across the country, the annual average temperature increased by approximately 0.89°C (about 0.15°C per decade) (Figure 3.27). Annual rainfall has decreased in the northern regions (by 5% to 10% over 61 years) and increased in the southern regions (by 5% to 15% over 61 years).

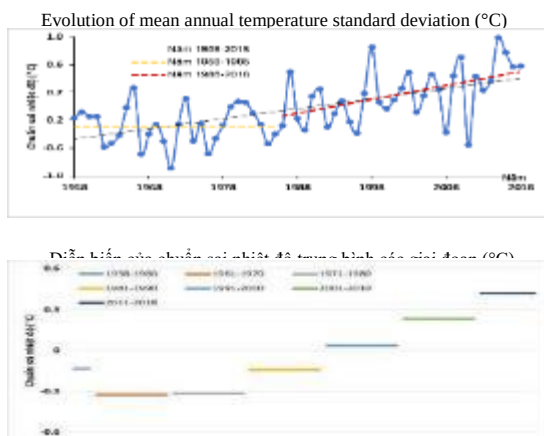


Figure 2.29. Average annual temperature and multi-year temperature deviation standards for the above periods at the national scale

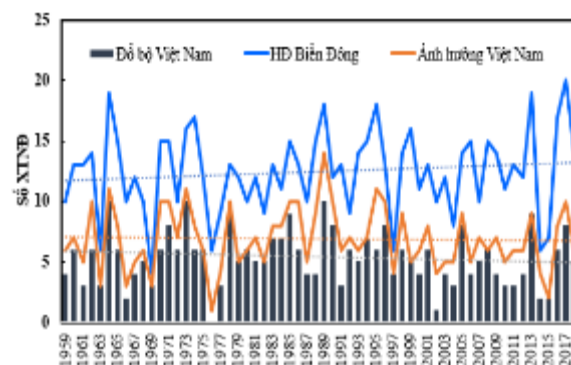


Figure 2.30. Development of the frequency of tropical cyclones during the period 1959-2018.

The highest daily temperature and the lowest daily temperature have shown a clear upward trend across most of the country, with the highest increase reaching up to 2.1°C. The number of hot days has increased in most regions of the country, with a common increase of 3-5 days per decade, especially in the Red River Delta, North Central, and South Central regions. The number of dry months has increased in the northern region, with the highest increase in the Red River Delta; it has decreased in the Central region, the southern territories, and the most significant decrease occurred in the South Central region. The number of cold days and severe cold days has decreased, particularly in the past two decades, although there have been some extreme cold spells with record low temperatures. Extreme rainfall events have decreased significantly in the Red River Delta but have increased in the South Central and Central Highlands regions.

The number of typhoons and tropical depressions in the East Sea, which directly impact Vietnam or make landfall in Vietnam, has remained largely unchanged (Figure 3.27). However, the number of strong typhoons (with maximum winds of level 12 or higher) has shown a slight increase.

2.7.2. Sea level rise in Viet Nam

According to data from coastal hydrometeorological stations and islands in Vietnam: The water level at all stations has shown an upward trend, with the fastest increase being over 6 mm per year at the Cua Ong, Bach Long Vi, and Con Dao stations. The water level at the Hon Ngu and Co To stations has shown a downward trend (5.7 mm and 0.6 mm per year, respectively). The water level at the Cồn Cỏ and Quy Nhơn stations has shown no clear trend. On average, for all stations, the sea level has increased by approximately 2.7 mm per year (Figure 3.29).

According to satellite data from 1993-2018: The average sea level in the entire East Sea has increased by 4.1 mm per year. The average sea level along Vietnam's coastal areas has increased by 3.6 mm per year.

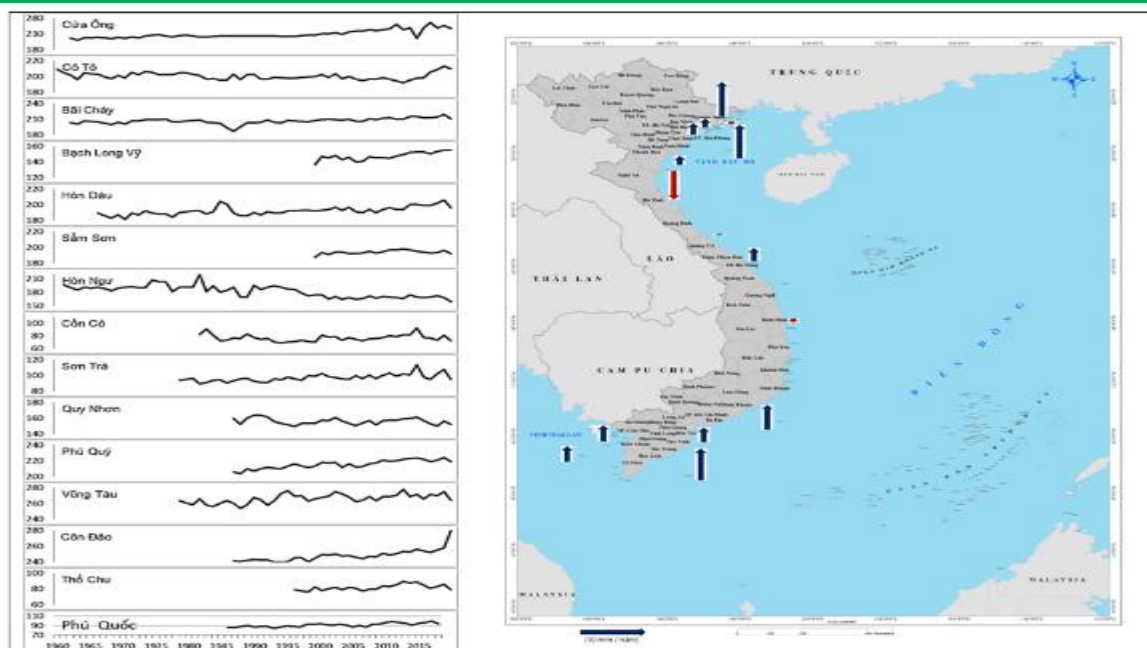


Figure 2.31. Trend of sea level changes at hydrometeorological monitoring stations (1961-2018)

2.7.3. Sea waves in Viet Nam

The wave height at most of the stations shows a decreasing trend, with the most significant decrease at Bach Long Vi station (38 mm/year), followed by Co To (25.8 mm/year) and Hon Ngu (18.3 mm/year). At Bai Chay station, the sea wave height has an increasing trend of 1.0 mm/year. On average, the wave height at the hydrological stations along Vietnam's coastline shows a decreasing trend of about 11.6 mm/year. If excluding the stations with abrupt decreases mentioned above, the average reduction in wave height is 5.7 mm/year.

The trend in wave height changes observed by satellite was calculated from data collected between 2009 and 2018. The average wave height for the entire East Sea decreased by about 6.2 mm/year. In contrast, the global wave height trend increased by 1.5 mm/year.

2.7.4. Climate change scenarios

Average Temperature:

The average annual air temperature across all regions of Vietnam has shown a tendency to increase compared to the baseline period (1986-2005); the extent of the increase depends on the RCP scenarios and climate regions.

According to the RCP4.5 scenario: The average annual temperature nationwide will increase by 1.2–1.7°C by mid-century, and by 1.6–2.4°C by the end of the century. Overall, temperatures in the North will increase more significantly than in the South.

According to the RCP8.5 scenario: The average annual temperature nationwide will rise by 1.7–2.3°C by mid-century, and by 3.2–4.2°C by the end of the century.

Extreme Temperatures:

Extreme temperatures are expected to rise in all climate regions. By the end of the century, according to the RCP4.5 scenario, the average annual maximum temperature will increase by 1.7–2.6°C, with the increase being more pronounced in the North (2.0–2.6°C) and in the South (1.7–2.9°C). The average annual minimum temperature will increase by 1.7–2.1°C. According to the RCP8.5 scenario, the average annual maximum temperature will rise by 3.2–4.7°C, with

the highest increases occurring in the northern mountainous provinces (4.0–4.7°C). The average annual minimum temperature will rise by 3.3–4.1°C. The minimum temperatures are rising faster than the maximum temperatures.

Annual Rainfall:

Annual rainfall is showing a tendency to increase across all climate regions. Rainfall during the rainy season and dry season is increasing across most areas of the country, with extreme rainfall also increasing.

According to the RCP4.5 scenario: Annual rainfall is expected to increase nationwide, with an increase of 10–15% by mid-century and 10–20% by the end of the century.

According to the RCP8.5 scenario: By mid-century, annual rainfall is expected to increase by 10–15% across most of the country. In island stations and northeastern coastal areas, rainfall could increase by 20–30%. By the end of the century, annual rainfall is expected to increase by 10–25%, with some areas in the Northeast seeing increases of over 40%.

Extreme Rainfall:

According to the RCP4.5 scenario, by the end of the century, the maximum 1-day rainfall is expected to increase by 20–30%, reaching 30–40% in most of the northern areas.

According to the RCP8.5 scenario, by the end of the century, the maximum 1-day rainfall is expected to increase by 25–40%, with most of northern Vietnam possibly experiencing increases of 40–50%.

Monsoon Winds and Extreme Weather Events:

Climate change could alter the frequency, intensity, and patterns of extreme weather phenomena. Some projected outcomes are summarized as follows:

- The number of typhoons and tropical storms is expected to remain largely unchanged but will be more concentrated at the end of the typhoon season, which is also when typhoons primarily affect the South. Strong to very strong typhoons are expected to increase.
- Summer monsoon: According to the RCP4.5 scenario, by the end of the 21st century, there will be minor changes in the onset time of the summer monsoon. However, the monsoon season is expected to start later, last longer, and become stronger compared to the baseline period. Similarly, under the RCP8.5 scenario, the onset time of the summer monsoon will show little change, but the season will start later, last longer, and become stronger compared to the baseline period.
- The number of days with cold spells and severe cold weather in the northern mountainous provinces, the Red River Delta, and the North Central Region is expected to decrease.
- The number of hot days (maximum temperature $\geq 35^{\circ}\text{C}$) and extremely hot days (maximum temperature $\geq 37^{\circ}\text{C}$) is expected to increase across most of the country, with the highest increases in the North Central Region, Red River Delta, and the South.
- Drought: According to the RCP4.5 scenario, by the end of the 21st century, the number of dry months will increase in most of the North Central Region, Central Highlands, and parts of the Red River Delta and South Central Coast, while it will decrease in most of the northern and central central regions. According to the RCP8.5 scenario, the number of dry months will increase across most of the country, with a decrease in some areas in the Northwest, Central Region, and the extreme south of the South.

2.7.5. Sea level rise scenario and flood risk due to climate change

Sea Level Rise Scenario considers only the changes in average sea level due to climate change,

without accounting for the effects of other factors that contribute to rising sea levels, such as storm surge, monsoon surge, tides, geological uplift/subsidence, and other processes.

Average Sea Level Rise Scenario for the Entire East Sea Region

By the end of the century, the sea level rise in the East Sea region is summarized as follows:

- According to the RCP2.6 scenario, the sea level rise is approximately 46 cm (ranging from 28 cm to 70 cm).
- According to the RCP4.5 scenario, the sea level rise is approximately 55 cm (ranging from 34 cm to 81 cm).
- According to the RCP8.5 scenario, the sea level rise is approximately 77 cm (ranging from 51 cm to 106 cm).

The spatial distribution of sea level rise in the East Sea shows that the central part of the East Sea (including the Paracel and Spratly Islands) experiences significantly higher sea level rise compared to other areas. The area with the lowest sea level rise is the Gulf of Tonkin and the northern East Sea. If we consider only the coastal strip of Vietnam, the area from Da Nang to Kien Giang experiences a higher sea level rise compared to the northern regions. This result aligns with the trend of sea level rise calculated from actual measurements at monitoring stations in the past.

Table 2.19. Sea level rise scenario for the whole East Sea area (cm)

RCP scenario	Time milestones of 21 st century							
	2030	2040	2050	2060	2070	2080	2090	2100
RCP 2.6	14 (8 ÷ 19)	20 (11 ÷ 26)	25 (14 ÷ 33)	30 (17 ÷ 41)	34 (20 ÷ 48)	38 (23 ÷ 55)	42 (25 ÷ 62)	46 (28 ÷ 70)
RCP4.5	12 (8 ÷ 18)	18 (11 ÷ 25)	23 (14 ÷ 33)	29 (18 ÷ 42)	35 (22 ÷ 51)	42 (26 ÷ 61)	48 (30 ÷ 71)	55 (34 ÷ 81)
RCP8.5	14 (10÷19)	20 (14÷27)	28 (20÷37)	34 (23 ÷ 47)	43 (28 ÷ 59)	52 (35 ÷ 72)	64 (42 ÷ 88)	77 (51÷106)

Sea Level Rise Scenarios for Coastal Areas and Islands of Vietnam

The sea level rise scenarios have been developed for the coastal provinces of Vietnam, divided into 9 coastal and island regions as follows: (i) The coastal area from Mong Cai to Hon Dau; (ii) The coastal area from Hon Dau to Deo Ngang; (iii) The coastal area from Deo Ngang to Deo Hai Van; (iv) The coastal area from Deo Hai Van to Mui Dai Lanh; (v) The coastal area from Mui Dai Lanh to Mui Ke Ga; (vi) The coastal area from Mui Ke Ga to Mui Ca Mau; (vii) The coastal area from Mui Ca Mau to Kien Giang; (viii) The Paracel Islands of Vietnam; (ix) The Spratly Islands of Vietnam.

Sea level rise scenarios for these regions according to RCP scenarios are presented in Tables 3.11 and 3.12. Overall, along the coastal areas of Vietnam, the sea level rise increases progressively from north to south.

According to the RCP4.5 scenario: In 2050, the coastal area from Mong Cai to Hon Dau has the lowest sea level rise of 22 cm (14 cm ÷ 30 cm). The Spratly Islands have the highest sea level rise of 24 cm (14 cm ÷ 31 cm); the average for the entire coastal area is 23 cm (13 cm ÷ 31 cm). In 2100, the coastal area from Mong Cai to Hon Dau has the lowest sea level rise of 52 cm (33 cm ÷ 75 cm), and the Spratly Islands have the highest sea level rise of 57 cm (33 cm ÷ 83 cm); the average for the entire coastal area is 53 cm (32 cm ÷ 76 cm).

Table 2.20. Sea level rise for Scenario RCP4.5 (cm)

Area	Time milestones of 21st century							
	2030	2040	2050	2060	2070	2080	2090	2100
Mong Cai - Hon Dau	12 (7÷17)	17 (10÷23)	22 (14÷30)	28 (17÷39)	34 (21÷47)	40 (25÷57)	46 (29÷66)	52 (33÷75)
Hon Dau – Ngang pass	12 (7÷16)	17 (10÷23)	22 (13÷30)	28 (17÷39)	34 (21÷47)	40 (24÷57)	46 (28÷66)	52 (32÷75)
Ngang Pass - Hai Van Pass	12 (7÷17)	17 (10÷23)	23 (14÷31)	28 (17÷39)	34 (21÷48)	41 (25÷57)	46 (29÷66)	53 (33÷75)
Hai Van Pass - Dai Lanh Cape	12 (7÷17)	17 (10÷23)	23 (14÷31)	29 (17÷39)	35 (21÷48)	41 (25÷58)	47 (29÷67)	53 (33÷77)
Dai Lanh Cape - Ke Ga Cape	12 (7÷17)	17 (10÷24)	23 (13÷32)	29 (17÷40)	35 (21÷49)	41 (25÷59)	47 (28÷68)	53 (32÷78)
Ke Ga Cape - Ca Mau Cape	12 (7÷17)	17 (10÷24)	23 (13÷31)	28 (17÷40)	34 (20÷49)	41 (24÷58)	47 (28÷68)	53 (32÷77)
Ca Mau Cape - Kien Giang	12 (7÷17)	17 (10÷24)	23 (14÷31)	29 (17÷40)	35 (21÷49)	41 (25÷59)	47 (29÷68)	54 (33÷78)
Hoang Sa islands	13 (8÷18)	19 (11÷25)	25 (15÷33)	31 (19÷41)	37 (23÷51)	44 (27÷61)	51 (31÷71)	58 (36÷80)
Truong Sa islands	13 (7÷18)	18 (10÷25)	24 (14÷34)	31 (17÷43)	37 (21÷52)	44 (25÷62)	50 (29÷68)	57 (33÷83)

According to the RCP8.5 scenario: In 2050, the coastal area from Mong Cai to Hon Dau will experience the lowest sea level rise of 26 cm (18 cm to 35 cm). The Spratly Islands will have the highest sea level rise of 28 cm (20 cm to 37 cm); the average for the entire coastal strip will be 27 cm (19 cm to 36 cm). In 2100, the coastal area from Mong Cai to Hon Dau will have the lowest sea level rise of 72 cm (49 cm to 101 cm), while the Spratly Islands will see the highest sea level rise of 77 cm (50 cm to 107 cm); the average for the entire coastal strip will be 73 cm (49 cm to 103 cm).

Table 2.21. Sea level rise for Scenario RCP8.5 (cm)

Area	Time milestones of 21st century							
	2030	2040	2050	2060	2070	2080	2090	2100
Mong Cai - Hon Dau	13 (9÷17)	19 (13÷25)	26 (18÷35)	32 (22 ÷ 45)	41 (28 ÷ 57)	50 (34 ÷ 70)	60 (41 ÷ 85)	72 (49 ÷ 101)
Hon Dau – Ngang pass	13 (9÷18)	19 (13÷25)	26 (18÷35)	32 (22 ÷ 45)	40 (28 ÷ 57)	50 (34 ÷ 71)	60 (41 ÷ 85)	72 (49 ÷ 101)
Ngang Pass - Hai Van Pass	13 (9÷18)	19 (13÷26)	27 (18÷36)	33 (22 ÷ 46)	41 (28 ÷ 58)	50 (34 ÷ 71)	61 (42 ÷ 86)	72 (49 ÷ 102)
Hai Van Pass - Dai Lanh Cape	13 (9÷18)	20 (14÷26)	27 (19÷36)	33 (22 ÷ 46)	41 (28 ÷ 58)	51 (35 ÷ 71)	62 (42 ÷ 86)	73 (50 ÷ 103)
Dai Lanh Cape - Ke Ga Cape	14 (10÷18)	20 (14÷26)	28 (19÷36)	33 (21 ÷ 46)	41 (27 ÷ 59)	51 (34 ÷ 73)	62 (41 ÷ 89)	74 (49 ÷ 105)
Ke Ga Cape - Ca Mau	14	20	28	32	41	51	61	73

Cape	(10÷18)	(14÷27)	(19÷37)	(21 ÷ 46)	(27 ÷ 59)	(33 ÷ 73)	(41 ÷ 88)	(48 ÷ 105)
Ca Mau Cape - Kien Giang	14 (10÷18)	20 (14÷27)	28 (19÷37)	33 (23 ÷ 47)	42 (29 ÷ 59)	52 (36 ÷ 73)	63 (44 ÷ 89)	75 (52 ÷ 106)
Hoang Sa islands	14 (10÷18)	20 (14÷26)	28 (19÷36)	34 (23 ÷ 47)	44 (29 ÷ 60)	54 (36 ÷ 74)	65 (43 ÷ 90)	78 (52 ÷ 107)
Truong Sa islands	14 (10÷19)	21 (14÷27)	28 (20÷37)	35 (23 ÷ 49)	44 (29 ÷ 61)	54 (36 ÷ 75)	65 (42 ÷ 90)	77 (50 ÷ 107)

Sea Wave Scenario

When assessing the impact of the average sea level rise due to climate change on the delta and coastal areas, it is necessary to consider the extreme sea levels caused by other factors such as sea waves, storm surges, tides, and storm surges combined with spring tides, etc.

The wave height tends to increase in the central and southern regions of the East Sea (including the Paracel Islands and Spratly Islands). Along the Vietnamese coast, the wave height tends to decrease in the Gulf of Tonkin, with the most significant decrease occurring in the northern part of the Gulf of Tonkin. However, the coastal area from Quang Tri to Ca Mau shows a slight increase or no clear trend. Specifically:

According to the RCP4.5 scenario, by the end of the century, the average wave height across the East Sea is expected to increase by about 9%. The coastal area from Mong Cai to Hon Dau is expected to see the most significant decrease in wave height, by about 27%; the coastal areas from Hai Van Pass to Cape Ca Mau will experience a slight increase in wave height, ranging from 1% to 9%. The coastal area from Cape Ca Mau to Kien Giang shows no clear trend. The Paracel and Spratly Islands will experience the largest increase in wave height, with an increase of 20% and 19%, respectively.

Table 2.22. Sea Wave Height Variability Compared to the Baseline Period (1986-2005) for the Coastal Areas of Vietnam and the Average of the East Sea

Unit: %

Area	Scenario RCP4.5		Scenario RCP8.5	
	Middle of the century	End of the century	Middle of the century	End of the century
Mong Cai - Hon Dau	-27	-27	-26	-24
Hon Dau – Ngang pass	-17	-16	-16	-14
Ngang Pass - Hai Van Pass	-3	-2	-2	-1
Hai Van Pass - Dai Lanh Cape	2	3	2	2
Dai Lanh Cape - Ke Ga Cape	1	2	1	1
Ke Ga Cape - Ca Mau Cape	7	9	9	9
Ca Mau Cape - Kien Giang	-1	0	0	-1
Hoang Sa islands	19	20	19	19
Truong Sa islands	18	19	18	17
Average of East Sea	8	9	8	7

According to the RCP8.5 scenario, by the end of the century, the average wave height across the entire East Sea is projected to increase by about 7%. The coastal area from Mong Cai to Hon Dau is expected to experience the largest decrease, with wave height reduced by

approximately 24%. Along the coast from Hai Van Pass to Cape Ca Mau, wave heights are projected to increase slightly, ranging from 1% to 9%. In the area from Cape Ca Mau to Kien Giang, wave heights are expected to decrease slightly, by around 1%. The Paracel Islands and the Spratly Islands are projected to see the greatest increase in wave heights, with rises of 19% and 17%, respectively.

According to the RCP8.5 scenario, by the end of the century, the average wave height in the South China Sea is expected to increase by approximately 7%. The coastal area from Mong Cai to Hon Dau will see the greatest decrease in wave height, with a reduction of around 24%; the coastal areas from Hai Van Pass to Cape Ca Mau will experience a slight increase in wave height, ranging from 1% to 9%. The area from Cape Ca Mau to Kien Giang will have a slight decrease in wave height, around 1%. The Paracel Islands and Spratly Islands will experience the largest increase in wave height, with increases of 19% and 17%, respectively.

Flood Risk Map Due to Sea Level Rise from Climate Change

The flood risk due to sea level rise from climate change is constructed based on the calculation of sea level rise scenarios in the South China Sea, coastal areas, and islands of Vietnam. In addition to climate change factors, some other dynamic factors that contribute to the increased flood risk, such as geological uplift and subsidence, terrain changes, shoreline alterations, and land subsidence, are indirectly accounted for using DEM data updated to 2020. However, the detailed impact of these factors, along with transportation and irrigation works like seawalls, embankments, dikes, and drainage systems, has not been considered in the flood risk calculations of this updated scenario.

The flood risk from sea level rise due to climate change is calculated for provinces at risk of flooding due to sea level rise, including 34 provinces/cities in the delta and coastal regions; the islands, Paracel Islands, and Spratly Islands of Vietnam. The flood risk map is constructed based on flood levels ranging from 10 cm to 100 cm, with an incremental increase of 10 cm. The flood risk calculation results, according to the projected sea level rise, are summarized in Table 3.14.

If the sea level rises by 100 cm, the flood risk for the following provinces is as follows:

- The Mekong Delta is the most vulnerable area, with 47.29% of its area at risk of flooding. Ca Mau and Kien Giang are the provinces with the highest flood risk (79.62% and 75.68% of their areas, respectively). About 13.20% of the Red River Delta is at risk; 1.94% of Quang Ninh Province is at risk of flooding. Approximately 1.53% of the coastal areas from Thanh Hoa to Binh Thuan in Central Vietnam are at risk of flooding. In this region, Thua Thien Hue has the highest risk (5.49% of its area), while Binh Thuan has the lowest risk (0.19% of its area). About 17.15% of Ho Chi Minh City's area and about 4.84% of Ba Ria - Vung Tau's area are at risk of flooding.

Table 2.23. Flood Risk Corresponding to Sea Level Rise Scenarios Due to Climate Change in 6 Provinces/City within the Project Area

District	Area (ha)	Flooding Rate (% of Area) According to Sea Level Rise									
		10 cm	20 cm	30 cm	40 cm	50 cm	60 cm	70 cm	80 cm	90 cm	100 cm
Hai Phong	154,052	1.03	1.56	2.11	2.75	3.81	5.58	8.37	12.61	18.51	25.06
Thai Binh	158,131	0.96	2.25	3.76	6.07	9.26	13.66	18.98	25.06	31.53	38.22
Thanh Ha	1,111,000	0.13	0.18	0.24	0.32	0.36	0.49	0.62	0.78	0.96	1.14
Binh Dinh	609,340	0.44	0.48	0.54	0.63	0.84	1.25	1.44	1.76	1.89	2.04

District	Area (ha)	Flooding Rate (% of Area) According to Sea Level Rise									
		10 cm	20 cm	30 cm	40 cm	50 cm	60 cm	70 cm	80 cm	90 cm	100 cm
Khanh Hoa	519,320	0.14	0.21	0.32	0.45	0.65	0.89	1.11	1.31	1.53	1.69
Kien Giang	634,878	0.66	3.38	12.63	23.67	36.82	48.85	75.68	66.16	71.69	75.68

(Source: Vietnam's Climate Change Scenarios Published in 2020)

CHAPTER 3. ANALYSIS OF ALTERNATIVES

As part of the environmental and social impact assessment, analyzing alternative solutions is essential when determining the proposed investment level, defining the scope of work, or considering design and construction options to avoid or minimize potential negative impacts, and to enhance the project's positive effects and benefits.

This analysis activity includes “with project” and “without project” scenarios, describing, identifying and comparing design options that are important to support decision making in selecting activities. construction activities in the Project Area. Accordingly, the selected activity is expected to have the least and lowest negative impacts while meeting the feasible technical solutions and cost-benefits applicable to the project. Furthermore, alternative analytical practices will also minimize adverse impacts and maximize positive impacts in terms of environmental and social aspects. The results of the analysis are presented below.

3.1 “With” and “Without” project

When implemented, the project will bring many positive impacts on socio-economic, environmental and climate benefits as follows:

- Once operational, the project will bring about substantial benefits that extend beyond just the number of fishermen engaged in fishing and aquaculture, or service providers supporting these activities. Specifically, the project's benefits lie in its contribution to the sustainable development of the fisheries sector in Vietnam:
- Taking into account the impact of climate change and extreme weather phenomena in project designing, particularly for fishing ports and storm shelters will help extend the life of the project and reduce maintenance costs of the project.
- Upgrading/building fishing ports and storm shelters will create favorable conditions for fishing vessels of participating provinces and neighboring provinces to safely shelter from storms, while reducing fishing costs and raising costs. Increase product value by shortening the distance between fishing ports and fishing grounds, and that contributes to improving income and preserving the nutritional value of aquatic products after fishing.
- Fishermen have the opportunity to work in a fishing, farming and seafood processing environment with better environmental hygiene conditions, which will help reduce occupational health and safety risks, while increasing quality and prices. Product treatment reduces post-harvest losses thanks to better fish and product preservation.
- Better waste management in the port area as well as at shrimp and fish farms contributes to reducing the generation of water pollutants and basin sedimentation. Therefore, in the long term, the project will contribute to improving the quality of surface water resources in the project area.
- Finally, the project contributes to creating aquatic products with biosafety, good nutrition and reasonable production costs combined with certification of fishing and aquaculture that do not violate IUU, which is the main factor to build brands, export products and compete better in international markets.
- The project also creates benefits in environmental and social aspects through the application of safety policies including: (i) raising awareness and concern about environmental and social issues as part of the benefits of beneficiaries, communities local copper; (ii) increase the presence of officials/experts on Environment and Society through training programs organized by the Ministry of Agriculture and Environment and the Department of Agriculture and Environment and extension officers of the Departments of Agriculture and Environment on screening capacity and management of Environment and Society; (iii) raise awareness of senior government officials on applying environmental and social safety principles in sustainable project development,

thus supporting the thorough consideration of environmental and social issues in the planning process. project planning and implementation.

Table 3.1. With" and "Without" project alternative analysis

Issue	Analysis of alternative		Note
	“Without” project	“With” project	
Socio-economic	Damage to boats and fishermen's live threats due to lack of safe shelter during the stormy season.	Boats and fishermen's lives are guaranteed because there is a safe place to stay during the stormy season.	✓
	-Loss to the local economy due to large fishing vessels not entering or leaving the fishing port/anchor area due to shallow shipping channels and lack of necessary logistics services. - The local socio-economic development is slow due to lack of synchronous infrastructure investment. People mainly organize spontaneous fishing, lacking sustainability, causing low efficiency and still causing adverse impacts on the environment.	- Forming an anchorage port and integrated boat and fish processing services helps turn offshore fishing into a key economic sector of the province and in accordance with the Government's Marine Strategy. - Create more jobs from services, processing... People benefit from synchronously invested infrastructure, improving quality of life.	✓
Natural environment	Some water surface areas and shrimp/fish/other seafood farming areas... will be abandoned.	Anchor port with full facilities: interceptor, boat mooring piles, service area...	✓
	The tidal regime and the sediment flow are not changed too much because human impacts (vessels entering and exiting, dredging...) are not too large.	The hydrological regimes and sediment flow may be altered, posing risks of sedimentation, erosion, and impacts on the aquatic ecosystem. However, these impacts are minor and can be mitigated (see the detailed impact assessment in Chapter 4)	✗
	Water quality is affected when discharges were mostly spontaneous and scattered.	There is a considerable risk of water pollution from wastewater and solid waste generated by boats and fishing port activities if not properly managed. However, the port design includes a coordinated wastewater collection and treatment system. As a result, this impact is expected to be effectively controlled and represents an improvement over previous conditions, where discharges were largely unregulated and dispersed.	✗

Issue	Analysis of alternative		Note
	“Without” project	“With” project	
	Rich aquatic resources. However, it is increasingly depleted because fishermen do not have the conditions to exploit seafood offshore.	Coastal aquatic resources are regenerated due to reduced pressure on coastal fishing.	✓

Note: ✓ Main positive impacts of the project

× Main negative impacts of the project

Investment in project construction will have impacts on the environment and socio-economic conditions of the area. However, these impacts only affect in a short period of time and are minimized with specific measures. Without the project, there will be no immediate impacts above, but will posing many issues regarding ensuring safe anchorage for vessels during the stormy season; Long-term loss of life and property to fishermen will certainly occur. With the project, this is a very feasible location due to favorable natural conditions and low investment costs. Especially with the scale of design, technology and scientific operation, in addition to ensuring safety for people and fishing vehicles, the project will also have other positive impacts such as infrastructure of the development area, People will benefit from the project's amenities, reduce production costs, create new jobs...

Potential environmental impacts can be controlled through mitigation measures applied during construction and operation. The environmental monitoring and management program will provide additional information to create a basis for better predictions about a number of environmental problems, from which appropriate measures will be applied to manage environmental problems and prevent and respond to environmental risks/incidents that may occur during the implementation of all 6 subprojects.

3.2 Considered alternatives

3.2.1. Lach Hoi fishing port upgrading and expansion subproject

There is only one proposed option for the scale, production technology, waste treatment technology, and location of the Lach Hoi Subproject. This option has been selected based on several key considerations: (i) compliance with the approved planning; technical feasibility to meet operational requirements, particularly in relation to the current status of existing fishing ports; (ii) cost-effectiveness and the assessment of E&S impacts to ensure overall project feasibility; and (iii) assurance that environmental impacts remain within permissible limits.

3.2.2. Lach Bang fishing port upgrading and expansion subproject

There is only one proposed option for the scale, production technology, waste treatment technology, and location of the Lach Bang Subproject. This option has been selected based on several key considerations: (i) compliance with the approved planning; technical feasibility to meet operational requirements, particularly in relation to the current status of existing fishing ports; (ii) cost-effectiveness and the assessment of E&S impacts to ensure overall project feasibility; and (iii) assurance that environmental impacts remain within permissible limits.

3.2.3. Tam Quan storm shelter upgrading investment subproject

There are two option for scale, production technology and location for implementing Tam Quan Subproject, Specifically:

+ Option 1: Dredging the Tam Quan storm shelter anchorage area. The estimated dredging volume is 900,450 m³ (including full dredging of Ro Islet).

+ Option 2: Dredging the storm shelter anchorage area without dredging Ro Islet. The estimated dredging volume is 523,224 m³.

An analysis of alternative options has been carried out based on the assessment of environmental and social impacts, particularly impacts related to resettlement and erosion/sedimentation factors

Factors / Options	Option 1 (Dredging Ro Islet)	Option 2 (Not dredging Ro Islet)
Location		
Technical aspect	This option will increase the anchorage capacity for boats and ships during storms.	This option will offer lower anchorage capacity, but still meets design standards.
Social aspect	23 households currently living on Ro Islet will need to be relocated and resettled.	No households will be affected or relocated under this subproject.
Environmental aspect	The large dredging volume (approx. 900,450 m ³) will impact the water quality of the Tam Quan River during dredging, increasing E&S risks and impacts at the dredged material disposal sites.	The dredged volume is nearly half of Option 1 (523,224 m ³). Environmental impacts will be lower compared to option 1
Cost aspect	Higher due to compensation and resettlement costs.	Lower, as land acquisition costs are minimal.

Based on the analysis of alternative wave regime modeling options for the subproject area—which informed the layout and planning of coastal protection structures—**Option 2** has been selected. This option minimizes community impact by avoiding resettlement and ensuring counterpart funding for subproject implementation. Additionally, it offers better protection for water quality and aquatic life in the Tam Quan River.

3.2.4. Khanh Hoa Major fishery center construction investment subproject

There is only one proposed option for the scale, production technology, waste treatment technology, and location of the Da Bac Fishing Port at the Major Fisheries Center of Khanh Hoa Subproject. This option has been selected based on several key considerations: (i) compliance with the approved planning; technical feasibility to meet operational requirements, particularly in relation to the current status of existing fishing ports; (ii) cost-effectiveness and the assessment of E&S impacts to ensure overall project feasibility; and (iii) assurance that environmental impacts remain within permissible limits.

3.2.5. Kien Giang Major fishery center construction and upgrading investment subproject

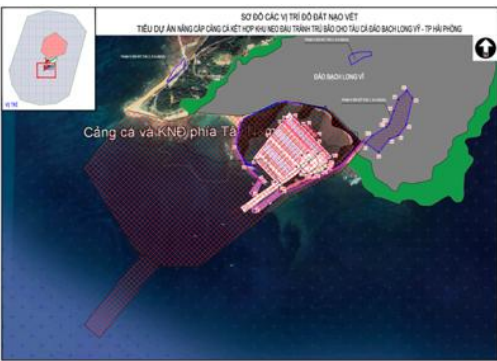
There is only one proposed option for the scale, production technology, waste treatment technology, and location of the Kien Giang Subproject. This option has been selected based on several key considerations: (i) compliance with the approved planning; technical feasibility to meet operational requirements, particularly in relation to the current status of existing fishing ports; (ii) cost-effectiveness and the assessment of E&S impacts to ensure overall project feasibility; and (iii) assurance that environmental impacts remain within permissible limits.

3.2.6. Bach Long Vi storm shelter construction and upgrading investment subproject

During the preparation phase, the Bach Long Vi Subproject considered two alternative options for dredged material disposal sites:

- **Option 1:** Utilize a single disposal site with an area of 5.13 hectares and a capacity of 76,000 m³.
- **Option 2:** Utilize three separate disposal sites:
 - Site 1: Located similarly to the site in Option 1 but with a smaller area of 4.0 ha and a capacity of 55,000 m³.
 - Site 2: Covers 0.48 hectares with a capacity of 12,000 m³.
 - Site 3: Covers 0.65 hectares with a capacity of 9,000 m³.

The alternative analysis was conducted based on environmental impact assessments on the intertidal ecosystem of the Bach Long Vi MPA, and took into account technical and economic factors related to the transportation of dredged materials from the Bach storm shelter anchorage to the disposal sites.

Factors / Options	Option 1 (Single Disposal Site)	Option 2 (Three Disposal Sites)
Location	 5.13 ha, adjacent to the intertidal zone of the MPA, 0.5 km from the port	 3 disposal sites as described above
Technical aspect	Conveniently located for transporting dredged material from the project area	Only Site 1 is conveniently located; Sites 2 and 3 are 1.3 km and 0.7 km away from the project
Environmental aspect	Occupies about 1.13 ha of the MPA's intertidal zone, potentially burying and degrading this ecological habitat	Does not occupy any part of the MPA's intertidal zone, thus minimizing ecological degradation
Cost aspect	More cost-effective	Higher costs are expected due to the additional expense of transporting dredged materials to two disposal sites located approximately 0.7 km and 1.3 km away from the port.

Based on the analysis of the alternatives and stakeholder consultations (particularly with the Management Board of the Bach Long Vi MPA and the Department of Agriculture and Environment of Hai Phong City), **Option 2 was selected**. Although this option incurs higher costs, it was chosen to ensure maximum reduction of impacts on the intertidal ecological resources.

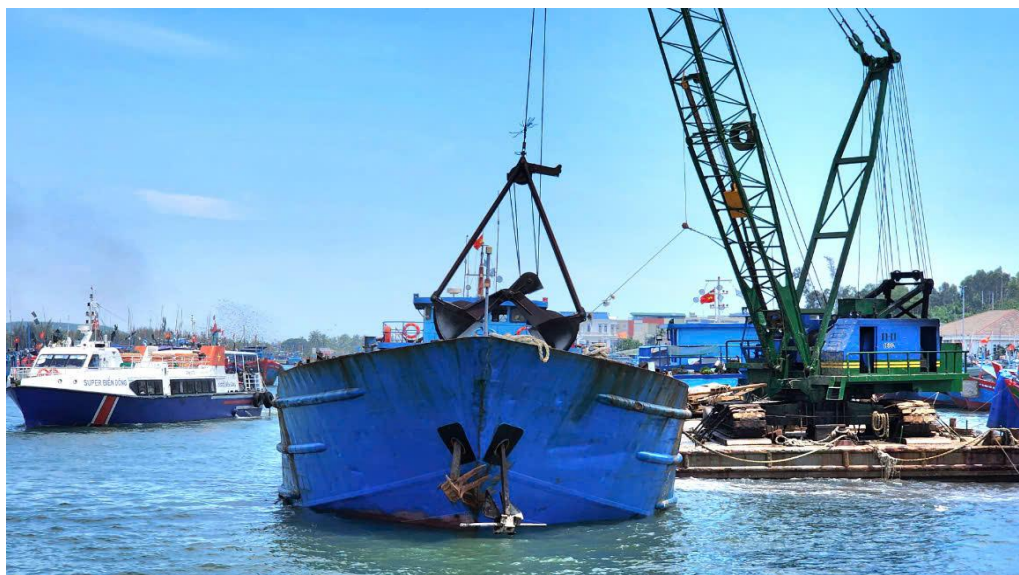
3.2.7. Analysis of Dredging Method Selection

Within the SFDP Project, there are four subprojects that involve dredging activities to create navigation channels, turning basins, and storm shelter anchorage areas. These include: Tam Quan, Khanh Hoa, Kien Giang, and Bach Long Vi Subprojects.

Currently, river/marine dredging methods in Vietnam typically involve three main approaches:

- Option 1: Use of grab bucket dredgers mounted on barges): This method employs grab bucket dredgers (either long-arm backhoe excavators or hydraulic clamshell excavators mounted on a 500T pontoon). Dredged material is loaded onto a 400T barge and transported an average distance of 12–30 km to the designated disposal site. A pump

installed on the barge is used to pump the material to the disposal area over a distance of less than 500 m.



- Option 2: Use of hopper suction dredgers: The dredger uses a cutter head to agitate the river/sea bottom, then sucks up the slurry into the hopper of the vessel. Water is discharged while the dredged sediment is retained.



- Option 3: Use of cutter suction dredgers: This method offers high construction efficiency. A cutter head agitates the sediment, and the slurry is then pumped via

pipelines directly to the disposal site. This method is ideal for short-distance discharge (pipeline length up to ~2 km).



Table 3.2. Comparison of River/Marine Dredging Methods

Criteria	Method 1 (Grab Dredger)	Method 2 (Hopper Suction Dredger)	Method 3 (Cutter Suction Dredger)
Technical	-Easily maneuverable in narrow areas. -Slower construction speed than suction dredgers. -Lower construction efficiency.	- Higher construction efficiency. - Difficult to operate in narrow areas or over long distances to disposal sites.	- Higher construction efficiency. - Disposal sites are located close to dredging areas (within 2 km pipeline limit).
Environmental & Social	- Lowest turbidity due to minimal disturbance of bottom sediment.	- Higher turbidity, potentially affecting aquatic life and aquaculture.	- Similar to Method 2, causing increased turbidity and potential impacts on aquatic ecosystems
Cost	Lowest cost	Highest cost	Moderate cost

Based on the following conditions: (1) Dredging activities are carried out in actively used navigation channels; (2) The channels are currently narrow and shallow; (3) The distance to the dredged material disposal sites must be considered; It is necessary to ensure safe operating conditions for both dredging vessels and commercial traffic, and to organize dredging fleets efficiently to achieve maximum productivity. Given the specific conditions of the subprojects, the two dredging methods selected for implementation across all four subprojects are: Option 1 (Grab Bucket Dredger) and/or Option 3 (Cutter Suction Dredger).

CHAPTER 4. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

The assessment on environmental and social impacts and risks for the Project' is carried out in three phases: pre-construction, construction and operation. The assessment results are the basis for making recommendations on mitigation measures and sound management plans for the project. The assessment team made great effort in complying with the requirements of ESS1 and other ESSs applied in the Project, and covering the issues mentioned in EHSG, etc. Of which all direct, indirect, cumulative impacts and risks are taken into consideration.

This chapter will be presented in the following order

A. Positive Impacts

B. Classification of Negative Impacts and Risks

C. Negative Impacts and Risks

- Negative Impacts and Risks at Pre-Construction phase
- Negative Impacts and Risks at Construction phase: Impacts from dust, emissions, noise, and vibration; Impacts from wastewater; Impacts from ordinary and hazardous solid waste; Reduction in surface water quality; Impacts on biological resources; Impacts on the landscape; Risk of soil erosion and landslides; Flooding and sedimentation risks; Road and waterway traffic safety risks; Impacts on existing infrastructure and related services; Social impacts; Risks to the safety and health of workers; Community safety and health; Impacts on cultural and historical resources and procedures for uncovering opportunities for discovery.
- Negative Impacts and Risks in Operation Phase
- Cumulative Impacts and Risks
- Climate Change Impacts and Risks

The assessment considers the impacts and risks listed in the ESS1 of the WB ESF, including those aspects listed in the EHSG, those related to community safety, those about climate change, economic and social impacts etc. The assessment considered the direct, indirect, and cumulative impacts and risks are required in the ESS1. The impacts and risks related to the workers and their working conditions with several aspects listed in ESS2 were discussed. The aspects mentioned in ESS3 about Pollution risks, use of energy have been considered, and forest, aquatic species, fishes and aquaculture and other living natural resources covered under ESS6 have been considered in the ESIA/ESMP etc. The potential negative environmental impacts and risks are presented below.

A. POSITIVE IMPACTS

The project is implemented to concretize the contents of the orientation of the National Development Strategy for the period 2021 - 2030, the Strategy for sustainable development of Vietnam's marine economy to 2030, vision to 2045, and the National Strategy on green growth and sustainable development, the country's 5-year socio-economic development plan 2021 - 2025, Fisheries industry development strategy to 2030 and vision to 2045, Planning for Fishing ports and storm shelters system by 2020, with a vision to 2030; ensure continuity, inheritance, stability, and hierarchy in the national planning system;

The implemented project will contribute to accelerating the socio-economic development of 6 provinces: Hai Phong, Thai Binh, Thanh Hoa, Binh Dinh, Khanh Hoa, Kien Giang; contributing to help sustainable development in line with cultural and human development; ensure national defense, security, political stability, social order and safety; ensure social security, narrow the gap between rich and poor, improve people's living standards; protect the ecological environment, adapt to climate change;

The project will create a driving force to help port, industrial, and shipping provinces/cities in Viet Nam develop in a modern, smart and sustainable manner, meeting the position of Southeast Asia region; become a modern international logistics service center by sea, air, highway, and high-speed rail; International center for training, research, application and development of science and technology in the fields of maritime, oceanography, and marine economics.

The project will contribute to reducing water pollution by collecting and treating industrial and domestic wastewater before discharging it into receiving bodies (rivers, seas). Proper wastewater treatment helps protect aquatic ecosystems and improve the quality of receiving water sources. The project also contributes to solid waste management, reducing the amount of waste discharged into rivers and seas, preventing waste pollution, and protecting marine life. The quality of life for coastal and riverside communities will improve by reducing water and environmental pollution, decreasing waterborne diseases, and promoting sustainable development. A clean and safe environment fosters tourism, sustainable aquaculture, and enhances the quality of life for local residents. On the other hand, implementation of the project will help concretize the planning of system of fishing port and storm shelter at the coastal area on islands with favorable natural conditions, accommodating many vessels, meeting mooring and logistics needs for fishing vessels and gradually develop towards industrialization and modernization; Forming important international exchange hubs as a driving force for the development of fisheries industrial parks, coastal economic zones, and large fisheries centers (in Hai Phong, Da Nang, Khanh Hoa, Ba Ria - Vung Tau, Kien Giang) associated with key fishing grounds; creating attraction and motivation for the seafood industry to develop effectively and sustainably.

Including 6 Subprojects in 5 Provinces/Cities as presented above, the project is classified as the group of investment projects to build and upgrade infrastructure serving exploitation of aquatic product and regional storm shelter for fishing vessels. When the Subprojects come into operation, they will improve the capacity of fishing ports; Improve infrastructure and services at the port, meet the needs of fisheries logistics, ensure food safety and hygiene, contribute to economic development, tourism, culture, society, and environmental sanitation. schools and new rural construction; Improve the livelihood conditions of fishermen in the area, create jobs and increase local income, improving quality of life. Sources of income of people from activities such as fishing, boat repair services, fish processing... The project is expected to contribute to job creation, it is forecast that by 2025 the entire fisheries industry will create jobs for 5 million workers, of which about 0.6 million are fisheries workers and aquaculture workers, about 3.5 million seafood workers, about 0.7 million seafood processing workers and 0.2 million fisheries logistics workers.

B. CLASSIFICATION OF NEGATIVE IMPACTS AND RISKS

There will be potential negative environmental and social impacts and risks in pre-construction, construction and operation of the investments under the six subprojects. These potential negative impacts and risks are classified based on criteria as below:

Significant Impacts (S)

- Impacts on large land area, important areas, or changes in environmental conditions in a period of more than two years;
- Impacts exceeding permitted standards and regulations. Long-term and large-scale impacts;
- Changes in ecological systems, impacts on ecological systems of large areas, or medium impacts (lasting for more than two years) yet required recovery period of the affected ecological systems is ten years;
- Impacts on health of people;
- Economic losses and damages to the sub-project nearby people and communities;

- Potential significant social and environmental impacts which can only be controlled and mitigated if proper mitigation measures are implemented.

Medium Impacts (M)

- Impacts on large areas for a period from six months to two years;
- Changes in ecological systems or ecological functions at the localities in a short time and recovery capacity is good. The impact levels are similar to current changes yet such impacts can have a cumulative effect;
- Impacts might (or might not) affect people's health, causing impacts on persons in the surrounding areas;
- Impacts are medium, localized and temporary and mitigation measures should be carried out.

Low Impacts (L)

- Social and environmental impacts that cause significant changes in less than six months or medium changes for a period of less than two years;
- Impacts are within permitted standards and regulations, causing minor changes at present. Impacts are fully controlled;
- Impacts that might affect daily activities yet not cause any obstruction to communities;
- Insignificant impacts on health and living standards of people;
- Impacts are minor, localized, and can be neglected.

No Impacts (N)

Based on the analysis of baseline data, field survey and discussions with officials and stakeholders, the project's potential negative impacts on the physical, biological and economic environments have been identified and assessed. Level of potential negative environmental impacts and risks are classified as substantial and specified in Table 4.1.

Table 4.1. Project's Potential Negative Impacts

Description	Physical			Biological		Social				Others	
	<i>Air, noise, vibration</i>	<i>Soil, water</i>	<i>Waste, dredged materials</i>	<i>Forest/ Terrestrial biology</i>	<i>Fish, aquatic system</i>	<i>Land acquisition, resettlement</i>	<i>Labor influx, community disturbance</i>	<i>Physical cultural resources</i>	<i>Livelihood</i>	<i>Local flooding, traffic, safety</i>	<i>Impact outside the project area</i>
1. Lach Hoi fishing port upgrading and expansion subproject , investment scope: - Construction of a pier with a length of 284m and a width of 10m. Elevation of wharf top +3.10m. - All wharves are equipped with a roofing system on the wharf - Arrange 03 fish sorting houses right behind the wharf on the beach area on pile foundation. - Add and complete the infrastructure system of electricity supply, water supply and drainage, 01 WWTP with capacity 300 m3/day.											
Pre construction	L	L	L	L	L	L	L	L	L	L	L
Construction	M	M	M	M	L	N	M	L	M	M	M
Operation	M	M	L	L	L	N	N	N	L	M	M
2. Lach Bang fishing port upgrading and expansion subproject , investment scope: - Remove the existing dock in Hai Thanh ward - Construction of a new vessel berth in Hai Thanh ward following the existing berth, length 180m, berth width 10m, berth top elevation + 2.15m, berth bottom elevation -4.50m. - Additional roofing system on all wharves: 400m on Hai Binh side and 180m on Hai Thanh side. - Upgrading and repairing internal roads in the Lach Bang fishing port area. - Additional and complete infrastructure systems for power supply, water supply, drainage and 01 WWTP with capacity 300 m3/day in Hai Binh ward, 01 WWTP with capacity 60 m3/day in Hai Thanh ward.											
Pre construction	L	L	L	N	L	L	L	N	L	L	L
Construction	M	M	L	L	L	L	M	L	M	L	M
Operation	M	M	L	N	L	N	M	N	L	M	L

Description	Physical			Biological		Social				Others	
	Air, noise, vibration	Soil, water	Waste, dredged materials	Forest/ Terrestrial biology	Fish, aquatic system	Land acquisition, resettlement	Labor influx, community disturbance	Physical cultural resources	Livelihood	Local flooding, traffic, safety	Impact outside the project area
3. Tam Quan storm shelter construction investment subproject , investment scope: - Embankment route with a length of 1,982m - Dredging the anchorage area and shipping channel - Invest in communication systems.											
Pre construction	L	L	L	L	L	M	L	L	M	L	L
Construction	S	M	S	M	M	L	M	L	S	M	M
Operation	M	M	L	N	N	N	M	N	L	M	M
4. Khanh Hoa major fishery center construction investment subproject , investment scope: - Upgrading and expanding wharf 1 to a width of 29m and a length of 200m. - Wharf 2: new construction of an overhang bridge with deck width of 29m and length of 122m. Onshore port with 255m of tuna port and 60m of service wharf area - Logistics works: Fish sorting house, Cold storage, Seafood sorting and auction house, Live seafood preservation area... - Administrative and service area construction: Central office building. - Technical infrastructure: Electricity supply system, water supply, drainage, 01 WWTP with capacity 600 m3/day, fuel supply.											
Pre construction	L	L	L	L	L	L	L	N	M	L	L
Construction	M	M	M	L	L	N	M	L	M	M	L
Operation	M	M	L	N	N	N	M	N	L	L	M
5. Kien Giang Major fishery center construction investment subproject , investment scope: - Harbor area: 700m long fishing wharf; The seafood import-export wharf is 100m long; The logistics service wharf is 200m long. - Logistics works: Seafood sorting and trading house,...											

Description	Physical			Biological		Social				Others	
	Air, noise, vibration	Soil, water	Waste, dredged materials	Forest/ Terrestrial biology	Fish, aquatic system	Land acquisition, resettlement	Labor influx, community disturbance	Physical cultural resources	Livelihood	Local flooding, traffic, safety	Impact outside the project area
- Administrative and service area works: Executive house. - Technical infrastructure: internal roads, cargo yards, Electricity supply system, water supply, drainage, 01 WWTP with capacity 600 m3/day											
Pre construction	M	M	M	M	L	M	L	L	L	L	L
Construction	M	M	M	L	L	L	M	N	M	M	M
Operation	M	M	L	N	N	N	L	N	L	L	L
6. Bach Long Vi storm shelter and fishing port construction investment subproject , investment scope - Upgrade breakwater with total length of 1100m; - Construction of vessel berth length of 80m; - Dredging the anchorage area to avoid storms; - Construction of a system of anchor posts and buoys to avoid storms.											
Pre construction	L	L	L	L	L	L	L	L	L	L	L
Construction	M	M	M	M	M	N	M	N	M	M	M
Operation	L	L	L	M	N	N	M	N	L	L	M

The structured assessment presented below will be proportionate to the level of potential impacts and risks during Pre-Construction, Construction and Operation phases. Where there are similar types of impacts and risks between types of works, more thorough assessment and analysis would be carried out for the items that the potential impacts and risks are more likely and significant and a brief discussion on the same topic will be provided for other works.

C. IMPACT AND RISK ASSESSMENT

During the project preparation phase (including 6 subprojects), the main impacts and risks are caused by soil recovery activities and UXO clearance in the areas where the subproject works will be constructed.

The construction phase of the project (including 6 subprojects) includes the following activities:

- Land clearance (LC): Demolition, clearing to prepare construction sites.
- Transport and gathering of construction materials, machinery, equipment, and waste, etc.
- Excavation, filling, road construction, and subproject development.
- Construction of the subprojects.
- Installation of machinery and equipment for the operation phase.
- Transport of dredged material to temporary storage areas, site restoration, etc.

Construction activities will cause general environmental and social impacts such as:

- Air pollution from dust and emissions.
- Noise and vibration impacts.
- Generation of wastewater.
- Generation of solid waste.
- Decreased water quality
- Impacts on aquatic life.
- Erosion, sedimentation, and local flooding.
- Increased safety risks and traffic disruption.
- Potential damage to existing infrastructure due to transport of construction materials and machinery, piling process
- Occupational health and safety for workers.
- Safety risks for the local community.
- Social impacts due to labor migration.
- Impacts on cultural resources.

Specific impacts during construction at each particular location for each subproject.

The operation phase of the project includes the activities of fishing ports/storm shelters as follows:

- (i) Operation of vessels entering and leaving the fishing ports/storm shelters;
- (ii) Operation of fisheries services (including activities of domestic wastewater treatment stations/seafood processing);
- (iii) Regular dredging of the shipping channel (for 4 subprojects: Tam Quan subproject, Bach Long Vi subproject, Kien Giang subproject, Khanh Hoa subproject), there are no plans for regular dredging activities.

The environmental and social impacts during the operation phase include:

The operation of vessels entering and leaving the fishing ports/storm shelters will cause the following impacts and risks:

- Air pollution from ship and boat emissions.
- Decreased quality of surface water due to increased oil and grease concentrations from vessels.
- Impact on the aquatic ecosystem in the area.

The operation of fisheries services (including domestic wastewater treatment) will cause the following impacts and risks:

- Air quality deterioration due to odors from seafood and wastewater treatment activities.
- Increased water pollution from wastewater generated by fisheries services.
- Increased waste generation from fisheries services.

Regular dredging activities to maintain the shipping channel/storm shelter will cause the following impacts and risks:

- Air quality deterioration due to the operation of dredging vehicles and machinery.
- Decreased surface water quality due to dredging activities (increased turbidity, TSS, oil and grease, etc.).
- Impact on the aquatic ecosystem in the area.
- Increased salinity intrusion.

The E&S impact and risk assessment for each subproject will cover all three phases—preparation, construction, and operation—and are presented below

4.1 LACH HOI FISHING PORT UPGRADING AND EXPANSION SUBPROJECT

4.1.1. Impacts and risks in the project preparation phase

4.1.1.1. Impacts due to land acquisition

The existing Lach Hoi fishing port, which has an area of 3.61 ha, will be upgraded and expanded to a total area of 7.65 ha. The expanded land area of 4.04 ha covers 2.18 ha of land for public purposes - currently serving as a transportation area in front of the port; 0.33 ha for commercial production (11 kiosks of single story, with an average area of about 50 m² per kiosk, which the Lach Hoi Fishing Port Management Board is renting out to some households for business); and 1.52 ha of the Ma River water surface.

In general, the impact level due to land acquisition of Lach Hoi subproject is Low and unchangable. The subproject affects income of 11 households who are renting kiosks from Lach Hoi Fishing Port Management Board to trade seafood and goods, serving the existing port. However, these households are currently involved in other industries such as agricultural production, fishing, etc., so they will not completely lose their household income. This impact will be minimized by income restoration measures stated in the project's RP.

4.1.1.2. Safety risks related to UXO

The Lach Hoi subproject will be upgraded and expanded on the existing Lach Hoi fishing port. UXO will be cleared for the expansion area of 4.04 ha. Generally, the risks from unexploded ordnance clearance for the Lach Hoi subproject are manageable and can be mitigated.

4.1.2. Impacts and risks in construction phase

4.1.2.1. General impacts and risks

a) Impacts on ambient air quality

The sources of Lach Hoi subproject's impact on ambient air quality during the construction phase include: (i) Dust generated from the demolition of existing structures/clearing for site preparation; (ii) Dust generated from excavation and leveling activities for the expanded area; (iii) Dust generated from the transportation of construction materials; (iv) Dust generated from waste transportation; (v) Dust generated from the storage and unloading of construction materials; (vi) Emissions from the operation of vehicles transporting materials and wastes; (vii) Emissions from the operation of construction equipment/machinery. Assessment of impact sources is detailed below.

❖ *Dusts generated from site preparation activities*

During the site preparation of the Lach Hoi subproject, dust is mainly generated from: (i) demolition of existing structures (approximately 1,285 m³ of debris from the demolition of sections of degraded embankments, port shorelines, and 11 grade-4 kiosks) and (ii) vegetation clearance (in the area of upgrading Lach Hoi fishing port, there are a few clusters of mangrove trees scattered along the Ma River bank, covering about 0.15 ha, equivalent to 1.5 tons of plant biomass)¹⁴.

Determine the volume of dust generated from earthwork and leveling of each Subproject, using the following formula:

$$W = E \times Q \times d \quad [\text{CT1}]$$

Where: W: Average amount of dust generated (kg);
E: Pollution coefficient (kg dust/ton);
Q: Emission amount (m³);
d: Debris d = 1.8 tons/m³ (According to Official Dispatch No. 1784/BXD-VP of the Ministry of Construction on promulgating material norms in construction).

The amount of diffused dust is calculated based on the pollution coefficient and the volume of excavated and embanked soil. According to the World Health Organization's guidance document, the pollution coefficient E is calculated using the following formula:

$$E = k * 0.0016 * \frac{\left(\frac{u}{2.2}\right)^{1.4}}{\left(\frac{M}{2}\right)^{1.3}} \quad [\text{CT2}]$$

In CT1, we have:

- E: Pollution coefficient (kg dust/ton).

¹⁴ The plant biomass coefficient (ϕ_i) is calculated according to the study "Ecological Succession and Biomass Calculation Methods for Characteristic Vegetation Cover" by Ogawa (1964) and Kato (1978), specifically for perennial trees with a coefficient of 10.1 tons/ha.

- k: Particle structure, with average value ($k = 0.2$ for dust with size $<10\mu\text{m}$ - Particle structure table (k) page 13.2.4-4 AP 42Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources).
- $\overline{u}$: Average wind speed (wind speed in the project area).
- M: Debris's average moisture of backfill materials.

The amount of dust generated from the demolition of existing port structures is determined according to the formula [1] and the formula [2] is used to calculate the dust emission factor. The dust emission factor due to the demolition of existing structures is calculated as follows: $E = 0.0288 \text{ kg/ton}$ ($k = 0.2$; U (wind speed) = 4.0 m/s ; M (average debris moisture) = 20%), with a demolition/clearing duration of about 3 months. Based on these algorithms, the amount of dust generated from the demolition of existing structures and vegetation clearance for the Lach Hoi subproject is 0.617 kg/day , and the dust concentration is 0.2 mg/m^3 , which is lower than the permissible limit according to QCVN 05:2023/BTNMT (permissible limit: 0.3 mg/m^3).

Dust generated from demolition and clearing activities will affect workers involved in demolition/clearing and the fishermen operating at the existing Lach Hoi fishing port.

The impact level is assessed as Low as (i) the dust concentration meets the permissible standards, (ii) the impact period is short (about 3 months), (iii) the affected people are not numerous, mainly workers and some fishermen operating at the existing fishing port, and (iv) this impact can be mitigated by appropriate measures.

❖ *Dust generated from earthworks*

Dust from the earthworks of the Lach Hoi subproject comes from excavation, backfilling, but the amount generated from leveling activities are negligible as the expansion area of the Lach Hoi port already has an existing foundation. The estimated volume of excavated soil is $16,040 \text{ m}^3$, with the excavation duration being about 12 months. Based on algorithms/formulas [1] and [2], the emission factor E is calculated to be 0.0288 kg/ton . The amount of dust generated from earthworks at the Lach Hoi subproject is determined to be 1.93 kg/day , and the dust concentration is 0.31 mg/m^3 , which is 1.03 times higher than the permissible limit according to QCVN 05:2023/BTNMT (permissible limit: 0.3 mg/m^3).

Dust generated from earthworks will affect construction workers, fishermen operating at the existing Lach Hoi fishing port, employees of Seafood processing plant under Thanh Binh Trading Joint Stock Company which is 20m away from the project site, and the existing residential areas of Quang Tien ward (about 80-100 meters from the construction site).

The impact level is assessed as medium because (i) the dust concentration exceeds the permissible standard but not significantly, (ii) the impact period is short-term (about 12 months), (iii) however, the number of affected people is large as mentioned above, and (iv) this impact can be mitigated through appropriate measures.

❖ *Dust from transportation of construction materials*

Dust from transportation of construction materials arises from the materials themselves and is stirred up by vehicle tires during transportation by diesel trucks on urban roads to the construction site of the Lach Hoi subproject. The expected construction period is 24 months.

The construction of Lach Hoi subproject's works will require a large amount of basic materials such as cement (2,983 tons), sand (16,897 tons), stone (32,715 tons), and steel (795 tons). The materials will be purchased from material depots and stores near the subproject area, with an

average distance of 10-15 km, transported by 10-ton trucks.

The level of impact of dust and emissions generated depends on many factors such as transportation distance, type and capacity of engine, type and amount of fuel used, air operation, quality of the road. The amount of dust generated during transportation is determined according to the formula of Air Chief, US Department of Environment, 1995:

$$L = 1,7 \times k \cdot \left[\frac{s}{12} \right] \times \left[\frac{S}{48} \right] \times \left[\frac{W}{2,7} \right]^{0,7} \times \left[\frac{w}{4} \right]^{0,5} \times [(365-p)/365], \text{ kg/(xe.km)} \quad [\text{CT3}]$$

Where: L - Dust emission coefficient (kg/km/vehicle trip);

k - Particle size, k = 0.2;

s - amount of land on the road, s = 5.7%;

S - Average speed of the vehicle, S = 40km/h;

W - Loaded weight of the vehicle;

w - Number of wheels, w = 8 wheels.

p – Average number of rainy days in a year.

Applying the formula [3] and input parameters such as the volume of materials mentioned above, the intermittent transportation period within 24 months of construction, the number of transportation trips calculated as 7 trips/day, the dust load generated from the transportation of construction materials, soil/sand for the subproject calculated is 0.351 (mg/m/s).

From dust and emissions generated, applying the SUTTON model to determine the average concentration of pollutants at any time with linear waste sources as follows:

$$C = \frac{0,8E \left\{ \exp \left[\frac{-(z+h)^2}{2\sigma_z^2} \right] + \exp \left[\frac{-(z-h)^2}{2\sigma_z^2} \right] \right\}}{\sigma_z \times u} \quad (\text{mg/m}^3) \quad [\text{CT4}]$$

In the formula [4]:

- C - Concentration of pollutants in the air (mg/m³)
- E - Load of pollutants from the waste source (mg/m.s)
- z - Height of calculation point (m)
- h - Height of the road surface compared to the surrounding ground (m)
- u - Average wind speed in the area (m/s)

Vertical pollutant diffusion coefficient σ_z with vertical direction (z) with atmospheric stability in the study area is type B, determined according to the following calculation formula:

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

In which: x is the distance from the calculation point to the exhaust source in the wind direction. The calculation method is to divide the coordinates of the calculated point along the horizontal (x) and vertical (z) axis. For the Thuy Tan subprojec area, the average wind speed of the area is **2 m/s**. The level of atmospheric stability is class B. Diffusion coefficient depends on the degree of

atmospheric diffusion, the vertical value σ_z is calculated according to Slade with atmospheric stability of type B and according to the distance $x = 25\text{m}$ from the center of the calculated road to the two sides.

Based on the dust load and generated emissions, SUTTON model (formula [4]) is applied, the average concentration of pollutants arising from transporting materials for the construction of Lach Hoi subproject determined meets the permissible standard in comparison with QCVN 05:2023/BTNMT within 1 hour (0.3 mg/m^3) at a distance of 10m .

Dust generated from material transportation will directly affect construction workers, fishermen operating at the existing Lach Hoi fishing port, and employees of Seafood Processing Plant under Thanh Binh Trading Joint Stock Company, located 20 meters away. Besides, it will indirectly affect residents of Quang Tien ward, located 80 meters from the construction site, and those living adjacent to the road, as well as teachers and students of Quang Tien Secondary School and Quang Tien Kindergarten, located 20-50 meters from the main material transportation route (Tran Hung Dao Street).

The impact level is assessed as Low because (i) the dust concentration is lower than the permissible standard, (ii) the impact is long-term but intermittent over approximately 24 months of construction, (iii) the direct impact is limited to construction workers and some fishermen who are currently working at the existing port, and (iv) this impact can be mitigated through appropriate measures.

❖ *Dusts generating from waste transportation*

Dust from waste transportation mainly arises from the waste itself, such as debris from demolition activities, excess excavated soil, construction waste (cement, leftover mortar, brick fragments, scrap metal, cardboard, etc.). It is expected that the project will transport waste (debris, household waste) by road to the disposal site of Dong Nam Waste Treatment Area, Dong Son District, located about 20-25km from the project area.

Similarly, applying formula [3], the input parameters such as: debris ($1,285\text{m}^3$), biomass from vegetation clearance (1.5 tons), excess excavated soil (approximately $16,040\text{m}^3$), construction debris (267m^3), intermittent transportation time over 24 months, and estimated 4 transport trips per day, the dust load generated from this activity is 0.01 mg/m/s .

Using formula [4] - the Sutton model with a wind speed of 4 m/s at the Lach Hoi port area and atmospheric stability classified as B, at a distance $x = 25\text{m}$ from the road centerline to both sides, and with the concentration of pollutants generated by the waste transportation activities, the dust concentration calculated is below the allowable limit of QCVN 05:2023/BTNMT within 1 hour (0.3 mg/m^3) at a distance of 10m .

Dust generated from waste transportation will directly affected construction workers, fishermen operating at the existing Lach Hoi fishing port, and employees of Seafood Processing Plant under Thanh Binh Trading Joint Stock Company, located 20 meters away, residents of Quang Tien ward, located 80 meters from the construction site, and those living adjacent to the road, as well as teachers and students of Quang Tien Secondary School and Quang Tien Kindergarten on the main material transportation route (Tran Hung Dao Street).

The impact level is assessed as Low because (i) the dust concentration is lower than the permissible standard, (ii) the impact is long-term but intermittent over approximately 24 months of construction, (iii) the direct impact is limited to construction workers and some fishermen who are

currently working at the existing port, and (iv) this impact can be mitigated through appropriate measures.

❖ **Dust from material gathering and loading and unloading:**

Dust is generated from gathering, loading and unloading materials at gathering sites in the subproject area. The construction of the subproject works will require a large amount of basic materials such as cement (2,983 tons), sand (16,897 tons), stone (32,715 tons), and steel (795 tons). Based on the dust emission coefficient generated from material loading and unloading, the dust load generated is 57.99 mg/m.s.

Calculate dust concentration arising from loading and unloading construction materials according to the method of *Tran Ngoc Chan, 1999, Air pollution and exhaust gas treatment (volume 1), Hanoi Science and Technology Publishing House*. Consider the air mass at the construction site to be visualized as a box with dimensions of length L (m), width W (m) and height H (m), one bottom edge of the air box is parallel to the wind direction. Assuming that the wind blowing into the box is polluted air and the air at the construction site at the time of construction is quite fresh, the average dust concentration generated in 1 hour is calculated according to the formula.

$$C = \frac{E_s \cdot L}{u \cdot H} (1 - e^{-ut/L}) \quad [CT5]$$

Where: C - Average concentration of dust generated in 01 hour (mg/m³);

E_s - Amount of pollution emissions calculated per unit area;

$E_s = M/(L \times W)$ (mg/m².s)

M- pollution load (mg/s);

u - Average wind speed blowing perpendicular to one edge of the air box (m/s);

H - Height of disturbance (m);

L, W - Length and width of the air box (m).

Apply the fomula [5], the dust load generated in 1 hour (mg/m³) during material loading and unloading activity is below permissible limit of QCVN 05:2023/BTNMT within 1 hour at a distance of 10m.

Dust from material gathering, loading and unloading will directly affect construction workers, fishermen operating at the existing Lach Hoi fishing port, and employees of Seafood Processing Plant under Thanh Binh Trading Joint Stock Company, located 20 meters away.

The impact level is assessed as Low because (i) the dust concentration is lower than the permissible standard, (ii) the impact is long-term but intermittent over approximately 24 months of construction, (iii) the direct impact is limited to construction workers and some fishermen who are currently working at the existing port, and (iv) this impact can be mitigated through appropriate measures.

❖ **Dust from vehicles transporting materials and wastes**

Emission comes from vehicles transporting materials such as cement (2,983 tons), sand (16,897 tons), stone (32,715 tons), and steel (795 tons) and waste such as debris (1,285m³), biomass from vegetation clearance (1.5 tons), excess excavated soil (approximately 16,040m³), construction debris (267m³). As these vehicles use DO fuel, the emission contains products from the fuel combustion process of internal combustion engines such as NO_x, SO₂, CO.

Based on input data of Lach Hoi subproject: materials and wastes are transported by the trucks which have a load capacity of 10 tons and fuel consumption of 0.4 liters of oil/truck.km (1 liter of diesel = 0.832 kg). The parameters of the number of transportation trucks and distance are as follows:

- Materials are transported intermittently within 24 months of construction, the number of transportation vehicles calculated is 7 trips/day with an average distance of 15km.
- Wastes are transported continuously within 24 months, the number of transportation vehicles calculated is 4 trips/day with an average distance of 20km.

Thus, the fuel consumption for these activities is 3.33 kg/day. Applying formula [3], we have emissions from these activities as below: SO₂: 0.0052 mg/m.s; NO₂: 0.0286 mg/m.s and CO: 0.146 mg/m.s.

As the emission load from the above transportation activities is quite low. However, to assess the impact of this activity on the ambient air quality, apply Formula [4] - **Sutton** model to calculate the concentration of pollutants in the emissions according to the distance (x) and height (z) of the emission load with the highest concentration of CO. The results of the concentration of emissions from transportation activities calculated meet QCVN 05:2023/BTNMT - National technical regulation on ambient air quality at a distance of 10m.

Gases exhausted from transportation process will directly affect construction workers, fishermen operating at the existing Lach Hoi fishing port, and employees of Seafood Processing Plant under Thanh Binh Trading Joint Stock Company, located 20 meters away. Besides, they indirectly affect residents of Quang Tien ward, located 80 meters from the construction site, and those living adjacent to the road, as well as teachers and students of Quang Tien Secondary School and Quang Tien Kindergarten on the main material transportation route (Tran Hung Dao Street).

The impact level is assessed as Low because (i) the emission concentration is lower than the permissible standard, (ii) the impact is long-term but intermittent over approximately 24 months of construction, (iii) the direct impact is limited to construction workers and some fishermen who are currently working at the existing port, and (iv) this impact can be mitigated through appropriate measures.

❖ *Dust and emissions due to operation of construction machinery*

Emissions are generated from the operation of construction machinery and equipment using diesel oil for internal combustion engines such as: floating cranes, excavators, graders, welders, generators, pile drivers, concrete mixers, etc. Pollutants emitted contain products from the fuel combustion process of internal combustion engines such as NO_x, SO₂, CO.

Similarly, to calculate the amount of emissions (CO, NO₂, SO₂) from machinery and equipment operating during construction, the report based on the document of NATZ Transport, Shun Dar Lin, 2005. With the oil using coefficient of 0.1 kg/ton, it will generate: SO₂ with 2.8 kg/ton of oil; NO₂ with 12.3 kg/ton of oil; CO with 0.05 kg/ton of oil.

According to the number of construction machines and the fuel consumption requirements for the Lach Hoi subproject, the average amount of DO oil used is 4.43 liters per hour. The estimated operation time is approximately 8 hours per day (1 shift), not continuously, within 24 months of construction.

The pollutant load in the course of burning Diesel oil is calculated according to the formula [6]:

$$\text{Pollutant load}(g/s) = \frac{\text{Emission coefficient} \left(\frac{g}{kgDO} \right) \times DO \text{ Demand} \left(\frac{kgDO}{day} \right)}{3600.8} \quad [\text{CT6}]$$

Using formula [6], the load of dust and gases emitted from the fuel combustion of the construction machinery in one working shift is as follows: 0.0623 g/s SO₂; 0.0088 g/s NO₂; 0.0022 g/s CO; 0.0623 g/s dust; 0.0623 g/s VOC.

Applying Formula [4] - the Sutton model with a wind speed of 4 m/s and a distance of 5-10 meters from the emission sources, the concentration of exhaust gases from construction machinery meets the QCVN 05:2023/BTNMT - National Technical Regulation on Ambient Air Quality.

The emissions from the construction machinery will have impacts on the workers directly involved in the construction and the fishermen operating at the existing Lach Hoi fishing port; employees of the Seafood Processing Plant under Thanh Binh Trading Joint Stock Company, located 20 meters away.

The impact level is assessed as Low because: (i) The concentration of emitted gases is lower than the allowable standard; (ii) The impact is long-term but intermittent, 8 hours/day over approximately 24 months of construction; (iii) The direct impact is limited to workers and some fishermen operating at the existing port; (iv) This impact can be mitigated by appropriate measures.

In general, the subproject's impact on ambient air quality is assessed as **Low to Medium** as (i) the concentration of emitted gases all meets or slightly exceeds allowable limit, (ii) the impact is long-term but intermittent (mainly concentrated around 8-10 hours per day and intermittently over 24 months of construction), (iii) the impact is limited to workers directly involved in the construction and fishermen operating at the existing Lach Hoi fishing port; employees of the Seafood Processing Plant under Thanh Binh Trading Joint Stock Company, located 20 meters away, and residential area of Quang Tien Ward, which is 80 meters from the construction site, people living along the road, and the teachers/students of Quang Tien Secondary School and Quang Tien Kindergarten located along the main material transportation route – Tran Hung Dao Street (iv) This impact can be minimized through appropriate measures.

b) Impacts due to noise

During the construction phase of the Lach Hoi subproject, noise is mainly from: (i) the operation of trucks transporting construction materials and waste; (ii) the operation of construction machinery and equipment; (iii) the demolition of existing structures, construction activities (especially the pile-driving ships for embankment/port reinforcement), and dismantling/completing the construction items; and (iv) the activities of engineers and workers involved in the construction.

Applying the typical noise standards for construction vehicles and equipment from the “U.S. Environmental Protection Agency - Noise from Construction Equipment and Machines NJID, 300.1, 31/12/1971” as shown in the table below and applying formulas [10] and [11], the noise level will decrease with distance and is determined according to the formula of Pham Ngoc Dang 2003. Air environment . NXB KHK 2003” as follows:

$$L_i = L_p - \Delta L_d - \Delta L_c (dBA) [\text{CT7}]$$

Where:

L_i - Noise level at a d distance from source (m)

L_p - Noise level at the source (1.5m distanced);

ΔL_d - Noise level reduction by distance at frequency i;

$$\Delta L_d = 20 \lg \left[\left(\frac{r_1}{r_2} \right)^{1+a} \right] \quad \text{[CT8]}$$

Where:

r_1 - Distance to noise source with L_p (m);

r_2 - Distance for noise level reduction calculation corresponding distance L_i (m);

a - Specific absorption coefficient of noise with ground terrain ($a = 0.1$);

ΔL_c - Noise reduction through obstacles.

The maximum noise level at various distances due to the operation of construction equipment is presented in the table below:

Table 4.2. Maximum noise by distance due to construction machines of Lach Hoi subproject

No	Machinery and equipment	Noise at distance 2m	Average	Noise by distance (dBA)				
				5m	20m	50m	100m	200m
1	Truck 10T	71 ÷ 80	75.5	71.5	65.5	61.5	58.5	55.5
2	Floating crane 30T	86 ÷ 88	87	83.0	77.0	73.0	70.0	67.0
3	Canoes 12-75CV	80 ÷ 87	83.5	79.5	73.5	69.5	66.5	63.5
4	Barge 300-1000T	85 ÷ 92	88.5	84.5	78.5	74.5	71.5	68.5
5	Mixer 250l	80 ÷ 94	87	83.0	77.0	73.0	70.0	67.0
6	Needle vibrator 1.5KW	74 ÷ 77	75.5	71.5	65.5	61.5	58.5	55.5
7	Excavator 2.3-3.6m ³	79 ÷ 82	80.5	76.5	70.5	66.5	63.5	60.5
8	Bulldozer 110-140CV	72 ÷ 79	75.5	71.5	65.5	61.5	58.5	55.5
9	Water pump 30CV	69 ÷ 71	70	66.0	60.0	56.0	53.0	50.0
10	Watering truck 5m ³	78 ÷ 81	79.5	75.5	69.5	65.5	62.5	59.5
11	Vibratory roller 25T	58 ÷ 70	64	60.0	54.0	50.0	47.0	44.0
12	Air compressor 360 m ³ /h	85 ÷ 89	87	83.0	77.0	73.0	70.0	67.0
13	Generator 50kVA	85 ÷ 87	86	82.0	76.0	72.0	69.0	66.0
14	Pile driving machine/ship 1.2T	82 ÷ 84	84	80.0	77.0	71.0	68.0	67.0
Average noise level				75.6	69.6	65.6	62.6	59.6
Total noise level (maximum)				90.2	84.2	80.2	77.2	70.2
QCVN 26:2010/BTNMT: Normal area noise level				70 dBA				
QCVN 24:2016/BYT: Working area noise level				85 dBA				

According to the calculation results, the average noise level (equivalent noise level) at a distance of 20–30 meters from the vehicles and construction equipment is within the permissible limits of QCVN 26:2010/BTNMT and QCVN 24:2016/BYT, except at the distance of 5 meters, where the

average noise level exceeds the allowable limit by approximately 5.6 dBA. However, the total noise level (maximum) at distances less than 200 meters from the source exceeds the allowable standards of QCVN 26:2010/BTNMT. At distances greater than 200 meters, the total noise level meets the allowable standards.

The impact of noise is limited to workers directly involved in construction and fishermen working in existing Lach Hoi fishing port; employees of the Seafood Processing Plant under Thanh Binh Trading Joint Stock Company, located 20m away.

The noise level at the construction site is assessed as Medium because: (i) the noise generated is intermittent during the construction period, but the total construction period lasts for 24 months; noise from the construction activities at the existing port will affect various parties; (ii) the equipment operates non-simultaneously, depending on working stage/shift or the construction progress/volume of each item. Different types of machinery will be used at different times, so the cumulative impact at the same position is very low compared to the calculated results; (iii) Furthermore, all vehicles and equipment are regularly inspected, and the noise will cease once the construction activities are completed; and (iv) the noise can be minimized through mitigation measures such as providing personal protective equipment and noise reduction devices.

c) Vibration impact

Vibration arises mainly from equipment, machines that operates with high capacity and regularly on the construction site such as bulldozers, excavators, air compressors, pile-driving ships, etc., for activities like ground leveling, pile-driving for embankment/port reinforcement. The typical vibration levels of some construction machinery and equipment are presented in the table below.

Table 4.3. Vibration of some typical construction machinery and equipment

No.	Machinery and equipment	Reference vibration (vertical direction, dB)
1	Excavator	80
2	Bulldozer	79
3	Heavy truck	74
4	Roller	82
5	Gas compressor	81
6	Pile driving ship	80

(Source: U.S. Environmental Protection Agency. *Vibration from construction equipment and construction machinery* NJID, 300.1, 31 – 12 – 197)

To predict vibration attenuation with distance, use the formula:

$$L = L_0 - 10 \lg (r/r_0) - 8.7a (r - r_0) \text{ (dB)} \quad \text{[CT9]}$$

Where:

- L vibration in dB at a distance of “r” meters from the source;
- L_0 vibration in dB measured at a distance of “ r_0 ” meters from the source. Vibration at a distance $r_0 = 10$ m is generally recognized as source vibration.
- a internal vibration reduction coefficient for clay foundation 0.5.

Using formula [9] to predict the reduction of vibration levels with distances that may occur at the Lach Hoi subproject site, the results are presented below.

Table 4.4. Vibration reduction by distance

No.	Machinery and equipment	Source vibration (r0=10m)		Vibration 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	Gas compressor	81	1.93	71.5	0.65	62.1	0.22	52.9	0.08	43.6	0.03
6	Pile driving ship	80	1.88	70.7	0.56	61.2	0.18	51.2	0.06	41.5	0.02

QCVN27:2010/BTNMT, allowable limit 75dB from 6 ÷ 21h and baseline limit from 21h÷6h.

DIN 4150, 1970 (Germany), 2mm/s: no damage; 5mm/s: mortar peeling; 10mm/s: likely to damage load-bearing parts; 20 ÷ 40mm/s: damage to load-bearing parts.

According to the calculation results, the vibration level from construction vehicles and equipment at a distance of 12 meters is within the permissible limits of QCVN 27:2010/BTNMT (<75dB) and will decrease as the distance from the vibration source increases.

Mainly the vibration of construction equipment directly impacts construction workers at the construction site and the structures at the existing port, with particular attention to the position of the monument to the Memorial plaque for Southern Compatriots Regrouping in the North (which is 20 meters away).

The level of direct impact due to vibrations is assessed as Medium because: (i) The operation of equipment is intermittent, with localized impacts at the construction site (the piling process for reinforcing the port embankment is expected to last around six months); (ii) Equipment operators work in shifts and are provided with personal protective equipment; (iii) The surrounding area of the Lach Hoi Fishing port upgrading and expansion subproject site consists of existing structures, including the port embankment (adjacent to the demolition site and next to the newly constructed section to the north), a memorial area located 20 meters away, existing seafood business kiosks, and Seafood Processing Plant under Thanh Binh Trading Joint Stock Company, which is also 20 meters away; (iv) The impact of vibrations can be fully mitigated by applying appropriate construction methods and planning tailored to each specific location.

Impact on vibration to current structures by the port embankment construction activities:

Among the total of 6 sub-projects, there are currently 5 sub-projects involving the construction of revetments and port wharves, including: Lạch Bạng, Lạch Hới, Tam Quan, Khánh Hoà, and Kiên Giang. These sub-projects apply two main construction methods: piling with specialized ships and bored piles.

- Two sub-projects, Lạch Bạng and Khánh Hoà, will apply the bored pile method;
- Three sub-projects, Lạch Hới, Kiên Giang, and Tam Quan, will apply the piling method with specialized ships to reinforce the revetments and port wharves.

The bored pile method has the significant advantage of not generating significant vibrations, thereby minimizing the risk of damage to surrounding existing structures or facilities.

The piling method with specialized ships helps ensure the stability of the project but may cause strong vibrations, posing a potential risk of cracking, damage, or collapse of nearby structures. When performing this work, the pile driving equipment will press a sizeable force on the pile down to the required depth. The impact force will cause waveform vibration on the ground. The vibration will cause fracture in geological links and links between the structure with geological background, causing trembling and cracking even collapsing for the building. According to the initial technical calculation, the risk on infrastructure impacts like cracking/collapse is within the radius of 30-50 m (for piles driven deeper than 10m) and a radius of approximately 5 – 30m (for piles driven less than 10m), depending on the geological characteristics and the depth of the piles in each area.

When carrying out this work, the pile driving equipment will apply a large compressive force on the pile to drive it to the required depth. The impact force will generate wave-like vibrations that propagate through the ground. These vibrations can cause geological connections to break as well as connections between the structure and the underlying geology, leading to shaking, cracking, and even collapse of the structure.

According to the initial technical calculations, the risk of infrastructure collapse may occur within a radius of 30–50m for piles driven deeper than 10m, and within a radius of approximately 5–30m for piles driven less than 10m, depending on the geological characteristics and the depth of the piles in each area.

For the Lạch Hới subproject, the pile driving area is located more than 50m away from existing structures such as the current dock quay, workshops, and existing fishery logistics service structures. However, it will be adjacent to the internal traffic roads within the port. Therefore, there is a potential risk of cracking or road collapse if appropriate construction and mitigation measures are not implemented.

The impact level is assessed as Medium because the internal roadbed in the port is reinforced with solid concrete pavement, with a width of 12–15m, and the pile driving work is not continuous but localized at each pile point. These impacts can be minimized through appropriate technical measures and reasonable construction organization.



Location of the river embankment reinforcement construction area of Lach Hoi subproject

d) Wastewater impact

The wastewater generated during construction of Lach Hoi subproject can be categorized into three main types: (i) Domestic wastewater from construction workers; (ii) Construction wastewater generated during construction; (iii) Rainwater runoff flowing through the construction site:

i. Domestic wastewater from construction workers:

Domestic wastewater during the construction phase of the Lach Hoi subproject originates from workers' activities. Expectedly, 60 workers will be mobilized over a construction period of 24 months. The estimated water supply norm is 50 liters/person/day. Assuming that 100% of the supplied water is converted into wastewater, the total generated domestic wastewater is calculated as 3 m³/day.

Domestic wastewater contains various components, including: Suspended solids (TSS), Organic matter (BOD₅, COD), Nutrients (N, P), Pathogenic microorganisms. The daily pollutant load generated by 60 workers (considering the maximum number of workers accommodated in the temporary camps) and the concentration of pollutants discharged into the environment are presented in the following table.

Table 4.5. Pollutant load in domestic wastewater

Pollutants	Pollution coefficient (g/person/day)		Load (kg/day)		Pollutant concentration (mg/l)		
					Before treatment	QCVN 14:2008 column B	
BOD ₅	45	54	2.7	3.24	642.9	771.4	50
COD	72	102	4.32	6.12	1028.6	1457.2	-
TSS	70	145	4.2	8.7	1000	2071.5	100
Grease	10	30	0.6	1.8	142.9	428.6	20
Total Nitrogen	6	12	0.36	0.72	85.8	171.5	50
Ammonia (N-NH ₄)	2.4	4.8	0.144	0.288	34.3	68.6	10
Phosphor	0.8	4	0.048	0.24	11.5	57.2	10
Total Coliforms	1.00E+06	1.00E+09	6.0E+04	6.0E+07	1.4E+07	1.4E+10	5000 (MNP/10 0ml)

(Source: Pollutant load factor in domestic wastewater according to documents from Metcalf and Eddy, *Wastewater Engineering – Third Edition*, 1991)

The concentrations of pollutants such as BOD, COD₅, TSS, NH₄⁺, etc., in domestic wastewater during the construction phase, if untreated, all exceed the permissible limits of QCVN 14:2008/BTNMT (Column B). Therefore, if domestic wastewater is not adequately treated before being discharged into the receiving source, which is the Ma River, the quality of the Ma River water will deteriorate as the pollutant concentrations increase. Aquatic species will be directly affected due to the reduction of dissolved oxygen in the water (this content will be specifically assessed in the next section).

In addition, the construction workers gathered at temporary camps during the construction of the Lach Hoi subproject; and the fishermen currently operating at the existing Lach Hoi port are also

directly affected by this waste source. This waste source contains many pathogenic microorganisms that pose risks of developing skin diseases, eye diseases, gastrointestinal diseases, and infectious diseases for the construction workers.

The risk level is assessed as **Low** as: (i) the amount of wastewater generated is intermittent throughout the day and is not large ($3 \text{ m}^3/\text{day}$); (ii) some local workers will rent local houses for temporary residence, so the actual amount of wastewater generated is much lower than calculated; (iii) the wastewater is generated intermittently during the day (mainly during the workers' rest and living hours but extended over approximately 24 months of construction); (iv) the flow rate of the Ma River which is the receiving source, is quite large (the average annual flow of the Ma River basin is about 19.52 billion m^3 , equivalent to 54.2 million m^3/day). These risks can be mitigated through appropriate mitigation measures.

ii. Construction wastewater:

Wastewater during the construction phase of the Lach Hoi subproject comes from (i) washing the wheels before leaving the construction site; (ii) the operation of small-capacity mortar and concrete mixers used for casting small components (the rest is commercial concrete which is to be purchased); and (iii) washing construction equipment and tools. The total amount of construction wastewater generated is approximately $5.98 \text{ m}^3/\text{day}$. Among them:

- Motor vehicle washing water is mainly used to clean the wheels before leaving the construction site. A vehicle washing station will be set up at the construction site to serve for this purpose. According to TCVN 4513-1988, internal water supply - design standards, the amount of water used to wash the entire vehicle is rated at 500 liters/wash, but during the construction phase, motor vehicles mainly only wash the wheels, so estimated average amount of wheel cleaning water is 100 liters/vehicle. The number of vehicles transporting materials is estimated to be 7 vehicles per day, and the number of waste transport trips is 4 per day (total at peak period is 11 trips per day), resulting in the wastewater generated being: $11 \times 100 = 1,100$ liters per day = 1.1 m^3 per day.
- Concrete mixing activities at construction sites use 250l concrete mixers, total capacity of $30 \text{ m}^3/\text{h}$. According to the document '*Concrete Technology and Special Concrete*' by Pham Duy Huu, Construction Publishing House 2009, the amount of water needed in the concrete mixing process with a capacity of $30 \text{ m}^3/\text{h}$ will be 9.69 m^3 for washing the aggregates and 5.4 m^3 for mixing the concrete. Of this, 80% of the water used to wash the aggregates will be recycled and reused. Therefore, the wastewater generated during the concrete mixing process at the construction site is $20\% \times 9.69 = 1.94 \text{ (m}^3/\text{h)}$. On average, the concrete mixing activities take place for 2 hours/day, so the amount of wastewater generated from the concrete mixing activities is $1.94 \times 2 = 3.88 \text{ (m}^3/\text{day)}$.
- Construction equipment and machinery are washed once at the end of each construction day, estimated to be about $1 \text{ m}^3/\text{day}$.

The amount of construction wastewater generated is not large, and the wastewater mainly consists of suspended solids, oils and grease, soil, sand, etc. When being directly discharged into the Ma River in the Lach Hoi project area, this wastewater will cause several impacts as follows: High levels of suspended solids, increasing the turbidity of the water, reducing the ability of oxygen dissolution from the air into the water, thereby adversely affecting the aquatic life in the Ma River; Sedimentation built up in the receiving body, which is the surface water of the Ma River.

The impact level is assessed as Low as: (i) the volume of construction wastewater generated at the site is not large ($5.98 \text{ m}^3/\text{day}$); (ii) the wastewater is concentrated in the construction site areas;

(iii) the wastewater is generated intermittently throughout the day (mainly 2 to 8 hours of construction but extends over approximately 24 months of construction); (iv) the flow rate of the receiving source, the Ma River, is quite large (accounting for only 0.000004% of the average annual flow of the Ma River basin); furthermore, this is the area of the existing Lach Hoi fishing port, so the water quality of the Ma River has already been impacted by previous fishing port activities and (v) the risks can be mitigated through appropriate measures.

iii. Rainwater runoff

Rainwater runoff during the construction phase is calculated based on the surface area of Thuy Tan fishing port site, excluding the water surface area. According to TCVN 7957:2008, the amount of rainwater runoff across the site of project construction areas is calculated according to the following formula:

$$Q_m = q.C.F \text{ (l/s)} \quad \text{[CT10]}$$

Where:

- q: Rain intensity (l/s.ha).
- C: Runoff coefficient (choose 0.4 corresponding to P of 02 years and the grass surface has an average slope of 2-7%).
- F: Basin area (ha).

Rain intensity is calculated according to the formula [11] below:

$$q = \frac{A (1 + ClgP)}{(t + b)^n}$$

Where:

- q: Rain intensity (l/s.ha).
- P: Repeat cycle of rain (P = 02 years).
- t: Rain flow time in the project area (about 90 minutes);
- A, C, b, n: Climate constant depends on rainfall conditions in the area.

Based on TCVN 7957:2008, rainwater runoff flowing through the Lach Hoi subproject site is calculated according to the formula [10], the construction area of the Lach Hoi fishing port is F=7.65 ha; the parameters based on the climate constants of Thanh Hoa province are: A=3640; C=0.53; b=19; n=0.72. Substituting these values into formula [11], the calculated rainfall intensity at the Lach Hoi subproject construction site is: **q=144.026 (l/s.ha)**.

Therefore, the rainwater runoff flow rate on the construction site is calculated to be 374.6 l/s, equivalent to 0.374 m³/s and 1,349 m³/h.

According to WHO data (1993), the concentration of pollutants in rainwater runoff is about 0.5 - 1.5 mg N/l, 0.004 - 0.03 mg P/l, 10 - 20 mg COD/l and 10 - 20 mg TSS/l, these parameters are lower than the allowed standards according to QCVN 40: 2011 / BTNMT - National standards on industrial wastewater quality. However, rainwater flows over the construction site area, carrying away materials, loose soil and rocks, mineral salts on the surface, leaked oil and grease, etc., increasing the content of suspended substances and impurities, organic matter, increases turbidity, oil and grease in water, reduces water quality, and negatively impacts the aquatic ecosystem of Ma

river, receiving source of the subproject. Pollutants from surface runoff can affect water quality and aquatic organisms living in surface water ecosystems of Ma river at Lach Hoi fishing port once the turbidity increases.

The impact level is assessed as medium as: (i) the amount of rainwater runoff at the construction site is moderate (1,349 m³/h, the heaviest rain lasts 1.5 hours); (ii) rainwater runoff is concentrated in the construction site areas; (iii) the rainwater runoff is usually intermittent throughout the year (the rainy season is from May to November but extends over approximately 24 months of construction); (iv) the flow rate of the receiving source, the Ma River, is quite large (accounting for only 0.000004% of the average annual flow of the Ma River basin); and (v) the risks can be mitigated by appropriate measures such as regular cleanup by workers at the construction site, installation of rainwater drainage systems, and sedimentation pits at each site to limit debris, loose soil, and rocks being washed away by rainwater runoff.

e) Solid waste

Solid waste generated during the construction phase for construction items includes the following 3 main types: (i) Construction solid waste; (ii) Domestic solid waste; (iii) Hazardous solid waste. The generated volume is evaluated as follows:

i. Construction Solid Waste:

Construction solid waste of Lach Hoi subproject is the volume of debris from demolition of degraded embankments, roads on the port with 1,285m³, and plant biomass with 1.5 tons, excess excavated soil with 16,040m³, debris with 267 m³ from construction activities at the site. The solid waste mainly includes common solid wastes, and waste materials, etc.

- The solid waste generated from the demolition of existing structures of Lach Hoi subproject is approximately 1,285 m³, mainly consisting of construction waste such as tiles, planks, mortar, concrete debris, and approximately 1.5 tons of cleared vegetation biomass (some wild mangrove and shrub bushes growing along the river in the port expansion area).
- The volume of excavated soil generated by the Lach Hoi subproject is not large, amounting to 16,040 m³.
- A small amount of debris generated during the construction includes excess mortar, wood chips, broken bricks, etc. According to *Decision No. 1172/QĐ-BXD dated December 26, 2012, issued by the Ministry of Construction stating the construction project estimate norms*, the estimated amount of construction solid waste generated is approximately 0.5% that of the materials used for the subproject, equivalent to about 267 tons.

The construction solid waste primarily affects the staff and workers involved in the construction, as well as the fishermen operating at the existing Lach Hoi fishing port. The employees of Seafood Processing Plant under Thanh Binh Trading Joint Stock Company, located 20 meters away, are also affected. This waste source increases dust concentration, which can impact the health of workers and fishermen. Randomly piled construction solid waste obstructs pathways with bulky items and slippery surfaces, which can cause accidents for workers and fishermen. Additionally, if the large volume of construction solid waste mentioned above is not properly collected and managed, it will be washed away by rainwater runoff on the construction site, reducing the quality of the receiving water source, the Ma River. It can cause sedimentation and blockage of the surface flow at the port, leading to the risk of local flooding at the construction site and surrounding areas, especially during the rainy season (from May to November every year).

In general, this direct impact is assessed to be **Moderate** because: (i) The volume of waste

generated is not large and localized at each construction site; (ii) Long-term construction period (about 24 months); (iii) construction solid waste will be collected and transported to the local approved disposal site of Waste Treatment Area Dong Nam commune, Dong Son district, about 20-25km from the subproject site. (iv) At the same time, this impact can be minimized through appropriate mitigation measures.

ii. Domestic solid wastes:

Domestic solid waste arises from daily activities of construction workers in camps which are planned to be installed in the construction site of Lach Hoi fishing port. The main components of domestic solid waste include easily decomposable organic substances and difficult-to-decompose inorganic substances such as nylon bags, bottles, and old personal items. The average amount of household solid waste emissions is about 0.5 kg/person/day QCXDVN 01:2021/BXD - National Technical Regulations on Construction Planning, with the expected 60 workers for Lach Hoi subproject, the amount of daily solid waste generated is 30kg/day, equivalent to 0.9 tons/month.

This waste component includes: organic matter, waste paper of all kinds, nylon, plastic, metal, damaged daily living items, etc. This waste contains 60 - 70% organic matter and 30 - 40% of other substances and especially may contain many bacteria and pathogens.

The direct impact will be on the workers participating in the construction and staying in temporary camps, and the fishermen operating at the existing port. Additionally, if the generated domestic waste is not collected and treated properly according to regulations, it can cause an unsightly area. When waste is littered on the ground, under the effects of weather and bacteria, organic compounds decompose, it creates malodors that pollute the air, increase the risk of disease outbreaks, and affects the health of staff and workers participating in the construction and activities of fishermen in nearby facilities like the seafood processing plant of Thanh Binh Trading Joint Stock Company, located 20 meters away from the construction site. Furthermore, if domestic solid waste is not collected and treated, it will be washed away by rainwater runoff, flowing into the Ma River at the Lach Hoi fishing port construction area, reducing the quality of surface water and affecting the aquatic ecosystem of the Ma River.

However, the impact of domestic waste is assessed as 'Low' and can be mitigated as: (i) The amount of waste generated at the construction site is not significant and is collected daily by the waste collection service which is currently serving for Lach Hoi port; (ii) It is locally generated at the construction sites; (iii) The impact duration extends over approximately 24 months of construction, and the contractor uses local labor to limit the amount of domestic waste generated; (iv) It can be mitigated through appropriate measures.

iii. Hazardous waste:

Sources of hazardous waste generated from the construction of project items include: (i) Oil-contaminated materials from the maintenance of construction machinery; (ii) Packaging, containers for lubricants, asphalt, gasoline, and paint; (iii) Excess tip of welding rod; (iv) Batteries, light bulbs, ink cartridges from office activities at construction sites. The volume of hazardous waste depends on the quantity of equipment/machinery, labor, and quantity of raw materials:

- Maintenance activities of construction vehicles, vehicles, and machines, if performed right at the construction site, also generate lubricant residue, lubricant bottles and lubricant-contaminated rags,... (estimated at about 3kg/month).
- Packaging containers, lubricant oil containers, asphalt containers, gasoline containers, and paint containers are not generated in large amounts (about 20kg/month).

- Waste welding rods are generated at the construction site due to shaping activities of steel frames of house within Lach Hoi fishing port. It is estimated that 5-7% of the excess welding rod tip will be generated from the welding rod weight, so each subproject will generate about 3.0kg of excess welding rod tips.
- In addition, there is a small amount of hazardous waste (broken battery, light bulbs, ink cartridges) generated from office activities, the volume is about 5kg/month.

No.	Hazardous wastes	Code	Estimated volume
1	Gloves, rags contaminated with hazardous waste, oil-stained filter cloths	18 02 01	3 kg/month
2	Broken light bulbs	16 01 06	5 kg/month
3	Metal waste packaging (paint cans, paint, paintbrushes) during the finishing stages of the subproject, with the painting process lasting approximately 2 months	18 01 02	20 kg/month
4	Waste welding rods	07 04 01	3 kg/month

The staff and workers participating in the construction, as well as the fishermen operating at the existing port will be directly affected. If hazardous waste is not properly collected and treated, it will cause unsightly conditions, deteriorate the quality of the surface water quality of the Ma River, and degrade the soil quality in the sub-project area.

The impact level is assessed as Low because: (i) the amount of hazardous solid waste generated at the construction site is not large (31 kg/month) and is localized to certain construction phases; (ii) there are existing functional units in the subproject area for the collection and treatment of hazardous waste; besides, repairs of equipment and construction vehicles are expected to be carried out at local professional repair centers; (iii) the impact is intermittent but extends over approximately 24 months of construction; (iv) the risks can be mitigated by appropriate measures.

f) Impact on Ecological Environment

Terrestrial ecosystem:

The impact on terrestrial biological resources is mainly due to the process of reinforcing the embankments of the expanded structures in the Lach Hoi fishing port and activities such as removing the organic soil layer/clearing vegetation, which will result in the loss of the vegetation cover (approximately 1.5 ha of naturally growing mangrove trees along the Ma River in the port expansion area). In addition, construction activities will generate noise and vibrations that may affect terrestrial animals (such as reptiles, birds, some domestic animals like buffaloes, cows, dogs, chickens, cats, etc.). During the dry season construction, workers may carelessly cause sparks while welding or cutting steel, burning construction waste, or engaging in cooking activities outside the camp/construction area, which could ignite nearby shrubs. This would destroy the surrounding vegetation and shrubs, damaging the landscape.

The affected subjects are terrestrial biological resources in and around the existing Lach Hoi fishing port area.

The impact level is assessed as medium because: (i) The Lach Hoi subproject area is being implemented on the land planned for expansion of fishing port, with some shade trees/landscape trees planted long-term at the existing port and 1.5 ha of naturally growing mangrove trees along the Ma River mentioned above. Therefore, terrestrial biological resources are insignificant (mainly

reptiles, field birds, some domestic animals like buffaloes, cows, dogs, chickens, cats, etc., from residential areas and existing kiosks on the port); (ii) Around the construction area, there are green belts planted along urban roads in the residential area of Quang Tien ward (*Terminalia catalpa*, Flamboyant tree, Crape myrtle tree, etc.); (iii) The impact is intermittent but extends over 24 months of construction; (iv) The impacts can be mitigated by appropriate measures.

Aquatic species:

As discussed above, wastewater and rainwater runoff running through the camp area and construction site can increase turbidity, organic content (represented by the BOD), nitrogen, and oils and grease in the receiving water source, the Ma River, in the Lach Hoi fishing port expansion area. Increased water turbidity will hinder light from reaching aquatic plants, leading to reduced photosynthesis activity. Increased suspended solids in the water can affect the respiratory systems of aquatic animals. The decomposition of organic matter will lead to a reduction in dissolved oxygen in the water, affecting aquatic life. Oils, grease, and other hazardous substances can be detrimental or fatal to aquatic flora and fauna, etc.

The potential impacts on the aquatic ecosystem of the Ma River are assessed as **Low** because: (i) There are no rare or endangered aquatic species in the project area. However, workers might catch fish (various natural fish species such as carp, goby, tilapia, grass carp, brackish water fish, shrimp, crab, clams, and mussels in the Ma River). Nonetheless, due to the activities of boats entering and exiting, and the discharge of untreated wastewater at the existing port, the water quality of the Ma River at the port has already deteriorated, and consultations with fishermen have indicated a significant decline in the quantity of these species at the port area. Additionally, wastewater and rainwater runoff can increase water turbidity, negatively affecting aquatic species, especially benthic organisms (aquatic organisms in the project area of the Ma River include: zooplankton mainly of copepods, cladocerans, and rotifers; benthic animals mainly of snails, mussels, clams, crabs, shrimps, etc.; aquatic plants mainly of water hyacinth, algae, etc.); (ii) The impact period is intermittent, mainly during the rainy season, but extends over approximately 24 months; (iii) These impacts can be mitigated by appropriate measures such as dredging settling pits at the construction site and treating wastewater from camps before discharging into the environment.

g) Impacts due to erosion, sedimentation and local flooding

During the construction and upgrading of the Lach Hoi subproject structures (3.61 ha of the existing port area being upgraded and 4.04 ha of the port expansion area), the erosion and sedimentation are mainly caused by rainwater runoff passing the construction site surface, carrying waste into the receiving water source, the Ma River, as follows:

Heavy rain can cause erosion, and carry floating materials such as waste soil and rocks, oils and grease, waste, mortar, concrete, etc. to the construction site. These materials, when being carried away by rainwater, will affect the water quality of the receiving source, the Ma River. However, these impacts are only temporary during the construction phase. Once the construction of the main structures and technical infrastructure of the fishing port is completed and the area is hardened, these impacts will cease.

Risk of localized flooding: During construction, the elevation of the ground in the Lach Hoi fishing port expansion area increases, and the surface of the area also changes, causing faster water accumulation, which affects drainage capacity. However, these impacts are not significant because the existing fishing port is being upgraded on an already concreted surface with existing drainage systems; the expanded area (4.04 ha) is also on existing land and port surface planned for the fishing port expansion, so it will not change the overall topography of the area. Moreover, the port

expansion area is along the Ma River where the drainage conditions are good. Therefore, there is no risk of localized flooding at the construction site.

Overall, the impact level is Low as: (i) The area is being developed on the planned land for port expansion and has accounted for natural factors (rainfall, Ma River water level, climate change impacts such as rising sea levels); (ii) The impact is intermittent, mainly occurring during the rainy season over a construction period of approximately 24 months; (iii) The Lach Hoi fishing port expansion area has a favorable terrain with existing water supply and drainage infrastructure of the current port; (iv) The impact can be mitigated by appropriate measures.

h) Impacts due to risks increase and traffic disruption

Road traffics:

Construction activities may moderately increase the number of road transport vehicles carrying construction materials (around 7 trips/day), transporting waste (around 4 trips/day), and moving construction machinery/equipment in and out of the Lach Hoi subproject area. The movement of heavy vehicles (excavators, cranes, bulldozers, rollers, etc.) can disrupt the existing traffic flow on the roads and increase the risk of traffic accidents for road users.

The increased traffic intensity due to transportation of materials will directly affect construction workers, fishermen operating at the existing Lach Hoi fishing port, and employees of Seafood Processing Plant under Thanh Binh Trading Joint Stock Company, located 20 meters away. Besides, it will indirectly affect residents of Quang Tien ward, located 80 meters from the construction site, and those living adjacent to the road, as well as teachers and students of Quang Tien Secondary School and Quang Tien Kindergarten, located 20-50 meters from the main material transportation route (Tran Hung Dao Street).

Additionally, the quality of the main transportation route—Tran Hung Dao road—could be affected by the activities of heavy construction trucks/machinery, creating potholes, rough patches, and water-filled depressions during rain, which increase the risk of traffic safety issues for people and vehicles.

The impact level is assessed as medium as: (i) The number of transport trips is small (11 trips/day), and the machinery is only mobilized for certain periods when needed and upon project completion; (ii) The impact period is intermittent (but long-term, lasting approximately 24 months); (iii) There are many affected parties, and the density of traffics on the main transport route is high due to trucks/motorcycles entering and exiting the existing port to transport seafood caught by fishermen and providing port logistics services, especially during peak hours of some schools/offices such as school start time (7-8 AM) and end time (4-6 PM) daily on the main transport route; (iv) This impact can be mitigated through appropriate measures.

Waterway traffics:

Water traffics may also be impacted by the increase in the number of construction machinery moving on the water, such as canoes, 30T floating cranes, barges, pile driving ships, etc., which need to travel to the construction site by waterway. Currently, water traffics on the Ma River in the Lach Hoi port area is quite busy (around 20 ships docking per trip, with about 300 ships regularly moored).

In addition, construction activities in the water (such as floating cranes, barges, and pile driving ships for the construction of port embankments) can narrow or block the docking area at the existing port section which is being renovated. However, this will not affect the port expansion area.

Impact on waterway traffic is assessed as medium and localized as: (i) The Ma River in the Lach Hoi subproject area has a width of about 550m-600m (in the project area, 4km from the sea, the river width near the sea is larger, around 700m-900m). The remaining width of the Ma River is still sufficient for local boats to navigate; (ii) Construction machinery on the water is fixed at a certain section, thus limiting the impact on the docking activities of fishing boats; (iii) The existing docking area of Lach Hoi port is quite long (about 250m, with multiple docking bridges), so it will not significantly affect the mooring activities of ships; (iv) Good waterway and road traffic safety management during the construction phase will prevent, mitigate, and reduce the impact on traffic, including traffic accidents.

i) Risks of damages to existing infrastructures due to construction material transportation and operation of machineries

Transporting materials to the construction site by heavy trucks can damage the roads. Tran Hung Dao street is the main route for transportation to Lach Hoi port, it is about 8-12 meters wide, with good quality asphalt concrete, drainage ditches along both sides, and sidewalks. The quality of Tran Hung Dao road can be affected by the activities of heavy trucks/construction machinery, creating potholes, rough patches, and water-filled depressions during rain, increasing the risk of traffic safety issues for people and vehicles. Moreover, the activities of cranes, excavators, bulldozers, etc., can affect existing technical infrastructure such as power grids, telephone lines, some kiosks near the port expansion construction area, and existing port docking bridges.

In addition, within the fishing port area, there are several businesses providing fishing logistics services. Specifically, at Lach Hoi fishing port, there are 05 facilities for preliminary processing and trading of seafood; 5 facilities for producing and supplying ice; 01 facility for supplying petroleum; 4 for providing essential goods; and 3 for purchasing products at the port. The construction activities for upgrading and expanding the port may somewhat affect the business operations of these service stores due to construction activities, the gathering of bulky materials, construction machinery, dust dispersion, noise, and waste, etc.

The impact level is assessed as medium because: (i) The quality of Tran Hung Dao road is currently good; the internal roads within the port are made of concrete and are quite wide and of good quality; the functional zones within the existing port are specifically arranged to avoid disruption by the construction activities for upgrading and expanding the port; (ii) The impact period is intermittent but long-term, lasting approximately 24 months of construction; (iii) The impact can be mitigated by taking appropriate construction management measures (such as: prior notification to fishermen and business households at the existing Lach Hoi port; using alternative transportation methods such as waterways instead of roads, if necessary; only allowing trucks with appropriate load capacities to operate on the road; restoring the road surface when it deteriorates during construction and upon completion of construction activities).

k) Issues related to occupational health and safety (OHS)

For the Lach Hoi subproject, it is expected to mobilize about 60 workers to participate in construction for approximately 24 months. Therefore, there will be potential occupational health and safety (OHS) risks as follows:

Risk of occupational accidents during construction:

- Workers may work in environments with increased dust and toxic gas pollution due to demolition, excavation, and machinery activities, which can lead to dizziness or fainting while working. Workers can have accidents due to exposure to electrical tools/equipment, dangerous objects such as sharp iron, nails, screws, and the simultaneous operation of

multiple machines in a narrow construction site, especially when workers are not paying attention, not using full personal protective equipment, and lacking awareness of safety regulations. Construction activities can cause other occupational accidents for workers such as fires and explosions due to welding-gas leaks, fuel leaks, welding activities, electric shocks, working at heights, falling into the sea, construction collapses, and the operation of bulky machinery and materials, as well as working in extreme weather conditions such as large waves, strong winds, and poor construction site organization.

- Regarding working conditions, workers' OHS problems can be caused by falling into water or even drowning while working on water/sea due to illness or loss of balance. In addition, they can also come into contact with materials containing toxic substances such as oils, etc. If direct contact is made, short-term health effects can be skin or respiratory system irritation while some substances have can penetrate through the skin and enter the body system. The accumulation of toxic substances during work will lead to more serious long-term health effects, so it is necessary to be concerned.
- Other OHS issues related to working conditions would be inadequate lighting or inadequate protection when working in specific conditions or locations.
- Working with construction electric or diesel tools and equipment (e.g. barges, sand pumps, cranes, hoists, drilling/piling machines, etc.), workers can also be electrocuted or burned. . Extreme weather conditions also cause OHS risks and issues. Strong winds and very heavy rain during storms in coastal areas can cause unfinished/temporary construction works, even construction factories to become unstable, and even cause some tools and equipment to move. Outdoor construction equipment and materials lead to accidents for people around, including workers. Working long hours on very hot days can also cause exhaustion and even fainting for workers.
- Regarding worker behavior, safety risks can come from workers' awareness and attitude towards the use of Personal Protective Equipment (PPE) and personal behaviors at the construction site. Regarding PPE, it is common for workers at larger and more experienced contractors to be well-trained in EHS and provided with adequate PPE, so they are often subject to more stringent safety rules on site. school. However, workers of smaller/local contractors using PPE (e.g. used as life jackets in rivers/sea) on construction sites depends on the level of enforcement. Examples of careless worker behavior that can lead to accidents or even dangers in construction areas include smoking near flammable materials such as oil tanks, careless handling of electrical wires, Illegal use of construction machinery.

The risk related to workplace accidents at the construction site is assessed as Medium because: (i) These impacts are always potentially present on the construction site at any time; (ii) The number of workers is not large (60 people); (iii) This risk may occur during the 24-month construction period; (iv) It can be mitigated by appropriate solutions such as safety training before and during the construction process and providing adequate labor equipment for workers.

Reduce workers' health:

- For dredging workers as well as other construction workers, inadequate living conditions in workers' housing also lead to health and safety problems. Illnesses related to water-borne diseases can be caused by not having enough clean water for use, not having access to adequate sanitation facilities, and poor sanitary conditions in and around the camp. Living at a construction site, away from home for a long time, if workers do not follow a healthy lifestyle and get into fights, drinking, or prostitution, they can also suffer long-term health effects from these activities.

- Increase the risk of infectious diseases (such as dengue fever, diphtheria, etc.), including HIV/AIDS, when workers come from different localities and interact with each other and with the local community.

The impact on workers' health is assessed as Low because: (i) Waste sources will be controlled through impact mitigation measures; (ii) The number of workers is not large (60 people), and there is convenient and widespread local information on issues related to the transmission of sexually transmitted diseases, including HIV/AIDS, and the use of prohibited substances; (iii) This risk may occur during the 24-month construction period; (iv) It can be mitigated by appropriate solutions such as safety training before and during the construction process.

Risk of fire and explosion:

Fire and explosion incidents, as well as electrical short circuits, may occur during the transportation and storage of fuel or due to the lack of safety in the temporary power supply system, causing damage to people and property during subproject implementation. The specific causes can be identified as follows:

- Temporary storage facilities for raw materials serving machinery and technical equipment during construction (paint, gasoline, etc.) are sources of fire and explosion. When incidents occur, they can cause damage to people, property, and the environment.
- Electrical incidents such as shocks, explosions, short circuits, etc., due to the temporary power supply system for construction machinery and equipment.
- The use of heating devices (welding, heating, etc.) can cause fires, explosions, or workplace accidents if preventive control measures are not in place.
- Especially in the case of thunderstorms, lightning strikes and workers' carelessness in using electrical equipment are the main causes of short circuits and explosions.
- Careless behavior of workers can lead to accidents or even danger in construction areas, including smoking near flammable materials such as fuel tanks, careless handling of electrical wires, unauthorized operation of construction machinery.

Electrical short circuits and explosions can damage construction machinery and equipment, and cause fires in camps and material gathering areas during the construction phase. Since such incidents can occur at any time, the project owner actively takes effective preventive and control measures to minimize and limit these negative impacts as much as possible.

Overall, the risk of fire and explosion at the construction site is assessed as medium because: (i) This risk is always potentially present on the construction site at any time, especially during the dry season; (ii) The existing fishing port consists of shops, seafood processing facilities, storage and supply services for fishing boats docking at the port, which contain flammable materials such as cardboard, gasoline, oil, etc.; (iii) This risk may occur during the 24-month construction period; (iv) It can be mitigated by appropriate solutions such as providing adequate firefighting equipment, ensuring that fire hydrants are available at Lach Hoi port, and regularly raising awareness among workers and fishermen/service facilities about fire fighting and prevention, as frequently disseminated by the Lach Hoi Fishing Port Management Board.

1) Issues related to community safety and health

Local residents living around the construction site, including the residential area of Quang Tien ward located about 80-100 meters from the Lach Hoi fishing port upgrading and expansion area, have a high density with about 200 households. Households and some schools and agency offices

along Tran Hung Dao road, the transportation route, are located about 20-50 meters from the road and may be exposed to hazardous waste, domestic solid waste, and construction solid waste. Moreover, increased dust levels, noise, and traffic density due to machinery and vehicle operations, soil subsidence and landslides, construction collapses, and uncovered deep holes at the construction site can cause health and safety risks for the community—especially fishermen and workers from some seafood processing and fishing logistics service facilities engaging in daily trading and activities at the port.

The risk to community health and safety is assessed as Medium because: (i) The construction area of the Lach Hoi subproject is being carried out at an existing fishing port with certain existing infrastructure and under the effective operation of the port management board; (ii) The number of concentrated workers is not large (about 60 people at the sub-project), concentrated in one construction area; (iii) The construction period is moderate (about 24 months); (iv) Local labor will be prioritized to employ; (v) Workers are trained in occupational safety and environmental hygiene before carrying out construction activities; (vi) This risk can be mitigated through appropriate construction arrangement measures and reasonable construction site layout.

m) Social impacts due to labor influx

It is estimated that about 60 workers will be mobilized during the peak period of the subproject implementation. This number of workers may come from different locations of project provinces/cities or other provinces. Some potential social risks and impacts related to labour influx of this project are predicted as follows:

- Inappropriate management of workers and worker camps may lead to environmental issues such as discharging wastewater to environment, throwing or dumping solid waste into Ma river or existing port...
- Labor influx may cause risks to local security or social stability if some workers participate in social evils (such as drinking, gambling, prostitutions etc.).
- The mobilization of migrant workers may lead to increased risks of infectious disease transmission, including HIV/AIDs when the workers come from different localities, interact with each other and with local communities. If pandemic happens, it will create additional burdens to local health care system of the province/city.
- Potential conflict between workers and local communities because of differences of background, culture, customs, jobs and incomes.
- Gender Based Violence (GBV), Sexual exploitation and abuse/Sexual Harassment (SEA/SH) risks related to the concentration of number of male workers to the project area. However, GBV and SEA/SH risks are assessed to be low and manageable.

In general, **Impacts due to labor influx of Lach Hoi subproject is assessed to be Low** because (i) the number of workers is not large (60) and they will register to temporary residence with local authorities during construction period and (ii) with the convenience and widespread dissemination of local media information regarding issues such as sexually transmitted diseases, including HIV/AIDS, the use of prohibited substances, and cultural behaviors; (iii) The Lach Hoi fishing port management board is already effectively operating to control general activities within the port, including managing contractors involved in the project; (iv) This risk may occur at any time during the 24-month construction period; (v) This risk can be mitigated through appropriate measure such as preparing a code of conduct for workers, and raising workers' awareness about cultural, social, and health issues before and during the construction process.

n) Impacts on cultural heritage

The position of upgrading and expanding Lach Hoi fishing port covers the Memorial Plaque for Southern compatriots regrouping to the North, located about 150 meters from the project site, and within Lach Hoi fishing port, located about 20 meters from the project site. These cultural assets will be temporarily impacted by dust, waste, vibrations, and the awareness of construction workers. This content will be evaluated in detail in the specific impact section below.

On the other hand, the subproject's construction activities, which include excavation and pile driving, may reveal cultural relics during the construction process. Therefore, the procedure for handling these chance finds is included in the project's Environmental and Social Management Plan (ESMP), which will be detailed in Chapter 5 below.

4.1.2.2. Site-specific impacts during construction of Lach Hoi sub-project

From the location, scale of investment, and characteristics of the social community in the area where the Lach Hoi subproject is implemented, as mentioned in Chapters 1 and 2, the specific impacts of the construction activities for the Lach Hoi subproject include:

- Loss of shoreline vegetation in the port expansion area;
- Disturbance to the operation of fishing vessels entering and exiting the existing Lach Hoi fishing port;
- Impacts on nearby seafood processing businesses/facilities;
- Impact on several sensitive receptors

The details of the impact assessment are presented below:

(i) Loss of shoreline vegetation in the port extension area

In the construction and upgrading area of Lach Hoi port, there are a few mangrove trees (black and grey mangrove trees) growing along the banks of the Ma River within the port area. These trees grow naturally on land designated for port development and are not part of protected forest land. These clumps of trees will need to be cleared to create space for the upgrade works of Lach Hoi port.



Cluster of parrot trees



Cluster of parrot trees

This felling will result in the loss of vegetation cover - about 0.15 ha of flooded mangrove trees growing naturally on the banks of the Ma River in the area where port extensions are being built. This will destroy the existing vegetation and green landscape in the port, this impact is inevitable according to the approved planning.

In addition, mangrove trees, known for their tendency to overgrow and grow in intertwined clumps, play a crucial role in retaining soil, protecting the banks, and minimizing the risk of landslides on

the Ma River banks. When these trees are cut down, it will increase the risk of riverbank erosion and landslides at these local locations.

In general, the impacts are assessed as medium due to (i) the Lach Hoi subproject being implemented on the planned fishing port expansion land, where, upon completion, the area will feature green landscaping with shade trees and a modern harbor infrastructure to replace the existing landscape; (ii) the bank of the Ma River, after the removal of vegetation, will be reinforced with embankments and harbor structures, including piles, to prevent erosion and landslides, ensuring compliance with current technical standards.

(ii) Disturbing the operation of the existing Lach Hoi fishing port:

Lach Hoi fishing port has a planned area of 45,000 m², including 30,000 m² of land and 15,000 m² of water surface for ship anchorage. The port was invested in and put into operation in 2003 with a total of 262 meters of wharves, including 75 meters of a 400 CV wharf, 3 U-shaped wharves each 26 meters long, and 110 meters of wharves upgraded from a 33 CV wharf, running along a 372-meter embankment, capable of receiving 1000 CV ships. The port serves about 20 ships per turn, with 300 ships anchored regularly and the ability to load and unload 400 tons of fish per day.

During construction, approximately 75 meters of the existing pier upstream on the Ma River will be retained for ongoing operations at the fishing port, while 105 meters downstream toward the East Sea will be demolished for upgrades. These activities may generate dust, emissions, wastewater, solid waste, and noise, and partially disrupt port operations due to the presence of construction equipment and the removal of part of the existing berth.



Existing port docks



Existing harbor shore

It is expected that the demolition and construction of the port embankment will involve various types of underwater construction vehicles, such as canoes, 30T floating cranes, barges, piling ships, etc. The construction of works under the subproject will mobilize about 23 construction machines of different types (as mentioned in Chapter 1, Section 1.5). To serve these ships, oil and water supply ships will also be involved. These activities will have the following specific impacts:

- The increased movement of construction machinery on the water, such as canoes, 30T floating cranes, barges, and piling ships, may disrupt the entry and exit of fishing vessels at Lach Hoi port. It also raises the risk of water traffic accidents due to potential collisions between fishing boats and construction equipment. Currently, water traffic in the Ma River near the port is already congested, with around 20 vessels per port call and 200–300 regularly anchored.
- Construction activities using floating cranes, barges, and piling ships for embankment works may narrow or congest the existing docking area at the renovated wharf, making it

difficult for fishing vessels to dock or depart. However, this impact is not expected in the newly extended section of the port.

This impact is assessed as medium, localized, and intermittent over the 24-month construction period due to: (i) The Ma River in the Lach Hoi subproject area is approximately 550–600 m wide (with the section near the estuary reaching 700–900 meters), leaving sufficient space for local boat traffic; (ii) Construction machinery will be fixed in specific sections, minimizing disturbance to fishing vessel movements; (iii) The Lach Hoi mooring area, adjacent to the existing fishing port, will be temporarily used during berth demolition. These impacts can be mitigated through waterway traffic safety management and well-organized consecutive wharf construction.

(iii) Affecting a number of neighboring aquatic enterprises/processing establishments;

In the Lach Hoi port area, there are several fishery logistics service businesses, including five seafood processing and trading facilities, five ice production and supply establishments, one petroleum supplier, four general supply shops, and three product purchasing units at the port. Notably, within 20–100 meters of the existing fishing port, there are also aquatic processing enterprises such as FXPT Seafood Import and Export Co., Ltd. (100 meters away) and Thanh Binh Trading Joint Stock Company (20 meters from the commune). Construction and upgrading activities at the port may partially affect the operations of these service businesses.

During the construction process, the operation of the existing fishing port will continue. However, the construction, upgrading, and expansion of Lach Hoi fishing port will cause disturbances to the production and business activities of the factory (seafood processing, trading, and export of frozen seafood such as shrimp and squid) due to factors such as dust, exhaust gases, traffic obstructions for vehicles transporting goods and workers (40 people) entering and exiting the company, and the beautification of the area in front of the factory due to the gathering of construction works, machinery, construction materials, and waste.

This impact is assessed as medium, localized, and intermittent during the 24-month construction period due to: (i) Construction will follow a rolling method, causing only temporary disruptions to factory operations; (ii) Internal roads in the harbor are wide (over 15 meters), allowing space for both construction and business activities to continue; (iii) The impact will be short-term, lasting about 2–3 months at the nearest construction site. This impact can be mitigated through appropriate construction and traffic management measures.



Seafood processing factory of Thanh Binh Commercial Joint Stock Company, 20m away

(i) Impact on sensitive receptors:

As outlined in Table 2.4 of Chapter 2, sensitive receptors potentially affected by the construction of the Lach Hoi subproject include:

- The memorial site honoring southern compatriots who relocated to the North (approximately 150 meters from the project site);
- The commemorative stele within the Lach Hoi fishing port (about 20 meters from the construction area);
- Several schools located along the main transportation route, including Quang Tien Secondary School (20 meters away) and Quang Tien Kindergarten (50 meters away).

The construction and upgrading activities of the subproject may lead to the following impacts and risks:

For PCR areas:

The main impacts during the construction process in these PCR areas are mainly due to dust, noise, and traffic obstruction caused by construction and material gathering. The impact level is assessed as medium because the construction time at each point lasts about 4-6 months, affecting religious and belief activities (such as pagoda ceremonies, festivals, etc.), especially on the days of the Full Moon and the First Day or Memorial Day.

For schools along the main transportation route:

The impacts on students and teachers at schools located along the main transportation route during the construction period include: (i) Traffic disturbances in the area during school start and end times, from Monday to Saturday, particularly between 6:30–7:30, 11:00–12:00, 13:00–14:00, and 16:30–17:30; (ii) Increased levels of dust and noise affecting the teaching and learning conditions of students and teachers; (iii) Increased risk of traffic accidents during school commuting times due to the rise in vehicle density (approximately 7 trips/day for transporting construction materials and 4 trips/day for waste transport by 10-ton trucks).

This level of impact is assessed as Medium due to: (i) the relatively low number of trucks involved in transportation (11 trips/day), with construction machinery only moving at specific times during mobilization and demobilization; (ii) the intermittent nature of the impact, with a short duration of about 24 months; (iii) the high density of traffic along the main transportation route, especially during peak hours when schools and offices operate, such as school start time (7:00–8:00) and dismissal (16:00–18:00) daily. This disturbance can be mitigated through appropriate traffic management measures.

4.1.3. Impacts and risks during operation phase

The sources of environmental and social impacts and risks during the operation phase of Lach Hoi Fishing Port arise from: (i) Operation of transportation vehicles such as ships, boats, and cargo trucks; fish and seafood loading and unloading activities; (ii) Activities of Port operators, fishermen at the port, boat/ship drivers, and port trader; (iii) Operations of fishing boats entering and existing the port and vessels sheltering in the port ; (iv) Operation of functional areas within the port (seafood receiving area, sorting area, storage area, etc.); (v) Operation of technical infrastructure systems such as the WWTP, waste storage facilities, public toilets, etc.

The dredging and maintenance of the navigation channel and the water areas in front of the port (usually every two years) will be carried out with other funds during the operation of the port, so the impacts and risks associated with this activity will be assessed separately in later stage.

The general impacts and risks during the operation phase of Lach Hoi Fishing Port include:

- Dust and emissions generated
- Noise
- Wastewater generated
- Solid waste generated
- Impacts on aquatic life and deterioration of surface water quality in the Ma River due to the concentration of vessels in the port area
- Traffic impacts and risks (waterway and roadway)
- Occupational health and safety risks and incidents
- Environmental risks and incidents

Detailed Impact Assessment is presented below:

(i) Dust and Emissions Generated

Sources of dust and emissions from the operation of Lach Hoi Fishing Port, especially in the fishery service areas, include:

- Dust and emissions from transportation vehicles such as ships/boats/trucks, and fish/seafood loading and unloading activities.
- Fishy odors generated from fishing vessels upon return to the port and from cold storage facilities used for seafood preservation.
- Odors and emissions (NH₃, H₂S, etc.) generated from the wastewater treatment system, solid waste storage facilities, etc.

❖ Dust and emissions from transportation ships/boats/trucks, fish/seafood loading and unloading activities

Dust and emissions of ships/boats/trucks are primarily generated from the operation of diesel powered generators and vessel exhaust systems. The pollutants mainly include dust, CO_x, SO_x, NO_x, Hydrocarbons (HC), etc. The emission load from vessels entering and leaving the port is difficult to estimate and depends on the daily ships going in and out of the port, with an estimated number of about 120 vessels, and at peak times of mooring and sheltering from storms, there will be around 1,200 vessels.

The emission load generated from vessel operations is presented in the following table:

Table 4.6: Emission factors of pollutants from diesel-engine vessels

(Unit: kg/day)

Means of transport	Dust	SO ₂	NO _x	CO	HC
Motor ships	6.8	136S	90.7	0.036	4.1

Source: WHO, 1993

Applying the formula for calculating the pollutant load in exhaust gases arising from the operation of ships/boats:

$$\text{Pollutant load (mg/m}\cdot\text{s)} = \text{Pollution coefficient (kg/day)} \times \text{number of ships in a day} \times 1000 \\ (\text{average distance} \times 86,400).$$

Where: 1000 is the conversion factor from “km” to “m”; 86,400 is the conversion factor from “day” to “seconds”; the sulfur (S) content in DO oil is 0.05%; average travel distance: 25 km. In addition, by applying formulas [1] and [2] from the general impact assessment during the construction phase, the calculated NO_x concentration exceeds the permissible standards specified in QCVN 05:2023/BTNMT – National Technical Regulation on Ambient Air Quality. Meanwhile, SO₂, CO concentrations, and concentrations at distances ≥ 10 m for HC and ≥ 30 m for dust remain within allowable limits.

Furthermore, once the subproject comes into operation, the density of road traffic in the area will increase significantly (by approximately 50–100 vehicles/day) due to the increased movement of staff and workers at the fishing port, as well as trucks transporting seafood, following the port’s upgrading. These vehicles, mainly using gasoline and diesel fuel, will emit exhaust gases containing pollutants such as NO₂, C_xH_y, CO, CO₂, HC, etc. The pollutant load from this activity is similar to that assessed during the operation phase of the existing fishing port and remains below permissible standards.

The affected parties (about 1,000 people) include mainly fishermen working at the port and on vessels entering/leaving the port (700–800 people); local residents engaging in trading at kiosks along the port (about 150–170 people); and port operation staff (about 30 people).

The impact level of this emission source is assessed as Low because: (the concentration is only greatest when all vessels gather at the port at once and only affect the area for a short time (according to general practice and procedures at fishing ports, the docking period can last from **30 minutes to 2 hours**); (ii) this source of emissions will gradually decrease when ships cease operating; and (iii) this source of emissions gradually dilutes into the air with fairly ventilated conditions on a large port with strong wind blows.

❖ *Fishy Odor Generated from Fishing Vessels upon Arrival at the port*

The source of fishy odors mainly appears when fishing vessels carrying seafood that is caught and frozen onboard. The fishy odor composition is mainly from NH₃, Hydrocarbons (HC), generated from the decomposition of organic matters and refrigeration equipment. The load of NH₃ emissions arising from refrigeration equipment and fishy odors from fishing boats is considered low, as the aquatic products (shrimp, crab, seafood, etc.) are quickly loaded and unloaded, sorted, and delivered to the market for consumption or immediately put into cold storage. The main gases generated from the decomposition of organic matter include CO₂, NH₃, H₂S, CO, CH₄, and Mercaptans. In which, the main odor-causing gases are NH₃, H₂S and Mercaptan, discomforting fishermen, traders, and sellers/buyers in the port area.

This impact is long-term and continuous, and the impact level assessed as Medium, because: (i) the volume of aquatic products arrived at the port is localized, depending fishing vessels (hourly - early morning (from 4 a.m. to 6 a.m.) and afternoon (from 2 p.m. to 4 p.m.), seasonally - the peak fishing season is normally from **June to September every year**); (ii) The seafood decomposition contributes to an increase in fishy odor, adversely affecting the environment in the port area (accounting for about 5%–10%). Nevertheless, this impact can be mitigated through appropriate measures.

❖ *Odors and Emissions (NH₃, H₂S, etc.) from the WWTP and Solid Waste Storage Facilities*

The Lach Hoi Subproject will invest in constructing one WWTP with a capacity of 300 m³/day using aerobic technology and closed treatment tanks; a waste gathering house with an area of 72

m², designed for waste storage within 3–5 days. Odors and emissions (NH₃, H₂S, CH₄, etc.) will be treated by the subproject WWTP (WWTP).

WWTP technology process: Wastewater from sources → Collection tank with grease and sand trap → Equalization tank → Reaction tank → Primary settling tank → Anoxic tank → Aerobic tank → Biological settling tank → Pressure filter tank → Disinfection tank, intermediate tank → Treated wastewater meeting QCVN 11-MT:2015/BTNMT – National Technical Regulation on Seafood Processing Wastewater (Column B, K_q = 1.2 and K_f = 1.1) → Discharge to Ma River.

According to this process, odors from the WWTP mainly arise from the collection tank, equalization tank, reaction tank, primary settling tank, and anoxic tank. Aerobic decomposition also produces odors but at a lower level. Gases generated primarily from anaerobic decomposition include H₂S, Mercaptans, CO₂, and CH₄, among which H₂S and Mercaptans are the main odor-causing substances.

Based on the aerobic treatment technology and the design of enclosed treatment tanks, the 300 m³/day WWTP will significantly reduce odors generated from substances such as H₂S, CH₄, and NH₃. However, odor concentrations may still remain at low levels in cases where complete elimination is not possible. Typically, the concentration ranges of odor-causing substances (H₂S, CH₄, NH₃) in aerobic wastewater treatment systems with enclosed tanks fall within the following thresholds:

- H₂S (Hydrogen Sulfide): The concentration of H₂S in enclosed aerobic treatment tanks is typically maintained below 0.1 ppm, and under ideal conditions, it can be even lower.
- CH₄ (Methane): The concentration of CH₄ in aerobic treatment tanks can range from 0.5 to 5 ppm, however, this figure depends on the level of ventilation and emission control in the tank.
- NH₃ (Ammonia): The concentration of NH₃ in enclosed treatment tanks can be controlled within the range of 1–3 ppm, depending on the nitrification process and aeration system.

The groups directly affected by odors from the WWTP and solid waste storage facility are plant operators and fishermen at the port (approximately 1,000 people in total). Since the WWTP use aerobic technology with closed treatment tanks, the odor is minimized. The decomposition process generates malodor but at a low level. In addition, the Lach Hoi Fishing Port WWTP will be built closely, (closed treatment blocks), so the odor generated will be minimized. Therefore, the impact level is assessed as **Medium** and can be mitigated by appropriate technological and technical measures.

(ii) Noise

The source of noise arises mainly from vessels when docking, vehicles entering to purchase and transport seafood for consumption and from the service area.

The maximum noise level forecasted (cumulative when many vessels enter and exit at the same time — for Lach Hoi Subproject: 120 vessels daily and up to 1,200 vessels during storms) is about 80–85 dBA for vessels, 85–95 dBA for road vehicles, and 75–79 dBA for service areas (exceeding permissible limits by about 1.07 to 1.12 times).

Noise mainly affects traders, workers at the fishing port, and fishermen (about 1,000 people in total). The affected area is typically within a radius of 10–20 meters around the receiving, sorting, and unloading areas. According to standard practices and procedures at fishing ports, docking times last from **30 minutes to 2 hours**).

However, field surveys at local existing fishing ports show that vessel docking, loading/unloading, and sorting activities do not always take place all day, usually within a month, the peak time of full-day operation is from the 8th to the 15th day of the lunar calendar. On other days, these activities take place in the early morning (4:00–6:00 a.m.) and afternoon (2:00–4:00 p.m.). Additionally, upon ship arrival, the engine will be turned off, the port space is wide towards the river, so the noise is also diffused quickly. Therefore, the impact level is assessed as Medium and can be mitigated through appropriate measure.

(iii) Wastewater Generated

The sources of wastewater generated from the operation of Lach Hoi Fishing Port include: domestic wastewater, wastewater from onshore service areas (particularly from fishery service facilities, and wastewater from vessels operating in the waters in front of the port. The wastewater volume is calculated based on the water supply volume (according to the wastewater discharge standard, taken as 100% of the water supply standard). The estimated wastewater flow for Lach Hoi Fishing Port is 287.48 m³/day. Details are shown below:

Table 4.7. Calculation of wastewater discharge flow of Lach Hoi fishing port

No.	Used for	Quantity		Standard		Calculated volume		Notes
1	Domestic use by local people	1000	Person	25	L/person	25	m ³ /day	For the busiest operation day of the port
2	Fish washing for sorting house	95.89	Ton	1	m ³ / ton	95.89	m ³ /day	
3	Clean fish sorting tools	10%	m ³	9.59	m ³ /day	9.59	m ³ /day	
4	Dock cleaning	3700	m ²	10.0	l/m ² _floor/day	37.00	m ³ /day	
5	Ship hold washing	120	ship	1.0	m ³ /ship	120.00	m ³ /day	
7	Average total daily water demand	Q _{Average day}				287.48	m ³ /day	
10		Q _T = 100%Q _{day_max}				287.48	m ³ /day	
		Rounded				300.00	m ³ /day	

(Source: Basic design of Lach Hoi Subproject, 2024)

The characteristics of each type of wastewater arising from the operation of Khanh Hoa Fishery Center are as follows:

- **Domestic wastewater:** arising from the working areas of staffs and employees in the service area and fishermen/traders at the port, the volume and pollution level of this waste source mainly depends on the number of workers at the port (about 1000 people) and the amount of water used daily at the operational facilities and public toilets, garbage storage facilities, WWTP. The domestic wastewater volume is estimated at 25 m³/day. The waste generated from this source is highly dirty, its composition mainly contains organic matters, nutrients, residues, suspended substances and pathogenic bacteria. Besides, it contains high organic content (BOD, COD), high solid content and many pathogenic bacteria. The above amount of wastewater, if not collected and treated appropriately, can cause the spread of pathogens, affecting coastal seawater sources in Ma

River, damaging the beautiful landscape in the surrounding areas.

Table 4.8: Predicted concentration of domestic wastewater during the operation phase

No.	Parameters	Unit	Untreated	Treated by septic tank	QCVN 14: 2008/BTNMT (column A, K=1.0)
1	COD	mg/l	608	61-152	-
2	BOD ₅	mg/l	329	49-99	30
3	TSS	mg/l	713	36-178	50
4	Total N	mg/l	60	20-40	-
5	Total P	mg/l	17	3-10	-
6	Animal and plant fats and oils	mg/l	133	42	10
7	Total Coliform*	MPN/100ml	10 ⁶ -10 ⁹	104	3,000

Note: The coefficient accounting for the project scale is $k = 1.0$ according to Table 2, QCVN 14:2008/BTNMT

Based on the above table, it can be seen that the concentration of organic substances in domestic wastewater after treatment with septic tanks is approximately and exceeds the permissible level by 1.0 to 2.0 times. TSS ranges from lower than to 1.8 times higher than that of permissible level. The content of animal and plant fats and oil is 2.1 times higher than permissible level. Therefore, wastewater treated by septic tanks needs further treatment at centralized water treatment facilities before being discharged into the receiving environment.

- *Wastewater from onshore service areas:* When the fisheries logistics service area comes into operation, a system of service areas, trade, and cold storage warehouse will be accompanied. The operation of these facilities will generate a large amount of domestic wastewater, production wastewater and organic impurities contaminated wastewater. Wastewater produced from aquatic product receiving facilities, seafood cold storage warehouse, this waste source primarily contains organic matters, animal fats, waste (fish scales, fish intestines, shrimp shells, etc.). These substances are easily decomposed, if not collected and treated, the decomposed products will cause foul smell to the surrounding area and polluting the surface water quality of the Ma River.

- *Ballast water:*

Ballast water is the water pumped into the ship's specialized tanks to maintain stability when the ship is not carrying cargo or to adjust the ship draft. The ballast water can be seawater, brackish water or fresh water, depending on the geographical location where the ship performs the water refill operation. At riverside fishing ports, especially in areas near river estuaries, ballast water is usually brackish water or seawater due to the impact of tides and saltwater intrusion.

During the process of ballast water refilling, various species such as plankton, microorganisms, and larvae can be sucked into the water tank and move along the ship to other water bodies. The discharge of untreated ballast water can cause the spread of alien organisms, affecting the indigenous ecosystem and the water quality.

For small and medium-sized fishing vessels operating at the Lach Hoi Subproject, the volume of ballast water may range from 10 to 50 m³. The ballast water is used by fishing vessels to ensure offshore operation and when harvesting seafood and is often reused. With a scale of about 1,200 ships under the Lach Hoi subproject, each replacement will generate about 12,000 m³ to 60,000 m³

of ballast water. However, ballast water does not need to be changed frequently, and inspections and maintenance of ballast tanks normally carried out periodically from 6 months to 1 year.

Domestic fishing vessels in Vietnam are typical small and medium in capacity, and do not operate in international waters, so they are not yet subject to the full mandatory provisions of the International Ballast Water Management Convention (BWM Convention). However, the discharge of ballast water still needs to comply with existing national regulations such as Decree No. 58/2017/ND-CP. According to regulations, the ballast water shall be discharged at least 200 nautical miles from the nearest shore and in waters with a depth of at least 200 m. In case the ship is unable to meet this condition, the ship may carry out a ballast water exchange at least 50 nautical miles from the nearest shore and at a depth of at least 200 m (quite far from the shore). In fact, fishing vessels often discharge ballast water individually and not simultaneously or at a domestic location, which helps minimize the risk of localized environmental impacts. In general, as being operated not-concentratedly, individually and primarily in domestic water areas, the impact of the ballast water on the environment in the subproject is assessed as medium and can be managed through appropriate management measures.

Pollutant load in seafood processing wastewater: To reference pollutant concentrations in this type of wastewater, monitoring results at similar existing fishing ports are presented below:

Table 4.9. Pollutant concentrations in influent wastewater of the treatment system at Zone E – Tam Quan Fishing Port, Binh Dinh Province

No.	Parameters	Unit	Results	QCVN 11-MT: 2015/BTNMT (ccolumn B) Kq = 0.9; Kf=1.1
1	pH	-	7.19	5.5 – 9
2	SS	mg/l	112	99
3	BOD ₅	mg/l	730	49.5
4	COD	mg/l	1180	148.5
5	NH ₄ ⁺	mg/l	117.12	19.8
6	NO ₃ ⁻	mg/l	0.15	-
7	Total N	mg/l	128.89	59.4
8	Total P	mg/l	20.06	19.8
9	Coliforms	MPN/100ml	21x10 ⁷	4,950

Source: Binh Dinh Center for Analysis and Testing

The analysis results show that concentrations of almost all tested parameters are as many times as QCVN 11-MT:2015/BTNMT (Column B) – National Technical Regulation on Seafood Processing Wastewater. Wastewater from fishing vessels operating in the water areas within the port: This source includes domestic wastewater, vessel cleaning water, deck washing water, etc. It is estimated that there are 120 vessels entering and leaving the port area everyday. The total volume of this wastewater is about at 120 m³/day. Its components primarily are suspended solids, oils and greases, and organic substances (BOD, COD, etc.). This wastewater, if is not properly controlled and is indiscriminately discharged into the receiving environment, will pollute the Ma River.

In general, the level of impact from wastewater generated by the operation of Lach Hoi fishing port is long-term, continuous, and at **medium** level, because the port has been upgraded and reconstructed with integrated functional subdivisions that taking consideration into environmental

sanitation efficiency. In addition, the receiving water body – the Ma river – has a relatively large flow (the total average annual flow volume of the Ma river basin is about 19.52 billion m³, equivalent to 54.2 million m³/day). This impact can be mitigated by appropriate measures (the fishing port will be equipped with a separate wastewater collection system and one centralized wastewater treatment station with a capacity of 300 m³/day-night, ensuring collection and treatment of all wastewater generated at the port as calculated above).

In addition, there is also a amount of rainwater flowing through the port areas that carries pollutants on the surface, then flowing into Ma river but not being treated. The highest monthly rainfall was 1525.4 mm in X/1991, equivalent to 50.8 mm/day. Therefore, the total rainfall in 01 day in the whole project area in case of the heaviest rain is $260.00\text{m}^2 \times 50.8\text{mm/day} / 1000 = 13,208\text{m}^3$. The composition of rainwater contains suspended solids, and surfactants washed away on the surface of the port area. The overflow rainwater will affect the rainwater collection system and flow into Ma river. However, However, with the nature of rainwater that is less likely to pollute the environment as the port is built with integrated drainage system and rainwater overflow only occurs in rainy season (from May to November every year, in Thanh Hoa province, there are about 150-160 rainy days per year), so the impact of rainwater flowing overflow is Low and can be minimized.

(iv) Solid Waste Generated

The sources of solid waste generated during the operation of Lach Hoi Fishing Port include: domestic solid waste from staff and workers at service areas and the operational house, as well as from fishermen operating at the port (the port is designed to serve approximately 1,000 people in total, including 30 operational staff); and waste from seafood sorting and trading activities. Based on the volume of solid waste currently generated at Lach Hoi Fishing Port and the scale after upgrading and expansion, the solid waste volume of the Lach Hoi Subproject is forecasted as follows:

- Domestic solid waste: The estimated rate of domestic solid waste from staff, visitors, and fishermen at the port is 0.15 kg/person/day (since they do not reside at the port), the volume is estimated at about 0.45 tons/month (4,500 kg/month). The main components include fruit peels, leftover food, paper scraps, plastic bottles, and nylon bags.
- Solid waste from seafood sorting activities: Forecasted to account¹⁵ for about 0.02% of the total seafood yields¹⁶ at Lach Hoi Port (25,000 tons/year), equivalent to approximately 420 kg/month (0.42 tons/month). The waste mainly contains plastic bags, paper scraps, plastic gloves, rubber gloves, packaging materials, damaged cartons, and broken foam boxes.
- By-products from seafood sorting and processing: Expected to account for about 1% of the total seafood yields at Lach Hoi Fishing Port (25,000 tons/year), corresponding to about 20.8 tons/month. The main components include fish heads, fins, bones, skin, fat, and intestines.
- Hazardous waste: Hazardous waste (oil-contaminated rags, gloves, hazardous component contaminated rag, packaging, grease containers for maintenance of machinery, equipment, batteries and accumulators, chemical packaging, printing ink cartridges, waste lead, damaged equipment, etc broken nets, plastic packaging, etc.) is estimated at around 200 kg/month. Waste

¹⁵ Based on the data estimated from the current operations of Lach Hoi fishing port, as surveyed and consulted by the project's environmental assessment team during the preparation of this ESIA report

¹⁶ Based on the data estimated from the current operations of Lach Hoi fishing port, as surveyed and consulted by the project's environmental assessment team during the preparation of this ESIA report

oil discharged into the Ma River could hinder the photosynthesis and respiration of aquatic organisms and may even cause death of aquatic species unless being properly treated.

If not collected and treated, these types of solid waste will cause air pollution (due to foul odors), surface water pollution along the Ma river near the port area, and negatively affecting the urban landscape of the port area. However, since investments are being integrated in technical infrastructure (waste collection, domestic wastewater collection and treatment, etc.), and the locality already contracted with a sanitation team for collection, transportation, and treatment of both general and hazardous waste, the impact from solid waste generated by the fishing port is assessed as **Low** and controllable. Moreover, before the Lach Hoi Subproject comes into operation, the Project Management Unit (PMU) will be required to obtain an environmental permit, ensuring this impact is controllable.

(v) Deterioration of Surface Water Quality and Impacts on Aquatic Life in the Ma River:

The water quality of the Ma River may deteriorate due to the operation of vessels entering and leaving the port during the operation phase (approximately 120 vessels/boats), caused by: (i) leakage of oil and grease resulting from accidents such as collisions or grounding of ships, or from discharging oily residues; (ii) ballast water and cooling water containing oil and grease; and domestic wastewater, solid waste, and hazardous waste as previously forecasted and assessed in the sections of ‘wastewater’ and ‘solid waste’.

The water quality of the Ma River may be degraded due to increased turbidity, suspended solids, and oil traces, which will reduce dissolved oxygen levels and impair photosynthesis of algae and aquatic plants.

In general, the impact on Ma River surface water quality due to the operation of Lach Hoi fishing port is long-term and continuous but at a low level because: (i) the port has been upgraded modernly and integrated with the operation procedures by an experienced Port Management Board, thereby the environmental sanitation due to in vessel operations will be ensured; (ii) the has a relatively large flow (average surface flow ranges from 19.52 billion m³, equivalent to 54.2 million m³/day). This impact can be mitigated through appropriate measures (the port will have a separate wastewater collection system and a centralized treatment plant with a capacity of 300 m³/day to ensure all generated wastewater is treated before discharge into the Ma River).

The impact on the Ma river’s aquatic ecosystem due to Lach Hoi fishing port operation is also long-term and continuous but assessed as **low** because: (i) the port’s operational area is localized within the water area in front of the port (36m wide, 400m); (ii) no rare or endangered aquatic species are found in the project area (aquatic species in the Ma river in this area include plankton such as copepods, cladocerans, and rotifers; benthic fauna such as snails, mussels, clams, and bivalves; aquatic plants mainly include water hyacinths and algae). The project area is not a protected habitat for valuable species. Thus, this impact can also be minimized by appropriate mitigation measures.

This impact can also be minimized with suitable mitigation measures.

(vi) Traffic Incidents:

❖ Waterway traffic accidents:

- Causes: During vessel operations, serious accidents such as shipwrecks, vessel collisions, or fires may occur. The daily vessel frequency at Lach Hoi fishing port is about 120 vessels/day. In stormy conditions, the port will accommodate approximately 1,200 fishing vessels seeking

shelter. However, all vessels will not arrive at once but over a period of 3 to 5 days following the Maritime Administration's directives.

During the operation of ships, shipwrecks, ship collisions, or severe fire incidents may occur. The transportation of products through the port will increase the waterway traffics in the channel in front of the port, greatly affecting the load-bearing capacity of the channel, obstructing visibility. Such increase in waterway traffic density is expected to lead to a higher risk of maritime accidents and oil spills, significantly affecting surface water quality and the ecosystem in the Lach Hoi port area on Ma river. In addition, dirty water and domestic solid waste, ballast water from vessels navigating the channels—especially in cases of collision where waste is not properly collected or treated—may leak and overflow into the sea and port areas. This will increase pollutant levels and negatively impact the surrounding ecosystems along the navigation routes.

- Scope of impact: When there is a waterway traffic accident, depending on the severities, oil spills may occur, affecting local soil and surface water quality, causing damages to property of fishermen and the port management authority, and economic damages to local communities who bear the costs of recovery after such incidents.

The impact level is assessed as medium and localized because: (i) The Ma River in the Lach Hoi subproject area has a width of approximately 550m-600m and is located only about 4 km away from the estuary, the width of the section near the eastury is larger with 700-900m. The remaining width of the river is still sufficient for local vessels to navigate; (ii) The berthing length of Lach Hoi port is relatively large (about 250 m consisting of several wharves). As the shelter area of the port is separated (about 400-500m away from the port), the sheltering and anchorage of vessels will be insignificant affected (iii) The application of proper waterway and road traffic safety management during operation will help avoid, minimize, and mitigate the impacts on waterway traffic, including navigation accidents.

❖ Incidents of vessels docking beyond the port's design capacity

Currently, Lach Hoi fishing port is classified as a Class II port, capable of handling 20 vessels per turn and accommodating about 1,000 vessels. After being upgraded to a Class I fishing port, it will be capable of handling 120 vessels per turn with a accomodation of 1,200 vessels. Once the port is operational, incidents of vessels berthing beyond the designed capacity may occur, leading to the following impacts:

- Vessels waiting for their turn to unload may experience long delay, potentially resulting in disputes over docking priority and causing disorder.

- Although, conventionally, docking is organized in sequence, some ship owners may attempt to push ahead, or maneuver around others to dock or leave the port, leading to traffic safety issues and negatively affecting the port's loading and unloading capacity.

- Wastewater and solid waste generated in excess of the subproject's treatment capacity of the designed waste treatment plant (WWTP, waste storage facilities).

The impact level is assessed as **Low** as the port facilities have been designed and calculated in accordance with technical standards to ensure operational sustainability (with the demand of a Class I fishing port: 120 vessels/turn and a total capacity of 1,200 docking vessels). In addition, all auxiliary infrastructure for Lach Hoi port operations has been invested integratedly. However, if such incidents persist over an extended period, they may pose risks of port infrastructure degradation, potentially leading to damage to docking facilities and resulting in certain losses. This impact can be mitigated by appropriate port operation management measures.

✓ ***Risk of falling into the river and drowning for vessel operators/fishermen on board.***

Such incidents are typically flagged during embarkation or disembarkation at docking areas, or in the event of vessel collisions, where individuals onboard may lose balance and fall, slip, or tumble into the sea. Although the docking areas are often designed with guard rails and warning signs, fishermen remain at risk of falling into rivers due to slippery surfaces, which can lead to drowning. During the rainy and flood seasons, transportation vehicles operating in these areas may also slip and fall into the river. This affects the health and even causes the lives of fishermen operating in and out of the port. The subproject's technical design has been reviewed and implemented to prevent such threats to fishermen when using port facilities. Therefore, this impact is assessed as Low and can be mitigated.

✓ ***Collisions and traffic accidents:***

Risk of collision between vehicles: With the involvement of a variety of vehicles (trucks, boats, forklifts, cranes, etc.) in the port area, collision accidents may occur, especially when vessels operate under limited visibility conditions, or lack of proper separation and routing.

Road traffic accidents: Vehicles transporting seafood between ports and the mainland can cause traffic accidents due to poorly prepared roads or careless driving behavior.

(vii) Occupational accidents

During the operation period, there will be 30 workers employed at Lach Hoi fishing port. Some risks and occupational accidents may occur, particularly in the complex working environment with multiple activities such as seafood unloading, cargo handling, and operation of mechanical equipment. Potential risks and incidents include:

Accidents involving mechanical equipment (cranes, forklifts, etc.):

Risks from lifting equipment, cranes: Using cranes and forklifts to load and unload seafood from ships ashore or from shore into storage warehouse can cause accidents if the equipment is not adequately maintained or operated incorrectly. Accidents may include falling heavy objects, snapped cables, or equipment malfunction.

Risks from electrical equipment and machinery: The operation of heavy machinery such as pumps, generators, or other motorized equipment may lead to electric shock, fire and explosion accidents if safety regulations are not observed.

Accidents due to unsafe working conditions:

Falls, trips, slips: Due to continuous movement on wet and slippery surfaces (caused by grease, seawater, or seafood waste), workers engaging in unloading and storage areas are at risk of slipping, falling.

Fire and explosion accidents:

Risk of fire and explosion from flammable materials: Substances such as oils, fuels, chemicals used in seafood processing or storage may lead to fire and explosion unless being handled and stored properly. Additionally, the use of electrical and mechanical appliances may result in electrical shorts or sparks, increasing the risk of fire.

Fire due to improper discharge: Flammable wastes such as oil, grease from boats, cranes, or from seafood processing may cause fires if not collected and disposed of properly.

Health-related accidents and illnesses:

Risk of infectious diseases: Working in humid environments and exposure to seawater can lead to infectious diseases, especially those related to the respiratory tract, skin, or waterborne diseases.

Respiratory diseases: Long-term exposure to dust from seafood or emissions from ships can cause respiratory diseases such as pneumonia, bronchitis, or other chronic diseases.

Diseases caused by marine life: Exposure to marine life can lead to injuries, infections, or poisoning due to toxins from seafood or other marine life.

Accidents caused by environmental factors:

Risks due to extreme weather conditions: Weather conditions such as heavy rain, storms, and strong winds can increase the risk of accidents for workers working outdoors, especially those working on docks.

Risks from sea waves and sea level rise: Working in conditions of high seawater or strong waves may expose workers to risks of being swept away or encountering accidents while operating on vessels or at the dock.

Other port-related occupational risks include:

- Fish holds containing miscellaneous fish which are sorted for long period at sea will generate toxic gases. The deeper the fish holds and the longer the voyage, the higher the risk of oxygen deprivation for fishermen working in the fish holds, leading to acute poisoning, fainting, or even death.

- In the receiving and sorting areas where washing activities are frequently carried out and seafood is handled, the floor is always wet, increasing the risk of slips and falls during the lifting and transporting of seafood containers and trolleys.

- Slip-and-fall accidents during the loading and unloading of seafood from vessels to the port, including incidents where seafood containers fall onto workers.

The risk level of occupational accidents at the port is assessed as **Medium** because: (i) these impacts are always potential to occur on the port at any time; (ii) The number of operation workers is relatively small (30 people); (iii) these risks may persist in extended period during the fishing port operation (iv) They can be mitigated through appropriate measures, such as occupational safety training before and during port operations and providing sufficient personal protective equipment (PPE) for all workers.

(vi) Potential Environmental Risks and Incidents

❖ ***Fire and Explosion Incidents:***

- **Causes:** As being analyzed and forecasted above, the environment in the area contains fuel vapors, so the potential of fire incidents is high when exposed to high heat sources or electrical short circuits. The power supply system for machinery, technical equipment, and electrical systems in auxiliary facilities, cargo yards, and the administration building may experience short circuits, fires, or explosions, causing damage to people and property. Additionally, the area containing fuel vapors used for refueling vessels is prone to high risk of fire incidents when exposed to high heat sources or electrical short circuits. A fire or explosion at Lach Hoi port may cause human life and property loss. Such incidents may lead to fire spread to warehouses, causing significant economic damage and threatening the safety of the port staff.

- Affected group: People and property within the project area may be affected. However, as the neighboring residential area is located over 150 meters away and separated from the port, it is less likely to be affected.

- Impact level: Assessed as Low because (i) functional areas are all designed with fire protection measures and on-site fire-fighting equipment, such as fire extinguishers; (ii) The arrangement of products and materials for the fishery service is allocated to specific zones with instructional signage, and dedicated personnel responsible for management and compliance with operational procedures; (iii) No incidents of electrical short circuits or fires have been recorded in the port area or surrounding residential zones; (iv) Such incidents are considered controllable, as the port management board undergoes regular trainings on fire prevention and response; and (v) The port area is landscaped with greenery, and water supply infrastructure has been designed with a fully equipped fire protection system. Therefore, the impact level is assessed as **Medium** and controllable.

❖ **Oil Spill Incidents:**

For the operation of the Lach Hoi Subproject, an oil spill incident may occur due to: (i) Vessel capsizing; (ii) waterway traffic accidents; (iii) spillage or leakage of oil and grease from fishing vessels entering or leaving the port; and (iv) storms, winds, low pressures and other extreme weather events.

Once an oil spill occurs, an oil-water mixture is quickly formed and spread after about 3-6 hours. The oil gradually dissipates through weathering related to various of physical and chemical processes, such as natural dispersion by wind and currents, sedimentation, evaporation, or the formation of oil suspensions floating on the water surface. This spill will harm the natural environment and economic activities in the area. Specifically:

- Part of the oil products will sink and decompose on the seabed, polluting the water and sediment, while another part may float with air bubbles from the seabed. Oil residue on the seabed is a source of water pollution, affecting benthic organisms that are a food source for aquatic species.

- When the water source is contaminated with oil, the decomposition oil products reduce the water source's ability to clean itself because the plankton and benthic organisms involved in the process die or decrease in number.

- When oil is spilled into water sources, the level of dissolved oxygen decreases because oxygen is consumed during the oxidation of oil products. Additionally, oil slicks on the surface hinder the aeration process, limiting oxygen exchange between the water and the atmosphere.

Fishing vessels passing through Lach Hoi port has capacity from 90 to 600 CV, with storage capacity from 0.152 to 16.188 tons of DO. The risk of oil spills is always present at the port, especially during the rainy and flood season when accidents and capsizing are more likely. The impact is assessed as **Medium** because: (i) the port area is arranged with a docking station in the form of anchorage, suitable for each type of ship with different capacity, length as well as purposes as required by vessel owner. The length and width of the berths are configured to support cargo handling operations and ensure convenient access to services such as loading, unloading, and other port-related activities for vessels; (ii) The navigation channel area and the turning area are designed to ensure appropriate width, channel depth, turning radius, and maneuvering space, thereby reducing the risk of congestion, collisions, and inconvenience during vessel berthing and service use at the Lach Hoi port. (iii) Coordination is based on years of experience in managing and operating the existing port, along with strict regulations governing vessel entry and exit. (iv) Shipowners who drive ship to enter and exist the port regularly, have long practical experience, so

there are insignificant risks of collision, overturning, leakage of materials as well as adapting to changes in weather and climate in the Lach Hoi port; This risk can be mitigated by appropriate measures such as providing adequate waterway traffic safety equipment/facilities at Lach Hoi port, organizing rational vessel traffic, raising awareness among vessel operators, and conducting regular inspections of vessels to identify potential malfunction (if any).

In addition, to minimize and manage potential oil spill incidents, the project owner must develop a vessel operation management plan and establish an emergency response plan for oil spills.

❖ ***Incidents of water supply and drainage pipelines broken and damage to wastewater treatment systems***

During the operation, water supply and drainage pipeline and wastewater treatment systems may encounter into the following incidents:

- Breakage or cracking of water supply pipelines due to unsafe construction materials.
- Water pipeline broken due to external force.
- Failures of the wastewater treatment system, such as malfunctioning treatment equipment, leading to untreated or inadequately treated wastewater being discharged into the environment.

Such incidents, when occurring, will lead to water wastage (for clean water supply) and discharge of environmental pollutants (for wastewater). However, the likelihood of these impacts is considered low, as the water supply network is installed in technical compartment, and water supply areas are equipped with a pressurized valve system to detect leaks in the pipeline system.

When the wastewater treatment system is broken, the level of air and water pollution will increased as assessed in the above sections. In addition, the materials used for pipelines are fire-resistant, corrosion-resistant, and highly durable, resulting in a very low risk of breakage or leakage. WWTP are designed with independent operating modules, with backup system, and equalization tanks that can be stored for up to 24 hours when all modules fail. Therefore, the impact from these incidents is minor and can be controlled through appropriate measures.

✓ ***Risks and Incidents from Improper Operation of the WWTP***

In addition to risks from vehicles and equipment operating WWTP, there are also risks stemming from humans and funding sources in the operation and maintenance of WWTP. These risks include but are not limited to:

- The WWTP operators' failure to comply with the operating process instructions that have been developed for the WWTP.
- The operators lack sufficient knowledge and qualifications to operate the WWTP.
- Poor capacity of human resource management during the operation of the WWTP.
- Infrequently periodic maintenance, replacement or repair of damaged machinery and vehicles.
- Improper frequency and volume of sludge collection, which may result in reduced treatment efficiency of the WWTP and failure to meet current national technical standards.

The above risks, if occurring, will reduce the wastewater treatment efficiency of the wastewater treatment and affect the quality of receiving water sources and the aquatic ecosystem in the port area. However, the risk is assessed as "Low" and can be minimized: (i) The operation of the WWTP is carried out by engineers who are knowledgeable and qualified in wastewater treatment technology; (ii) The operation will be arranged in shifts and always have staff on duty, operating in accordance with the regulated instructions; (iii) The WWTP is periodically inspected and

maintained daily or immediately when an incident occurs; (iv) At WWTP, machinery and equipment are always available for replacement in case of damages.

Furthermore, before the WWTP is officially put into operation, the subproject must register for trial operation and apply for an environmental license.

4.2 LACH BANG FISHING PORT UPGRADING AND EXPANSION SUBPROJECT

4.2.1. Impacts and risks in the project preparation phase

4.2.1.1. Impacts due to land acquisition

The area of construction and upgrading Lach Bang subproject is located in existing Lach Bang fishing port, it includes 02 areas: the port on the Hai Thanh ward side and the port on the Hai Binh ward side. Total area to be acquired for expansion of the fishing port is 2.62ha, of which:

- The expansion area of the port on the Hai Thanh ward side covers 0.53 ha, including: 0.28 ha of transportation land (managed by Hai Thanh ward People's Committee) and 0.06 ha of non-agricultural production and business land (managed by Lach Bang Port Management Board); 0.19 ha of Lach Bang river water surface area (managed by Hai Thanh ward People's Committee).
- The expansion area of the port on the Hai Binh ward side covers 2.09 ha, including: 2.0 ha of non-agricultural production and business land (15 kiosks rented by 15 households from the Lach Bang Port Management Board; and 01 petrol business facility); 0.04 ha of Lach Bang river water surface area; and 0.05 ha of unused land managed by Hai Binh ward People's Committee.

In general, the impact level due to land acquisition of Lach Bang subproject is Low and unchangable. The subproject affects income of 15 households who are renting kiosks from Lach Bang Fishing Port Management Board to trade seafood and goods, serving the existing port and 01 business trading petroleum. However, these households are currently involved in other industries such as fishing, etc., This impact will be minimized by income restoration measures stated in the project's RP.

4.2.1.2. Safety risks related to UXO

The total area to be acquired for the expansion of Lach Bang fishing port is 2.62 ha. If the subproject does not conduct unexploded ordnance (UXO) clearance, it may pose risks of explosion of mines remaining from the war during the construction of the main subproject items. The direct impact will be on construction workers, fishermen, and the surrounding infrastructure of the existing Lach Bang fishing port. This impact is assessed as **Medium** and long-term, affecting the psychology, health, property, and lives of workers and residents near the incident area. Additionally, the explosion of UXOs will have a wide impact, affecting air quality and degrading soil quality. However, this impact can be mitigated through UXO clearance by relevant authorities.

4.2.2. Impacts and risks in construction phase

4.2.2.1. General impacts and risks

a) Impacts on ambient air quality

The sources of Lach Bang subproject's impact on ambient air quality during the construction phase include: (i) Dust generated from the demolition of existing structures/clearing for site preparation; (ii) Dust generated from excavation and leveling activities for the expansion area; (iii) Dust

generated from the transportation of construction materials; (iv) Dust generated from waste transportation; (v) Dust generated from the storage and unloading of construction materials; (vi) Emissions from the operation of vehicles transporting materials and wastes; (vii) Emissions from the operation of construction equipment/machinery. Assessment of impact sources is detailed below.

i. Dusts generated from site preparation activities

During the site preparation of the Lach Bach subproject, dust is mainly generated from: (i) demolition of existing structures (approximately 900 m³ of debris from the demolition of sections of degraded embankments, and 15 grade-4 kiosks).

The amount of dust generated from the demolition of existing port structures is determined according to the formula [1] and the formula [2] is used to calculate the dust emission factor. The dust pollution factor due to the demolition of existing structures is calculated as follows: $E = 0.01749 \text{ kg/ton}$ ($k = 0.2$; U (wind speed) = 4.0 m/s; M (average debris moisture) = 20%), with a demolition/clearing duration of about 1 month. Based on these algorithms, the amount of dust generated from the demolition of existing structures and vegetation clearance for the Lach Bang subproject is 0.787 kg/day, and the dust concentration is 0.16 mg/m³, which is lower than the permissible limit according to QCVN 05:2023/BTNMT (permissible limit: 0.3 mg/m³).

Dust generated from demolition and clearing activities will affect workers involved in demolition/clearing and the fishermen operating at the existing Lach Bang fishing port, seafood processing facility on Hai Thanh ward side, located 50m away.

The impact level is assessed as Low because (i) the dust concentration meets the permissible standards, (ii) the impact period is short (about 1 month), (iii) the affected people are not numerous, mainly workers and some fishermen operating at the existing fishing port, and (iv) this impact can be mitigated by appropriate measures.

ii. Dust generated from earthworks

Dust from the earthworks of the Lach Bang subproject comes from excavation, backfilling, but the amount generated from leveling activities are negligible as the expansion area of the Lach Bang port already has an existing foundation. The estimated volume of excavated soil is 14,914 m³, with the excavation duration being about 12 months. Based on algorithms/formulas [1] and [2], the emission factor $E = 0.0288 \text{ kg/ton}$ ($k = 0.2$; U (wind speed) = 4.0 m/s; M (average moisture of excavated soil) = 14%), the earthwork is carried out in about 12 months. The amount of dust generated from earthworks at the Lach Bang subproject is determined to be 1.79 kg/day, and the dust concentration is 0.19 mg/m³, lower than the permissible limit according to QCVN 05:2023/BTNMT (permissible limit: 0.3 mg/m³).

Dust generated from earthworks will affect construction workers, fishermen operating at the existing Lach Bang fishing port, residential area in Hai Binh, Hai Thanh wards, located 20m away from the subproject site.

The impact level is assessed as Low because (i) the dust concentration meets the permissible standard, (ii) the impact period is short-term (about 12 months), (iii) however, the number of affected people is large as mentioned above, and (iv) this impact can be mitigated through appropriate measures.

iii. Dust from transportation of construction materials

Dust from transportation of construction materials arises from the materials themselves and is stirred up by vehicle tires during transportation by diesel trucks on urban roads to the construction

site of the Lach Bang subproject. The expected construction period is 24 months.

The construction of Lach Bang subproject's works will require a large amount of basic materials such as cement (2,144 tons), sand (8,321 tons), stone (15,169 tons), and steel (920 tons). The materials will be purchased from material depots and stores near the subproject area, with an average distance of 10-15 km, transported by 10-ton trucks. Applying the formula [3] and input parameters such as the volume of materials mentioned above, the intermittent transportation period within 24 months of construction, the number of transportation trips calculated as 5 trips/day, the dust load generated from the transportation of construction materials, soil/sand for the subproject calculated is 0.229 (mg/m/s).

Based on the dust load and generated emissions, SUTTON model (formula [4]) is applied, the average concentration of pollutants arising from transporting materials for the construction of Lach Bang subproject determined is lower than the permissible standard in comparison with QCVN 05:2023/BTNMT within 1 hour (0.3 mg/m³) at a distance of 10m.

Dust generated from material transportation will directly affect construction workers, fishermen operating at the existing Lach Bang fishing port, and seafood processing facility in Hai Binh, Hai Thanh ward, located 20-50 meters away on the main transportation route.

The impact level is assessed as Low because (i) the dust concentration is lower than the permissible standard, (ii) the impact is long-term but intermittent over approximately 24 months of construction, (iii) the direct impact is limited to construction workers and some fishermen who are currently working at the existing port, residential areas in Hai Binh, Hai Thanh wards, located 20-50m away, and (iv) this impact can be mitigated through appropriate measures

iv. Dusts generating from waste transportation

Dust from waste transportation mainly arises from the waste itself, such as debris from demolition activities, excess excavated soil, construction waste (cement, excess mortar, brick fragments, scrap metal, cardboard, etc.). It is expected that the project will transport waste (debris, household solid waste) by road to the disposal site of inter-district solid waste treatment area in Truong Lam commune, Nghi Son city, 15 away from the subproject site.

Similarly, applying formula [3], the input parameters such as: debris (900 m³), excess excavated soil (approximately 14,914m³), construction debris (190 m³), intermittent transportation time in 24 months, and estimated 3 transport trips per day, the dust load generated from this activity is 0.009 mg/m/s

Using formula [4] - the Sutton model with a wind speed of 4 m/s at the Lach Bang port area and atmospheric stability classified as B, at a distance $x = 25\text{m}$ from the road centerline to both sides, and with the concentration of pollutants generated by the waste transportation activities, the dust concentration calculated is below the allowable limit of QCVN 05:2023/BTNMT within 1 hour (0.3 mg/m³) at a distance of 10m. Dust generated from waste transportation will affect construction workers, fishermen operating at the existing Lach Bang fishing port, and seafood processing facility in Hai Thanh ward, located 50 meters away; and residential areas in Hai Binh, Hai Thanh wards, located 20-50m away on the main transportation route.

The impact level is assessed as Low because (i) the dust concentration is lower than the permissible standard, (ii) the impact is long-term but intermittent over approximately 24 months of construction, (iii) the direct impact is limited to construction workers and some fishermen who are currently working at the existing port and residential areas in Hai Binh, Hai Thanh wards, located 20-50m away on the main transportation route, and (iv) this impact can be mitigated through appropriate measures.

v. Dust from material gathering and loading and unloading:

Dust is generated from gathering, loading and unloading materials at gathering sites in the subproject area. The construction of the subproject works will require a large amount of basic materials such as cement (2,144 tons), sand (8,321 tons), stone (15,169 tons), and steel (920 tons). Based on the dust emission coefficient generated from material loading and unloading, the dust load generated is 41.67 mg/m.s.

Apply the formula [5], the dust load generated in 1 hour (mg/m³) during material loading and unloading activity of Lach Bang subproject is below permissible limit of QCVN 05:2023/BTNMT within 1 hour at a distance of 10m.

Thus, the direct impact of these activities will be on construction workers and residents living in the subproject area within a radius of 10m. It also affects construction workers and some fishermen working in existing fishing port, seafood processing facility in Hai Thanh ward.

The impact level is assessed as Low because (i) the dust concentration is lower than the permissible standard, (ii) the impact is long-term but intermittent over approximately 24 months of construction, (iii) the direct impact is limited to construction workers and some fishermen who are currently working at the existing port, seafood processing facility in Hai Thanh ward; (iv) this impact can be mitigated through appropriate measures

vi. Dust from vehicles transporting materials and wastes

Emission comes from vehicles transporting materials of Lach Bang subproject such as cement (2,144 tons), sand (8,321 tons), stone (15,169 tons), and steel (920 tons) and waste such as debris from demolition of structure for site preparation (900m³), excess excavated soil (approximately 14,914m³), construction debris (190m³). As these vehicles use DO fuel, the emission contains products from the fuel combustion process of internal combustion engines such as NO_x, SO₂, CO.

Based on input data of Lach Bang subproject: materials and wastes are transported by the trucks which have a load capacity of 10 tons and fuel consumption of 0.4 liters of oil/truck.km (1 liter of diesel = 0.832 kg). The parameters of the number of transportation trucks and distance are as follows:

- Materials are transported intermittently within 24 months of construction, the number of transportation vehicles calculated is 5 trips/day with an average distance of 10-15km.
- Wastes are transported continuously within 24 months, the number of transportation vehicles calculated is 3 trips/day with an average distance of 15km.

Thus, the fuel consumption for these activities is 2.66 kg/day. Applying formula [3], we have emissions from these activities as below: SO₂: 0.00417 mg/m.s; NO₂: 0.0229 mg/m.s and CO: 0.1167 mg/m.s.

As the emission load from the above transportation activities is quite low. However, to assess the impact of this activity on the ambient air quality, apply Formula [4] - Sutton model to calculate the concentration of pollutants in the emissions according to the distance (x) and height (z) of the emission load with the highest concentration of CO. The results of the concentration of emissions from transportation activities calculated meet QCVN 05: 2023/BTNMT - National technical regulation on ambient air quality at a distance of 10m.

Direct impact will be on construction workers, fishermen operating at the existing Lach Bang fishing port, and indirect impact will be on employees of seafood processing facility in Hai Thanh ward, located 50m away; and residential areas in Hai Binh, Hai Thanh wards, located 20-50 meters

away on the main transportation route.

The impact level is assessed as Low because (i) the emission concentration is lower than the permissible standard, (ii) the impact is long-term but intermittent over approximately 24 months of construction, (iii) the direct impact is limited to construction workers and some fishermen who are currently working at the existing port, and (iv) this impact can be mitigated through appropriate measures.

vii. Dust and emissions due to operation of construction machinery

Emissions are generated from the operation of construction machinery and equipment using diesel oil for internal combustion engines such as: floating cranes, excavators, graders, welders, generators, pile drivers, concrete mixers, etc. Pollutants emitted contain products from the fuel combustion process of internal combustion engines such as NO_x, SO₂, CO.

Similarly, to calculate the amount of emissions (CO, NO₂, SO₂) from machinery and equipment operating during construction, the report based on the document of NATZ Transport, Shun Dar Lin, 2005. With the oil using coefficient of 0.1 kg/ton, it will generate: SO₂ with 2.8 kg/ton of oil; NO₂ with 12.3 kg/ton of oil; CO with 0.05 kg/ton of oil

According to the number of construction machines and the fuel consumption requirements for the Lach Bang subproject, the average amount of DO oil used is 4.98 liters per hour. The estimated operation time is approximately 8 hours per day (1 shift), not continuously, within 24 months of construction.

Using formula [6], the load of dust and gases emitted from the fuel combustion of the construction machinery in one working shift is as follows: 0.1273 g/s SO₂; 0.0181 g/s NO₂; 0.0045 g/s CO; 0.1273 g/s dust; 0.1273 g/s VOC.

Applying Formula [4] - the Sutton model with a wind speed of 4 m/s and a distance of 5-10 meters from the emission sources, the concentration of exhaust gases from construction machinery meets the QCVN 05:2023/BTNMT - National Technical Regulation on Ambient Air Quality.

Gases exhausted from operation of construction machinery will directly affect construction workers, fishermen operating at the existing Lach Bang fishing port, and indirectly affect employees of seafood processing facility in Hai Thanh ward, located 50m away; and residential areas in Hai Binh, Hai Thanh wards, located 20-50 meters away.

The impact level is assessed as Low because: (i) The concentration of emitted gases is lower than the allowable standard; (ii) The impact is long-term but intermittent, 8 hours/day over approximately 24 months of construction; (iii) The direct impact is limited to workers and some fishermen operating at the existing port; (iv) This impact can be mitigated by appropriate measures.

In general, the subproject's impact on ambient air quality is assessed as **Low** because (i) the concentration of emitted gases all meets or slightly exceeds allowable limit, (ii) the impact is long-term but intermittent (mainly concentrated around 8-10 hours per day and intermittently in 24 months of construction), (iii) the direct impact is limited to workers directly involved in the construction and fishermen operating at the existing Lach Bang fishing port; and indirect impact is on employees in seafood processing facility in Hai Thanh ward, 50m away; and existing residential areas in Hai Binh, Hai Thanh wards, located 50m -100m from the construction site and households living along the main transportation route, located 20-50m away from the road (the saline-resistant dyke road accessing Lach Bang fishing port on the Hai Binh ward side and the Van Nhan road accessing the fishing port on the Hai Thanh ward side).

b) Impacts due to noise

During the construction phase of the Lach Bang subproject, noise is mainly from: (i) the operation of trucks transporting construction materials and waste; (ii) the operation of construction machinery and equipment; (iii) the demolition of existing structures, construction activities (especially the pile-driving ships for embankment/port reinforcement), and dismantling/completing the construction items; and (iv) the activities of engineers and workers involved in the construction.

Applying the typical noise standards for construction vehicles and equipment from the “U.S. Environmental Protection Agency - Noise from Construction Equipment and Machines NJID, 300.1, 31/12/1971” as shown in the table below and applying formulas [10] and [11], the noise level will decrease with distance. The maximum noise level at various distances due to the operation of construction equipment is presented in the table below:

Table 4.10. Maximum noise by distance due to construction machines of Lach Bang subproject

No	Machinery and equipment	Noise at distance 2m	Average	Noise by distance (dBA)				
				5m	20m	50m	100m	200m
1	Truck 10T	71 ÷ 80	75.5	71.5	65.5	61.5	58.5	55.5
2	Floating crane 30T	86 ÷ 88	87	83.0	77.0	73.0	70.0	67.0
3	Canoes 12-75CV	80 ÷ 87	83.5	79.5	73.5	69.5	66.5	63.5
4	Barge 300-1000T	85 ÷ 92	88.5	84.5	78.5	74.5	71.5	68.5
5	Mixer 250l	80 ÷ 94	87	83.0	77.0	73.0	70.0	67.0
6	Needle vibrator 1.5KW	74 ÷ 77	75.5	71.5	65.5	61.5	58.5	55.5
7	Excavator 2.3-3.6m ³	79 ÷ 82	80.5	76.5	70.5	66.5	63.5	60.5
8	Bulldozer 110-140CV	72 ÷ 79	75.5	71.5	65.5	61.5	58.5	55.5
9	Water pump 30CV	69 ÷ 71	70	66.0	60.0	56.0	53.0	50.0
10	Watering truck 5m ³	78 ÷ 81	79.5	75.5	69.5	65.5	62.5	59.5
11	Vibratory roller 25T	58 ÷ 70	64	60.0	54.0	50.0	47.0	44.0
12	Air compressor 360 m ³ /h	85 ÷ 89	87	83.0	77.0	73.0	70.0	67.0
13	Generator 50kVA	85 ÷ 87	86	82.0	76.0	72.0	69.0	66.0
Average noise level				75.6	69.6	65.6	62.6	59.6
Total noise level (maximum)				90.2	84.2	80.2	77.2	70.2
QCVN 26:2010/BTNMT: Normal area noise level				70 dBA				
QCVN 24:2016/BYT: Working area noise level				85 dBA				

According to the calculation results, the average noise level (equivalent noise level) at a distance of 20–30 meters from the vehicles and construction equipment is within the permissible limits of QCVN 26:2010/BTNMT and QCVN 24:2016/BYT, except at the distance of 5 meters, where the average noise level exceeds the allowable limit by approximately 5.6 dBA. However, the total noise level (maximum) at distances less than 200 meters from the source exceeds the allowable standards of QCVN 26:2010/BTNMT. At distances greater than 200 meters, the total noise level meets the allowable standards.

The noise mainly has impacts on construction workers, residents living near the subproject area

and along transportation road. The noise with high intensity will affect health, causing insomnia, fatigue, and psychological discomfort. Noise also reduces the productivity of workers on the construction site, making them less focused and more prone to work accidents.

Noise will directly affect construction workers and fishermen working in existing Lach Bang fishing port; indirectly affect employees of the sea food processing facility in Hai Thai ward, located 50m away, and existing residential areas in Hai Binh, Hai Thanh wards, located 50m-100m away from the construction site.

The noise level at the construction site is assessed as Medium because: (i) the noise generated is intermittent during the construction period, but the total construction period lasts for 24 months; noise from the construction activities at the existing port will affect various parties; (ii) the equipment operates non-simultaneously, depending on working stage/shift or the construction progress/volume of each item. Different types of machinery will be used at different times, so the cumulative impact at the same position is very low compared to the calculated results; (iii) Furthermore, all vehicles and equipment are regularly inspected, and the noise will cease once the construction activities are completed; and (iv) the noise can be minimized through mitigation measures such as providing personal protective equipment and noise reduction devices.

c) Vibration impact

Vibration arises mainly from equipment, machines that operates with high capacity and regularly on the construction site such as bulldozers, excavators, air compressors, pile-driving ships, etc., for activities like ground leveling, pile-driving for embankment/port reinforcement. The typical vibration levels of some construction machinery and equipment are presented in the table below.

Table 4.11. Vibration of some typical construction machinery and equipment

No.	Machinery and equipment	Reference vibration (vertical direction, dB)
1	Excavator	80
2	Bulldozer	79
3	Heavy truck	74
4	Roller	82
5	Gas compressor	81

(Source: U.S. Environmental Protection Agency. *Vibration from construction equipment and construction machinery NJID, 300.1, 31 – 12 – 197*)

Using formula [9] to predict the reduction of vibration levels with distances that may occur at the Lach Bach subproject site, the results are presented below.

Table 4.12. Vibration reduction by distance

No.	Machinery and equipment	Source vibration (r0=10m)		Vibration 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

No.	Machinery and equipment	Source vibration (r0=10m)		Vibration 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)
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	Gas compressor	81	1.93	71.5	0.65	62.1	0.22	52.9	0.08	43.6	0.03

QCVN27:2010/BTNMT, allowable limit 75dB from 6 ÷ 21h and baseline limit from 21h÷6h.

DIN 4150, 1970 (Germany), 2mm/s: no damage; 5mm/s: mortar peeling; 10mm/s: likely to damage load-bearing parts; 20 ÷ 40mm/s: damage to load-bearing parts.

According to the calculation results, the vibration level from construction vehicles and equipment at a distance of 12 meters is within the permissible limits of QCVN 27:2010/BTNMT (<75dB) and will decrease as the distance from the vibration source increases. Mainly the vibration of construction equipment directly impacts construction workers at the construction site and may directly affect surrounding structures at near distance (less than 10m) with the risks of subsidence/cracking.

Vibration of construction equipment will have impact on machinery operators and construction workers executing items which generate high vibration at the site and works of existing Lach Bang fishing port.

The level of direct impact due to vibrations is assessed as medium because: (i) The operation of equipment is intermittent, with localized impacts at the construction site (the piling process for reinforcing the port embankment is expected to last around six months); (ii) Equipment operators work in shifts and are provided with personal protective equipment; (iii) The surrounding area of the Lach Bang fishing port upgrading subproject site consists of existing structures, including the port embankment (adjacent to the demolition site and next to the new construction of docking area toward Hai Thanh ward, seafood processing facility, located 50m from the subproject site); (iv) The impact of vibrations can be fully mitigated by applying appropriate construction methods and planning tailored to each specific location.

Impact of vibrations on nearby port structures during piling activities for port embankment construction

Lạch Bạng sub-project will apply the bored pile method for reinforcing the quay footings and the port. Specifically, it is expected that reinforced concrete bored piles with a diameter of D800 and a length of approximately 13–14m will be used. The bored pile offers a major advantage: it does not generate significant vibrations, thereby minimizing the risk of affecting nearby existing structures or constructions.

d) Wastewater impact

The wastewater generated during construction of Lach Bach subproject can be categorized into three main types: (i) Domestic wastewater from construction workers; (ii) Construction wastewater generated during construction; (iii) Rainwater runoff flowing through the construction site:

Domestic wastewater from construction workers:

Domestic wastewater during the construction phase of the Lach Bang subproject originates from

workers' activities. Expectedly, 50 workers will be mobilized over a construction period of 24 months. The estimated water supply norm is 50 liters/person/day. Assuming that 100% of the supplied water is converted into wastewater, the total generated domestic wastewater is calculated as 2.5 m³/day.

Domestic wastewater contains various components, including: Suspended solids (TSS), Organic matter (BOD₅, COD), Nutrients (N, P), Pathogenic microorganisms. The daily pollutant load generated by 50 workers (considering the maximum number of workers accommodated in the temporary camps) and the concentration of pollutants discharged into the environment are presented in the following table:

Table 4.13. Pollutant load in domestic wastewater

Pollutants	Pollution coefficient (g/person/day)		Load (kg/day)		Pollutant concentration (mg/l)		
					Before treatment	QCVN 14:2008 Column B	
BOD ₅	45	54	2.25	2.7	642.9	771.4	50
COD	72	102	3.6	5.1	1028.6	1457.2	-
TSS	70	145	3.5	7.25	1000	2071.5	100
Grease	10	30	0.5	1.5	142.9	428.6	20
Total Nitrogen	6	12	0.3	0.6	85.8	171.5	50
Ammonia (N-NH ₄)	2.4	4.8	0.12	0.24	34.3	68.6	10
Phosphor	0.8	4	0.04	0.2	11.5	57.2	10
Total Coliforms	1.00E+06	1.00E+09	5.0E+04	5.0E+07	1.4E+07	1.4E+10	5000 (MNP/100ml)

The concentrations of pollutants such as BOD, COD₅, TSS, NH₄⁺, etc., in domestic wastewater during the construction phase, if untreated, all exceed the permissible limits of QCVN 14:2008/BTNMT (Column B). Therefore, if domestic wastewater is not adequately treated before being discharged into the receiving source, which is the Bang River (or in another word, Lach Bang river) – the coastal river mouth, the quality of the Bang River water will deteriorate as the pollutant concentrations increase. Aquatic species will be directly affected due to the reduction of dissolved oxygen in the water (this content will be specifically assessed in the next section).

In addition, the construction workers gathered at temporary camps during the construction of the Lach Bang subproject; and the fishermen currently operating at the existing Lach Bang port are also directly affected by this waste source. This waste source contains many pathogenic microorganisms that pose risks of developing skin diseases, eye diseases, gastrointestinal diseases, and infectious diseases for the construction workers.

The risk level is assessed as **Low** because: (i) the amount of wastewater generated is intermittent throughout the day and is not large (2.5 m³/day); (ii) there will have some local workers and some worker will rent local houses for temporary residence, so the actual amount of wastewater generated is much lower than calculated; (iii) the wastewater is generated intermittently during the day (mainly during the workers' rest and living hours but extended over approximately 24 months

of construction); (iv) the flow rate of the Bang River which is the receiving source, is quite large (The average surface flow rate of Bang River ranges from 20.4 to 38 liters/second/km², with a river basin area of 236 km², corresponding to 0.42 to 0.77 million m³/day). These risks can be mitigated through appropriate mitigation measures.

Construction wastewater:

Wastewater during the construction phase of the Lach Bang subproject comes from (i) washing the wheels before leaving the construction site; (ii) the operation of small-capacity mortar and concrete mixers used for casting small components (the rest is commercial concrete which is to be purchased); and (iii) washing construction equipment and tools. The total amount of construction wastewater generated is approximately 5.68 m³/day. Among them:

- Motor vehicle washing water is mainly used to clean the wheels before leaving the construction site. According to TCVN 4513-1988, internal water supply - design standards, the amount of water used to wash the entire vehicle is rated at 500 liters/wash, but during the construction phase, motor vehicles mainly only wash the wheels, so estimated average amount of wheel cleaning water is 100 liters/vehicle. The number of vehicles transporting materials is estimated to be 3 vehicles per day, and the number of waste transport trips is 3 per day (total at peak period is 8 trips per day), resulting in the wastewater generated being: $8 \times 100 = 800$ liters per day = 0.8 m³ per day.
- Concrete mixing activities at construction sites use 250l concrete mixers, total capacity of 30 m³/h. According to the document '*Concrete Technology and Special Concrete*' by Pham Duy Huu, Construction Publishing House 2009, the amount of water needed in the concrete mixing process with a capacity of 30 m³/h will be 9.69 m³ for washing the aggregates and 5.4 m³ for mixing the concrete. Of this, 80% of the water used to wash the aggregates will be recycled and reused. Therefore, the wastewater generated during the concrete mixing process at the construction site is $20\% \times 9.69 = 1.94$ (m³/h). On average, the concrete mixing activities take place for 2 hours/day, so the amount of wastewater generated from the concrete mixing activities is $1.94 \times 2 = 3.88$ (m³/day).
- Construction equipment and machinery are washed once at the end of each construction day, estimated to be about 01 m³/day.

The component of construction wastewater generated mainly consists of suspended solids, oils and grease, soil, sand, etc. If not being treated before discharging into Bang river, this wastewater will cause several negative impacts on the river water such as: High levels of suspended solids, increasing the turbidity of the water, reducing the ability of oxygen dissolution from the air into the water, thereby adversely affecting the aquatic life in the Bang River; Sedimentation buildup in the receiving body, which is the surface water of the Bang River.

The impact level is assessed as Low as: (i) the volume of construction wastewater generated at the site is not large (5.68 m³/day); (ii) the wastewater is concentrated in the construction site areas; (iii) the wastewater is generated intermittently throughout the day (mainly 2 to 8 hours of construction but extends over approximately 24 months of construction); (iv) the flow rate of the receiving source, the Bang River, is quite large (accounting for only 0.0006% of total average annual flow of the Bang River basin); furthermore, this is the area of the existing Lach Bang fishing port, so the water quality of the Bang River has already been impacted by previous fishing port activities and (v) the risks can be mitigated through appropriate measures.

Rainwater runoff

Based on TCVN 7957:2008, rainwater runoff flowing through the Lach Bang subproject site is

calculated according to the formula [10], the construction area of the Lach Bang fishing port is $F=12.9$ ha (covering 2.62ha of expansion area, the remaining 9.47ha area of existing port with renovation/upgrading activities); the parameters based on the climate constants of Thanh Hoa province are: $A=3640$; $C=0.53$; $b=19$; $n=0.72$. Substituting these values into formula [11], the calculated rainfall intensity at the Lach Bang subproject construction site is: **$q=144.026$ (l/s.ha)**.

Therefore, the rainwater runoff flow rate on the construction site is calculated to be 592.0 l/s, equivalent to 0.592m³/s and 2.131 m³/h. (the heaviest rain lasts 1.5 hours)

According to WHO data (1993), the concentration of pollutants in rainwater runoff is about 0.5 - 1.5 mg N/l, 0.004 - 0.03 mg P/l, 10 - 20 mg COD/l and 10 - 20 mg TSS/l, these parameters are lower than the allowed standards according to QCVN 40: 2011 / BTNMT - National standards on industrial wastewater quality. However, rainwater flows over the construction site area, carrying away materials, loose soil and rocks, mineral salts on the surface, leaked oil and grease, etc., increasing the content of suspended substances and impurities, organic matter, increases turbidity, oil and grease in water, reduces water quality, and negatively impacts the aquatic ecosystem of Bang river, receiving source of the subproject. Pollutants from surface runoff can affect water quality and aquatic organisms living in surface water ecosystems of Bang river at Lach Bang fishing port once the turbidity increases.

The impact level is assessed as medium because: (i) the amount of rainwater runoff at the construction site is moderate (2,131 m³/h, the heaviest rain lasts 1.5 hours); (ii) rainwater runoff is concentrated in the construction site areas; (iii) the rainwater runoff is usually intermittent throughout the year (the rainy season is from May to November but extends over approximately 24 months of construction); (iv) the flow rate of the receiving source, the Bang River, is quite large (accounting for only 0.0006% of total average annual flow of the Bang River basin); and (v) the risks can be mitigated by appropriate measures such as regular cleanup by workers at the construction site, installation of rainwater drainage systems, and sedimentation pits at each site to limit debris, loose soil, and rocks being washed away by rainwater runoff.

e) Solid waste

Solid waste generated during the construction phase for construction items includes the following 3 main types: (i) Construction solid waste; (ii) Domestic solid waste; (iii) Hazardous solid waste. The generated volume is evaluated as follows:

Construction Solid Waste:

Construction solid waste of Lach Bang subproject is the volume of debris from demolition of degraded embankments, roads on the port with 900 m³, excess excavated soil with 14,914m³, debris with 190 m³ from construction activities at the site. The solid waste mainly includes common solid wastes, and waste materials, etc.

- The amount of solid wastes from demolition of existing Lach Bang subproject works is small (about 900m³) mainly consisting of construction waste such as tiles, planks, concrete, and iron sheets.
- The volume of excavated soil generated by the Lach Bang subproject is not large, amounting to 14,914 m³.
- A small amount of debris generated during the construction includes excess mortar, wood chips, broken bricks, etc. According to *Decision No. 1172/QĐ-BXD dated December 26, 2012, issued by the Ministry of Construction stating the construction project estimate norms*, the estimated amount of construction solid waste generated is approximately 0.5%

that of the materials used for the subproject, equivalent to about 190 tons.

These types of solid waste, if not well controlled, can obstruct construction work and increase the amount of dust in and around the construction site, affecting workers and residents living near the project area.

The construction solid waste primarily affects the staff and workers involved in the construction, as well as the fishermen operating at the existing Lach Bang fishing port. The waste also has indirect impacts on employees of the seafood processing facility in Hai Thanh ward, located 50m away; and existing residential areas in Hai Binh, Hai Thanh wards, located 50m away from the construction site. This waste source increases dust concentration, which can impact the health of workers and fishermen. Randomly piled construction solid waste obstructs pathways with bulky items and slippery surfaces, which can cause accidents for workers and fishermen. Additionally, if the large volume of construction solid waste mentioned above is not properly collected and managed, it will be washed away by rainwater runoff on the construction site, reducing the quality of the receiving water source, the Bang River. It can cause sedimentation and blockage of the surface flow at the port, leading to the risk of local flooding at the construction site and surrounding areas, especially during the rainy season (from May to November every year).

In general, this direct impact is assessed to be **Moderate** because: (i) The volume of waste generated is not large and localized at construction site; (ii) Long-term construction period (about 24 months); (iii) construction solid waste will be collected and transported to the local disposal site of Solid waste treatment area in Truong Lam commune, Nghi Son town, 15km from the subproject area. (iv) At the same time, this impact can be minimized through appropriate mitigation measures

Domestic solid wastes:

Domestic solid waste arises from daily activities of construction workers in camps which are planned to be installed in the construction site of Lach Bang fishing port. The main components of domestic solid waste include easily decomposable organic substances and difficult-to-decompose inorganic substances such as nylon bags, bottles, and old personal items. The average amount of household solid waste emissions is about 0.5 kg/person/day QCXDVN 01:2021/BXD - National Technical Regulations on Construction Planning, with the expected 50 workers for Lach Bang subproject, the amount of daily solid waste generated is 25kg/day, equivalent to 0.8 tons/month.

This waste component includes: organic matter, waste paper of all kinds, nylon, plastic, metal, damaged daily living items, etc. This waste contains 60 - 70% organic matter and 30 - 40% of other substances and especially may contain many bacteria and pathogens.

The direct impact will be on the workers participating in the construction and staying in temporary camps, and the fishermen operating at the existing port. Additionally, if the generated domestic waste is not collected and treated properly according to regulations, it can cause loss of beauty of the area. When waste is littered on the ground, under the effects of weather and bacteria, organic compounds decompose, it creates malodors that pollute the air, increase the risk of disease outbreaks, and affects the health of staff and workers participating in the construction and activities of fishermen in nearby facilities like the seafood processing facility in Hai Thanh ward, located 50m away. Furthermore, if domestic solid waste is not collected and treated, it will be washed away by rainwater runoff, flowing into the Bang River at the Lach Bang fishing port construction area, reducing the quality of surface water and affecting the aquatic ecosystem of the Bang River.

However, the impact of domestic waste is assessed as Low and can be mitigated because: (i) The amount of waste generated at the construction site is not significant and is collected daily by the workers; (ii) It is locally generated at the construction sites; (iii) The contractor use local workers

to limit the domestic waste generated; (iv) there is a solid waste collection and treatment team who is effectively operating in the Lach Bang port.

Hazardous waste:

Sources of hazardous waste generated from the construction of project items include: (i) Oil-contaminated materials from the maintenance of construction machinery; (ii) Packaging, containers for lubricants, asphalt, gasoline, and paint; (iii) Excess tip of welding rod; (iv) Batteries, light bulbs, ink cartridges from office activities at construction sites. The volume of hazardous waste depends on the quantity of equipment/machinery, labor, and quantity of raw materials:

- Maintenance activities of construction vehicles, vehicles, and machines, if performed right at the construction site, also generate lubricant residue, lubricant bottles and lubricant-contaminated rags,... (estimated at about 3kg/month).
- Packaging containers, lubricant oil containers, asphalt containers, gasoline containers, and paint containers are not generated in large amounts (about 15kg/month).
- Waste welding rods are generated at the construction site due to shaping activities of steel frames of house within Lach Bang fishing port. It is estimated that 5-7% of the excess welding rod tip will be generated from the welding rod weight, so each subproject will generate about 3.0kg of excess welding rod tips.
- In addition, there is a small amount of hazardous waste generated from office activities, the volume is about 5kg/month .

No.	Hazardous wastes	Code	Estimated volume
1	Gloves, rags contaminated with hazardous waste, oil-stained filter cloths	18 02 01	3 kg/month
2	Broken light bulbs	16 01 06	5 kg/month
3	Metal waste packaging (paint cans, paint, paintbrushes) during the finishing stages of the subproject, with the painting process lasting approximately 2 months	18 01 02	15 kg/month
4	Waste welding rods	07 04 01	3 kg/month

Affected subjects: If hazardous waste is not collected, it will cause oil and harmful waste to infiltrate surface water, directly affecting aquatic species in the Bang River area at the existing Lach Bang port. Hazardous waste will negatively impact the landscape and degrade soil quality in the subproject area unless being properly collected and treated. Additionally, the hazardous waste will directly impact the health of construction staff and workers, as well as fishermen operating at the existing port.

The impact level is assessed as Low because: (i) the amount of hazardous solid waste generated at the construction site is not large (26 kg/month) and is localized to certain construction phases; (ii) there are existing functional units, in the subproject area, in charge of the collection and treatment of hazardous waste; besides, repairs of equipment and construction vehicles are expected to be carried out at local professional repair centers; (iii) the impact is intermittent but extends over approximately 24 months of construction; (iv) the risks can be mitigated by appropriate measures.

f) Impact on Ecological Environment

Terrestrial ecosystem:

The impact on terrestrial biological resources is mainly due to the process of reinforcing the embankments of the expanded structures in the Lach Bang fishing port and activities such as removing the organic soil layer/clearing vegetation, which will result in the loss of the vegetation cover (approximately 2.62 ha) in the port expansion area. In addition, construction activities will generate noise and vibrations that may affect terrestrial animals (such as reptiles, birds, some domestic animals like buffaloes, cows, dogs, chickens, cats, etc.). During the dry season construction, workers may carelessly cause sparks while welding or cutting steel, burning construction waste, or engaging in cooking activities outside the camp/construction area, which could ignite nearby shrubs. This would destroy the surrounding vegetation and shrubs, damaging the landscape of existing Lang Bach fishing port.

The affected subjects are terrestrial biological resources in and around the existing Lach Bang fishing port area.

The impact level is assessed as Low because (i) the Lach Bang subproject area is implemented on the planned expansion land of the fishing port with some wild plants and shrubs growing naturally along the Lach Bang riverbank. Therefore, terrestrial biological resources are insignificant (mainly reptiles, field birds, and some domesticated animals such as buffaloes, cows, dogs, chickens, cats... raised by local residential areas and existing kiosk owners at the port); (ii) Around the construction area, there are green belts planted along urban roads in the residential areas of Hai Thanh and Hai Binh wards (*Terminalia catalpa*, Flamboyant tree, Crape myrtle tree, etc.); (iii) The impact duration is not continuous but extends 24 months of construction; (iv) These impacts can be mitigated with appropriate measures

Aquatic species:

As discussed above, wastewater and rainwater runoff running through the camp area and construction site can increase turbidity, organic content (represented by the BOD), nitrogen, and oils and grease in the receiving water source, the Bang River, in the Lach Bang fishing port expansion area. Increased water turbidity will hinder light from reaching aquatic plants, leading to reduced photosynthesis activity. Increased suspended solids in the water can affect the respiratory systems of aquatic animals. The decomposition of organic matter will lead to a reduction in dissolved oxygen in the water, affecting aquatic life. Oils, grease, and other hazardous substances can be detrimental or fatal to aquatic flora and fauna, etc.

Additionally, wastewater and rainwater runoff can increase water turbidity, negatively affecting aquatic species, especially benthic organisms (aquatic organisms in the subproject area of the Bang River include: zooplankton mainly of copepods, cladocerans, and rotifers; benthic animals mainly of snails, mussels, clams, crabs, shrimps, etc.; aquatic plants mainly of water hyacinth, algae, etc.)

Near the existing port area, there is one household raising fish in floating cages near the Hai Binh ward port that may be affected by the subproject construction activities. However, after consulting with local residents, it was found that this household is currently farming illegally on the river. Therefore, the household will be notified in advance about the subproject's construction activities so they can plan to change their farming methods or temporarily stop fish farming during the construction period to avoid economic losses. This issue will be discussed in detail in the site-specific impact assessment.

The potential impacts on the aquatic ecosystem of the Bang River are assessed as **Low** because: (i) There are no rare or endangered aquatic species in the subproject area. However, workers might catch fish (various natural fish species such as carp, goby, tilapia, grass carp, brackish water fish, shrimp, crab, clams, and mussels in the Bang River. However, in general, due to the activities of boats entering and exiting, and the discharge of untreated wastewater at the existing port, the water

quality of the Bang River at the port has already deteriorated, and consultations with fishermen have indicated a significant decline in the quantity of these species at the port area); (ii) The impact is not continuous, mainly occurring during the rainy season but lasting for 24 months; (iii) This impact can be mitigated through appropriate measures, including dredging sedimentation pits on the construction site and treating wastewater from the camps before discharging into the environment.

g) Impacts due to erosion, sedimentation, and local flooding

During the construction and upgrading of the Lach Bang subproject structures with an area of 12.09 ha (covering 2.62ha of expansion area, the remaining 9.47ha area of existing port with renovation/upgrading activities), the erosion and sedimentation are mainly caused by rainwater runoff passing the construction site surface, carrying waste into the receiving water source, the Bang River, as follows:

Heavy rain can cause erosion, and carry floating materials such as waste soil and rocks, oils and grease, waste, mortar, concrete, etc. to the construction site. These materials, when being carried away by rainwater, will affect the water quality of the receiving source, the Bang River. However, these impacts are only temporary during the construction phase. Once the construction of the main structures and technical infrastructure of the fishing port is completed and the area is hardened, these impacts will cease.

Risk of localized flooding: During construction, the elevation of the ground in the Lach Bang fishing port expansion area increases, and the surface of the area also changes, causing faster water accumulation, which affects drainage capacity. However, these impacts are not significant because the existing fishing port is being upgraded on an already concreted surface with existing drainage systems; the expanded area (2.62 ha, of which 0.53ha of the port on Thanh Hai side and 2.09 of the port on Hai Binh side) is also on existing land and port surface planned for the fishing port expansion, so it will not change the overall topography of the area. Moreover, the port expansion area is along the Bang River where the drainage conditions are good. Therefore, there is no risk of localized flooding at the construction site.

Overall, the impact level is Low because: (i) The area is being developed on the planned land for port expansion and has accounted for natural factors (rainfall, Bang River water level, climate change impacts such as rising sea levels); (ii) The impact is intermittent, mainly occurring during the rainy season over a construction period of approximately 24 months; (iii) The Lach Bang fishing port expansion area has a favorable terrain with existing water supply and drainage infrastructure of the current port; the port toward Hai Binh ward has been invested with a breakwater (in the shape of crab claws), providing protection against wave impacts and reducing the risk of pollutant dispersion in the river; (iv) The impact can be mitigated by appropriate measures.

h) Impacts due to risks increase and traffic disruption

Road traffics:

Construction activities may moderately increase the number of road transport vehicles carrying construction materials (around 5 trips/day), transporting waste (around 3 trips/day), and moving construction machinery/equipment in and out of the Lach Bang subproject area. The movement of heavy vehicles (excavators, cranes, bulldozers, rollers, etc.) can disrupt the existing traffic flow on the roads and increase the risk of traffic accidents for road users.

The increased traffic intensity due to transportation of materials will directly affect construction workers, fishermen operating at the existing Lach Bang fishing port; and indirectly affect

employees of the seafood processing facility in Hai Thanh ward, located 50m away; and existing residential area in Hai Binh ward, Thanh Hai ward, located 50-100m away from the construction site and 20-50m away from the surface of the main transportation route.

Additionally, the quality of the main transportation route— salt intrusion prevention dike road (toward Hai Binh ward) and Van Nhan road (toward Hai Thanh ward) could be affected by the activities of heavy construction trucks/machinery, creating potholes, rough patches, and water-filled depressions during rain, which increase the risk of traffic safety issues for people and vehicles.

This impact is assessed as Low because: (i) The number of transport trips is small (8 trips/day), and the machinery is only mobilized for certain periods when needed and upon project completion; (ii) The impact period is intermittent (but long-term, lasting approximately 24 months); (iii) There are many affected parties, and the density of traffics on the main transport route is high due to trucks/motorcycles entering and exiting the existing port to transport seafood caught by fishermen and providing port logistics services, especially during peak hours of some schools/offices such as school start time (7-8 AM) and end time (4-6 PM) daily on the main transport route; (iv) This impact can be mitigated through appropriate measures.

Waterway traffics:

Water traffics may also be impacted by the increase in the number of construction machinery moving on the water, such as canoes, 30T floating cranes, barges, pile driving ships, etc., which need to travel to the construction site by waterway. Currently, water traffics on the Bang River in the Lach Bang port area is quite busy (around 20 ships docking per trip, with about 300 ships regularly moored).

In addition, construction activities in the water (such as floating cranes, barges, and pile driving ships for the construction of port embankments) can narrow or block the docking area at the existing port section which is being renovated. However, this will not affect the port expansion area.

Impact on waterway traffic is assessed as medium and localized because: (i) The Bang River in the Lach Bang subproject area has a width of about 150m-250m, only 1km from the sea. The remaining width of the Bang River is still sufficient for local boats to navigate; (ii) Construction machinery on the water is fixed at a certain section, thus limiting the impact on the docking activities of fishing boats; (iii) The existing docking area of Lach Bang port is quite long (about 180m, with multiple docking bridges), so it will not significantly affect the mooring activities of ships; (iv) Good waterway and road traffic safety management during the construction phase will prevent, mitigate, and reduce the impact on traffic, including traffic accidents.

i) Risks of damages to existing infrastructures due to construction material transportation and operation of machineries

Transporting materials to the construction site by heavy trucks can damage the roads. The main transportation road to Lang Bach port is the salt-intrusion prevention dyke road (on Hai Binh side) and Van Nhan road (Hai Thanh side), it is about 8-12 meters wide, with good quality asphalt concrete, drainage ditches along both sides, and sidewalks. The quality of the dike road and Van Nhan road can be affected by the activities of heavy trucks/construction machinery, creating potholes, rough patches, and water-filled depressions during rain, increasing the risk of traffic safety issues for people and vehicles. Moreover, the activities of cranes, excavators, bulldozers, etc., can affect existing technical infrastructure such as power grids, telephone lines, some kiosks near the port expansion construction area, and existing port docking bridges.

In addition, within the fishing port area, there are several businesses providing fishing logistics services. Specifically, at Lach Bang fishing port, there are 21 facilities for preliminary processing and trading of seafood; facilities for producing and supplying ice; 01 facility for supplying petroleum; for providing essential goods; and for purchasing products at the port; for repair and building ships. The construction activities for upgrading and expanding the port may affect the business operations of these service stores due to construction activities, the gathering of bulky materials, construction machinery, dust dispersion, noise, and waste, etc.

The impact level is assessed as medium because: (i) The quality of the salt-intrusion prevention dike and Van Nhan road is currently good; the internal roads within the port are made of concrete and are quite wide and of good quality; the functional zones within the existing port are specifically arranged to avoid disruption by the construction activities for upgrading and expanding the port; (ii) The impact period is intermittent but long-term, lasting approximately 24 months of construction; (iii) The impact can be mitigated by taking appropriate construction management measures (such as: prior notification to fishermen and business households at the existing Lach Bang port; using alternative transportation methods such as waterways instead of roads, if necessary; only allowing trucks with appropriate load capacities to operate on the road; restoring the road surface when it deteriorates during construction and upon completion of construction activities).

k) Issues related to occupational health and safety (OHS)

For the Lach Bang subproject, it is expected to mobilize about 50 workers to participate in construction for approximately 24 months. Therefore, there will be potential occupational health and safety (OHS) risks as follows:

Risk of occupational accidents during construction:

- Workers may work in environments with increased dust and toxic gas pollution due to demolition, excavation, and machinery activities, which can lead to dizziness or fainting while working. Workers can have accidents due to exposure to electrical tools/equipment, dangerous objects such as sharp iron, nails, screws, and the simultaneous operation of multiple machines in a narrow construction site, especially when workers are not paying attention, not using full personal protective equipment, and lacking awareness of safety regulations. Construction activities can cause other occupational accidents for workers such as fires and explosions due to welding-gas leaks, fuel leaks, welding activities, electric shocks, working at heights, falling into the sea, construction collapses, and the operation of bulky machinery and materials, as well as working in extreme weather conditions such as large waves, strong winds, and poor construction site arrangement.
- Regarding working conditions, workers' OHS problems can be caused by falling into water or even drowning while working on water/sea due to illness or loss of balance. In addition, they can also come into contact with materials containing toxic substances such as oils, etc. If direct contact is made, short-term health effects can be skin or respiratory system irritation while some substances have can penetrate through the skin and enter the body system. The accumulation of toxic substances during work will lead to more serious long-term health effects, so it is necessary to be concerned.
- Other OHS issues related to working conditions would be inadequate lighting or inadequate protection when working in specific conditions or locations.
- Working with construction electric or diesel tools and equipment (e.g. barges, sand pumps, cranes, hoists, drilling/piling machines, etc.), workers can also be electrocuted or burned. .

Extreme weather conditions also cause OHS risks and issues. Strong winds and very heavy rain during storms in coastal areas can cause unfinished/temporary construction works, even construction factories to become unstable, and even cause some tools and equipment to move. Outdoor construction equipment and materials lead to accidents for people around, including workers. Working long hours on very hot days can also cause exhaustion and even fainting for workers.

- Regarding worker behavior, safety risks can come from workers' awareness and attitude towards the use of Personal Protective Equipment (PPE) and personal behaviors at the construction site. . Regarding PPE, it is common for workers at larger and more experienced contractors to be well-trained in EHS and provided with adequate PPE, so they are often subject to more stringent safety rules on site. school. However, workers of smaller/local contractors using PPE (e.g. used as life jackets in rivers/sea) on construction sites depends on the level of enforcement. Examples of careless worker behavior that can lead to accidents or even dangers in construction areas include smoking near flammable materials such as oil tanks, careless handling of electrical wires, Illegal use of construction machinery.

The risk related to workplace accidents at the construction site is assessed as medium because: (i) These impacts are always potentially present on the construction site at any time; (ii) The number of workers is not large (50 people); (iii) This risk may occur during the 24-month construction period; (iv) It can be mitigated by appropriate solutions such as safety training before and during the construction process and providing adequate labor equipment for workers.

Reduce workers' health:

- For dredging workers as well as other construction workers, inadequate living conditions in workers' housing also lead to health and safety problems. Illnesses related to water-borne diseases can be caused by not having enough clean water for use, not having access to adequate sanitation facilities, and poor sanitary conditions in and around the camp. Living at a construction site, away from home for a long time, if workers do not follow a healthy lifestyle and get into fights, drinking, or prostitution, they can also suffer long-term health effects from these activities.
- Increase the risk of infectious diseases (such as dengue fever, diphtheria, etc.), including HIV/AIDS, when workers come from different localities and interact with each other and with the local community.

The impact on workers' health is assessed as Low because: (i) Waste sources will be controlled through impact mitigation measures; (ii) The number of workers is not large (50 people), and there is convenient and widespread local information on issues related to the transmission of sexually transmitted diseases, including HIV/AIDS, and the use of prohibited substances; (iii) This risk may occur during the 24-month construction period; (iv) It can be mitigated by appropriate solutions such as safety training before and during the construction process.

Risk of fire and explosion:

Fire and explosion incidents, as well as electrical short circuits, may occur during the transportation and storage of fuel or due to the lack of safety in the temporary power supply system, causing damage to people and property during subproject implementation. The specific causes can be identified as follows:

- Temporary storage facilities for raw materials serving machinery and technical equipment during construction (paint, gasoline, etc.) are sources of fire and explosion. When incidents

occur, they can cause damage to people, property, and the environment;

- Electrical incidents such as shocks, explosions, short circuits, etc., due to the temporary power supply system for construction machinery and equipment.
- The use of heating devices (welding, heating, etc.) can cause fires, explosions, or workplace accidents if preventive control measures are not in place.
- Especially in the case of thunderstorms, lightning strikes and workers' carelessness in using electrical equipment are the main causes of short circuits and explosions.
- Careless behavior of workers can lead to accidents or even danger in construction areas, including smoking near flammable materials such as fuel tanks, careless handling of electrical wires, unauthorized operation of construction machinery.

Electrical short circuits and explosions can damage construction machinery and equipment, and cause fires in camps and material gathering areas during the construction phase. Since such incidents can occur at any time, the project owner actively takes effective preventive and control measures to minimize and limit these negative impacts as much as possible.

Overall, the risk of fire and explosion at the construction site is assessed as medium because: (i) This risk is always potentially present on the construction site at any time, especially during the dry season; (ii) The existing fishing port consists of shops, seafood processing facilities, storage and supply services for fishing boats docking at the port, which contain flammable materials such as cardboard, gasoline, oil, etc.; (iii) This risk may occur during the 24-month construction period; (iv) It can be mitigated by appropriate solutions such as providing adequate firefighting equipment, ensuring that fire hydrants are available at Lach Bang port, and regularly raising awareness among workers and fishermen/service facilities about fire fighting and prevention, as frequently disseminated by the Lach Bang Fishing Port Management Board.

I) Issues related to community safety and health

Local residents living around the construction site, including the residential area of Hai Binh ward and Hai Thanh ward located about 50-100 meters from the Lach Bang fishing port upgrading and expansion area, have a high density with about 200-300 households. Households along the transportation road (salt-intrusion dike road and Van Nhan road) may be exposed to hazardous waste, domestic solid waste, and construction solid waste. Moreover, increased dust levels, noise, and traffic density due to machinery and vehicle operations, soil subsidence and landslides, construction collapses, and uncovered deep holes at the construction site can cause health and safety risks for the community—especially fishermen and workers from some seafood processing and fishing logistics service facilities engaging in daily trading and activities at the port.

The risk to community health and safety is assessed as medium because: (i) The construction area of the Lach Bang subproject is being carried out at an existing fishing port with certain existing infrastructure and under the effective operation of the port management board; (ii) The number of concentrated workers is not large (about 50 people at the sub-project), concentrated in one construction area; (iii) The construction period is moderate (about 24 months); (iv) Local labor will be prioritized to employ; (v) Workers are trained in occupational safety and environmental hygiene before carrying out construction activities; (vi) This risk can be mitigated through appropriate construction arrangement measures and reasonable construction site layout.

(xii) Social impacts due to labor influx

It is estimated that about 50 workers will be mobilized during the peak period of subproject implementation. This number of workers may come from different locations of project

provinces/cities or other provinces. Some potential social risks and impacts related to labour influx of this project are predicted as follows:

- Inappropriate management of workers and worker camps may lead to environmental issues such as discharging wastewater to environment, throwing or dumping solid waste into Bang river or existing port...
- Labor influx may cause risks to local security or social stability if some workers participate in social evils (such as drinking, gambling, prostitutions etc.).
- The mobilization of migrant workers may lead to increased risks of infectious disease transmission, including HIV/AIDs when the workers come from different localities, interact with each other and with local communities. If pandemic happens, it will create additional burdens to local health care system of the province/city.
- Potential conflict between workers and local communities because of differences of background, culture, customs, jobs and incomes.
- Gender Based Violence (GBV), Sexual exploitation and abuse/Sexual Harassment (SEA/SH) risks related to the concentration of number of male workers to the project area. However, GBV and SEA/SH risks are assessed to be low and manageable.

In general, impacts due to labor influx of Lach Bang subproject is assessed to be **Low** because (i) the number of workers is not large (50) and they will register to temporary residence with local authorities during construction period and (ii) with the convenience and widespread dissemination of local media information regarding issues such as sexually transmitted diseases, including HIV/AIDS, the use of prohibited substances, and cultural behaviors; (iii) The Lach Bang fishing port management board is already effectively operating to control general activities within the port, including managing contractors involved in the project; (iv) This risk may occur at any time during the 24-month construction period; (v) This risk can be mitigated through appropriate measure such as preparing a code of conduct for workers, and raising workers' awareness about cultural, social, and health issues before and during the construction process.

(xiii) Impacts on cultural heritage

There is no cultural heritage in the position of upgrading and expanding Lach Bang fishing port affected according to description of Chapter 2. However, the subproject has excavation activities at large scale, thus, chance find could be revealed in the course of construction. Therefore, the procedure for handling these chance finds was included in the project's and Environmental and Social Management Plan (ESMP), which will be detailed in Chapter 5 below.

4.2.2.2. Site-specific impacts during the construction of Lach Bang subproject

The Lach Bang subproject will be implemented on both sides of the Lach Bang River—one port located in Hai Binh Ward and the other in Hai Thanh Ward—approximately 1.5 km from the estuary (Lach Estuary). The surrounding area is densely populated, with a significant number of ships and boats moored nearby. Based on the location, investment scale, and the characteristics of social infrastructure in the area where the subproject is implemented, as described in Chapter 2, the construction of the Lach Bang subproject is expected to result in the following site-specific impacts:

- Disruption to the operation of the existing Lach Bang fishing port
- Interference with the operation of the Duy Xuyen ferry terminal, posing safety risks for ferry passengers

- Increased pollution, potentially affecting the production and business activities of some local aquatic and seafood processing establishments and fishery logistics operations
- Impacts on aquaculture activities in the Bang river.

The detailed impact assessment is presented below:

(i) Disturbance to the operation of the existing Lach Bang fishing port.

The existing Lach Bang fishing port consists of two component ports: Hai Thanh Port and Hai Binh Port, specifically:

- The fishing port located in Hai Thanh Ward has a total planned land area of 2.75 ha and a planned water surface area of 1.75 ha. It includes 90 meters of wharf, technical infrastructure, and supporting auxiliary facilities.
- The fishing port located in Hai Binh Ward has a total planned area of 41.6 ha, which includes both the pier area and an 8.7-hectare onshore logistics zone. The access channel and the water surface in front of the wharf cover 31.9 ha. The port has more than 400 meters of wharf, designed to accommodate fishing vessels of up to 400 CV. It is a regular loading and unloading site for over 1,000 fishing vessels from Hai Thanh Ward, Hai Binh Ward, neighboring communes, and provinces outside the region, with an annual handling capacity of approximately 30,000 tons of goods.



During the construction of the port on the Hai Binh ward side, the entire 400m landing bridge will be retained for the continued operation of the existing fishing port. However, the operation of the fishing port will be partially disturbed by several onshore construction activities near the port, such as the installation of a roof system on the pier, the upgrading of the existing fish sorting house, and the improvement of transport infrastructure, water supply, and drainage within the port area. These activities may result in increased dust, exhaust emissions, wastewater, solid waste, and noise, and may hinder part of the port's operations due to the presence of construction machinery and equipment.

In addition, it is expected that approximately 17–20 types of construction machinery will be mobilized for the subproject (as mentioned in Chapter 1, Section 1.5). During construction, oil and water supply vessels will also be required to serve these machines. Currently, around 200–300 ships circulate daily in and out of the existing Lach Bang fishing port area, and approximately 1,000 ships anchor here during storm sheltering. There is a potential risk of collision between

dredging equipment, material transport vessels, cargo ships, and the fishing boats of local people during the construction phase.

For the port at Hai Thanh ward side, construction may disturb the operation of fishing vessels entering and exiting the existing 90m wharf. On this side, the subproject will build a new 180m wharf extension to the north of the current wharf. While the existing pier will continue to function during construction, disturbances are anticipated due to the following reasons:

- The increased movement of construction machinery on the water surface, including canoes, 30-ton floating cranes, barges, and piling ships, will interfere with the navigation of fishing vessels, increasing waterway traffic safety risks.
- On-site construction activities (e.g., floating cranes, barges, piling vessels for building port embankments) anchored near the wharf may reduce or congest docking space for existing ships, as the new wharf will be built adjacent to the existing one. After the new wharf is completed, ships will dock there, and the old 90m wharf will be renovated into a roadbed with a covered structure installed along its length.

These impacts are considered moderate, given the extensive construction scope of over 40.6 hectares divided between two sites. Construction will be phased to prevent simultaneous disruption across all areas, and methods will be implemented according to the design to minimize interference with port operations. The impact on existing port activities is expected to be temporary and intermittent throughout the 24-month construction period, localized, and at **moderate level**. The Ngang River in the project area, which is 150–250 meters wide and only 1.5 km from the estuary, provides ample space for vessel movement and facilitates faster circulation. Construction equipment will be anchored at fixed points to limit disruption, and both the 400-meter wharf at Hai Binh and the 90-meter wharf at Hai Thanh will remain operational. These impacts can be further mitigated through effective waterway traffic safety management and careful organization of construction activities at the existing wharves.

(ii) Interference with the operation of the Duy Xuyen ferry terminal, posing safety risks for ferry passengers

The Duy Xuyen ferry wharf is located approximately 100 meters from the Lach Bang fishing port upgrade area on the Hai Thanh ward side. The ferry crossing the Lach Bang river serves the people of Hai Thanh and Hai Binh wards, as well as the surrounding areas. The ferry terminal operates daily from 5 a.m. to 10 p.m. The construction of work items on the water surface (such as floating cranes, barges, and piling ships for port embankment construction) may cause disturbances to the operation of the ferry terminal, specifically:

- The mobilization of construction machinery by waterway to the construction site, including canoes, 30-ton floating cranes, barges, and piling ships for the construction of the subproject, will disrupt ferry navigation, as ferries may need to avoid these vessels, increasing the risk of collisions between ships/boats/ferries.
- On-site construction activities, such as floating cranes, barges, and piling vessels for the construction of harbor embankments, will narrow or congest the docking area at the existing ferry terminal.
- The increased risk of collisions between ships and boats also heightens the risks for ferry passengers, such as the potential for drowning and falls. Additionally, construction activities will generate dust and emissions, which may affect ferry passengers.
- These impacts will cause inconvenience and disturbance to the community due to changes

or interruptions in travel routes.

The impact on the operation of the Duy Xuyen ferry terminal and the associated risks to ferry users will occur during the construction period, which lasts for approximately 12 months during the construction of work items on the water. The impact is localized and of moderate intensity, considering that: (i) The Ngang River in the Lach Bang subproject area has a width of about 150m–250m, with sufficient remaining width for ferry operations; (ii) Except for the brief period of mobilizing machinery to the construction site, construction machinery on the water surface will be permanently anchored at fixed points, minimizing the impact on ferry movement on both sides of the river.

These impacts and risks can be mitigated through effective waterway traffic safety management measures and careful organization of construction activities at the existing wharves.



Activities of the existing Duy Xuyen ferry terminal

(iii) Increased pollution, potentially affecting the production and business activities of some local aquatic and seafood processing establishments and fishery logistics operations

For some petrol stations in Hai Thanh ward and Hai Binh ward:

The petrol station in Hai Thanh ward is located 80 meters away from the upgraded area of Lach Bang fishing port (Hai Thanh ward). The petrol station in Hai Binh ward is located 20 meters away from the Lach Bang fishing port area (Hai Binh ward). These petrol stations mainly serve the fishing ports and the people in Hai Binh and Hai Thanh wards, catering to about 100-200 vehicles per day. During the construction process, the activities of these facilities will continue. However, the construction activities for the work items under the subproject will cause the following impacts:

- An increase in dust and noise levels due to the operation of trucks and construction machinery, excavation, and gathering of construction materials.
- Traffic disturbances and an increased risk to traffic safety due to the higher density of transport vehicles and construction machinery.
- Temporary interruptions or disturbances to the business activities of the petrol stations (Hai Binh ward) because construction activities may obstruct access to the shops for vehicles.

In general, this impact is low due to the construction activities near the petrol station area being of short duration (1-3 months) and intermittent. The construction site in the existing port area is large, and the internal routes in the port are wide, so these impacts can be mitigated by appropriate measures.

For fishery logistics business establishments at the fishing port on the Hai Binh ward side:

In addition to the two petroleum trading establishments mentioned above, there are many other business establishments serving fishery logistics in the fishing port area. Specifically, there are a total of 21 preliminary processing and trading establishments of aquatic products; ice production and supply establishments; petroleum supply establishments; supply establishments of necessities; establishments purchasing products at the port; and shipbuilding and repair establishments, most of which are concentrated on the Hai Binh ward side of the port.

During the construction process, the activities of these facilities will continue. However, the construction and upgrading activities at the port will partly affect the service businesses of these establishments due to construction activities, the gathering of bulky materials, construction machinery, scattered dust, noise, waste, etc.



In general, the impact on the existing fishery logistics facilities is temporary, occurring intermittently during the 24-month construction period, localized, and at moderate level. Specifically: (i) The ground area of the wharf is quite large and has been functionally subdivided; (ii) Construction machinery, construction materials, and waste collection areas will be concentrated in designated areas on the port. This impact can be mitigated through appropriate site management measures.

(v) Impacts on aquaculture activities

About 400 to 500m upstream from the port area (sub-project area), near the Lach Bang 2 bridge, there are currently several cages used for raising shrimp, fish, and oysters on the bed of the Lach Nhang river.

The mobilization of waterway machinery is expected to travel from the Lach Bang estuary to the subproject area, avoiding the river section where these aquaculture activities are taking place. Therefore, the aquaculture activities will not be affected. Additionally, the Lach Bang subproject does not involve dredging ships for fairways and turning areas, so there will be no pollution spread due to dredging. The underwater construction area is localized to the existing port area on the Hai Thanh ward side, where the new 180m wharf is being built.

There is a potential risk of spreading pollutants (such as TSS, grease, etc.) from machinery and domestic construction activities to the water quality of the Bang river. However, the aquaculture area is located upstream, approximately 400-500m away from the project site. Additionally, the existing fishing port has embankments/dikes (in the form of crab claws), which help minimize the impacts of waves, wind, and riverbank erosion, thereby reducing the spread of pollutants in the river. As a result, the risk of pollutant spread from oil leaks of underwater construction machinery

(such as canoes, barges, pile drivers, etc.) is rated as **Low** and can be controlled with appropriate measures.



Aquacultural farming area on the Bang river, about 500m from the existing fishing port area.

4.2.3. Impacts and risks during operation phase

The sources of environmental and social impacts and risks during the operation phase of Lach Bang Fishing Port arise from: (i) Operation of transport vehicles such as ships/boats/cargo trucks; fish/seafood loading and unloading activities; (ii) Activities of operators, fishermen at the port, ship/boat drivers, traders at the port; (iii) Operation of fishing vessels transporting seafood in and out of the port; (iv) Operation of functional areas within the port (receiving area, sorting area, storage area for aquatic products); (v) Operation of technical infrastructure systems such as the WWTP, waste storage facilities, public toilets, etc.

The maintenance dredging activities of the navigation channel and the water area in front of the port (usually every 2 years), will be carried out with other funding sources during the operation of the port, so the impacts and risks related to this activity will be assessed separately later.

The general impacts and risks during the operation phase of Lach Bang Fishing Port include:

- Dust and emissions generated
- Noise
- Wastewater generated
- Solid waste generated
- Impacts on aquatic life and deterioration of surface water quality in the Bang River due to the concentration of vessels in the port area and maintenance dredging of navigation channels).
- Impacts on aquaculture activities.
- Impacts and risks related to transportation (waterway/road)
- Occupational safety risks and incidents
- Environmental risks and incidents: fire, oil spills, etc

Detailed Impact Assessment is presented below:

(i) Dust and Emissions Generated

Sources of dust and emissions from the operation of Lach Bang Fishing Port, especially in the fishery service areas, include:

- Dust and emissions from transportation vehicles such as ships/boats/trucks, and fish/seafood loading and unloading activities.

- Fishy odors generated from fishing vessels upon return to the port and from cold storage facilities used for seafood preservation.
- Odors and emissions (NH₃, H₂S, etc.) generated from the wastewater treatment system, solid waste storage facilities, etc.

The impacts on the air environment are specifically assessed as follows:

❖ **Dust and emissions from transportation ships/boats/trucks, fish/seafood loading and unloading activities**

Dust and emissions of ships/boats/trucks are primarily generated from the operation of diesel powered generators and vessel exhaust systems. The pollutants mainly include dust, CO_x, SO_x, NO_x, Hydrocarbons (HC), etc. The emission load from vessels entering and leaving the port is difficult to estimate and depends on the daily ships going in and out of the port, with an estimated number of about 150 vessels, and at peak times of mooring and sheltering from storms, around 1,200 vessels will gather in Hai Binh ward and about 300 vessels in Hai Thanh ward.

The emission load generated from vessel operations is presented in the following table:

Table 4.14: Emission factors of pollutants from diesel-engine vessels

(Unit: kg/day)

Means of transport	Dust	SO ₂	NO _x	CO	HC
Motor ships	6.8	136S	90.7	0.036	4.1

Source: WHO, 1993

Applying the formula for calculating the pollutant load in exhaust gases arising from the operation of ships/boats:

$$\text{Pollutant load (mg/m}\cdot\text{s)} = \text{Pollution coefficient (kg/day)} \times \text{number of ships in a day} \times 1,000 \\ (\text{average distance} \times 86,400).$$

Where: 1000 is the conversion factor from “km” to “m”; 86,400 is the conversion factor from “day” to “seconds”; the sulfur (S) content in DO oil is 0.05%; average travel distance: 25 km. In addition, by applying formulas [1] and [2] from the general impact assessment during the construction phase, the calculated NO_x concentration exceeds the permissible standards specified in QCVN 05:2023/BTNMT – National Technical Regulation on Ambient Air Quality. Meanwhile, SO₂, CO concentrations, and concentrations at distances ≥ 10 m for HC and ≥ 30 m for dust remain within allowable limits.

In addition, when the subproject comes into operation, road traffic density in the area will increase significantly (by about 50 vehicle trips/day at Hai Thanh ward port and about 100 vehicle trips/day at Hai Binh ward port) due to the movement of staff and workers at fishing ports and seafood transportation trucks, etc., increase when upgrading fishing ports. As these are gasoline and diesel-powered vehicles, they will emit an amount of emissions, including NO₂, C_xH_y, CO, CO₂, HC into the air. The load of pollutants arising from this activity is also similar to that assessed in the operation period because the pollutant load generated from activities of the existing fishing port are lower than the allowable limits.

The affected group is estimated at around 1,000 people at Hai Binh ward port and 250 people at Hai Thanh ward port. This includes mainly fishermen working at the port and onboard vessels docking at the port (about 800–900 people); local residents engaged in trading at kiosks along the port (about 150–200 people); and port operation staff (about 30 people).

The impact level of this emission source is assessed as Low because: (i) the concentration is only greatest when all vessels gather at the port at once and only affect the area for a short time (according to general practice and procedures at fishing ports, the docking period can last from 30 minutes to 2 hours); (ii) this source of emissions will gradually decrease when ships cease operating; and (iii) this source of emissions gradually dilutes into the air with fairly ventilated conditions on a large port with strong wind blows.

❖ Fishy odor generated from fishing vessels upon arrival at the port

The source of fishy and foul odors arises when fishing vessels dock at the port carrying freshly caught and frozen seafood stored onboard. The fishy odor composition is mainly from NH_3 , Hydrocarbons (HC), generated from the decomposition of organic matter and refrigeration equipment. The load of NH_3 emissions arising from refrigeration equipment and fishy odors from fishing boats is considered low, as the aquatic products (shrimp, crab, seafood, etc.) are quickly loaded and unloaded, sorted, and delivered to the market for consumption or immediately put into cold storage. The main gases generated from the decomposition of organic matter include CO_2 , NH_3 , H_2S , CO , CH_4 , and Mercaptans. In which, the main odor-causing gases are NH_3 , H_2S and Mercaptan, discomforting fishermen, traders, and sellers/buyers in the port area.

The impact is assessed as Medium as (i) the volume of aquatic products arrived at the port is localized, depending on fishing vessels (hourly - early morning (from 4 a.m. to 6 a.m.) and afternoon (from 2 p.m. to 4 p.m.), seasonally - the peak fishing season is normally from June to September every year); (ii) The seafood decomposition contributes to an increase in fishy odor, adversely affecting the environment in the port area (accounting for about 5%–10%). Nevertheless, this impact can be mitigated through appropriate measures.



Fish/seafood sorting activities on the existing Lach Bang port shore (Hai Binh ward)

❖ ***Odors and Emissions (NH_3 , H_2S , etc.) from the WWTP and Solid Waste Storage Facilities***

The Lach Bang Subproject will invest in constructing one WWTP with a capacity of 300 m^3/day using aerobic technology and closed treatment tanks, along with a 76 m^2 solid waste collection house designed for storage period of about 3–5 days at the port in Hai Binh ward; and one WWTP

with a capacity of 60 m³/day using aerobic technology and closed treatment tanks, plus a 60 m² enclosed public toilets with a septic tank at the port in Hai Thanh ward. Odors and emissions (NH₃, H₂S, etc.) will be treated by the subproject's wastewater and solid waste treatment systems.

WWTP technology process: Wastewater from sources → Collection tank with grease and sand trap → Equalization tank → Reaction tank → Primary settling tank → Anoxic tank → Aerobic tank → Biological settling tank → Pressure filter tank → Disinfection tank, intermediate tank → Treated wastewater meeting QCVN 11-MT:2015/BTNMT – National Technical Regulation on Seafood Processing Wastewater (Column B, K_q = 1.2 and K_f = 1.1) → Discharge to Bang River.

According to this process, odors from the WWTP mainly arise from the collection tank, equalization tank, reaction tank, primary settling tank, and anoxic tank. Aerobic decomposition also produces odors but at a lower level. Gases generated primarily from anaerobic decomposition include H₂S, Mercaptans, CO₂, and CH₄, among which H₂S and Mercaptans are the main odor-causing substances.

Based on the aerobic treatment technology and the design of enclosed treatment tanks, the 300 m³/day WWTP will significantly reduce odors generated from substances such as H₂S, CH₄, and NH₃. However, odor concentrations may still remain at low levels in cases where complete elimination is not possible. Typically, the concentration ranges of odor-causing substances (H₂S, CH₄, NH₃) in aerobic wastewater treatment systems with enclosed tanks fall within the following thresholds:

- H₂S (Hydrogen Sulfide): The concentration of H₂S in enclosed aerobic treatment tanks is typically maintained below 0.1 ppm, and under ideal conditions, it can be even lower.
- CH₄ (Methane): The concentration of CH₄ in aerobic treatment tanks can range from 0.5 to 5 ppm, however, this figure depends on the level of ventilation and emission control in the tank.
- NH₃ (Ammonia): The concentration of NH₃ in enclosed treatment tanks can be controlled within the range of 1–3 ppm, depending on the nitrification process and aeration system.

The groups directly affected by odors from the WWTPs and solid waste collection houses are the operating workers and fishermen at the port in Hai Binh ward (about 1,000 people) and Hai Thanh ward (about 250 people).

Since the WWTP uses aerobic technology with closed treatment tanks, the odor is minimized. The decomposition process generates malodor but at a low level. In addition, the WWTPs at Lach Bang fishing port will be built closely (closed treatment blocks), so the odor generated will be minimized. Therefore, the level of this impact is assessed as Medium and can be mitigated by appropriate technological and technical measures.

(ii) Noise

The source of noise arises mainly from vessels when docking, vehicles entering to purchase and transport seafood for consumption and from the service area.

The maximum noise level forecasted (taking account into the cumulative noise when many vessels enter and exit at the same time, with about 120 vessels per day at the Lach Bang subproject in Hai Binh ward, 30 vessels per day at the Hai Thanh port, and up to 1,200 vessels in Hai Binh and 300 vessels in Hai Thanh during storm sheltering) is approximately 80–85 dBA for vessels, 85–95 dBA for road traffic, and 75–79 dBA for service area operations (exceeding allowable limit by 1.07 to 1.12 times).

Noise mainly and directly affects traders, port workers, and fishermen (a total of about 1,250 people), typically within a radius of 10–20 m around the receiving, sorting, and unloading areas. according to general practices and procedures at fishing ports. The docking period can last from 30 minutes to 2 hours.

However, field surveys at local existing fishing ports show that vessel docking, loading/unloading, and sorting activities do not always take place all day, usually within a month, the peak time of full-day operation is from the 8th to the 15th day of the lunar calendar. On other days, these activities take place in the early morning (4:00–6:00 a.m.) and afternoon (2:00–4:00 p.m.). Additionally, Upon ship arrival, the engine will be turned off, the port space is wide towards the river, so the noise is also diffused quickly. Therefore, the impact level is assessed as Medium and can be mitigated through appropriate measures.

(iii) Wastewater Generated

The sources of wastewater generated from the operation of Lach Bang fishing port include: domestic wastewater, wastewater from onshore service areas, particularly from fisheries service facilities, and wastewater from vessels operating in the water areas in front of the port. The wastewater volume is calculated based on the water supply volume (according to the wastewater discharge standard, taken as 100% of the water supply standard). The detailed calculation of wastewater volume is presented in the following tables:

For Lach Bang fishing port in Hai Binh ward, the wastewater volume is 287.5 m³/day:

No.	Used for	Quantity		Standard		Calculated volume		Notes
1	Domestic use by local people	1,000	Person	25	L/person	25.0	m ³ /day	For the busiest operation day of the port
2	Fish washing water for sorting house	85.0	Ton	1	m ³ / ton	85.0	m ³ /day	
3	Cleaning of fish sorting tools	10%	m ³	8.5	m ³ /day	8.5	m ³ /day	
4	Dock cleaning	4.000	m ²	10.0	l/m ² _floor/day	40.0	m ³ /day	
5	Ship hold washing	120	ship	1.0	m ³ /ship	120.0	m ³ /day	
6	Average total daily water demand	Q _{day_average}				278.5	m ³ / day	
		Q _T = 100%Q _{day_max}				278.5	m ³ / day	
		Rounded				300.0	m ³ / day	

For Lach Bang fishing port in Hai Thanh ward, the wastewater volume is 54.25 m³/ day:

No.	Used for	Quantity		Standard		Calculated volume		Notes
1	Domestic use by local people	250	Person	25	L/person	6,25	m ³ / day	For the busiest operation
2	Fish washing water for sorting house	0	Ton	1	m ³ / ton	0	m ³ / day	

3	Cleaning of fish sorting tools	10%	m ³	0	m ³ /day	0	m ³ / day	day of the port
4	Dock cleaning	1.800	m ²	10,0	l/m ² _ floor/day	18,0	m ³ / day	
5	Ship hold washing	30	ship	1,0	m ³ / ship	30,0	m ³ / day	
6	Average total daily water demand	Q _{day_average}				54,25	m ³ / day	
		Rounded				60.0	m ³ / day	

The characteristics of each type of wastewater arising from the operation of the fishing port are as follows:

- **Domestic wastewater:** arising from the working areas of staffs and employees in the service area and fishermen/traders at the port, the volume and pollution level of this waste source mainly depends on the number of workers at the port (about 1000 people in Hai Binh port and 250 people in Hai Thanh port) and the amount of water used daily at the operational facilities and public toilets, garbage storage facilities, WWTP. The domestic wastewater volume is estimated at 25 m³/day in Hai Binh port and 6.25 m³/day in Hai Thanh port. The waste generated from this source is highly dirty, its composition mainly contains organic matters, nutrients, residues, suspended substances and pathogenic bacteria. Besides, it contains high organic content (BOD, COD), high solid content and many pathogenic bacteria. The above amount of wastewater, if not collected and treated appropriately, can cause the spread of pathogens, affecting coastal seawater sources in Bang River, damaging the beautiful landscape in the surrounding area.

Table 4.15: Predicted concentration of domestic wastewater during the operation phase

No.	Parameters	Unit	Untreated	Treated by septic tank	QCVN 14: 2008/BTNMT (column A, K=1.0)
1	COD	mg/l	608	61-152	-
2	BOD ₅	mg/l	329	49-99	30
3	TSS	mg/l	713	36-178	50
4	Total N	mg/l	60	20-40	-
5	Total P	mg/l	17	3-10	-
6	Animal and plant fats and oils	mg/l	133	42	10
7	Total Coliform*	MPN/100ml	10 ⁶ -10 ⁹	104	3,000

Note: The coefficient accounting for the project scale is $k = 1.0$ according to Table 2, QCVN 14:2008/BTNMT

Based on the above table, the concentration of organic substances in domestic wastewater after treatment via septic tank is approximately and exceeds the permissible level by 1.0 to 2.0 times. TSS ranges from lower than to 1.8 times higher than that of permissible level. The content of animal and plant fats and oil is 2.1 times higher than permissible level. The Coliform is 30 times higher than the permissible limits. Therefore, wastewater treated by septic tanks needs further treatment at centralized water treatment facilities before being discharged into the receiving environment.

- **Wastewater from onshore service areas:** When the fisheries logistics service area comes into operation, a system of service areas, trade, and cold storage warehouses will be accompanied. The operation of these facilities will generate a large amount of production wastewater (about 85 m³/day at the Hai Binh port area; there is no such source at the Hai Thanh port area as no fisheries service facilities are planned). This wastewater contains organic impurities. Wastewater produced from aquatic product receiving facilities, seafood cold storage warehouse, this waste source primarily contains organic matters, animal fats, waste (fish scales, fish intestines, shrimp shells, etc.). These substances are easily decomposed, if not collected and treated, the decomposed products will cause foul smell to the surrounding area and polluting the surface water quality of the Bang River.

- **Wastewater from vessels operating in the port waters:** This source of waste includes domestic wastewater, toilet wastewater on ships, and deck washing water. According to the design, the fishing port will accommodate 120 vessels for the Hai Binh port and 30 vessels for the Hai Thanh port. The total wastewater volume is estimated at 120 m³/day at the Hai Binh port and 30 m³/day at the Hai Thanh port. This wastewater composes of suspended solids, grease, organic substances (BOD, COD). If this waste source is not controlled, but discharge into the receiving environment, it will cause pollution to the Bang River. This wastewater source will be controlled according to the subproject's design plan: wastewater from vessel hold cleaning will be collected and treated at the two WWTPs (with capacities of 300 m³/day at Hai Binh ward and 60 m³/day at Hai Thanh ward) to be constructed under the Lach Bang subproject.-

- **Ballast water:**

Ballast water is the water pumped into the ship's specialized tanks to maintain stability when the ship is not carrying cargo or to adjust the ship draft. The ballast water can be seawater, brackish water or fresh water, depending on the geographical location where the ship performs the water refill operation. At riverside fishing ports, especially in areas near river estuaries, ballast water is usually brackish water or seawater due to the impact of tides and saltwater intrusion.

During the process of ballast water refilling, various species such as plankton, microorganisms, and larvae can be sucked into the water tank and move along the ship to other water bodies. The discharge of untreated ballast water can cause the spread of alien organisms, affecting the indigenous ecosystem and the water quality.

For small and medium-sized fishing vessels operating at Lach Bang subproject, the amount of ballast water ranges from **10 to 50 m³**. The ballast water is used by fishing vessels to ensure offshore operation and when harvesting seafood is often reused. With a scale of about 1,200 ships under the Lach Bang subproject, each replacement will generate about 12,000 m³ to 60,000 m³ of ballast water. However, the ballast water does not need to be changed too frequently, and the inspection and maintenance of the ballast water tank is normally carried out periodically from **6 months to 12 months**.

Domestic fishing vessels in Vietnam are typical small and medium in capacity, and do not operate in international waters, so they are not yet subject to the full mandatory provisions of the International Ballast Water Management Convention (BWM Convention). However, the discharge of ballast water still needs to comply with existing national regulations such as Decree No. 58/2017/ND-CP. According to regulations, the ballast water shall be discharged at least 200 nautical miles from the nearest shore and in waters with a depth of at least 200 m. In case the ship is unable to meet this condition; the ship may carry out a ballast water exchange at least 50 nautical miles from the nearest shore and at a depth of at least 200 m (quite far from the shore). In fact, fishing vessels often discharge ballast water individually and not simultaneously or at a domestic

location, which helps minimize the risk of localized environmental impacts. In general, as being operated not-concentratedly, individually and primarily in domestic water areas, the impact of the ballast water on the environment in the subproject is assessed as **Medium** and **can be controlled** through appropriate management measures.

Pollutant load in seafood processing wastewater: To reference pollutant concentrations in this type of wastewater, monitoring results at similar existing fishing ports are presented below:

Table 4.16: Pollutant concentrations in influent wastewater of wastewater treatment system at Zone E – Tam Quan Fishing Port, Binh Dinh Province

No.	P	Unit	Results	QCVN 11-MT: 2015/BTNMT (column B) Kq = 0.9; Kf=1.1
1	pH	-	7.19	5.5 – 9
2	SS	mg/l	112	99
3	BOD ₅	mg/l	730	49.5
4	COD	mg/l	1180	148.5
5	NH ₄ ⁺	mg/l	117.12	19.8
6	NO ₃ ⁻	mg/l	0.15	-
7	Total N	mg/l	128.89	59.4
8	Total P	mg/l	20.06	19.8
9	Coliforms	MPN/100ml	21x10 ⁷	4,950

Source: Binh Dinh Center for Analysis and Testing

The analysis results show that concentrations of almost all tested parameters are as many times as QCVN 11-MT:2015/BTNMT (Column B) – National Technical Regulation on Seafood Processing Wastewater.

In general, the level of impact from wastewater generated by the operation of Lach Bang fishing port is long-term, continuous, and at **medium** level, because the port has been upgraded and reconstructed with integrated functional subdivisions that taking consideration into environmental sanitation efficiency. (ii) The receiving water body – the Bang River – has a relatively large flow (the total average annual flow volume of the Bang river basin is about 0.42 to 0.77 million m³). This impact can be mitigated by appropriate measures (the fishing port will be equipped with a separate wastewater collection system and one centralized wastewater treatment station with a capacity of 300 m³/day-night (Hai Binh Port) and 60 m³/day-night (Hai Thanh port), ensuring collection and treatment of all wastewater generated at the port as calculated above).

In addition, there is also an amount of rainwater flowing through the port areas that carries pollutants on the surface, then flowing into Bang River but not being treated. The highest monthly rainfall was 1525.4 mm in X/1991, equivalent to 50.8 mm/day. Therefore, the total rainfall in 01 day in the whole project area in case of the heaviest rain is 260,000m²x50.8mm/day/1000 = 13,208 m³. The composition of rainwater contains suspended solids, and surfactants washed away on the surface of the port area. The overflowing rainwater will affect the rainwater collection system and flow into Bang River. However, rainwater is less likely to pollute the environment as the port is built with an integrated drainage system and that rainwater overflow only occurs in rainy season (from May to November every year, in Thanh Hoa province, there are about 150-160 rainy days per year), so the impact of rainwater flowing overflow is Low and can be minimized.

(iv) Solid Waste Generated

Sources of solid waste generated during the operation of Lach Bang fishing port include: domestic solid waste from staff and workers at service areas and the operational house, as well as from fishermen operating at the port (with a design capacity of about 1,000 people at the Hai Binh port area and about 250 people at the Hai Thanh port area, including about 30 operators); and solid waste from seafood sorting and trading activities. Based on the volume of solid waste currently generated at Lach Bang fishing port and the subproject scale after upgrading and expansion, the estimated solid waste load for the Lach Bang Subproject is as follows:

- *Domestic solid waste:* According to “Vietnam Environment Monitor 2004 – Solid Waste,” the average waste generation per capita is 0.15 kg/day (as people do not reside at the port). With an estimated 1,000 people at the Hai Binh port area and 250 people at the Hai Thanh port area, the total amount of daily domestic solid waste is about 187.5 kg/day (equivalent to about 0.1875 tons/day). The main components include: fruit peels, leftover food, wastepaper, plastic bottles, plastic.

- *Solid waste from seafood sorting:* Estimated¹⁷ to account for about 0.02% of the total seafood yields at Lach Bang fishing port according to the design (45,000 tons/year), equivalent to about 750 kg/month (0.75 tons/month). The main components are: nylon bags, scrap paper, disposable nylon gloves, rubber gloves, packaging materials, damaged cartons, and broken foam boxes.

- *By-products from seafood sorting and processing:* Estimated to account for about 1% of the total seafood throughput¹⁸ at Lach Bang fishing port according to the design (45,000 tons/year), equivalent to about 37.5 tons/month. The main components include fish heads, fins, bones, skins, fats, intestines, etc.

- *Hazardous waste:* Hazardous waste (oil-contaminated rags, gloves, hazardous component contaminated rag, packaging, grease containers for maintenance of machinery, equipment, batteries and accumulators, chemical packaging, printing ink cartridges, waste lead, damaged equipment, etc broken nets, plastic packaging, etc.) is estimated at about 300 kg/month. Waste oils discharged into the Bang River could hinder the photosynthesis and respiration of aquatic organisms and may even cause the death of aquatic species unless being properly controlled.

If not collected and treated, these types of solid waste will cause air pollution (due to foul odors), surface water pollution along the Bang river near the port area, and negatively affect the urban landscape of the port area. However, since investments are being integrated in technical infrastructure (waste collection, domestic wastewater collection and treatment, etc.), and the locality already contracted with a sanitation team for collection, transportation, and treatment of both general and hazardous waste, the impact from solid waste generated by the fishing port is assessed as **low and manageable**. Moreover, before the Lach Bang Subproject comes into operation, the Project Management Unit (PMU) will be required to obtain an environmental permit, ensuring this impact is controllable.

¹⁷ Based on the data estimated from the current operations of Lach Bang fishing port, as surveyed and consulted by the project’s environmental assessment team during the preparation of this ESIA report.

¹⁸ According to studies on raw material using efficiency in the seafood processing industry, as well as research on by-product management, findings are often published in specialized scientific journals on fisheries in Vietnam,

(v) Deterioration of Surface Water Quality and Impacts on Aquatic Life in the Bang River:

The water quality of the Bang River may deteriorate due to the operation of vessels entering and leaving the port during the operation phase (approximately 150 vessels/boats per day), caused by: (i) leakage of oil and grease resulting from accidents such as collisions or grounding of ships, or from discharging oily residues; (ii) cooling water containing oil and grease; and domestic wastewater, solid waste, and hazardous waste as previously forecasted and assessed in the sections on ‘wastewater’ and ‘solid waste.’

The water quality of the Bang River may be degraded due to increased turbidity, elevated suspended solids, and oil traces, which will reduce dissolved oxygen levels and impair photosynthesis of algae and aquatic plants.

Overall, the impact on Bang River surface water quality due to the operation of Lach Bang fishing port is assessed as medium because: (i) Lach Bang fishing port has been renovated and upgraded modernly and integratedly with operation procedures by an experienced Port Management Board, thereby the environmental sanitation issues due to vessel operations will be ensured (ii) the receiving water body of the Bang River has a relatively large flow (average surface flow ranges from 20.4 to 38 liters/second/km², with a basin area of 236 km², equivalent to 0.42 to 0.77 million m³/day); (iii) the fishing port is equipped with a separate wastewater collection system and two WWTPs with capacities of 300 m³/day (Hai Binh port) and 60 m³/day (Hai Thanh port), ensuring that all generated wastewater is collected and treated prior to being discharged into the Bang River.

The impact on the Bang river’s aquatic ecosystem due to Lach Bang fishing port operation is also long-term and continuous but assessed as **Low** because: (i) the port’s operational area is localized within the water area in front of the port (36m wide, 400m long in Hai Binh and 180m on Hai Thanh side); (ii) no rare or endangered aquatic species are found in the project area (aquatic species in the Bang river in this area include plankton such as copepods, cladocerans, and rotifers; benthic fauna such as snails, mussels, clams, and bivalves; aquatic plants mainly include water hyacinths and algae). The project area is not a protected habitat for valuable species. Thus, this impact can also be minimized by appropriate mitigation measures.

(v) Impacts on aquaculture activities

At a distance of about 400–500 m upstream from the Lach Bang fishing port area (near Lach Bang 2 Bridge), there are several cages and rafts for farming shrimp, fish, and oysters on the Lach Bang River.

During operation, the dredging and maintenance of the navigation channel in the port area is expected to be carried out at least every two years. This activity will affect the water quality of the Bang River (mainly due to increased turbidity and suspended solids-TSS), which may temporarily impact aquaculture activities in various ways and to varying degrees, as discussed below.



Existing oyster and aquaculture area on the Bang River (about 400–500 m from the navigation channel to the fishing port)

However, the aquaculture area is located upstream, not too close to the project site (400–500 m away as mentioned above). In addition, the existing fishing port has already been equipped with revetments/embankments (in the form of crab-claw structures), which help minimize the impacts of waves, winds, riverbank erosion, and the spread of pollutants in the river. Currently, in the existing Lach Bang port, the maintenance and dredging activity was carried out and the sources of impact have been well controlled. Therefore, the risk of turbidity and TSS spreading from channel maintenance and dredging is assessed as Low and can be controlled through appropriate mitigation measures.

The potential impacts of channel maintenance and dredging on aquaculture activities can be mitigated by implementing appropriate dredging methods and construction schedules with consideration into feedback from public consultations with affected households.

(vi) Traffic Incidents:

❖ Waterway traffic accidents

- Cause: During vessel operations, serious accidents such as shipwrecks, vessel collisions, or fires may occur. The average number of vessels entering and leaving Lach Bang fishing port is about 150 vessels/day. In the event of a storm, the port will accommodate approximately 1,500 fishing vessels seeking shelter. However, these vessels will not all arrive at the same time but over the period from 3 to 5 days under the directives of the Maritime Administration.

During the operation of ships, shipwrecks, ship collisions, or severe fire incidents may occur. The transportation of products through the port will increase the waterway traffic in the channel in front of the port, greatly affecting the load-bearing capacity of the channel, obstructing visibility. Such increase in waterway traffic density is expected to lead to a higher risk of maritime accidents and oil spills, significantly affecting surface water quality and the ecosystem in the Bang port area on Bang River. In addition, dirty water and domestic solid waste, ballast water from vessels navigating the channels—especially in cases of collision where waste is not properly collected or treated—may leak and overflow into the sea and port areas. This will increase pollutant levels and negatively impact on the surrounding ecosystems along the navigation routes.

- Scope of impact: When there is a waterway traffic accident, depending on severities, oil spills may occur, affecting local soil and surface water quality, causing damages to property of fishermen and the port management authority, and economic damages to local communities who

bear the costs of recovery after such incidents.

- The impact level is assessed as medium and localized because: (i) The Bang River in the Lach Bang subproject area has a width of approximately 150–250 m and is located only about 1 km away from the estuary. The remaining width of the river is still sufficient for local vessels to navigate, and its proximity to the estuary allows faster circulation of boats compared to other water bodies; (ii) The berthing length of Lach Bang port is relatively large (about 250 m on the Hai Binh side and 180 m on the Hai Thanh side, consisting of several wharves), so the docking activities of vessels are insignificantly affected; and (iii) The application of proper waterway and road traffic safety management during operation will help avoid, minimize, and mitigate the impacts on waterway traffic, including navigation accidents.

❖ ***Vessel docking beyond the port's design capacity***

Currently, Lach Bang fishing port is classified as a Class II port, capable of handling 20 vessels per turn and accommodating about 1,000 vessels. After being upgraded to a Class I fishing port, it will be capable of handling 150 vessels per turn with a accommodation of 1,500 vessels. Once the port is operational, incidents of vessels berthing beyond the designed capacity may occur, leading to the following impacts:

- Vessels waiting for their turn to unload may experience long delay, potentially resulting in disputes over docking priority and causing disorder.

- Although, conventionally, docking is organized in sequence, some ship owners may attempt to push ahead, or maneuver around others to dock or leave the port, leading to traffic safety issues and negatively affecting the port's loading and unloading capacity.

- Wastewater and solid waste generated in excess of the subproject's treatment capacity of the designed waste treatment plant (WWTP, waste storage facilities).

Impact Assessment: This impact is considered to be **Low**, as the port facilities have been designed and calculated in accordance with technical standards to ensure operational sustainability (with the demand of a Class I fishing port: 120 vessels/turn in Hai Binh ward, 30 vessels/turn in Hai Thanh ward, and a total capacity of 1,500 docking vessels). In addition, all auxiliary infrastructure for Lach Bang port operations have been integratedly invested. However, if such incidents persist over an extended period, they may pose risks of port infrastructure degradation, potentially leading to damage to docking facilities and resulting in certain losses. This impact can be mitigated by appropriate port operation management measures.

❖ ***Risk of falling into the river and drowning for vessel operators/fishermen on board***

Such incidents are typically flagged during embarkation or disembarkation at docking areas, or in the event of vessel collisions, where individuals onboard may lose balance and fall, slip, or tumble into the sea. Although the docking areas are often designed with guard rails and warning signs, fishermen remain at risk of falling into rivers due to slippery surfaces, which can lead to drowning. During the rainy and flood seasons, transportation vehicles operating in these areas may also slip and fall into the river. This affects the health and even causes the lives of fishermen operating in and out of the port. The subproject's technical design has been reviewed and implemented to prevent such threats to fishermen when using port facilities. Therefore, this impact is assessed as Low and can be mitigated.

(vii) Occupational risks

During the operation phase, there will be 30 operators in Lach Bang fishing port. Some risks and occupational accidents may occur, particularly in the complex working environment with multiple

activities such as seafood unloading, transportation, and operation of mechanical equipment. Potential risks and incidents include:

❖ ***Accidents due to collisions and traffic accidents:***

Risk of collision between vehicles: With the involvement of a variety of vehicles (trucks, boats, forklifts, cranes, etc.) in the port area, collision accidents may occur, especially when vessels operate under limited visibility conditions, or lack of proper separation and routing.

Road traffic accidents: Vehicles transporting seafood between ports and the mainland can cause traffic accidents due to poorly prepared roads or careless driving behavior.

❖ ***Accidents involving mechanical equipment (cranes, forklifts, etc.):***

Risks from lifting equipment, cranes: Using cranes and forklifts to load and unload seafood from ships ashore or from shore into storage warehouse can cause accidents if the equipment is not adequately maintained or operated incorrectly. Accidents may include falling heavy objects, snapped cables, or equipment malfunction.

Risks from electrical equipment and machinery: The operation of heavy machinery such as pumps, generators, or other motorized equipment may lead to electric shock, fire and explosion accidents if safety regulations are not observed.

❖ ***Accidents due to unsafe working conditions:***

Falls, trips, slips: Due to continuous movement on wet and slippery surfaces (caused by grease, seawater, or seafood waste), workers engaging in unloading and storage areas are at risk of slipping, falling.

❖ ***Fire and explosion accidents:***

Risk of fire and explosion from flammable materials: Substances such as oils, fuels, chemicals used in seafood processing or storage may lead to fire and explosion unless being handled and stored properly. Additionally, the use of electrical and mechanical appliances may result in electrical shorts or sparks, increasing the risk of fire.

Fire due to improper discharge: Flammable wastes such as oil, grease from boats, cranes, or from seafood processing may cause fires if not collected and disposed of properly.

❖ ***Health-related accidents and illnesses:***

Risk of infectious diseases: Working in humid environments and exposure to seawater can lead to infectious diseases, especially those related to the respiratory tract, skin, or waterborne diseases.

Respiratory diseases: Long-term exposure to dust from seafood or emissions from ships can cause respiratory diseases such as pneumonia, bronchitis, or other chronic diseases.

Diseases caused by marine life: Exposure to marine life can lead to injuries, infections, or poisoning due to toxins from seafood or other marine life.

Accidents caused by environmental factors:

Risks due to extreme weather conditions: Weather conditions such as heavy rain, storms, and strong winds can increase the risk of accidents for workers working outdoors, especially those working on docks.

Risks from sea waves and surge: Working in conditions of high seawater or strong waves may expose workers to risks of being swept away or encountering accidents while operating on vessels or at the dock or piers.

Other port-related occupational risks include:

- Fish holds containing miscellaneous fish which are sorted for long period at sea will generate toxic gases. The deeper the fish holds and the longer the voyage, the higher the risk of oxygen deprivation for fishermen working in the fish holds, leading to acute poisoning, fainting, or even death.

- In the receiving and sorting areas where washing activities are frequently carried out and seafood is handled, the floor is always wet, increasing the risk of slips and falls during the lifting and transporting of seafood containers and trolleys.

- Slip-and-fall accidents during the loading and unloading of seafood from vessels to the port, including incidents where seafood containers fall onto workers.

The risk level of occupational accidents at the port is assessed as **Medium** because: (i) these impacts are always potential to occur on the port at any time; (ii) The number of operation workers is relatively small (30 people); (iii) these risks may persist the long term during the fishing port operation period; and (iv) , they can be mitigated by appropriate measures such as occupational safety training before and during operation and providing personal protective equipment for workers, etc.

(viii) Potential Environmental Risks and Incidents

❖ Fire and Explosion Incidents:

- Causes: being analyzed and forecasted above, the environment in the area contains fuel vapors, so the potential of fire incidents is high when exposed to high heat sources or electrical short circuits. The power supply system for machinery, technical equipment, and electrical systems in auxiliary facilities, cargo yards, and the administration building may experience short circuits, fires, or explosions, causing damage to people and property. Additionally, the area containing fuel vapors used for refueling vessels is prone to high risk of fire incidents when exposed to high heat sources or electrical short circuits. A fire or explosion at Lach Bang port may cause human lives and property loss. Such incidents may lead to fire spread to warehouses, causing significant economic damage and threatening the safety of the port staff.

- Affected group: People and property within the project area may be affected. However, as the neighboring residential area is located over 100 meters away and separated from the port, it is less likely to be affected.

- Impact level: Assessed as Low because (i) functional areas are all designed with fire protection measures and on-site fire-fighting equipment, such as fire extinguishers; (ii) The arrangement of products and materials for the fishery service is allocated to specific zones with instructional signage, and dedicated personnel responsible for management and compliance with operational procedures; (iii) No incidents of electrical short circuits or fires have been recorded in the port area or surrounding residential zones; (iv) Such incidents are considered controllable, as the port management board undergoes regular trainings on fire prevention and response; and (v) The port area is landscaped with greenery, and water supply infrastructure has been designed with a fully equipped fire protection system. Therefore, the impact level is assessed as **Medium** and controllable.

❖ Oil Spill Incidents:

For the operation of the Lach Bang Subproject, an oil spill incident may occur due to: (i) Vessel capsizing; (ii) waterway traffic accidents; (iii) spillage or leakage of oil and grease from fishing vessels entering or leaving the port; and (iv) storms, winds, low pressures and other extreme weather events.

Once an oil spill occurs, an oil-water mixture is quickly formed and spread after about 3-6 hours. The oil gradually dissipates through weathering related to various of physical and chemical processes, such as natural dispersion by wind and currents, sedimentation, evaporation, or the formation of oil suspensions floating on the water surface. This spill will harm the natural environment and economic activities in the area. Specifically:

- Part of the oil products will sink and decompose on the seabed, polluting the water and sediment, while another part may float with air bubbles from the seabed. Oil residue on the seabed is a source of water pollution, affecting benthic organisms that are a food source of fish.

- When the water source is contaminated with oil, the decomposition oil products reduce the water source's ability to clean itself because the plankton and benthic organisms involved in the process die or decrease in number.

- When oil is spilled into water sources, the level of dissolved oxygen decreases because oxygen is consumed during the oxidation of oil products. Additionally, oil slicks on the surface hinder the aeration process, limiting oxygen exchange between the water and the atmosphere.

Fishing vessels passing through Lach Bang port has capacity from 90 to 600 CV, with storage capacity from 0.152 to 16.188 tons of DO. The risk of oil spills is always present at the port, especially during the rainy and flood season when accidents and capsizing are more likely. The impact is assessed as **Medium** because: (i) the port area is arranged with a docking station in the form of anchorage, suitable for each type of ship with different capacity, length as well as purposes as required by vessel owner. The length and width of the berths are configured to support cargo handling operations and ensure convenient access to services such as loading, unloading, and other port-related activities for vessels arriving at the Lach Bang port; (ii) The navigation channel area and the turning area are designed to ensure appropriate width, channel depth, turning radius, and maneuvering space, thereby reducing the risk of congestion, collisions, and inconvenience during vessel berthing and service use at the Lach Bang port. (iii) Coordination is based on years of experience in managing and operating the existing port, along with strict regulations governing vessel entry and exit (iv) Shipowners who drive ship to enter and exist the port regularly, have long practical experience, so there are insignificant risks of collision, overturning, leakage of materials as well as adapting to changes in weather and climate in the Lach Bang port; This risk can be mitigated by appropriate measures such as providing adequate waterway traffic safety equipment/facilities at Lach Bang port, organizing rational vessel traffic, raising awareness among vessel operators, and conducting regular inspections of vessels to identify potential malfunctions (if any).

In addition, to minimize and manage potential oil spill incidents, the project owner must develop a vessel operation management plan and establish an emergency response plan for oil spills.

❖ ***Incidents of water supply and drainage pipelines broken and damage to wastewater treatment systems***

During the operation, water supply and drainage pipeline and wastewater treatment systems may encounter into the following incidents:

- Breakage or cracking of water supply pipelines due to unsafe construction materials.

- Water pipeline broken due to external force.

Failures of the wastewater treatment system, such as malfunctioning treatment equipment, leading to untreated or inadequately treated wastewater being discharged into the environment.

Such incidents, when occurring, will lead to water wastage (for clean water supply) and discharge of environmental pollutants (for wastewater). However, the likelihood of these impacts is considered low, as the water supply network is installed in technical compartment, and water supply areas are equipped with a pressurized valve system to detect leaks in the pipeline system.

When the wastewater treatment system is broken, the level of air and water pollution will increase as assessed in the above sections. In addition, the materials used for pipelines are fire-resistant, corrosion-resistant, and highly durable, resulting in a very low risk of breakage or leakage. WWTP are designed with independent operating modules, with backup system, and equalization tanks that can be stored for up to 24 hours when all modules fail. Therefore, the impact from these incidents is minor and can be controlled through appropriate measures.

✓ ***Risks and incidents due to improper operation of WWTP***

In addition to risks from vehicles and equipment operating WWTP, there are also risks stemming from humans and funding sources in the operation and maintenance of WWTP. These risks include but are not limited to:

- The WWTP operators' failure to comply with the operating process instructions that have been developed for the WWTP.
- The operators lack sufficient knowledge and qualifications to operate the WWTP.
- Poor capacity of human resource management during the operation of the WWTP.
- Infrequently periodic maintenance, replacement or repair of damaged machinery and vehicles.
- Improper frequency and volume of sludge collection, which may result in reduced treatment efficiency of the WWTP and failure to meet current national technical standards.

The above risks, if occurring, will reduce the wastewater treatment efficiency of the wastewater treatment and affect the quality of receiving water sources and the aquatic ecosystem in the port area. However, the risk is assessed as "Low" and can be minimized: (i) The operation of the WWTP is carried out by engineers who are knowledgeable and qualified in wastewater treatment technology; (ii) The operation will be arranged in shifts and always have staff on duty, operating in accordance with the regulated instructions; (iii) The WWTP is periodically inspected and maintained daily or immediately when an incident occurs; (iv) Replacement of machinery and means are always available in case of damages.

Furthermore, before the WWTP is officially put into operation, the subproject must register for trial operation and apply for an environmental license.

4.3 TAM QUAN STORM SHELTER CONSTRUCTION AND UPGRADING INVESTMENT SUBPROJECT

4.3.1. Impacts and risks during preparation phase

4.3.1.1. Land acquisition impacts

Land acquisition area

The area designated for the Tam Quan subproject construction covers 109.13 ha, of which the majority consists of riverbed soil with an area of 97.64 ha (Surface water of Tam Quan River), aquaculture land with an area of 3.71 ha, and land for specialized use with an area of 2.64 ha.

No	Land types	Land use code	Tam Quan subproject Unit: ha
I	Total Land Acquisition Area		114.77
1	Agricultural Land	NNP	7.45
1.1	Land for agricultural production	SXN	0.51
1.1.1	Annual crop land	CHN	0
1.1.1.1	Rice cultivation land	LUA	0
1.1.1.2	Land for other annual crops	HNK	0
1.1.2	Land for perenial crops	CLN	0.51
1.2	Forestry land	LNP	0
1.3	Aquaculture land	NTS	6.94
2	Non-agricultural land	PNN	104.70
2.1	Residential land	OTC	1.42
2.1.1	Rural residential land	ONT	0
2.2	Land for specialized use	CDG	2.81
+	Non-Agricultural Production and Business Land	CSK	1.61
+	Land for public use purposes	CCC	1.20
2.3	River, Canal, Stream, and Waterway Land	SON	100.47
2.4	Dedicated water surface land	MNC	0
3	Unused land	CSD	2.62

(Source: Draft Resettlement Plan of the Project, 2024)

Subproject's affected household:

No	Subproject	Total affected household & organization	Household losing production land	Household losing aquacultural land	Household losing agricultural land	Household losing non-agricultural land	Number of households affected by non-agricultural production and business activities:	Relocated household
1	Tam Quan subproject (Binh Dinh)	17	17	0	0	0	0	0

(Source: Draft Resettlement Plan of the Project, 2024)

Impact on residential land: None.**Impact on agricultural land:**

- Rice cultivation land: None
- Annual crops: 0.51 ha affected. Perennial plants primarily include varieties of periwinkle, mango, and banana.
- Aquaculture ponds: 6.94 ha affected. The main aquaculture species are fish and shrimp.

Impact on houses and structures: None**Impact on sensitive facilities:** None**Temporary impacts during construction:****4.3.1.2. Safety Risks Related to UXO**

The Tam Quan Subproject is a completely new construction investment, so the mine clearance activities will be carried out over the entire construction area of the subproject (about 114.77 ha). Given the large scale, the risks associated with UXO clearance activities for the Tam Quan Subproject are significant but can be mitigated

4.3.2. Impacts and risks during construction phase**4.3.2.1. General impacts and risks****(i) Impact on ambient air quality****❖ Dust generated from demolition/site clearance activities**

According to the basic design explanation of the Tam Quan Subproject, there is no demolition of existing structures, so only a small amount of vegetation biomass will be cleared for the construction of the 5 sections of the Tam Quan river embankment (mainly small shrubs and grass cover), so this impact is negligible.

❖ **Dust generated from backfilling, leveling activities**

According to the basic design explanation of the Tam Quan Subproject, based on the algorithms/formulas [1] mentioned above, the mass and concentration of dust generated during construction at the site are determined as follows.

Table 4.17. Dust volume generated from earthwork, backfill activities

Subproject	Excavation volume (m ³)	Backfill volume (m ³)	Dust emission load (kg) (kg)	Expected backfilling time (month)	Dust emission load (kg/day)	Concentration (mg/m ³)	QCVN 05:2023 (mg/m ³)
Tam Quan subproject	119.653	334.406	5.203	18	1,62	0,68	0,3

The calculated dust concentration (average 1 hour) generated during excavation and ground leveling activities for the Tam Quan subproject, when compared with the allowable limit according to QCVN 05:2023/BTNMT (limit: 0.3 mg/m³), is as follows: the dust concentration exceeds the allowable limit by 2.26 times. The affected groups are the workers and residents living in the areas near the project, including Tam Quan North Ward, Tam Quan North Primary School, Thien Tranh Market, and Tam Quan North Aquaculture Area.

In practice, the amount of dust dispersion is not large compared to the calculations, as the construction duration of each item in the project varies (mainly concentrated in the first 3-6 months of the construction phase) and is not simultaneous. Moreover, the dust concentration decreases rapidly with distance from the source, and the mitigation measures mentioned in the subsequent chapters will minimize the impact of dust on the surrounding air environment and local residents near the project areas. Therefore, the level of impact is considered medium and can be minimized.

❖ **Dust and gas emissions from transporting construction materials and waste**

The process of transporting raw materials (such as cement, sand, soil, gravel, steel, etc.) from supply areas to the construction sites, or the transportation of excess solid waste from the construction sites to the disposal area, will generate dust and gas emissions from the transportation vehicles (main pollutants include CO, SO₂, NO₂ from engine combustion).

For the Tam Quan subproject, it is expected to use vehicles powered by diesel fuel with a 15-ton payload, operating on urban roads with an average distance of 10-15 km to the construction site or waste disposal area.

By applying formula [3] and input parameters such as the quantity of construction materials, soil fill, etc., and transportation durations, the dust emission load (kg) for the Tam Quan subproject is determined in the table below.

Table 4.18. Dust load generated by the transportation of construction materials and backfill soil under Tam Quan subproject

Subproject	Mass of construction materials (tons)	Transportation duration (month)	Number of transport vehicle trips (trips/day)	Mass of backfill soil (tons)	Transportation duration (month)	Number of transport vehicle trips (trips/day)	Total of vehicle trips (trip/day)	Dust emission load (*) (mg/m/s)
Tam Quan subproject	119.653	24	9	334.406	24	35	44	0,748

From the dust load and emissions, applying the SUTTON model (formula [4]), the average concentration of pollutants generated from the transportation of construction materials and soil used for the Tam Quan subproject is calculated as follows:

Table 4.19. Dust concentration generated by the transportation of construction materials and backfill soil under Lach Hoi subproject

Subproject	X (m)	Dust concentration (mg/m3)				QCVN 05:2023/BTNMT
		Z=1,5	Z=3	Z=5	Z=10	(mg/m ³)
Tam Quan subproject	10	0,3323	0,3111	0,2719	0,1974	0,3
	50	0,2612	0,2581	0,2511	0,2258	

According to the calculation results in the table above, the concentration of dust and emissions from the transportation of construction materials for the Tam Quan subproject exceeds the permissible limit at a distance of 10m by about 1.1 times but remains below the allowable limit of QCVN 05:2023/BTNMT (within 1 hour) at a distance of 50m.

For the construction works of the Tam Quan subproject, the volume of materials transported is large, with vehicle traffic ranging from more than 20 trips per day (approximately 44 trips per day throughout the construction period of 24 - 36 months), and an average transport distance of 10 - 15 km. Dust and gas emissions directly affect the households living along the main transportation routes, but the population density is not high. This direct impact is assessed as medium and can be minimized.

✓ **Generated dust and gas emissions from waste transportation:**

The waste being transported includes: solid waste from demolition activities, excavated soil, rubble from construction work (excess cement, lime mortar, broken bricks, scrap steel, cardboard waste, etc.), dredged materials from the ship channel, turning area, and mooring area of Tam Quan.

Similarly, by applying formula [3], the dust emission load (kg) from these activities is calculated for each subproject as shown in the table below.

Table 4.20. Dust emission load from waste transportation for Tam Quan subproject

Demolition volume (m ³)	Excavated soil volume (m ³)	Dredged volume (m ³)	Excavated soil volume reused for on-site filling (m ³)	Volume to be disposed of (m ³)	Transportation duration (month)	Number of transport vehicle trips (trips/day)	Dust emission load (*) (mg/m/s)
-	119.653	447.146	334.406	232.393	36	16,5	0,03

Applying formula [4] - the Sutton model with a wind speed of 1.6 m/s and atmospheric stability classified as type B, at a distance of $x = 25\text{m}$ from the centerline of the road, the concentration of pollutants generated by the waste transportation activities of the Tam Quan subproject, and the dust concentration resulting from these activities, are calculated as follows

Table 4.21. Dust concentration generated from waste transportation

Subproject	X (m)	Dust concentration (mg/m ³)				QCVN 05:2023/BTNMT
		Z=1,5	Z=3	Z=5	Z=10	(mg/m ³)
Tam Quan subproject	10	10	0,1984	0,1923	0,1847	0,3
	50	50	0,1865	0,1863	0,1857	

Note: The calculation results above have accounted for the cumulative environmental conditions of the ambient air.

According to the results presented in the table above, the dust and emissions generated by the waste transportation process from the construction activities of the Tam Quan subproject are all within the permissible limits of QCVN 05:2023/BTNMT for 1 hour. However, the dust and emissions from the transportation process may combine with those from regular traffic vehicles, along with hot weather, potentially affecting the health and daily activities of people living along the main transport routes (the distance from the roads to residential houses ranges from 5 to 100 meters). These effects will occur throughout the construction period of the Tam Quan subproject and will decrease by the time the project is operational. The impact is moderate and can be minimized through appropriate measures.

❖ **Dust from material stacking and unloading activities**

The materials being unloaded primarily include crushed stone, sand, cement, steel, etc., with quantities provided in Table 1.10 - Material Quantities, Chapter 1. Based on the dust pollution coefficients for unloading materials, the dust load from unloading these main materials of the Tam Quan subproject can be calculated as follows:

Table 4.22. Dust load during the material loading and unloading process.

Subproject	Total mass of main materials (tons) (ton)	Total dust emission from material handling. (kg)	Dust emission load (kg/day).	Dust emission load (mg/m.s).
Tam Quan subproject	124.932	1715	1,59	55,21

To calculate the average dust concentration in 1 hour (mg/m^3) during the material unloading process of the Tam Quan subproject, you can apply formula [5]. The specific calculation result is as follows:

Table 4.23. Dust concentration generated during material loading and unloading

Subproject	X (m)	Dust concentration (mg/m^3)				QCVN 05:2023/BTNMT
		Z=1,5	Z=3	Z=5	Z=10	(mg/m^3)
Tam Quan subproject	10	0,377	0,239	0,210	0,200	0,3
	50	0,232	0,195	0,188	0,185	

According to the calculation results in the table above, the concentrations of dust and exhaust gases from the material unloading process during the construction activities of the Tam Quan subproject are all lower than the allowable limits of QCVN 05:2023/BTNMT for 1 hour at distances greater than 10m. Therefore, the main impact of this activity is on the construction workers and the residents living within a radius of 10m around the subproject sites. This impact is considered low and can be mitigated through appropriate measures.

❖ **Emissions from transportation vehicles and waste disposal**

The transportation vehicles and machinery and equipment used in the construction process primarily run on DO fuel, which will generate pollutants from the combustion process of the internal combustion engines, such as NO_x , SO_2 , and CO. These emissions are mobile sources and will directly affect road users on the transport routes, dispersing into the surrounding air, thus impacting the workers and residents near the construction sites of the subprojects. The details about the number of transportation vehicles, transportation distances, and fuel consumption of the Tam Quan subproject are presented in the table below.

Table 4.24. Fuel consumption from transportation of excavated soil and earthwork

Subproject	Expected time (months)	Total trip (Trip/day)	Distance (km)	Fuel consumption (kg/day)	Generated SO_2 ($\text{mg}/\text{m.s}$)	Generated NO_2 ($\text{mg}/\text{m.s}$)	Generated CO($\text{mg}/\text{m.s}$)
Tam Quan subproject	36	2	15	6.66	0.0104	0.0573	0.0292

Due to the relatively low emission load, to assess the impact of this activity on the surrounding air environment, Formula [4] - the Sutton model is applied to calculate the pollutant concentration in the exhaust emissions based on the distance (x) and height (z), with the highest concentration of CO. The calculated results for the concentrations of emissions from transportation activities comply with QCVN 05: 2023/BTNMT - National Technical Regulation on Ambient Air Quality. Therefore, the impact level is considered low. The emissions are considered minor, and the pollutants tend to disperse quickly into the surrounding environment, leading to a rapid reduction in concentration. The effect of the emissions is small, but mitigation measures are still necessary to control the health impacts on workers involved in construction activities.

❖ **Dust and emissions from construction equipment operations**

Similarly, to calculate the emissions of gases (CO , NO_2 , SO_2) from the operation of machinery and equipment during construction activities, such as excavators, graders, mixers, pile drivers, etc.,

when using diesel fuel, the number of construction machines and the fuel consumption requirements for the Tam Quan subproject are shown in the following table:

Table 4.25. Diesel oil demand for construction machinery and equipment

Machinery and equipment	Tam Quan subproject	Fuel consumption per shift (diesel liters)
25T vibratory roller	81.61	40.32
110 HP motor grader	401.3	38.88
Excavator $\leq 0,8 \text{ m}^3$	135	64.8
8.5T steel wheel roller	669.97	24
Bulldozer $\leq 110 \text{ CV}$	163	54.6
7T dump truck	2.1	25.5
Water spraying truck 5 m^3	106.26	22.5
Total DO use (liter/hour)	9.17	
Maximum diesel oil (DO) consumption (kg/h) (DDO = 0.85 kg/lit)	4.58	

Noted: The density of diesel oil (DO) is 0.85 kg/L ; Source: WHO, 1993.

Applying formula [6], the pollution load of dust and gas emissions from fuel combustion activities of construction machinery is calculated as follows:

Table 4.26. Dust and gas emissions from fuel combustion activities of construction machinery.

Emission load of exhaust gases (g/s)	Pollution coefficient (g/kg DO)	Tam Quan subproj
SO ₂	20*S	0,0615
NO ₂	2.84	0.0087
CO	0.71	0.0022
Dust	0.28	0.0615
VOC	0.035	0.0615

Where: S is the sulfur concentration in the fuel (0.25%).

Applying Formula [4] - the Sutton model with a wind speed of 1.6 m/s and a distance of $5\text{-}10 \text{ m}$ from emission sources, the concentration of emissions from construction machinery and equipment complies with QCVN 05:2023/BTNMT - National Technical Regulation.

Table 4.27. Concentration of emissions generated by construction equipment.

Subproject	SO ₂ concentration (mg/m ³)	NO ₂ concentration (mg/m ³)	CO concentration (mg/m ³)
Tam Quan subproject	0.0025	0.0052	0.0001

Subproject	SO ₂ concentration (mg/m ³)	NO ₂ concentration (mg/m ³)	CO concentration (mg/m ³)
QCVN 05:2033 one hour on average (mg/m ³)	0.35	0.2	30

In general, the emission concentration of exhaust gases from construction vehicles on the site is not high and is within the permissible limits of QCVN 05:2033/BTNMT. The main affected parties are the workers on-site and the nearby residential areas, such as those living close to the construction site. The impacts are localized at the construction site, within a radius of approximately 50-100 meters from the work area. The direct impact duration lasts throughout the construction period, but it is mainly concentrated for about 8-10 hours a day and is intermittent. Therefore, the impact is assessed as LOW and can be minimized.

(ii) Noise impact

During the construction phase of the Subprojects, the main sources of noise are: transportation activities for construction materials, excess solid waste; construction and demolition activities of the Subprojects; operations of construction equipment on-site, such as pile drivers, concrete vibrators, excavators, backhoes, dredgers, trucks, etc.

Table 4.28. Noise level generated by machinery and equipment during construction phase

No.	Machinery and equipment	Noise level (dBA) 1.5m from source
1	Bulldozer	93
2	Compactor (road roller)	72 – 74
3	Excavator	72 – 84
4	Dredging excavator	72 – 93
5	Grader	80 – 93
6	Concrete mixer	75 – 88
7	Concrete pump	80 – 83
8	Concrete vibrator	85
9	Generator	72 – 83
10	Hydraulic pile driver	70 - 85

(Source: United States Environmental Protection Agency – Noise from Construction Equipment and Building Machinery NJID, 300.1, 12/31/1971)

Applying formulas [10] and [11], noise levels will gradually decrease with distance. The maximum noise levels at different distances due to construction equipment operation are presented in the Table below.

Table 4.29. Maximum noise level by distance

No	Machinery and equipment	Noise level at 1.5m from the source (dBA)	Noise level at 15m from the source (dBA)		Noise level at 30m from the source (dBA)		Noise level at 50m from the source (dBA)		Noise level at 100m from the source (dBA)		Noise level at 200m from the source (dBA)	
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
1	Bulldozer	93	73.0		67.0		62.5		56.5		50.5	
2	Compactor (road roller)	72-74	52.0	54.0	46.0	48.0	41.5	43.5	35.5	37.5	29.5	31.5
3	Excavator	72-84	52.0	64.0	46.0	58.0	41.5	53.5	35.5	47.5	29.5	41.5
4	Dredging excavator	72-93	52.0	73.0	46.0	67.0	41.5	62.5	35.5	56.5	29.5	50.5
5	Grading machine	80-93	60.0	73.0	54.0	67.0	49.5	62.5	43.5	56.5	37.5	50.5
6	Concrete mixer	75-88	55.0	68.0	49.0	62.0	44.5	57.5	38.5	51.5	32.5	45.5
7	Concrete pump	80-83	60.0	63.0	54.0	57.0	49.5	52.5	43.5	46.5	37.5	40.5
8	Concrete vibrator	85	65.0		59.0		54.5		48.5		42.5	
9	Generator	72-83	52.0	62.5	46.0	56.5	41.5	52.0	35.5	46.0	29.5	40.0
10	Hydraulic pile driver	70 - 85	52.0	64.0	46.0	58.0	41.5	53.5	35.5	47.5	29.5	41.5
QCVN 26:2010/BTNMT (6-21h)			70 dBA									

According to the calculation results above, the noise level at a distance of 30m from the construction equipment and machinery falls within the allowable limits (<70dB). The noise level decreases as the distance from the construction area to the affected zone increases. Among the noise sources, the most significant is the mobile noise from transport vehicles carrying construction materials through areas with residential populations.

The noise primarily affects construction workers, local residents near the project area, and along the transportation route. High noise intensity can impact health, causing issues like insomnia, fatigue, and irritability. It can also reduce worker productivity, making it harder to concentrate, which can lead to workplace accidents.

The sensitive groups affected by the noise from the Tam Quan subproject include: construction workers, residents of Tam Quan ward, Tam Quan North Elementary School, Thien Tranh Market, and the aquaculture area in Tam Quan North Ward.

However, according to the calculated noise levels at the construction site, the impact is minimal, occurring for short durations. The equipment does not operate simultaneously but in phases or shifts, and depending on the progress and the amount of work, different machines will be used. Therefore, the cumulative noise impact at a given location is very low. Moreover, all vehicles and equipment undergo regular maintenance, and the noise will cease once the construction is completed. Noise can be reduced through measures such as providing workers with protective gear and noise-reduction equipment.

(iii) Impact of vibration:

The vibration is mainly generated from large and frequently operating equipment on-site, such as bulldozers, excavators, and air compressors, resulting from activities like ground leveling, piling, and the construction of embankments and port wharves.

Table 4.30. Vibration levels of some typical construction equipment

No	Type of machinery, equipment used	Reference vibration levels (vertically, dB)
1	Soil excavator	80
2	Bulldozer	79
3	Heavy truck	74
4	Roller	82
5	Air compressor	81
6	Hydraulic pile driver	70 - 85

(Source: U.S. Environmental Protection Agency – Vibration from construction equipment and machinery, NJID, 300.1, 31 – 12 – 1971)

Applying formula [9] to forecast the vibration reduction levels with distance that may occur at the Tam Quan subproject construction site, the results are presented below:

Table 4.31. Vibration attenuation over distance in construction.

No	Machinery, equipment	Source vibration ($r_0=10m$)		Vibration 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	Soil 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
6	Hydraulic pile driver	85	10	70.7	0.56	61.2	0.18	51.2	0.06	41.5	0.02

QCVN27:2010/BTNMT, permissible level is 75dB from 6:00 AM to 9:00 PM, and the baseline level is from 9:00 PM to 6:00 AM..

DIN 4150, 1970 (German Standard): 2mm/s: No damage, 5mm/s: Plaster detachment, 10mm/s: Potential damage to load-bearing elements, 20–40mm/s: Damage to load-bearing elements.

According to the calculation results in the table above, the vibration levels of construction vehicles and equipment at a distance of 12 meters are within the permissible limits of QCVN 27:2010/BTNMT (<75dB) and will decrease as the distance from the source of vibration increases. The vibration mainly affects the workers at the construction site. However, the impact of vibration should be considered in areas near residential areas, though at a low level.

In general, the direct impact of vibration is assessed as Medium due to the intermittent operation of equipment, localized effects at the construction site, workers operating the equipment in shifts, and wearing protective gear. The impact of vibration can be completely mitigated by applying appropriate construction methods and plans tailored to each project site.

(iv) Wastewater generated

Domestic wastewater of workers:

It is expected that the Tam Quan subproject will mobilize about 100 workers over the 36-month construction period. According to the water supply standard of 100 liters per person per day (Source: QCVN 01:2021/BXD – National technical regulation on construction planning), however, for workers not staying at the construction site, the estimated water supply standard is 50 liters per person per day. The total domestic wastewater generated during the construction phase of the Tam Quan subproject is as follows:

Table 4.32. Domestic wastewater generated at each subproject

Subproject	Number of workers (people)	Total construction time (month)	Domestic wastewater (m3/day)	Total generated wastewater (m3)
Tam Quan subproject	100	36	5	5,400

Domestic wastewater contains components such as total suspended solids (TSS), organic matter (BOD₅, COD), nutrients (N, P), and pathogenic microorganisms.

The amount of pollutants generated by 100 people (calculated based on the maximum number of workers that can be mobilized at the construction camp) daily and the pollutant concentrations released into the environment are provided in the table below:

Table 4.33. Pollutant Load in Domestic Wastewater

Pollutant	Pollution Coefficient (g/person/day)		Pollutant load (kg/day)		Pollutant concentration (mg/l)		
					Before treatment	QCVN 14:2008/ BTNMT Column B	
BOD ₅	45	54	4.5	5.4	642.9	771.4	50
COD	72	102	7.2	10.2	1028.6	1457.2	-
TSS	70	145	7	14.5	1000	2071.5	100
Grease	10	30	1	3	142.9	428.6	20
Total Nitrogen	6	12	0.6	1.2	85.8	171.5	50
Ammonia (N-NH ₄)	2.4	4.8	0.24	0.48	34.3	68.6	10
Phosphor	0.8	4	0.08	0.4	11.5	57.2	10
Total Coliforms	1,00E+06	1,00E+09	1,0E+05	1,0E+08	1,4E+07	1,4E+10	5000 (MNP/10 0ml)

The load and pollutant concentrations, such as BOD, COD5, TSS, NH₄⁺, etc., in the domestic wastewater generated during the construction phase of the subprojects, if not treated, exceed the permissible limits of QCVN 14:2008/BTNMT (Column B). Therefore, if the domestic wastewater is not adequately treated before being discharged into the receiving water body, the Tam Quan River at the estuary, the pollutant concentration will increase, and the quality of surface water in the Tam Quan River at the estuary will degrade. This will have a direct impact on aquatic species due to reduced dissolved oxygen in the water (this will be evaluated further in a later section).

Moreover, with a discharge containing numerous pathogenic microorganisms, there is a risk of skin, eye, gastrointestinal diseases, and infectious diseases spreading among the workers involved in construction. However, the impact is assessed as low because: (i) the wastewater generation is not continuous throughout the day; (ii) local workers and rental housing will be used, so the actual wastewater generated will be much lower than the calculations; (iii) the impact duration is long, throughout the construction period and beyond. Appropriate mitigation measures can be applied to reduce these risks.

Construction Wastewater:

Construction wastewater primarily arises from the cleaning of equipment, construction tools, and vehicles entering and leaving the Tam Quan subproject site. A vehicle washing station is installed at the construction site for casting components. Wastewater is generated during the cleaning of transport vehicles and the cleaning of concrete mixing equipment at the construction site. Vehicles are cleaned once a day at the end of the day.

The vehicle washing water is mainly used to clean the wheels of the vehicles before they leave the site. According to TCVN 4513-1988 (Interior water supply – design standard), the water used to wash a complete vehicle is 500 liters per wash. However, during the construction phase, vehicles are primarily used to wash the wheels, so the estimated water usage per vehicle is 100 liters. The number of vehicles transporting materials for the Tam Quan subproject is calculated to be 44 vehicles per day, and the estimated water consumption for washing vehicles is 100 liters per vehicle. Thus, the total wastewater generated is: $44 \times 100 = 4,400$ liters per day = 4.4 m³ per day.

The main components of the construction wastewater are suspended solids, soil, sand, oil, and grease. If not collected and treated before being directly discharged into the Tam Quan River – East Coast estuary, this could have some negative impacts on the water quality of the Tam Quan River. The high levels of suspended solids would increase water turbidity, reducing the dissolved oxygen levels in the water, and thereby negatively affecting aquatic life.

The impact is assessed as localized at the construction site (the existing Tam Quan port). Furthermore, the frequency of construction wastewater generation is intermittent. The affected area is the water quality of the Tam Quan River at the estuary. However, as this is an existing port area, the water quality of the coastal waters has already been impacted by prior fish port activities. Therefore, the impact is assessed as LOW and can be mitigated.

Rainwater Runoff:

According to TCVN 7957:2008, the amount of rainwater runoff over the construction areas of the Tam Quan subproject is calculated using the formula [10]. The calculated result is as follows:

Table 4.34. Rainwater runoff through construction site

No	Description	Rainwater drainage basin (ha)	Flow coefficient	Flow rate (m3/s)
1	Tam Quan subproject	2.48	0.2	7.15

The total volume of rainwater runoff generated is approximately 7.15 m³/s at the Tam Quan subproject. According to WHO data (1993), the pollutant concentration in rainwater runoff is around 0.5 - 1.5 mg N/l, 0.004 - 0.03 mg P/l, 10 - 20 mg COD/l, and 10 - 20 mg TSS/l. These values are below the permissible limits according to QCVN 40: 2011 / BTNMT - National Technical Regulation on Industrial Wastewater Quality.

Rainwater runoff across the construction site carries materials such as loose soil, stones, surface mineral salts, and leaked oils and fats, which increase the concentration of suspended solids, organic matter, turbidity, and oils and fats in the water. This degrades water quality and negatively impacts the aquatic ecosystem of rivers and canals receiving runoff at each project site. Pollutants from surface runoff can affect water quality and aquatic organisms living in the Tam Quan River ecosystem and the storm shelter area, especially as turbidity increases. Aquatic species may be harmed by the pollution, which could make respiration and photosynthesis more difficult, for example.

This impact occurs during the rainy season in Binh Dinh from September to December. However, the direct impact of rainwater runoff is assessed as medium because: (i) The construction site is regularly cleaned by workers, thus limiting the amount of loose material, soil, and stones carried away by runoff; (ii) Each construction site is equipped with a rainwater drainage system; (iii) Most construction activities at sea occur in the dry season, although the construction period is long (36 months). Therefore, the impact from rainwater runoff can be mitigated through appropriate technical measures and management practices.

(v) Solid Waste Generation: Construction Solid Waste:

Construction solid waste mainly consists of debris from demolishing old structures, excess excavated soil/dredged material, packaging materials, metal scraps, steel, etc., at the site. The composition includes common solid waste and other waste materials. The estimated amount of construction waste generated by the Tam Quan subproject is shown in the table below:

Table 4.35. Volume of Solid Waste Generated from Construction Works

Subproject	Demolition volume (m ³)	Excavated soil volume (m ³)	Dredged volume (m ³)	Volume of Excavated Soil/Dredged Sand Reused On-Site(m ³)	Volume to be disposed of (m ³)
Tam Quan subproject	-	119,653	447,146	334,406	232,393

(Source: Cost estimate for project basic design, 2023)

The excavated soil volume of the Tam Quan subproject is quite large, amounting to 119,653 m³. The dredging volume of the Tam Quan subproject is also considerable, at 447,146 m³ (mostly arising from dredging activities for the Tam Quan storm shelter). Sediment monitoring results at the project site show that the dredged mud does not show signs of pollution with heavy metals or organic compounds. The composition of dredged material is primarily sand (coastal and river mouth areas), so it can be utilized as fill material for the construction site and areas requiring land

leveling or filling of low-lying areas. The project is expected to reuse around 334,406 m³ of excavated soil and suitable dredged materials. Surplus dredged material is expected to be transported to a temporary disposal site and is anticipated to be auctioned as mineral resources in the future in accordance with current regulations.

A small amount of debris will be generated during the construction of the subprojects, including surplus mortar lime, wood scraps, broken bricks, etc. Additionally, some solid waste such as scrap steel and cement bags may be generated after construction. However, these types of solid waste have reuse value and can either be reclaimed for reuse or sold to interested parties, reducing their environmental impact.

If not well-managed, these types of solid waste could hinder construction activities and increase dust levels in and around the construction site, impacting workers and nearby residents. With the relatively high volume of construction waste generated as calculated above, if not collected and properly disposed of, it could obstruct flow during the construction of buildings, potentially leading to flooding and traffic congestion in the existing Tam Quan port and storm shelter area.

Overall, this direct impact is assessed as medium because: (i) The waste volume is large but localized at the dredging site, and the project is expected to reuse most of the excavated soil and dredged material as mentioned; (ii) The construction period is long (approximately 24-36 months); (iii) Construction waste will be collected and transported (via waterways) to an approved temporary storage area; (iv) Most of the dredged material (mostly sand) can be reused as sand resources (for construction and filling purposes) through future resource auctions. Furthermore, this impact can be mitigated through appropriate measures.

Household Solid Waste:

Household solid waste arises from the daily activities of construction workers at temporary camps. The main components of household solid waste are biodegradable organic waste and non-biodegradable inorganic waste, such as plastic bags, bottles, and used personal items. The average household solid waste generation is approximately 0.5 kg/person/day (QCXDVN 01:2021/BXD - National Technical Regulation on Urban Planning issued by the Ministry of Construction, applying to grade III cities). With an estimated workforce of 60 workers at the Tam Quan subproject, the generated household waste is as follows:

Table 4.36. Daily waste generation at construction sites

Subproject	Number of workers (people)	Total construction time (month)	Domestic waste (kg/day)	Domestic waste (ton/month)	Total domestic waste generated (ton)
Tam Quan subproject	100	36	50	1.5	54

According to the table above, the total amount of household solid waste generated at the Tam Quan subproject is approximately 50 kg/day, with a construction duration of 24 to 36 months, resulting in an estimated total of 54 tons of household solid waste. This waste includes organic materials, various types of paper scraps, nylon, plastic, metal, damaged daily household items, etc. The waste contains 60–70% organic matter and 30–40% other substances, and it may especially contain a large number of bacteria and pathogens.

If this waste is not collected and treated according to regulations, it could lead to visual pollution in the area, affecting the operation of the existing Tam Quan fishing port and anchorage. When

waste is scattered on the soil, under the influence of weather and bacteria, organic compounds decompose, producing foul odors that cause air pollution, increase the risk of disease outbreaks, and impact the health of workers, nearby residents, and neighboring facilities. Furthermore, improperly collected and untreated household waste will be washed away by rainwater runoff into the Tam Quan River, reducing the quality of water resources and harming the aquatic ecosystem.

However, the impact of household waste is considered to be "LOW" and can be mitigated due to: (i) The amount of waste generated on the construction site is not large and is collected daily by construction workers; (ii) Waste is generated locally at construction sites; (iii) The contractor employs local labor to minimize the amount of household waste generated; (iv) The workers' camps are located away from residential areas, and the existing Tam Quan port has an effective solid waste collection and treatment unit in operation.

Hazardous waste:

The sources of hazardous waste from the construction of the project's subprojects include: (i) Oil-contaminated materials from machinery maintenance; (ii) Waste asphalt from road construction, asphalt containers; (iii) Packaging, containers for oil, asphalt, fuel, and paint; (iv) Welding rod tips; (v) Batteries, light bulbs, and toner cartridges from office activities at the construction site. The amount of hazardous waste depends on the number of equipment/machinery, workers, and materials used.

Maintenance activities for vehicles, machines, and construction equipment, if carried out on-site, will produce waste oil, oil containers, and oil-soaked rags, etc. (estimated at about 5 kg/month per project). If not collected and treated, this waste will affect the aesthetics and pollute the surface water and groundwater at the project site. The project owner will implement collection and treatment measures in accordance with hazardous waste regulations to minimize the environmental impact in the area. All equipment repair activities will be carried out at repair centers.

Packaging, containers for waste oil, asphalt, fuel, and paint are not expected to be produced in large quantities (around 10–30 kg/month for each construction site). However, if this waste is not collected, it can cause visual pollution and potentially lead to soil and water contamination.

Welding rod tips generated on-site during steel framing activities are estimated to be 5–7% of the total welding rod volume, with approximately 5.0 kg of leftover welding rod tips for the Tam Quan subproject to be collected. However, the amount of welding rod waste is not continuous and is minimal; it will be collected and disposed of in a designated hazardous waste collection area in accordance with regulations.

In addition, a small amount of hazardous waste is generated from office activities, approximately 5–7 kg/month.

If hazardous waste is not collected, it can cause the following impacts: (i) Oil and grease infiltrating water, directly affecting marine life in the Lach Hoi port area, reducing growth and development, and potentially causing death in aquatic species; (ii) Heavy metals entering the food chain and affecting human health.

Although the amount of hazardous waste generated at each construction site is small, localized to specific areas, and only occurs during construction, the hazardous waste will be collected, managed, and treated according to hazardous waste regulations. Therefore, this direct impact is considered to be moderate and can be reduced through appropriate management and treatment measures tailored to the specific characteristics of the project.

Surface water quality deterioration:

Rainwater runoff through the excavation area can carry soil particles and other waste materials into the receiving water, increasing water turbidity. Additionally, runoff passing through fuel storage or vehicle repair areas without a roof may wash oil, grease, and other hazardous waste into the receiving water, causing pollution. As discussed above, wastewater from workers' camps at the construction site could also contaminate water due to increased organic content (BOD), nitrogen, and pathogenic microorganisms. The deterioration of surface water quality will negatively affect aquatic life and the water users.

The Tam Quan storm shelter anchorage will be dredged, with an estimated dredging volume of 433,793 m³. Dredging the river/sea bank to build the port berth could significantly affect the water quality of the river/sea near the shore. The water quality will degrade due to increased turbidity (T) and total suspended solids (TSS) when the water column is disturbed by dredging. Oil and grease may also increase if leakage occurs from barges and dredging equipment, as discussed below.

Turbidity and TSS increase from dredging activities:

The dredging process is a primary cause of water turbidity in the dredged area as the particles are stirred up, dispersed, and suspended in the water. The turbidity of the river/sea water near the project site may increase due to dredging for the following reasons:

- Bottom sediment being disturbed and dispersed into the water column.
- Sediment spilling during the bucket dredging process while moving from the river/sea bed to the surface.
- A small amount of dredged material may spill from the bucket during transport to barges.
- Water leaking from wet dredged material will return to the river/sea at the project site.

Dredged material spillage: According to the dredging evaluation handbook¹⁹, when using a suction dredger, grab dredger, or barge to dredge 1 m³ of sand, approximately 0.3–0.4 kg of sediment will be lost. This lost sand will be evenly distributed along the dredging area, increasing water turbidity before it settles at the bottom of the river/sea.

Dredged material dispersion: The degree to which sediment is stirred and dispersed (thus affecting turbidity) mainly depends on the geological structure of the seabed and the dredging method, such as water turbidity being lower when dredging sand layers compared to muddy sand layers. The use of grab dredgers will cause higher turbidity than suction dredgers.

The dispersion of sediment in the river/sea water is the main cause of increased suspended solids (TSS). Sand particles will settle by gravity and accumulate at the river/sea bottom within a short period. Thus, sediment/sand may contribute to increased turbidity for a short time but will not significantly increase TSS. Increased TSS will directly affect the ecosystem in the dredged area, reducing light diffusion into the river/sea water, decreasing photosynthesis of plants (e.g., algae), limiting growth and reproduction, and changing the habitat of organisms. However, the ecosystem at the port areas under construction is relatively low in biodiversity, mostly consisting of existing ports where ships regularly enter and exit, and the coastal water area, so the level of impact is low and can be mitigated by appropriate construction measures.

Oil and grease:

A certain amount of fuel and oil will be stored on barges or other dredging materials and vessels.

¹⁹ Japan Ministry of Transport 1992

Some lubricating oils may also leak onto the surface of barges during operations. Rainwater could wash off the leaked oil and grease into the river/sea near the dredging area, impacting water quality. However, this risk is considered low and controllable because fuel is usually stored in sealed containers, and the amount of fuel stored on the barge is limited. The concentration of heavy metals in river/sea sediments is low and within permissible limits, so there are no issues with the release of heavy metals into the water during dredging activities.

Surface water

vi) Environmental impacts

As discussed above, wastewater and rainwater runoff over the camp and construction site, along with dredging activities, could increase turbidity, organic content (represented by BOD), nitrogen, and oil into receiving water sources. The increase in water turbidity will hinder sunlight from reaching aquatic plants, leading to a reduction in photosynthesis activity. The increase in suspended solids in the water can affect the respiratory systems of aquatic animals. The decomposition of organic matter will lead to a decrease in dissolved oxygen in the water, impacting aquatic life. Oil and other harmful substances could be detrimental or lethal to aquatic plants and animals. Therefore, wastewater from the construction site must be properly managed, especially in areas with high aquatic resource value. The potential impact of dredging and disposal of dredged materials on aquatic life will be further discussed for specific project locations.

When dredging disrupts water quality and coastal flow, it affects aquatic plants and animals in various ways as discussed below.

Impact on Phytoplankton: Increased turbidity and suspended solids due to dredging will obstruct sunlight from penetrating deeper into the water, limiting the photosynthesis of floating plants, restricting their growth, and limiting their ability to absorb essential nutrients in the aquatic ecosystem. Some phytoplankton may be carried away with the dredged material or damaged by dredging equipment. After the dredging is completed, the remaining phytoplankton will continue to develop and spread, so the ecosystem can recover relatively quickly. On the other hand, since sediment usually settles 15 minutes after dredging stops and affected areas are within a 500m–600m radius, the impact on phytoplankton is temporary, with limited space. Photosynthesis and respiration in many species can be restored when pollutant levels (turbidity, TSS) decrease.

Impact on Zooplankton: Some bottom-dwelling animals will be removed along with the sediment/sand from their habitats during dredging. Others may die when their habitats are destroyed by dredging activities. This impact is unavoidable and mainly affects the bottom layer within the dredging corridor, but it may naturally recover after about a year (Prussian et al. 1999)²⁰.

Potential impacts on fish, shrimp, and other aquatic species in rivers/seas: Increased turbidity and suspended solids may obstruct the respiration of aquatic species in rivers/seas. CH₄ and H₂S²¹ released from sediment when disturbed may adhere to gills, hindering respiration. However, fish and shrimp tend to react immediately when their habitat is disturbed, swimming away as dredging begins. Therefore, the potential impact of death due to habitat change on shrimp, fish, etc., during dredging will be minimal. However, if oil and grease spill into the water during construction, this could be a source of acute toxicity to aquatic species and could accumulate in the food chain, from

20 The monitoring by the U.S. Environmental Protection Agency (USEPA) on the restoration of dredging activities in a river in Alaska showed significant recovery of macroinvertebrate diversity after one year.

21 According to secondary studies, the main gases are CH₄ and H₂S

lower plants (algae, phytoplankton) to higher aquatic animals (fish, etc.).

In general, the potential impacts of dredging the pier/channel for sub-projects will not cause significant damage to the aquatic ecosystem of the river/sea because these ecosystems (as described in Chapter 2) are impoverished and not rich, as most existing ports already have numerous human exploitation activities. Dredging of the harbor is conducted in the existing harbor area and is assessed as not causing significant impact on current aquatic species. The bottom-dwelling species' habitat will be most affected, but the affected areas are confined to the dredging corridor and depth. This potential impact can be reversed as the habitat and ecosystem of bottom-dwelling species can naturally recover within 12–18 months after dredging. Partial disruption of bottom-dwelling habitats and a decrease in some bottom species populations are not expected to have significant effects on the food chain in the river/sea ecosystem in the area. The potential impacts of dredging can be managed through mitigation measures and monitoring activities proposed in Chapter 5 of this ESMP.

(vii) Erosion, sedimentation, and localized flooding impacts

Potential erosion could occur at high levels in areas with exposed soil and areas where excavated soil/dredged material is stored. Erosion on sloped soil may cause land subsidence and slippage, leading to property damage and even fatalities. Rainwater runoff from the construction site or surrounding disposal areas may carry high levels of suspended solids, leading to sedimentation that damages trails and pollutes receiving water sources. This sedimentation can cause blockages in the existing drainage system, leading to localized flooding.

During construction, due to dredging, extensive filling of areas, and the scouring effects of rainfall and tidal fluctuations, the sediment concentration may increase significantly for an extended period, contributing to further sediment deposition in the construction area.

- Heavy rain may cause erosion, carrying suspended materials across the construction site. These materials may negatively affect the quality of water in receiving water bodies and cause sedimentation in those bodies. However, it is assessed that these impacts are only temporary during construction; after the infrastructure system is completed, and the area is stabilized, these impacts will cease.

- During construction, the elevation of the area increases, and the bedding surface changes, causing water to accumulate more quickly, affecting the drainage capacity of the area.

In addition, during construction, the project will level all planned soil zones to create a construction base and technical infrastructure systems. The filling process will alter the area's natural elevation, changing the topography from depressed areas with uneven elevation to stable, uniform elevations. Previously lowland areas, such as rice fields and ponds, will be filled, resulting in exposed soil or concrete surfaces. This will lead to an increase in water flow into the river, as the area will have poorer self-regulation, which will affect the river's flow.

(viii) Impact due to increased risk and traffic disruption

Construction activities may lead to a significant increase in the number of vehicles entering and leaving the Tam Quan sub-project area, which is an existing harbor and storm shelter. The movement of heavy vehicles could disrupt the existing traffic flow on the roads and increase traffic safety risks for road users.

The Tam Quan anchorage covers 60 ha in Hoai Nhon town, with a current capacity of 1,000–1,200 boats. The total number of boats in Hoai Nhon has already exceeded 2,300, and during the rainy season, the anchorage accommodates around 250–300 boats from Phu My district and Quang Ngai

province.



Boats docked at the existing Tam Quan harbor and anchored for storm shelter.

Additionally, waterway traffic could be impacted due to the increase in the number of boats transporting materials by water to the construction site, while construction activities in the water may narrow or block transportation routes. Implementing good waterway and land traffic safety management during the construction phase will help avoid, mitigate, and reduce impacts on traffic, including accidents.

During dredging, various types of equipment will be used, such as 1390CV dredging vessels, 585CV dredging vessels, 200-400T barges, tugboats, boats, (40T skiffs), speedboats, etc. To support these vessels, there will also be fuel and water supply boats. Currently, the existing port area still has vessels passing through. Dredging the channel and constructing the port will inevitably affect waterway traffic during the 24 to 36-month construction period, such as obstructing waterway traffic, narrowing the width of the waterway due to dredging equipment occupying part of the water surface during construction, and the risk of collisions between dredging equipment, fuel supply boats, cargo ships docking, and local fishing vessels.

Barge docking on the water and transporting dredged materials along the waterway will disrupt local waterway traffic, increasing the risk of collisions between local water traffic and dredging machinery. Dredging will limit local vessels' access to the port for docking purposes.

However, this impact will only occur during the dredging process. The main traffic in and out of the port will be fishing vessels, which generally depart and return at specific times. The surface area of the ports is quite large, especially in the existing ports, which have multiple docking compartments. Therefore, the disruption of waterway traffic in the project area will be minor and can be minimized through proper construction organization.

The impact on waterways is assessed as low and localized due to: (i) The cross-section of the existing port and new ports is relatively wide, ranging from 200 to 500m, and the dredged area only occupies a small portion of the water surface (about 1/10 to 1/5 of the water surface in the port area). The remaining width of the current path will still be sufficient for local vessels; (ii) Dredging equipment is usually stationed in one spot for only a few hours at a time.

(ix) The risk of damage to existing infrastructure due to transporting construction materials and machinery

Most of the project site is located in rural areas, where most rural roads are made of concrete. Transporting materials to the site using heavy trucks may cause road damage. Repairing concrete roads technically may be very difficult, so this impact needs to be avoided by solutions such as using alternative transportation methods (waterways) or only allowing trucks with appropriate

loads to travel on the road. Furthermore, crane operations may affect existing infrastructure such as power lines, telephone lines, water supply, and drainage systems. This impact can be avoided or minimized by conducting a site survey and consulting with local authorities and relevant agencies before construction.

Construction activities, including port construction and dredging, will use heavy machinery such as clamshell dredgers, which have high booms (30–40m long). If not properly controlled, they could hit the existing dock shores while moving and dredging the channel or maneuvering in rivers or seas.

Additionally, many existing shrimp farming cages may be at risk if dredging vessels collide with them, damaging the shores or shrimp nets, or water supply/drainage pipes at the existing port, resulting in productivity losses for shrimp farmers and other marine life if proper notice and relocation plans are not in place.

Moreover, there are many businesses providing fisheries logistics services at the fishing port. Dredging and port upgrades may affect these businesses' operations. However, the impact is minimal and can be mitigated by implementing an appropriate dredging plan and construction organization.

(x) Occupational Health and Safety (OHS) Issues

Workers may be exposed to an increased level of dust and toxic gases due to demolition, soil excavation, and machinery operation, leading to dizziness or fainting during work. Workers may also face accidents from contact with electrical tools/equipment, sharp objects, nails, screws, and the operation of various machines simultaneously in a narrow work area, especially if workers do not pay attention, fail to use protective equipment properly, or neglect safety regulations. Construction activities may lead to other occupational accidents, such as fires or explosions from gas or fuel leaks, welding activities, electrocution, working at heights, falling into the sea, collapsing buildings, and working with bulky machinery and materials in extreme weather conditions, such as large waves and strong winds, or weak site organization.

Regarding working conditions, OHS issues for workers may include falling into the water or drowning when working on water or the sea due to illness or loss of balance. Workers may also be exposed to hazardous materials such as oil. If exposed directly, the short-term health effects may be skin or respiratory irritation, while some substances could penetrate the skin and enter the body. The accumulation of harmful substances during work will result in more serious long-term health effects, requiring proper management.

Other OHS issues related to working conditions include inadequate lighting or insufficient protection when working in specific locations or environments.

Working with electric or diesel-powered construction tools and equipment (e.g., barges, sand pumps, cranes, pile drivers, etc.) may expose workers to electrocution or burns. Extreme weather conditions are also a risk factor for OHS issues. Strong winds and heavy rain during storms in coastal areas can make construction sites unstable, possibly causing equipment, tools, and construction materials to shift, leading to accidents for those nearby, including workers. Working long hours in extremely hot conditions may also lead to exhaustion or even fainting.

For dredging workers, as well as other subprojects, inadequate living conditions at worker accommodations may lead to health and safety issues. Waterborne diseases may occur if there is insufficient clean water, lack of proper sanitation facilities, or poor hygiene conditions at or around the camp. Living on-site away from home for extended periods, if workers engage in unhealthy activities like fighting, drinking, or engaging in sex work, may also result in long-term health

impacts.

Regarding worker behavior, safety risks can arise from workers' awareness and attitude toward using Personal Protective Equipment (PPE) and their individual behaviors on-site. For PPE, workers from larger, more experienced contractors are usually well-trained in EHS and provided with full PPE, so they typically follow stricter safety rules. However, workers from smaller/local contractors may not consistently use PPE (e.g., life vests on rivers/seas) depending on enforcement levels. Careless behaviors, such as smoking near flammable materials like oil tanks, mishandling electrical wiring, or unauthorized operation of construction machinery, can also pose significant safety risks.

Overall, the risk of workplace accidents at the construction site is moderate and can be minimized with appropriate solutions such as safety training before and during construction and providing workers with sufficient protective equipment.

(xi) Public Health and Safety Issues

Local residents living around the construction site, along transport routes, and near disposal areas may be exposed to hazardous waste, unpleasant odors from dredging activities, temporary sludge storage, and pathogens from poor sanitation. Furthermore, increased dust concentration, noise, and traffic density due to machinery operation and transportation, soil subsidence, construction collapse, and unprotected deep holes on the roads could pose risks to public health and safety.



Residential area near the upgraded fishing port and Tam Quan storm shelter area.

Health and community safety risks are assessed as medium due to: (i) The construction area for the Tam Quan subproject is located on an existing fishing port, which will be specifically evaluated in the section on specific impacts; (ii) The concentration of workers is not large (about 100 people at the subproject), and they are concentrated in one construction area; (iii) The construction period for the subprojects under the subproject is long (about 36 months); (iv) The project owner/contractor prioritizes the recruitment of local workers; (v) Workers are trained on occupational safety and environmental hygiene before construction activities begin; (vi) Risks can be mitigated through construction organization measures, combined with reasonable layout of the construction site.

(xii) Social impacts due to labor flow

It is estimated that about 100 workers will be mobilized at the peak of the Tam Quan subproject. These workers may come from different areas of the province/city or from other provinces. Some potential social risks and impacts related to the labor flow of this subproject are forecast as follows:

- The improper management of workers and their camps may lead to environmental issues such as wastewater discharge, littering, or dumping solid waste into rivers, seas, or agricultural land.
- The influx of labor may pose a risk to local security or social stability if some workers engage in social vices (such as drinking, gambling, prostitution, etc.).
- The recruitment of migrant workers may increase the risk of infectious disease transmission, including HIV/AIDS, as workers from different areas interact with each other and the local community. If an outbreak occurs, it would put additional strain on the local healthcare system.
- Potential conflicts between workers and the local community due to differences in origin, culture, customs, employment, and income.
- Gender-based violence (GBV), exploitation, and sexual harassment/assault (SEA/SH) may be associated with the concentration of male labor in the project area. However, the risks of GBV and SEA/SH are considered low and manageable.

(xiii) Impact on cultural heritage

The construction activities of the project are related to significant excavation and dredging, so cultural relics may be exposed during construction. Therefore, the process for managing accidental discoveries has been included in the project's ESMF and ESMP (to be outlined in Chapter 5 below).

4.3.2.2. Site-specific impacts during the construction of Tam Quan subproject

The subproject Tam Quan will be invested in the construction of work items with the aim of becoming a regional-level storm shelter anchorage for 1,200 ships, with fishing vessels of up to 35 m in length able to take shelter. The investment scale of the subproject's work items will include: (i) Construction of embankments to protect the coastline with a total length of 2,494 m; (ii) Dredging of anchorages and fairways with a dredged volume of about 511,129 m³; (iii) Investment in ship mooring facilities, buoy systems, signaling, communication and lighting systems to support storm warning for vessels.

From the location, investment scale, and characteristics of the social community in the subproject implementation area presented in Chapter 2, the specific impacts of the construction of the Tam Quan subproject are identified as follows:

- i. Disturbance to the operation of the existing Tam Quan fishing port
- ii. Impacts on aquatic life and deterioration of water quality due to dredging
- iii. Impacts on waterway traffic activities on the Tam Quan River within the project area
- iv. Environmental pollution risks at dredged material storage sites
- v. Impacts on sensitive receptors
- vi. Impacts on aquaculture activities in the project area
- vii. Risk of embankment landslides due to extreme weather
- viii. Risks on house cracking/collapse due to piling process by the port embankment construction

The details of the impact assessment are presented below:

i. Disturbance to the operation of the existing Tam Quan fishing port

The Tam Quan subproject has a planned area of 115 ha, of which 10.74 ha are allocated for Tam Quan fishing port and 104.26 ha for the anchorage and channel. Tam Quan fishing port was

announced by the People's Committee of Hoai Nhon town as a type II fishing port, with a design capacity of 40,000 tons/year. Currently, the maximum capacity of the Tam Quan storm shelter anchorage is 1,000 – 1,200 ships. The existing port area still has vessels frequently navigating, with a density of more than 100 ships/day (peaking at about 30–50 ships/hour).



Tam Quan estuary area

During the construction process, ship mooring facilities, waters in front of the wharf, and logistics services will remain in operation, so the activities of the existing port will still be maintained normally. However, the presence and operation of construction equipment such as wire-bucket excavators, floating cranes, tugboats, barges, and canoes in the subproject area will affect and disturb the daily operation of vessels, hindering the entry and exit of Tam Quan fishing port. At the same time, construction activities may adversely impact the environment due to dust, exhaust gases, wastewater, solid waste, and noise, and will partially disrupt the operation of the existing port by concentrating construction machinery and equipment.

Nevertheless, these impacts are assessed at a medium level because: (i) Although the number of vessel movements in and out of Tam Quan port and anchorage is relatively high (averaging more than 100 times/day, with peak density of 30–50 times/hour), traffic is concentrated mainly between 1–4 a.m. and/or 6–9 a.m., when fishermen depart or return (at which times construction activities are minimal or suspended); (ii) The Tam Quan River in this area is about 250–450 m wide (within the project area, 2.2 km from the estuary). The remaining river width is still sufficient for vessel traffic, and near the estuary, boats move more quickly than in upstream waters; (iii) Construction machinery operating on water will be anchored in fixed sections, so impacts on vessel entry/exit are limited; (iv) The existing port will remain intact throughout construction; (v) Dredging will be carried out section by section along the Tam Quan River. During rough seas or storms—when vessels need to enter the anchorage—dredging will be suspended. With a total anchorage and channel area of 104.26 ha, there remains sufficient space for vessels to take shelter. These impacts can be mitigated through waterway traffic safety management and careful organization of construction activities at existing wharves.

ii. Impacts on aquatic life and deterioration of water quality due to dredging

The Tam Quan subproject will carry out dredging of the access channel and anchorage area, with a dredged volume of about 511,129 m³. Dredging activities will affect water quality and aquatic life in the Tam Quan River, within the subproject area, about 2.2 km from the estuary.

Dredging of the fairway and anchorage will be conducted using suction dredgers that pump material directly to the disposal sites (0.4–0.5 km from the dredging area). Potential impacts on the aquatic ecosystem include:

- Disturbance or loss of benthic habitats for shrimp, crabs, fish, snails, mussels, and aquatic eggs;

- Resuspension of bottom sediments, increasing suspended solids and pollutant concentrations in the water;
- Reduced light penetration due to higher turbidity, affecting photosynthesis, metabolism, and food availability for aquatic organisms;
- Changes in terrain (dredged bottom depth from -4.5 m to -5.5 m, channel width 40–50 m), altering habitats for fish, shrimp, and crabs that must relocate and adapt;
- Transformation or loss of aquatic vegetation such as grasses and low-level plants;
- Declines in dissolved oxygen and photosynthetic activity due to increased turbidity and suspended solids.

Dredging will be carried out along the length of the Tam Quan River within the subproject area, with a relatively large dredged volume of 511,129 m³. The maximum increase in SS concentration at a location 50 m from the dredging center is about 150 mg/l compared to the baseline environment, and it decreases with distance. After 1 hour, the dilution ratio at 100 m from the source is 1/2, at 200 m is 1/5, and at 500 m is 1/10, corresponding to concentrations of 75 mg/l, 30 mg/l, and 15 mg/l, respectively. The increase in TSS concentration in the water may affect aquatic species and could potentially impact water intake for aquaculture ponds located about 30–100 m from the dredging site (impacts on aquaculture activities will be assessed in detail in Section (vi) of this part). This impact is temporary and will occur during the construction period of about 24 months. The subproject area does not contain rare or valuable aquatic species under protection, nor species at risk of extinction (aquatic organisms in the Tam Quan River mainly include plankton such as copepods, cladocerans, and rotifers; benthic fauna such as snails, clams, mussels, and tubificid worms; and aquatic plants such as water hyacinths and algae). The habitats and ecosystems of benthic organisms are expected to naturally recover within 12–18 months after dredging. Partial disturbance to benthic habitats and a reduction in some benthic populations are not considered likely to cause significant impacts on the food chain of the river/sea ecosystem in the subproject area. Potential impacts of dredging are manageable through mitigation measures and monitoring activities proposed under the subproject's ESMPt. The potential impacts on the aquatic ecosystem of the Tam Quan River from dredging activities are assessed as **medium**.

iii. Impacts on waterway traffic activities on the Tam Quan River in the project area

Currently, a large number of fishing vessels anchor on the Tam Quan River, with daily arrivals at the port. The maximum capacity of the Tam Quan storm shelter anchorage is 1,000–1,200 vessels. The existing port area still has vessels navigating back and forth with a density of over 100 trips/day, with the highest density of about 30–50 trips/hour during fishing departures or vessel arrivals. Departure time is typically from 1–4 a.m., while arrivals are usually from 6–9 a.m., which often occurs outside or before the main construction hours.

Construction activities such as pile driving for embankment works, or the operation of dredging equipment including clamshell dredgers, floating cranes, tugboats, barges, and canoes, will reduce the navigable width of the Tam Quan River and narrow the safe navigation corridor. This may obstruct vessels entering the port and anchoring in the river, and pose risks of collisions between fishing vessels or between vessels and dredging equipment, leading to safety risks for vessels, equipment, and crew.

In addition, construction sites for embankment works will occupy parts of the existing anchorage area, forcing vessels that previously docked there to relocate to other sites, disrupting the river traffic flow and potentially causing disputes among vessel owners over anchorage space.

However, these impacts are assessed as **Low**, due to the following reasons: (i) The Tam Quan River in the dredging area of the subproject is about 250–450 m wide, while the dredged channel width is 40–50 m, meaning the reduction in navigable width is not significant (about 1/5 to 1/9 of the river width). (ii) Although vessel traffic density is high during peak hours (1–4 a.m. and 6–9 a.m.), construction activities are minimal or not yet underway at those times, and dredging equipment is mostly concentrated at a single point, so impacts are localized. (iii) Dredging will be carried out in phases across small sections with a comprehensive warning system in place. (iv) The storm shelter anchorage has a large water surface area of 104.26 ha, allowing vessels to easily find alternative mooring spots (if temporary relocation is required during embankment construction). Overall, the impacts and risks can be effectively mitigated through proper implementation of waterway traffic safety management and well-organized construction planning.

iv. Impacts and risks of environmental pollution at dredged material disposal sites

For the Tam Quan subproject, two dredged material disposal sites are arranged about 0.4–0.5 km from the subproject area: (i) Disposal site No. 1 is about 0.4 km southwest of the subproject area, with an area of approximately 2.5 ha; (ii) Disposal site No. 2 is about 0.5 km west of the subproject area, with an area of approximately 2.4 ha. The total area of the dredged material disposal sites is 4.9 ha, sufficient to contain the entire dredged material volume of the subproject (511,129 m³). After disposal, the elevation will be raised 1–2 m higher than the current ground level. Both dredged material disposal sites have been planned by the Hoai Nhon Town People's Committee for the development of the Tam Quan Fishery Infrastructure Area and the Tam Quan Port resettlement area. Surrounding the dredged material disposal sites are the Cong Thach residential area, Tam Quan Bac ward, and the Tam Quan River (there are no rice fields around the disposal sites).



Location of dredging material disposal site for Tam Quan subproject

If the dredged material is not properly managed, the process of gathering dredged material at the dump may have the following potential impacts:

- **Impact of leachate from dredged materials:** After the dredged material is pumped directly to the storage site, the wet dredged material will gradually settle and release water, forming leachate that flows out of the disposal site by gravity. Experience from other river dredging projects shows that the ratio of sand/mud to water in dredged material is about 8:2, meaning

water accounts for roughly 20% of the total volume of dredged materials. This indicates that the volume of leachate is significant. If not properly controlled, leachate from dredged materials may cause localized flooding around reservoirs. In addition, this leachate can have relatively high turbidity (fine suspended solids from dredging materials), potentially leading to sediment deposition in sewers, drainage ditches, and the receiving waters of the Tam Quan River.

- Spill/discharge of dredged material into the surrounding environment: The disposal site yard is designed with a specific height and storage area, approximately 1–2 m higher than the current ground level. When dredged material is dumped near the edge or top of the site, it may spill beyond the boundaries. Furthermore, slopes formed at the dump can collapse under the load, causing material to fall outside the designated area, cover vegetation, or fill surrounding land, thereby affecting the daily activities of nearby residents.
- Risk of salinity contamination from dredged materials to the soil environment at the reservoir: The sub-project area is located at the mouth of the Tam Quan River, near the East Sea, so dredged material may be slightly contaminated with salinity. The material is pumped to disposal sites about 0.4–0.5 km from the dredging site. Leachate from salinity-contaminated dredged material can seep into the ground at the disposal site or flow into surrounding areas. Therefore, dumping dredged materials without management and technical measures may impact the soil environment at the disposal site or nearby lands.

Environmental impacts and risks at dredged material dumps are assessed as **Medium**, based on the following factors:

- i. Leachate from dredged materials: The volume of leachate is relatively large, about 20% of the dredged volume. However, this water is channeled back to the Tam Quan River, helping to limit flooding and salinity infiltration into the ground. Therefore, the risk from leachate is considered negligible.
- ii. Spill/discharge risk: Although the dredged material volume is considerable (511,129 m³), the disposal sites are designed with sufficient area to accommodate it. After pumping and drainage, the material will be leveled and compacted. Since the reservoirs are in low-lying areas, the elevation after leveling will be about 1–2 m higher than the current ground level. This may pose a risk of spilling dredged material into the surrounding environment. However, this impact can be controlled by implementing technical measures to prevent subsidence and landslides in disposal sites.
- iii. Disposal site design: The yards have sloped surfaces suitable for topography and dumping height, helping to limit material spillage to surrounding areas.
- iv. Environmental quality of dredged materials: monitoring indicate that dredged materials are not contaminated with heavy metals. The disposal sites are planned within areas for Tam Quan fishery infrastructure or fishing port resettlement, with no remaining agricultural land nearby. The two disposal sites are adjacent to the Tam Quan subproject dredging area, with background conditions similar to the project area (mainly old NTTS ponds no longer in operation). One side borders the Tam Quan River, and the other sides have no agricultural land. Therefore, the risk of salinity contamination from dredged materials to the soil at the disposal site is minimal.

These impacts can be controlled and minimized through appropriate measures. Before deposition, it is necessary to check the salinity of the dredged material to ensure any risks are identified and mitigated promptly.

v. **Impact on sensitive receptors**

As shown in Table 2.8 (Chapter 2), within a 300 m radius from the subproject implementation area, there is no PCR and no major sensitive receptors. However, near dredged material disposal site No. 1, there is a sensitive receptor, **An Loc Temple**, about 500 m away. This temple is a site where religious rituals are carried out by the people of Cong Thanh village and surrounding residents of Tam Quan Bac Ward.

The main impacts during construction at this sensitive receptor (An Loc Temple) are primarily related to dust and noise generated during the dredging, pumping, and spreading of dredged material at the storage site, which may affect religious activities, especially during the Full Moon, the first day of the Lunar New Year, or other holidays.

Overall, the level of impact is assessed as **Low** because: (i) The dredged material is in liquid form, so it does not generate dust or noise. Dust and noise are mainly caused by leveling and compaction activities at the storage area and embankment construction areas No. 2 and 3 near An Loc Temple. Compaction activities are intermittent, using bulldozers and compactors, and the dispersion range is typically 50–100 m; (ii) No raw material transportation passes directly through An Loc Temple; (iii) Religious and belief activities occur only on the full moon, the first day of the lunar year, or holidays, not daily. This impact can be further mitigated through appropriate construction management measures.

vi. **Impacts on aquatic farming activities**

The existing status of the Northern, Western, and Southwestern areas of the Tam Quan storm shelter shows that there are about 80 households engaged in aquaculture (primarily shrimp farming), located 30–100 m from the dredging area. These are all ponds with solid banks, and cage or raft farming directly on the Tam Quan River is not used. Aquaculture activities mainly use natural water from the Tam Quan River or the Dai Ong Kheo River.

The mobilization of machinery for bank embankment construction, fairway dredging, and storm shelter anchorages does not pass through sections of the river where aquaculture activities are conducted. However, dredging of ship channels and storm shelter anchorages may pose potential risks to the water quality of the Tam Quan River due to the spread of pollutants (grease), suspended solids (TSS), and turbidity, which may affect aquaculture activities.

This impact can be controlled thanks to the technical specifications of the ponds and the existing water intake process. All ponds are constructed with solid banks and do not use cage or raft farming directly on the river. Construction activities only cause temporary disturbances to water intake into the ponds, usually lasting 4–7 days per crop (main water intake), depending on the volume and area to be supplied with water for each crop in the region, with an average of 2–3 crops per year depending on weather and water quality. In addition, pond water is periodically renewed every 2–4 weeks to ensure water quality in the pond, remove residues and impurities, and adjust salinity to suit shrimp growth requirements. Periodic water draws usually last from a few hours to one day, depending on the water volume needed for each pond and the flow rate.

Dredging is carried out along the length of the Tam Quan River within the subproject area, with a considerable dredging volume of 511,129 m³. The maximum increase in SS concentration at 50 m from the dredging center is approximately 150 mg/L compared to the background environment and decreases gradually with distance. According to the impact assessment of fairway dredging activities from several similar projects (ESIA Quang Nam Province Adaptive Urban Project, EIA Long Son Port Dredging Project in Thanh Hoa Province), after 1 hour, the dilution rate at 100 m from the source is 1/2, at 200 m is 1/5, and at 500 m is 1/10, corresponding to 75 mg/L, 30 mg/L,

and 15 mg/L, respectively. The increase in TSS concentration in the water affects aquaculture areas near the dredging site (30–100 m from the dredging location). The spread of turbidity pollutants may slightly or significantly affect water intake for aquaculture, potentially depleting feed in the water or causing shrimp mortality in the ponds.

On the other hand, the water intake process for shrimp/aquaculture in the project area has clear technical specifications, including treatment steps such as filtration, sedimentation, disinfection, and quality inspection to ensure the input water meets standards before entering the ponds. Specifically: (i) Shrimp/aquaculture water is taken from upstream of the Tam Quan River or upstream of the Dai Ong Kheo River during high tide; (ii) Water is channeled through a separate water intake channel from the drainage channel to avoid pathogen contamination; (iii) Water is pumped into a sedimentation pond or intermediate sedimentation tank through a 2-layer cotton filter bag 8–10 m long to remove debris, larvae, omnivorous fish, crabs, and snails; (iv) Water is allowed to settle for 3–7 days and disinfected with chemicals (Saponin/Chlorine/Benzalkonium chloride/Potassium); (v) After disinfection, water is aerated for at least 10 consecutive days to decompose chemical residues, chlorine residues are re-checked, then water is tested for pH, salinity, alkalinity, toxic gases, dissolved oxygen, etc., before slowly being channeled into the main ponds.

The ideal turbidity before stocking shrimp is approximately 10–20 mg/L. Therefore, construction timing can be controlled in advance to avoid water intake periods, and TSS can settle naturally if dredging activities are stopped for 4–6 hours under favorable conditions or 12–24 hours under less favorable conditions such as high waves and strong winds.

Overall, the impact on aquaculture activities in the area is assessed as **Low**, based on the following factors:

- (i) Current water quality in the sub-project area has shown TSS exceeding permissible limits
- (ii) Dredging lasts for 24 months and takes place over a wide area (fairway and mooring area), but construction is carried out in sections of 100–200 m, so impacts are localized at dredging locations;
- (iii) Impact occurs intermittently, only about 8 hours per day, with partial water recovery during the remaining time;
- (iv) Most ponds are located upstream of the dredging area (water is taken from upstream of the Tam Quan River or the upper Dai Ong Kheo River);
- (v) Ponds are surrounded by banks, water intake time depends on location (different tide levels), main water intake lasts about 4–7 days per crop, and periodic water intake lasts only a few hours to one day according to high tide, ensuring the best water quality;
- (vi) The water intake process removes impurities, reduces suspended solids, and limits risks from water sources to shrimp/aquaculture farming;
- (vii) Two weeks prior to dredging, the Project Owner/Contractor coordinates with local authorities to communicate detailed construction plans and discuss water intake timing with residents to ensure aquaculture activities are not interrupted.

This impact can be minimized through appropriate construction measures and reasonable dredging scheduling, avoiding overlapping with water intake periods for ponds in the project area.



Aquatic farming area near Tam Quan subproject

vii. Risk of embankment landslides due to extreme weather

The Tam Quan subproject will construct 5 embankments with a total length of 2,494 m. The top of the embankments varies in height from +2.2 m to +2.5 m (State system). The M400 reinforced concrete structure is 2.2–2.5 m wide, and the back of the embankment includes a cement concrete road structure 3.5 m wide.

The project area is typically affected by rains and storms from September to December each year. On average, the subproject is affected by 1–2 storms annually. Prolonged heavy rain can cause flooding and water surges during storms, impacting the construction and stability of the subproject embankments.

- Prolonged heavy rain increases groundwater pressure behind the embankment, washes away surface soil, and may cause embankment subsidence.
- Large storms and high tides may generate waves over the top of the embankment, causing landslides on the embankment crest and slopes.
- Waves and rising tides can erode the embankment crest, affecting structural stability and potentially causing embankment failure.

The risk of embankment landslides is assessed as medium because: (i) The number of annual storms affecting the subproject area is relatively low (1–2 storms/year); (ii) The embankment height of 2.2–2.5 m has been selected in accordance with topographic characteristics, climatic conditions, climate change considerations, and the 1/2,000 scale planning of fishing ports and anchorage areas for shelter from Tam Quan storms; (iii) The embankment foundation is 1.0 m thick, arranged in 2 layers of D30 box stone. The embankment body includes PVC 110 drainage pipes to drain water during heavy rains, reducing pressure from rainwater; (iv) Additionally, this impact can be mitigated by implementing construction restrictions during the rainy and stormy season from September to December, using rolling mats in sections, and constructing closed diaphragms to stabilize the embankment legs, body, crest, and top.



Location of embankments of Tam Quan subproject

viii. *Risks on house cracking/collapse due to piling process by the port embankment construction*

The pile driving will take place at five scattered quay sections along the Tam Quan River, designed to accommodate vessels seeking shelter during storms. Most of these locations are situated more than 50 meters away from residential houses or existing structures. However, quay sections 1A and 1B are located approximately 7–30 meters from residential houses, thus posing the risk on structural impacts—such as cracking or collapse—within a 5–30 meter radius.

For the Tam Quan sub-project, the area for pile driving to reinforce the quay footings (with 5 scattered quay sections at 5 different locations) along the Tam Quan River to accommodate ships/vessels for shelter during storms is located more than 50 meters away from residential houses or existing structures, except for quay sections 1A and 1B, which are located approximately 7–30 meters from residential houses, thus posing the risk of infrastructure impacts such as cracking or collapse within the radius of 5-30m. This risk was considered during the design phase, and the construction method was selected accordingly. Due to the limited space, the "pile driving" method was chosen over the "pile pressing" method. The geological conditions in the area are quite stable (as stated in Chapter 2). The pile depth is not large (7m), and the vibrating hammer used has moderate weight (usually under 20 tons), meaning the vibration impact is likely to be lower than initially forecast.

This risk was considered during the design phase, and the construction method was selected accordingly. Due to spatial constraints, the pile driving method was chosen over pile pressing. Fortunately, the geological conditions in the area are relatively stable (as detailed in Chapter 2), the pile depth is modest (7 meters), and the vibrating hammer used is of moderate weight (typically under 20 tons), which suggests that the vibration impact will likely be lower than initially anticipated.

The impact level is considered Significant due to the proximity of residential houses near the construction area (about 10 houses at a distance of 10m and 50–70 houses at a distance of 30m) within the affected radius of the pile driving activity. However, the project design includes a 3.5-meter-wide access road to the quay, with 1-meter shoulders on each side, which will be reinforced with a stable foundation and paved with asphalt/cement concrete. The pile driving will be intermittent and localized at each pile point. These impacts can be minimized through appropriate technical measures and efficient construction organization.

	
<i>Location of embankment section 1A – Tam Quan sub-project</i>	<i>Location of embankment section 1B – Tam Quan sub-project</i>

The risk of cracking or damaging the existing structures mentioned above is unlikely to occur if the contractor strictly follows the prescribed construction methods, implements appropriate ground reinforcement measures, and installs protective piles around the structures prior to commencing construction activities. In the event that such damage does occur, the contractor will be required to either reconstruct the affected structures or provide compensation, in accordance with agreements made with the property owners or the management units responsible for those structures.

4.3.3. Impacts and risks during operation phase

The sources of environmental and social impacts and risks during the operation of the Tam Quan storm shelter area stem from the following activities: (i) movements of ships and boats entering and leaving the Tam Quan storm shelter area; (ii) activities of operators, fishermen, and traders aboard vessels using the anchorage. Dredging and maintenance of ship channels and the waters in front of the port (typically conducted every two years) will be funded from separate sources during the port's operational phase; therefore, impacts and risks related to these activities will be assessed in a separate report at a later stage.

The common environmental and social impacts and risks during the operational phase of the Tam Quan storm shelter subproject include:

- Dust and air emissions from ship and boat operations at the mooring area
- Noise generated by ship and boat operations
- Wastewater discharge
- Solid waste generation
- Risks related to waterway traffic
- Degradation of surface water and coastal seawater quality due to intensive vessel activity at the anchorage
- Environmental risk incidents such as fires, explosions, oil spills, capsizing, and drowning.

Detailed assessments of these impacts and risks are as follows:

(i) Dust and air emissions

Dust and emissions during the operation of the Tam Quan storm shelter anchorage subproject mainly originate from the operation of vessels entering and leaving the anchorage area for storm shelter (approximately 1,200 vessels).

These emissions are primarily generated by onboard generators (using diesel oil) and exhaust from vessel chimneys, which release pollutants such as suspended particulate matter, carbon monoxide (CO), sulfur dioxide (SO₂), nitrogen dioxide (NO₂), and hydrocarbons (HC). The total emission load from vessels entering and leaving the anchorage is difficult to quantify precisely as it depends on daily vessel traffic, which is estimated at approximately 1,200 ships/boats.

Table 4.37.: Emission coefficients of pollutants of ships powered by diesel engines

(Unit: kg/day)

Mean of transport	Suspended dust	SO ₂	NO ₂	CO	HC
Motor ships	6,8	136S	90,7	0,036	4,1

Source: WHO, 1993

Applying the formula for calculating the pollutant load in exhaust gases arising from the operation of ships/boats:

$$\text{Pollution load (mg/m.s)} = \text{Pollution coefficient (kg/day)} \times \text{number of ships in a day} \times 1000 \\ (\text{average distance} \times 86,400)$$

In which: 1000 is used to convert the unit "km" to "m"; 86,400 is the conversion factor from "day" to "second"; the sulfur content (S) in DO oil is 0.05%; and the average travel distance is 2.5 km. Pollution loads calculated are as follows: SO₂ is 75.56 mg/m.s, NO₂ is 50.39 mg/m.s, CO is 0.02 mg/m.s, and HC is 2.28 mg/m.s.

Applying the formula for calculating the concentration of pollutants in the exhaust gas of ships/boats shows that the concentration of NO₂ exceeds the permitted standard specified in QCVN 05:2023/BTNMT – National Technical Regulation on ambient air, while SO₂, CO concentrations and concentrations at a distance of ≥ 10 m for HC and ≥ 30 m for dust are within the permissible limits.

The affected subjects, totaling about 120 people, include 20 workers operating the Tam Quan anchorage area and approximately 100 fishermen operating on boats entering and exiting the Tam Quan storm shelter area, as well as passengers and traders operating in the anchorage area.

The impact of this source of emissions is assessed as Low because: (i) The concentration is only greatest when all vessels gather at the anchorage for a short time to avoid the storm (the docking time can last from 30 minutes to 2 hours/time; every year, there are usually about 3–5 storms that make landfall in the area during the rainy season from September to December in Binh Dinh province), so it only affects the area for a short time; (ii) This source of emissions will gradually decrease when ships stop operating; (iii) This source of exhaust gradually dilutes into the air with fairly ventilated conditions on a large harbor with strong sea breezes.

(ii) Noise

The noise source is mainly from vessels when docking at the storm shelter area, from fishermen, guests/traders operating in the anchorage area. Maximum noise level forecast (taking into account the cumulative noise when many vessels enter and exit at the same time, for Tam Quan subproject is 1200 vessels) for vessels is in the range of 80–85 dBA, 1.06 to 1.13 times higher than QCVN 26:2010/BTNMT – National Technical Regulation on Noise (75 dBA for common areas).

Noise mainly affects workers working at the anchorage, fishermen and guests/traders, usually concentrated in a radius of about 10–20 m around the anchorage area and for a short period of time (can last from 30 minutes to 2 hours/time) and the peak is only 3–5 times per year, corresponding to the number of storms landing in Binh Dinh province.

The impact of noise from ships/boats and fishermen's activities at the Tam Quan storm shelter area is Medium because: (i) Boats usually anchor about 350 ships/boats daily and 1200 ships/boats during storms. Ships only return to shelter from storms for a short time and intermittently when there is a storm (about 30 minutes to 2 hours/time for each storm, and this area has about 3–5 storms on average every year). This impact can be mitigated by appropriate measures.

(iii) Wastewater generation

The source of domestic wastewater during the operation of the Tam Quan storm shelter area is from the activities of operators, fishermen and guests/traders. The Tam Quan storm shelter will meet the regional storm shelter anchorage for 1,200 ships.

- In case of a storm, a maximum of about 1200 ships will be gathered. However, all crew members are not allowed to stay on the ship and have to be relocated deep inland to avoid the storm, so domestic wastewater generated at these times is insignificant.
- In normal cases (about 350 ships moored daily): It is expected that the number of officers and employees operating the mooring area will be 20 people, and the number of visitors will be about 100 people (total number of people living in the mooring area per day is about 120 people).

According to the average daily per capita water supply standard published in TCXDVN 13606:2023 of the Ministry of Construction on water supply – pipeline network and works, the average daily water supply standard per capita is 40–60 liters/day. Taking an average of 50 liters/person/day, the total amount of water used for daily life is estimated for all seafarers at the port as follows: 50 liters/person/day × 120 people = 6,000 liters/day (6 m³/day). According to Decree No. 80/2014/ND-CP dated 06/8/2014 regulating water drainage and wastewater treatment, the amount of wastewater is calculated as 100% of the water volume consumption. Therefore, the amount of domestic wastewater discharged into the environment is 6 m³/day.

Thus, the total amount of domestic wastewater of ships during the anchorage period for storm shelter is 6 m³/day. During the storm sheltering period, although approximately 1200 vessels will be concentrated, due to the storm, in order to ensure the safety of the fishermen, all crew members will not remain on the vessels but will be relocated further inland for shelter. Therefore, the amount of domestic wastewater generated will be insignificant. Typical pollution parameters: organic compounds (BOD₅), COD, Ammonium, nutrients (total N, total P), suspended solids, microorganisms, total animal and plant oils.

Ballast water:

Ballast water is the water pumped into the ship's specialized tanks to maintain stability when the ship is not carrying cargo or to adjust the ship draft. The ballast water can be seawater, brackish water or fresh water, depending on the geographical location where the ship performs the water

refill operation. At riverside fishing ports, especially in areas near river estuaries, ballast water is usually brackish water or seawater due to the impact of tides and saltwater intrusion.

During the process of ballast water refilling, various species such as plankton, microorganisms, and larvae can be sucked into the water tank and move along the ship to other water bodies. The discharge of untreated ballast water can cause the spread of alien organisms, affecting the indigenous ecosystem and the water quality.

For small and medium-sized fishing vessels operating at Tam Quan subproject, the ballast water level can range from 10 to 50 m³. The ballast water is used by fishing vessels to ensure offshore operation and when harvesting seafood is often reused. With a scale of about 1200 ships under the Tam Quan subproject, each replacement will generate about 12,000 m³ to 60,000 m³ of ballast water. However, the ballast water does not need to be changed too frequently, and the inspection and maintenance of the ballast water tank is normally carried out periodically from 6 months to 1 year.

Domestic fishing vessels in Vietnam are typical small and medium in capacity, and do not operate in international waters, so they are not yet subject to the full mandatory provisions of the International Ballast Water Management Convention (BWM Convention). However, the discharge of ballast water still needs to comply with existing national regulations such as Decree No. 58/2017/ND-CP. According to regulations, the ballast water shall be discharged at least 200 nautical miles from the nearest shore and in waters with a depth of at least 200 m. In case the ship is unable to meet this condition, the ship may carry out a ballast water exchange at least 50 nautical miles from the nearest shore and at a depth of at least 200 m (quite far from the shore). In fact, fishing vessels often discharge ballast water individually and not simultaneously or at a fixed location, which helps minimize the risk of localized environmental impacts.

In general, the level of impact by wastewater from the operation of Tam Quan subproject is assessed as Low due to: (i) The amount of wastewater generated intermittently during the day and not large (maximum about 6.0 m³/day); (ii) Operators and fishermen, guests/traders are often locals, so the actual amount of wastewater generated is much lower than calculated; (iii) The existing Tam Quan fishing port area right next to the mooring area has a standard domestic wastewater collection and treatment system²², so this waste source will be controlled.

(iv) Generated solid waste

Conventional Solid Waste

Sources of waste generation during the operation of the project include:

- Domestic waste of about 20 officials and employees working at the operator's building; from about 100 passengers/trader. The forecast of the load incurred for subproject Tam Quan is as follows: According to the data of "Vietnam Environment Monitor 2004 - Solid waste", the average amount of waste per capita is 0.5 kg/day. With the number of officials, employees and guests is about 120 people. Thus, the total load of solid waste discharged in a day is about 60 kg/day (about 1,800 kg/month and 21,600 kg/year, respectively). The main ingredients include: fruit peels, leftover food, wastepaper, plastic bottles, and nylon.

²² Wastewater at Tam Quan fishing port and anchorage area is currently being collected to the wastewater treatment station at Tam Quan Bac Concentrated Seafood Processing Zone for standard treatment before being discharged into the outside environment.

- Waste from ships/boats: Solid household waste generated from vessels docking for shelter, with an estimated waste generation of around 12,000 - 15,600 kg per trip (at peak times when 1200 vessels are present, each offshore fishing trip typically lasts about 1 month, with each vessel generating around 10 - 13 kg per trip). The main components include: fruit peels, leftover food, paper scraps, plastic bottles, tin can shell, beer cans, plastic bags, etc. For offshore fishing vessels, each trip lasts nearly 1 month, and an average fishing vessel has 10 - 12 crew members who consume about 40 packs of bottled water, each pack containing 6 bottles of 1.5 liters. Therefore, each fishing vessel uses an average of 240 plastic bottles during a fishing trip²³.

Sensitive receptors: These types of domestic solid waste, if not collected and treated, will cause air pollution (due to the generation of foul odors), directly affecting operators, fishermen/guests (120 people), polluting the surface water of the Tam Quan River and affecting the general urban landscape of the area.

However, the impact of domestic waste is assessed as Low and can be mitigated because: (i) The amount of waste generated on the mooring area is not much and is collected daily by the service unit at the mooring area/port; (ii) the existing Tam Quan port area has a unit to collect and transport domestic solid waste to the gathering and treatment area of Hoai Nhon town to treat it, so domestic solid waste generated during the operation period will be controlled.

Hazardous waste: No hazardous waste is generated during the operation period for the Tam Quan storm shelter area.

(v) Deterioration of water quality of Tam Quan River due to the operation of vessels entering and exiting the storm shelter area:

Water quality of Tam Quan River may be degraded due to the operation of ships/boats (about 350 ships/boats daily and 1200 ships/boats in storms) entering and exiting the storm shelter area in the operation period due to: (i) 6.0 m³/day of domestic wastewater of operating workers and fishermen/guests operating at the anchorage; (ii) ballast water and machine cooling water containing grease (small amounts and not generated frequently); (iii) 1,800 kg/month of domestic solid waste and 12,000 – 15,600 kg/month of solid waste from ships/boats, etc. as considered and evaluated in the corresponding contents mentioned above.

The sediment dredging activity at the Tam Quan Sub-Project area to maintain the shipping channel is expected to be conducted periodically every 2 years, with an estimated dredging volume of approximately 500-700m³. This dredged sediment will be stockpiled at the designated disposal areas used by the subproject during the operational phase. Similar to the analysis and assessment of the impact on surface water quality during the construction phase due to dredging activities, the dredging of the shipping lane and mooring area will cause certain impacts on surface water and the aquatic ecosystem in the area due to increased turbidity, TSS, and bottom disturbances caused by dredging equipment (suction dredgers). With an estimated dredging volume of 500-700m³ per dredging operation (every 2 years), the impact is considered moderate and can be minimized.

In general, the impact on the surface water quality of the Tam Quan River from the operation of the Tam Quan storm shelter is long-term, but at a low level due to (i) the number of vessels entering and exiting the anchorage area daily is moderate (350 ships/day). In the peak case, there will be about 1200 ships in and out of anchorage, but this large number of ships usually only comes to

²³ According to a survey conducted by the Binh Dinh Provincial Fisheries Sub-Department.

shelter from storms for a short time and not continuously (about 30 minutes to 2 hours/time for each storm, and this area has about 3–5 storms on average every year); (ii) the existing Tam Quan fishing port area right next to the mooring area has a standard domestic wastewater collection and treatment system, so this waste source will be controlled; (iii) the lowest flow of Tam Quan River is about 55 m³/s and the average flow to Tam Quan estuary is 375 m³/s in the rainy and flood season; (iv) the Tam Quan storm shelter will be operated by the Fishing Port Management Board and Urban Services of Hoai Nhon town which has experience, so the control of the operation of ships/vessels. This impact can be controlled with appropriate measures.

(vi) Potential traffic incidents and risks

Waterway traffic accidents:

- Cause: During the operation of ships, shipwrecks, ship collisions or fire incidents of serious severity may occur. The number of vessels entering and leaving the Tam Quan storm shelter is not continuous. When a storm hits, the port will accommodate around 1,200 fishing vessels seeking shelter. However, these vessels will not all arrive at the same time; instead, they will be distributed over a period of 3 to 5 days, according to the instructions from the Maritime Administration. During the operation of ships, shipwrecks, ship collisions, or severe fire incidents may occur. The transportation of products through the port will increase the waterway traffics in the channel in front of the port, greatly affecting the load-bearing capacity of the channel, obstructing visibility. Such increase in waterway traffic density is expected to lead to a higher risk of maritime accidents and oil spills, significantly affecting surface water quality and the ecosystem in Tam Quan river at the port area. In addition, dirty water and domestic solid waste from vessels navigating the channels—especially in cases of collision where waste is not properly collected or treated—may leak and overflow into the sea and port areas. This will increase pollutant levels and negatively impact the surrounding ecosystems along the navigation routes.
- Scope of impact: When there is a waterway traffic accident, depending on the different severity, oil spills may occur, affecting the soil and water environment in the area, damaging to property of fishermen and port management authorities, and may even damage the lives of vessel operators and crew members.
- Impact level: Depending on the different severity, it can cause oil spills, affecting the soil and water environment in the area, causing property damage to fishermen. In general, the level of this impact is moderate, localized and controllable due to: (i) Tam Quan River at the Tam Quan storm shelter area with a width of about 250 m – 450 m. The remaining width of the existing Tam Quan River is still viable for local boats to travel; (ii) the area of the subproject is large (>100 ha), ensuring enough space to moor about 1000–1200 ships during the operation period, so it will not affect the mooring activities of ships/boats much; and (iii) applying good waterway and land traffic safety management during the construction period will be avoided, minimizing and mitigating impacts on traffic including traffic accidents, etc.

Risk of falling into the river and drowning:

- These cases are warned when going up or down the docks or when colliding with ships, people on board often lose their balance and may fall/fall/slide into the river, especially during rainstorms.
- Although the berths at Tam Quan storm shelter area are often designed with barriers and warning signs,... Fishermen/boat drivers are at risk of accidents falling into the river due to

slippery and drowning or in the rainy and flood season, traveling on boats/ships that are prone to slipping and slipping into the river. This affects the health and even the lives of participants, especially fishermen on the anchorage area. The design needs to be done to prevent threats to fishermen when using embankments on the anchorage. Therefore, this impact is Low and can be minimized.

(vii) Potential environmental incidents and risks

Environmental incidents caused by fire and explosion:

- Cause: As analyzed and forecasted above, the environment in the area contains petroleum vapor, so the potential for fire incidents is large when there is a high heat source, or due to an electrical short.
- Impact level: When there is a fire and explosion, it will cause damage to the project area in terms of people and property. The neighboring residential area is about 50–100 m from the project area, so it will also be likely to be affected. In general, this level of impact is low and can be controlled because the mooring area is mainly on the water and ships/boats will stop operating when entering the anchorage, so the risk of fire/explosion will also be minimal.

Oil spill incident:

- Causes: For the operation of Tam Quan subproject, the oil spill incident may be caused by: (i) Overturning of the transport vessel; (ii) Waterway traffic accidents; (iii) Spilling and leaking grease from fishing vessels entering and exiting the anchorage area.

When there is an oil spill, a mixture of oil and water quickly forms and spreads, through which the oil is gradually depleted by weathering, which is the result of a series of various physical and chemical processes, for example, the process of dispersing natural oil on the water surface by the wind, water flow, the process of settling oil into the water or, conversely, due to evaporation or the formation of an oil suspension floating on the surface of the water. This incident will cause harm to the natural environment and socio-economic activities in the region, specifically:

- Part of the oil products that settle and decompose at the bottom of the water source pollutes the water source by the dissolved products, and the part that floats up with air bubbles separating from the bottom of the water source. The oil-containing residue that accumulates at the bottom is a source of pollution to the river, affecting the bottom flora – the food of the fish.
- When the water source is contaminated with oil, the decomposition oil products reduce the water source's ability to clean itself because the plankton and benthic organisms involved in the process die or decrease in number.
- When oil is spilled into the water source, the amount of dissolved oxygen in the water will decrease due to the oxygen consumed for the oxidation of oil products; oil scum interferes with the process of clearing the water surface.
- Impact level: Depending on the different severity, oil spills affect the soil environment, regional water, and aquatic biological resources. In general, this level of impact is Medium because this risk is always latent to occur in the harbor at any time, especially during the rainy and flood season, which is prone to boat accidents and boat capsizing,... This risk can be mitigated by appropriate solutions such as providing a full range of waterway traffic safety warning equipment/means at the Tam Quan storm shelter area; organize waterway traffic reasonably, propagate to raise awareness with ship drivers, periodically inspect

ships/boats to detect risk of failure (if any). In addition, to minimize possible incidents, the project owner will have a plan to manage the operation of the vessel and have a response plan in the event of an oil spill.

(viii) Incidents caused by lightning strikes during rainstorms:

Ships moving to anchor to shelter from storms will be at risk of being struck by lightning due to thunderstorms and strong winds,... When struck by lightning, ships will be at risk of fire and explosion and lead to the risk of sinking the ship. The reason for the fire and sinking of the ship was due to thunder and lightning causing the communication system and radios on the means to emit a fire that caused the ship to burn.

When this incident occurs, it will cause certain damages to people and property. In general, this level of impact is Low because this risk is usually rare (only occurs during the rainy and stormy season) and is only localized at certain points due to the intensity of lightning. This problem is inevitable and can be mitigated with appropriate preventive measures.

4.4 KHANH HOA MAJOR FISHERY CENTER UPGRADING INVESTMENT SUBPROJECT

4.4.1. Impacts and risks during preparation phase

4.4.1.1. Land acquisition impacts

Land Acquisition Area

The upgraded construction area within the existing Da Bac Port includes an expansion of 9.66 ha, which is part of the available land within the port. Specifically: 9.64 ha of public-use land, 0.02 ha of non-agricultural production and business land.

The total land acquisition area for the **Khanh Hoa Subproject** is detailed in the following table.

No	Type of land	Code	Khanh Hoa subproject Unit: ha
I	Total Land Acquisition Area		9.66
1	Agricultural Land	NNP	
1.1	Land for agricultural production	SXN	
1.1.1	Annual crop land	CHN	
1.1.1.1	Rice cultivation land	LUA	
1.1.1.2	Land for other annual crops	HNK	
1.1.2	Land for perennial crops	CLN	
1.2	Forestry land	LNP	
1.3	Aquaculture land	NTS	
2	Non-agricultural land	PNN	9.66
2.1	Residential land	OTC	
2.1.1	Rural residential land	ONT	

No	Type of land	Code	Khanh Hoa subproject Unit: ha
2.2	<i>Land for specialized use</i>	CDG	9.66
+	Non-Agricultural Production and Business Land	CSK	0.02
+	Land for public use purposes	CCC	9.64
2.3	<i>River, Canal, Stream, and Waterway Land</i>	SON	
2.4	<i>Dedicated water surface land</i>	MNC	
3	Unused land	CSD	

(Source: Draft Resettlement Plan of the Project, 2024)

Number of affected households, organizations under the subproject: None

Impact on residential land: Not available

Impact on agricultural land:

- **Rice cultivation land:** Not available
- **Annual crop land:** Not available
- **Aquaculture ponds and lagoons:** Not available

Impact on Housing and Structures: Not available

Impact on Sensitive Facilities: Not available

Temporary Impact During Construction

Currently, more than **30 households** are engaged in marine aquaculture **20m – 200m** east of the project's dredging area, primarily farming lobsters and fish. However, this aquaculture activity is informal and not within the city's designated aquaculture zones. Additionally, unregulated aquaculture has been degrading surface water quality.

As a result, the Cam Ranh City People's Committee is developing a livelihood transition program to support affected households. Since these households invested in aquaculture before the project's approval, the project must include appropriate support measures and create opportunities for occupational transition.

During the construction phase, aquaculture production in adjacent areas within Cam Ranh Bay will experience temporary impacts. Approximately 30 households will be affected at varying levels, depending on the distance between their aquaculture farms and the dredging areas.

4.4.1.2. Safety Risks Related to Unexploded Ordnance (UXO)

The Khanh Hoa Subproject involves the renovation and upgrading of the existing Da Bac fishing port. Since UXO clearance activities have already been carried out, there are no potential safety risks related to unexploded ordnance for the subproject.

4.4.2. Impacts and risks during construction phase

4.4.2.1. General impacts and risks

(i) Impact on ambient air quality

❖ **Dust generated from demolition/site clearance activities**

According to the preliminary design explanation of the Khanh Hoa Subproject, since the project involves upgrading and expanding within the existing area of Da Bac fishing port, without any demolition of existing structures, the impact from this activity is considered insignificant.

❖ **Dust generated from backfilling, leveling activities**

According to the preliminary design explanation of the Khanh Hoa Subproject, the volume of excavation and filling for the project is small (approximately 6,012 m³). Based on the algorithms/formulas [1] mentioned above, the volume and dust concentration generated during construction at the worksite are determined as follows.

Table 4.38. Dust volume generated from earthwork, backfill activities

Subproject	Excavation volume (m ³)	Backfill volume (m ³)	Dust emission load (kg)	Expected backfilling time (month)	Dust emission load (kg/day).	Concentration (mg/m ³)	QCVN 05:2023 (mg/m ³)
Khanh Hoa subproject	6.012	6.012	1.170	6	4,28	0,13	0,3

The calculated dust concentration (average 1 hour) generated during the excavation and construction works, when compared to the permissible limits according to **QCVN 05:2023/BTNMT** (limit: **0.3 mg/m³**), shows that the dust concentration is **lower than the permissible limit**. The affected parties include the workers and the residents of the existing residential areas (the people in the **Cam Linh ward**).

In practice, the amount of dust dispersed is **not significant** compared to the calculations, as the construction time for different phases of the **Khanh Hoa Subproject** varies (primarily concentrated in the first **3-6 months** of the construction phase) and is not simultaneous. Furthermore, the dispersion of dust decreases rapidly with distance from the source, and mitigation measures discussed in subsequent chapters will minimize the impact on the surrounding air quality and local residents near the subproject areas. Therefore, the impact level is considered **low** and **mitigable**.

❖ **Dust and Emissions from Material and Waste Transport**

The transportation of materials and waste (such as cement, sand, fill soil, stone, steel, etc.) from supply areas to construction sites or the transport of excess solid waste from construction sites to temporary disposal areas will generate dust and emissions from the vehicles. The emissions mainly come from vehicle engines and include gases like **CO, SO₂, NO₂**.

For the **Khanh Hoa Subproject**, it is expected that **diesel-powered vehicles** with a **15-ton capacity** will be used on **urban roads**, traveling an average distance of **10-15 km** to the construction site or waste disposal area.

By applying **formula [3]** and input parameters such as the volume of materials, fill soil, etc., and the duration of transport activities, the **dust emission load (kg)** from the **Khanh Hoa Subproject** is determined in the following table.

Table 4.39. Dust load generated by the transportation of construction materials and backfill soil under Khanh Hoa subproject

Subproject	Mass of construction materials (tons)	Transportation duration (month)	Number of transport vehicle trips (trips/day)	Mass of backfill soil (tons)	Transportation duration (month)	Number of transport vehicle trips (trips/day)	Total of vehicle trips (trip/day)	Dust emission load (*) (mg/m/s)
Khanh Hoa subproject	67.154	36	21	8.417	12	1	2	0,031

Based on the dust load and emissions generated, applying the **SUTTON model (formula [4])** allows for the calculation of the average concentration of pollutants resulting from the transportation of materials and fill soil for the **Khanh Hoa Subproject** construction activities, as calculated below:

Table 4.40. Dust concentration generated by the transportation of construction materials and backfill soil under Khanh Hoa subproject

Subproject	X (m)	Dust concentration (mg/m ³)				QCVN 05:2023/BTNMT
		Z=1,5	Z=3	Z=5	Z=10	(mg/m ³)
Khanh Hoa subproject	10	0,1778	0,1686	0,1571	0,1501	0,3
	50	0,1598	0,1595	0,1586	0,1555	

According to the calculation results in the table above, the dust and gas emissions from the transportation of materials for the **Khanh Hoa Subproject** construction activities are all below the allowable limits of **QCVN 05:2023/BTNMT** (within 1 hour).

For the construction projects of **Khanh Hoa Subproject**, the volume of materials transported is large, with vehicle traffic ranging from over 20 trips/day (approximately 22 trips/day) throughout the 24-36 months of construction, and an average transport distance of 10-15km. Dust and gas emissions will directly impact households living along the main transport routes. However, the population density is not high. This direct impact is assessed as medium and can be mitigated.

✓ **Generated dust and gas emissions from waste transportation**

The transportation of waste includes: solid waste from demolition activities, excavated soil, debris from construction works (excess cement, mortar lime, broken bricks, scrap steel, cardboard, etc.), dredged materials from the boat channel, turning basin, and anchorage area of **Khanh Hoa**.

Similarly, by applying formula [3], the dust emission load (kg) from this activity is determined for each subproject as shown in the table below.

Table 4.41. Dust emission load from waste transportation

Subproject	Demolition volume (m ³)	Excavated soil volume (m ³)	Dredged volume (m ³)	Excavated soil volume reused for on-site filling (m ³)	Volume to be disposed of (m ³)	Transportation duration (month)	Number of transport vehicle trips (trips/day)	Dust emission load (*) (mg/m/s)
Khanh Hoa subproject	-	6.012	63.031	6.012	63.031	36	20	0,19

By applying formula [4] – the Sutton model with a wind speed of 1.6 m/s and an atmospheric stability class of B, at a distance of $x = 25\text{m}$ from the centerline of the road to both sides, the concentration of pollutants generated by the waste transportation activities of **Khanh Hoa Subproject**, and the dust concentration resulting from this activity are calculated as follows:

Table 4.42. Dust concentration generated from waste transportation

Subproject	X (m)	Dust concentration (mg/m ³)				QCVN 05:2023/BTNMT
		Z=1,5	Z=3	Z=5	Z=10	(mg/m ³)
Khanh Hoa subproject	10	0,2147	0,1932	0,1666	0,1502	0,3
	50	0,1729	0,1720	0,1700	0,1629	

Note: The calculation results above have considered the environmental background air conditions.

According to the calculation results in the table above, the dust and exhaust emissions from the waste transportation process generated by the construction activities of the **Khanh Hoa Subproject** are all below the allowable limits of QCVN 05:2023/BTNMT for a 1-hour period. However, dust and emissions from the transportation process may combine with dust and exhaust from daily traffic, along with hot weather, which could affect the health and daily activities of residents living along the main transportation routes (the distance from the roads to residential houses ranges from 5 to 100 meters). The impact will occur throughout the construction phase of the **Khanh Hoa Subproject**, decreasing until the project becomes operational. This impact is considered moderate and can be minimized with appropriate measures.

❖ *Dust from the gathering and unloading of materials:*

The materials unloaded primarily include: gravel, sand, cement, steel, etc., with the quantities expected as outlined in **Table 1.10 - Material Quantities**, Chapter 1. Based on the dust emission coefficient during the unloading process, the dust load from unloading the main materials for the **Khanh Hoa Subproject** can be calculated as follows:

Table 4.43. Dust load during the material loading and unloading process.

Subproject	Total mass of main materials (tons)	Total dust emission from material handling. (kg)	Dust emission load (kg/day).	Dust emission load (mg/m.s).
Khanh Hoa subproject	67,154	3602	3.34	115.97

Applying formula [5], the calculation results for the average dust concentration (mg/m³) generated during the material unloading process of the **Khanh Hoa Subproject** over 1 hour are as follows:

Table 4.44. Dust concentration generated during material loading and unloading

Subproject	X (m)	Dust concentration (mg/m ³)				QCVN 05:2023/BTNMT
		Z=1,5	Z=3	Z=5	Z=10	(mg/m ³)
Khanh Hoa subproject	10	0.254	0.181	0.166	0.160	0.3
	50	0.157	0.152	0.151	0.151	

According to the calculation results in the table above, the dust and exhaust emissions from the unloading process of materials generated by the construction activities of the Khanh Hoa Subproject are all below the allowable limits of QCVN 05:2023/BTNMT for a 1-hour period at distances over 10 meters. Therefore, the affected parties by this activity are the workers involved in the construction and residents living within the project areas, within a radius of less than 10 meters. The impact is considered low and can be minimized with appropriate measures.

❖ *Exhaust emissions from vehicles transporting materials and waste*

The transportation vehicles, as well as machinery and equipment used for construction, primarily use DO oil, which will generate pollutants containing products from the combustion process of internal combustion engines such as NO_x, SO₂, and CO. These exhaust emissions are from mobile sources, so they will directly impact people participating in traffic on the transportation routes, spreading into the surrounding air, affecting workers and residents near the construction site of the subproject. The parameters regarding the number of vehicles, transportation distances, and fuel consumption of the Khanh Hoa Subproject are presented in the table below.

Table 4.45. Fuel consumption from transportation of excavated soil and earthwork

Subproject	Expected time (months)	Total trips (trip/day)	Distance (km)	Fuel consumption (kg/day)	Generated SO ₂ (mg/m.s)	Generated NO ₂ (mg/m.s)	Generated CO(mg/m.s)
Khanh Hoa subproject	36	17	15	56.58	0,0885	0,4870	0,2479

Due to the relatively low amount of emissions, to assess the impact of this activity on the surrounding air quality, the Sutton model (Formula [4]) is applied to calculate the concentration of pollutants in the exhaust according to distance (x) and height (z) from the emission source, with CO being the highest concentration. The calculation results show that the concentration of exhaust emissions from transportation activities meets the QCVN 05: 2023/BTNMT - National Technical

Regulation on Ambient Air Quality.

Therefore, the impact level is low. Emissions are considered small, and the gases tend to disperse quickly into the surrounding environment, resulting in a rapid decrease in concentration. While the impact of exhaust emissions is minor, mitigation measures are necessary to control health effects for workers involved in the construction process.

❖ *Dust and emissions from construction equipment operations*

Similarly, to calculate the emissions (CO, NO₂, SO₂) from the operation of machinery and equipment during construction, such as excavators, bulldozers, mixers, pile drivers, etc., which use diesel fuel, the number of machinery units and fuel consumption requirements for the Khanh Hoa subproject are provided in the following table:

Table 4.46. Diesel oil demand for construction machinery and equipment

Machinery and equipment	Khanh Hoa subproject	Fuel consumption per shift (diesel liters)
25T vibratory roller	75	40.32
110 HP motor grader	18.3	38.88
Excavator ≤ 0.8 m ³	1049	64.8
8.5T steel wheel roller	354	24
Bulldozer ≤ 110 CV	6.89	54.6
7T dump truck	26.3	25.5
Water spraying truck 5 m ³	59.8	22.5
<i>Total DO use (liter/hour)</i>	<i>14.1</i>	
<i>Maximum diesel oil (DO) consumption (kg/h) (DDO = 0.85kg/liter)</i>	<i>12.00</i>	

Noted: The density of diesel oil (DO) is 0.85 kg/L; Source: WHO, 1993.

Applying formula [6], the pollution load of dust and gas emissions from fuel combustion activities of construction machinery is calculated as follows:

Table 4.47. Dust and gas emissions from fuel combustion activities of construction machinery.

Gas emissions (g/s)	Emission factor (g/kg DO)	Khanh Hoa subproject
SO ₂	20*S	0.0691
NO ₂	2.84	0.0098
CO	0.71	0.0025
Dust	0.28	0.0691
VOC	0.035	0.0691

Where: S is the sulfur concentration in the fuel (0.25%).

Applying Formula [4] - the Sutton model with a wind speed of 1.6 m/s and a distance of 5-10 m from emission sources, the concentration of emissions from construction machinery and equipment complies with QCVN 05:2023/BTNMT - National Technical Regulation

Table 4.48. Concentration of emissions generated by construction equipment.

Subproject	SO ₂ concentration (mg/m ³)	NO ₂ concentration (mg/m ³)	CO concentration (mg/m ³)
Khanh Hoa subproject	0.0012	0.0053	0.00022
QCVN 05:2023 one hour on average (mg/m³)	0.35	0.2	30

Overall, the concentration of emissions generated by construction vehicles on-site is not high and remains within the allowable limits of QCVN 05:2023/BTNMT. The primary affected subjects are construction workers on-site and nearby residential areas, such as communities living close to the construction site. The impacts are localized within a radius of approximately 50–100 meters from the construction site. The direct impact lasts throughout the construction period but mainly occurs for about 8–10 hours per day and is not continuous. Therefore, the impact is assessed as MINOR and can be mitigated.

(ii) Impact of noise

During the construction phase of the subprojects, noise is mainly generated from the following sources: transportation of construction materials and surplus solid waste; construction and demolition activities of the subprojects; and the operation of construction equipment on-site, such as pile drivers, concrete vibrators, excavators, bucket excavators, grab dredgers, trucks, etc.

Table 4.49. Noise level generated by machinery and equipment during construction phase

No	Machinery and equipment	Noise level (dBA) 1.5m from source
1	Bulldozer	93
2	Compactor (road roller)	72 – 74
3	Excavator	72 – 84
4	Dredging excavator	72 – 93
5	Grader	80 – 93
6	Concrete mixer	75 – 88
7	Concrete pump	80 – 83
8	Concrete vibrator	85
9	Generator	72 – 83

(Source: United States Environmental Protection Agency – Noise from Construction Equipment and Building Machinery NJID, 300.1, 12/31/1971)

Applying formulas [10] and [11], noise levels will gradually decrease with distance. The maximum noise levels at different distances due to construction equipment operation are presented in the

Table below.

Table 4.50. Maximum noise level by distance

No	Machinery and equipment	Noise level at 1.5m from the source (dBA)	Noise level at 15m from the source (dBA)		Noise level at 30m from the source (dBA)		Noise level at 50m from the source (dBA)		Noise level at 100m from the source (dBA)		Noise level at 200m from the source (dBA)	
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
1	Bulldozer	93	73.0		67.0		62.5		56.5		50.5	
2	Compactor (road roller)	72-74	52.0	54.0	46.0	48.0	41.5	43.5	35.5	37.5	29.5	31.5
3	Excavator	72-84	52.0	64.0	46.0	58.0	41.5	53.5	35.5	47.5	29.5	41.5
4	Dredging excavator	72-93	52.0	73.0	46.0	67.0	41.5	62.5	35.5	56.5	29.5	50.5
5	Grading machine	80-93	60.0	73.0	54.0	67.0	49.5	62.5	43.5	56.5	37.5	50.5
6	Concrete mixer	75-88	55.0	68.0	49.0	62.0	44.5	57.5	38.5	51.5	32.5	45.5
7	Concrete pump	80-83	60.0	63.0	54.0	57.0	49.5	52.5	43.5	46.5	37.5	40.5
8	Concrete vibrator	85	65.0		59.0		54.5		48.5		42.5	
9	Generator	72-83	52.0	62.5	46.0	56.5	41.5	52.0	35.5	46.0	29.5	40.0
QCVN 26:2010/BTNMT (6-21h)			70 dBA									

According to the above calculations, the noise levels at a distance of 30m from construction vehicles and equipment remain within the allowable limit (<70dB). Noise levels decrease as the construction activities move farther from affected areas. Among the noise sources, the most significant is the mobile noise generated by transportation vehicles carrying construction materials through residential areas.

The primary impacts of noise affect construction workers, residents living near the project site, and those along the transportation routes. High-intensity noise can negatively impact health, leading to sleep disturbances, fatigue, and psychological discomfort. It can also reduce work productivity on-site, causing decreased concentration, which increases the risk of occupational accidents.

Sensitive receptors affected by noise in the Khanh Hoa subproject include construction workers and the existing residential area in Cam Linh ward.

However, based on the noise level calculations, the impact at construction sites is considered LOW and occurs over a short period. The equipment operates in phases, not simultaneously, and is used depending on the progress and workload of different construction components, resulting in minimal cumulative noise at any given location. Additionally, all vehicles and equipment undergo regular inspections, and noise emissions will cease once construction is completed. Noise can be mitigated through measures such as providing workers with protective equipment and noise-reduction devices.

(iii) Impact of vibration

Vibration mainly originates from high-power equipment operating frequently on-site, such as bulldozers, excavators, and air compressors, as well as from activities like ground leveling and pile driving for embankment/port reinforcement.

Table 4.51. Vibration levels of some typical construction equipment

No.	Type of machinery/equipment	Reference vibration levels (Vertical direction, dB)
1	Soil excavator	80
2	Bulldozer	79
3	Heavy truck	74
4	Roller	82
5	Air compressor	81

(Source: U.S. Environmental Protection Agency – *Vibration from construction equipment and machinery*, NJID, 300.1, 31 – 12 – 1971)

Applying formula [9] to predict the vibration attenuation over distance that may occur within the construction site of Khanh Hoa subproject, the results are presented below.

Table 4.52. Vibration attenuation over distance in construction.

No	Equipment	Source vibration ($r_0=10m$)		Vibration 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	Soil 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

QCVN27:2010/BTNMT, The permissible level is 75 dB from 6:00 to 21:00, and the baseline level from 21:00 to 6:00..

DIN 4150, 1970 (German Standard): 2mm/s: No damage, 5mm/s: Plaster detachment, 10mm/s: Potential damage to load-bearing elements, 20–40mm/s: Damage to load-bearing elements.

According to the calculation results in the Table above, the vibration levels of construction vehicles and equipment at a 12m distance are all within the permissible limits of QCVN 27:2010/BTNMT (<75dB) and will decrease as the affected location moves farther from the vibration source. The primary impact of construction equipment vibration is directly on workers at the construction site. However, vibration effects should be noted in construction areas near residential zones, although the impact remains low.

Overall, direct vibration impacts are assessed as MINOR due to the non-continuous operation of equipment, localized impact at construction sites, shift-based operation of machinery, and the

provision of protective gear for workers. Vibration impacts can be mitigated through the application of appropriate construction methods and planning for each specific project site.

Impact on vibration to current structures by the port embankment construction activities:

Khánh Hoà sub-project will use the bored pile method to reinforce the quay footings and port docks. Specifically, it is expected that reinforced concrete bored piles of D800, with lengths ranging from 17 to 19m, will be used. The bored pile method has the significant advantage of not generating significant vibrations, thus minimizing the risk of impacting surrounding existing structures or constructions.

(iv) Wastewater Generation

Domestic Wastewater from Workers:

The Khanh Hoa subproject is expected to employ approximately 120 workers over a 36-month construction period. According to the water supply standard of 100 liters/person/day (Source: QCVN 01:2021/BXD – National Technical Regulation on Construction Planning), the estimated water supply standard for workers not residing on-site is 50 liters/person/day. The total amount of domestic wastewater generated during the construction phase of the Khanh Hoa subproject is as follows:

Table 4.53. Domestic wastewater generated at each subproject

Subproject	Number of workers (people)	Construction time (month)	Domestic wastewater (m3/day)	Total generated wastewater (m3)
Khanh Hoa subproject	120	36	6	6.480

Domestic wastewater contains components such as total suspended solids (TSS), organic matter (BOD₅, COD), nutrients (N, P), and pathogenic microorganisms.

The amount of pollutants discharged daily by 1,200 workers (calculated based on the maximum number of workers that may be mobilized at the campsite) and the concentration of pollutants released into the environment are provided in the Table below.

Table 4.54. Pollutant Load in Domestic Wastewater

Pollutant	Pollution Coefficient (g/person/day)		Pollutant load (kg/day)		Pollutant concentration (mg/l)		
					Before treatment	QCVN 14:2008 /BTNM T Column B	
BOD ₅	45	54	5,4	6,48	642,9	771,4	50
COD	72	102	8,64	12,24	1028,6	1457,2	-
TSS	70	145	8,4	17,4	1000	2071,5	100
Grease	10	30	1,2	3,6	142,9	428,6	20
Total Nitrogen	6	12	0,72	1,44	85,8	171,5	50
Ammonia (N-NH ₄)	2,4	4,8	0,288	0,576	34,3	68,6	10

Pollutant	Pollution Coefficient (g/person/day)		Pollutant load (kg/day)		Pollutant concentration (mg/l)		
					Before treatment	QCVN 14:2008 /BTNM T Column B	
Phosphor	0,8	4	0,096	0,48	11,5	57,2	10
Total Coliforms	1,00E+06	1,00E+09	1,2E+05	1,2E+08	1,4E+07	1,4E+10	5000 (MNP/1 00ml)

The pollutant load and pollutant concentrations such as BOD, COD5, TSS, NH₄⁺, etc., in domestic wastewater during the construction phase of subprojects, if left untreated, all exceed the permissible limits of QCVN 14:2008/BTNMT (Column B). Therefore, if domestic wastewater is not adequately treated before being discharged into the receiving body—the coastal waters of Cam Ranh Bay—the concentration of pollutants will increase, leading to a decline in coastal water quality. Aquatic species will be directly affected due to a reduction in dissolved oxygen levels (this aspect will be specifically assessed in a later section).

Additionally, wastewater containing a high concentration of pathogenic microorganisms poses a risk of developing skin diseases, eye infections, gastrointestinal disorders, and other infectious diseases among construction workers. However, the impact is assessed as LOW due to the following reasons: (i) wastewater generation is intermittent throughout the day; (ii) local laborers and rented accommodations reduce the actual wastewater volume significantly compared to calculations; (iii) the impact duration extends throughout the construction phase and beyond. Appropriate mitigation measures can be implemented to minimize these risks.

Construction Wastewater:

Construction wastewater primarily originates from washing construction equipment, tools, and vehicle cleaning at the Khanh Hoa subproject site. At the construction site of the precast yard, one vehicle washing station is set up. Wastewater is generated from washing transport vehicles and cleaning concrete mixing equipment at the construction site, with cleaning activities conducted once at the end of each working day.

Mechanical vehicle washing mainly involves cleaning the tires before exiting the site. According to TCVN 4513-1988 (Standards for Internal Water Supply - Design Standards), the standard water consumption for washing an entire vehicle is 500 liters per wash. However, during the construction phase, only the tires are cleaned, with an estimated water consumption of 100 liters per vehicle. The number of transport vehicles used in the Khanh Hoa subproject is estimated at 22 per day, leading to an estimated water usage for vehicle washing of 100 liters/vehicle, resulting in a total wastewater volume of: $22 \times 100 = 2200$ liters/day = 2.2 m³/day.

The primary components of construction wastewater include suspended solids, soil, sand, and oil/grease. If not collected and treated before being discharged directly into the East Sea, it could lead to several negative impacts on the coastal water quality of Cam Ranh Bay. A high concentration of suspended solids increases water turbidity and reduces oxygen diffusion from the air into the water, thereby negatively affecting aquatic life.

This impact is considered localized at the construction site (Da Bac Port). Moreover, construction wastewater generation is intermittent. The affected entity is the coastal water quality in the Da Bac

Port area within Cam Ranh Bay. However, as this is an existing port area, the coastal water quality has already been affected by previous port activities. Therefore, the impact is assessed as LOW and can be mitigated.

Rainwater Runoff:

According to TCVN 7957:2008, the rainwater runoff volume across the construction areas of the Khanh Hoa subproject is calculated using formula [10], with the results presented as follows:

Table 4.55. Rainwater runoff through construction site

No	Description	Rainwater drainage basin area (ha)	Flow coefficient	Flow rate (m ³ /day)
2	Khanh Hoa subproject	0.5	0.2	1.43

The total volume of rainwater runoff generated at Khanh Hoa subproject is approximately 1.43 m³/s. According to WHO (1993), the pollutant concentration in rainwater runoff is about 0.5 - 1.5 mg N/l, 0.004 - 0.03 mg P/l, 10 - 20 mg COD/l, and 10 - 20 mg TSS/l. These parameters are lower than the permissible limits specified in QCVN 40:2011/BTNMT - National Technical Regulation on Industrial Wastewater Quality.

Rainwater runoff from the construction site carries various materials, including loose soil and stone, surface minerals, and leaked oil and grease, increasing the concentration of suspended solids, organic matter, turbidity, and oil content in the water. This degrades water quality and negatively impacts aquatic ecosystems in the rivers and canals receiving the runoff at each project site. Pollutants from surface runoff may also affect water quality and marine life in the coastal waters of Cam Ranh Bay, particularly around Da Bac Port and the storm shelter anchorage area, as increased turbidity can impact aquatic species by hindering respiration and photosynthesis.

The impact occurs mainly during the rainy season in Khanh Hoa Province, from September to December. However, the direct impact of rainwater runoff is assessed as MEDIUM due to the following reasons: (i) Construction sites are regularly cleaned by workers, reducing the amount of loose debris and soil carried by runoff. (ii) Each construction site is equipped with a rainwater drainage system. (iii) Most offshore construction activities take place during the dry season, with a short construction period.

Therefore, the impact of rainwater runoff can be mitigated through appropriate technical and management measures.

(v) Solid Waste Generation

Construction Solid Waste:

Construction solid waste mainly consists of excavated soil debris, excess dredged material, packaging materials, metal scraps, and steel fragments at the site. The composition includes common solid waste and construction debris. The estimated amount of construction solid waste generated at Khanh Hoa subproject is presented in the following **table**:

Table 4.56. Volume of Solid Waste Generated from Construction Works

Subproject	Demolition volume (m ³)	Excavated soil volume (m ³)	Dredged volume (m ³)	Volume of Excavated Soil/Dredged Sand Reused On-Site(m ³)	Volume to be disposed of (m ³)
Khanh Hoa subproject	-	6.012	63.031	6.012	63.031

(Source: Cost estimate for project basic design, 2023)

The volume of excavated soil generated by the Khanh Hoa subproject is relatively small, amounting to 6,012 m³, and will be entirely reused for on-site filling.

The volume of dredged material from the Khanh Hoa subproject is expected to be moderate at approximately ... m³. Monitoring results of sediment in the project area indicate that the dredged sludge does not show signs of contamination by heavy metals or organic substances. The dredged material consists mainly of sand (from coastal and estuarine areas), making it suitable for use as filling material for the project and other areas requiring land leveling or backfilling. This dredged material is expected to be transported to a temporary disposal site and may be auctioned as a mineral resource in the future, following applicable regulations.

A small amount of construction debris will be generated during the implementation of the subprojects, including excess lime mortar, wood scraps, broken bricks, etc. Additionally, after construction, certain solid waste materials such as scrap steel and cement bags may be produced. However, these materials hold reuse value and can be recovered for reuse or sold to interested parties, thereby minimizing their release into the environment.

If not properly managed, these solid wastes could obstruct construction activities, increase dust levels in and around the construction site, and negatively impact workers and nearby residents.

Sensitive residential areas and affected entities are listed in the table below.

With the estimated amount of construction solid waste generated, failure to properly collect, store, and dispose of it could impede water flow during construction, leading to flooding and clogging of drainage channels at Lach Hoi fishing port and the existing storm shelter anchorage.

Overall, this direct impact is assessed as medium due to: (i) The large and localized volume of waste generated at the dredging site of the storm shelter anchorage; (ii) The moderate dredging duration (approximately 12 months); (iii) The construction solid waste will be collected and transported by waterway to a temporary disposal site approved by local authorities; (iv) Most of the dredged material (mainly sand) can be repurposed as a resource (construction sand, fill sand) through future resource auctions. Additionally, this impact can be mitigated through appropriate minimization measures.

Domestic Solid Waste

Domestic solid waste is generated from the daily activities of construction workers at temporary camps. It mainly consists of biodegradable organic matter and non-biodegradable materials such as plastic bags, bottles, and old personal items. The average domestic solid waste generation rate is approximately 0.5 kg/person/day (based on QCXDVN 01:2021/BXD – National Technical Regulation on Construction Planning issued by the Ministry of Construction, applied for grade III cities). With an estimated workforce of 120 workers for the Khanh Hoa subproject, the amount of

domestic solid waste generated is calculated as follows:

Table 4.57. Daily waste generation at construction sites

Subproject	Number of workers (people)	Total construction time (month)	Domestic waste (kg/day)	Domestic waste (ton/month)	Total domestic waste generated (ton)
Khanh Hoa subproject	120	36	60	1,8	64,8

According to the above Table, the total amount of domestic solid waste generated at the Khanh Hoa subproject is approximately 60 kg/day. With a construction period ranging from 24 to 36 months, the total domestic solid waste generated at the site is estimated to be around 64.8 tons. This waste consists of organic matter, various types of paper scraps, nylon, plastics, metals, and damaged daily-use items. It contains 60–70% organic matter and 30–40% other materials and may harbor a significant number of bacteria and pathogens.

If not collected and treated properly, the generated domestic waste could negatively impact the aesthetics of the area and affect the operation of the existing Da Bac fishing port. When waste is improperly discarded on the soil surface, exposure to weather conditions and bacterial activity leads to the decomposition of organic compounds, producing foul odors that pollute the air, increase the risk of disease outbreaks, and affect the health of workers, nearby residents, and surrounding facilities. Additionally, if not collected and treated, domestic solid waste could be washed away by rainwater runoff into the coastal waters of Cam Ranh Bay near Da Bac Port, deteriorating water quality and affecting the aquatic ecosystem.

However, the impact of domestic waste is assessed as "**MINOR**" and can be mitigated due to the following factors: (i) The amount of waste generated at the site is not substantial and is collected daily by construction workers. (ii) Waste generation is localized at specific construction sites. (iii) The contractor employs local labor to minimize domestic waste generation. (iv) Worker camps are situated away from residential areas and Da Bac Port, where an existing waste collection and treatment service is operating efficiently.

Hazardous Waste

Hazardous waste generated during the implementation of the subprojects includes: (i) Oil-contaminated materials from construction machinery maintenance. (ii) Discarded asphalt from roadwork and asphalt containers. (iii) Packaging waste such as used oil drums, asphalt barrels, fuel containers, and paint cans. (iv) Welding rod stubs. (v) Batteries, fluorescent bulbs, and ink cartridges from office activities at the construction site.

The quantity of hazardous waste depends on the number of equipment/machinery, workforce, and volume of construction materials used.

If vehicle and equipment maintenance is conducted on-site, it will generate oil sludge, used oil containers, and oil-contaminated rags, estimated at approximately 5 kg/month per construction site. If not properly collected and treated, these wastes could degrade the landscape and pollute surface water and groundwater in the project area. The project owner will implement appropriate hazardous waste collection and disposal measures to minimize environmental impact. All equipment and vehicle repairs will be conducted at specialized repair centers.

The amount of waste from used oil drums, asphalt barrels, fuel containers, and paint cans is relatively small (about 10–30 kg/month per construction site). However, if not collected, these

wastes could affect the landscape and pose potential risks of soil and water contamination.

Welding rod stubs are generated from steel frame fabrication activities. The estimated waste rate is 5–7% of the total welding rod volume, with approximately 5.0 kg of welding rod stubs expected to be collected at the Khanh Hoa subproject site. However, this waste is infrequent and minimal and will be collected and stored at designated hazardous waste collection points in accordance with regulations.

Additionally, a small amount of hazardous waste will be generated from office activities, estimated at **5–7 kg/month**.

If not collected properly, hazardous waste can cause the following impacts:

- (i) Oil and grease contamination in water bodies, directly affecting marine life near Da Bac Port, hindering growth, development, and potentially causing mortality among aquatic species.
- (ii) Heavy metals entering the food chain, accumulating in seafood, and posing health risks to humans.

Although the amount of hazardous waste generated at each construction site is relatively small, localized, and limited to the construction period, it will be collected, managed, and disposed of in compliance with hazardous waste regulations. Therefore, the direct impact is assessed as **medium** and can be mitigated through proper management and disposal measures tailored to the project's characteristics.

Surface Water Quality Degradation

Degradation of Surface Water Quality

Runoff rainwater flowing through excavated soil areas may carry soil particles, sand, and other waste into receiving water sources, increasing water turbidity. Additionally, runoff from fuel storage areas or uncovered vehicle repair zones may wash away oil, grease, and other hazardous waste into water sources, leading to pollution. As discussed earlier, domestic wastewater from worker camps at the construction site may also contribute to water pollution by increasing organic content (BOD), nitrogen, and pathogenic microorganisms. The degradation of surface water quality will negatively impact aquatic life, as discussed later, and affect water users.

Dredging of the navigation channel and turning basin will involve an estimated dredging volume of ... m³. Dredging along riverbanks or coastal areas for port and wharf construction can significantly impact the quality of river and coastal waters. The turbidity (T) and total suspended solids (TSS) levels in river and coastal waters will increase due to water column disturbance from dredging activities. Oil and grease levels may also rise if leaks occur from barges and dredging equipment, as discussed below.

Increased Turbidity and TSS from Dredging Activities

Dredging processes cause water turbidity in the dredging area due to sediment disturbance, dispersion, and suspension in the water. Turbidity levels in river and coastal waters at subproject sites may increase due to dredging for the following reasons:

- Bottom sediment is stirred up and diffused from the river or seabed into the water column.
- Sediment spills during the movement of dredging buckets from the river/seabed to the water surface.
- A small portion of dredged material may fall off the bucket during transfer to barges.
- Leachate from wet dredged material may return to the river/sea at the subproject site.

Sediment Spillage: According to the River/Marine Dredging Assessment Handbook²⁴, when using suction dredgers, grab buckets, cutter suction dredgers, or barges, dredging 1m³ of sand results in a loss of 0.3–0.4 kg of silt and sand. This lost sand will distribute evenly along the dredged area, increasing water turbidity before settling back to the river or seabed.

Sediment Dispersion: The extent to which disturbed bottom sediment disperses and spreads (thus affecting turbidity) mainly depends on seabed geological composition and dredging methods. For example, turbidity levels will be lower when dredging sand layers than when dredging sandy silt layers. Additionally, using grab buckets causes higher turbidity than suction dredgers.

The dispersion of silt in river and marine waters is the primary cause of increased total suspended solids (TSS). Sand particles sink quickly due to gravity and settle at the river or seabed within a short period. Consequently, silt and sand may temporarily increase turbidity but will not significantly contribute to long-term TSS levels. Increased TSS directly affects the ecosystem at the dredging site by reducing light penetration in water, limiting photosynthesis in aquatic plants (algae, moss), restricting growth and reproduction, and altering aquatic habitats. However, ecosystems at port construction sites generally have low biodiversity, consisting mainly of existing ports with frequent vessel activity in coastal waters. Therefore, the impact level is minimal and can be mitigated through appropriate construction measures.

Oil and Grease

Certain amounts of fuel and oil will be stored on barges and other dredging vessels. Some lubricants may also leak onto the surface of barges during operations. Rainwater may wash leaked oil and grease into river and coastal waters near dredging areas, turning basins, and ports, impacting water quality. However, this risk is assessed as low and manageable since fuel is typically stored in sealed containers, and fuel volumes on barges are generally limited. The concentration of heavy metals in river and marine sediment is low and within permissible limits, so there is no concern regarding the release of heavy metals into the water column during dredging.

(vi) Impacts on Ecological Environment

As discussed earlier, wastewater and runoff from worker camps and construction sites, as well as dredging activities, may increase water turbidity, organic content (represented by BOD), nitrogen, and oil/grease in receiving water sources. Increased water turbidity will block sunlight from reaching aquatic plants, reducing photosynthetic activity. Higher suspended solids in water can affect the respiratory systems of aquatic animals. The decomposition of organic matter will reduce dissolved oxygen levels in water, impacting aquatic life. Oil, grease, and other hazardous substances may be harmful or lethal to aquatic flora and fauna. Therefore, wastewater from construction sites must be properly managed, particularly in areas with significant fisheries resources. Potential impacts from dredging and disposal of dredged material on aquatic life will be further discussed at specific project locations.

Dredging disrupts coastal water quality and flow, affecting marine and aquatic vegetation and wildlife in various ways, as discussed below.

Impact on Phytoplankton: Increased turbidity and suspended solids from dredging reduce sunlight penetration into the water, limiting phytoplankton photosynthesis, growth, and nutrient absorption—critical to the aquatic ecosystem. Some phytoplankton may be carried away with dredged material or damaged by dredging equipment. After dredging, the remaining phytoplankton

²⁴ Japan Ministry of Transport 1982.

will continue to grow and spread, allowing the ecosystem to recover relatively quickly. Additionally, since silt typically settles within 15 minutes after dredging stops and the affected area ranges from 500m to 600m in radius, the impact on phytoplankton is temporary and limited in scope. The photosynthetic and respiratory capabilities of many species can recover as pollutant concentrations (turbidity, TSS) decrease.

Impacts on zooplankton: Some benthic organisms will be removed along with the mud/sand layer from their habitats during dredging activities. Others may die as their habitats are destroyed due to dredging operations. This impact is unavoidable, mainly affecting the benthic layer within the dredging corridor, and natural recovery may occur after about one year (Prussian et al., 1999)²⁵.

Potential impacts on fish, shrimp, and aquatic species in rivers/seas: Increased water turbidity and suspended solids may hinder the respiration of aquatic species in rivers and seas. CH₄ and H₂S²⁶ released from disturbed bottom sediments can adhere to the gills, obstructing their respiration. However, fish and shrimp tend to react immediately when their habitat is disturbed, swimming away as soon as dredging begins. Therefore, the potential impact of mortality due to habitat changes during dredging is minimal. However, if oil or grease spills into the water during construction, it could pose an acute toxic threat to aquatic species and accumulate in the food chain, from lower-level organisms (algae, phytoplankton) to higher-level aquatic animals (fish, etc.)

Overall, the potential impact of dredging at port/ship channel locations within the subprojects is not expected to cause significant effects on the river/marine aquatic ecosystem. As described in Chapter 2, these ecosystems are generally poor and not diverse due to existing port operations and human exploitation. Since the dredging takes place in the existing port area, it is assessed that there will be no impact on the current aquatic species. The benthic habitat will be most affected; however, the impacted areas are limited to the dredging corridor and depth. This potential impact is reversible, as benthic habitats and ecosystems can naturally recover within 12–18 months after dredging. Partial disturbance to the benthic habitat and reduction in some benthic populations are not expected to significantly affect the food chain within the river/marine ecosystem. The potential impacts of dredging can be managed through mitigation measures and monitoring activities proposed in Chapter 5 of this ESMP.

(vii) Impacts from Erosion, Sedimentation, and Localized Flooding

Potential erosion may occur significantly in exposed soil areas and excavated soil disposal sites. Erosion on slopes may lead to soil collapse and landslides, causing property damage or even fatalities. Runoff from the construction site or disposal areas may carry high suspended solids, leading to sedimentation that damages pathways and pollutes receiving water bodies. Such sedimentation could clog the existing drainage system, resulting in localized flooding.

During construction, extensive dredging and filling activities, combined with the erosive effects of rain and tidal fluctuations, will lead to prolonged increases in sediment concentration. This will contribute to sediment accumulation in the construction area.

- Heavy rainfall may cause erosion, washing suspended materials from the construction site into nearby water bodies, affecting water quality and causing sedimentation. However, these impacts are temporary and will cease once construction is completed, the infrastructure is

²⁵ Monitoring by the United States Environmental Protection Agency (USEPA) on the recovery of dredging activities in a river in Alaska showed that significant recovery in macroinvertebrate diversity occurred after one year

²⁶ According to secondary studies, the main gases are CH₄ and H₂S.

stabilized, and the area is paved.

- During construction, the increase in site elevation and changes to the base layer will accelerate water runoff, affecting local drainage capacity.

Additionally, the project involves leveling the entire planned land plots to create construction platforms and infrastructure systems. This process will alter the area's natural topography, transforming low-lying, uneven terrain into a stable and uniform elevation. Converting former agricultural fields, ponds, and lakes into bare land or concrete surfaces will reduce the area's water retention capacity, increasing runoff into the river and affecting its flow.

(viii) Impacts from Increased Risks and Traffic Disruptions

Construction activities may lead to a significant increase in vehicle movement in and out of the subproject areas. The movement of heavy trucks can disrupt existing traffic flow and increase the risk of traffic accidents.

Similarly, waterway traffic may also be affected due to an increase in vessels transporting materials to the construction site. Additionally, in-water construction activities may narrow or obstruct navigation routes. Implementing good traffic safety management during the construction phase will help avoid, mitigate, and reduce impacts on traffic, including potential accidents.

Various types of vessels will be used during dredging, including 1390 HP and 585 HP suction dredgers, 200–400T barges, tugboats, boats (40T), and speedboats. Additional service vessels, such as fuel and water supply boats, will also operate. The existing port area already accommodates vessel traffic. Dredging the navigation channel and port construction will somewhat impact waterway activities for 24–36 months, causing navigation obstructions, reducing available waterway width due to dredging equipment occupying part of the water surface, and increasing collision risks between dredging vessels, fuel and material supply vessels, cargo ships, and local fishing boats.

The presence of barges on the water and the transportation of dredged materials along waterways will disrupt local water traffic, increasing interactions between local vessels and dredging machinery. Dredging may also limit local vessels' access to the port for docking purposes.

However, these impacts will only last during the dredging phase. Fishing vessels primarily depart and return at specific hours, and the port areas are relatively spacious, particularly at existing ports with multiple docking berths. Therefore, the obstruction to waterway traffic at the project site is expected to be minimal and can be mitigated through appropriate construction planning.

The impact on waterways is considered low and localized due to: (i) The width of existing and new ports, which generally ranges from 200 to 500 meters, while the dredging area occupies only a fraction (about 1/10 to 1/5) of the total water surface at the port locations. The remaining width of the channel will still allow for local vessel movement. (ii) Dredging equipment typically remains in one position for several hours at a time.

(ix) Risk of Damage to Existing Infrastructure Due to Transportation of Construction Materials and Equipment

Most project sites are in rural areas where roads are primarily made of concrete. Transporting materials to the site using heavy trucks may damage roads. Repairing concrete roads can be technically challenging, making it essential to prevent such impacts by using alternative transportation methods (e.g., waterways) or restricting truckloads to appropriate weight limits.

Moreover, crane operations may impact existing technical infrastructure such as power lines, telephone lines, and water supply and drainage systems. These impacts can be avoided or minimized through pre-construction site surveys and consultations with local authorities and relevant agencies.

Port construction and dredging will require heavy machinery, including bucket dredgers with booms extending 30–40 meters. If not properly controlled, these machines may risk colliding with existing port structures during movement and dredging operations in river/marine navigation channels and turning basins.

Additionally, existing shrimp farming cages may be at risk if dredging vessels collide with or damage their barriers/nets or interfere with water intake and discharge pipes of current port facilities. This could reduce productivity for shrimp farmers and other aquaculture operations if not properly addressed through prior notifications and relocation planning.

Furthermore, in fishing port areas, numerous businesses provide logistics services for the fishing industry. Dredging and port upgrades may affect these service businesses' operations to some extent. However, the impact is expected to be minor and mitigable through well-planned dredging schedules and appropriate construction arrangements.

(x) Occupational Health and Safety (OHS) Issues

The Khanh Hoa Subproject is expected to mobilize 120 workers for construction over a period of 24–36 months. The following are the predicted and assessed OHS risks during the implementation of port construction and dredging activities:

Regarding working conditions, OHS issues for workers may arise from falling into the water or even drowning while working on water/sea due to illness or loss of balance. Additionally, they may be exposed to hazardous materials such as oil. Direct exposure may cause short-term health effects like skin or respiratory irritation, while certain substances can penetrate the skin and enter the body system. The accumulation of toxic substances during work may lead to severe long-term health effects, necessitating proper safety measures.

Other OHS concerns related to working conditions include insufficient lighting or inadequate protection when working in specific conditions or locations.

Working with electrical or diesel-powered construction tools and equipment (e.g., barges, sand pumps, cranes, pile drivers, etc.), workers may face risks such as electric shocks or burns. Harsh weather conditions also pose OHS risks. Strong winds and heavy rain during storms in coastal areas can destabilize temporary construction structures or even construction plants, potentially causing accidents due to the movement of outdoor tools, equipment, and construction materials, endangering workers and others nearby. Prolonged exposure to extreme heat can cause exhaustion or even fainting among workers.

For dredging workers and other subprojects, inadequate living conditions in worker accommodations can also lead to health and safety issues. Waterborne diseases may arise from a lack of clean water, insufficient access to sanitation facilities, and poor hygiene conditions within and around the camps. Living at construction sites for extended periods, workers who engage in unhealthy activities such as fighting, heavy drinking, and prostitution may also suffer long-term health consequences.

Regarding worker behavior, safety risks may stem from their awareness and attitudes toward using Personal Protective Equipment (PPE) and personal conduct at construction sites. Workers from larger and more experienced contractors are typically well-trained in Environmental, Health, and

Safety (EHS) protocols and provided with adequate PPE, leading to stricter adherence to safety rules. However, workers from smaller/local contractors may have varying levels of PPE compliance depending on enforcement (e.g., using life jackets on rivers/seas). Examples of careless worker behavior that can lead to accidents or hazards at construction sites include smoking near flammable materials such as oil tanks, mishandling electrical wires, and unauthorized operation of construction machinery.

Overall, the risk of occupational accidents at the construction site is considered moderate and can be mitigated through appropriate measures, such as safety training before and during construction and providing adequate work equipment for workers.

(xi) Community Health and Safety Issues

Dredging and construction activities at the port will disrupt waterway traffic, increasing the risk of water transport accidents and injuries to local fishermen.

- For dredging construction vehicles: During the construction of the docking port, machinery and equipment will occupy part of the water surface, obstructing waterway traffic and potentially leading to vessel collisions. Such incidents can occur at any time during construction, causing property damage, ecological harm to the marine environment, and negative economic impacts on the region.
- For transport vehicles carrying dredged materials to disposal sites: Water transport accidents often occur due to overloading beyond the vessel's permitted capacity, leading to ship/barge sinking and oil spills. Waterway accidents may also occur due to storms or vessel collisions at sea.

The impact on waterways is assessed as low and localized due to: (i) the existing cross-section of Cam Ranh port being quite wide, mostly ranging from 100 to 200 meters, with the dredging area occupying only a portion of the water surface (Bottom width = ...m). The remaining width of the existing passage must be sufficient for local vessels to navigate; (ii) dredging equipment typically remains in one position for several hours at a time.

Activities from worker camps, such as wastewater and household waste discharge into the environment, can also cause conflicts with the local community. Disputes may also arise from workers utilizing local resources such as clean water, food, and other essentials, leading to increased prices.

A concentration of workers may cause social disturbances and security issues, including gambling, prostitution, and drug use. The project area is relatively large, with many vacant land areas suitable for camp placement, minimizing direct contact with local residents. However, communal living in the Cam Linh Ward area during construction may still cause conflicts with local residents due to uncollected and untreated wastewater and waste, leading to adverse impacts on the community, such as odor, environmental aesthetics, and public health concerns. The influx of laborers may also increase the risk of Gender-Based Violence (GBV) and Sexual Exploitation and Abuse (SEA).

The risk to community health and safety is assessed as medium due to: (i) a relatively small workforce (around 120 workers) concentrated in one construction area; (ii) a relatively long construction period for the Khanh Hoa subprojects (approximately 24–36 months); (iii) project owners/contractors prioritizing the recruitment of local laborers; (iv) workers receiving training on occupational safety and environmental sanitation before commencing construction activities.

(xii) Social Impacts Due to Labor Influx

An estimated 120 workers will be mobilized at the peak of the Khanh Hoa Subproject implementation. These workers may come from various locations within the project province/city or from other provinces. The following are potential social risks and impacts associated with labor influx:

- Poor management of workers and worker camps may lead to environmental issues such as wastewater discharge into the environment and improper disposal of solid waste into rivers, seas, or agricultural land.
- The influx of laborers may pose security risks or social instability if some workers engage in social vices (e.g., alcohol abuse, gambling, prostitution, etc.).
- The mobilization of migrant labor may increase the risk of infectious disease transmission, including HIV/AIDS, as workers interact with each other and the local community. In the event of an outbreak, this would place an additional burden on the local healthcare system.
- Potential conflicts between workers and the local community due to differences in origin, culture, customs, employment, and income.
- Gender-Based Violence (GBV), exploitation, and sexual abuse/harassment (SEA/SH) risks due to the concentration of male workers in the project area. However, the risks of GBV and SEA/SH are assessed as low and manageable.

(xiii) Impact on Cultural Heritage

The expansion and upgrading of Khanh Hoa fishing port will take place within the existing Da Bac port area, meaning no cultural heritage assets will be affected.

However, the project's construction activities involve significant excavation and dredging, which may lead to the unearthing of cultural relics. Therefore, a chance-find procedure has been included in the project's and Environmental and Social Management Plan (ESMP), as outlined in Chapter 5 below.

4.4.2.2. Site-specific impacts during the construction of Khanh Hoa subproject

Khanh Hoa Major fishery center Upgrading Subproject involves investment in upgrading or building new work items on a total land use area of 9.66 ha in Cam Linh Ward, Cam Ranh City, Khanh Hoa Province. Work items to be invested in upgrading or new construction include: (i) New construction: 01 protruding wharf with a width of 29 m and a length of 122 m; 01 residential wharf with a width of 5 m and a length of 60 m; the embankment of the residential fish wharf with a length of 140 m; logistics works (sorting houses, operators, yards, roofs, water tanks); (ii) Rehabilitation: wharf 1 with a width of 29 m and a length of 200 m; existing logistics service wharves and fishing wharves; technical infrastructure works (power supply, water supply, drainage system, wastewater treatment station, fuel supply); (iii) Dredging the waters in front of the wharf, the return area, and the channel with a dredged material volume of about 69,333 m³.

Based on the location, investment scale, and natural, socio-economic, and environmental conditions in Chapter 2, the construction process of the Khanh Hoa subproject will have the following specific impacts:

- Disturbance on the operation of Da Bac fishing port (ships, seafood processing business)
- Impact on aquatic life and deterioration of water quality due to dredging
- Safety and disturbance of water traffic
- Impacts and risks of environmental pollution at dredged material storage sites

- Impact on aquaculture activities
- Effects on sensitive receptors

Details of the specific impact assessment are presented below:

(i) Interruption/impact the operation of Da Bac fishing port

Da Bac fishing port was invested in construction, repair, and upgrading in 2009 and currently includes wharves for fishing vessels, seafood sorting houses, port management board offices, service kiosks, ice producers, security stations, gas stations, and guard stations. Cam Ranh Bay in this area is about 1.5 km wide. The investment in the construction of the Khanh Hoa subproject is designed to handle a seafood throughput of 100,000 tons/year, with 250 ships docking per day. The length of fishing vessels that can dock at the port is up to 40 m.



Existing status of Da Bac fishing port area

During the construction process, some activities at Da Bac fishing port will be disturbed, mainly related to the rehabilitation of items such as onshore wharf (tuna wharf), existing fishing wharf, and logistics service wharf. Access to these terminals will be difficult due to the presence of construction machinery, construction materials, and construction activities in existing terminal segments.

At the same time, the construction of items such as wharves, fishing wharves, sorting houses, operators, internal roads, yards, and water supply and drainage systems within the port premises may affect and disturb the daily activities of fishermen and port operators.

Impacts include: increased dust, emissions, wastewater, solid waste, noise, and hindrance to part of the operation of the existing fishing port area due to the concentration of machinery and equipment participating in construction (both on land and underwater). In addition, the construction process will disturb the operation of fishing vessels entering and exiting Da Bac fishing port. Although the construction of new wharves or rehabilitation of existing wharves is carried out on a rolling basis, the operation of the existing wharf continues normally. However, the process of new construction and rehabilitation still causes certain disturbances due to the following reasons:

- The increase in the number of construction machinery moving on the water surface, such as wire-bucket excavators, floating cranes, tugboats, barges, canoes, and pile drivers, serving the construction of docks, dredging of fairways, and return areas of the **subproject**, will disturb the entry and exit activities of existing fishing vessels/boats docked, increase the density of water traffic, and create potential safety risks.
- The operation of construction machinery (such as floating cranes, barges, piling ships) for the construction of embankments of residential fishing wharves can narrow or cause congestion in the existing docking area.

After the new docking station is completed, ships will be directed to dock at the new wharf, and the old wharf will be rehabilitated to ensure that there is no disruption to port operations.

The impact is assessed as medium because: (i) The number of boats entering and exiting Da Bac port is not large, averaging about 30–35 times/day and not concentrated at one time. Waterway traffic activities usually occur when fishermen's boats go out to sea (about 1–4 am) or when boats dock (from 6–9 am); (ii) Cam Ranh Bay in the area of Da Bac fishing port has a width of about 1.5 km, is open, and has many approaches. The dredged area has a maximum diameter of about 120 m, accounting for only about 1/12 of the width of the water surface, so circulation of ships is still ensured; (iii) Construction machinery is anchored permanently at certain sections, minimizing the impact on the flow of ships in and out of the port; (iv) The construction of new wharves is prioritized first, while the existing wharves (residential fishing wharves, onshore wharves, logistics service wharves, existing fishing wharves) remain operational and are only rehabilitated after the new wharves are built, ensuring uninterrupted port operations; (v) Dredging activities are carried out along each section of the fairway, the turnaround area, and the water area in front of the wharf. During rough seas or thunderstorms, which is when ships need to enter Cam Ranh Bay to anchor and shelter from storms, dredging activities will be suspended. With an area of more than 60 km² in Cam Ranh Bay, the area can still receive ships seeking shelter from storms.

These impacts can be mitigated through the application of waterway traffic safety management measures and reasonable construction organization at existing wharves.



Location of Khanh Hoa sub-project in Cam Ranh Bay area

(ii) Impact on aquatic life and deterioration of water quality due to dredging process

The subproject implementation area is in Cam Ranh Bay, about 3 km from coral reefs and seagrass beds. As described in Chapter 2, the area is mainly used for fishing and aquaculture, with moderate biodiversity, and no rare or endangered aquatic species.

Dredging activities include the water area in front of the wharf, the return area, and the channel with a volume of dredged materials of about 69,333 m³. Although the dredging volume is not large, the construction process lasts 24 months. Dredging activities will have an impact on the water quality and aquatic life of Cam Ranh Bay in the Da Bac fishing port area as follows:

- Causing disturbance of the bottom or loss of habitat of some benthic animals such as shrimp, crabs, fish, squid, snails, oysters, etc., or aquatic animal eggs.
- Dredging agitates the bottom sediments, increases sand sludge and suspended solids (TSS), causes turbidity, obstructs light to the bottom layer, and affects the metabolism and development of aquatic organisms. Increased turbidity reduces dissolved oxygen and limits photosynthesis of algae and plants in the water, which in turn affects food sources and habitats of aquatic species.

- Changes in sea topography (dredging bottom elevation of the waters in front of the wharf and ship turning area from -4.5 m to -5.7 m, dredging height of ship fairway from -3.7 m to -5.7 m), significantly changing the living space and habitat of some species: fish, shrimp, crabs, squid, oysters, etc., which must move and adapt to the new shelter.
- Transforming or losing natural plant cover such as algae and watergrass, affecting food sources and habitats of aquatic species.

However, these impacts are assessed as medium based on the following factors: (i) The scope of dredging is limited to the existing waters of Da Bac fishing port and does not affect ecologically sensitive areas; there are no rare or endangered aquatic species; (ii) The maximum increase in SS concentration at a location 50 m from the center of dredging is about 150 mg/l and decreases gradually with distance. After 1 hour, the dilution rate at 100 m from the source is 1/2, at 200 m from the source is 1/5, and at 500 m from the source is 1/10, corresponding to 75 mg/l, 30 mg/l, and 15 mg/l, respectively. The concentration of TSS in the water increases, mainly affecting aquatic flora and fauna and negligibly affecting aquaculture activities about 300 m from the dredging site (the impact on aquaculture activities will be assessed in detail below); (iii) Potential impacts are local and reversible. The habitat and ecosystem of benthic organisms are forecasted to be naturally restored 12–18 months after dredging. Disturbing part of the habitat of benthic organisms and reducing some populations of benthic organisms is not expected to lead to any significant impact on the food chain in the ecosystem of Cam Ranh Bay.

The potential impacts of dredging can be managed through mitigation measures and monitoring activities consistent with subproject characteristics, such as rolling construction, periodic water quality monitoring, and limiting construction during periods of aquatic life reproduction or adverse weather events.

(iii) Safety and disturbance of waterway traffic

Currently, the Da Bac fishing port area still has boats circulating back and forth, with about 30–35 turns of ships/boats per day. In addition, this area also serves as a storm shelter anchorage for the province and surrounding areas, with a capacity of up to 1,000 fishing boats.

During dredging or new construction, rehabilitation, and upgrading of ports and embankments, many types of vessels and equipment will be used, such as bucket excavators, floating cranes, suction boats, tugboats, boats, canoes, barges, etc. In addition, during construction, vessels supplying oil and water for these vehicles and equipment will also operate on the water surface. The gathering and operation of these vehicles can narrow channels, obstruct port entry and exit activities, and increase the risk of collision between ships and construction equipment, affecting water traffic safety.

Dredging of ship channels, water areas in front of wharves, and turning areas will narrow the range of vessel movement, with the largest narrowed diameter of about 120 m. The mooring of barges and construction vehicles on the water surface will disturb waterway traffic in the subproject area, limiting the access of local vessels to the port and anchoring activities in Cam Ranh Bay.

The most affected area is the turning point with a diameter of about 120 m, while the water surface width at the construction area in Cam Ranh Bay is up to about 1.5 km. Therefore, the narrowed area occupies only about 1/12 of the water surface and does not significantly hinder the overall flow of movement.

However, the impact on waterway traffic is assessed as low because: (i) The construction area occupies a small area compared to the total water surface, and the construction vehicles are concentrated in certain locations; (ii) The density of vessels entering and exiting the subproject area

is not large, about 30–35 ships/boats per day; (iii) Dredging activities shall be carried out in small sections and accompanied by an appropriate system of warnings and water traffic regulations; (iv) The water surface area of the storm shelter anchorage in Cam Ranh Bay is larger than 60 km², so ships can easily find a new anchorage.

Impacts and risks can be mitigated through proper application of waterway traffic safety management measures, coordination of ship movements, and reasonable construction organization.

(iv) Impacts and risks of environmental pollution at dredged material storage sites

The volume of materials arising from dredging the fairway for ships entering and exiting the port, the ship return area, and the water area in front of the wharf of the Khanh Hoa subproject is not large (only about 69,333 m³).

The project has identified 02 dredged material disposal sites located within Da Bac fishing port, with a total area of 3.1 ha, capable of receiving the entire volume of dredged materials of the subproject:

- Disposal site No. 1 is about 0.5 km north of the dredging area, with an area of about 2.6 ha. The existing status is that the land is an old aquaculture reservoir that is no longer used and has completed land recovery. It was previously used to store dredged materials to maintain the channel and turning basin of Da Bac fishing port.
- Disposal site No. 2 is about 0.3 km east of the dredging area, with an area of about 0.5 ha. The existing status is that the water surface belongs to the fishing port, which will be used as a disposal site for materials from dredging the water area, return area, and channel in front of the official wharf. After leveling, this area is planned to be developed into garages and service areas of Khanh Hoa Large Fisheries Center.

After pouring dredged materials, the disposal site will have an altitude of +1.5 m, equal to the ground height of the existing technical infrastructure at Da Bac port. However, if not properly managed, the process of collecting dredged materials at the disposal site may have the following potential impacts:

- *Impact of leachate from dredged material:* After the dredged material is pumped from the dredging area to the disposal site, the wet dredged material will gradually settle, and leachate will escape from the dredged material by gravity. Experience from other similar dredging projects shows that the ratio of sand-to-water sludge in dredged fluid is 8:2, equivalent to 13,867–14,000 m³ of leachate. The volume of leachate is not large, estimated at 14,000 m³. However, if not properly controlled, leachate from dredged materials can cause local flooding around the disposal sites, carry fine substances, cause sedimentation in the drainage system, and affect the receiving waters of Cam Ranh Bay in the Da Bac fishing port area.
- *Salinity-related effects:* Salinity in marine sediments is often high, especially during the dry season. Water seeping into the ground at the disposal site can cause brackish conditions or salinization of the soil. Therefore, dumping dredged materials without proper management and technical measures may affect the soil environment at the disposal site or surrounding land areas. The impact is mainly in the area of Disposal Site No. 1, because this area is located directly on the mainland in Da Bac port. However, this area was previously used to store dredged materials for channel and turning basin maintenance, and its original status as an old aquaculture pond is no longer in use. The disposal site is located within Da Bac port, with similar ground conditions, and is expected to be planned for the next phase of infrastructure development of Khanh Hoa Large Fisheries Center. There is no agricultural

land around it, so it is reasonable to reuse this area for the same purpose, as long as appropriate technical measures continue to be applied to control salinization. Meanwhile, Disposal Site No. 2 is the water surface within the scope of Da Bac fishing port, and the water is directly connected to Cam Ranh Bay, helping to minimize the risk of salinity spread.

- *Risk of spilling/discharging dredged material into the surrounding environment:* Although the volume of material is not large and the leveling height is suitable, the risk of material spillage still exists if the disposal site is not properly reinforced, especially at Disposal Site No. 2. If the embankment of the disposal site is not secured, the dredged material may spill into Cam Ranh Bay (in the Da Bac port area), affecting aquatic flora and fauna such as shrimp, crabs, fish, squid, snails, oysters, etc., existing in the Da Bac port area, although the biodiversity here is considered low.



Location of dredged material disposal site for Khanh Hoa subproject

However, the impacts related to the dredged material disposal sites are assessed at a low level because: (i) The volume of dredged material is not large (only about 69,333 m³), and the disposal sites have a total area of about 3.1 ha, which is sufficient to receive all dredged materials; (ii) Disposal Site No. 1 was previously used to store dredged materials for the maintenance of fairways and turning basins of Da Bac fishing port, and its continued use in this period is suitable; (iii) The disposal sites are located in low-lying areas, so after leveling, the ground elevation will be equal to the current ground elevation of Da Bac fishing port, helping to limit the risk of overflow; (iv) The amount of leachate generated from the dredged material is not large, which is channeled and flows back to Cam Ranh Bay in the Da Bac port area, reducing the risk of flooding and salinity; v) The environmental quality of the monitored dredged material shows no contamination with heavy metals; (vi) The disposal sites for dredged materials, after leveling, are planned for the development of fishery infrastructure.

These impacts can be controlled and mitigated through appropriate measures such as shore reinforcement, leachate management, and periodic environmental monitoring.

(v) Impact on aquaculture activities

Currently, there are more than 30 households farming seafood (mainly lobster and fish) in the area about 300 m north and northwest of the subproject dredging location. This is a spontaneous farming area, not included in the official planning of Cam Ranh City. Because this spontaneous farming activity is degrading the quality of surface water in Cam Ranh Bay, the People's Committee of Cam Ranh City is developing a career change program to support the livelihood of these households.

Aquaculture activities mainly use natural water directly from Cam Ranh Bay, so they may be affected by fluctuations in water quality during the construction of the subproject.



Location of aquatic farming area near the subproject area

The mobilization of machinery for the construction of wharves and embankments, as well as dredging of turnaround areas, water areas in front of wharves, and fairways, does not pass through aquaculture areas. However, dredging still carries risks related to the spread of pollutants such as grease and suspended solids (TSS) to aquaculture sites. This may affect the volume of water available for aquaculture, potentially depleting natural feed or causing the death of aquatic species in ponds.

The impact is assessed at a low level due to: (i) The current seawater quality in the subproject area is generally good, with only Ammonium (NH_4^+-N) exceeding the permissible limit by 3.36 to 4.48 times due to spontaneous aquaculture activities; (ii) Dredging activities last for 24 months, but are carried out in sections (fairway, ship return area, water area in front of the wharf, with the largest dredging diameter of about 120 m); (iii) Construction activities occur intermittently during the day, only about 8 hours, which helps reduce the risk of prolonged effects on water quality; (iv) The location of the ponds is mostly upstream and more than 300 m from the dredging area, so the likelihood of pollutants reaching the farming area is limited; (v) Due to the geological characteristics of the coastal sea area in Cam Ranh Bay, the dredged material is mainly sand (95%) with a particle size of 0.1–1 mm, so TSS propagation in water is limited to approximately 100–150 m from the center of dredging. This impact can be mitigated through technical measures such as scheduling construction activities in accordance with aquaculture water intake times and monitoring water quality during construction.

(vi) Influence on sensitive receptors

For PCR areas:

As shown in Table 2.10 (Chapter 2), within a 300 m radius of the subproject implementation area, there are no cultural, religious, or heritage sites (PCR). However, along the main material transportation routes of the subproject (Nguyen Trai Street, 30/4 Street, Nguyen Trong Ky Street), there are several PCRs located near the road, including: Nam Hai Da Bac Mausoleum (about 50 m away), Tu Van Pagoda (about 80 m away), and Ba Ngoi Parish (about 60 m away).

The main impacts during construction in the PCR areas (Nam Hai Da Bac Mausoleum, Tu Van Pagoda, Ba Ngoi Parish) are primarily related to dust, noise, traffic obstruction, and increased risk of traffic accidents due to the transportation of materials for the subproject. These impacts may affect religious activities and beliefs of local people, especially during Full Moon, First Day, or public holidays.

The level of impact on PCR areas is assessed as low because: (i) The frequency of transportation is not high, averaging about 10 trips/day, up to 2 trips/hour; (ii) Exposure to dust and noise is brief,

only about 1–2 minutes per vehicle pass; (iii) Religious activities do not occur daily, mainly on holidays, allowing for adjustment of transportation schedules to avoid overlap.

These impacts can be effectively mitigated through construction management measures such as dust suppression with watering, adjusting transportation schedules, installing warning signs, and coordinating with local authorities during holidays.

For schools on the main transit route:

Several schools are located near the main transport route, including Cam Linh Primary School (about 70 m away), Tran Hung Dao High School (about 50 m away), and Nguyen Trong Ky Secondary School (about 50 m away). Construction and upgrading activities of the subproject may cause the following impacts and risks:

The impacts on students and teachers at these schools during construction are:

- Traffic disturbances near schools during school hours (6:30–7:30, 11:00–12:00, 13:00–14:00, 16:30–17:30, Monday through Friday);
- Increased dust and noise levels affecting teaching and learning conditions;
- Higher risk of traffic accidents at intersections near schools due to trucks transporting materials (about 7 trips/day) and waste (about 3 trips/day), mainly 10-ton trucks.

This level of impact is assessed as medium because: (i) Although the number of trucks is low (10 trips/day), construction machinery and equipment are mobilized at the start and completion of the subproject, lasting approximately 24 months; (ii) The density of vehicles and equipment on the road is not high (about 2 trips/hour), but there are potential traffic safety risks and accidents at intersections near schools during peak hours (7–8 am and 16–18 pm). This impact can be minimized through careful scheduling of construction activities and implementing traffic management measures adapted to local conditions.

4.4.3. Impacts and risks during operation phase

The source of environmental and social impacts and risks during the operation of Khanh Hoa Major Fishery Center is from: (i) Operation of ships/boats/cargo trucks; fish/seafood loading and unloading activities; (ii) Activities of operators, fishermen at the port, ship/boat drivers, visitors to the port; (iii) Operation of vessels transporting aquatic products in and out of the port; (iv) Operation of functional areas in the port (receiving area, sorting area, storage area for aquatic products; (v) Operation of technical infrastructure systems such as WWTP, waste storage facilities, public toilets, etc.

Particularly, the dredging and maintenance of navigation channels and water areas in front of the port (usually dredged and maintained every 2 years) will be carried out with other funding sources during the operation of the port, so the impacts and risks related to this activity will be assessed separately later.

General impacts and risks during the operation of Khanh Hoa subproject include:

- Dust and emissions generated
- Noise
- Wastewater generated
- Solid waste generated
- Impacts on aquatic life and deterioration of coastal seawater quality (due to concentration of ships and dredging, maintenance of navigation channel in the port area)
- Disturbance to the aquaculture activities

- Traffic risks and incidents (road, waterway)
- Risks and incidents of occupational safety.
- Environmental risk incidents: fires, explosions, oil spills

The details of the impact assessment are presented below:

(i) Dust and emissions generated

Sources of dust and emissions from the operation of Khanh Hoa Major Fishery Center, especially in fishery service areas, generate the dust and emissions as follows:

- Dust and emissions from means of transportation ships/boats/trucks; fish/seafood loading and unloading activities.
- The fishy smell arises from fishing vessels when returning to the port, cold storage warehouse for aquatic product preservation.

Odors, exhaust gases (NH₃, H₂S,...) from wastewater treatment systems, solid waste storage facilities. The impacts on the air environment are specifically assessed as follows:

❖ *Dust and emissions from transportation ships/boats/trucks; fish/seafood loading and unloading activities*

Dust and emissions of ships/boats/trucks are primarily generated from the operation of diesel powered generators and vessel exhaust systems. The pollutants mainly include dust, CO_x, SO_x, NO_x, Hydrocarbons (HC), etc. The emission load from vessels entering and exiting the port is difficult to estimate and depends on the number of daily ships going in and out of the port, with the number of ships ranges from 250 – 1,000 ships.

The emission load due to the operation of the vessel is shown in the following table:

Table 4.58: Emission coefficients of pollutants generated from diesel powered ships

(Unit: kg/day)

Means of transport	Dust	SO ₂	Nox	CO	HC
Motor ships	6.8	136S	90.7	0.036	4.1

Source: WHO, 1993

Applying the formula for calculating the pollutant load in exhaust gases arising from the operation of ships/boats:

$$\text{Pollution load (mg/m.s)} = \text{Pollution coefficient (kg/day)} \times \text{number of ships in a day} \times \frac{1,000}{(\text{average distance} \times 86,400)}.$$

In which: 1,000 is used to convert the unit “km” to “m”; 86,400 is the conversion factor from “day” to “second”; The sulfur (S) content in DO oil is 0.05%; The average travel distance is 25 km. Applying formulas [1] and [2] in the general impact assessment section during the construction phase, the calculation of the concentration of pollutants in the exhaust gas of the ship/boat shows that: The NO_x concentration exceeds the permissible standard specified in QCVN 05:2023/BTNMT- National Technical Regulation on Ambient Air. SO₂, CO concentrations and concentrations at a distance of ≥10m for HC and ≥30m for dust are within the permissible limits.

In addition, when the sub-project comes into operation, the road traffic density in the area will increase significantly (an increase of about 150-200 trucks/day) due to the movement of staff and workers at fishing ports and seafood transportation trucks, etc., increase when upgrading fishing

ports. As these are gasoline and diesel powered vehicles, they will emit an amount of emissions, including NO₂, C_xH_y, CO, CO₂, HC into the air. The load of pollutants arising from this activity is also similar to that assessed in the operation period because the pollutant load generated from activities of the existing fishing port is lower than the allowable limits.

The affected group (a total of about 1,200 people) are mainly fishermen at the port and ships entering and exiting the port (about 900 – 1,000 people); local people trading in kiosks at the port (about 100 - 150 people), port operators (35 people).

The impact level is assessed as Low because (i) the concentration is only greatest when all vessels gather at the port at once and only affect the area for a short time (according to general practice and procedures at fishing ports, the docking period can last from 30 minutes to 2 hours); (ii) this source of emissions will gradually decrease when ships cease operating and (iii) this source of exhaust gradually dilutes into the air with fairly ventilated conditions on a large port with strong wind blows.

❖ ***The fishy smell arises from the fishing boats when arrival at the port.***

The source of fishy odors mainly appears when fishing vessels carrying seafood that is caught and frozen at the port. The fishy odor composition is mainly from NH₃, Hydrocarbons (HC), generated from the decomposition of organic matter and refrigeration equipment. The load of NH₃ emissions arising from refrigeration equipment and fishy odors from fishing boats is considered low, as the aquatic products (shrimp, crab, seafood, etc.) are quickly loaded and unloaded, sorted, and delivered to the market for consumption or immediately put into cold storage.

The composition of gases from the decomposition of organic matters includes CO₂, NH₃, H₂S, CO, CH₄, Mercaptan,... In which, the main odor-causing gases are NH₃, H₂S and Mercaptan, discomforting fishermen, traders, and sellers/buyers in the port area.

The impact is assessed as Medium as (i) the volume of aquatic products arrived at the port is localized, depending fishing vessels (hourly - early morning (from 4 a.m. to 6 a.m.) and afternoon (from 2 p.m. to 4 p.m.), seasonally - the peak fishing season is normally from June to September every year); (ii) The seafood decomposition contributes to an increase in fishy odor, adversely affecting the environment in the port area (accounting for about 1% - 2%). This impact can be controlled through appropriate operational measures such as: shortening loading and unloading time, enhancing cold storage practices, cleaning the receiving area regularly and raising the workers' awareness in handling seafood handling procedures.

❖ ***Odors, exhaust gases generated by wastewater treatment systems, solid waste storage facilities, public toilets***

Khanh Hoa subproject is planned to build 01 wastewater treatment station with a capacity of 600 m³/day, 01 solid waste collection facilities with an area of 96 m², 01 public toilet with an area of 87 m². Odors, exhaust gases (NH₃, H₂S,...) arise from the wastewater treatment system of the sub-project.

Wastewater treatment technology process: Wastewater from sources → Collection tank → Grease and sand separation → equalization tank → pH adjustment tank → coagulation tank → flocculation tank → primary sedimentation tank → intermediate tank → anaerobic tank → anoxic tank → anaerobic MBBR tank → biological sedimentation tank → disinfection tank → treated wastewater meets QCVN 40:2011/BTNMT - National Technical Regulation on industrial wastewater (column B, K_q=1.0 and K_f=1.0) → receiving source (Cam Ranh Bay).

According to the above technological process, the odor from the WWTP mainly arises from the following tanks: collection tank, equalization tank, reaction tank, primary sedimentation tank, intermediate tank, anaerobic tank and anoxic tank. Aerobic decomposition also produces odors but at low levels. Gases emitted mainly from anaerobic decomposition include H_2S , Mercaptan, CO_2 , CH_4 , of which H_2S and Mercaptans are the key odor-causing substances.

Based on aerobic treatment technology and the design of closed treatment tanks, the WWTP with a capacity of 600 m³/day will significantly reduce odors arising from substances such as H_2S , CH_4 , NH_3 . However, odor concentrations can still persist at low levels in cases where they cannot be completely eliminated. Normally, the concentration of odorants (H_2S , CH_4 , NH_3) in aerobic wastewater treatment systems with closed tanks will fluctuate within the following thresholds:

- H_2S (Hydrogen Sulfide): H_2S concentrations in closed aerobic treatment tanks are typically maintained below 0.1 ppm (parts per million), and under ideal conditions, it can be even lower.
- CH_4 (Methane): The concentration of CH_4 in aerobic treatment tanks can range from 0.5 to 5 ppm, however, this figure depends on the level of ventilation and emission control in the tank.
- NH_3 (Ammonia): NH_3 concentrations in closed treatment tanks can be controlled in the range of 1-3 ppm, depending on the nitrification process and aeration system.

The group affected by the odor from the WWTP and waste collection facilities are workers operating the Khanh Hoa Major Fishery Center (about 35 more individuals after the port expansion) and fishermen and visitors/traders at the port (about 1,100 people).

Since the WWTP use aerobic technology with closed treatment tanks, the odor is minimized. The decomposition process generates malodor but at a low level. The decomposition process generates malodor but at a low level. In addition, the WWTP of Khanh Hoa Major Fishery Center will be built closely (closed treatment blocks), so the odor generated will be minimized. Therefore, the level of this impact is moderate and can be mitigated by appropriate technological and technical measures.

(ii) Noise

The source of noise arises mainly from vessels when docking, vehicles entering to purchase and transport seafood for consumption and from the service area.

Maximum noise level forecast (taking into account the cumulative noise when many vessels enter and exit at the same time, for Khanh Hoa subproject is 250 ships/turn and in case of a storm is about 1,000 ships) ranges from 80 □ 85 dBA for vessels, 85 □ 95 dBA for road traffics and with noise arising from the service area being from 75 - 79 dBA (exceeding permissible level from 1.07 to 1.12 times).

Noise mainly affects sellers, workers working at fishing ports, fishermen and visitors/traders (about 1000 people in total), usually gathered in a radius of about 10-20 m around the receiving, sorting and loading and unloading area (according to general practices and procedures at fishing ports. The docking time can last from 30 minutes to 2 hours).

However, according to the field survey at the existing Da Bac fishing port, the activities of ships docking, loading and unloading, and sorting aquatic products do not always take place all day, usually within a month, the peak time of full-day operation is from the 8th to the 15th day of the lunar calendar. On the other days, the activities mainly take place from 4 a.m. to 6 a.m and from 2 p.m. to 4 p.m.; Upon ship arrival, the engine will be turned off, the port space is wide towards the

river, so the noise is also diffused quickly. In case of a storm, the noise level will increase due to cumulative noise of about 1000 ships, within 3-5 days, about 300 ships anchoring per day. Then, the resonant noise level is about 105 to 110 dBA, exceeding the permissible level by 1.4 to 1.57 times (however, this noise is localized, only for a short time from 30 to 45 minutes and will stop when the ships have docked). Therefore, this impact is Low and can be mitigated by appropriate measures.

(iii) Wastewater generated

Sources of wastewater generated from the operation of Khanh Hoa Fishery Center include: domestic wastewater, wastewater from onshore service areas, especially from fishery service areas, wastewater from ships operating in the water areas in front of the port. The generated wastewater flow is calculated according to the supply water flow. The wastewater volume is calculated based on the supplied water volume (according to wastewater drainage standards equivalent to 100% of the water supply standards). The calculation of wastewater volume is detailed in the following table:

Table 4.59. Calculation of wastewater volume of Khanh Hoa subproject

No.	Used for	Quantity		Standard		Calculated volume	
1	Staff of operational facilities	35	Person	25	L/person	0.88	m ³ /day
2	Fish washing	345	Ton	1	m ³ /ton	345.0	m ³ /day
3	Floor washing						
3.1	At fishing boat dock <24m	2295	m ²	1	l/m ² floor	2.295	m ³ /day
3.2	At fishing boat dock >24m	9340	m ²	1	l/m ² floor	9.34	m ³ /day
3.3	At local dock	600	m ²	1	l/m ² floor	0.6	m ³ /day
3.4	At service dock	600	m ²	1	l/m ² floor	0.6	m ³ /day
3.5	At the operating area	6300	m ²	0.5	l/m ² floor	3.15	m ³ /day
3.6	At the seafood sorting and trading area	18.000	m ²	5	l/m ² floor	90.0	m ³ /day
4	Garbage storage facilities, WWTP, public toilets	3	Engineering	3	m ³ /building	9.0	m ³ /day
5	Average daily water demand	Q day average				461	m ³ /day
6	Coefficient	1.3					
7	Total wastewater drainage demand	QT= 100% Qday_max				599	m ³ /day
		Rounded				600	m ³ /day

(Source: Basic design of Khanh Hoa subproject)

The characteristics of each type of wastewater arising from the operation of Khanh Hoa Fishery Center are as follows:

- *Domestic wastewater*: arising from the working areas of staffs and employees serving in the service area and fishermen/traders at the port, the volume and pollution level of this waste source mainly depend on the number of worker and the amount of water used daily at the operational facilities and public toilets, garbage storage facilities, WWTP. It is estimated that about 35 people work/operate on the port. The domestic wastewater volume is estimated at 0.88 m³/day. The waste generated from this source is highly dirty, its composition mainly contains organic matters, nutrients, residues, suspended substances and pathogenic bacteria. Besides, it contains high organic content (BOD, COD), high solid content and many pathogenic bacteria, detailed in table 4.48. The above amount of wastewater, if not collected and treated appropriately, can cause the spread of pathogens, affecting coastal seawater sources in Cam Ranh Bay, damaging the beautiful landscape in the surrounding area.

According to the forecast of the concentration of pollutants in domestic wastewater shown in the table, it can be seen that the concentration of organic substances in domestic wastewater after treatment with septic tanks is approximately and exceeds the permissible level by 1.0 to 2.0 times. TSS ranges from lower than to 1.8 times higher than that of permissible level. The content of animal and plant fats and oil is 2.1 times higher than permissible level; the Coliform is 30 times higher than permissible level. Therefore, wastewater treated by septic tanks needs further treatment at centralized water treatment facilities before being discharged into the receiving environment.

- *Wastewater of the onshore service area:* When the fishery logistics service area comes into operation, a system of service areas, trade, and frozen warehouse will be accompanied. The operation of these facilities will generate a large amount of production wastewater (about 345 m³/day of wastewater from fish washing and 115 m³/day of wastewater from cleaning the floor in the fishery service areas as shown in the table above), wastewater contains organic impurities. Wastewater produced from aquatic product receiving facilities, seafood cold storage warehouse, this waste source primarily contains organic matters, animal fats, waste (fish scales, fish intestines, shrimp shells, etc.). These substances are easily decomposed, if not collected and treated, the decomposed products will cause foul smell to the surrounding area, affecting coastal seawater sources in Cam Ranh Bay.

- *Wastewater from vessel operation in the water areas in front of the port:* This source of waste includes domestic wastewater, toilet wastewater on ships, and deck washing water with about 12,235 m³/day. According to the design scale, the number of ships entering and leaving the port area is about 250 ships. The composition of this type of wastewater contains suspended solids, grease, organic substances (BOD, COD). If this waste source is not controlled, but when discharge into the receiving environment, it will pollute coastal seawater in Cam Ranh Bay. As presented in the design plan, wastewater from ship hold cleaning will be collected to the WWTP (with a capacity of 600 m³/day) invested under the Khanh Hoa subproject.

- *Ballast water :*

Ballast water is the water pumped into the ship's specialized tanks to maintain stability when the ship is not carrying cargo or to adjust the ship draft. The ballast water can be seawater, brackish water or fresh water, depending on the geographical location where the ship performs the water refill operation. At riverside fishing ports, especially in areas near river estuaries, ballast water is usually brackish water or seawater due to the impact of tides and saltwater intrusion.

During the process of ballast water refilling, various species such as plankton, microorganisms, and larvae can be sucked into the water tank and move along the ship to other water bodies. The discharge of untreated ballast water can cause the spread of alien organisms, affecting the indigenous ecosystem and the water quality.

For small and medium-sized fishing vessels operating at Khanh Hoa subproject, the amount of ballast water ranges from 10 to 50 m³. The ballast water is used by fishing vessels to ensure offshore operation and when harvesting seafood is often reused. With a scale of about 250 ships under the Khanh Hoa subproject, each replacement will generate about 2,500 m³ to 12,500 m³ of ballast water. However, the ballast water does not need to be changed too frequently, and the inspection and maintenance of the ballast water tank is normally carried out periodically from 6 months to 1 year.

Domestic fishing vessels in Vietnam are typical small and medium in capacity, and do not operate in international waters, so they are not yet subject to the full mandatory provisions of the International Ballast Water Management Convention (BWM Convention). However, the discharge

of ballast water still needs to comply with existing national regulations such as Decree No. 58/2017/ND-CP. According to regulations, the ballast water shall be discharged at least 200 nautical miles from the nearest shore and in waters with a depth of at least 200 m. In case the ship is unable to meet this condition, the ship may carry out a ballast water exchange at least 50 nautical miles from the nearest shore and at a depth of at least 200 m (quite far from the shore). In fact, fishing vessels often discharge ballast water individually and not simultaneously or at a fixed location, which helps minimize the risk of localized environmental impacts.

As being operated not-concentratedly, individually and primarily in domestic water areas, the impact of the ballast water on the environment in the subproject is assessed as **Medium** and **can be controlled** through appropriate management measures.

In general, the level of impact by wastewater from the operation of Khanh Hoa Fishery Center is **Medium** because (i) The Center is concentratedly built, the operation efficiency in terms of environmental sanitation of functional subdivisions have been taken into thorough consideration; (ii) Within the center, a separate wastewater collection system and a wastewater treatment facility with a capacity of 600 m³/day is built to ensure the collection and treatment of all wastewater generated.

- In addition, there is also a amount of rainwater flowing through the port areas that carries pollutants on the surface, then flowing into Cam Ranh Bay but not being treated. The highest monthly rainfall was 1525.4 mm in X/1991, equivalent to 50.8 mm/day. Therefore, the total rainfall in 01 day in the whole project area in case of the heaviest rain is $65.00\text{m} \times 50.8\text{mm/day} / 1000 = 3,302\text{m}^3$. The composition of rainwater contains suspended solids, and surfactants washed away on the surface of the port area. The overflowing rainwater will affect the rainwater collection system and flow into Cam Ranh Bay. However, with the nature of rainwater that is less likely to pollute the environment, the port is built with a consistent, intermittently drainage system due to rainy season (from May to November every year, in Kien Giang province, there are about 200 rainy days per year in Cam Ranh area), so the impact of rainwater flowing overflow is Low and can be minimized.

(iv) Solid waste Generated

General Solid Waste:

Sources of waste generated during the operation of Khanh Hoa Major Fishery Center include: Domestic waste of about 35 staffs and employees working in the service area and operational house; waste from aquatic product sorting and trading process. Forecast of the load incurred for Khanh Hoa subproject is as follows:

- For domestic waste: According to the data of “Vietnam Environment Monitor 2004 - Solid waste,” the average amount of waste per capita is 0.1 - 0.3 kg/day (because they do not stay at the port). With the about 35 employees, the total load of solid waste discharged in a day is about 3.5 - 10.5 kg/day and 15 – 45 kg/day for visitors/traders (100 – 150 people).

- *Solid waste generated from aquatic classification* activities is forecasted²⁷ to account for about 0.02% of the total fishery yields at Khanh Hoa Major Fishery Center according to the design (100,000 tons/year), about 1.67 tons/month). The main components include: fruit peels, leftover

²⁷ From the estimated data from the operation of the existing Lach Bang fishing port, the consultant surveyed/consulted in the process of preparing this ESIA.

food, wastepaper, plastic bottles, plastic.

- **By-products from seafood sorting and processing** accounted for about 1% of the total aquatic production²⁸ at Khanh Hoa Major Fishery Center according to the design (100,000 tons/year), equivalent to 83.3 tons/month. The main components include: head, fins, bones, fish skin, fat, and fish intestines.

Hazardous waste:

When the subproject is put into operation, hazardous waste (oil-contaminated rags, gloves, hazardous component contaminated rag, packaging, grease containers for maintenance of machinery, equipment, batteries and accumulators, chemical packaging, printing ink cartridges, waste lead, damaged equipment, etc broken nets, plastic packaging, etc.) is estimated about 20 kg/day (equivalent to about 600 kg/month).

These types of solid waste, if not collected and treated, will cause air pollution (due to foul odors), pollution for coastal water in Cam Ranh Bay and negatively affect the general urban landscape of the Da Bac fishing port area. However, with the investment in technical infrastructure (garbage collection, domestic wastewater collection and treatment, etc.) and locally, there is a unit that collects, transports and treats waste quite well every day, so the impact of waste generated from fishing ports is moderate and controllable. On the other hand, before Khanh Hoa subproject puts environmental treatment works into operation, the PMU will have to carry out procedures for applying for an environmental license, so this impact is controllable.

In addition, with integrated investment in technical infrastructure works, including a 96 m² waste storage facility designed to ensure proper classification and storage of both general and hazardous wastes in at the port and there is a specialized team who has functioned well in hazardous wastes collection, transportation and treatment, so the impact of hazardous waste generated from Khanh Hoa fishery center is moderate and controllable.

(v) Deterioration of the quality of coastal seawater resources and aquatic life in Cam Ranh Bay

Similar to the analysis and assessment of impacts on coastal seawater quality in Cam Ranh Bay during the construction phase above, the periodic dredging to maintain the channel and mooring area in the project area (usually about every 2 years) will cause certain impacts on coastal seawater and the ecosystem in the area. However, the extent of the impact depends on the actual volume to be dredged and the implementation plan. The volume of dredging mud for maintenance is estimated at 500-700m³/dredging (every 2 years). This volume is not large, so the level of impact is assessed at a low level.

In addition, the quality of coastal seawater resources in Cam Ranh Bay may reduce due to the operation of ships/boats entering and exiting the port (about 250 boats/turn and designed for 1000 anchored ships) in the operation phase due to: (i) Leakage of oils and fats, caused by accidents such as collisions or grounding, discharging oily sludge, or ballast water mixed with oil; (ii) Ballast water and cooling water containing oils, household waste, solid waste, hazardous and toxic waste, etc.

²⁸ According to a number of studies on the efficiency of raw material use in the seafood processing industry and studies on by-product management in seafood processing, they are often published in Vietnam's specialized fisheries scientific journals.

In general, the level of impact on the quality of coastal seawater in Cam Ranh Bay from the operation of Khanh Hoa Fishery Center port is moderate because (i) the Fisheries Center is built along with the modern operation process by the Khanh Hoa Fisheries Management Center who has good experience in control of vessels going in and out of the port, ensuring environmental sanitation; (ii) The Fisheries Center will be built with a separate wastewater collection system and a WWTP with a capacity of 600 m³/day to ensure the collection and treatment of all generated wastewater up to class B, QCVN40:2011/BTNMT before discharging to the receiving body of Cam Ranh Bay.

The impact of the operation of the fishing port on biological resources in Cam Ranh Bay is assessed **at a low level** because (i) the operation area of the port is localized within the water area in front of the port (29m wide, 600m long); (ii) there are no rare and endangered aquatic species in the subproject area (the subproject implementation area is in Cam Ranh Bay, but about 3km away from the coral reef and seagrass areas. The subproject area belongs to the scope of exploitation and aquaculture activities, so the diversity is low. In and around the subproject area there are no environmentally sensitive areas). At the same time, (ii) the subproject area is not an area where valuable species are being protected; (iv) These impacts can be mitigated by appropriate measures.

(vi) Disturbance to existing aquaculture activities

Currently, there are more than 30 households farming seafood in the subproject area (mainly lobster and fish farming) located about 20-300m north of the dredging area, although this farming area is spontaneous, not in the area where aquaculture is allowed within the subproject implementation area. According to the current scale, there are about 30-35 ships/turn entering and exiting the Da Bac fishing port area every day. When the upgrade is carried out according to the subproject's scale, Khanh Hoa Major Fishery Center will accommodate up to 250 ships/turn (7 times higher than the existing status). This increase is expected to intensify wave impacts and degrade surface water quality due to the higher frequency of vessel movements in and out of the port. Pollution sources include wastewater from fishing vessels containing suspended solids (SS), oil and grease, as well as domestic wastewater with pollutants such as COD, BODs, and nitrate from fishermen on board, awareness of fishermen/ship drivers, wastewater from production activities of fishery centers, etc. These sources of impact will have an indirect impact (disturbance) on the existing aquaculture area.



Location of the spontaneous aquaculture area on the Bay



Aquaculture area on Cam Ranh Bay

This impact is assessed as medium because (i) when the Sub-Project is implemented, the Port Management Board will notify existing farming households to have plan for the next crops in

accordance with the operation of the port after the upgrade and expansion; (ii) In the coming time, local authorities will also mobilize and control spontaneous aquaculture sites and have plans appropriate to natural conditions and sustainable management of local aquatic resources, so this impact is controllable.

(viii) Traffic incidents:

❖ ***Waterway traffic accidents:***

Causes: During the operation of ships, shipwrecks, ship collisions or serious fire incidents may occur. Everyday, there are 250 ships entering and exiting Khanh Hoa Major Fishery Center. When a storm makes landfall, the port will receive about 1,000 fishing boats to anchor, but ships anchoring to shelter from the storm will not rush at the same time but will be scattered within 3 to 5 days according to the directives of the Maritime Administration.

During the operation of ships, shipwrecks, ship collisions, or severe fire incidents may occur. The transportation of products through the port will increase the waterway traffics in the channel in front of the port, greatly affecting the load-bearing capacity of the channel, obstructing visibility. Such increase in waterway traffic density is expected to lead to a higher risk of maritime accidents and oil spills, significantly affecting surface water quality and the ecosystem in the Cam Ranh Bay port area. In addition, dirty water and domestic solid waste from vessels navigating the channels—especially in cases of collision where waste is not properly collected or treated—may leak and overflow into the sea and port areas. This will increase pollutant levels and negatively impact the surrounding ecosystems along the navigation routes.

Scope of impact: When there is a waterway traffic accident, depending on severities, oil spills may occur, affecting the soil and water environment in the area, damaging to property of fishermen and port management authorities, and may even damage the lives of vessel operators and fishermen onboard.

The impact level is **moderate** and localized due to: (i) Cam Ranh Bay is a large bay, which is still spacious for local vessels to travel; (ii) the existing wharf of Da Bac port area is quite long (about 500m, including many piers), and (iii) Applying effective waterway and land traffic safety management during the operation period will avoid, minimize and mitigate impacts on waterway traffic including traffic accidents.

❖ ***The incident of ships docking beyond the design capacity***

During the operation phase, Khanh Hoa Major Fishery Center will be capable of accommodate upto 250 vessels/turn. When fishing ports are put into operation, there may be the cases when the number of vessels docking beyond the design capacity, leading to the following impacts:

- Vessels waiting for their turn to unload may experience long delay, potentially resulting in disputes over docking priority and causing disorder.
- Although, conventionally, docking is organized in sequence, some ship owners may attempt to push ahead, or maneuver around others to dock or leave the port, leading to traffic safety issues and negatively affecting the port's loading and unloading capacity.
- Wastewater and solid waste generated in excess of the subproject's treatment capacity of the designed waste treatment facilities (WWTP, waste storage facilities).

This impact level is considered **Low** because the works in the port have been calculated and designed according to regulations to ensure the sustainability of port operation (with the demand of Khanh Hoa Major Fishery Center of 250 ships/turn and the accommodation capacity of

1000 ships docking) and all infrastructure for the operation of the fishing center fish are also invested. However, if such incidents persist over an extended period, they may pose risks of port infrastructure degradation, potentially leading to damage to docking facilities and resulting in certain losses. This impact can be mitigated by appropriate port operation management measures.

❖ ***Risk of falling into the river/sea and drowning for boat drivers/fishermen on board:***

Such incidents are typically flagged during embarkation or disembarkation at docking areas, or in the event of vessel collisions, where individuals onboard may lose balance and fall, slip, or tumble into the sea. Although the docking areas are often designed with guard rails and warning signs, fishermen remain at risk of falling into rivers due to slippery surfaces, which can lead to drowning. During the rainy and flood seasons, transportation vehicles operating in these areas may also slip and fall into the sea. This affects the health and even causes the lives of fishermen operating in and out of the port.

❖ ***Accidents due to collisions and traffic accidents:***

Risk of collision between vehicles: With the involvement of a variety of vehicles (trucks, boats, forklifts, cranes, etc.) in the port area, collision accidents may occur, especially when vessels operate under limited visibility conditions, or lack of proper separation and routing.

Road traffic accidents: Vehicles transporting seafood between ports and the mainland can cause traffic accidents due to poorly prepared roads or careless driving behavior.

(ix) Occupational accident incidents

During the operation period, there will be about more than 35 operators and about 1,100 fishermen/guests/traders operating at the Khanh Hoa Major Fishery Center. In operation of the fishing port, there will be potential risks and incidents of occupational accidents, especially in a complex working environment involving loading and unloading seafood, product transportation, and the operation of mechanical equipment. The following are potential risks and incidents:

Accidents caused by the use of motorized equipment (cranes, forklifts, etc.):

Risks from lifting equipment, cranes: Using cranes and forklifts to load and unload seafood from ships ashore or from shore into storage warehouse can cause accidents if the equipment is not adequately maintained or operated incorrectly. Accidents may include falling heavy objects, snapped cables, or equipment malfunction.

Risks from electrical equipment and machinery: The operation of heavy machinery such as pumps, generators, or other motorized equipment may lead to electric shock, fire and explosion accidents if safety regulations are not observed.

Accidents due to unsafe working conditions:

Falls, trips, slips: : Due to continuous movement on wet and slippery surfaces (caused by grease, seawater, or seafood waste), workers operating in unloading and storage areas are at risk of slipping, falling, or even tumbling into the river.

Accidents from fire and explosion:

Risk of fire and explosion from flammable materials: Substances such as oils, fuels, chemicals used in seafood processing or storage may lead to fire and explosion unless being handled and stored properly. Additionally, the use of electrical and mechanical appliances may result in electrical shorts or sparks, increasing the risk of fire.

Fire due to improper discharge: Flammable wastes such as oil, grease from boats, cranes, or from seafood processing may cause fires if not collected and disposed of properly.

Health and disease accidents:

Risk of infectious diseases: Working in humid environments and exposure to seawater can lead to infectious diseases, especially those related to the respiratory tract, skin, or waterborne diseases.

Respiratory diseases: Long-term exposure to dust from seafood or emissions from ships can cause respiratory diseases such as pneumonia, bronchitis, or other chronic diseases.

Diseases caused by marine life: Exposure to marine life can lead to injuries, infections, or poisoning due to toxins from seafood or other marine life.

Accidents due to environmental factors:

The accident occurred due to environmental factors at other ports as follows:

- Risks due to extreme weather conditions: Weather conditions such as heavy rain, storms, and strong winds can increase the risk of accidents for workers working outdoors, especially those working on docks.

- Risks from sea waves and surge: Working in conditions of high seawater or strong waves may expose workers to risks of being swept away or encountering accidents while operating on vessels or at the dock.

- Fish holds containing miscellaneous fish which are sorted for long period at sea will generate toxic gases. The deeper the fish holds and the longer the voyage, the higher the risk of oxygen deprivation for fishermen working in the fish holds, leading to acute poisoning, fainting, or even death.

- In the receiving and sorting areas where washing activities are frequently carried out and seafood is handled, the floor is always wet, increasing the risk of slips and falls during the lifting and transporting of seafood containers and trolleys.

- Slip-and-fall accidents during the loading and unloading of seafood from vessels to the port, including incidents where seafood containers fall onto workers.

In general, the risk related to occupational accidents at Khanh Hoa Major Fishery Center **is Moderate** because (i) these impacts are always potential to occur on the port at any time; (ii) the number of operators, fishermen/guests/traders operating on the port is quite large (about 1,200 people); (iii) these risks may persist the long term during the fishing port operation period, but they can be mitigated by appropriate measures such as occupational safety training before and during operation and providing personal protective equipment for workers, etc.

(vii) Potential environmental risk incidents

❖ **Oil spill:**

For the operation of Khanh Hoa subproject, an oil spill incident may occur due to: (i) Vessel capsizing; (ii) Waterway traffic accidents; (iii) Leakage or spillage of oil from vessels transporting seafood in and out of the port and (iv) storms, winds, low pressures and other extreme weather events.

Once an oil spill occurs, an oil-water mixture is quickly formed and spread after about 3-6 hours. The oil gradually dissipates through weathering related to various of physical and chemical processes, such as natural dispersion by wind and currents, sedimentation, evaporation, or the

formation of oil suspensions floating on the water surface. This spill will harm the natural environment and economic activities in the area. Specifically:

- Part of the oil products will sink and decompose on the seabed, polluting the water and sediment, while another part may float with air bubbles from the seabed. Oil residue on the seabed is a source of water pollution in the port, affecting benthic organisms that are a food source for aquatic life.
- When the water source is contaminated with oil, the decomposition oil products reduce the water source's ability to clean itself because the plankton and benthic organisms involved in the process die or decrease in number.
- When oil is spilled into water sources, the level of dissolved oxygen decreases because oxygen is consumed during the oxidation of oil products. Additionally, oil slicks on the surface hinder the aeration process, limiting oxygen exchange between the water and the atmosphere.
- Ships passing through Khanh Hoa Major Fishery Center have a capacity of 90 – 600CV and contain about from 0.152 to 16,188 tons of DO. The oil spill potential is always to happen in the port at any time, especially in flood season when maritime accidents and vessel capsizing are more likely.

The impact is assessed at a **Moderate** level because (i) the port area is arranged with a docking station in the form of anchorage suitable for each type of ship with different capacity, length as well as purposes as required by vessel owner. The length and width of the berths are configured to support cargo handling operations and ensure convenient access to services such as loading, unloading, and other port-related activities for vessels arriving at the port; (ii) The navigation channel area and the turning area are designed to ensure appropriate width, channel depth, turning radius, and maneuvering space, thereby reducing the risk of congestion, collisions, and inconvenience during vessel berthing and service operations at the port. (iii) Shipowners who drive ship to enter and exist the port regularly have long practical experience so there are insignificant risks of collision, overturning, leakage of materials as well as adapting to changes in weather and climate in the region.

This incident can be mitigated through a vessel management plan and a response plan in the event of an oil spill.

❖ ***Environmental incidents caused by fire and explosion:***

Cause: being analyzed and forecasted above, the environment in the area contains fuel vapors, so the potential of fire incidents is high when exposed to high heat sources or electrical short circuits.

The power supply for the machinery, technical equipment, electrical systems in the auxiliary facilities, warehouses, yards, operators, etc. could be at risk of short circuits, fire, and explosions, causing damage to both people and property. Additionally, the area containing fuel vapors used for refueling vessels is prone to high risk of fire incidents when exposed to high heat sources or electrical short circuits. This fuel storage area is at high risk of fire and explosion. Fire incidents in Khanh Hoa Major Fishery Center could cause damage to both human life and property within the port area. This may lead to a fire spreading to storage areas, posing serious threats to the safety of port staff and workers.

Affected group: This could cause damage to human life (about 35 operators; 1,100 fishermen and guests/traders on the port and property. However, as the neighboring residential area is located over 100 meters away and separated from the port, it is less likely to be affected.

- The impact level is assessed as Low and controllable because (i) Functional areas are all designed with fire protection measures and on-site fire-fighting equipment, such as fire extinguishers, (ii) The arrangement of products and materials for the fishery service is allocated to specific zones with instructional signage, and dedicated personnel responsible for management and compliance with operational procedures at the port; (iii) No incidents of electrical short circuits or fires have been recorded in the port area or surrounding residential zones (iv) Such incidents are considered controllable, as the port management board undergoes regular trainings on fire prevention and response and (v) The port area is landscaped with greenery, and water supply infrastructure has been designed with a fully equipped fire protection system.

❖ ***Incidents of broken water supply and drainage pipelines and damage to wastewater treatment systems***

During the operation, water supply and drainage pipeline and wastewater treatment systems may encounter the following incidents:

- Breakage or cracking of water supply pipelines due to unsafe construction materials.
- Water pipeline broken due to external force.
- The wastewater treatment system encounters problems such as damage to treatment equipment, leading to untreated wastewater flowing into the environment.

Such incidents, when occurring, will lead to water wastage (for clean water supply) and discharge of environmental pollutants (for wastewater). However, the likelihood of these impacts is considered low, as the water supply network is installed in technical compartments, and water supply areas are equipped with a pressurized valve system to detect leaks in the pipeline system.

The broken wastewater treatment system will increase the level of air and water pollution as assessed in the above sections.

In addition, the materials used for pipelines are fire-resistant, corrosion-resistant, and highly durable, resulting in a very low risk of breakage or leakage. WWTPs are designed with independent operating modules, with backup system, and equalization tanks that can be stored for up to 24 hours when all modules fail. Therefore, the impact from these incidents is minor and can be controlled through appropriate measures.

✓ ***Risks and incidents due to wastewater treatment plant***

In addition to risks from vehicles and equipment operating WWTP, there are also risks stemming from humans and funding sources in the operation and maintenance of WWTP. These risks include but are not limited:

- The WWTP operators' failure to comply with the operating process instructions that have been developed for the WWTP.
- The operators lack sufficient knowledge and qualifications to operate the WWTP.
- Weakness in human resource management during the operation of the WWTP.
- Infrequently periodic maintenance, replacement or repair of damaged machinery and vehicles.
- Improper frequency and volume of sludge collection, which may result in reduced treatment efficiency of the WWTP and failure to meet current national technical standards.

The above risks, if occurring, will reduce the wastewater treatment efficiency of the wastewater treatment and affect the quality of receiving water sources and the aquatic ecosystem in Cam Ranh Bay in the port area. However, the risk is assessed as "Low" and can be minimized: (i) The

operation of the WWTP is carried out by engineers who are knowledgeable and qualified in wastewater treatment technology; (ii) The operation will be arranged in shifts and always have staff on duty, operating in accordance with the regulated instructions; (iii) The WWTP is periodically inspected and maintained daily or immediately when an incident occurs; (iv) Replacement of machinery and means are always available in case of damages.

Furthermore, before officially put into operation, the subproject must register for trial operation and apply for an environmental license.

4.5 KIEN GIANG MAJOR FISHERY CENTER UPGRADING SUBPROJECT

4.5.1. Impacts and risks in the preparation phase

4.5.1.1. Impact due to land acquisition

The total area to be acquired for implementation of the Kien Giang subproject is approximately 15.78 ha, of which:

- The area for construction of work items is 11.27 ha, including: 1.83 ha of wet rice farming land; 5.52 ha of perennial cropland (fruit trees such as mango, pomelo, orange, jackfruit, etc.); 1.68 ha of rural residential land; 0.14 ha of non-agricultural production and business land; 2.09 ha of land for public purposes;
- The land area planned to build resettlement site for households who are subject to relocation due to construction of the subproject is 4.51, including: 4.45 ha of wet rice farming land and 0.06 ha of specialized land (transportation land).

The total number of households affected by the Kien Giang project is 102, all of whom lose their agricultural production land. Additionally, 68 households lose their residential land and need to relocate; 26 households were affected by non-agricultural business operations. Two organizations were impacted, including: the Tay Yen A Commune People's Committee and one business establishment. The impacts of land acquisition on households and organizations are assessed as follows:

Impacts on residential land: There are 68 households losing residential land and must relocate for resettlement. The relocated residents face the following issues:

- Loss of houses and community relationships: When relocated, they will lose the long-established relationships with neighbors, village communities, and extended families
- Disruption of daily activities: Relocated households will need to adapt to and familiarize themselves with the new environment and customs. For families with young children, relocation may involve changing schools or facing longer distances to schools compared to their previous residence.
- Impact on the access to public facilities and infrastructure: The technical infrastructure in the new residential area may not be as adequate or convenient as in the previous location, causing concerns and worries for the relocated people regarding convenience and support for their work and daily family activities.
- For those relocated but still retaining agricultural land in the previous area: impact on the production, harvesting, and transportation of agricultural products, increased costs, longer time and distances for transporting agricultural supplies, distribution, procurement, and consumption of products, as well as job challenges for families. Consequently, this affects their income and production or business plans.

In addition, households that are not subject to relocation - those who only lose part of their land—will remain at their current location for livelihood and living. However, these households still face the following impacts:

- The income structure of these households has changed due to the loss of parts of roadside land and riverside land used for business activities. This is because the infrastructure has not yet been adequately developed, leading to a decline in income and revenue compared to before land acquisition.
- The lives of residents are disrupted and altered due to the dismantling, acquisition, and reduction of residential land, leading to social impacts such as reduced income during the land clearance and construction phases, changes in people's habits and customs, and increased social risks from labor influx (approximately 120 construction workers), such as social issues, sexual abuse, the spread of infectious diseases, and disturbances in social orders. However, once the project is put into operation, it will create opportunities for job development, increase income, and promote socio-economic growth not only for the local residents but also for the entire project area (An Bien district, Kien Giang province).
- Increased impacts from the construction of project components, affecting mental and physical health if there are no measures or facilities in place for environmental protection to mitigate the impacts and emissions during the construction process.

Impact on agricultural land:

- There are 6.29 ha of rice farming land affected, most of which is single-crop wet rice land
- Perennial crops: a total of 5.52 ha of perennial cropland is affected. The main crops include nipa palm, orange, lime, pomelo, and jackfruit (grown in household gardens).

Among six subproject, Kien Giang subproject has the largest area of agricultural land to be acquired. According to preliminary survey results, all households are subjected to agricultural land acquisition, with an area less than 30% of their total agricultural production land. The acquisition of agricultural land impacts people's employment and livelihoods, as well as their income. The socio-economic impacts due to agricultural land acquisition, particularly rice land, are shown as follows:

- At the macro level: The acquisition of agricultural land may impact agricultural growth. However, the area of rice land acquired for this subproject accounts for a very small proportion compared to the total rice cultivation area of the other subproject provinces, so the impact on local agricultural growth is negligible.
- At the micro level: Households engaged in cultivation have an average income of about 4-6 million VND per month, but this income is unstable. The residents in the subproject area mainly earn income from other sources such as business, trading, and labor work. Those who lose agricultural land will face a reduction in their daily food supply and a decrease in income from selling agricultural products (rice, crops, aquatic products, and fruits). This is the primary source of income for households in the area. The loss of this income will lead them to face issues related to food security and annual income to cover living expenses. However, since the land area lost of household is small (accounting for a very small proportion of the agricultural land currently cultivated), the reduction in income and food supply is also not significant.

Impacts on houses and structures:

- Grade IV houses: There are 41 Grade IV houses affected, with a total area of 2,460 m². Most of the houses offer minimal amenities and functionality, typically featuring only 1–2 shared rooms, a shared kitchen, and shared restrooms. The quality of the interior and exterior finishes is low, with plastering and limewashing but no tiling. The structure includes load-bearing columns, enclosing walls, and non-combustible flooring materials. However, the roofs and ceilings are made of flammable materials (e.g., asbestos cement, metal sheets). The overall usage quality is low, with a lifespan of less than 20 years.
- Temporary houses: There are 27 temporary houses, with a total area of about 1,350 m². The structures consist of various types of steel frames and mixed timber (square or round wood with a diameter of over 15 cm), with roofs made of metal sheets, asbestos cement, or nipa palm in some cases. The walls are made of metal sheets or wooden planks, and the floors are constructed with bricks.
- Other structures include concrete yards; water tanks (25 units); wells (23 units); bathrooms and toilets (28 units); and other constructions such as gates and fences.

Impacts on sensitive receptors: Approximately 60 graves in the gardens of households are affected, most of which are constructed with bricks and various types of stone. The relocation of these graves will be carried out in compliance with legal regulations to ensure the project’s smooth implementation. The impacts of the grave relocation process on the lives of the people are as follows:

- Impact on the spiritual and customary aspects of the community.
- The relocation cost is not limited to demolition, excavation, and building new graves; it also includes expenses for rituals and waiting for an “auspicious day.”
- The relocation of graves that do not address the aforementioned issues and the compensation that is not realistic may not only result in social impacts but also create conflicts between the affected individuals and construction workers, prolonging the land clearance process.

The relocation of graves within the Kien Giang subproject area is expected to be carried out by the households themselves. The project owner will coordinate with the local People’s Committee to arrange an area for the reburial of the graves. These impacts are unavoidable, but the project owner and local authorities will provide their best support to help the households quickly stable the new burial sites.

Impacts on infrastructure: This subproject affects approximately 2.5 kilometers of rural roads (concrete roads) in the Nga Bat Village residential area, along with about 1.5 kilometers of low-voltage power lines and about 1.5 kilometers of water supply pipelines. The infrastructure affected within the permanent acquisition area of the Kien Giang subproject will be restored by investing in new construction (transportation, electricity, water systems, etc.) in the resettlement area, along with the relocation of the entire population within the permanent acquisition area.

In general, the impact level of land acquisition for the Kien Giang subproject is significant and irreversible. It affects the income of 102 households who lose agricultural production land. Among them, 68 households are also affected with residential land and must relocate to a new resettlement area. However, these households will be provided with accommodations in the new resettlement area and will only experience partial income impacts, as they are already engaged in other occupations such as agricultural production (with remaining cultivable land in the area), fishing, and aquaculture. These impacts will be mitigated through income restoration measures outlined in the project’s Resettlement Plan (RP).

4.5.1.2. Safety risks related to unexploded ordnances

As the Kien Giang subproject is newly built, unexploded ordnance clearance will be carried out in entire the construction area and resettlement area of Kien Giang subproject (about 15.78ha).

If no demining and explosive ordnance clearance activities are carried out in the subproject area, there is a risk posed during the construction phase of the main project components due to bombs and explosive materials leftover from the war. The directly affected groups include construction workers, residents of Tay Yen A commune located 50–150 meters from the subproject area, and the surrounding infrastructure of the Kien Giang subproject.

This impact is assessed as medium but long-lasting, affecting the mental health, physical well-being, property, and lives of workers and nearby residents in the event of an incident. Additionally, the detonation of unexploded ordnance and explosives poses widespread effects, affecting air quality and degrading soil quality. However, this impact can be mitigated through demining and explosive ordnance clearance conducted by specialized units.

4.5.2. Impacts and risks during construction phase

4.5.2.1. General Impacts and risks

(i) Impacts on ambient air quality

The sources of Kien Giang subproject's impact on ambient air quality during the construction phase include: (i) Dust generated from activities for site preparation; (ii) Dust generated from earthworks and ground leveling; (iii) Dust generated from the transportation of construction materials; (iv) Dust generated from waste transportation; (v) Dust generated from the storage and unloading of construction materials; (vi) Emissions from vehicles transporting materials and wastes; (vii) Emissions from the operation of construction equipment/machinery. Assessment of impact sources is detailed below.

❖ Dust generated from demolition, vegetation clearance for site preparation

Dust sources from site preparation for Kien Giang subproject mainly come from demolition of existing structures and vegetation clearance. The amount of demolition/vegetation clearance is as follows:

- Demolition of about 41 Grade IV houses affected, with a total area of 2,460 m²; 27 temporary houses, with a total area of about 1,350 m²; and other structures including concrete yards and water tanks (25 units);
- Relocation of 60 graves scattered in the gardens of households;
- Clearing vegetation on approximately 5.52 ha of perennial cropland, primarily consisting of nipa palm, orange, lime, pomelo, jackfruit, and other similar crops.

The demolition volume has been calculated to include 2,500 m³ of debris such as brick fragments, plaster fragments, wood, steel, etc., from the demolition of houses and existing architectural structures of residents, along with 107 m³ of biomass from vegetation clearance of perennial crops and shrubs within the project area, totaling approximately 2,607 m³. The demolition of these structures will generate dust.

The amount of dust generated from the demolition of houses and existing structures is determined according to formula [1] and the formula [2] is used to calculate the dust emission factor. The dust pollution factor due to the demolition of existing structures calculated is as follows: $E = 0.01255 \text{ kg/ton}$ ($k = 0.2$; U (wind speed) = 3.1 m/s; M (average debris moisture) = 20%), with a

demolition/clearing duration of about 6 months. Based on these algorithms, the amount of dust generated from the demolition of existing structures and vegetation clearance for the Kien Giang subproject is 0.273 kg/day, and the dust concentration is 0.06 mg/m³, which is lower than the permissible limit according to QCVN 05:2023/BTNMT (permissible limit: 0.3 mg/m³).

Dust generated from demolition and clearing activities will affect workers and people in existing Tay Yen A residential area (located from 50-100m away from the site).

The impact level is assessed as **Medium** because (i) the dust concentration meets the permissible standards, (ii) the impact period is short (about 6 months), (iii) the affected people are not numerous, mainly workers and some people living near the subproject area, located about 50m away and (iv) this impact can be mitigated by appropriate measures.

For biomass from vegetation clearance, the project owner lets local people collect all agricultural productions before clearing the site. As a result, the actual biomass amount generated by the project is only 30% of the above-calculated volume.

❖ ***Dust generated from earthworks and ground leveling***

Dust arising mainly from the earthwork and ground leveling of Kien Giang Subproject is assessed to be the most significant source in the construction phase as this is the newly built work. The volume of soil/sand from earthwork and ground level of the subproject is significant (estimated 163,338 m³ backfill sand), the leveling lasts 6 months.

Based on formula [2], we determine the dust pollution emission coefficient due to earthwork, ground leveling of Kien Giang subproject as follows: $E = 0.02068 \text{ kg/ton}$ ($k = 0.2$; U (wind speed) = 3.1 m/s; M (average moisture of backfill sand) = 14%).

Based on the algorithms/formula [1], the amount of dust generated from the ground leveling of Kien Giang subproject is 18.77 kg/day and dust concentration generated is 2.08 mg/m³, 6.9 times higher than allowable limit in QCVN 05:2023/BTNMT (permissible limit: 0.3 mg/m³).

Dust generated from earthworks and ground leveling of Kien Giang subproject will affect construction workers, local people in existing Tay Yen A commune (located about 50-100m away from the site), Ba Nga Bat Shrine (located about 100m away), Ong Bon Shrine (located about 100m away).

The impact level is assessed as **medium** because: (i) The dust concentration exceeding the standard is significant but this area is located near Cai Lon river and has open layout; (ii) The impact is short-term (about 6 months); (iii) the affected people is not numerous as the population in Tay Yen A is sparse and scattered, located 50–150 meters away, with sensitive structures situated over 100 meters away, and (iv) these impacts are mitigated through appropriate mitigation measures.

❖ ***Dust from transportation of construction materials***

The dust generated from the transportation of construction materials originates from the materials being transported (due to wind and river waves) during the transport process via diesel-powered waterway vehicles (400-ton barges) on the Cai Lon River. The average transport distance is 10–15 km to the construction site of the Kien Giang subproject, with non-continuous transportation over the estimated 36-month construction period.

To construct the works under the Kien Giang subproject, a large volume of basic materials will be required, including cement (10,099 tons), sand (440,706 tons), stone (39,272 tons), and steel (1,770 tons). These materials will be purchased from material disposal sites and shops near the subproject

area.

Applying the formula [3] and input parameters such as materials, backfill sand/soil, etc. of the subproject, the intermittent transportation period within 36 months of construction, the number of transportation trips calculated as 4 trips/day, the dust load generated from the transportation of construction materials, soil/sand for the subproject calculated is 0.13 (mg/m/s).

Using formula [4], dust concentration generated from transportation of material and backfill sand/soil for construction of Kien Giang subproject is lower than allowable limit of QCVN 05:2023/BTNMT within 1 hour (0.3 mg/m³).

The groups affected by the dust generated during the transportation of construction materials on the Cai Lon River in the Kien Giang subproject area include workers directly involved in transportation and a small number of fishermen navigating the waterways in the region.

The impact level is assessed as Low because (i) the dust concentration is lower than the permissible standard, (ii) the impact is long-term but intermittent over approximately 36 months of construction, (iii) the affected people is minimal (mainly workers and a small number of fishermen navigating the waterways in the region, and (iv) this impact can be mitigated through appropriate measures.

❖ *Dusts generating from waste transportation*

Dust from transportation of waste arises from the dredged materials/excess excavated soil and is swept up from vehicle tires during transportation by diesel vehicles. Solid waste of Kien Giang subproject is from the demolition/clearance, excess excavated soil, dredged materials from navigation channels, turning basins, and ship lanes, as well as construction debris (excess cement, lime mortar, brick fragments, steel scraps, cardboard, etc.).

For dredged materials from navigation channels and turning basins (approximately 5,432 m³), they will be directly deposited at storage areas within the construction site for subsequent phases of the subproject. The excavated soil volume (12,459 m³) will be fully utilized for on-site filling within the subproject area. Therefore, there will be no potential for dust generation from the transportation of dredged materials or surplus excavated soil to storage areas in the Kien Giang subproject.

For debris from demolition/clearing activities (2,607 m³) and construction debris (4,419 m³), a contract will be signed with a functional unit for road transportation (using 10-ton trucks) to the local solid waste treatment area, located 15 km away. The transportation duration is 12 months, with an average of 1.95 trips per day (approximately 2 trips per day). Similarly, by applying formula [3] and the mentioned input parameters, the dust emission load calculated from this activity is 0.11 mg/m/s.

Using formula [4] - the Sutton model with a wind speed of 3.1 m/s and atmospheric stability classified as B, at a distance $x = 25\text{m}$ from the road centerline to both sides, the concentration of dust generated from transportation of waste of Kien Giang subproject, is below the allowable limit of QCVN 05:2023/BTNMT within 1 hour (0.3 mg/m³) at a distance of 10m.

The affected group include workers and people in residential areas in existing Tay Yen A commune on the main transportation route of Kenh Moi and NH63, section through the subproject area.

The impact level is assessed as **Low** because (i) the dust concentration is lower than the permissible standard, (ii) the impact period is short-term (about 12 months) (iii) the impact is only limited to construction workers and some households scattered along Kenh Moi road and NH63, section to Kien Giang subproject site (iii) This impact can be mitigated by appropriate measures.

❖ *Dust from material gathering and loading and unloading:*

The construction of the subproject works will require a large amount of basic materials such as cement (10,099 tons), sand (440,706 tons), stone (39,272 tons), and steel (1,770 tons). The volume of materials will be purchased from material disposal sites and shops near the subproject area. Based on the dust emission coefficient generated from material loading and unloading of Kien Giang subproject, the dust load generated is 207.64 mg/m.s

Apply the formula [5], the dust load generated in 1 hour (mg/m³) during material loading and unloading activity of Kien Giang subproject is below permissible limit of QCVN 05:2023/BTNMT within 1 hour (0.3 mg/m³) at a distance of 10m.

Thus, the direct impact of these activities will be on construction workers and residents living in Tay Yen A residential area, located 50m away.

The impact level is assessed as **Low** because (i) the dust concentration meets the permissible standard, (ii) the impact is long-term but intermittent over approximately 36 months of construction, (iii) the impact is limited to construction workers and some households in Tay Yen A residential areas, located 50 away from Kien Giang subproject area, and (iii) this impact can be mitigated through appropriate measures.

❖ *Dust from vehicles transporting materials and wastes*

Emission comes from vehicles transporting materials of Kien Giang subproject such as cement (10,099 tons), sand (440,706 tons), stone (39,272 tons), and steel (1,770 tons) and waste such as debris (from demolition of structure/vegetation clearance (2,607 m³), construction debris (4,419 m³). As these vehicles use DO fuel, the emission contains products from the fuel combustion process of internal combustion engines such as NO_x, SO₂, CO.

The parameters of the number of transportation trucks and distance are as follows:

- The transportation of materials will be non-continuous over a period of 36 months via waterways, using barges with a capacity of 400 tons. The fuel consumption rate is 1.02 liters of diesel per barge per kilometer (1 liter of diesel equals 0.832 kg). The calculated number of barge trips is 4 trips per day, with an average distance of 10 km.
- The transportation of waste will be non-continuous over a period of 36 months by road, using trucks with a capacity of 10 tons. The fuel consumption rate is 0.4 liters of diesel per truck per kilometer (1 liter of diesel equals 0.832 kg). The calculated number of truck trips is 2 trips per day, with an average distance of 15 km.

Thus, the fuel consumption for these activities is 13.31 kg/day. Applying formula [3], we have emissions from these activities as below: SO₂: 0.0208 mg/m.s; NO₂: 0.1146 mg/m.s and CO: 0.583 mg/m.s.

As the emission load from the above transportation activities is quite low. However, to assess the impact of this activity on the ambient air quality, apply Formula [4] - **Sutton** model to calculate the concentration of pollutants in the emissions according to the distance (x) and height (z) of the emission load with the highest concentration of CO. The results of the concentration of emissions from transportation activities calculated meet QCVN 05: 2023/BTNMT - National technical regulation on ambient air quality.

Gases typically disperse quickly into the surrounding environment, leading to a rapid decrease in concentration. Therefore, the group affected by emissions generated during the transportation of materials and waste consists of workers directly involved in the construction process.

Impact level is assessed to be **Low** because (i) the concentration of emissions is lower than allowable limit; (ii) The impact is long-term but not continuous (about 36 months); and (iv) This impact can be mitigated by appropriate measures.

❖ **Emissions from operation of construction machinery**

Emissions are generated from the operation of construction machinery and equipment using diesel oil for internal combustion engines such as: Excavator, ground leveling machine, welding machine, grab dredger, generator, pile driving barge, pile press machine, concrete mixer, etc. Pollutants emitted contain products from the fuel combustion process of internal combustion engines such as NO_x, SO₂, CO.

Similarly, to calculate the number of emissions (CO, NO₂, SO₂) from machinery and equipment operating during construction, the report based on the document of NATZ Transport, Shun Dar Lin, 2005. With the oil using coefficient of 0.1 kg/ton, it will generate: SO₂ with 2.8 kg/ton of oil; NO₂ with 12.3 kg/ton of oil; CO with 0.05 kg/ton of oil.

Based on the number of input construction machinery and demand on fuel use for Kien Giang subproject as mentioned in Chapter 1, the average DO amount used is 4.48 liter/h. The estimated operation time of around 8 hours/day (1shift), intermittent over the construction period of 36 months.

Applying the formula [6], the load of dust and gases emitted from the fuel combustion of the construction machinery is as follows: 0.0742 g/s SO₂; 0.0105 g/s NO₂; 0.0026 g/s CO; 0.0742 g/s dust; 0.0742 g/s VOC

Applying Formula [4] - the Sutton model with a wind speed of 3.1 m/s and a distance of 5-10 meters from the emission sources, the concentration of exhaust gases from construction machinery all meet the QCVN 05:2023/BTNMT - National Technical Regulation on Ambient Air Quality.

Gases typically disperse quickly into the surrounding environment, leading to a rapid decrease in concentration. Therefore, the group affected by emissions generated during the transportation of materials and waste consists of workers directly involved in the construction process.

The impact level is assessed as **Low** because (i) The concentration of emitted gases lower than the allowable standard, (ii) the impact is long-term but intermittent (about 36 months), (iii) the affected people are not numerous, mainly workers and (iii) This impact can be mitigated by appropriate measures.

In general, the subproject's impact on ambient air quality of Kien Giang subproject area is assessed as **Low to Medium** because (i) the concentration of emitted gases all meets or slightly exceeds allowable limit, (ii) the impact is long-term but intermittent (mainly concentrated around 8-10 hours per day and intermittently over 36 months of construction), (iii) the impact is limited to workers directly involved in the construction and some households in Tay Yen A, located 50m away and some sensitive receptors that could be affected (Ba Ngat Bat Shrine and Ong Bon Shrine, located from 100m-200m) (iii) this impact can be mitigated through appropriate measures.

(ii) Impacts due to noise

During the construction phase of the Kien Giang subproject, noise arises mainly from: (i) the operation of trucks transporting construction materials and waste; (ii) the operation of construction machinery and equipment; (iii) dismantling/completing the construction items; and (iv) the activities of staff and workers involved in the construction.

Applying the typical noise standards for construction vehicles and equipment from the “U.S. Environmental Protection Agency - Noise from Construction Equipment and Machines NJID, 300.1, 31/12/1971” as shown in the table below. Applying formulas [10] and [11], the noise level will decrease with distance and is determined according to the formula of Pham Ngoc Dang 2003. Air environment. *NXB KHKH 2003*” as follows:

Table 4.60. Maximum noise by distance due to construction machines of Kien Giang subproject

No	Machinery and equipment	Noise at distance 2m	Average	Noise by distance (dBA)				
				5m	20m	50m	100m	200m
1	Truck 10T	71 ÷ 80	75.5	71.5	65.5	61.5	58.5	55.5
2	Floating crane 30T	86 ÷ 88	87	83.0	77.0	73.0	70.0	67.0
3	Canoes 12-75CV	80 ÷ 87	83.5	79.5	73.5	69.5	66.5	63.5
4	Barge 300-1000T	85 ÷ 92	88.5	84.5	78.5	74.5	71.5	68.5
5	Suction dredger 1200CV	89 ÷ 95	92	88.0	82.0	78.0	75.0	72.0
6	Tugboat 360-1200CV	83 ÷ 89	86	82.0	76.0	72.0	69.0	66.0
7	Mixer 250l	80 ÷ 94	87	83.0	77.0	73.0	70.0	67.0
8	Needle vibrator 1.5KW	74 ÷ 77	75.5	71.5	65.5	61.5	58.5	55.5
9	Excavator 2.3-3.6m ³	79 ÷ 82	80.5	76.5	70.5	66.5	63.5	60.5
10	Bulldozer 110-140CV	72 ÷ 79	75.5	71.5	65.5	61.5	58.5	55.5
11	Water pump 30CV	69 ÷ 71	70	66.0	60.0	56.0	53.0	50.0
12	Sand pump 126-350CV	72 ÷ 80	76	72.0	66.0	62.0	59.0	56.0
13	Watering truck 5m ³	78 ÷ 81	79.5	75.5	69.5	65.5	62.5	59.5
14	Vibratory roller 25T	58 ÷ 70	64	60.0	54.0	50.0	47.0	44.0
15	Air compressor 360 m ³ /h	85 ÷ 89	87	83.0	77.0	73.0	70.0	67.0
16	Generator 50kVA	85 ÷ 87	86	82.0	76.0	72.0	69.0	66.0
17	Pile driving machine/ship 1.2T	82 ÷ 84	84	80.0	77.0	71.0	68.0	67.0
Average noise level				75.6	69.6	65.6	62.6	59.6
Total noise level (maximum)				90.2	84.2	80.2	77.2	70.2
QCVN 26:2010/BTNMT: Normal area noise level				70 dBA				
QCVN 24:2016/BYT: Working area noise level				85 dBA				

According to the calculation results, the average noise level (equivalent noise level) at a distance of 20–30 meters from the vehicles and construction equipment is within the permissible limits of QCVN 26:2010/BTNMT and QCVN 24:2016/BYT, except at the distance of 5 meters, where the average noise level exceeds the allowable limit by approximately 5.6 dBA. However, the total noise level (maximum) at distances less than 200 meters from the source exceeds the allowable

standards of QCVN 26:2010/BTNMT. At distances greater than 200 meters, the total noise level meets the allowable standards.

The sensitive groups affected by noise of the Kien Giang subproject include workers and residents in the existing residential areas of Tay Yen A Commune, located 50 meters away, Ba Nga Bat Shrine, 100 meters away, and Ong Bon Shrine, 180 meters away. Additionally, mobile noise from waste transportation trucks (approximately 2 trips per day) passing through populated areas (some existing households in Tay Yen A commune along Kenh Moi road and National Highway 63) will also have an impact.

The noise level at the construction site is assessed as Medium because: (i) the noise generated is intermittent during the construction period, but the total construction period lasts for 36 months; (ii) the equipment operates non-simultaneously, depending on working stage/shift or the construction progress/volume of each item. Different types of machinery will be used at different times, so the cumulative impact at the same position is very low compared to the calculated results; (iii) Furthermore, all vehicles and equipment are regularly inspected, and the noise will cease once the construction activities are completed; and (iv) the noise can be minimized through mitigation measures such as providing personal protective equipment and noise reduction devices.

(iii) Vibration impact

Vibration arises mainly from equipment, machines that operates with high capacity and regularly on the construction site such as bulldozers, excavators, air compressors, pile-driving ships, etc.. from leveling activities, driving piles to reinforce embankments/ports. The typical vibration levels of some construction machinery and equipment are presented in the table below.

Table 4.61. Vibration of some typical construction machinery and equipment

No.	Machinery and equipment	Reference vibration (vertical direction, dB)
1	Excavator	80
2	Bulldozer	79
3	Heavy truck	74
4	Roller	82
5	Gas compressor	81
6	Pile driving ship	80

(Source: U.S. Environmental Protection Agency. Vibration from construction equipment and construction machinery NJID, 300.1, 31 – 12 – 197)

Applying the formula [9] to predict the vibration reduction levels over distance that may occur within the construction site of the Kien Giang subproject, results are presented below.

Table 4.62. Vibration reduction by distance in construction

No	Machinery and equipment	Source vibration (r ₀ =10m)		Vibration 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

No	Machinery and equipment	Source vibration (r ₀ =10m)		Vibration 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)
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	Gas compressor	81	1.93	71.5	0.65	62.1	0.22	52.9	0.08	43.6	0.03
6	Pile driving ship	80	1.88	70.7	0.56	61.2	0.18	51.2	0.06	41.8	0.03

QCVN27:2010/BTNMT, allowable limit 75dB from 6 ÷ 21h and baseline limit from 21h÷6h.

DIN 4150, 1970 (Germany), 2mm/s: no damage; 5mm/s: mortar peeling; 10mm/s: likely to damage load-bearing parts; 20 ÷ 40mm/s: damage to load-bearing parts.

According to the calculation results, the vibration level from construction vehicles and equipment at a distance of 12 meters is within the permissible limit of QCVN 27:2010/BTNMT (<75dB) and will decrease as the distance from the vibration source increases.

Mainly the vibration of construction equipment directly impacts construction workers and structures at the construction site.

In general, the level of direct impact due to vibration is assessed as MINOR because: (i) The operation time of equipment is intermittent, with localized impacts at the construction site (the piling process for reinforcing the port embankment is expected to last from three to six months); (ii) Equipment operators work in shifts and are provided with personal protective equipment; (iii) The surrounding area of Kien Giang Subproject is quite open, except some households scattered near the construction site, located 50m-100m away; However, these are separated by existing garden plots, green spaces, or farmland (iv) The impact of vibrations can be fully mitigated by applying appropriate construction methods and planning tailored to each specific location.

Impact on vibration to current structures by the port embankment construction activities:

Kiên Giang sub-project will also apply the method of pile driving using specialized vessels to reinforce the quay footings and port docks with PHC piles of approximately 25m in length. This method ensures the stability of the structure but may cause strong vibrations, which could potentially lead to cracking, damage, or collapse of nearby structures.

However, the area where the pile driving will take place is entirely within the port's premises, which will be cleared of any obstructions and is located more than 150m away from residential buildings, existing structures, and facilities. Therefore, there will be no potential risk of cracking or collapse of nearby roads or structures.

(iv) Wastewater impact

Domestic wastewater from construction workers:

Domestic wastewater during the construction phase of Kien Giang subproject originates from workers' activities. Expectedly, 120 workers will be mobilized and they will reside in the

temporary camps. The estimated water supply norm is 50 liters/person/day. Assuming that 100% of the supplied water is converted into wastewater, the total generated domestic wastewater is calculated as 6 m³/da.

Domestic wastewater contains components such as: suspended solids (TSS), organic matter (BOD₅, COD), nutrients (N, P) and pathogenic microorganisms. The amount of pollutants emitted by 120 people (calculated according to the largest number of workers that can be mobilized at the camp) and the concentration of pollutants released into the environment are given in the following Table:

Table 4.63. Pollutant load in domestic wastewater

Pollutants	Pollution coefficient (g/person/day)		Load (kg/day)		Pollutant concentration (mg/l)		
					Before treatment		QCVN 14:2008 column B
BOD ₅	45	54	5.4	6.48	642.9	771.4	50
COD	72	102	8.64	12.24	1028.6	1457.2	-
TSS	70	145	8.4	17.4	1000	2071.5	100
Grease	10	30	1.2	3.6	142.9	428.6	20
Total Nitrogen	6	12	0.72	1.44	85.8	171.5	50
Ammonia (N-NH ₄)	2.4	4.8	0.288	0.576	34.3	68.6	10
Phosphor	0.8	4	0.096	0.48	11.5	57.2	10
Total Coliforms	1.00E+06	1.00E+09	1.2E+05	1.2E+08	1.4E+07	1.4E+10	5000 (MNP/100ml)

(Source: Pollutant load factor in domestic wastewater according to documents from Metcalf and Eddy, *Wastewater Engineering – Third Edition*, 1991)

The load and concentration of pollutants such as BOD, COD₅, TSS, NH₄⁺... in domestic wastewater during the construction phase of subproject works, if not treated, all exceed the allowable limit of QCVN 14:2008/BTNMT (column B). Thus, if domestic wastewater is not adequately treated before being discharged into receiving sources, the concentration of pollutants increases, the quality of surface water of Cai Lon river declines, and aquatic species are directly affected.

Thus, the domestic wastewater will affect the surface water quality and aquatic species in Cai Lon river. Beside, workers gathered in worker camps at Kien Giang subproject area will be directly affected by this wastewater source.

The risk level is assessed as Low as: (i) the amount of wastewater generated is not large at each worker camp (6 m³/day); (ii) the wastewater is generated intermittently during the day (mainly during the workers' rest and living hours but extended over approximately 36 months of construction); (iv) The flow rate of the receiving source, the Cai Lon River, is quite large (Approximately 200–300 m³/s, the wastewater discharge from workers accounts for only 2% to 3% of the flow rate of the Cai Lon River). Additionally, local labor will be hired, and they will return

home instead of staying in temporary camps (usually accounting for about 30-40% of the total labor force), so the actual amount of wastewater generated is much lower than calculated. These risks can be mitigated through appropriate mitigation measures.

Construction wastewater:

Wastewater during the construction phase of the Kien Giang subproject comes from (i) washing the wheels before leaving the construction site; (ii) the operation of small-capacity mortar and concrete mixers used for casting small components (the rest is commercial concrete which is to be purchased); and (iii) washing construction equipment and tools. The total amount of construction wastewater generated is approximately 5.08 m³/day. Among them:

- Motor vehicle washing water is mainly used to clean the wheels before leaving the construction site. According to TCVN 4513-1988, internal water supply - design standards, the amount of water used to wash the entire vehicle is rated at 500 liters/wash, but during the construction phase, motor vehicles mainly only wash the wheels, so estimated average amount of wheel cleaning water is 100 liters/vehicle. The number of vehicles transporting materials (the remaining is 400-ton barges for transporting construction materials) is estimated to be 2 vehicles per day, resulting in the wastewater generated being: $2 \times 100 = 200$ liters per day = 0.2 m³ per day.
- Concrete mixing activities at construction sites use 250l concrete mixers, total capacity of 30 m³/h. According to the document, *Concrete Technology and Special Concrete by Pham Duy Huu, Construction Publishing House 2009*, the concrete mixing process with a capacity of 30m³/h will require 9.69m³ of water to wash aggregate and 5.4 m³ of water to mix concrete. Of which, 80% of the aggregate washing water will be recirculated and reused. Thus, wastewater generated during the concrete mixing process for each project is $20\% \times 9.69 = 1.94$ (m³/h). On average, concrete mixing activities take place 2 hours/day, so the amount of wastewater generated from concrete mixing activities is $1.94 \times 2 = 3.88$ (m³/day).
- Construction equipment and machinery are washed once at the end of each construction day, estimated to be about 1 m³/day.

The amount of construction wastewater generated is not large, and the wastewater mainly consists of suspended solids, oils and grease, soil, sand, etc. When being directly discharged into the Cai Lon river in the Kien Giang subproject area, this wastewater will cause several impacts as follows: High levels of suspended solids, increasing the turbidity of the water, reducing the ability of oxygen dissolution from the air into the water, thereby adversely affecting the aquatic life in the Cai Lon River; Sedimentation build up in the receiving body, which is the surface water of the Cai Lon river.

The impact level is assessed as **Low** because: (i) the volume of construction wastewater generated at the site is not large (5.08 m³/day); (ii) the wastewater is concentrated in the construction site areas; (iii) the wastewater is generated intermittently throughout the day (mainly 2 to 8 hours of construction but extends over approximately 36 months of construction); (iv) The flow rate of the receiving source, the Cai Lon river, is quite large (Approximately 200–300 m³/s, the construction wastewater flow accounts for only about 2% of the flow rate of the Cai Lon river) and (v) the risks can be mitigated through appropriate measures.

Rainwater runoff

Based on TCVN 7957:2008, rainwater runoff flowing through Kien Giang subproject site is calculated according to the formula [10], the construction area of Kien Giang subproject is $F=11.27$

ha (not including water surface area); the parameters based on the climate constants of Kien Giang province (refer neighboring province as Tra Vinh) are: $A=9150$; $C=0.53$; $b=28$; $n=0.97$. Substituting these values into formula [11], the calculated rainfall intensity at Kien Giang subproject construction site is: $q=103.749$ (l/s.ha). Therefore, the rainwater runoff flow rate on the construction site is calculated to be 467.7 l/s, equivalent to $0.468 \text{ m}^3/\text{s}$ and $1.685 \text{ m}^3/\text{h}$.

According to WHO data (1993), the concentration of pollutants in rainwater runoff is about 0.5 - 1.5 mg N/l, 0.004 - 0.03 mg P/l, 10 - 20 mg COD/l and 10 - 20 mg TSS/l, these parameters are lower than the allowed standards according to QCVN 40: 2011 / BTNMT - National standards on industrial wastewater quality. However, rainwater flows over the construction site area, carrying away materials, loose soil and rocks, mineral salts on the surface, leaked oil and grease, etc., increasing the content of suspended substances and impurities, organic matter, increases turbidity, oil and grease in water, reduces water quality of Cai Lon river, and negatively impacts the aquatic ecosystem of Cai Lon river.

The impact level is assessed as **Medium** because: (i) the amount of rainwater runoff at the construction site is moderate ($1,685 \text{ m}^3/\text{h}$, the heaviest rain lasts 1.5 hours); (ii) rainwater runoff is concentrated in the construction site areas; (iii) the rainwater runoff is usually intermittent throughout the year (the rainy season is from May to November but extends over approximately 36 months of construction); (iv) the flow rate of the receiving source, the Cai Lon River, is quite large (Approximately $200\text{--}300 \text{ m}^3/\text{s}$, equivalent to $25.92 \text{ m}^3/\text{day}$); and (v) the risks can be mitigated by appropriate measures such as regular cleanup by workers at the construction site, installation of rainwater drainage systems, and sedimentation pits at each site to limit debris, loose soil, and rocks being washed away by rainwater runoff.

(v) Solid waste

Solid waste generated during the construction phase for Kien Giang subproject items includes the following 3 main types: (i) Construction solid waste; (ii) Domestic solid waste; (iii) Hazardous solid waste. The generated volume is evaluated as follows:

Construction Solid Waste:

The sources of solid waste generation in the Kien Giang subproject include demolition/vegetation clearance activities, excess excavated soil, dredged materials from navigation channels, turning basins, and ship lanes, as well as construction debris (excess cement, lime mortar, brick fragments, steel scraps, cardboard, etc.).

- For dredged materials from navigation channels and turning basins (approximately $5,432 \text{ m}^3$), they will be directly deposited at storage areas within the construction site for subsequent project phases. The excavated soil volume ($12,459 \text{ m}^3$) will be fully utilized for on-site filling within the subproject area. Therefore, there will be no potential generation of solid waste from dredged materials or excess excavated soil.
- For debris from demolition/clearing activities ($2,607 \text{ m}^3$) and debris generated during the construction of project components, including excess lime mortar, wood scraps, broken bricks, cement bag wrappers, trees, and wood used for scaffolding. According to *Decision No. 1172/QĐ-BXD dated December 26, 2012, issued by the Ministry of Construction stating the construction project estimate norms*, the estimated amount of construction solid waste generated is approximately 0.5% that of the materials used for the subproject, equivalent to about 4,419 tons.

The construction solid waste primarily affects the staff and workers involved in the construction, as this waste source increases dust concentration, which can impact the health of employees.

Randomly piled construction solid waste obstructs pathways with bulky items and slippery surfaces, which can cause accidents for employees and workers. Additionally, if the large volume of construction solid waste mentioned above is not properly collected and managed, it will be washed away by rainwater runoff on the construction site, reducing the quality of the receiving water source, the Cai Lon River. It can cause sedimentation and blockage of the surface flow at the port, leading to the risk of local flooding at the construction site and surrounding areas, especially during the rainy season (from May to November every year).

In general, this direct impact is assessed to be **Low** because: (i) The volume of waste generated is not large and localized at each construction site; (ii) the construction period is long term (about 36 months); (iii) construction solid waste will be temporarily gathered at a disposal site located within the premises of the construction area of the Kien Giang Major Fishery Center. (iv) Most of the dredged material (with main component of sand) could be used for future sand resource (for construction, backfill) through auction; At the same time, this impact can be minimized through appropriate mitigation measures.

Domestic solid wastes:

Domestic solid waste arises from daily activities of construction workers in camps which are planned to be installed in the construction site of Kien Giang subproject. This subproject will mobilize about 120 construction workers during 36 months. The average amount of household solid waste emissions is about 0.5 kg/person/day (according to QCXDVN 01:2021/BXD - National Technical Regulations on Construction Planning), the amount of daily solid waste generated is 60 kg/day, equivalent to 1.8 tons/months.

This waste component includes: organic matter, waste paper of all kinds, nylon, plastic, metal, damaged daily living items, etc. This waste contains 60 - 70% organic matter and 30 - 40% of other substances and especially may contain many bacteria and pathogens.

The direct impact will be on the workers participating in the construction and staying in temporary camps. Additionally, if the generated domestic waste is not collected and treated properly according to regulations, it can cause loss of beauty in the area. When waste is littered on the ground, under the effects of weather and bacteria, organic compounds decompose, it creates malodors that pollute the air, increase the risk of disease outbreaks, and affects the health of staff and workers participating in the construction and activities of nearby households in Tay Yen A commune, located 50m away from the site. Furthermore, if domestic solid waste is not collected and treated, it will be washed away by rainwater runoff, flowing into Cai Lon river at Kien Giang subproject area, reducing the quality of surface water and affecting the aquatic ecosystem of the Cai Lon river.

The impact is assessed as **Low** as: (i) The amount of household solid waste generated at the construction site is small (60kg/day); (ii) Although Tay Yen A commune has not had domestic solid waste collection system as consistent as other current urban areas, there are environmental and sanitation teams working in each village/commune in the subproject area; (iii) The impact duration extends over approximately 36 months of construction (iv) It can be mitigated through appropriate measures as collecting, classifying domestic solid waste at the site and contracting with local environmental and sanitation team to collect and transport to the disposal site for treatment as regulated.

Hazardous waste:

Sources of hazardous waste generated from the construction of project items include: (i) Oil-contaminated materials from the maintenance of construction machinery; (ii) Discarded asphalt

from the road construction process and asphalt containers; (iii) Packaging, containers for lubricants, asphalt, gasoline, and paint; (iv) Excess tip of welding rod; (iv) Batteries, light bulbs, ink cartridges from office activities at construction sites. The volume of hazardous waste depends on the quantity of equipment/machinery, labor, and quantity of raw materials:

- Maintenance activities of construction vehicles, vehicles, and machines, if performed right at the construction site, also generate lubricant residue, lubricant bottles and lubricant-contaminated rags,... (estimated at about 5kg/month).
- Packaging containers, lubricant oil containers, asphalt containers, gasoline containers, and paint containers are not generated in large amounts (about 10-30kg/month).
- Waste welding rods are generated at the construction site due to shaping activities of steel frames. It is estimated that 5-7% of the excess welding rod tip will be generated from the welding rod weight, so each subproject will generate about 5.0kg of excess welding rod tips.
- In addition, there is a small amount of hazardous waste (broken battery, light bulbs, ink cartridges) generated from office activities, the volume is about 5-7kg/month.

No.	Hazardous wastes	Code	Estimated volume
1	Gloves, rags contaminated with hazardous waste, oil-stained filter cloths	18 02 01	5 kg/month
2	Broken light bulbs	16 01 06	5 kg/month
3	Metal waste packaging (paint cans, paint, paintbrushes) during the finishing stages of the subproject, with the painting process lasting approximately 2 months	18 01 02	30 kg/ month
4	Waste welding rods	07 04 01	5 kg/ month

Hazardous waste will directly affect staff, workers at the site, cause loss of beauty of the area, reduce surface water quality and soil quality in the subproject area unless it is collected and treated properly.

The impact level is assessed as **Low** because: (i) the amount of hazardous solid waste generated at the construction site is not large (45 kg/month) and is localized in certain construction phases; (ii) there are existing functional units in the subproject area for the collection and treatment of hazardous waste; besides, repairs of equipment and construction vehicles are expected to be carried out at local professional repair centers; (iii) the impact is intermittent but extends over approximately 36 months of construction; (iv) the risks can be mitigated by appropriate measures.

(vi) Impact on Ecological Environment

Terrestrial ecosystem:

The impact on terrestrial biological resources is mainly due to the process of demolition/vegetation clearance and ground leveling of Kien Giang Subproject works, which require removing organic soil layer, leading to loss of the vegetation cover. In addition, construction activities will generate noise and vibration that may affect terrestrial animals (such as reptiles, birds, some domestic animals like buffaloes, cows, dogs, chickens, cats, etc.). During the dry season construction, workers may carelessly cause sparks while welding or cutting steel, burning construction waste, or engaging in cooking activities outside the camp/construction area, which could ignite nearby

shrubs. This would destroy the surrounding vegetation and shrubs, damaging the landscape of the riverine delta region.

The affected subjects are terrestrial biological resources in and around Kien Giang subproject in Tay Yen A commune.

The impact level is assessed as **Medium** because: (i) The Kien Giang subproject area is situated in an existing residential zone, featuring a landscape of residential land interspersed with rice fields, perennial crop land (fruit trees), a few small shrubs, and a portion of the area used for aquaculture ponds. Therefore, terrestrial biological resources are negligible (mainly shrubs, grass, reptiles, field birds, and some domestic animals such as buffaloes, cows, dogs, chickens, cats, etc.). (ii) Around the construction area, there are no significant green spaces; however, there is a concentrated residential area located 50–150 meters from the construction site; (iii) The impact period is intermittent but lasts for 36 months of construction; (iv) This impact can be mitigated through appropriate measures.

Aquatic species:

As discussed above, wastewater and rainwater runoff through the camp area and construction site, dredging activities can increase turbidity, organic content (represented by the BOD), nitrogen, and oils and grease in the receiving water source, the Cai Lon River, in the construction site of Kien Giang Major Fishery Center. Increased water turbidity will hinder light from reaching aquatic plants, leading to reduced photosynthesis activity. Increased suspended solids in the water can affect the respiratory systems of aquatic animals. The decomposition of organic matter will lead to a reduction in dissolved oxygen in the water, affecting aquatic life. Oils, grease, and other hazardous substances can be detrimental or fatal to aquatic flora and fauna, etc. The potential impacts due to the process of dredging and disposal of dredging materials on aquatic species will be further discussed in the site-specific impacts of Kien Giang subproject.

The potential impacts on the aquatic ecosystem of the Cai Lon river are assessed as **Low** because: (i) There are no rare or endangered aquatic species in the project area. However, workers might catch fish (various natural fish species such as carp, goby, field perch, catfish in the Cai Lon River). Additionally, wastewater and rainwater runoff can increase water turbidity, negatively affecting aquatic species, especially benthic organisms (aquatic organisms in the project area of the Cai Lon River include: zooplankton mainly of copepods, cladocerans, and rotifers; benthic animals mainly of snails, mussels, clams, crabs, shrimps, etc.; aquatic plants mainly of water hyacinth, algae, etc.); (ii) The impact period is intermittent, mainly during the rainy season, but extends over approximately 36 months; (iii) These impacts can be mitigated by appropriate measures such as dredging settling pits at the construction site and treating wastewater from camps before discharging into the environment.

(vii) Impacts due to erosion, sedimentation and local flooding

During construction activities such as ground leveling, dredging of navigation channels, and turning basins, large areas will be reclaimed to completely establish the new Kien Giang Fishery Center (11.27 ha). The erosive effects of rain and tidal fluctuations will lead to a significant increase in sediment levels over a long period of time, with this sediment contributing to enhanced sedimentation in the Cai Lon River within the construction area.

- Heavy rain can cause erosion and carry floating materials to the construction site. Materials that can be swept away by rainwater will affect the water quality of receiving water bodies, and cause sedimentation in the above water bodies. However, according to the assessment, the above impacts are only immediate during the construction period. After the construction of the technical infrastructure system is completed and the area is hardened, the above impacts will stop.

- During construction, the ground level of the area increases, the buffer surface of the area also changes, making the water concentration time faster, affecting the area's drainage capability.
- Additionally, during the construction phase, the subproject will level all planned land parcels to create a foundation for building structures and technical infrastructure systems serving the Kien Giang Major Fishery Center (with the lowest foundation height of +1.8 m and a total area of 11.27 ha, taking into account the hydrological conditions of the Cai Lon River, particularly the impacts of rising tides and high tides). The leveling process will alter the natural elevation of the area, transforming the terrain from uneven low-lying zones to a uniformly stable elevation. Previously, the area consisted of rice fields interspersed with residential and garden land, but during construction, it will be leveled into bare ground or concrete surfaces. This will increase the volume of water flowing into the river rapidly due to the area's reduced ability to self-regulate, thereby affecting the flow of the Cai Lon river.

However, the impact level is **Medium** as: (i) The area planned with a consistent elevation has taken into account natural factors (rainfall, the water level of the Cai Lon River, the impact of climate change due to sea level rise during the 36-month construction period); (ii) The Kien Giang subproject area has favorable topography with one side bordering the Cai Lon river, providing good drainage capability. However, the remaining three adjacent sides are existing residential areas. Although there is an agricultural irrigation system in place to facilitate rainwater drainage for the entire area, localized flooding risks may still occur for these residential areas, as many families have not yet elevated their foundations or in financial shortage to do so; (iii) This impact can be mitigated by appropriate measures.

(viii) Impacts due to risks increase and traffic disruption

Road traffics:

The construction activities of the subproject involve a small number of vehicles entering and exiting the subproject area, as waterway transportation will primarily be used. There will only be an increase of approximately 2–3 trips per day by trucks transporting waste and carrying machinery/equipment in and out of the subproject area. The movement of heavy vehicles (excavators, cranes, bulldozers, rollers, etc.) can disrupt the existing traffic flow on the roads and increase the risk of traffic accidents for road users.

The affected groups include employees and workers involved in the construction, residents of Tay Yen A commune currently located 50–100 meters from the construction site, and some residents living along the main transportation route (scattered residential areas along Kien Moi Road and National Highway 63), who are also impacted by the increased transportation activities on the existing roads. Additionally, the quality of the main transportation route could be affected by the operation of heavy construction trucks/machinery, creating potholes, rough patches, and water-filled depressions during rain, which increase the risks of traffic safety for people and vehicles.

The impact level is assessed as **Low** as: (i) The number of transportation trips is small (2–3 trips/day), and the machinery is only mobilized for certain periods when needed and upon project completion; (ii) The impact period is intermittent (but long-term, lasting approximately 36 months); (iii) the affected people are not numerous as the density of traffics on the main transport route is not high due to (01 concentrated residential area in Tay Yen A commune, on Kien Moi road and some households living scattered on NH63, section to the subproject area, and (iii) This impact can be mitigated by appropriate measures.

Waterway traffics:

Waterway traffic on the Cai Lon river may also be affected due to the increased number of vessels transporting materials to the construction site of the Kien Giang subproject (approximately 4

trips/day using barges with a capacity of 400 tons). Notably, during dredging and pile driving for quay reinforcement, various types of vessels will be utilized, including 1390HP suction dredgers, 585HP suction dredgers, 200–400 ton barges, tugboats, boats (40-ton boats), canoes, and pile-driving vessels. Additionally, support vessels such as fuel and water supply ships will be involved in facilitating these operations. Currently, there are still vessel activities on the Cai Lon river, section of constructing port, but with a low density (approximately 30 trips/day).

In addition, the dredging of the channel and the construction of the port will somewhat affect waterway traffic during 24-36 months of construction, such as obstructing waterway traffic due to narrowing the width of waterway transportation as dredgers occupying part of the water surface during construction, and the risk of collisions between dredging vessels, fuel supply boats, and cargo ships alongside other cargo vessels (primarily transporting construction materials such as sand, stone, gravel, and agricultural products from the region's orchards) on the Cai Lon river.

The impact on waterway traffic is assessed as medium and localized because: (i) The Cai Lon river's cross-section in the subproject area being relatively wide (averaging 600 meters), with the dredging area for navigation channels and turning basins at the port occupying only a portion of the water surface (approximately 25 meters, accounting for only 1/10 to 1/5 of the Cai Lon river's water surface area at the port area). The remaining width of the river is sufficient for local vessels to navigate; (ii) dredging equipment is usually stationary and operates for a few hours at a time; (iii) the density of vessels passing through the area remains low (about 30 trips per day); and (iv) implementing effective waterway and road traffic safety management during the construction phase will help avoid, minimize, and mitigate traffic impacts, including traffic accidents.

(ix) Risks of damages to existing infrastructures due to construction material transportation and operation of machineries

Almost construction sites are located in rural area where rural roads are concreted, except for Kienh Moi road and NH63 which are of asphalt concrete roads with good quality and complete signage and median strips equipped with reflectors. Transporting materials to the construction site by heavy trucks can damage the roads. The quality of dike road which is the main transportation route can be affected by the activities of heavy trucks/construction machinery, creating potholes, rough patches, and water-filled depressions during rain, increasing the risks of traffic safety for people and vehicles. Moreover, the activities of cranes can affect existing technical infrastructure such as power grids, telephone lines, irrigation systems (existing Xeo Ro culvert) and existing rainwater drainage ditch in the subproject area.

However, **the impact level is assessed as Medium** because: (i) The quality of the existing road surface is from moderate to good; (ii) The impact is intermittent but long-term, lasting for 36 months of construction; and (iii) The impact is mitigated by appropriate construction plan and methods (such as only allowing trucks with appropriate loads to travel on the road, and restoring the road surface when it deteriorates during and after construction activities).

(x) Issues related to occupational health and safety (OHS)

For the Kien Giang subproject, it is expected to mobilize about 120 workers to participate in construction for approximately 36 months. Therefore, there will be potential occupational health and safety (OHS) risks as follows:

- Workers may work in environments with increased dust and toxic gas pollution due to demolition, excavation, and machinery activities, which can lead to dizziness or fainting while working. Workers can have accidents due to exposure to electrical tools/equipment, dangerous objects such as sharp iron, nails, screws, and the simultaneous operation of multiple machines in a narrow construction site, especially when workers are not paying attention, not using full personal protective equipment, and lacking awareness of safety

regulations. Construction activities can cause other occupational accidents for workers such as fires and explosions due to welding-gas leaks, fuel leaks, welding activities, electric shocks, working at heights, falling into the sea, construction collapses, and the operation of bulky machinery and materials, as well as working in extreme weather conditions such as large waves, strong winds, and poor construction site organization.

- Regarding working conditions, workers' OHS problems can be caused by falling into water or even drowning while working on water surface (in Cai Lon river) due to illness or loss of balance. In addition, they can also come into contact with materials containing toxic substances such as oils, etc. If direct contact is made, short-term health effects can be skin or respiratory system irritation while some substances have can penetrate through the skin and enter the body system. The accumulation of toxic substances during work will lead to more serious long-term health effects, so it is necessary to be concerned.
- Other OHS issues related to working conditions would be inadequate lighting or inadequate protection when working in specific conditions or locations.
- Working with construction electric or diesel tools and equipment (e.g. barges, sand pumps, cranes, hoists, drilling/piling machines, etc.), workers can also be electrocuted or burned. . Extreme weather conditions also cause OHS risks and issues. Strong winds and very heavy rain during storms in coastal areas can cause unfinished/temporary construction works, even construction factories to become unstable, and even cause some tools and equipment to move. Outdoor construction equipment and materials lead to accidents for people around, including workers. Working long hours on very hot days can also cause exhaustion and even fainting for workers.
- Regarding worker behavior, safety risks can come from workers' awareness and attitude towards the use of Personal Protective Equipment (PPE) and personal behaviors at the construction site. Regarding PPE, it is common for workers at larger and more experienced contractors to be well-trained in EHS and provided with adequate PPE, so they are often subject to more stringent safety rules on site. However, workers of smaller/local contractors using PPE (e.g. used as life jackets in rivers/sea) on construction sites depends on the level of enforcement. Examples of careless behavior by workers that can lead to accidents or even hazards at construction sites include smoking near flammable materials such as oil tanks, mishandling electrical wires, and unauthorized operation of construction machinery

Reduce workers' health

- For dredging workers as well as other construction workers, inadequate living conditions in workers' housing also lead to health and safety problems. Illnesses related to water-borne diseases can be caused by not having enough clean water for use, not having access to adequate sanitation facilities, and poor sanitary conditions in and around the camp. Living at a construction site, away from home for a long time, if workers do not follow a healthy lifestyle and get into fights, drinking, or prostitution, they can also suffer long-term health effects from these activities.
- Increase the risk of infectious diseases (such as Covid, dengue fever, diphtheria, etc.), including HIV/AIDS, when workers come from different localities and interact with each other and with the local community.

Risk of fire and explosion:

Fire and explosion incidents, as well as electrical short circuits, may occur during the transportation and storage of fuel or due to the lack of safety in the temporary power supply system, causing damage to people and property during subproject implementation. The specific causes can be identified as follows:

- Temporary storage facilities for raw materials serving machinery and technical equipment during construction (paint, gasoline, etc.) are sources of fire and explosion. When incidents occur, they can cause damage to people, property, and the environment;
- Electrical incidents such as shocks, explosions, short circuits, etc., due to the temporary power supply system for construction machinery and equipment;
- The use of heating devices (welding, heating, etc.) can cause fires, explosions, or workplace accidents if preventive control measures are not in place;
- Especially in the case of thunderstorms, lightning strikes and workers' carelessness in using electrical equipment are the main causes of short circuits and explosions;
- Careless behavior of workers can lead to accidents or even danger in construction areas, including smoking near flammable materials such as fuel tanks, careless handling of electrical wires, unauthorized operation of construction machinery.

Electrical short circuits and explosions can damage construction machinery and equipment, and cause fires in camps and material gathering areas during the construction phase. Since such incidents can occur at any time, the project owner actively takes effective preventive and control measures to minimize and limit these negative impacts as much as possible.

Overall, the risk of fire and explosion at the construction site of Kien Giang subproject is assessed as medium because: (i) This risk is always potentially present on the construction site at any time; (ii) The number of workers mobilized is moderate (120); (iii) This risk is only taken place within 36 months of construction and (iv) could be mitigated by appropriate measures such as training in occupational safety before and after construction and provide sufficient PPE for workers.

(xi) Issues related to community safety and health

Local residents living around the construction site and along the transportation route (residential areas in Tay Yen A Commune, located 50–100 meters from the project site) may still be exposed to hazardous waste, odors generated from dredging activities, temporary sludge storage, and pathogens due to poor sanitation. Furthermore, increased levels of dust, noise, and traffic density caused by machinery and vehicles, along with risks such as soil subsidence, landslides, structural collapse, and uncovered deep pits on roads, may pose safety and health risks to the community.

The health and safety risks for the community from the Kien Giang subproject are assessed as **Medium** because: (i) Although Kien Giang subproject works are built, separately, within the construction site area and without spreading along existing traffic routes, it is near existing residential areas (Tay Yen A, located 50m-100M away from the construction site); (ii) The number of workers is not large (about 120 people), concentrated in one construction area; (iii) The construction period of the project's components is quite long (about 36 months); (iv) Local labor will be prioritized to hire; (v) Workers are trained in labor safety and environmental sanitation before commencing construction activities; (vi) These impacts can be mitigated through appropriate construction method, combined with reasonable construction site layout.

(xii) Social impacts due to labor influx

Labor influx

It is estimated that about 120 workers will be mobilized during the peak period of the subproject implementation. This number of workers may come from different locations of project provinces/cities or other provinces. Some potential social risks and impacts related to labour influx of this project are predicted as follows:

- Inappropriate management of workers and worker camps may lead to environmental issues such as discharging wastewater to environment, throwing or dumping solid waste into river/sea or agricultural land.

- Labor influx may cause risks to local security or social stability if some workers participate in social evils (such as drinking, gambling, prostitutions etc.).
- The mobilization of migrant workers may lead to increased risks of infectious disease transmission, including HIV/AIDs when the workers come from different localities, interact with each other and with local communities. If pandemic happens, it will create additional burdens to local health care system of the province/city.
- Potential conflict between workers and local communities because of differences of background, culture, customs, jobs and incomes.
- Gender Based Violence (GBV), Sexual exploitation and abuse/Sexual Harassment (SEA/SH) risks related to the concentration of number of male workers to the project area. However, GBV and SEA/SH risks are assessed to be low and manageable.

In general, **Impacts due to labor influx of Kien Giang subproject is assessed to be Low** because (i) the number of workers is not large (120) and they will register to temporary residence with local authorities during construction period and (ii) with the convenience and widespread dissemination of local media information regarding issues such as sexually transmitted diseases, including HIV/AIDS, the use of prohibited substances, and cultural behaviors; (ii) This risk may occur at any time during the 36-month construction period; (v) This risk can be mitigated through appropriate measure such as preparing a code of conduct for workers, and raising workers' awareness about cultural, social, and health issues before and during the construction process.

(xiii) Impacts on cultural heritage

The location for the new construction of Kien Giang Major Fishery Center includes Ba Nga Bat Shrine (located approximately 100 meters from the subproject site) and Ong Bon Shrine (located approximately 180 meters from the project site). These cultural assets will experience temporary impacts from dust, waste, and the behavior of construction workers. This matter will be assessed in detail in the site-specific impact section below.

On the other hand, the subproject's construction activities involve significant excavation and dredging, which may uncover cultural relics during the construction process. Therefore, the chance find handling procedures have been included in the project's ESMP (to be detailed in Chapter 5 below).

4.5.2.2. Site-specific impacts – Kien Giang subproject

Kien Giang Major fishery center construction investment Subproject will be completely newly constructed on an area of 31.27 ha (including 11.27 ha of land and 20 ha of water surface) in Tay Yen A Commune, An Bien District, Kien Giang Province. Investments under Kien Giang subproject will include: (i) Construction of a fishing wharf; an import-export wharf for aquatic products; and a logistics service wharf; (ii) Construction of logistics facilities such as seafood sorting and trading areas; (iii) Construction of administrative and service buildings, including the operation center; (iv) Construction of technical infrastructure such as internal roads, yards, power supply systems, water supply, drainage, wastewater treatment, and fuel supply systems.

Based on the location, investment scale, and characteristics of the social center in the area where the subproject is implemented, the site-specific impacts of the construction of the Kien Giang subproject are as follows:

- Impact on aquatic life and deterioration of water quality due to dredging activities;
- Environmental pollution risks and impacts at the dredged material storage sites;
- Impacts on sensitive receptors, including physical cultural resources (PCR).

Details of the impact assessment are presented below:

(i) Impact on aquatic life and deterioration of water quality due to dredging activities

Under Kien Giang subproject, there will be dredging activities in the waters in front of the port, with an estimated volume of dredged materials of approximately 5,432 m³. These dredging activities are expected to affect water quality and aquatic life in the Cai Lon River, within the subproject area, which is located about 8 km from the mouth of Rach Gia Bay.

The dredging of the water area in front of the port will be conducted using suction vessels that directly discharge the dredged materials into the disposal site within the construction site of the subproject. This process may cause impacts on the aquatic ecosystem of the Cai Lon River, including the following:

- Disturbance of the riverbed or loss of habitat for certain benthic species such as clams, oysters, snails, mussels, or aquatic eggs.
- Agitation of bottom sediments, leading to increased suspended silt and mud, which raises pollutant concentrations in the water. The higher content of suspended solids reduces light penetration to the riverbed, thus limiting the photosynthesis of algae species and negatively affecting the metabolism and growth of organisms, resulting in a reduction in food sources for aquatic fauna.
- Alteration of terrain (dredging depth to -5.5 meters with a width of 36 meters), significantly changing the living environment and habitat of species such as fish, shrimp, and crabs, which will have to migrate and adapt to new habitats.
- Transformation or loss of natural vegetation, including low-level aquatic plants and grasses.
- Water pollution due to increased turbidity and higher suspended solid content, leading to reduced dissolved oxygen levels and diminished photosynthesis in aquatic algae and plants.

The potential impacts on the aquatic ecosystem of the Cai Lon River from dredging activities are assessed as Low due to the following reasons: (i) the dredging area is limited to a portion of the water section in front of the port (36 meters wide, 480–540 meters long), with a relatively small dredging volume; (ii) there are no rare or endangered aquatic species in the subproject area (typical aquatic species in the Cai Lon River in this area include zooplankton such as cheepers, beards, and rotifers; benthic organisms such as snails, mussels, and cochleas; and aquatic plants such as duckweed and algae); (iii) the impacts are short-term in nature, as dredging is expected to last for about 3 months, and thus will not cause significant long-term damage to the aquatic ecosystem of the Cai Lon River; (iv) the area is not a protected habitat for valuable species; (v) the impacts can be mitigated and are reversible.

(ii) Environmental pollution risks and impacts at dredged material disposal sites

For the Kien Giang Subproject, the disposal site for dredged materials is arranged within the subproject premises (on land reserved for future construction phases). The area of the disposal site is 0.6 ha, with a storage capacity of approximately 12,000 m³. During the disposal process, the dumped material will be elevated 1 to 2 meters above the existing ground level.



Location of temporary dredging material disposal site of Kien Giang subproject

The process of collecting dredged materials at this temporary disposal site will pose the following potential impacts:

- Impact of water runoff from dredged materials: After being pumped directly into the temporary disposal site, the wet dredged materials will gradually settle and release water. This water will drain from the dredged material and flow out of the yard by gravity. Experience from other river dredging projects indicates that the ratio of sediment to water in dredged material is approximately 8:2, meaning water accounts for 20% of the total dredged volume. This indicates a considerable volume of water runoff. If not properly managed, leakage of this water could cause localized flooding around the temporary storage site. The runoff may also contain high turbidity (fine particles from the dredged material), which could lead to sediment accumulation in drains/ditches and receiving water bodies connected to the Cai Lon River.
- Spillage or discharge of dredged materials into the surrounding environment: The temporary disposal site will be constructed with a specific height (approximately 1–2 meters above the existing ground level). When dredged materials are dumped near the edge or top of the disposal site, there is a risk of overflow beyond the designated boundary. Additionally, the slopes of the yard could become unstable under pressure, potentially collapsing and causing materials to spill outside the designated area, covering vegetation, filling surrounding land or the construction site of the subproject, and even posing a risk to human safety.
- Risk of salinity contamination from dredged materials to the soil environment at the temporary storage site: Based on interviews with local residents, the area is currently not affected by salinity. Monitoring results show that salinity in the sediment ranges from 0.63‰ to 0.68‰, which is at a low threshold and has no impact on local crops such as rice and vegetables. (In general, salinity from 0.75‰ to 1.5‰ may reduce the yield of salt-sensitive crops; salinity between 1.5‰ and 3.5‰ may affect the yield of many crop species; salinity from 3.5‰ to 6.5‰ allows only salt-tolerant species to survive.)

In summary, the volume of dredged materials generated during the channel dredging phase of the Kien Giang Major fishery center construction investment Subproject is relatively small (about 5,432 m³), and the environmental monitoring results confirm that the dredged materials are not contaminated with heavy metals. Since the dumping site for dredged materials is located within the

subproject construction area, the risks of soil and water pollution during the construction period are considered moderate and can be mitigated.

(iii) Impacts on sensitive receptors, including PCRs (Ba Nga Bat Temple, Ong Bon Temple)

As stated in Table 2.12 (Chapter 2), sensitive receptors potentially affected during the construction of the Kien Giang Major fishery center construction investment Subproject include Ba Nga Bat Temple, located approximately 100 meters away, and Ong Bon Temple, about 180 meters away. These are religious sites where ritual activities of Nga Bat Hamlet, Tay Yen A Commune are conducted.

The main impacts on these physical cultural resources (PCRs) during construction are expected to be dust, noise, traffic disruption due to construction activities and material gathering, all of which may affect local religious and spiritual practices (such as ceremonies, festivals, etc.), especially during significant occasions such as full moon days, the first day of the lunar month, the Lunar New Year, and other holidays.

Overall, this level of impact is assessed as medium, given that construction activities at each location will occur intermittently over the 36-month construction period of the subproject and can be mitigated through the implementation of appropriate control measures.

4.5.3. Impacts and risks during operation phase

This is the newly built work of the project. The sources of environmental and social impacts and risks during the operation phase of Kieng Giang Fishery Center arise from: (i) Operation of transportation vehicles such as ships/boats/cargo trucks; fish/seafood loading and unloading activities; (ii) Activities of operators, fishermen at the port, ship/boat drivers, traders at the port; (iii) Operation of fishing vessels transporting seafood in and out of the port; (iv) Operation of functional areas within the port (seafood receiving area, sorting area, storage area); (v) Operation of technical infrastructure systems such as the WWTP, waste storage facilities, public toilets, etc.

Particular, the maintenance and dredging activities of the navigation channel and the water area in front of the port (usually every 2 years), will be carried out with other funding sources during the operation of the port, so the impacts and risks related to this activity will be assessed separately later.

The general impacts and risks during the operation phase of Kien Giang Fishery Center include:

- Dust and emissions generated
- Noise
- Wastewater generated
- Solid waste generated
- Impacts on aquatic life and deterioration of surface water quality due to the concentration of vessels in the port area, maintenance and dredging of navigation channels)
- Riverbed evolution after the subproject is built and put into operation
- Impacts and risks related to transportation (waterway/road)
- Occupational safety risks and incidents
- Environmental risks and incidents: fire, oil spills, etc.

Detailed Impact Assessment is presented below:

(i) Dust and Emissions Generated

Sources of dust and emissions from the operation of Kien Giang Fishery Center, especially in the fishery service areas, include:

- Dust and emissions from transportation vehicles such as ships/boats/trucks, and fish/seafood loading and unloading activities.
- Fishy odors generated from fishing vessels upon arrival to the port, and from cold storage facilities used for seafood preservation.
- Odors and emissions (NH₃, H₂S, etc.) generated from the wastewater treatment system, solid waste storage facilities, etc.:

❖ ***Dust and emissions from transportation ships/boats/trucks, fish/seafood loading and unloading activities***

Dust and emissions of ships/boats/trucks are primarily generated from the operation of diesel powered generators and vessel exhaust systems. The pollutants mainly include dust, CO_x, SO_x, NO_x, Total Hydrocarbons (HC), etc. The emission load from vessels entering and leaving the port is difficult to estimate and depends on the number of daily ships going in and out of the port, with an estimated number of about 180 vessels, and at peak times, 1,000 vessels mooring and sheltering from storms. The emission load generated from vessel operations is presented in the following table:

Table 4.64. Emission factors of pollutants from diesel-engine vessels

(Unit: kg/day)

Means of transport	Dust	SO ₂	NO _x	CO	HC
Motor ships	6.8	136S	90.7	0.036	4.1

Source: WHO, 1993

Applying the formula for calculating the pollutant load in exhaust gases arising from the operation of ships/boats:

$$\text{Pollutant load (mg/m}\cdot\text{s)} = \text{Pollution coefficient (kg/day)} \times \text{number of ships in a day} \times 1,000 \\ (\text{average distance} \times 86,400).$$

Where: 1,000 is the conversion factor from “km” to “m”; 86,400 is the conversion factor from “day” to “seconds”; the sulfur (S) content in DO oil is 0.05%; average travel distance: 25 km. In addition, by applying formulas [1] and [2] from the general impact assessment during the construction phase, the calculated NO_x concentration exceeds the permissible standards specified in QCVN 05:2023/BTNMT – National Technical Regulation on Ambient Air Quality. Meanwhile, SO₂, CO concentrations, and concentrations at distances ≥ 10 m for HC and ≥ 30 m for dust remain within allowable limits.

In addition, when the subproject comes into operation, road traffic density in the area will increase significantly (by about 50 -100 vehicle trips/day) due to the movement of staff and workers at fishing ports and seafood transportation trucks, etc. increases when the Fishery Center becomes operational. As these are gasoline and diesel powered vehicles, they will emit an number of emissions, including NO₂, C_xH_y, CO, CO₂, HC into the air. By applying formula [1] and [2], the pollutant loads arising from this activity are all lower than allowable limit.

The affected group is estimated at around 800- 1000 people, mainly including fishermen working at the port and onboard vessels docking at the port (about 500–600 people); local residents

engaging in trading at kiosks along the port (about 200 - 300 people); and port operation staff (about 70 – 80 people).

The impact level of this emission source is assessed as Low because: (i) the concentration is only greatest when all vessels gather at the port at once and only affect the area for a short time (according to general practice and procedures at fishing ports, the docking period can last from 30 minutes to 2 hours); (ii) this source of emissions will gradually decrease when ships cease operating; and (iii) this source of emissions gradually dilutes into the air with fairly ventilated conditions on a large port with strong wind blows.

❖ ***Fishy Odor Generated from Fishing Vessels upon Arrival at the port.***

The source of fishy and foul odors arises when fishing vessels dock at the port carrying freshly caught and frozen seafood stored onboard. The fishy odor composition is mainly from NH_3 , Hydrocarbons (HC). The load of NH_3 emissions arising from refrigeration equipment and fishy odors from fishing boats is considered low, as the aquatic products (shrimp, crab, seafood, etc.) are quickly loaded and unloaded, sorted, and delivered to the market for consumption or immediately put into cold storage.

The main gases generated from the decomposition of organic matters include CO_2 , NH_3 , H_2S , CO , CH_4 , and Mercaptans. In which, the main odor-causing gases are NH_3 , H_2S and Mercaptan, discomforting sellers/buyers and those who live in the port area.

The impact is assessed as Medium as (i) the volume of aquatic products arrived at the port is localized, depending on fishing vessels (hourly - early morning (from 4 a.m. to 6 a.m.) and afternoon (from 2 p.m. to 4 p.m.), seasonally - the peak fishing season is normally from June to September every year); (ii) The seafood decomposition contributes to an increase in fishy odor, adversely affecting the environment in the port area (accounting for about 5%–10%). Nevertheless, this impact can be mitigated through appropriate measures.

❖ ***Odors and Emissions (NH_3 , H_2S , etc.) from the WWTP and Solid Waste Storage Facilities***

For the Kien Giang Subproject, 01 WWTP with a capacity of 600 m^3/day using aerobic technology and closed treatment tanks, along with a 96 m^2 solid waste collection house designed for storage period of about 3–5 days at the port. Odors and emissions (NH_3 , H_2S , etc.) will be generated from the subproject's wastewater and solid waste treatment systems.

WWTP technology process: Wastewater from sources → Collection tank → grease and sand separation → Equalization tank → pH adjustment tank → Flocculation tank → Primary sedimentation tank → Intermediate tank → Anaerobic tank → Anoxic tank → Aerobic MBBR tank → Biological settling tank → Disinfection tank → Treated wastewater meeting QCVN 40:2011/BTNMT – National Technical Regulation on Industrial Wastewater (Column B, $K_q=1.0$ and $K_f = 1.0$) → continuous monitoring → Receiving source (Cai Lon river).

According to this process, odors from the WWTP mainly arise from the collection tank, equalization tank, Flocculation tank, Primary sedimentation tank, Anaerobic tank and Anoxic tank. Aerobic decomposition also produces odors but at a lower level. Gases generated primarily from Aerobic decomposition include H_2S , Mercaptans, CO_2 , and CH_4 , among which H_2S and Mercaptans are the main odor-causing substances.

Based on the aerobic treatment technology and the design of enclosed treatment tanks, the 600 m^3/day WWTP will significantly reduce odors generated from substances such as H_2S , CH_4 , NH_3 . However, odor concentrations may still remain at low levels in cases where complete elimination

is not possible. Typically, the concentration ranges of odor-causing substances (H_2S , CH_4 , NH_3) in aerobic wastewater treatment systems with enclosed tanks fall within the following thresholds:

- H_2S (Hydrogen Sulfide): The concentration of H_2S in enclosed aerobic treatment tanks is typically maintained below 0.1 ppm (parts per million), and under ideal conditions, it can be even lower.
- CH_4 (Methane): The concentration of CH_4 in aerobic treatment tanks can range from 0.5 to 5 ppm, however, this figure depends on the level of ventilation and emission control in the tank
- NH_3 (Ammonia): The concentration of NH_3 in enclosed treatment tanks can be controlled within the range of 1–3 ppm, depending on the nitrification process and aeration system.

The groups directly affected by odors from the WWTPs and solid waste collection facility are the workers operating the Fishery Center (about 70-80 people) and fishermen, local people visitors/traders at the port (about 700-900 people)

Since the WWTP uses aerobic technology with closed treatment tanks, the odor is minimized. The decomposition process generates malodor but at a low level. In addition, the WWTP of Kien Giang Fishery Center will be built closely (closed treatment blocks), so the odor generated will be minimized. Therefore, the level of this impact is assessed as Medium and can be mitigated by appropriate technological and technical measures.

(ii) Noise

The source of noise arises mainly from vessels when docking, vehicles entering to purchase and transport seafood for consumption and from the service area.

The maximum noise level forecasted (taking account into the cumulative noise when many vessels enter and exit at the same time, with about 180 vessels/day and about 1000 vessels seeking shelter from storm) is approximately 80–85 dBA for vessels, 85–95 dBA for road traffics, and 75–79 dBA for service area operations (exceeding allowable limit by 1.07 to 1.12 times).

Noise mainly and directly affects traders, port workers, fishermen and visitors/traders (a total of about 800-1000 people), typically within a radius of 10–20 m around the receiving, sorting, and loading/unloading areas. According to general practices and procedures at fishing ports. The docking period can last from 30 minutes to 2 hours.

However, field surveys at local existing fishing ports show that vessel docking, loading/unloading, and sorting activities do not always take place all day, usually within a month, the peak time of full-day operation is from the 8th to the 15th day of the lunar calendar. On other days, these activities take place in the early morning (4:00–6:00 a.m.) and afternoon (2:00–4:00 p.m.). Additionally, upon ship arrival, the engine will be turned off, the port space is wide towards the river, so the noise is also diffused quickly. In the event of a storm, noise levels may increase due to the simultaneous arrival of approximately 1,000 vessels over a period of 3 to 5 days, with around 300 vessels docking per day. The cumulative noise level may reach approximately 105 to 110 dBA. However, this noise is localized and short-term, typically lasting only 30 to 45 minutes, and ceased when the vessels have completed docking. Therefore, the impact level is assessed as Medium and can be mitigated through appropriate measures.

(iii) Wastewater Generated

The sources of wastewater generated from the operation of Kien Giang Fishery Center include: domestic wastewater, wastewater from onshore service areas, particularly from fisheries service

facilities, and wastewater from vessels operating in the water areas in front of the port. The wastewater volume is calculated based on the water supply volume (according to the wastewater discharge standard, taken as 100% of the water supply standard). The detailed calculation of wastewater volume is presented in the following tables:

Table 4.65. Calculation of the wastewater drainage volume of Kien Giang Fishery Center

No.	Used for	Quantity		Standard		Calculated volume		Notes
1	Water supply for operators	77	Person	25	L/people	1.93	m ³ /day	For the busiest operation day of the port
2	Fish washing	360	Ton	1	m ³ / ton	360.0	m ³ /day	
3	Floor washing	4225	m ²	5	l/m ² floor	21.1	m ³ /day	
4	Water supply for production employees and visitors	300	Person	25	L/people	7.5	m ³ /day	
5	Water supply for Waste storage house, Water supply plant, WWTP	3	Work	3	m ³ / work	9.0	m ³ /day	
6	Average total daily water demand	Q _{day_average}				400	m ³ /day	
7	Coefficient	1,3						
8	Total wastewater drainage demand	Q _T = 100%Q _{ngay_max}				519	m ³ /day	
		Rounded				600	m ³ /day	

(Source: Basic design of Kien Giang Subproject)

The characteristics of each type of wastewater arising from the Kien Giang Fishery Center are as follows:

- **Domestic wastewater:** arising from the working areas of staffs and employees serving in the service area and fishermen/traders at the port, the volume and pollution level of this waste source mainly depends on the number of workers at the Kien Giang Fishery Center and the amount of water used daily. It is estimated there are 70-80 people regularly working in the operation house and 300 people are production employees and visitors/traders. The domestic wastewater is about 25l/day/person, equivalent to 9.43 m³/day in total. The waste generated from this source is highly dirty, its composition mainly contains organic matters, nutrients, residues, suspended substances and pathogenic bacteria. Besides, it contains high organic content (BOD, COD), high solid content and many pathogenic bacteria. The above amount of wastewater, if not collected and treated appropriately, can cause the spread of pathogens, affecting coastal seawater sources in Cai Lon River, damaging the beautiful landscape in the surrounding area.

Table 4.66. Predicted concentration of domestic wastewater during the operation phase

No.	Parameters	Unit	Untreated	Treated by septic tank	QCVN 14: 2008/BTNMT (column A, K=1.0)
1	COD	mg/l	608	61-152	-

No.	Parameters	Unit	Untreated	Treated by septic tank	QCVN 14: 2008/BTNMT (column A, K=1.0)
2	BOD ₅	mg/l	329	49-99	30
3	TSS	mg/l	713	36-178	50
4	Total N	mg/l	60	20-40	-
5	Total P	mg/l	17	3-10	-
6	Animal and plant fats and oils	mg/l	133	42	10
7	Total Coliform*	MPN/100ml	10 ⁶ -10 ⁹	10 ⁴	3,000

Notes: The coefficient accounting for the project scale is k=1.0, according to Table 2, QCVN 14:2008/BTNMT

As we can see in the table above, the concentration of organic substances in domestic wastewater after treatment via septic tank is approximately and exceeds the permissible level by 1.0 to 2.0 times. TSS ranges from lower than to 1.8 times higher than that of permissible level. The content of animal and plant fats and oil is 2.1 times higher than permissible level. The Coliform is 30 times higher than the permissible limits. Therefore, wastewater treated by septic tanks needs further treatment at centralized water treatment plant before being discharged into the receiving environment.

- **Wastewater from onshore service areas:** When the fisheries logistics service area comes into operation, a system of service areas, trading, and cold storage warehouses will be accompanied. The operation of these facilities will generate a large amount of production wastewater (about 360 m³/day of wastewater from fish washing and 21.1 m³/day from floor washing). This wastewater contains organic impurities. Wastewater produced from aquatic product receiving facilities, seafood cold storage warehouse, this waste source primarily contains organic matters, animal fats and oils, waste (fish scales, fish intestines, shrimp shells, etc.). These substances are easily decomposed, if not collected and treated, the decomposed products will cause foul smell to the surrounding area and pollute the surface water quality of the Cai Lon River.

- **Wastewater from vessels operating in the port's water areas:** This source of waste includes domestic wastewater, toilet wastewater on ships, and deck washing water. According to the design, the fishing port will accommodate 180 vessels. The wastewater is composed of suspended solids, grease, organic substances (BOD, COD). If this waste source is not controlled, but discharged into the receiving environment, it will cause pollution to the Cai Lon River. This wastewater source will be controlled according to the subproject's design plan: wastewater from ship hold cleaning will be collected and treated at the two WWTPs (with capacities of 600 m³/day) to be constructed under the Kien Giang subproject

- **Ballast water:**

Ballast water is the water pumped into the ship's specialized tanks to maintain stability when the ship is not carrying cargo or to adjust the ship draft. The ballast water can be seawater, brackish water or fresh water, depending on the geographical location where the ship performs the water refill operation. At riverside fishing ports, especially in areas near river estuaries, ballast water is usually brackish water or seawater due to the impact of tides and saltwater intrusion.

During the process of ballast water refilling, various species such as plankton, microorganisms, and larvae can be sucked into the water tank and move along the ship to other water bodies. The discharge of untreated ballast water can cause the spread of alien organisms, affecting the

indigenous ecosystem and the water quality.

For small and medium-sized fishing vessels (fishing boat), the amount of ballast water ranges from 10 to 50 m³. The ballast water is used by fishing vessels to ensure offshore operation and when harvesting seafood is often reused. With a scale of about 180 ships under the Kien Giang subproject, each replacement will generate about 1,800 m³ to 5,000 m³ of ballast water. However, the ballast water does not need to be changed too frequently, and the inspection and maintenance of the ballast water tank is normally carried out periodically from 6 months to 1 year.

Domestic fishing vessels in Vietnam are typical small and medium in capacity, and do not operate in international waters, so they are not yet subject to the full mandatory provisions of the International Ballast Water Management Convention (BWM Convention). However, the discharge of ballast water still needs to comply with existing national regulations such as Decree No. 58/2017/ND-CP. According to regulations, the ballast water shall be discharged at least 200 nautical miles from the nearest shore and in waters with a depth of at least 200 m. In case the ship is unable to meet this condition, the ship may carry out a ballast water exchange at least 50 nautical miles from the nearest shore and at a depth of at least 200 m (quite far from the shore). In fact, fishing vessels often discharge ballast water individually and not simultaneously or at a domestic location, which helps minimize the risk of localized environmental impacts. In general, as being operated not-concentratedly, individually and primarily in domestic water areas, the impact of the ballast water on the environment in the subproject is assessed as **Medium** and can be controlled through appropriate management measures.

Pollutant load in seafood wastewater: To reference the concentration levels of pollutants in this type of wastewater, monitoring results from existing fishing ports—specifically from Zone E of Tam Quan Fishing Port in Binh Dinh Province, as cited in the environmental assessment for the Lach Hoi subproject—indicate that most tested parameters significantly exceed the limit set forth in QCVN 11-MT:2015/BTNMT (Column B), the National Technical Regulation on Wastewater from Seafood Processing.

Overall, the level of impact from wastewater generated during the operation of the Kien Giang Fisheries Center is assessed as medium because: (i) the Center has been constructed with integrated functional zones which are designed to ensure effective environmental sanitation during operation; and (ii) a separate wastewater collection system and a treatment plant with a capacity of 600 m³/day.night have been installed, ensuring complete collection and treatment of the estimated wastewater volume.

In addition, there is also a amount of rainwater flowing through the port areas that carries pollutants on the surface, then flowing into Cai Lon river but not being treated. The highest monthly rainfall was 1525.4 mm in X/1991, equivalent to 50.8 mm/day. Therefore, the total rainfall in 01 day in the whole project area in case of the heaviest rain is $112,700\text{m}^2 \times 50.8\text{mm/day} / 1000 = 5,725\text{m}^3$. The composition of rainwater contains suspended solids, and surfactants washed away on the surface of the port area. The overflowing rainwater will affect the rainwater collection system and flow into Cai Lon River. However, with the nature of rainwater that is less likely to pollute the environment, the port is built with an integrated, intermittent drainage system due to rainy season (from May to November every year, in Kien Giang province, there are about 85 rainy days per year), so the impact of rainwater flowing overflow is Low and can be minimized.

(iv) Solid Waste Generated

Sources of solid waste generated during the operation of Kien Giang subproject include: domestic solid waste of about 70-80 workers and employees at the service area and operation house; solid was from seafood sorting and trading process. Based on the volume of solid waste generated by

fishermen/visitors at the Fishery Center. The load of solid waste generated by Kien Giang Subproject is as follows:

- *Domestic solid waste:* According to “Vietnam Environment Monitor 2004 – Solid Waste,” the average waste generation per capita ranges from 0.1 – 0.3 kg/day (as people do not reside at the port). The total amount of domestic solid waste is about 7.7 – 23.1 kg/day for 77 staffs and employees; about 30 - 90kg/day for 300 visitors/traders.

- *Solid waste from seafood sorting activities* Estimated²⁹ to account for about 0.02% of the total seafood yields at Kien Giang Major Fishery Center according to the design (100,000 tons/year), equivalent to about 1.67 tons/month. The waste mainly contains: nylon bags, scrap paper, disposable nylon gloves, rubber gloves, packaging materials, damaged cartons, and broken foam boxes.

- *By-products from seafood sorting and processing:* Estimated to account for about 1% of the total seafood throughput³⁰ at Kien Giang Major Fishery Center according to the design (100,000 tons/year), equivalent to about 83.3 tons/month. The main components include fish heads, fins, bones, skins, fats, intestines, etc.

- *Hazardous waste:* Hazardous waste (oil-contaminated rags, gloves, hazardous-component contaminated rag, packaging, grease containers for maintenance of machinery, equipment, batteries and accumulators, chemical packaging, printing ink cartridges, waste lead, damaged equipment, etc broken nets, plastic packaging, etc.) is estimated at about 600 kg/month. The volume of hazardous waste is estimated at about 2kg/day. Waste oils discharged into the Cai Lon River could hinder the photosynthesis and respiration of aquatic organisms and may even cause the death of aquatic species unless being properly controlled.

If not collected and treated, these types of solid waste will cause air pollution (due to foul odors), surface water pollution along the Cai Lon river near the port area, and negatively affect the urban landscape of the Kien Giang Fishery Center. However, since investments are being integrated in technical infrastructure (waste collection, domestic wastewater collection and treatment, etc.), and the locality already contracted with a sanitation team for collection, transportation, and treatment of both general and hazardous waste, the impact from solid waste generated by the fishing port is assessed as **medium and manageable**. Moreover, before the Kien Giang Subproject comes into operation, the Project Management Unit (PMU) will be required to obtain an environmental permit, ensuring this impact is controllable.

(v) Deterioration of Surface Water Quality and Impacts on Aquatic Life in Cai Lon river:

The water quality of the Cai Lon River may deteriorate due to the operation of vessels entering and leaving the port during the operation phase (approximately 180 vessels/boats per day), caused by: (i) leakage of oil and grease resulting from accidents such as collisions or grounding of ships, or from discharging oily residues; (ii) cooling water containing oil and grease; and domestic wastewater, solid waste, and hazardous waste as previously forecasted and assessed in the sections on ‘wastewater’ and ‘solid waste’.

²⁹ Based on the data estimated from the current operations of Lach Bang fishing port, as surveyed and consulted by the project’s environmental assessment team during the preparation of this ESIA report.

³⁰ According to studies on raw material using efficiency in the seafood processing industry, as well as research on by-product management, findings are often published in specialized scientific journals on fisheries in Vietnam,

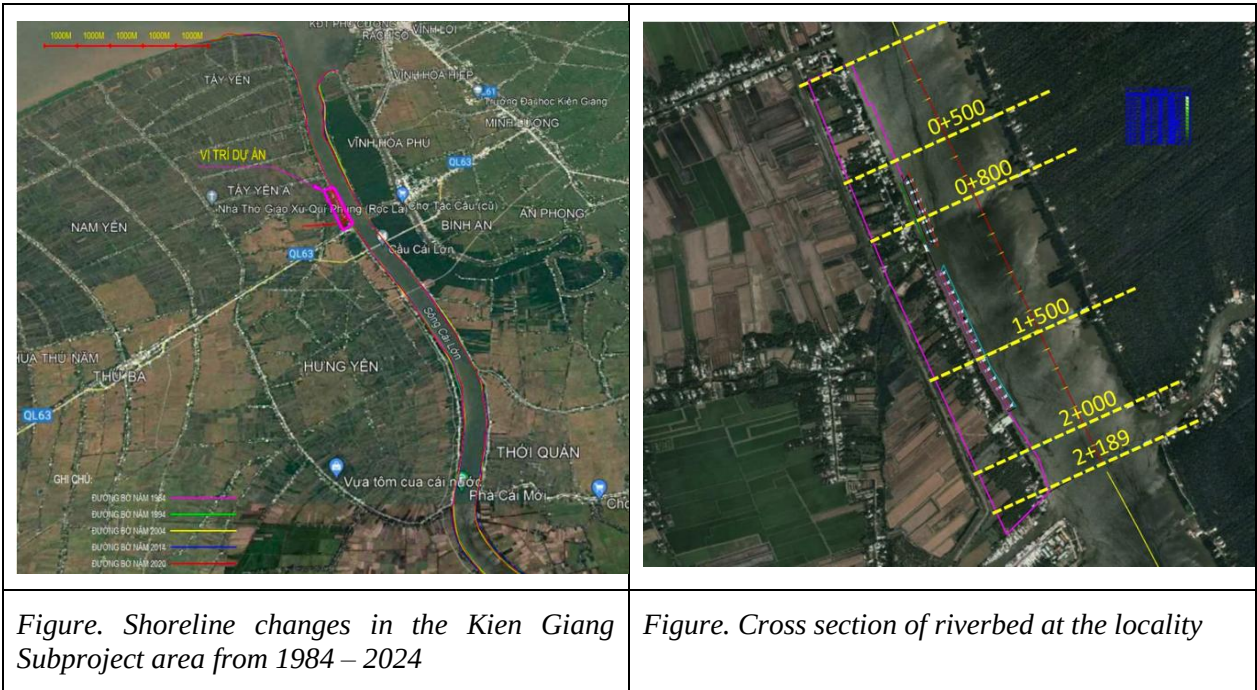
In addition, dredging and maintenance activities for the navigation channel and the water area in front of the port—scheduled every 2 to 3 years with a relatively small dredging volume of just over 5,000 m³, as calculated and assessed during the subproject’s construction phase—are expected to impact the surface water quality of the Cai Lon River. The water quality may deteriorate due to increased turbidity, high content of suspended solids, and traces of oil and grease, which can lead to reduced dissolved oxygen and hinder the photosynthetic capacity of algae and aquatic plants.

Overall, the impact on Cai Lon River surface water quality due to the operation of Kien Giang Fishery Center is assessed as medium because: (i) the Center is integrated with the management procedures managed by Kien Giang Port Management Authority who has long experience, so the environmental sanitation issues due to vessel operations will be ensured; (ii) the receiving water body of the Cai Lon River has a relatively large flow (ranges from 200 – 300 m³/s, the flow of domestic wastewater generated by workers makes up only 2% to 3% of the flow rate of the Cai Lon River); (iii) The Fishery Center will be equipped with a separate WWTP with capacities of 600 m³/day, ensuring that all generated wastewater is collected and treated prior to being discharged into the Cai Lon River.

The impact on the Cai Lon river’s aquatic ecosystem due to the port operation is assessed as **Low** because: (i) the port’s operational area is localized within the water area in front of the port (36m wide, 540m long); (ii) no rare or endangered aquatic species are found in the project area (aquatic species in the Cai Lon river in this area include plankton such as copepods, cladocerans, and rotifers; benthic fauna such as snails, mussels, clams, and bivalves; aquatic plants mainly include water hyacinths and algae). The project area is not a protected habitat for valuable species. Thus, this impact can also be minimized by appropriate mitigation measures.

(vi) Impacts on Cai Lon riverbed after the subproject is put into operation:

To assess the subproject’s impact on the river section within the study area, relevant data was collected, and shoreline changes were analyzed from 1984 to 2020. The overlaid topographic maps indicate that the Cai Lon River at the project site has experienced no significant changes in morphology from 1984 to the present (2024), as illustrated in the following figures.



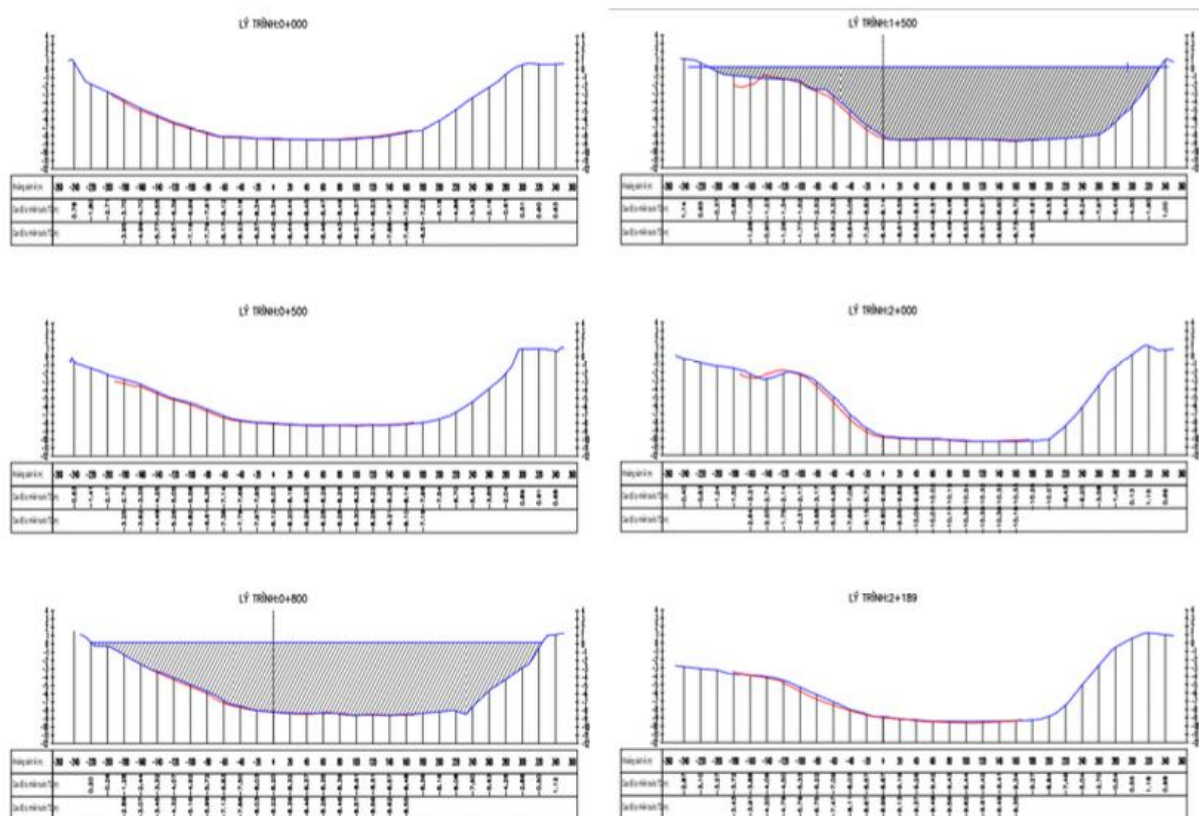


Figure. Sections of riverbed changes from 2021 – 2023

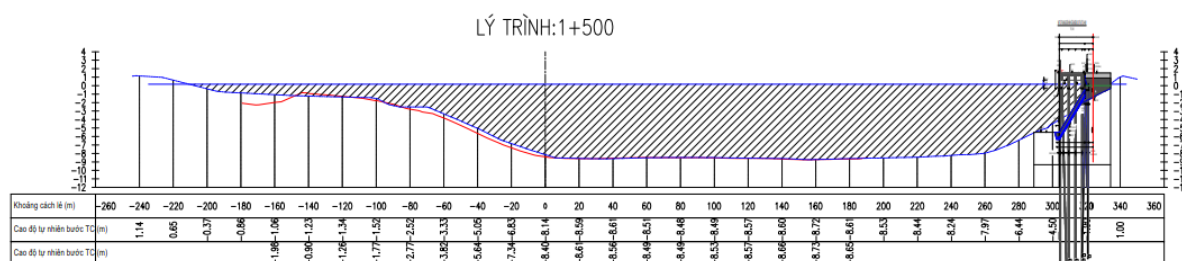


Figure. Cross section in the subproject construction

Accordingly, after the construction of the Kien Giang Fisheries Center, the impact on the river's wetted cross-section is minimal. The original wetted cross-sectional area was 3,199 m², and after construction, it increased slightly to 3,290 m²—representing a change of only 0.3%. Therefore, it can be concluded that the construction of the subproject does not significantly affect sedimentation situation at the studied river section.

(vii) Traffic impacts and risks

❖ Waterway traffic accidents:

Cause: During vessel operations, serious accidents such as shipwrecks, vessel collisions, or fires may occur. The average number of vessels entering and leaving the Kien Giang Fishery Center is about 180 vessels/day. In the event of a storm, the port will accommodate approximately 1,000 fishing vessels seeking shelter. However, these vessels will not all arrive at the same time but over the period from 3 to 5 days under the directives of the Maritime Administration.

During the operation of ships, shipwrecks, ship collisions, or severe fire incidents may occur. The transportation of products through the port will increase the waterway traffic in the channel in front of the port, greatly affecting the load-bearing capacity of the channel, obstructing visibility. Such increase in waterway traffic density is expected to lead to a higher risk of waterway accidents and oil spills, significantly affecting surface water quality and the ecosystem in the port area on Cai Lon River and the area adjacent to the Rach Gia Bay estuary. In addition, dirty water and domestic solid waste, ballast water from vessels navigating the channels—especially in cases of collision where waste is not properly collected or treated—may leak and overflow into the sea and port areas. This will increase pollutant levels and negatively impact on the surrounding ecosystems along the navigation routes.

Scope of impact: When there is a waterway traffic accident, depending on severities, oil spills may occur, affecting local soil and surface water quality, causing damages to property of fishermen and the port management authority, or even cause life of ship operators and fishermen onboard.

❖ ***Vessel docking beyond the port's designed capacity***

The Kien Giang Major Fishery Center will be capable for 180 vessel/turn. When the fishing port comes into operation, the incident of vessel docking exceeds the design capacity may occur, leading the following impacts:

- Vessels waiting for their turn to unload may experience long delay, potentially resulting in disputes over docking priority and causing disorder.
- Although, conventionally, docking is organized in sequence, some ship owners may attempt to push ahead, or maneuver around others to dock or leave the port, leading to traffic safety issues and negatively affecting the port's loading and unloading capacity.
- Wastewater and solid waste generated in excess of the subproject's treatment capacity of the designed waste treatment plant (WWTP, waste storage facilities).

Impact Assessment: This impact is considered to be **Low**, as the port facilities have been designed and calculated in accordance with technical standards to ensure operational sustainability (with the demand of major fishery center: 180 vessels/turn and accommodation of 1000 vessels sheltering from storm). However, if such incidents persist over an extended period, they may pose risks of port infrastructure degradation, potentially leading to damage to docking facilities and resulting in certain losses. This impact can be mitigated by appropriate port operation management measures.

✓ ***Risk of falling into the river and drowning for vessel operators/fishermen on board***

Such incidents are typically flagged during embarkation or disembarkation at docking areas, or in the event of vessel collisions, where individuals onboard may lose balance and fall, slip, or tumble into the sea. Although the docking areas are often designed with guard rails and warning signs, fishermen remain at risk of falling into rivers due to slippery surfaces, which can lead to drowning. During the rainy and flood seasons, transportation vehicles operating in these areas may also slip and fall into the river. This affects the health and even causes the lives of fishermen operating in and out of the port. The subproject's technical design has been reviewed and implemented to prevent such threats to fishermen when using port facilities. Therefore, this impact is assessed as Low and can be mitigated.

(viii) Occupational accidents

During the operation phase, there will be 70-80 workers operating the Kien Giang Major Fishery Center. Some risks and occupational accidents may occur, particularly in the complex working

environment with multiple activities such as seafood unloading, transportation, and operation of mechanical equipment. Potential risks and incidents include:

Accidents due to collisions and traffic accidents:

Risk of collision between vehicles: With the involvement of a variety of vehicles (trucks, boats, forklifts, cranes, etc.) in the port area, collision accidents may occur, especially when vessels operate under limited visibility conditions, or lack of proper separation and routing.

Road traffic accidents: Vehicles transporting seafood between ports and the mainland can cause traffic accidents due to poorly prepared roads or careless driving behavior.

Accidents involving mechanical equipment (cranes, forklifts, etc.):

Risks from lifting equipment, cranes: Using cranes and forklifts to load and unload seafood from ships ashore or from shore into storage warehouses can cause accidents if the equipment is not adequately maintained or operated incorrectly. Accidents may include falling heavy objects, snapped cables, or equipment malfunction.

Risks from electrical equipment and machinery: The operation of heavy machinery such as pumps, generators, or other motorized equipment may lead to electric shock, fire and explosion accidents if safety regulations are not observed.

Accidents due to unsafe working conditions:

Falls, trips, slips: Due to continuous movement on wet and slippery surfaces (caused by grease, seawater, or seafood waste), workers engaging in unloading and storage areas are at risk of slipping, falling.

Fire and explosion accidents:

Risk of fire and explosion from flammable materials: Substances such as oils, fuels, chemicals used in seafood processing or storage may lead to fire and explosion unless being handled and stored properly. Additionally, the use of electrical and mechanical appliances may result in electrical shorts or sparks, increasing the risk of fire.

Fire due to improper discharge: Flammable waste such as oil, grease from boats, cranes, or from seafood processing may cause fires if not collected and disposed of properly.

Health-related accidents and illnesses:

Risk of infectious diseases: Working in humid environments and exposure to seawater can lead to infectious diseases, especially those related to the respiratory tract, skin, or waterborne diseases.

Respiratory diseases: Long-term exposure to dust from seafood or emissions from ships can cause respiratory diseases such as pneumonia, bronchitis, or other chronic diseases.

Diseases caused by marine life: Exposure to marine life can lead to injuries, infections, or poisoning due to toxins from seafood or other marine life.

Accidents caused by environmental factors:

In addition, occupational accidents may occur due to environmental factors in the port, including:

- Risks due to extreme weather conditions: Weather conditions such as heavy rain, storms, and strong winds can increase the risk of accidents for workers working outdoors, especially those working on docks.

- Risks from sea waves and surge: Working in conditions of high seawater or strong waves may expose workers to risks of being swept away or encountering accidents while operating on vessels or at the dock or piers.

- Fish holds containing miscellaneous fish which are sorted for long periods at sea will generate toxic gases. The deeper the fish holds and the longer the voyage, the higher the risk of oxygen deprivation for fishermen working in the fish holds, leading to acute poisoning, fainting, or even death.

- In the receiving and sorting areas where washing activities are frequently carried out and seafood is handled, the floor is always wet, increasing the risk of slips and falls during the lifting and transporting of seafood containers and trolleys.

- Slip-and-fall accidents during the loading and unloading of seafood from vessels to the port, including incidents where seafood containers fall onto workers.

Overall, risks related to occupational accidents in Kien Giang Fishery Center is **Medium** because (i) these impacts are always potential to occur on the port at any time; (ii) The number of operation workers is not large (70-80 people); (iii) these risks may persist the long term during the fishing port operation period; and (iv) they can be mitigated by appropriate measures such as occupational safety training before and during operation and providing personal protective equipment for workers, etc.

(ix) Potential Environmental Risks and Incidents

❖ Fire and Explosion Incidents:

Causes: being analyzed and forecasted above, the environment in the area contains fuel vapors, so the potential of fire incidents is high when exposed to high heat sources or electrical short circuits.

The power supply system for machinery, technical equipment, and electrical systems in auxiliary facilities, cargo yards, and the administration building may experience short circuits, fires, or explosions, causing damage to human life and property. Additionally, the area containing fuel vapors used for refueling vessels is prone to high risk of fire incidents when exposed to high heat sources or electrical short circuits. A fire or explosion at Kien Giang Major Fishery Center may cause human lives and property loss. Such incidents may lead to fire spread to warehouses, causing significant economic damage and threatening the safety of the port staff.

Affected group: People and property within the project area may be affected. However, as the neighboring residential area is located over 150 meters away and separated from the port, it is less likely to be affected.

Impact level: Assessed as Medium because (i) functional areas are all designed with fire protection measures and on-site fire-fighting equipment, such as fire extinguishers; (ii) The arrangement of products and materials for the fishery service is allocated to specific zones with instructional signage, and dedicated personnel responsible for management and compliance with operational procedures; (iii) The port area is landscaped with greenery, and water supply infrastructure has been designed with a fully equipped fire protection system.

❖ Oil Spill Incidents:

For the operation of the Kien Giang Subproject, an oil spill incident may occur due to: (i) Vessel capsizing; (ii) waterway traffic accidents; (iii) spillage or leakage of oil and grease from fishing vessels entering or leaving the port; and (iv) storms, winds, low pressures and other extreme weather events.

Once an oil spill occurs, an oil-water mixture is quickly formed and spread after about 3-6 hours. The oil gradually dissipates through weathering related to various physical and chemical processes, such as natural dispersion by wind and currents, sedimentation, evaporation, or the formation of oil suspensions floating on the water surface. This spill will harm the natural environment and economic activities in the area. Specifically:

- Part of the oil products will sink and decompose on the seabed, polluting the water and sediment, while another part may float with air bubbles from the seabed. Oil residue on the seabed is a source of water pollution, affecting benthic organisms that are a food source of fish.

- When the water source is contaminated with oil, the decomposition oil products reduce the water source's ability to clean itself because the plankton and benthic organisms involved in the process die or decrease in number.

- This reduction in dissolved oxygen can negatively affect aquatic life, disrupt photosynthesis in submerged plants and algae, and lead to localized hypoxic conditions.

Fishing vessels passing through Kieng Giang Fishery Center have capacity from 90 to 600 CV, and contain about 0.152 to 16.188 tons of DO. The risk of oil spills is always present at the port, especially during the rainy and flood season when accidents and capsizing are more likely. The impact is assessed as **Medium** because: (i) the port area is arranged with a docking station in the form of anchorage, suitable for each type of ship with different capacity, length as well as purposes as required by vessel owner. The length and width of the berths are configured to support cargo handling operations and ensure convenient access to services such as loading, unloading, and other port-related activities for vessels arriving at the port; (ii) The navigation channel area and the turning area are designed to ensure appropriate width, channel depth, turning radius, and maneuvering space, thereby reducing the risk of congestion, collisions, and inconvenience during vessel berthing and service use at the port. This risk can be mitigated by appropriate measures such as providing adequate waterway traffic safety equipment/facilities at the port, organizing rational vessel traffic, raising awareness among vessel operators, and conducting regular inspections of vessels to identify potential malfunctions (if any).

In addition, to minimize and manage potential oil spill incidents, the project owner must develop a vessel operation management plan and establish an emergency response plan for oil spills.

❖ ***Incidents of water supply and drainage pipelines broken and failures of wastewater treatment systems***

During the operation, water supply and drainage pipeline and wastewater treatment systems may encounter the following incidents:

- Breakage or cracking of water supply pipelines due to unsafe construction materials.
- Water pipeline was broken due to external force.
- Failures of the wastewater treatment system, such as malfunctioning treatment equipment, leading to untreated or inadequately treated wastewater being discharged into the environment.

Such incidents, when occurring, will lead to water wastage (for clean water supply) and discharge of environmental pollutants (for wastewater). However, the likelihood of these impacts is considered low, as the water supply network is installed in technical compartments, and water supply areas are equipped with a pressurized valve system to detect leaks in the pipeline system.

When the wastewater treatment system is broken, the level of air and water pollution will increase as assessed in the above sections.

In addition, the materials used for pipelines are fire-resistant, corrosion-resistant, and highly durable, resulting in a very low risk of breakage or leakage. WWTPs are designed with independent operating modules, with backup system, and equalization tanks that can be stored for up to 24 hours when all modules fail. Therefore, the impact from these incidents is minor and can be controlled through appropriate measures.

✓ ***Risks and incidents due to improper operation of wastewater treatment plant***

In addition to risks from vehicles and equipment operating WWTP, there are also risks stemming from humans and funding sources in the operation and maintenance of WWTP. These risks include but are not limited to:

- The WWTP operators' failure to comply with the operating process instructions that have been developed for the WWTP.
- The operators lack sufficient knowledge and qualifications to operate the WWTP.
- Weakness in human resource management during the operation of the WWTP.
- Infrequently periodic maintenance, replacement or repair of damaged machinery and vehicles.
- Improper frequency and volume of sludge collection, which may result in reduced treatment efficiency of the WWTP and failure to meet current national technical standards.

The above risks, if occurring, will reduce the wastewater treatment efficiency of the wastewater treatment and affect the quality of receiving water sources and the aquatic ecosystem. However, the risk is assessed as "Low" and can be minimized: (i) The operation of the WWTP is carried out by engineers who are knowledgeable and qualified in wastewater treatment technology; (ii) The operation will be arranged in shifts and always have staff on duty, operating in accordance with the regulated instructions; (iii) The WWTP is periodically inspected and maintained daily or immediately when an incident occurs; (iv) At WWTP, machinery and means are always available for replacement in case of damages.

Furthermore, before the WWTP is officially put into operation, the subproject must register for trial operation and apply for an environmental license.

4.6 BACH LONG VI STORM SHELTER UPGRADING SUBPROJECT

4.6.1. Impacts and risks during preparation phase

4.6.1.1. Impacts on land acquisition

The subproject is planned with a total area of 32.15 ha, including:

- 26.35 ha of non-agricultural land (comprising 0.42 ha of special-use land for public purposes and 25.94 ha of special-use water surface land);
- 5.8 ha of unused land.

In addition, to serve construction activities, the subproject will use 03 disposal sites with a total area of 5.13 ha as disposal sites for dredged materials (according to Decision No. 2397/UBND-MT dated October 30, 2024, by the Hai Phong City People's Committee approving the location for dumping dredged materials). The total reception capacity of these 03 disposal sites is 76,000 m³.

The entire area for the construction of project items belongs to the existing land managed by the Port Management Board and the Bach Long Vi anchorage area. The land planned for the 03 disposal sites is managed by the People's Committee of Bach Long Vi district. Therefore, no

households are subject to relocation or directly affected by land acquisition during subproject implementation. Accordingly, this impact is assessed as non-existent.

In summary, to implement the activities of the Bach Long Vi subproject, no land is recovered from the people, so impacts related to livelihoods and living conditions due to land acquisition are entirely non-existent.

4.6.1.2. Safety risks related to unexploded ordnances

Although the Bach Long Vi subproject is implemented within the existing fishing port land and storm shelter area for ships, the possibility of unexploded ordnance remaining in the subproject area is considered to be very low. However, due to dredging activities in the fairway, turning basin, and storm shelter anchorage, the subproject will still carry out mine clearance over the entire planned area of 32.15 ha. Mine clearance activities will be conducted by specialized, authorized units. This impact is considered negligible.

4.6.2. Impacts and risks during the construction phase

4.6.2.1. General impacts and risks

(i) Impact on ambient air quality

Sources of impact on ambient air quality during the construction of the subproject include: (i) Dust generated from demolition and site clearance; (ii) Dust generated from excavation and leveling activities; (iii) Dust generated from the transportation of construction materials; (iv) Dust generated from the waste transportation process; (v) Dust generated during the gathering, loading, and unloading of construction materials; (vi) Emissions generated by vehicles transporting raw materials and waste; (vii) Emissions generated from the operation of construction equipment and machinery.

Dust generated from demolition and site preparation

The subproject area is currently an existing fishing port along with some infrastructure works (logistics area) of the port. The subproject upgrades several structures based on the foundation of existing works (western breakwater; system of piers and anchorage for storm sheltering) and constructs new piers of over 15m and a 315m breakwater extension (within the current land area). Therefore, the demolition of old structures for upgrades as well as the presence of plant biomass in the construction area is minimal (the estimated volume of demolition materials is approximately 4,278 m³), primarily including broken bricks and plant biomass.

Based on formula [1], the total amount of dust generated during the demolition and site preparation process is estimated at 96.64 kg. With the expected demolition and site preparation period lasting about 30 days, the average daily dust emission is approximately 3.2 kg/day, resulting in a dust concentration of 0.14 mg/m³, which is lower than the permissible limit specified in QCVN 05:2023/BTNMT (allowable limit: 0.3 mg/m³).

The sensitive receptors affected by dust generated from demolition and site preparation activities are mainly construction workers present at the site and some fishermen accessing or exiting the port area (within a distance of approximately 50–150m from the construction site).

This impact is assessed as medium because: (i) The concentration of dust is below the regulated standard; (ii) The duration of impact is limited (approximately 30 days); (iii) The number of affected receptors is not large, mainly workers and a few fishermen in the port area; (iv) This impact can be effectively mitigated through appropriate construction management and environmental control measures.

- **Dust generated from excavation, leveling and dredging**

According to the project design, the Bach Long Vi subproject does not involve any earthwork activities; dredging mainly takes place within the storm shelter anchorage area (10.2 ha), the ship fairway, and the turning basin (3.3 ha). The dredged material primarily consists of sedimentary rock located at the seabed, which will be broken up by dredging vessels, loaded onto barges, and then transported to shore before being hauled to designated storage sites. The total volume of dredged material is estimated at approximately 51,550 m³.

The amount of dust generated from this activity is considered insignificant, as the dredged material is mainly rock, and when brought to shore, it remains wet, which greatly reduces the potential for dust dispersion. Therefore, this impact is assessed as negligible.

In summary, the Bach Long Vi subproject does not involve excavation, and the dredging process generates minimal dust, so this environmental impact is considered very low.

- **Dust from the process of transporting construction materials from the mainland to Bach Long Vi island**

According to the design, to construct the work items, the subproject must use a large volume of basic materials such as cement (3,409 tons), sand (8,346 tons), stone (36,513 tons), and steel (219 tons). With the peculiarities of Bach Long Vi island, where there is currently no local supplier of construction materials, these materials will be provided by agents in Hai Phong City and transported to the island by sea via Dinh Vu port, directly to the Bach Long Vi port area where the subproject is implemented.

The process of transporting materials may generate dust, especially during the shipping of sand and cement. Small particles may become airborne due to wind, particularly when ships travel at high speeds in dry weather and strong wind conditions. Sand and cement dust can affect air quality at sea and pose respiratory risks to workers on board.

With the volume of construction materials required for the subproject's components, using ships with a capacity of 20,000 tons, the total number of trips is estimated at 3, with each trip lasting about 10 hours. Therefore, the total impact duration is approximately 30 hours.

Dust particles generated from construction materials, if dispersed into the air, will quickly settle and fall into the sea due to the characteristics of the marine environment, limiting their spread. During the transportation process, ship owners and contractors will implement full shielding of storage compartments to reduce dust dispersion and prevent seawater intrusion into construction materials during transit. As such, the potential for dust spread is minimal.

Sensitive receptors during the transportation of construction materials are mainly workers directly present on the ships.

This impact is assessed as low due to the following reasons: (i) the impact duration is only about 30 hours; (ii) in the air environment at sea, any generated dust quickly settles into the sea; (iii) the number of affected subjects is small, mainly limited to shipboard workers; and (iv) this impact can be mitigated by appropriate measures, such as shielding all material compartments.

- **Dust generated by the transportation of waste and dredging materials**

As described in chapter 1, the Bach Long Vi subproject does not generate excavated materials, but the volume of dredging materials is 51,550m³, and the volume of waste materials from the process of luminescence, demolition, and construction is 4,278m³. Thus, the total volume of materials to be dumped accounts for 55,828m³. These materials will be transported to 03 disposal sites

(disposal site No. 01 is 0.5 km away from the subproject; disposal site No. 02 is 1.3 km away from the subproject, and disposal site No. 03 is 0.7 km away from the subproject). Of these, disposal site No. 01 has the capacity to receive 55,000m³, disposal site No. 02 receives 12,000m³, and disposal site No. 03 receives 9,000m³. The material is first filled into disposal site No. 01, then transferred to disposal site No. 03, and lastly to disposal site No. 02. The dredging materials are transported ashore safely, then transferred to the disposal sites by trucks with a load of 10 tons. The transportation route will be a dike road surrounding Bach Long Vi Island (described in detail in chapter 1).

The transportation of waste and dredging materials will generate dust from the dredged material/excess excavated rock transported and swept up from the tires during transportation from the construction site to the subproject's dredging material storage site.

The means of transporting these materials from the port area to the disposal sites are cars with a load of 10 tons. The fuel used for this vehicle is diesel. The transportation distance to disposal site No. 01 is 0.5km; to disposal site No. 02 is 1.3km; and to disposal site No. 03 is 0.7km.

The dust load generated during the transportation of construction materials is determined according to the formula [CT3] of Air Chief, U.S. Environmental Administration, 1995: $L = 0.255\text{kg/km}$.

With a total volume of materials to be transported amounting to 55,828 m³, this type of material is primarily soil and weathered rock dredged from the seabed in the anchorage area of TaU and ship boats. These materials have an average weight of about 2600 kg/m³. Therefore, the total converted weight of the dredged materials will be equivalent to 145,152 tons, which corresponds to 14,515 transport trips. Considering the capacity of the 03 storage sites and the distance from the port area to these storage sites, the total distance transported by truck will be approximately 15,960 km.

With a construction period of 18 months, there will be an average of about 27 transportation trips per day, corresponding to a total transportation distance of 30 km per day. The amount of dust generated from these transportation activities will be 11.3 kg.

Applying the SUTTON model, the average concentration of pollutants at any time with linear sources is determined according to the formula [CT4]:

The vertical pollutant diffusion coefficient σ_z (z) with atmospheric stability class B is calculated based on the following formula: $\sigma_z = 0.53 \times 250.73$ (m)

In this calculation, x represents the distance from the calculation point to the exhaust source in the wind direction. The calculation method divides the point coordinates into horizontal axis (x) and vertical axis (z). For the Bach Long Vi area, the average wind speed, as stated in Chapter 2 of the report, is approximately 6 m/s. The atmospheric stability is classified as type B. The diffusion coefficient depends on the level of atmospheric diffusion, and the vertical coefficient σ_z is calculated for atmospheric stability type B at a distance $x = 25$ meters from the center of the road to the sides.

The average dust concentration generated from the transportation of waste and dredging materials at Bach Long Vi subproject over one hour will be 545 $\mu\text{g/m}^3$ at the center of the road, 370.9 $\mu\text{g/m}^3$ at a distance of 10 meters, and 285.4 $\mu\text{g/m}^3$ at a distance of 20 meters. According to QCVN 05:2023/BTNMT, the permissible dust concentration for 1 hour is 300 $\mu\text{g/m}^3$. Therefore, at the center of the road, the dust concentration exceeds the standard by 1.8 times, at 10 meters it exceeds by 1.2 times, and at 20 meters it is below the allowable limit.

The sensitive receptors affected by the dust generated by the transportation of waste and dredging materials are workers directly involved in the construction at the port area, people, fishermen entering and exiting the port and some people living along the route surrounding the island near Bach Long Vi port.

The level of impact is assessed as Medium because (i) the concentration of dust generated is not large, (ii) the short-term impact period (about 1 to 8 months), (iii) the affected objects are not large, only the workers participating in the construction at the port area, fishermen entering and exiting the port, and a small number of people living near the port area along the seawall, (iv) the impact of this dynamic can be completely controlled and mitigated by appropriate measures.

• Dust from gathering, loading, and unloading construction materials:

As described in Chapter 1, to build the Bach Long Vi subproject, the project will have to use a large amount of basic materials such as cement (3,409 tons), sand (8,346 tons), stone (36,513 tons), steel (219 tons), etc. In addition to the amount of dust generated by the transportation process, the process of loading and unloading this material will also create a certain amount of dust entering the environment.

Based on the dust pollution coefficient generated during the loading and unloading of materials, referred to in AP 42, Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources, for example:

- For crushed stone: 0.0035 kg of dust/ton
- For sand: 0.0011 kg of dust/ton
- For cement: 0.36 kg of dust/ton,

We calculated that the total amount of dust generated from the loading and unloading of the main materials was 1,364.5 kg.

Calculation of dust concentration arising from the loading and unloading of construction materials according to the method of Tran Ngoc Chan, 1999, *Air pollution and treatment emissions (Volume 1)*, Hanoi Science and Technology Publishing House. Think of the air mass at the construction site area as a box with the dimensions of length L (m), width W (m), and height H (m), one side of the bottom of the air box is parallel to the wind direction. Assuming that the air blowing into the box is polluted air and the air at the construction site at the time of construction is quite fresh, the average concentration of dust generated in 1 hour is calculated according to the formula [CT5].

The average dust content in 1 hour, taking into account the background environment of the subproject construction area of the Bach Long Vi project arising from the loading and unloading of construction materials, will be $437 \mu\text{g}/\text{m}^3$ at the loading and unloading area (exceeding QCVN 05:2023/BTNMT by 1.45 times) and $297.16 \mu\text{g}/\text{m}^3$ at a distance of 10m from the loading and unloading location.

Sensitive receptors affected by dust arising from material loading and unloading activities are workers participating in loading and unloading materials within a distance of 10m from the loading and unloading location.

The impact level is assessed to be low because (i) the concentration of dust generated in excess of the norm at the loading and unloading location is not large, (ii) the impact time is short and intermittent (only occurs when there is material loading and unloading activities), (iii) the affected object is only a small number of workers directly involved in loading and unloading materials, (iv) this impact can be reduced and minimized by appropriate measures.

• Gas emissions from means of transporting materials and waste:

In addition to dust generation, the process of transporting materials for construction, transporting waste, and dredging materials will generate emissions due to vehicles using DO oil fuel. The process of burning fuel will produce emissions such as NO_x, SO₂, and CO.

In Chapter 1, the report describes that construction materials were transported from the mainland to the island by ship through Dinh Vu port and to Bach Long Vi port. The distance traveled is 171 km, and the means of transport is a ship with a load of 20,000 tons, with a total of 3 trips. Thus, the total distance for the transport train will be $171 \text{ km} \times 3 \text{ trips} \times 2 \text{ directions} = 1,026 \text{ km}$.

This type of ship has an average fuel consumption of about 1.25 tons of diesel per hour.

The number of hours the ship travels from the mainland to the port and vice versa will be $10 \text{ hours} \times 3 \text{ trips} \times 2 \text{ directions} = 60 \text{ hours}$. Thus, the total amount of fuel used is 75 tons of oil. For dredging materials and wastes: With the volume of waste and dredging needing to be transported to 3 planned waste sites (waste site No. 01 receives 55,000 m³, 0.5 km away from the subproject; waste site No. 02 receives 12,000 m³, 1.3 km away from the subproject; and waste site No. 03 receives 9,000 m³, 0.7 km away from the subproject), the means of transport is a truck with a load of 10 tons. Therefore, the distance to transport waste materials and dredged materials is 15,960 km.

With trucks having a tonnage of 10 tons and fuel consumption of 0.4 liters of oil/vehicle.km (1 liter of diesel = 0.832 kg), the fuel consumption will be 6,384 liters of oil (equivalent to 5,311 kg).

Additionally, with barges used to transport dredged materials from the dredging area to the shore, the fuel used by these barges is DO oil with an average consumption of about 30 liters/hour. The average operating hours of the barge are about 8 hours/day, so the average daily use of 240 liters of DO oil (equivalent to 199.7 kg) is expected.

Thus, the total fuel used to transport materials from the mainland to the port and transport waste materials from the construction site to the dump site is 80,510 kg of oil.

Applying the formula [3], the load of emissions generated is: SO₂ = 117.0 mg/m.s, NO₂ = 66.1 mg/m.s, and CO = 732.8 mg/m.s.

Using the Sutton model, we can calculate the concentration of pollutants in exhaust gas according to the distance (x) and altitude (z) of the exhaust gas. The results of calculating the concentration of emissions arising from the activities of vehicles transporting materials and waste are below the permissible level according to QCVN 05:2023/BTNMT - National Technical Regulation on Ambient Air Quality.

Subjects affected by emissions generated by the process of transporting raw materials and dredging waste include workers working directly on transport ships, workers directly participating in dredging, fishermen entering and exiting the port area, and people living along the route of transporting dredged materials (the road surrounding the island from the project area towards dumps No. 01 and 02).

The impact level is assessed as low due to (i) the concentration of emissions generated being lower than the QCVN, (ii) the impact period being intermittent and the construction area being an open sea, (iii) the affected objects not being large, mainly some workers present on the transport ships, barges, and some people living along the transport route, (iv) this impact can be mitigated by appropriate measures.

Waste caused by the operation of construction equipment

As described in Chapter 1, the construction process for the subproject will involve the use of several types of construction equipment such as grab bucket excavators, floating cranes, 25-ton and 50-ton cranes, canoes, tugboats, and dump trucks. All of these devices use diesel fuel for their internal combustion engines. The operation of this equipment will produce exhaust gases, including NO_x, SO₂, and CO.

To calculate emissions (CO, NO₂, SO₂) from the operation of machinery and equipment during construction, the report is based on documents from NATZ Transport, Shun Dar Lin, 2005. With an oil consumption rate of 0.1 kg/ton, the emissions are as follows: SO₂: 2.8 kg per ton of oil; NO₂: 12.3 kg per ton of oil and CO: 0.05 kg per ton of oil

Based on the input of construction machinery and fuel demand for the Bach Long Vi subproject (as mentioned in Chapter 1), the average total amount of DO oil used is 7.12 liters per hour. The estimated operation time for the construction machinery is about 8 hours per day (1 shift), which is intermittent over the total construction period of 18 months for the subproject work items.

The load of pollutants during diesel combustion is calculated according to the following formula [CT6]:

The dust and exhaust gas load resulting from the fuel combustion of engines during a working shift is calculated as follows: SO₂: 0.173 g/s; NO₂: 0.019 g/s; CO: 0.005 g/s

Using Formula [4] (Sutton model) with a wind speed of 6 m/s in the subproject area and a distance of 5-10 m from the generated sources, the emission levels from construction machinery and equipment are much lower than the permissible limits in QCVN 05:2023/BTNMT - National Technical Regulation on ambient air quality.

The sensitive receptors from the operation of construction machinery/equipment are workers participating in the construction within 50 meters of the construction site. The impact level is assessed as **Low** because: (i) The concentration of emissions generated is within the standard limits. (ii) The impact period is long-term but intermittent (mainly 8-10 hours/day for about 18 months of construction); (iii) The affected group is small as the construction area is far from residential areas; (iv) This impact can be mitigated with appropriate measures.

In general, the impact on ambient air quality in the Bach Long Vi subproject area is assessed as **Low to Medium**. The affected groups are mainly workers directly involved in construction at the site, and a small number of people living near the Bach Long Vi fishing area, which is adjacent to the route surrounding the island. These impacts can be controlled and minimized during construction.

(ii) Noise impacts

Sources of noise during the construction of the Bach Long Vi subproject include: (i) Operation of transportation vehicles and construction equipment; (ii) Construction, dismantling, and completion of work items; (iii) Activities of employees and workers participating in construction.

Noise levels are determined using typical standards for construction vehicles and equipment from the "U.S. Committee for Environmental Protection - Noise from Construction Equipment and Construction Machinery NJID, 300.1, 31/12/1971." The noise level will gradually decrease with distance and is calculated according to the formulas [CT7] and [CT8] from "Pham Ngoc Dang 2003. Air Environment. Science and Technology Publishing House 2003" as follows:

The surrounding construction area of the Bach Long Vi subproject is adjacent to the sea, so $\Delta L_c = 1.0$.

Based on the amount of machinery and equipment capable of operating simultaneously on the construction site and the formulas mentioned above, the maximum noise pressure at various distances caused by the operation of construction equipment is presented in the table below:

Table 4.67. Noise levels generated by construction equipment at various distances in the Bach Long Vi subproject

No.	Name of equipment and machinery	Noise level at a distance of 2m	Average	Noise level corresponds to distance (dBA)				
				5m	20m	50m	100m	200m
1	Truck 10T	71 ÷ 80	75,5	71.5	65.5	61.5	58.5	55,5
2	30T Floating Crane	86 ÷ 88	87	83.0	77.0	73.0	70.0	67,0
3	12-75HP Barrel	80 ÷ 87	83,5	79.5	73.5	69.5	66.5	63,5
4	360-1200CV Tugboat	83 ÷ 89	86	82.0	76.0	72.0	69.0	66,0
5	1.5KW Hammer Compactor	74 ÷ 77	75,5	71.5	65.5	61.5	58.5	55,5
6	Car watering 5m3	78 ÷ 81	79,5	75.5	69.5	65.5	62.5	59,5
7	25T Vibratory Roller	58 ÷ 70	64	60.0	54.0	50.0	47.0	44,0
8	50kVA Generator	85 ÷ 87	86	82.0	76.0	72.0	69.0	66,0
Average noise level				75.6	69.6	65.6	62.6	59.6
Total noise level (maximum)				90.2	84.2	80.2	77.2	70.2
QCVN 26:2010/BTNMT: Noise levels in normal areas				70 dBA				
QCVN 24:2016/BYT: Noise level in the working area				85 dBA				

Based on the results in the table above, it can be seen that within 20 meters from the noise source, the noise level is mostly higher than the allowable limit according to QCVN 26:2010/BTNMT and QCVN 24:2016/BYT. However, beyond the 20-meter range, most of the noise generated by these devices when operating is lower than the allowable limit.

The nearest residential area is at least 80 meters away from the project, so the affected group is mainly workers participating in construction at the site. The impact time is intermittent and shift-based (only when the equipment is active). Therefore, this impact is assessed as Medium. The project owner will supervise and request the contractor to limit the simultaneous operation of multiple devices and ensure that the equipment is periodically checked. Workers will be required to be equipped with and use labor protection equipment and noise protection gear.

(iii) Vibration impact

The source of vibration mainly comes from the operation of onshore construction equipment and machinery with large capacity, used in activities such as leveling and piling to reinforce the embankment around the existing port area. The typical vibration levels of some construction machinery and equipment are presented in the table below.

Table 4.68. Vibration levels of some typical construction equipment

No.	Type of means and equipment used	Reference vibration level (in vertical direction, dB)
1	Excavator	80
2	Bulldozer	79
3	Heavy Duty Trucks	74
4	Roller	82
5	Generator	81

(Source: U.S. Environmental Protection Commission Vibration from Construction Equipment and Construction Machinery NJID, 300.1, 31 - 12 - 197)

To forecast the vibration level that decreases with distance, use the formula [CT9].

The results of the vibration forecast caused by the operation of Bach Long Vi subproject construction machinery are presented below.

Table 4.69. The vibration level decreases with the distance during construction

No.	Device	Source vibration ($r_0=10m$)		Vibration level at a distance							
				r =12m		r =14m		r =16m		r =18m	
				Laeq (dB)	Lveq (mm/s)	Laeq (dB)	Lveq (mm/s)	Laeq (dB)	Lveq (mm/s)	Laeq (dB)	Lveq (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 Duty Trucks	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	Generator	81	1,93	71,5	0,65	62,1	0,22	52,9	0,08	43,6	0,03
QCVN27:2010/BTNMT, the permissible level is 75dB from 6 ÷ 21h and the floor level is from 21h ÷ 6h.											
According to the document DIN 4150, 1970 (German LB), 2mm/s: no damage; 5mm/s: mortar peeling; 10mm/s: possible damage to the bearing part; 20 ÷ 40mm/s: damage to the bearing part.											

According to the calculation results, the vibration level of construction vehicles and equipment at a distance of 12m is within the permissible limit of QCVN 27:2010/BTNMT (<75dB) and will decrease as the affected location is farther away from the source of vibration. The objects affected by the vibration of construction equipment are construction workers at the construction site and construction works on the site.

In general, the impact caused by vibration is low due to the small amount of equipment used to cause vibration (mainly onshore equipment), the equipment operating individually and not simultaneously, and the localized nature of the construction activities. Additionally, there are almost no works around the construction area, and it is far from residential areas (the nearest residential area to the subproject is 80m). The effects caused by vibration can be completely minimized through the application of construction measures and construction plans suitable for each type of equipment and each construction site.

(iv) Impacts arising from estimated emissions***a. Workers' domestic wastewater:***

Wastewater is mainly generated from the daily activities of workers at the construction site. The project plans to arrange one camp for workers to stay at the site. The number of workers mobilized to participate in construction at the peak time is expected to be 20 people. Jobs that do not require high skills will be mobilized by local contractors. Therefore, it is expected that about 10 people, who require high skills, will be brought in from other areas to work and stay at the camp. According to QCXDVN 01:2021/BXD National Technical Regulation on construction planning, the water supply norm for daily life is 80 liters/person/day. However, since workers will not be staying at the construction site, the water demand is estimated to be 50% of the norm for those staying at the camp. Therefore, the domestic water demand for workers during this period is estimated as follows:

$$(40 \text{ liters/person/day} \times 10 \text{ people}) + (80 \text{ liters/person/day} \times 10 \text{ people}) = 1200 \text{ liters/day} \\ = 1.2 \text{ m}^3/\text{day}$$

The amount of wastewater generated is calculated as 100% of the water supply. Therefore, on average, about 1.2 m³ of domestic wastewater will be discharged per day.

Domestic wastewater contains components such as: suspended solids (TSS), organic matter (BOD₅, COD), nutrients (N, P) and pathogenic microorganisms. The load of pollutants in domestic wastewater is calculated in the following table:

Table 4.70. Load of pollutants in domestic wastewater

Parameters	Pollution coefficient (g/person/day)	Load (kg/day)	Pollutant concentration (mg/l)	
			Pre-treatment	QCVN 14:2008 Column B
BOD ₅	45-54	0.9 - 6.48	107.2 - 128.6	50
COD	72-102	1.44 - 2.04	171.4 - 242.9	-
TSS	70-145	1.4 - 2.9	166.7 - 345.3	100
Oils and fats of animals and plants	10-30	0.2 - 0.6	23.8-71.4	20
Total Nitrogen	6-12	0.12 - 0.24	14.3-28.6	50
N-NH ₄	2.4-4.8	0.05 - 0.09	5.7-11.4	10
General Pho Pho	0.8-4	0.02 - 0.08	1.9 - 9.5	10

(Source: Pollution load coefficient in domestic wastewater according to Metcalf and Eddy, Wastewater Engineering - Third Edition, 1991)

Pollutants such as BOD, COD₅, TSS, Animal and Plant Greases, etc., in domestic wastewater when untreated exceed the permissible limits according to QCVN 14:2008/BTNMT (column B). Therefore, if domestic wastewater is not collected and treated before being discharged into the receiving body, it will increase the concentration of pollutants, pollute the seawater in the project area, and negatively affect the life of aquatic species.

Thus, the objects affected by the domestic wastewater include the seawater quality in the Bach Long Vi port area and the aquatic ecosystem, particularly the organisms living in the water within

the port area. Additionally, workers residing in the camp area of Bach Long Vi subproject are also directly affected by this waste source.

The impact level is assessed as Low because: (i) the amount of domestic wastewater generated is not large (1.2 m³/day) and will be collected and treated by a mobile toilet system with septic tanks installed by the contractor near the construction site; (ii) the wastewater is generated intermittently during the day but will last for the duration of the construction period (about 18 months); and (iii) appropriate mitigation measures can be implemented to minimize these impacts.

b. Construction wastewater:

Sources of construction wastewater during the construction phase of Bach Long Vi subproject include: (i) wastewater from washing vehicle wheels before leaving the construction site; (ii) wastewater from the operation of small-capacity mortar and concrete mixers; and (iii) wastewater from washing construction equipment and tools. The total amount of construction wastewater generated is about 5.08 m³/day.

- Motor vehicles wash water: This is mainly water used to wash the wheels of vehicles before they leave the port area. According to TCVN 4513-1988 (Internal Water Supply - Design Standard), the amount of water used to wash the entire vehicle is rated at 500 liters per wash. However, during the construction period, motor vehicles will mainly only wash the wheels, so it is estimated that the average amount of water required to clean the wheels is 100 liters per vehicle. With an average of 27 vehicle trips per day, the total amount of wastewater generated is 2.7 m³/day.
- Concrete mixing activities: At the construction site, a 250L concrete mixer with a total capacity of 30 m³/h is expected to be used. According to "Concrete Technology and Special Concrete" by Pham Duy Huu (Construction Publishing House, 2009), the amount of water needed for concrete mixing at 30 m³/h will require 9.69 m³ of water to wash aggregates and 5.4 m³ of water to mix the concrete. Of this, 80% of the aggregate washing water will be recycled and reused. Therefore, the wastewater generated from concrete mixing is $20\% \times 9.69 = 1.94$ m³/h. Concrete mixing takes place for 2 hours a day, so the amount of wastewater generated from concrete mixing is $1.94 \times 2 = 3.88$ m³/day.
- Washing of construction equipment and machinery: This generally occurs once at the end of each construction day, with an estimated 1 m³/day of wastewater generated.

The amount of construction wastewater generated is not large and is intermittent. The wastewater consists mainly of suspended solids, grease, soil, sand, etc. This presents potential risks such as: increased turbidity in the water due to high suspended solids content, which could adversely affect aquatic life and the environmental landscape of the area, as well as increased sedimentation in the receiving water body. The impact level is assessed as Low due to: (i) the amount of construction wastewater generated is not large (7.58 m³/day); (ii) wastewater is concentrated in the construction site areas; (iii) wastewater is generated intermittently during the day; and (iv) appropriate mitigation measures can be implemented to reduce the impact.

c. Rainwater runoff

Rainwater is generally considered a clean water source, but when it overflows from the construction area, construction equipment, or disposal sites, it can carry pollutants into the receiving water bodies, resulting in water pollution.

The estimated amount of rainfall runoff during the construction period is calculated based on the surface area of the construction site in the Bach Long Vi port area (excluding water bodies) and

the area of the disposal sites. According to TCVN 7957:2008, the rainwater runoff through the project construction areas is calculated using the formula [CT10]; and

Rainfall intensity is calculated using the formula [CT11]:

This quantity depends on the climatic characteristics of each locality. Since TCVN 7957:2008 does not provide specific climatic parameters for each province in the project area, the calculation parameters are determined based on the climatic constants of the Bach Long Vi area, with the following coefficients: $A = 11,650$; $C2 = 0.58$; $b = 32$; $n = 0.95$. Therefore, instead of using formula [11], the rainfall intensity in the construction area of the subproject is calculated as $q = 84.4$ (l/s.ha). Based on this, the rainwater runoff on the ground surface of the subproject construction area is calculated to be 383 l/s, equivalent to 0.383 m³/s or 1,378 m³/h.

According to WHO data (1993), the concentration of pollutants in runoff rainwater is approximately 0.5 – 1.5 mg N/l, 0.004 – 0.03 mg P/l, 10 – 20 mg COD/l, and 10 – 20 mg TSS/l. These values are lower than the permissible limits specified in QCVN 40:2011/BTNMT – National Technical Regulation on Industrial Wastewater. However, it is estimated that rainwater flowing over the construction site will wash away materials, loose soil and rock, surface mineral salts, oil and grease leaks, etc., thereby increasing the concentration of suspended solids and organic matter, raising turbidity and oil content in water, and degrading the quality of coastal seawater in the Bach Long Vi port area, adversely affecting the aquatic ecosystem.

The impact level is assessed as Medium because: (i) Bach Long Vi is an area with lower rainfall compared to the mainland, and the volume of rainwater overflow at the construction site is moderate (1,378 m³/h calculated for the heaviest rainfall in 2024 lasting 3.5 hours with a rainfall of 112 mm); (ii) most construction materials are strictly managed by the contractor, and dredged materials from undersea areas brought ashore will be immediately transported to and reinforced at the disposal sites; (iii) these impacts can be mitigated by appropriate mitigation measures.

(v) Generated solid waste

a. Construction solid waste:

Sources of construction solid waste from the subproject include dredging materials from the anchorage area, fairway, and vessel turnaround area, as well as construction waste generated during construction activities at the site (the subproject does not generate excavation materials).

- Dredging materials: According to the design, the subproject will dredge the fairway and vessel turnaround area (with an area of 3.3 ha, bottom elevation of -2.9 m, ensuring safe access and departure for fishing vessels up to 35 meters in length) and the storm shelter anchorage area (area of 10.2 ha, bottom elevation ranging from -1.1 m to -1.6 m). The total dredged volume is estimated at 51,550 m³. Survey results show that the dredged area mainly consists of rocks and sedimentary mud. Monitoring results at the dredging site indicate that the dredged sludge is not contaminated with heavy metals or organic substances.
- Construction waste: This type of waste is generated during site preparation and construction of the subproject's work items, with the main components being broken bricks, cement debris, foam, wood from damaged scaffolding, etc. The total volume of this waste is estimated at approximately 4,278 m³.

All dredged and construction waste will be collected and transported to three designated disposal sites: disposal site No. 01 in the east, disposal site 02 in the southwest, and Disposal site No. 03 in the central part of the island. These sites are currently vacant lands approved for use as disposal

sites under Decision No. 2397/UBND-MT dated October 30, 2024, issued by the Hai Phong City People's Committee.

At the construction site, if not properly managed, collected, and transported, construction solid waste can pose environmental and health risks to workers, such as obstructing movement and causing accidents from stepping on or slipping over waste, as well as affecting the visual landscape and environmental quality of the area. During rainfall, these wastes may be carried by runoff to the coastal area, thereby affecting construction activities, water quality, and the aquatic ecosystem. However, once generated, these waste materials will be managed, collected, and immediately transported to designated storage sites in accordance with regulations.

Although all three disposal sites are located on vacant land, disposal site 01 and disposal site 02 are situated adjacent to the tidal zone and near the coral ecosystem. If these sites are not properly managed with suitable control and mitigation measures, they pose a high risk of environmental impact on the surrounding ecosystem and the Bach Long Vi Marine Protected Area (these impacts will be assessed in detail in the specific impact assessment of the subproject).

The impact of solid waste is assessed at a medium level due to: (i) the relatively large amount of waste generated, although localized at the construction site; (ii) the construction period lasting approximately 18 months; (iii) the dredged materials, mainly sedimentary rock, and construction waste will be collected and transported to disposal sites No. 01, 02, and 03 in accordance with regulations (disposal sites approved by the Ministry of Agriculture and Rural Development and Hai Phong City People's Committee) at distances ranging from 0.5 to 0.7 km from the construction site; and (iv) the impact can be mitigated through appropriate mitigation measures.

b. Domestic solid waste:

The source of domestic solid waste originates from the daily activities of construction workers at the subproject construction site. According to QCXDVN 01:2021/BXD – National Technical Regulation on Construction Planning, the average domestic solid waste generation rate is approximately 0.5 kg/person/day. At peak construction time, the expected workforce is 20 people, including 10 local workers and 10 workers residing at the on-site camp (workers not residing on-site are counted at 50% of the standard waste generation rate). Therefore, the estimated amount of domestic solid waste generated per day is calculated as:

$$(10 \text{ people} \times 0.5 \text{ kg/day} + 10 \text{ people} \times 0.25 \text{ kg/day}) = \mathbf{9 \text{ kg/day}}$$

The main components of domestic solid waste include easily degradable organic matter such as fruit peels, vegetables, leftover food, etc., and non-biodegradable inorganic materials such as plastic bags, bottles, and old personal items. Domestic solid waste typically contains 60–70% organic matter and 30–40% other components and may also contain a high load of bacteria and pathogens.

If not promptly and properly collected, this waste can cause environmental pollution characterized by foul odors from decomposing organic matter, reduce visual aesthetics, and create favorable conditions for the proliferation of harmful organisms. In addition, since the construction site is located near the sea, there is a risk of waste being discarded or washed into the sea, causing marine pollution and negatively affecting the local landscape and ecosystem.

The level of impact is assessed as **medium** due to the following reasons: (i) the daily amount of domestic solid waste generated is small (9 kg/day); (ii) the construction duration is about 18 months; (iii) the impact can be mitigated through appropriate measures, such as collecting and sorting domestic solid waste at the construction site, and coordinating with the local environmental

sanitation team to organize the collection and transportation of waste to the designated treatment and disposal facilities in accordance with regulations.

c. Hazardous waste:

Sources of hazardous waste at the subproject construction site include: (i) grease-contaminated cleaning rags from the maintenance of construction machinery and equipment; (ii) packaging materials and containers of lubricants, asphalt, petroleum products, and paints; (iii) leftover welding rod tips; and (iv) used batteries, fluorescent bulbs, and ink cartridges from office activities on site. The estimated volume of hazardous waste generated is as follows:

- Maintenance activities of vehicles and construction machinery, if carried out directly at the construction site, will generate waste such as used lubricants (waste oil), empty lubricant bottles, and oil-contaminated rags, with an estimated volume of 10 kg/month.
- Packaging materials and containers of lubricants, asphalt, petroleum, and paints are generated in small quantities, estimated at about 5 kg/month.
- Waste from welding rods arises during the fabrication of steel frames. The proportion of leftover welding rod tips is estimated at 5–7% of the total welding rod volume, resulting in an estimated generation of about 3 kg/month.
- In addition, a small amount of hazardous waste such as broken batteries, fluorescent light bulbs, and ink cartridges is generated from office operations at the site, with an estimated volume of 2–3 kg/month.

Table 4.71. Statistics on the composition and quantity of hazardous waste generated by Bach Long Vi subproject

No.	Types of hazardous waste (hazardous waste)	Hazardous waste Code	Estimated volume
1	Gloves, hazardous waste adhesive wipes, oil-stained filter cloth	18 02 01	10 kg/month
2	Fluorescent bulbs burn	16 01 06	3 kg/month
3	Rigid packaging made of waste metal (paint box shell, paint, paint brush during the completion of the project, paint rolling time is about 2 months)	18 01 02	5 kg/month
4	Welding rod tip	07 04 01	3 kg/month

Direct sensitive receptors include construction workers, with the potential for impacts such as loss of aesthetics, degradation of seawater and soil environmental quality in the subproject area if hazardous waste is not properly collected and treated.

The level of impact is assessed as **Low** due to the following reasons: (i) The volume of hazardous solid waste generated at the construction site is small (approximately 21 kg/year) and localized within the site; (ii) The impact occurs intermittently throughout the estimated 18-month construction period; (iii) Hazardous waste can be effectively managed and minimized through appropriate mitigation measures.

(vi) Impact on biological resources

✓ **For organisms in high-tide and high-tide zones:**

The construction area of the subproject is located within the existing land area of Bach Long Vi Port. All three designated disposal sites are on vacant land, so the impact on terrestrial biological resources within the subproject's land use area is considered negligible. However, disposal site No. 02 is located near the forest ecosystem on the island (a regenerated forest approximately 20 meters away, separated by road No. 5A), where the dominant vegetation includes species such as morning glory, chicken grass, cactus, cogon grass, and cattail. Fauna primarily consists of birds, reptiles, and some frog species.

The main impacts from construction activities on terrestrial organisms include noise and dust generation if not adequately controlled.

The level of impact is assessed as **Low** because: (i) Land acquisition for the subproject only involves existing land areas and vacant tidal flat land; (ii) Biodiversity of the surrounding flora and fauna is low; (iii) The impact period is intermittent over 18 months of construction; (iv) The impacts can be managed and mitigated by suitable measures.

✓ ***For creatures in tidal and subtidal areas***

The tidal and subtidal zones of Bach Long Vi Island are characterized by high biodiversity, home to many conserved marine species such as grape seaweed, abalone, dune snails (male and female), cotton lobsters, red lobsters, incense snails, pearl mussels (female), sea cucumbers, green mussels, squid, anchovies, sea bass, dotted fish, groupers, mother-of-pearl, and purple sea urchins.

The fishing port area and disposal sites No. 01 and No. 02 are located only 50–150 meters from these tidal areas.

Therefore, if the subproject fails to implement strict management and mitigation measures during construction, there is significant potential risk to the area's ecosystem and biodiversity, especially the protected species. Potential impacts include:

- (i) Leakage of grease from construction machinery and dredging equipment, if not properly collected and managed, may spill into the water, spreading across the sea surface, impeding oxygen exchange and affecting the growth and survival of aquatic organisms;
- (ii) Improperly managed solid waste and dredged material entering the sea can deteriorate the local landscape, reduce seawater quality by increasing turbidity, raise organic matter and pathogen levels in the water, and under tidal influence, carry pollutants to nearby protected areas, affecting their marine systems and the development of aquatic life such as coral reefs;
- (iii) Dredging activities—limited to the storm shelter anchorage, navigational channel, and turnaround basin—may disturb seabed materials (mainly gravel and silty sand). This process can increase water turbidity, release organic matter and toxic substances (e.g., heavy metals) from sediments into the water, and, under tidal influence, carry pollutants into the protected area, threatening the ecosystem and the development of aquatic species.
- (iv) If dredged material and construction waste are disposed of at disposal site No. 01 without proper management and mitigation measures, they may be washed out to sea during high tide, directly affecting the marine environment and ecosystems such as coral reefs around Bach Long Vi Island.

All the potential impacts mentioned above will be further analyzed in detail in the subproject's specific environmental impact assessment section.

The potential impacts on tidal and subtidal ecosystems are assessed as **Medium** due to: (i) The scale of the subproject's construction and dredging activities is not large and primarily occurs

within the existing port area, which is already enclosed by embankments, and mitigation measures will be applied during construction to control pollutant dispersion; (ii) Before disposing of dredged materials at sites No. 01 and No. 02, the subproject will implement mitigation measures such as constructing perimeter walls around the disposal areas to prevent tidal intrusion and pollutant dispersal; (iii) These impacts can be effectively controlled and mitigated by applying appropriate environmental protection measures.

(vii) Impacts caused by erosion, sedimentation, erosion, landslides and local flooding

The construction area of the subproject's work items is located within the existing fishing port area but lies in the tidal zone, making it frequently affected by tidal waves. The anchorage and storm shelter area (10.2 ha), along with the fairway and surrounding areas (3.3 ha), will be dredged to a depth of -2.9m. This may increase the risk of erosion, scouring, and sedimentation if construction measures are not properly implemented, particularly for the 500m long breakwater. However, these impacts are considered low due to the following reasons: (i) the breakwater is being upgraded, which ensures its effectiveness in reducing wave action and preventing erosion and cavitation; (ii) the geological condition of the area primarily consists of seaweed rock, which inherently reduces the potential for erosion.

During construction, if construction materials, waste, and dredged materials are not properly managed and collected, heavy rainfall can wash them into the sea, increasing the risk of sedimentation in the 10.2-hectare anchorage and storm shelter area, causing pollution and affecting the quality, progress, and objectives of the subproject. This impact is considered low because (i) construction materials and waste generated during construction will be strictly managed by the contractor; (ii) the impacts can be controlled through appropriate and effective mitigation measures.

For disposal sites No. 01 and No. 02, although currently vacant land, they are located outside the sea dike and thus face a high risk of erosion and being swept into the sea by tides if no appropriate containment measures are in place. When dredged materials and construction waste are carried away, they will not only affect the seawater quality in the coastal zone surrounding the island but also pose potential threats to the marine ecosystem, especially the nearby coral ecosystems. This impact will be further assessed in detail in the specific environmental impact section of the subproject.

The magnitude of this impact is considered moderate because: (i) disposal site No. 01 is situated in the tidal zone, and during high tide, the dredged materials may be washed into the sea without containment barriers; (ii) disposal site No. 02, although about 100m from the tidal zone, may also be impacted by rough seas or unfavorable weather conditions (e.g., storms, heavy rain), allowing high tides to reach and wash away the deposited materials if no protective walls are constructed; (iii) these impacts can be fully controlled and mitigated through the construction of perimeter barriers and the application of additional reinforcement measures for both disposal sites.

(viii) Impacts due to increased risks and traffic disturbances

✓ ***For road traffic infrastructure and activities:***

During the construction phase of the subproject, several traffic routes may be affected, including the route used for transporting fuel from the supplier to the school and the route used for transporting dredged and waste materials from the construction site to the designated disposal sites.

According to the assessment, the transportation of dredged and waste materials will mainly take place along the concrete road running around the coastline. The total volume of materials to be transported is estimated at 55,828 m³, equivalent to approximately 84,858 tons after conversion.

On average, about 16 trips per day will be made from the construction site to disposal sites No. 01, 02, and 03.

These transportation routes are located along the sea dike of Bach Long Vi Island, which has already been constructed with solid concrete. Therefore, the impact on the traffic infrastructure of the dike caused by transportation activities is considered negligible.



Figure 4.1. Concretized roads on the island

For road traffic activities: All traffic routes on Bach Long Vi Island have low traffic density, so the increase in vehicle volume for transporting dredged materials (approximately 16 trips/day along the sea dike route) is considered to have a negligible impact.

In summary, the level of impact is assessed as low due to: (i) the small number of transport vehicles involved and the fact that the routes are solidly concreted, (ii) the intermittent nature of the impact over the construction period of approximately 18 months, (iii) the low density of road users, and (iv) the fact that these impacts can be fully controlled and mitigated with appropriate measures.

The directly sensitive receptors include local residents participating in traffic, a small number of households living along the transportation routes, and construction workers active at the port area.

Scope of impact: The sea dike route linking the disposal sites to the construction site, with a length ranging from 0.5 to 1.3 km.

✓ **For waterway traffic activities:**

Given the characteristics of the subproject, the construction site is located within the port area, which currently accommodates frequent ship movements and storm sheltering (about 100 ship movements). During construction, the operation of equipment such as dredgers, tugboats (150–1200 HP), barges, and floating cranes may interfere with the navigation of vessels entering and leaving Bach Long Vi Island. This situation presents potential traffic safety risks within the port area, including possible collisions between vessels. In severe cases, such collisions could lead to ship sinking and oil spills, which would negatively affect the regional marine environment and aquatic ecosystems.



Figure 4.2. Ships entering and exiting and staying in the area of Bach Long Vi port

The impact on waterway navigation is assessed as medium and localized due to the following reasons: (i) The affected area is limited to the anchorage and navigation channel, covering approximately 13.5 ha; (ii) The current traffic volume at the port is about 100 vessels per day; (iii) The shoreline surrounding the port area helps contain and limit the dispersion of pollutants beyond the port boundary; (iv) The application of effective waterway traffic safety management measures during the construction phase will help avoid, reduce, and mitigate potential impacts on traffic, including ship-to-ship collisions and collisions between ships and construction equipment.

(x) Occupational health and safety (OHS) issues

For the Bach Long Vi subproject, around 20 workers are expected to participate in construction activities over an 18-month period. As such, there are potential occupational health and safety risks as follows:

✓ Risk of occupational accidents during construction:

- Workers may be exposed to increased levels of dust, toxic gases, and noise pollution due to demolition, site preparation, and the operation of construction machinery and equipment. These environmental factors can negatively affect the health of workers. Additionally, workers are at risk of accidents involving live tools, dangerous objects like sharp iron, nails, screws, and the simultaneous operation of various types of machinery on the same site. Accidents can be exacerbated when workers fail to use proper protective equipment or lack awareness of safety regulations. Construction activities also pose other occupational hazards, such as fire and explosion risks due to welding gas leakage, fuel, welding operations, electric shocks, working at heights, falling into water, building collapses, and the operation of heavy machinery and materials, especially in extreme weather conditions such as strong winds and large waves. Poor site organization also contributes to these risks.
- In terms of working conditions, workers' occupational health and safety (OHS) issues may arise from accidents like falling into the water or even drowning, often due to illness or loss of balance. Workers may also be exposed to toxic substances, such as oil or gases, which can cause short-term health effects like skin or respiratory irritation. Some substances can even enter the body through the skin, leading to more serious long-term health effects. It is crucial to address these risks proactively.
- Other OHS concerns related to working conditions include inadequate lighting or insufficient protection in certain working environments.
- Working with construction tools and machinery, such as electric or diesel-powered tools (e.g., barges, grab bucket excavators, cranes, electric welding machines), can lead to

electrical shocks or burns. Extreme weather conditions, such as strong winds or heavy rain during storms, may also cause construction work to halt, potentially displacing tools, equipment, and materials, which can result in accidents affecting workers and others nearby. Prolonged work in extreme heat can lead to exhaustion or fainting.

- Regarding worker behavior, safety risks can stem from workers' attitudes toward personal protective equipment (PPE) and their conduct at the construction site. Larger, more experienced contractors often train workers on environmental, health, and safety (EHS) practices and provide sufficient PPE, leading to better adherence to safety protocols. However, for smaller or local contractors, compliance with PPE usage (e.g., life jackets when working at sea) largely depends on the level of supervision and enforcement by the contractor and the workers' awareness of safety requirements.

✓ ***Deterioration of workers' health***

- Inadequate living conditions for workers contribute to health and safety issues. These conditions can lead to waterborne diseases, potentially caused by insufficient access to clean water, poor food hygiene, a lack of proper sanitation facilities, and unsanitary conditions at and around the camp.
- Living at the construction site for extended periods, away from home, can negatively impact workers' health if the contractor fails to supervise and workers do not maintain a healthy lifestyle (such as engaging in fighting, drinking, or prostitution). Such behaviors not only jeopardize workers' long-term health but can also affect the social security of the area, leading to issues like the spread of sexually transmitted diseases.
- The risk of infectious diseases, such as dengue fever, diphtheria, and HIV/AIDS, increases when workers from different areas interact with each other and with the local communities. This interaction heightens the potential for disease transmission.

✓ ***Fire and explosion risks:***

Fire, explosion incidents, and electrical shorts may occur during the transportation and storage of fuel or due to the lack of safety in the temporary power supply system, resulting in damage to people and property during the construction of the Project. The specific causes can be identified as follows:

- Temporary fuel storage warehouses for machinery and technical equipment during the construction process (such as paint, gasoline, etc.) are potential sources of fire and explosion. When an incident occurs, it can cause damage to people, materials, and the environment.
- Incidents involving shock, fire, explosion, and electrical shorts may arise from the temporary power supply system for construction machinery and equipment.
- The use of heating equipment (e.g., welding, heating) can lead to fire, explosion, or occupational accidents if preventive control measures are not implemented.
- Thunderstorms, strong winds, and worker carelessness in using electrical equipment are key causes of electrical shorts, fires, and explosions.
- Careless worker behavior, such as smoking near flammable materials, oil storage areas, or substance storage, mishandling of electrical wires, or unauthorized operation of construction machinery, can lead to accidents or even dangerous situations at construction sites.

Electrical shorts, fires, and explosions can damage construction machinery and equipment and may result in fires in shacks and material storage areas during the construction phase. As these incidents can occur at any time, the Project Owner will implement effective prevention and control measures to minimize these negative impacts.

Overall, the risk associated with occupational accidents at the construction site is considered Medium due to (i) the constant potential for these impacts to occur at any time; (ii) the relatively small number of workers (20 people); (iii) the 18-month construction period; and (iv) the possibility of mitigating these risks through solutions such as occupational safety training before and during construction, providing adequate labor equipment for workers, strengthening supervision, and enforcing appropriate sanctions for contractors and workers.

(xi) Public health and safety issues

Local people living around the construction site, along the transportation route, boat owners entering and exiting the Bach Long Vi port area, and tourists visiting Bach Long Vi island may be exposed to hazardous waste, odors arising from dredging activities, and waste storage, which could be a source of pathogenic germs due to poor hygiene. Additionally, the increase in dust concentration, noise levels, and water traffic density in the port area, resulting from the operation of construction machinery and equipment, as well as subsidence, landslides, and collisions between ships and construction equipment, could pose health and safety risks to the community.

Public health and safety risks are assessed to be low because: (i) The subproject construction area is concentrated in the Bach Long Vi port area; (ii) The number of workers is relatively small (about 20 people); (iii) The construction time for the work items is approximately 18 months; (iv) The project owner/contractor will prioritize hiring local labor; (v) Workers will be trained in occupational safety and environmental sanitation before beginning construction activities; (vi) Risks can be mitigated through measures to organize construction activities, combined with a reasonable construction site layout.

(xii) Social disturbances caused by labor influx

✓ **Labor influx:**

It is estimated that about 20 workers will be mobilized during the peak period of the implementation of the Subproject. The number of potential social risks and impacts related to the labor flow of this project is forecasted as follows:

- Improper management of workers and worker camps can lead to environmental issues, such as discharging untreated wastewater into the environment or dumping solid waste into the sea or vacant land around the area.
- The movement of workers can pose a risk to local security or social stability if some workers engage in social evils, such as drinking, gambling, prostitution, etc.
- The mobilization of migrant workers can increase the risk of transmitting sexually transmitted diseases, including HIV/AIDS, when workers from different localities interact with each other and with local communities. In the case of an epidemic, this would place an additional burden on the local health system.
- Potential conflicts may arise between workers and local communities, ship owners, and tourists visiting Bach Long Vi Island due to differences in background, culture, customs, employment, income, or minor disputes.

- Gender-based violence (GBV), exploitation, and sexual abuse/sexual harassment (SEA/SH) may be associated with the concentration of male workers in the project area. However, the risk of GBV and SEA/SH is considered low and controllable.

In general, the social impact of labor influx on the Subproject is considered low because: (i) The number of workers is not large (20 people) and will be registered for temporary residence with the local government during the construction process, and (ii) Risks can be mitigated through appropriate solutions, such as promulgating a code of conduct for workers, promoting cultural, social, and health awareness for workers before and during construction.

✓ ***Child labor, forced labor, abuse, and sexual exploitation of female and migrant workers:***

Without proper management and supervision, the use of child labor (under 18 years old) may occur, which would harm children's development. Migrant child workers are vulnerable to abuse and exploitation, negatively impacting their psychological and health well-being. Female workers (including female children) are also vulnerable to harassment and sexual abuse in worker camps. According to Vietnam's regulations (the legal working age is 18 years old or older) and the experience of projects using the Bank's capital, the risk of child labor, forced labor, child abuse (VAC), and gender-based violence (GBV) is assessed as low and can be mitigated.

✓ ***Risk of spreading infectious diseases:***

Local people and workers are at risk of transmitting infectious diseases such as sexually transmitted diseases (STDs) and HIV/AIDS. New workers may be more susceptible to infections from diseases in the local community. The impact can be minimized through training to equip workers with essential knowledge. With the country's experience in infectious disease prevention and control, along with the experience of implementing Bank-funded projects, the risk level is considered low. However, during environmental and social assessment, surveys and social assessments should be conducted to identify and assess local infectious disease risks. Prevention solutions will be included in the Subproject Labour Management Plan (LMP).

Additionally, workers hired by contractors at each Subproject may work at the same time in the same restricted area, leading to potential social conflicts. These conflicts could arise from competition for site access, demands for shacks and food, waste disposal, etc., affecting both the workers and the community. These impacts are assessed as low, and the risks can be managed through the application of a Code of Conduct and other measures outlined in the Labour Management Protocol. Furthermore, the boundaries of the construction sites will be clearly defined and agreed upon among the contractors, with coordination from the project owner, the PMU, and supervision by the construction supervision consultancy unit for independent environmental and social monitoring in the project area.

(xiii) Impact on the cultural and spiritual heritage of the people:

Within the scope of the Subproject construction, no cultural heritage sites are expected to be affected as described in the current situation in Chapter 2. However, some cultural sites near the river, such as Tran Hung Dao Temple (60m away), Whale Temple (50m away), Monument to Heroes and Martyrs (90m away), and Bach Long Vi Pagoda (180m away), may experience impacts from dust and noise resulting from construction activities. However, based on the dust and noise impact assessment in Chapter 3, these impacts are considered to be low and can be controlled with appropriate mitigation measures.

Additionally, the dredging process in the port area may uncover historical or spiritual cultural items significant to the local community. If such discoveries are made, the project will implement the

incidental discovery handling process outlined in the project's and Environmental and Social Management Plan (ESMP), as detailed in Chapter 5.

4.6.2.2. Site-specific Impacts during construction of Bach Long Vy subproject

Bach Long Vi is an island district located in the East Sea, in the Gulf of Tonkin region. The construction site for the project components is in the port area on Bach Long Vi Island, which is also where ships take shelter during storms. Bach Long Vi Island is part of the Bach Long Vi Marine Reserve (the construction site is within the designated port development zone, which borders the ecological restoration zone). This area has diverse and rich marine ecosystems that need to be preserved and developed. Given these characteristics, the construction process for the project will bring about several specific impacts, namely:

- Disturbance to the current activities at Bach Long Vi Port
- Safety risks for vessels and fishermen entering and leaving the Bach Long Vi port area
- The risk of pollution and waterway traffic safety issues during the transportation of materials from the mainland
- Impacts on the marine environment and ecosystem due to the potential spread of pollutants from dredging activities
- Pollution risk at dredged material storage site No. 01
- Impacts on sensitive receptors

The detailed assessment of the impacts is presented below:

(i) Disturbance to the operation activities at existing Bach Long Vi Port

Currently, Bach Long Vi **Port** has a dock area of 28.5 ha (measured to the base of the quay). However, due to sediment accumulation around the port basin, the usable water surface area for vessels to anchor is only 7.4 ha. The geological survey of the seabed in the port basin area shows that, besides a small layer of accumulated sediments from long-term usage, the seabed is mainly composed of weathered rocks. Therefore, dredging to expand the water area for vessel anchorage is necessary. On average, the port receives around 100 ship arrivals per day (excluding stormy days, when the number of ships seeking shelter in the port can rise to 150-200 vessels). The port's logistics service area covers 2,000 m², located at the back, with the residential and office buildings of the port management covering approximately 400 m².



Figure 4.3. Bach Long Vi Port receives approximately 100 vessel arrivals and departures daily.

During construction of the Bach Long Vi sub-project, the activities of the existing port will continue as usual. The entire existing 75-meter-long small dock will remain in place for vessels to enter and exit the port. The area to be dredged covers 13.5 hectares (47.4% of the dock area), including the channel and turning area (3.3 ha) and the mooring area (10.2 ha). The project has

proposed solutions for routing vessels in and out of the port. Dredging will be done in phases within specific areas, and a warning system will be installed around the dredging zones to guide vessels safely. Construction equipment such as an excavator dredger, a crane barge, a tugboat, barges, and material transport canoes will operate only within the dredging area.

However, the presence and activities of these devices will affect and disrupt the daily operations of vessels, particularly at the port entrance (70m wide), reducing the available area for vessels to move within the dock (currently, only 7.4ha of usable water surface). It will also affect the movement of vessels inside the dock.

Onshore works, such as the construction of a new 80m dock, upgrading the 80m breakwater, and upgrading and installing mooring posts and buoys around the port area, will also impact vessel docking for loading and unloading passengers and cargo.

These impacts are considered **moderate** for several reasons: (i) the number of vessels entering and exiting the port is not large, averaging about 100 trips per day and not concentrated at any one time; (ii) the impact will be limited to the port area, which is contained within the existing breakwater system; (iii) dredging will be carried out in phases in smaller areas of the dock; (iv) on days with rough seas or storms, when vessels need to enter the dock for shelter, dredging operations will be temporarily suspended and construction equipment will be moved closer to shore to minimize disruption to vessels seeking shelter; (v) the number of construction devices is not large, and the water surface area required for dredging equipment is limited. These impacts can be effectively controlled with appropriate construction measures to minimize effects on the existing Bach Long Vi storm shelter operations.

(ii) Safety risks for vessels and fishermen entering and leaving the Bach Long Vi port area

With a dock area of 7.4 ha where vessels can maneuver, an average of about 100 vessel trips per day (including fishing boats, cargo vessels, etc., with a maximum length of 35m) is recorded, along with dredging construction equipment such as an excavator dredger, crane barge, tugboat, barges, and transport canoes. This situation presents inherent safety risks for vessels moving within the dock, such as the potential for collisions between vessels or between vessels and dredging equipment, which can pose safety hazards to the ships, vehicles, and their passengers.

Currently, the port entrance is about 70m wide. During dredging operations, especially at the port entrance, vessels will not be able to enter the dock and will have to dock outside the breakwater. This will cause disruptions and inconveniences for vessels, interrupting their movement and posing risks of collisions between vessels and the breakwater when they anchor close to the shore and face large waves.

In the event of a collision, especially a severe one leading to capsizing, there is a risk of oil and grease leakage into the water environment, which could have significant impacts on the marine ecosystem if not controlled and addressed promptly.

However, these impacts are considered **moderate** and localized within the dock area because: The number of vessels entering and exiting the port is not large (approximately 100 trips per day); The entire dock area is enclosed by the existing breakwater; Dredging activities inside the dock will be conducted in phases in smaller areas with proper warning systems in place. Dredging at the channel entrance will take a short time (around one month); The project has measures in place to warn and guide vessels safely in and out of the port; The breakwater system already in place will limit the spread of oil and grease in the event of a collision; All impacts and risks can be minimized by implementing appropriate traffic safety management measures and organizing the construction process efficiently.

(iii) The risk of pollution and waterway traffic safety issues during the transportation of materials from the mainland

As outlined in the general impact section, the volume of materials required for the construction of the Bạch Long Vi subproject necessitates the use of vessels with a capacity of 20,000 tons, resulting in a total of three transport trips. Each trip is expected to take approximately 10 hours at sea, following the route from Dinh Vu Port (Hai Phong city) to Bạch Long Vi Island. In addition to dust generation, transporting materials by sea presents potential risks such as collisions with other vessels, mechanical failures (e.g., sinking), and threats to maritime safety, including oil spills. However, these risks are considered **low**, as all transport vessels undergo safety inspections prior to departure, and the captains are experienced and familiar with the route. Furthermore, the total travel time is relatively short, 30 hours for all three trips.

(iv) Impacts on the marine environment and ecosystem due to the potential spread of pollutants from dredging activities

Although the dredging area of the project, as previously assessed, mainly consists of weathered rock, there is still a layer of sedimentary silt accumulated at the bottom of the port basin. During dredging, fragments of weathered rock and disturbed silt may increase water pollution, primarily turbidity and other pollutants present in the sediment. These pollutants can spread further due to wave action and tidal movements, potentially affecting the habitat of aquatic organisms and ecosystems within the marine ecological restoration zone.

The strictly protected zone, located in the northern part of Bạch Long Vi Island, is situated at a safe distance from the dredging area and the material transport route (approximately 3.5–4.0 km away). Additionally, the dredging area is surrounded by a wave-blocking embankment system, which prevents the spread of disturbed silt and ensures that the strictly protected zone remains unaffected.

For disposal sites No. 01 and No. 02, the distances to the strictly protected zone are approximately 2.7 km and 2.0 km, respectively. The transport route for dredged materials is located onshore, on the southern side of the island, making it unlikely to impact the strictly protected zone of the conservation area.

Furthermore, oil and grease may leak from construction equipment if not properly managed, or in the event of collisions between vessels or between vessels and construction machinery. Such leaks can quickly spread across the water surface, posing risks to the environment and aquatic ecosystems. If oil is released, it will float and spread across the water surface, blocking oxygen exchange between the air and water. This can lead to oxygen deficiency for organisms living below the surface, and prolonged exposure may result in the death of aquatic life, thereby harming the marine environment and ecosystem.

However, these risks are assessed as **moderate**, as the dredging activities are confined within the harbor area, which is protected by a breakwater. This containment limits the potential for pollutants to spread beyond the harbor. Additionally, the impacts are localized within the harbor and will occur only during the dredging phase (approximately 18 months), which can be managed and minimized through appropriate measures.

(v) Pollution risks at dredged material disposal sites

As described in Chapters 1 and 2, the project plans for 03 material disposal site at 03 different locations. Among them, disposal site 03 is entirely located on the island (in the central area of the island), and disposal site 02 is located outside the seawall but is not affected by tidal flooding. Both of these sites are in the development zone of the marine protected area, so the impact of dumping dredged materials into disposal sites 02 and 03 is negligible.

For disposal site 01, which covers an area of 4.0 ha (433m long, with an average width of 100m), it is located outside the seawall on the eastern side of the island, approximately 500m from the dredging area. The topography of this site is lower than the seawall by 1.2m to 1.5m. This area lies in a pebble tidal zone with a bedrock foundation, has low conservation value due to infrequent water submergence, and lacks vegetation. Dredged materials can be deposited in disposal site 01 at an elevation of 1.5m above the existing ground level (matching the height of the seawall), and the site can accommodate approximately 55,000m³. The location of disposal site 01 is within the development zone and is about 50m away from the restoration zone of the MPA. In the total 4.0ha area planned for disposal site 01, 20% of the area (0.8ha) lies in the tidal zone and can be submerged during high tide. However, this 0.8ha area is planned as a reserve in case disposals site 02 and 3, and 80% of disposal site 01 are filled (the combined capacity of disposal sites 02, 03, and 80% of disposal site 01 is 65,000m³, while the projected dredging volume is 55,828m³).

During rough sea conditions, the entire disposal site 01 area may be submerged. Rising tides could wash the dredged materials deposited at the site into the sea and potentially infiltrate the restoration zone of the Bach Long Vi MPA, which contains coral ecosystems and numerous rare marine species (detailed descriptions of these species are provided in Chapter 2). This could negatively impact the habitat of marine organisms.

However, this impact is assessed as moderate, as most of the material deposited at the disposal sites consists of weathered rock dredged from the bottom of the harbor (located 200-500m from Site 01). Thus, the likelihood of tidal current transport is limited. The analysis of the dredged sediment quality also shows that the concentrations of contaminated substances (As, Cd, Pb, Zn, Cr, Total PCB, chlorinated organic pesticides, and organophosphate) are very low, indicating minimal risk to the environment and marine life. Additionally, disposal site No. 01 is designed with a solid fence made of large rock-filled gabions to prevent tidal intrusion and reduce the likelihood of materials being washed into the tidal zone of the ecological restoration area.

(vi) Impacts on sensitive areas

As described in Chapter 2 of the report, there are several sensitive areas around the project construction site, including:

- The tidal flat is located approximately 500m from the fishing port area and about 20m from disposal site 01. The impacts on this tidal flat area from the project are mainly due to the activity of dumping dredged material into disposal site 02, as described in section (v) above.
- Bach Long Pagoda is located near the transportation route for dredged material to disposal site 02, about 180m from the project area. The pagoda covers an area of 1000m² and is a spiritual site visited by local people on the island. The primary impacts from material transportation activities include dust, noise, and potential disturbances to the visitors to the pagoda. However, the visits mainly occur on the 1st and 15th days of each lunar month, so the impact is considered minimal.
- The Tran Hung Dao Temple and Whale Worship Temple are about 50m from the project area. These are also spiritual sites visited by local people and tourists on the 1st and 15th days of each lunar month. The main impacts of the project on the temple and the shrine are dust and noise.
- The bathing area is approximately 120m from the subproject area. It is a natural swimming area for local residents and tourists. However, swimming activities mainly take place in June, July, and August each year. The impact of the project on the environment, particularly

water quality, is due to the dredging activities. However, since the dredging area is within the harbor and separated by a seawall, this impact is assessed as **low**.

4.6.3. Impacts and risks in operation phase

The sources of environmental and social impacts and risks during the operation of the Bach Long Vi fishing port and storm shelter on Bach Long Vi Island, Hai Phong City arise from: (i) Operation of transportation vehicles such as ships, boats, and cargo trucks; fish and seafood loading and unloading activities; (ii) Port operators, fishermen at the port, boat/ship drivers, and port traders; (iii) Operations of fishing boats going in and out of the port and vessels sheltering in the port; (iv) Operations of functional areas within the port (seafood receiving area, sorting area, storage area, etc.); (v) Operations of technical infrastructure systems such waste collection and treatment facilities, toilets, etc. The dredging and maintenance of the navigation channel and the water areas in front of the port (usually dredged every two years) will be carried out with other funds during the operation of the port, so the impacts and risks associated with this activity will be assessed separately later.

The general impacts and risks during the operation phase of the Bach Long Vi storm shelter on Bach Long Vi Island include:

- Dust and emissions
- Noise
- Wastewater generated
- Solid waste generated
- Impacts on aquatic life and deterioration of coastal seawater quality
- Impacts on the marine ecosystem of the Bach Long Vi Marine Reserve
- Impacts on aquatic species
- Sedimentation potential in the dock basin over time.
- Incident risks:
 - + Traffic accidents: waterway accidents, overloading of the vessels in the storm shelter area in the port
 - + Occupational accidents
 - + Environmental incidents: oil spills, fires, explosions
 - + Natural disasters and extreme weather events

The impacts are detailed in the following:

(i) Dust and Emissions Generated

The sources of dust and emissions arise from the operation of the storm shelter on Bach Long Vi Island, particularly in the fishery service areas include:

- Dust and emissions from transportation vehicles such as ships, boats, and cargo trucks; fish and aquatic product loading and unloading activities.
- Fishy odor from fishing vessels docking at the port, and from cold storage facilities for seafood preservation.

- Unpleasant odors and emissions (NH₃, H₂S, etc.) from toilets areas, solid waste storage areas, etc.

❖ **Operation of transportation vehicles (ships/boats/cargo trucks); fish and seafood loading and unloading activities**

Once the project is put into operation, the average daily number of vessels going in and out of the port area is expected to increase slightly compared to the current levels (about 100 trips/day). However, on stormy days, the figure will rise significantly (the port is designed to accommodate up to 405 vessels of various types). These vessels currently use DO fuel, and their operation will generate considerable amounts of dust and emissions, mainly including dust, CO_x, SO_x, NO_x, VOCs, etc.

As these vessels going in and out of the port have various engine capacity, their fuel consumption is different, it is difficult to quantify precisely the total pollution load generated. However, if estimated the highest load when the port is at full capacity (405 vessels of various type), and it is assumed that the average fuel consumption rate is 1.0 ton of DO fuel per hour, the total pollution load, if all 405 vessels are running, will be:

The emission coefficients of pollutants of ships powered by diesel engines are shown in the following table:

Table 4.72. Emission coefficients of pollutants of ships powered by diesel engines

(Unit: kg/day)

Means of transport	Dust	SO ₂	NO _x	CO	HC
Motor ships	6.8	136S	90.7	0.036	4.1

Source: WHO, 1993

Applying the formula for calculating the pollutant load in exhaust gases arising from the operation of ships/boats :

Pollution load (mg/m.s) = Pollution coefficient (kg/day) × number of ships in a day × 1000 / (average distance × 86,400).

Where:

- 1000 is used to convert “km” to “m”;
- 86,400 is used to convert “day” to “seconds”;
- The sulfur content (S) in DO fuel is 0.05%;

By applying formulas [1] and [2] from the general impact assessment in the construction phase, the concentrations of dust and emissions such as NO_x, SO₂, CO, and HC at a distance of ≥10m are within the permissible limits according to QCVN 05:2023/BTNMT – National Technical Regulation on Ambient Air Quality.

Additionally, when the subproject is put into operation, the traffic density in the area may slightly increase compared to the current level (approximately 50 trips/day, mainly by motorcycles and small trucks with a load capacity of under 2 tons). According to the monitoring results described in Chapter 2, the air quality in the Bach Long Vi construction area currently meets standards, with levels of parameters such as CO, SO₂, NO₂, TSP, Pb, and noise much lower than the permissible limits in QCVN 05:2023/BTNMT. Therefore, the increase in vehicle traffics when the subproject is operational is unlikely to significantly impact the air quality in the area.

The affected groups are fishermen working at the port and those who are on vessels entering and anchoring at the port; some traders picking up aquatic products for sale on the island; and operational staff at the port (about 150 people on regular days and 500 people on the days when the port capacity is full).

The impact level is assessed as **low** because (i) the concentrations is only greatest when all vessels gather at the port at once, and the impact is only in the short time when vessels entering and docking at the port (about from 30 minutes to 2 hours; (ii) The port area is very spacious and located on an island off the East Sea, so the emissions generated will quickly dilute into the surrounding air.

❖ **Fishy odor from fishing vessels when docking at the port.**

The source of the unpleasant fishy odor arises from fishing vessels docking at the port with the seafood caught and frozen onboard. The primary components of the unpleasant odor are ammonia (NH₃) and hydrocarbons (HC). The emission load of NH₃ from the refrigeration equipment and the fishy odors from the fishing vessels is low because the seafoods (such as shrimp, crabs, and other products) is unloaded quickly upon arrival. After sorting, these products are promptly delivered to the market or transferred to cold storage facilities.

The main gases generated from the decomposition of organic matters include CO₂, NH₃, H₂S, CO, CH₄, mercaptans, etc. Among these, the gases causing the unpleasant odor are mainly NH₃, H₂S, and mercaptans, which discomfort traders, residents, and those passing through the area.

However, this impact is long-term and continuous. The level of impact is assessed as medium because (i) the volume of seafood products is various in each arrival (depending on days and seasons, with the peak fishing season primarily concentrated from June to September annually); (ii) the risk of seafood spoilage and decomposition contributes to increased fishy odors, negatively affecting the port environment (accounting for about 5% - 10%). Nevertheless, this impact can be mitigated by appropriate measures.

❖ **Odor and emissions from the toilets and solid waste storage areas.**

The Bach Long Vi subproject does not include WWTP. When the subproject becomes operational, existing toilets will be continued to use for fishermen and visitors, and managed by at the Bach Long Vi Port Management Board. Therefore, in the toilet area, unpleasant odors and emissions (NH₃, H₂S, mercaptans, etc.) are generated. The pollution level depends on the frequency of use at any given time, especially if they are not cleaned regularly. In this case, H₂S and mercaptans are the main substances responsible for the odor.

Additionally, in the waste collection area, since the waste contains a large number of organic substances, if not cleaned, collected, and transported to the disposal site regularly, the decomposition of these organic substances will generate foul odors and gases such as H₂S, CO₂, CH₄, and attract insects and microorganisms that can cause diseases.

The main groups affected will be port operators (about 20 people), fishermen, and customers/traders at the port.

However, the impact level is assessed as medium because (i) the number of people using the toilets daily is not large and is not concentrated, with the expected increase being around 100 people/day in the upgraded port, which is not significant compared to the current situation. The toilets at the Bach Long Vi Port Management Board are already equipped with septic tanks and are well-maintained with proper hygiene management, so the impact is insignificant; (ii) the port area has contracted with a waste collection team that carries daily the solid waste to the central disposal site in Bach Long Vi District for treatment; (iii) this impact can be mitigated by appropriate measures.

(ii) Noise

The source of noise mainly arises from the vessels docking at the port, vehicles involved in purchasing and transporting seafood products for consumption, and from the service areas.

The maximum noise level forecast (considering cumulative noise when many vessels enter and leave at the same time, with the highest number of vessels at Bach Long Vi subproject being 405 vessels, and the average being 100 vessel trips) are estimated to be around 80-85 dBA for the vessels, 85-95 dBA for the transportation vehicles, and 75-79 dBA for the service areas.

The noise mainly affects fishermen involved in trading and those picking up products at the port; staff of the Port Management Board, fishermen, and tourists visiting the island via the port vessels. The radius of noise impact is approximately 10-20 meters from the source.

Given that the port is located on an island off the coast, the port activities such as docking, unloading, and sorting seafood do not occur continuously but only for short periods in the day, typically in the early morning from 4:00 AM to 7:00 AM. The local people, who mainly work in fishing and port-related jobs, are generally accustomed to the noise, so the impact is assessed as **low** and can be mitigated by appropriate measures.

However, during period of rough seas (strong winds), which is the peak sheltering time of vessels, the noise level is expected to be significant due to the combination of noise from the vessels and whistling sound of strong winds. Nevertheless, this impact is unavoidable, and under such conditions, the noise from the vessels is insignificant compared to the ambient noise of the wind howls

(iii) Generated Wastewater

The sources of wastewater from the operation of the storm shelter on Bach Long Vi Island include: domestic wastewater, wastewater from the onshore service areas, particularly from the fishery service areas, and wastewater from the vessels operating in the water area in front of the port. The wastewater volume is calculated based on the supplied water volume (according to wastewater drainage standards equivalent to 100% of the water supply standards). The detailed calculation of the wastewater volume is shown in the table below:

No.	Used for	Quantity	Standard	Calculated volume		Notes
1	Staff of Port Management Board	20	People	25 L/person	0.5 m ³ /day	For the busiest operation day of the port
2	Fish washing	15	Tons	1 m ³ /ton	15 m ³ /day	
3	Floor washing	400	m ²	5 L/m ² floor	2.0 m ³ /day	
4	Visitors	100	People	25 L/person	2.5 m ³ /day	
5	Total average daily water demand	Q _{day _ average}		20 m ³ /day		
7	Coefficient	1.3				
8	Total wastewater drainage demand	Q _T = 100%Q _{day_max}		26 m ³ /day		

(Source: Basic Design Explanation for Bach Long Vi subproject)

Characteristics of each type of wastewater are as follows:

- **Domestic wastewater:** Mainly from the Port Management Board area. This wastewater contains high organic content (BOD, COD, nitrogen, and phosphorus compounds) and many pathogenic bacteria. If not collected and treated properly, it could lead to pathogen spreading, negatively

affecting the surface water quality of Bach Long Vi's marine area, and causing environmental pollution and damaging beautiful local landscape. Domestic wastewater mainly originates from the working areas of the Port Management Board and service areas. At the peak time when about 405 vessels dock at the port (with approximately two people per vessel), and 20 port staff are present, the estimated number of people at the storm shelter would be around 800. The estimated domestic wastewater volume generated is about 65 m³/day. The calculated pollution load in the domestic wastewater during the operation phase is detailed as follows:

Table 4.73. Domestic wastewater concentration forecasted in operation phase

No.	Parameters	Unit	Not treated	Treated via septic tank	QCVN 142008/BTNMT (Column A, K=1.0)
1	COD	mg/l	608	61-152	-
2	BOD ₅	mg/l	329	49-99	30
3	TSS	mg/l	713	36-178	50
4	Total N	mg/l	60	20-40	-
5	Total P	mg/l	17	3-10	-
6	Animal and plant fats and oils	mg/l	133	42	10
7	Total Coliform*	MPN/100ml	10 ⁶ -10 ⁹	10 ⁴	3,000

Notes: The coefficient accounting for project scale, $k = 1.0$, according to the Table 2, QCVN 14:2008/BTNMT

Based on the table above, it can be seen that the concentration of organic substances in the domestic wastewater after treatment with a septic tank is approximately equal to or exceeds the allowable limit by 1.0 to 2.0 times. TTS is lower than to exceed allowable limit by 1.8 times. The content of animal and plant fats and oils is 2.1 times over the allowable limit; the Coliform is 3 times higher than the allowable limit. Therefore, the wastewater treated through septic tank needs further treatment before being discharged into the receiving environment.

- **Wastewater from service activities:** When the fishery service area becomes operational, it will come along with a system of service, commercial, and cold storage areas. The operation of these facilities will generate a significant amount of production wastewater (about 15 m³/day from fish washing and 2.0 m³/day from floor cleaning), which contains organic impurities. Wastewater from the fish receiving and cold storage areas contains organic matters, animal fats and oils, and wastes (fish scales, fish intestines, shrimp shells, etc.), which, if not collected and treated, could decompose and cause foul odors, negatively affecting the surrounding area and water quality at the port.
- **Wastewater from vessels operating in the port** basin includes domestic wastewater, sanitation water from onboard facilities, and water used for cleaning ship decks. According to the design, an average of 180 vessels operate daily in the port area, generating an estimated 90 m³ of wastewater per day (with each vessel discharging approximately 0.5 m³ per day). This wastewater typically contains suspended solids, oil and grease, and organic substances such as BOD and COD. If not properly controlled and discharged directly into the receiving environment, this source of pollution could negatively affect water quality in the port basin. To manage this wastewater, the project will require the Bach Long Vi Port Management Board to strictly monitor and prohibit vessels from discharging untreated wastewater into the

environment. All vessels must be equipped with wastewater treatment systems, including screening and sedimentation units. Sediment and black water from sanitation systems must be collected, brought ashore, and handled by licensed service providers in accordance with regulations.

- **Ballast water:** During navigation, to ensure hull stability, vessels often take additional water into ballast tanks on board. The amount of ballast water varies upon the cargo weight. Ballast water is not replaced frequently but is checked periodically to ensure there is no accumulation of impurities or invasive species (such as bacteria, marine animals) in the water. However, if ballast water contains invasive species, it will be discharged outside, harming the environment and the ecosystem in the discharge area.

For small and medium-sized fishing vessels, the amount of ballast water typically ranges from 10 to 50 m³. The Bach Long Vi port is designed to accommodate a maximum of 405 vessels. The total amount of ballast water contained in the vessels is estimated at around 8,100 m³ (on average 20 m³ per vessel). However, the actual amount of wastewater generated is minimal, as not all vessels discharge ballast water simultaneously. Additionally, the International Convention for the Control and Management of Ships' Ballast Water (BWM), which came into force on September 8, 2017, stipulates that "to manage their ballast water to minimize the transport and release of harmful aquatic organisms and pathogens into the environment, and ships must have a ballast water treatment system to ensure ballast water is managed on all voyages through this system". However, this convention only applies to newly built vessels from September 8, 2017, onward. For fishing vessels built before this date or small and medium-sized fishing vessels in Vietnam, it is not mandatory to follow the BWM convention.

Therefore, regarding the management aspect, ballast water from the vessels will not be discharged into the environment at the project site but filtered by sludge and oils filtration systems of the vessel. The filtered water will be reused as ballast water, and the sludge will be collected and transported to shore for treatment by the port's service provider (according to the regulations in Decree No. 58/2017/ND-CP dated May 10, 2017, and Circular No. 41/2017/TT-BGTVT dated November 14, 2017 regulating the collection and treatment of wastes on vessels in port waters). Thus, the impact of ballast water is **moderate** and can be minimized.

In general, the impact of change generated during the operation of the Bach Long Vi storm shelter is **moderate** because (i) the volume of wastewater generated is not significant, and ballast water is not required to be changed frequently or simultaneously; (ii) most of the wastewater is treated through sludge and oils filtration systems before being reused.

(iv) Solid Waste Generated

The sources of waste generated during the project operation phase include: household solid waste from the 20 staff working at the service area and operational house; solid waste from the sorting and trading of seafood; solid waste from fishermen/visitors in the dock basin. The estimated waste load of Bach Long Vi subproject is as follows:

- **Domestic solid waste:** According to "Vietnam Environment Monitor 2004 - Solid waste," the average per capita waste is 0.5 kg/day. With 20 staff members, the total solid waste generated per day is approximately 10 kg/day. For visitors/fishermen (100 people) the figure is approximately 50 kg/day.
- **Solid waste from vessels docking at the port:** This waste includes:
 - Waste from seafood sorting when docking is forecasted to account for approximately 0.02% of the total seafood volume. According to the design, the annual seafood

yields on Bach Long Vi Port are 10,000 tons (833 tons/month), so the solid waste generated will be around 1.16 tons/month. The main components include fruit peels, leftover food, scrap paper, plastic bottles, and nylon bags.

- *By-products from seafood sorting and processing* brought in by the vessels account for about 1% of the total seafood yields. With the existing capacity of the port, the corresponding amount of waste generated is 8.3 tons/month. The main components include fish heads, fins, bones, skin, fat, and fish intestines.

Hazardous Waste:

- The hazardous waste mainly includes oil-contaminated rags, gloves, contaminated with hazardous substances, packaging materials, discarded oil and grease containers from machinery maintenance, damaged batteries and accumulators, chemical packaging, ink cartridges, lead waste, broken equipment, damaged fishing nets, and plastic packaging materials. The estimated generation of hazardous waste is about 10 kg/day (approximately 300 kg/month).
- If these types of waste are not collected and treated, they will cause environmental pollution, including due to foul odors, surface water pollution along the port shoreline, and negative impacts on the landscape of Bach Long Vi Fishing Port area. However, with the integrated investment in infrastructure and the local waste collection, transportation, and treatment services that have been well functioned, the impact of solid waste from the storm shelter is moderate and manageable.
- Additionally, with the investment in appropriate infrastructure for sorting and storing both regular and hazardous waste at the port, and with effective local waste management, the impact of hazardous waste is **moderate** and can be controlled.

(v) Impact on Aquatic Life and Degradation of Coastal Water Quality (due to the concentration of vessels and dredging activities in the dock basin):

Similar to the analysis of the impact on water quality during the construction phase described above, the periodic dredging of the navigation channel and vessel mooring area within the subproject area will cause certain impacts on surface water and the ecosystem in the area. However, the level of impact depends on the actual volume of sediment to be dredged and the implementation plan. With an estimated dredged sediment volume of 100-300m³ per dredging time (every two years), the volume is relatively small, and therefore the impact level is assessed as **medium**.

Additionally, the quality of the seawater may reduce due to the operation of vessels entering and leaving the port (about 100 vessel/trips) in the operation phase due to: (i) Leakage of oils and fats, caused by accidents such as collisions or grounding, discharging oily sludge, or ballast water mixed with oil; (ii) Ballast water and cooling water containing oils, household waste, solid waste, hazardous and toxic waste, etc.

Overall, the impact on the surface water quality in the Bach Long Vi Port area from the operation of the Bach Long Vi fishing port and storm shelter area is **low** because (i) the system and operations at the port is managed by Bach Long Vi Port Management Board who has good experience in control of vessels going in and out of the port (ii) The volume of domestic wastewater generated is insignificant, approximately 26m³/day; (iii) the port area is surrounded by concrete breakwater.

The impact on the marine ecosystem of Bach Long Vi Island due to the operation of the Fishing Port is assessed as **low** because: (i) The operation area of the port is localized within the dock basin, and is surrounded by a concrete breakwater; (ii) The Bach Long Vi Port area is located in

the northwest of the island, far from the strictly protected area of the Bach Long Vi MPA (located in the northern part of the island); (iii) The impact can be minimized through appropriate measures.

(vi) Impact on the Marine Ecosystem of the Bach Long Vi MPA

When the project becomes operational, many vessels will pass through, enter and exit Bach Long Vi Port daily. To enter and leave the port, vessels must pass through the area designated as the Bach Long Vi MPA. This poses several potential environmental risks to the marine environment within the reserve, such as oil leaks from vessels; or dust and emissions generated from fuel combustion on vessels, which will be dispersed into the air and subsequently settle into the sea. The movement of vessels through the area will create waves, disturbing the normal water environment, causing marine organisms to move away from the vessel's path.

Additionally, to save on treatment costs, some ship owners may change ballast water when operating near or through the marine reserve. This poses the risk of introducing harmful microorganisms or invasive species into the area, affecting marine life.

However, these impacts are assessed as medium and can be controlled by: (i) The Bach Long Vi MPA is regularly monitored by the management staff of the MPA, coast guard and navy forces; (ii) The waters in the reserve are quite deep (>10m), so vessel movement does not significantly affect deep-water organisms; however, surface and mid-water organisms may still be affected by waves and wastes; (iii) The most affected area within the reserve is the area adjacent to Bach Long Vi Port, which is part of the development subzone. The strictly protected reserve area is located in the northern part of Bach Long Vi Island (2-3 km from the port area), so it is less likely to be affected, but on-going monitoring is necessary due to wide-ranging mobility of marine species and their potential exposure to indirect pollution spread.

(vii) Impact on aquatic life:

When Bach Long Vi Port becomes operational, there will be more vessels coming in and out, creating a new habitat and environmental conditions. This will impact the growth and development of existing marine organisms, particularly small marine creatures such as mollusks, shrimp, crabs, and small fish, which are easily affected by changes in water flow, noise, and water quality.

The port serves as a gathering point for vessels seeking shelter from storms, tourism, and seafood transportation. This makes the port a potential source of pollution. Wastewater from port operation, floor washing, organic waste, blood, or fish remains discharged into the sea will increase BOD, COD, and ammonia in the water, posing the risk of localized eutrophication if not properly controlled. This will directly affect the dissolved oxygen content in the water, which can be detrimental to aquatic species.

Pollutants in the port area, if not properly controlled, may spread outside and affect the marine environment in the Bach Long Vi Marine Reserve, particularly in areas with coral ecosystems, which are home to many marine organisms such as mollusks, crustaceans, seaweed, and fish. These organisms play an important role in maintaining marine ecological balance.

However, these impacts are assessed as medium and can be controlled by: (i) Bach Long Vi Port is being upgraded, so habitat changes will not be significant; (ii) The port is designed with a surrounding breakwater and only one entrance, so the spread of pollutants from the port to the outside will be limited; (iii) The port's internal environment will be regularly monitored and assessed; (iv) The operations of vessels going in and out will be controlled, so oil leaks and ballast water discharge will be managed.

(viii) Sediment Accumulation the storm shelter area over time

The port is designed with a surrounding breakwater and one entrance, so sediment accumulation in the dock basin over time is inevitable. The sources of sediment accumulation can be from various sources. Specifically:

- Sediment and sand carried by waves from offshore areas are trapped within the dock basin due to the surrounding breakwaters
- Mud, sand, and other materials attached to the vessels entering the port tend to fall in the port area
- Materials generated from seafood transportation activities and from vessels docking in the basin but not being fully collected
- Waste discharged from onshore activities can flow into the dock basin and accumulate on the seabed.

Over time, the accumulation of these materials in the port basin will gradually deteriorate water environment in the area, reducing water quality and aquatic species within the basin, reducing the depth of the port, impairing vessel navigation and anchoring operations, and diminishing the port's capacity to receive, dock and provide shelter for vessels.

This impact is assessed as **moderate** and can be controlled because: (i) The port is of medium scale, and the sediment accumulation is expected not to exceed the port's capacity; (ii) Sediment accumulation in the dock basin will be regularly monitored and dredged as part of a regular maintenance plan by the Port Management Board; (iii) Environmental issues related to wastewater discharge, solid waste from vessels, and shore activities will be consistently controlled through environmental management procedures and technical monitoring.

(vii) Potential Traffic Risk Incidents

a) Traffic Risk Incidents

❖ Waterway accidents

- **Causes:** During the operation of ships, shipwrecks, ship collisions or fire incidents of serious severity may occur. The number of vessels entering and leaving the port daily is not large (about 100 vessels/day). In the event of stormy weather, the number of vessels seeking shelter at the port increases (up to 450 vessels at peak times). These vessels do not arrive at once, but over a period of 3 to 5 days.
- In the process of vessel operations, accidents such as shipwrecks, vessel collisions, or severe fires can occur. The transportation of goods in the port will increase the traffic density at the navigation channel in front of the port, significantly affecting the load capacity of the navigation channel, obstructing visibility. The increase in waterway traffic density will lead to an increase in maritime accidents, oil spills which affect severely the surface water quality and aquatic ecosystems in the Bach Long Vi port area. Additionally, dirty water, household waste, etc., from vessels in the navigation channel, in case of collision, if not collected and properly treated, could spill over into the sea and the port area, increasing pollution levels and affecting the surrounding ecosystems.
- **Impact scope:** When waterway traffic accidents occur, upon the severity, they may cause oil spills, affecting the soil and water environment, damaging the property of fishermen and the port management board. It could even result in fatalities for vessel operators and fishermen on board.

❖ Incidents of Vessels Docking Beyond the Design Capacity:

In the operational phase, the Bach Long Vi Fishing Port will be capable of accommodating 450 vessels seeking storm shelter. However, in the condition of rough sea, it is highly likely that the number of vessels seeking shelter during stormy weather will exceed the port's design capacity (>450 vessels). This may lead to the following impacts:

- Vessels waiting for their turn to unload may experience long delay, potentially resulting in disputes over docking priority and causing disorder.
- Although the docking is organized in sequence, some ship owners may attempt to push ahead, or maneuver around others to dock or leave the port, leading to traffic safety issues and negatively affecting the impacting port operations.
- When the number of vessels exceeds the port's capacity, some vessels will have to anchor outside the port, which increases the risk of collisions between vessels or with the port's structures, especially during rough seas.
- The number of ships entering port rises will leads to the burden on the port environment due to waste generated, risks of oil contamination, etc.

This impact is assessed as **low**, as the port's infrastructure has been designed according to standards to ensure sustainability during port operations. However, if this issue persists for an extended period, it may lead to degradation of the port and could cause damage to docking facilities and result in significant losses. However, this impact can be minimized through appropriate port management measures.

b) Occupational Safety Incidents:

In the operation phase, there are about 20 workers operating at the port. During the port's operation, certain risks and incidents may occur, especially in a complex working environment with various activities like unloading seafood, transportation, and operating mechanical equipment. Below are potential risks and incidents related to occupational safety and the environment:

❖ *Accidents due to collisions and traffic accidents:*

The risk of vehicle collisions: With the involvement of various types of vehicles (trucks, boats, forklifts, cranes, etc.) in the port area, accidents can occur, particularly under conditions of limited visibility or inadequate traffic flow management. Road traffic accidents: Vehicles transporting seafood between the port to the mainland may cause accidents due to poorly maintained roads or careless driving behavior.

❖ *Accidents due to the use of mechanical equipment (cranes, forklifts, etc.)*

Risks from lifting equipment: The use of cranes and forklifts to load and unload seafood from vessels to the shore or from the shore to storage facilities may lead to accidents if the equipment is not properly maintained or operated incorrectly. Potential incidents include falling heavy objects, snapped cables, or equipment malfunction. However, the cranes and forklifts used for seafood handling are small to medium capacity, so the risk is considered **low** and manageable.

❖ *Accidents due to unsafe working conditions*

Slips, trips, and falls: In the conditions of constant movement on wet and slippery surface (due to grease, seawater, or seafood waste), workers operating in loading and storage areas may be at risk of slipping, falling, or even falling into the river.

❖ *Health-related accidents and illness*

- Risk of infectious diseases: Working in a wet environment and exposure to seawater can lead to infectious diseases, especially respiratory, skin-related diseases, or waterborne diseases.
- Respiratory illnesses: Prolonged exposure to dust from seafood or emissions from ships could cause respiratory illnesses such as pneumonia, bronchitis, or other chronic diseases.
- Diseases from marine organisms: Exposure to marine life can lead to injuries, infections, or poisoning from toxic seafood or marine organisms.

❖ **Occupational Environmental Safety Incidents:**

In addition to technical failures and natural disasters, workplace related incidents can also occur, including:

- Fish holds containing miscellaneous fish which are sorted for long period at sea will generate toxic gases. The deeper the fish holds and the longer the voyage, the higher the risk of gas-related incidents for fishermen working in the fish holds, leading to acute poisoning, fainting, or even death.
- In the receiving and sorting areas where washing activities are frequently carried out and seafood is handled, the floor is always wet, increasing the risk of slips and falls during the lifting and transporting of seafood containers and trolleys.

Despite above risks, the occupational safety incidents at Bach Long Vi storm shelter are assessed as **manageable** because: (i) Weather forecasting is becoming increasingly quite accurate, allowing vessels to take active to seek shelter in case of adverse weather conditions, minimizing risks due to natural disasters; (ii) The port management board operates effectively, responsibly, requiring vessels to dock safely and ensuring that fishermen do not stay on vessels during adverse weather conditions; (iii) Crew members working on the vessels are experienced, especially in managing and using fish holds, reducing the risk of oxygen deprivation; (iv) Areas with risks of slipping are marked with warning signs to minimize accidents. However, to ensure safety, it is essential to maintain existing control measures, enhance labor safety training, conduct regular inspections, and improve working conditions at the port.

c) Potential Environmental Risk Incidents

❖ **Environmental Incidents Due to Fire and Explosion:**

- **Causes:** As being analyzed and forecasted above, the environment in the area contains fuel vapors, so the potential of fire incidents is high when exposed to high heat sources or electrical short circuits.

The electricity for the machinery, technical equipment, electrical systems in the auxiliary facilities, warehouses, and Port Management Board could be at risk of short circuits, fire, and explosions, causing damage to both people and property. Additionally, the area contains fuel vapors used for refueling vessels, which presents a high potential for fire incidents when exposed to high heat sources or electrical short circuits. This fuel storage area is at high risk of fire and explosion. Fire incidents could cause damage to both human life and property within the port area. This may lead to a fire spreading to storage areas, posing serious threats to the safety of port staff and workers.

Affected parties: This could cause damage to human life and property, particularly the 20 port staff and the vessels docking at the port. However, as the neighboring residential

area is located over 100 meters away and separated from the port, it is less likely to be affected.

- **Impact Level:** The impact is assessed as **low** and manageable because (i) Functional areas are designed with fire protection measures and on-site fire-fighting equipment, such as fire extinguishers, (ii) The arrangement of products and materials for the fishery service is allocated to specific zones with instructional signage, and dedicated personnel responsible for management and compliance with operational procedures at the port, (iii) No incidents of electrical short circuits or fires have been recorded in the port area or surrounding residential zones, (iv) Such incidents are considered controllable, as the port management board undergoes regular training on fire prevention and response, and (v) The port area is landscaped with greenery, and water supply infrastructure has been designed with a fully equipped fire protection system.

❖ **Oil Spill Incidents:**

For the Bach Long Vi Subproject, oil spill incidents can occur due to: (i) Vessel capsizing; (ii) Waterway traffic accidents; (iii) Leakage or spillage of oil from vessels transporting seafood in and out of the port.

Once an oil spill occurs, an oil-water mixture quickly forms and spreads. The oil gradually dissipates through weathering related to various physical and chemical processes, such as natural dispersion by wind and currents, sedimentation, evaporation, or the formation of oil suspensions floating on the water surface. This spill will harm the natural environment and economic activities in the area. Specifically:

- Part of the oil products will sink and decompose on the seabed, polluting the water and sediment, while another part may float with air bubbles from the seabed. Oil residue on the seabed is a source of water pollution in the port, affecting benthic organisms that are a food source for aquatic life.
- When water is contaminated with oil, the oil quickly spreads across the water surface, blocking the penetration of oxygen and light into the water, leading to a rapid decrease in oxygen levels, which negatively affects aquatic organisms, particularly plankton and benthic life, thereby reducing the water's self-purification capacity.

To minimize and reduce these incidents, the Port Management Board will set out measures to manage vessel operations and response plans in case of an oil spill incident.

d) Incidents Due to Natural Disasters:

❖ **Severe weather events**

Severe weather events such as heavy rain, storms, strong winds, and rough seas can increase the risk of collisions between vessels docked at the port. This not only causes property damage but poses risks to the life of people on board. Additionally, such incidents can cause oil spills, fuel leaks, and waste generated from the vessels, causing water pollution at the port area. In the event of large storm surges, if vessels are not securely anchored, there is a high risk of capsizing. This is a highly dangerous situation, especially during the rainy and storm season, requiring the port to implement a safe docking plan and timely weather warnings.

❖ **Risk from sea waves and rising water level:**

Working in conditions of high sea level or large waves can cause workers to be swept away or injured while working on ships or at the pier. These risks often occur unexpectedly,

especially during sudden weather changes, and require protective measures, training in emergency response skills, and early warnings.

D. CUMULATIVE IMPACTS

Cumulative impacts are the incremental impacts of the project when combined with other related past, present, and reasonably foreseeable future development activities, including unplanned but predictable activities that may occur later or in different locations. This assessment aims to identify Environmental and Social (E&S) risks arising from overlaps, synergies, or interactions between subprojects under the SFDP and other ongoing projects in the region.

D.1. Ground and scope of the cumulative impact assessment

Spatial and temporal boundaries of the cumulative impact assessment

i. Spatial boundary

The study area of this Cumulative Impact Assessment (CIA) includes six project implementation sites across five provinces/cities in Vietnam: Hai Phong, Thanh Hoa, Khanh Hoa, Binh Dinh (now Gia Lai), and Kien Giang (now An Giang). As the subprojects are geographically dispersed, cumulative impacts are mainly considered within each region rather than across regions.

ii. Temporal boundary

The temporal boundaries set for this CIA include:

- Construction phase – lasting 36 months, starting in 2026 and continuing until the end of 2028. The assessment temporarily covers all construction-related activities, including site clearance, excavation and dredging, construction of port structures, and transportation of materials and waste to storage/disposal sites.
- Operation phase, starting in 2029, when the fishing ports and anchorage areas become operational.

The project's pre-construction phase is not considered in the CIA, as no impacts are anticipated.

Identification of valued environmental and social components (VECs)

This ESIA considers whether the construction and operation of the project may contribute to cumulative impacts on valued environmental and social components (VECs) that may also be adversely affected by other current or future developments in or near the project area.

The identification of VECs in the CIA is based on the technical characteristics of the sub-projects, the ecological and social sensitivity of the area, and the potential for interaction with other development activities. VECs are categorized by phase to ensure a comprehensive assessment of potential cumulative risks.

These VECs are also used as the basis for analyzing specific cumulative impacts in later sections of the report.

+ Construction phase:

- Air quality (Total Suspended Particulates – TSP): Dust and emissions from construction may combine with other emission sources in the area, affecting the environment and public health.
- Road and waterway traffic safety: Transporting materials by road and water increases vehicle and vessel density, creating a risk of collisions if not well coordinated.

- Social impacts in construction areas: Temporary labor and pressure on social infrastructure may accumulate if construction occurs near residential areas or other projects.

+ *Operation phase:*

- Surface water quality in rivers/seas at fishing ports and anchorages, and aquatic life: Wastewater, solid waste, and oil leaks from vessels may affect estuaries, coral reefs, seagrass beds, and aquaculture zones.
- Waterway traffic safety: Vessel density increases during peak fishing seasons or storms, posing risks of collisions and congestion in waterways.
- Coastal livelihoods and social infrastructure: Changes in production models, labor migration, and resource-use conflicts may put pressure on coastal communities.

Factors affecting VECs:

- Natural factors: Strong winds, heavy rains, storms, and tidal surges may increase dust dispersion, coastal erosion, turbidity, and impacts on aquatic life.
- Development-related factors: Regional plans, projects, and other development activities in the area such as urbanization, coastal tourism, industry, and aquaculture may create synergistic or conflicting impacts with the sub-projects.

Existing status of Valued Environmental Components:

Air quality: The ESIA for the SFDP Project reports that current air quality in the project area is relatively good, with no signs of pollution. All measured indicators are below the limits set in the National technical regulation on ambient air quality QCVN 05:2023/BTNMT and the WHO Ambient Air Quality Guidelines (which are stricter than QCVN 05).

Waterway traffic safety: Information on traffic safety is limited in the existing documents of the above-mentioned projects. Therefore, water traffic density and vessel types are considered as additional indicators to assess risks related to waterway traffic safety.

Relevant plans and projects:

A list of relevant sectoral, regional, and local development plans is provided in the annex or in Section I.1.2. of the report. These plans reflect development trends in fisheries, marine economy, coastal tourism, and technical infrastructure in the localities, helping to assess synergistic, conflicting, or cumulative impacts during the project's operation phase.

Projects related to the same geographic areas as the subprojects are listed in [Table 4.74](#) below.

4.6.4. Cumulative impacts at the overall project level

The simultaneous implementation of subprojects during 2026–2028 is expected to generate many positive cumulative impacts nationwide. A modern system of fishing ports and anchorages will help improve the efficiency of marine fishing, reduce post-harvest losses, support offshore fishing, and address the European Commission's IUU "yellow card." At the same time, the project enhances fisheries inspection capacity and infrastructure development.

A technical foundation has been established to support the protection of fishery resources, promote the development of the marine economy, create jobs, and enhance fishery sector management capacity in coastal localities. Coordinated investment across multiple provinces contributes to the formation of an inter-regional network of fishing ports, supports value chain-based production, and strengthens climate change adaptation.

In addition to the aforementioned benefits, the simultaneous implementation of subprojects also presents potential cumulative impacts that must be identified and managed. During the construction phase, the total emissions of dust, gases, and noise may increase significantly at the project-wide scale, especially if dredging, material transport, and construction activities are conducted concurrently across multiple coastal areas. There could also be growing pressure on supply chains for materials, equipment, and technical labor, potentially impacting project timelines and implementation efficiency.

During the operation phase, once the fishing ports and storm shelter anchorages become operational, the number of fishing vessels, logistics services, and fisheries inspection activities will increase in each locality. During peak periods—such as the fishing season or storm events—vessels from surrounding areas may converge at anchorages, resulting in increased traffic density, risks of channel congestion and vessel collisions, and deterioration of water quality due to oil leaks and waste discharge.

Beyond technical impacts, the operational phase may also intensify conflicts over coastal resource use among sectors such as fisheries, tourism, industry, and ecological conservation. There will also be pressure on social infrastructure, including transport, water supply, waste treatment, and livelihoods of coastal fishers. In the context of climate change, coastal subprojects will increasingly face risks such as sea level rise, saltwater intrusion, and more frequent and intense storms, which could affect storm shelter effectiveness, freshwater availability, and fisheries activities.

However, the subprojects under the SFDP are geographically dispersed, spanning from Northern to Southern Vietnam, with distances ranging from hundreds to thousands of kilometers. Each locality has distinct ecological, hydrological, and waterway transport systems, without direct interconnection or shared transport routes. As such, spatial cumulative impacts among the subprojects are dispersed and do not form a clearly interconnected regional system.

Overall, the cumulative impacts from the simultaneous implementation of SFDP subprojects are assessed as potentially synergistic over time, particularly in areas such as waterway traffic, water quality, and coastal resource use. However, due to the geographical separation and absence of shared hydrological or transportation infrastructure, spatial accumulation is limited. These impacts are primarily local in nature and can be effectively managed through decentralized local governance, combined with centralized technical guidance from the central PMU. The overall cumulative impact level is assessed as low to moderate and requires ongoing monitoring and coordination to ensure the long-term sustainability of the project.

4.6.5. Cumulative impacts at the sub-project level

Infrastructure investments under each subproject have been developed in accordance with the respective locality's urban spatial and sectoral development plans. Within the scope of this Cumulative Impact Assessment (CIA), several other local projects, plans, and development activities have already been, are currently being, or will be implemented within the same area and timeframe as the SFDP subprojects.

These projects may overlap in area of influence or have interactive impacts with the subprojects and therefore must be considered in the cumulative impact assessment. A list of related projects in the five provinces/cities where the subprojects are being implemented is presented in Table below, together with a brief assessment of the potential cumulative impacts.

Table 4.74. A list of related projects in the five provinces/cities

No.	Basic information of related projects considered for cumulative impact assessment	Cumulative impacts
1	Lach Hoi fishing port upgrading and expansion subproject	
	Memorial Project for Southern Residents, Officials, Soldiers, and Students Relocated to the North in Quang Tien Ward, Thanh Hoa City •Project owner: Sam Son City Construction Investment Project Management Board •Total Investment: VND 225 billion •Commencement: 28/08/2022 •Completion: 27/10/2024 • Distance to the subproject: 200–350 m Lach Hoi Subproject Implementation schedule: Construction is expected to start in 2026.	Since the Memorial Project was completed at the end of 2024, no cumulative impacts from this project are expected during the construction phase of the Lach Hoi Subproject.
2	Lach Bang fishing port upgrading and expansion subproject subproject	
	Dot Tien Pagoda Construction Project • Project owner: Thanh Hoa Provincial Buddhist Association •Total investment: VND 75 billion •Commencement: 29/10/2023 • Expected completion: 2025 (completion of main items) • Distance from the subproject: 800 m Lach Bang Subproject Implementation schedule: • Construction is expected to start in 2026.	- In the case that the Dot Tien Pagoda Project is completed on schedule in 2025, no cumulative impacts are expected during the construction of the Lach Bang Subproject. - However, if the Dot Tien Pagoda Project extends its construction into 2026, potential cumulative impacts may arise, including: • Increased dust and emissions due to simultaneous construction activities of the two projects • Higher traffic density, posing risks of traffic accidents and local congestion. • Increased concentration of workers in the area, potentially leading to social issues related to labor influx, such as pressure on social infrastructure, public order, etc. - The cumulative impacts are assessed as medium due to: • The relatively large distance between the two projects (~800 m). • The potential overlap in construction periods being short, approximately 6 months. These impacts can be effectively mitigated through appropriate environmental and social management measures.
	Hai Binh Ward Sea Dyke and Revetment Rehabilitation and Upgrade Project, Nghi Son	- In the case that the dyke rehabilitation project is completed on schedule (2025), no

No.	Basic information of related projects considered for cumulative impact assessment	Cumulative impacts
	Town • Project owner: Project Management Board for Investment in Agricultural Works and Rural Development, Thanh Hoa Province • Total investment: 18 billion VND • Implementation period: October 2023 – 2025 • Revetment length: 860 m • Distance to the Subproject: 10 m Lach Bang Subproject implementation schedule: • Construction is expected to start in 2026.	cumulative impacts are expected during the construction of the Lach Bang Subproject (2026). - However, if the construction of this project is delayed into 2026, potential cumulative impacts may arise, including: • Increased dust and emissions from the simultaneous construction activities of the two projects. • Increased traffic density in the area, leading to higher risks of traffic-related incidents. • A higher concentration of construction workers in the area, potentially causing social impacts related to labor influx. Overall, these cumulative impacts are assessed as medium due to the relatively small scale of the related project and the short period of overlapping construction (approximately 6 months). This project will also contribute to mitigating shoreline erosion and the spread of pollutants by waves and wind, thanks to the construction of a solid dyke and sea revetment.
3	“Upgrading Tam Quan storm shelter anchorage and fishing port” subproject	
	Tam Quan Fishing Port Infrastructure Project, Hoai Nhon Town • Project owner: People’s Committee of Binh Dinh Province • Total investment: 113 billion VND • Implementation period: 2021–2024 (completed) Tam Quan Subproject implementation schedule: • Construction is expected to start in 2026.	Since the Tam Quan Fishing Port Infrastructure Project was completed in 2024, no cumulative impacts from this project are expected during the construction phase of the Tam Quan Subproject (storm shelter mooring area) in 2026.
4	Khanh Hoa major fishery center upgrading subproject	
	1. Related project: • Project name: Dynamic Fishing Port , under Khanh Hoa Major Fishery Center (Phase 1) • Total investment: VND 171.48 billion • Implementation period: Completed in 2024 • Scale: Includes wharf area and technical infrastructure	Phase 1 was completed in 2024, including components such as the wharf area and technical infrastructure. Phase 2 is planned for implementation in 2026, with expansion elements including finger piers, dredging of navigation channels, and additional technical infrastructure.

No.	Basic information of related projects considered for cumulative impact assessment	Cumulative impacts
	2. Subproject: Khanh Hoa Major Fishery Center - Planned implementation: 2026 - The subproject “Construction of Khanh Hoa Major Fishery Center” represents Phase 2 of the Dynamic Fishing Port Project under the Khanh Hoa Major Fishery Center. - This subproject includes components such as finger piers, dredging of navigation channels, and technical infrastructure.	Since both phases belong to the same overall project, implementing Phase 2 after the completion of Phase 1 does not generate negative cumulative impacts during construction. On the contrary, positive cumulative impacts can be recognized, specifically: Increased investment efficiency: Phase 1 established the technical infrastructure foundation, facilitating the implementation of Phase 2, saving both cost and time. Harmonization of fishery infrastructure: Continued investment helps complete a modern Fishing Port system, enhancing the capacity to accommodate larger vessels and improve cargo circulation. Promotion of local socio-economic development: Creates employment, develops fishery logistics services, and strengthens port management and operation capacity. In summary, the cumulative impacts between the two phases are positive and mutually reinforcing, contributing to the establishment of a modern, efficient, and sustainable fishery center in Khanh Hoa.
5	Upgrading Kien Giang Major fishery center construction investment Subproject	
	No related project available	No cumulative impacts are expected during the construction phase.
6	“Upgrading Bach Long Vi storm shelter ” subproject	
	No related project available	No cumulative impacts are expected during the construction phase.

a) Analysis of cumulative impacts during the construction phase

During the construction phase (2026–2028), most subprojects are not expected to generate direct cumulative impacts from other nearby fisheries development projects or plans, as these projects were completed prior to implementation. However, there remains the possibility of indirect cumulative impacts arising from other development activities in the same area, particularly in sectors such as urbanization, tourism, industry, cultural–religious projects, or technical infrastructure.

These impacts are forecasted and not precisely defined at the time of assessment but should be considered in environmental management and construction coordination. The main potential impact categories include:

Impacts on air quality

During the construction phase (2026–2028), air quality in the subproject areas may experience cumulative effects from other development activities in the region, especially projects in **tourism, urban, industrial, and infrastructure sectors**. These projects have either been constructed or are planned for implementation in the coming years, and even if not simultaneous, they may still generate emissions within the same geographical area.

However, baseline air quality data in the subproject areas indicate that air quality is currently good, and monitored parameters are well below regulatory limits. Therefore, cumulative impacts on air quality are assessed as low and manageable through the application of mitigation measures in the ESMP.

Cumulative impacts on waterway traffic safety

During construction, transporting construction materials via waterways will increase vessel traffic on rivers and coastal waters near the subprojects, such as the Ma River (Lach Hoi), Bang River (Lach Bang), Tam Quan River (Tam Quan), Cam Ranh Bay (Khanh Hoa), and Cai Lon River (Kien Giang).

Cumulative impacts may arise when waterway transport activities from other regional projects—such as seaports, industrial zones, riverside tourism areas, or technical infrastructure—occur concurrently or close to the subproject’s construction schedule. Vessel density could increase by 4–20 trips per day depending on the area, particularly during peak periods such as the fishing season or storms, when vessels congregate for shelter, increasing cumulative risks.

Risks include maritime accidents, surface water pollution, noise, and impacts on aquatic ecosystems. These impacts can be controlled if projects coordinate waterway traffic and comply with construction safety measures.

Social impacts: Some subprojects may face labor pressure, social infrastructure constraints, or land-use conflicts if religious, cultural, or technical infrastructure projects are implemented nearby. These factors should be monitored to ensure community safety and welfare.

Overall, cumulative impacts during construction at each subproject are expected to be low to moderate, localized, and manageable through schedule management, local coordination, and mitigation measures under the ESMP.

b) Assessment of cumulative impacts during the operation phase

Once SFDP subprojects become operational, the fish ports and storm shelter mooring areas will serve as hubs for fishing, logistics, and fisheries inspection activities at each locality. Cumulative impacts during this phase depend not only on infrastructure scale but also on ecological characteristics, vessel density, and the level of development in related sectors.

The following summarizes cumulative impacts during operation at fish ports and storm shelter mooring areas of SFDP subprojects:

Increased waterway traffic and maritime safety risks: With operational fish ports and mooring areas, vessel traffic for fishing, logistics, and inspection will increase significantly at each locality. During peak periods, such as the fishing season or storms, vessels from nearby areas may concentrate at the port, increasing traffic density. This cumulative impact could lead to congestion, collisions, and higher maritime accident risks if an effective waterway traffic management system is not in place. The impact is assessed as medium and can be mitigated through monitoring, guidance, and traffic regulation, especially during high-demand periods such as storms.

Increased pressure on road traffic and coastal infrastructure

Transportation of fish, seafood, and logistics materials from ports to processing facilities, wholesale markets, or distribution centers will increase road traffic near the ports. Continuous operation of trucks, refrigerated vehicles, and private vehicles may cause localized congestion, air pollution, and noise, particularly in subprojects near residential areas or lacking proper traffic planning. These impacts could accumulate over time if fish throughput increases rapidly without corresponding infrastructure upgrades. The impact is considered minor as seafood arrivals are seasonal and can be managed through ESMP mitigation measures.

Increased wastewater and coastal litter: Port operations generate wastewater from fish washing, ice production, processing, and workers' domestic activities. Without effective treatment systems, these discharges may cause localized pollution, affecting surface water quality and aquatic life. Solid waste such as plastic packaging, foam boxes, damaged nets, and fishing gear may accumulate at ports or drift into the sea, degrading coastal habitats. These impacts tend to accumulate over time if not regularly managed. However, the impact is assessed as minor because wastewater from operational ports is collected and treated by the subproject's treatment systems.

Coastal resource use conflicts and social impacts

Operating fish ports at subprojects may increase spatial competition among sectors such as fisheries, tourism, coastal industry, and ecological conservation. Some areas may experience conflicts between fishing and coastal tourism, particularly in regions with natural landscapes or marine protected areas. Additional pressure may arise on social infrastructure, including transport, water supply, waste management, and vessel safety, especially during peak seasons. Port modernization and strengthened IUU control may also affect small-scale fishers' livelihoods, altering traditional production patterns, labor displacement, or demographic changes. Overall, coastal resource use conflicts and related social impacts are localized, temporary, and manageable through spatial planning, inter-sector coordination, social infrastructure upgrades, and community livelihood support policies. The impacts are considered minor with no significant negative effects on socioeconomic development or coastal environmental conservation.

Climate change risks to port operations

Coastal subprojects face increasing risks from climate change. Sea level rise may flood ports or reduce storm shelter efficiency. Saltwater intrusion may affect freshwater and aquaculture sources. Increased storm frequency and intensity could disrupt fishing and port operations. Without adaptive design and flexible operational plans, these impacts could accumulate over time, affecting subproject sustainability. Although climate change poses potential risks to coastal port operations, these impacts are predictable and can be integrated into planning and design, and mitigated through technical and management solutions. The impacts are therefore assessed as minor, with no significant effect on overall project sustainability if appropriate adaptation measures are implemented.

Water quality degradation and impacts on aquatic life

During operation, fish ports and storm shelter mooring areas concentrate fishing, processing, storage, and trade activities. These activities often produce wastewater with high organic content, grease, and other pollutants from fish washing, ice production, vessel cleaning, and workers' domestic use. Without effective treatment, discharges can accumulate at ports, degrading coastal surface water quality.

This impact may directly affect aquatic life, particularly in sensitive ecosystems such as estuaries, seagrass beds, coral reefs, or nearby aquaculture areas. Water quality degradation can reduce

reproduction, increase disease and mortality in aquatic species, affecting fishery and aquaculture productivity. Without control and regular monitoring, these impacts could accumulate, causing localized marine environmental degradation and affecting coastal livelihoods. However, the impact is assessed as minor and not significantly harmful to marine environments or local community livelihoods if managed with appropriate ESMP measures.

E. CLIMATE CHANGE ISSUES

4.6.6. Impacts of Climate Change on the Project

The project will be negatively affected by climate change. As presented in Chapter 2, the severe impacts of climate change will affect each subproject area. According to meteorological data and climate projections for Vietnam's marine areas under the Climate Change Scenario of Vietnam published in 2020:

- The frequency of storms and tropical depressions is relatively high from August to November.
- Rainfall is concentrated in the rainy season (ranging from about 50–60 rainy days/year to about 200 rainy days/year in each subproject area, mainly from August to November).
- The area is affected by sea level rise at an average rate of 3–5 mm/year (according to the Climate Change Scenario of the Ministry of Natural Resources and Environment).
- There is a possibility of prolonged heatwaves and strong winds, affecting outdoor construction safety.

The climate change factors will affect each subproject area as follows:

Climate change factor	Areas affected by climate change factors					
	Lach Hoi subproject	Lach Bang subproject	Tam Quan subproject	Khanh Hoa subproject	Kien Giang subproject	Bach Long Vi subproject
Storms and tropical depressions	√	√				√
Heavy rainfall	√	√				
Sea level rise and tidal surges			√	√	√	√
Heatwaves and strong winds	√	√				√

With the increasingly complex trends of climate change, negative impacts on the lives of people affected in the project area will occur during both the construction and operation phases, specifically as follows:

Affected subproject	Climate change factor	Impacts during construction phase	Impacts during the operation phase of the fishing port
- Lach Hoi - Lach Bang	Storm and strong winds	- Causing disruptions during construction, damaging	- Causing damage to wharves, warehouses, and the mooring system.

Affected subproject	Climate change factor	Impacts during construction phase	Impacts during the operation phase of the fishing port
- Bach Long Vi		unfinished structures and construction equipment. - Increasing the risk of occupational accidents due to strong winds. - Delaying construction progress because of adverse weather conditions.	- Increasing the risk of rope breakage and ship capsizing in the harbor basin.
- Lach Hoi - Lach Bang	Extreme rains	- Flooding the construction area, affecting the movement of workers and materials. - Causing difficulties in concrete pouring and the construction of underwater structures. - Easily washing away waste and construction materials into surrounding areas, causing pollution. - Flooding construction sites, especially coastal works, leading to construction disruptions. - Affecting the transportation of construction materials and equipment to and from the site.	- Flooding of disposal sites and fish processing areas. - Washing away by-products and waste into rivers and the sea.
- Tam Quan - Khanh Hoa - Kien Giang - Bach Long Vi	Sea level rise and tide	- Flooding construction sites, especially coastal works, causing construction disruptions. - Affecting the transportation of construction materials and equipment to and from the site.	- Saltwater intrusion penetrating deep into cold storage facilities and riverside warehouses. - Increasing the risk of bank erosion and land loss around the port.
- Lach Hoi - Lach Bang - Tam Quan	Flow fluctuations at river mouths	- Altering the terrain and flow around the works, affecting construction methods and the installation of structural components. - Causing difficulties in pile drilling, pile driving, and the construction of underwater structures.	Altering natural waterways → causing sedimentation, shallowing of estuaries, and difficulties for vessels entering and leaving.
- Lach Hoi - Lach Bang - Bach Long Vi	Heat wave	- Affecting the health of construction workers, potentially leading to exhaustion or other heat-related health issues. - Reducing the quality of construction materials such as	- Affecting the quality of stored fish in case of power outages. - Increasing the demand for refrigeration and storage costs.

Affected subproject	Climate change factor	Impacts during construction phase	Impacts during the operation phase of the fishing port
		concrete and asphalt when working in high temperatures.	

It is noteworthy that the impacts of sea level rise include:

- Flooding of ports, warehouses, and cold storage facilities: Ports are usually located in low-lying coastal areas and are at risk of saltwater intrusion and deep flooding when sea levels rise (projected in Vietnam to be 0.5–1 m by the end of the century).
- Damage to infrastructure: Equipment such as wharves, internal roads, and electrical–water systems are prone to corrosion from saltwater and prolonged flooding.
- Salinization of freshwater sources (particularly for Kien Giang subproject and Lach Hoi subproject): This causes difficulties in seafood processing, cleaning fishing vessels, and providing water for workers and local residents near the port.

The level of impact is assessed as **Medium** due to (i) the project areas having a relatively high frequency of storms and floods, but mainly only from August to November; and (ii) the breakwater and port structures being designed with foundation calculations to ensure structural durability. The project's designs have taken into account the elevation of ports and warehouses to avoid impacts from sea level rise. However, prolonged flooding could still pose risks of erosion and scour along port revetments, causing certain damage.

In addition, in marine areas, extreme weather events (major storms, heavy rainfall, strong winds) will directly cause the following effects:

- Major storms and strong gusts: Boats cannot enter or leave the port → disrupting the supply chain, increasing storage and seafood preservation costs.
- High waves: Causing erosion of port banks, damage to wharves, and threatening the safety of workers and fishermen.
- Extreme rainfall: Causing localized flooding, damaging machinery, and polluting water sources and food.

The level of impact is assessed as Medium because (i) the project areas have a relatively high frequency of extreme weather events, as they are all located in river-mouth coastal areas (including Lach Hoi, Lach Bang, Tam Quan, Kien Giang subprojects) or on bays/islands (Khanh Hoa and Bach Long Vi subprojects); and (ii) technical measures and operational management/maintenance plans have been considered in the design to control these risks. However, if extreme weather events occur more frequently or with greater intensity, they could cause certain damage, which can be controlled with reasonable measures.

Overall, the impacts of climate change are unavoidable during the construction and operation of the project. The level of impact is Medium, usually occurring only in the rainy/flood season (from August to November) and intermittently. These impacts can be mitigated through preventive and adaptive measures combined with design and construction plans to minimize damage and risks as much as possible.

4.6.7. Impacts of the project on Climate Change

a. Construction phase:

During construction, the project will generate greenhouse gas (GHG) emissions due to the use of fossil fuels. The most commonly used fossil fuel for construction equipment in the project areas is Diesel Oil (DO) and electricity. The GHG emissions from diesel combustion on construction equipment are calculated based on the estimated diesel fuel demand (see Chapter 3, impacts from construction machinery emissions) and the 2014 Emission Factors from the U.S. Environmental Protection Agency (EPA) Greenhouse Gas Inventory³¹. Furthermore, GHG emissions are generally expressed in carbon dioxide equivalent (CO₂e). To convert gases to CO₂e, their Global Warming Potential (GWP) is multiplied by the amount of each gas. The emission factors calculated for the project have not yet been converted to equivalent carbon dioxide (CO₂e). To perform this conversion, emissions must be multiplied by the corresponding GWP values listed in the tables below.

³¹ https://www.epa.gov/sites/production/files/2015-07/documents/emission-factors_2014.pdf

Table 4.75. Results of GHG emission calculations for the project regarding the use of DO fuel during the construction phase

Subproject	Trip/day	DO fuel (liters/day)	DO quantity per day (tons)	Calorific value (TJ)	DO fuel emission factor (tons/TJ)			Emissions (tons/day)			CO ₂ e (ton/day)
					CO ₂	CH ₄	N ₂ O	CO ₂	CH ₄	N ₂ O	
Lach Hoi subproject	120	2,300	1,978	85	77.4	0.003	0.0006	6,583.18	0.26	0.051032	6,604.7
Lach Bang – Hai Binh subproject	120	1,300	1,118	48	77.4	0.003	0.0006	3,720.93	0.14	0.028844	3,733.1
Lach Bang – Hai Thanh subproject	30	1,000	860	37	77.4	0.003	0.0006	2,862.25	0.11	0.022188	2,871.6
Tam Quan subproject	350	2,300	1,978	85	77.4	0.003	0.0006	6,583.18	0.26	0.051032	6,604.7
Khanh Hoa subproject	250	3,000	2,580	111	77.4	0.003	0.0006	8,586.76	0.33	0.066564	8,614.8
Kien Giang subproject	180	3,000	2,580	111	77.4	0.003	0.0006	8,586.76	0.33	0.066564	8,614.8
Bach Long Vi subproject	100	1,500	1,290	55	77.4	0.003	0.0006	4,293.38	0.17	0.033282	4,307.4
Total											41,351.1

Source: (*) Greenhouse gas emission factors, 2014 Inventory (EPA).

Note

Calorific value of DO fuel, GJ/t 43

DO density (kg/liter) 0.86

Table 4.76. Results of GHG emission calculations for the project regarding electricity use and total GHG emissions during the construction phase

Subproject	Electricity (kWh/day)	Electricity emission factor 2024 (kg/kWh)	CO ₂ e emissions from electricity use	CO ₂ e emissions from fuel oil use	Total CO ₂ e emissions during the construction phase (tons/day)
Lach Hoi subproject	6,000	0.6811	4.087	6,324	6,328
Lach Bang – Hai Binh subproject	6,000	0.6811	4.087	3,574	3,579
Lach Bang – Hai Thanh subproject	1,500	0.6811	1.022	2,750	2,751
Tam Quan subproject	17,500	0.6811	11.919	6,324	6,336
Khanh Hoa subproject	12,500	0.6811	8.514	8,249	8,257
Kien Giang subproject	9,000	0.6811	6.130	8,249	8,255
Bach Long Vi subproject	5,000	0.6811	3.406	4,124	4,128
Total			39.16	39,594	39,633

Note: Potential global warming and the corresponding CO₂e of N₂O and CH₄ equivalents.

No	Gas	GWP 100 years ³² CO ₂ e (ton)
1	CH ₄	29.8
2	N ₂ O	273
3	CO ₂	1
	Total	

Overall, the amount of GHG emissions during the three-year construction phase of the project is estimated to be small, equivalent to 39,633 CO₂eq (tons/day). Specifically: the largest GHG emissions come from the Khanh Hoa and Kien Giang subprojects (about 8,255 tons/day), Bach Long Vi subproject about 4,128 tons/day, Tam Quan subproject about 6,336 tons/day, Lach Bang subproject (total of Hai Thanh and Hai Binh areas) about 6,330 tons/day, and the lowest is Lach Hoi subproject at about 6,328 tons/day.

b. Operation phase:

During the operation phase, the project will generate greenhouse gas emissions from two main sources: (i) Fishing vessels and port operations using diesel fuel and electricity (generating CO₂); (ii) Seafood processing activities (generating CO₂, CH₄, and N₂O).

Source of gas emissions	Main emitted gases	Impact on climate change
Diesel engines of fishing vessels	CO ₂ , N ₂ O	Contributing to increased greenhouse gas emissions in coastal areas
Transport vehicles, fish processing equipment, and machinery at the port	CO ₂ , CH ₄ (in case of refrigerant leakage)	Increasing direct emissions
Use of electrically powered machinery and equipment	CO ₂ e	Increasing indirect emissions

The project's operational design parameters are as follows

No.	Subproject	Unit (trip)	Type I fish port (vessel traffic) trips/day	Aquaculture production (tons/year)
1	Lach Hoi subproject	Vessels/day	120	25,000
2	Lach Bang – Hai Binh subproject	Vessels/day	120	35,000

³² GWP100 - 100-year Global Warming Potential

No.	Subproject	Unit (trip)	Type I fish port (vessel traffic) trips/day	Aquaculture production (tons/year)
	Lach Bang – Hai Thanh subproject	Vessels/day	30	10,000
3	Tam Quan subproject	Vessels/day	350	Mooring area
4	Khanh Hoa subproject	Vessels/day	250	100,000
5	Kien Giang subproject	Vessels/day	180	100,000
6	Bach Long Vi subproject	Vessels/day	100	Mooring area

With the design parameters of the subprojects and the fuel consumption norms as follows:

Parameter/description	Value
Seafood throughput at the port (according to project design)	See the summary table above
Average fuel consumption	50 liters of diesel per 1 ton of fish caught (according to Vietnam standards & FAO) ³³
Diesel CO ₂ emission factor	2.68 kg CO ₂ per liter of diesel (IPCC 2006, Ministry of Natural Resources and Environment) ³⁴
Proportion of seafood processed and stored at the port	60% (commonly assumed for a Class I fishing port) ³⁵
CO ₂ emissions from processing and cold storage	40 kg CO ₂ per ton of fish (including electricity, ice, water, by-product treatment, etc.) ³⁶

By applying the GHG emission factors and the calculation formulas for greenhouse gas loads mentioned above during the construction phase, the calculated results for the operation phase are as follows:

³³ https://www.switch-asia.eu/site/assets/files/3527/vietnam_seafood_guideline_en_1_11_22.pdf?utm_source=chatgpt.com

³⁴ https://thuvienphapluat.vn/van-ban/Tai-nguyen-Moi-truong/Quy-dinh-2626-QD-BTNMT-2022-cong-bo-he-so-phat-thai-phuc-vu-kiem-ke-khi-nha-kinh-532253.aspx?utm_source=chatgpt.com; https://www.ipcc-nggip.iges.or.jp/public/2006gl/?utm_source=chatgpt.com

³⁵ https://thuisanvietnam.com.vn/bao-cao-cua-vien-kinh-te-va-quy-hoach-thuy-san-ve-nghien-cuu-nang-cao-nang-luc-quan-ly-nha-nuoc-ve-thuy-san/?utm_source=chatgpt.com

³⁶ A study by Hanoi University of Science and Technology estimated the total CO₂ emissions at an export seafood processing facility in Vietnam during the period from March 2022 to March 2023

Table 4.77: GHG emission calculation results for the project from diesel fuel use during the operation phase

Subproject	Trips/day	Diesel (liters/day)	Diesel fuel mass/day (tons)	Calorific value (TJ)	CO ₂	CH ₄	N ₂ O	CO ₂	CH ₄	N ₂ O	CO ₂ e (ton/day)
Lach Hoi subproject	120	30,000	25,800	1,109	77.4	0.007	0.002	85,867.56	7.77	2.2188	86,703.9
Lach Bang – Hai Binh subproject	120	36,000	30,960	1,331	77.4	0.007	0.002	103,041.07	9.32	2.66256	104,044.7
Lach Bang – Hai Thanh subproject	30	9,000	7,740	333	77.4	0.007	0.002	25,760.27	2.33	0.66564	26,011.2
Tam Quan subproject	350	105,000	90,300	3,883	77.4	0.007	0.002	300,536.46	27.18	7.7658	303,463.8
Khanh Hoa subproject	250	75,000	64,500	2,774	77.4	0.007	0.002	214,668.90	19.41	5.547	216,759.8
Kien Giang subproject	180	54,000	46,440	1,997	77.4	0.007	0.002	154,561.61	13.98	3.99384	156,067.1
Bach Long Vi subproject	100	30,000	25,800	1,109	77.4	0.007	0.002	85,867.56	7.77	2.2188	86,703.9
Total											979,754.5

Table 4.78: GHG emission calculation results for the project from electricity use and total GHG emissions during the operation phase

Subproject	Electricity (kWh/day)	Electricity emission factor 2024 (kg/kWh)	CO ₂ e emissions from electricity use	CO ₂ e emissions from diesel fuel use	Total CO ₂ e emissions during the Operation Phase (tons/day)
Lach Hoi subproject	11,160	0.6811	7.601	86,704	86,712
Lach Bang – Hai Binh subproject	13,560	0.6811	9.236	104,045	104,054
Lach Bang – Hai Thanh subproject	3,744	0.6811	2.550	26,011	26,014
Tam Quan subproject	16,800	0.6811	11.442	303,464	303,475
Khanh Hoa subproject	17,664	0.6811	12.031	216,760	216,772

Subproject	Electricity (kWh/day)	Electricity emission factor 2024 (kg/kWh)	CO ₂ e emissions from electricity use	CO ₂ e emissions from diesel fuel use	Total CO ₂ e emissions during the Operation Phase (tons/day)
Kien Giang subproject	7,656	0.6811	5.215	156,067	156,072
Bach Long Vi subproject	5,520	0.6811	3.760	86,704	86,708
Total			51.83	979.754	979.806

Source: (*) Emissions – Greenhouse Gas Effect Factors – Greenhouse Gas Inventory 2014 (EPA).

In general, the amount of GHG emissions during the project's operation phase is estimated to be quite large, equivalent to 979,806 CO₂eq (tons/day) or nearly 1 million tons/day. Specifically: the largest emissions are from the Tam Quan subproject, about 303,475 tons/day; Khanh Hoa subproject, about 216,772 tons/day; Kien Giang subproject, about 156,072 tons/day; Lach Bang subproject (total of Hai Thanh and Hai Binh areas), about 130,000 tons/day; and the lowest from Lach Hoi subproject and Bach Long Vi subproject, about 86,700 tons/day. This emission level is not small compared with major fishing ports, and it could increase if production rises in the future or if technologies are not improved. During the operation phase, the Fisheries Port Management Boards will carry out detailed greenhouse gas inventories (if necessary).

Thus, the project will certainly contribute at a medium level to greenhouse gas emissions, arising from activities such as fishing, transportation, preservation, and processing of aquatic products. Without effective control and adaptation measures, the port will be a source of negative impacts on climate change both regionally and nationwide.

In addition, during the operation phase, a certain amount of greenhouse gas emissions will also result from the combustion of fossil fuels such as gasoline, diesel, and biodiesel used by vehicles entering and leaving the port. Due to the variety of fuels used and the diversity as well as the number of vehicles traveling on the access roads to the port, calculating the volume of greenhouse gas emissions is a technical challenge. However, it is considered minor since these are existing routes for motorcycles, small vehicles, and trucks, which have already been invested/upgraded comprehensively and currently carry a medium volume of traffic.

CHAPTER 5. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

Based on the potential impacts and risks identified and assessed in Chapter 4, an Environmental and Social Management Plan (ESMP) has been developed for the SFDP MAE project. The primary objective of the ESMP is to prevent, mitigate, and manage adverse environmental and social impacts associated with the project.

The ESMP outlines detailed procedures for implementation, monitoring, supervision, and reporting to ensure effective management of these impacts. It also includes a capacity building program to strengthen the skills and knowledge of relevant stakeholders, as well as a comprehensive cost estimate for all proposed measures.

The main components of this ESMP include:

- Mitigation Measures for E&S risks and impacts.
- Implementation Arrangement
- The project Compliance Framework
- Environmental Monitoring Program
- Capacity building programs.
- Cost estimation.
- Grievance Redress Mechanism

5.1 MITIGATION MEASURES

This section proposes mitigation measures for the key project impacts anticipated during the feasibility study, detailed design, site preparation, construction, and operation phases.

The mitigation measures for the detailed design phase for all subprojects are provided in Section 5.1.1, while Section 5.1.2 details the mitigation measures for the preparation period.

Regarding the layout of mitigation measures during construction, there are two fundamental parts to this ESMP. Given that most key impacts will occur due to civil works and the transportation of construction and waste materials, many potential negative impacts on the physical, biological, and social environments (e.g., noise, dust, water pollution, waste generation, and social disturbances) could be mitigated through a set of general measures typically applied to most construction projects. As part of the project's ESMP, these generic measures have been translated into standard environmental and social specifications, namely the Environmental and Social Codes of Practice (ESCOPs). The ESCOPs will be applied to mitigate the typical impacts of civil works across all subprojects and will be included in all construction contracts. The content of the ESCOPs is detailed in Section 5.1.3.

In addition to these general measures, each of the six subprojects presents site-specific impacts that require site-specific measures during construction. Section 5.1.3 discusses the site-specific measures to be implemented during construction for each subproject where additional mitigation measures are needed beyond those identified in the ESCOPs. These site-specific construction measures will be incorporated into the relevant construction contracts.

Similarly, Section 5.1.4 details the mitigation measures to be applied during the operational phase. This section is divided into two subsections: Section 5.1.4.1 describes the measures applicable to the operation of all subprojects, while Section 5.1.4.2 presents the site-specific operational measures relevant to each individual subproject.

5.1.1. Mitigation measures during detailed design – applicable to 6 subprojects

5.1.1.1. For work items with river/sea dredging activities

Subprojects involving river or sea dredging components include: Tam Quan subproject, Khanh Hoa subproject, Kien Giang subproject, and Bach Long Vi subproject. During the detailed design phase, these subprojects need to implement the following measures:

- Conduct consultations with relevant stakeholders (such as the Departments of Agriculture and Environment of the provinces, management boards of existing fishing ports or storm shelter areas, the MPA Management Board for Bach Long Vi subproject, local communities, etc.) regarding locations and peak periods when dredging should be limited or avoided, as well as feasible dredging options and techniques.
- Design and install signage systems to ensure waterway safety during each stage of construction and project operation.
- Design the dredging channel alignment reasonably to maintain access to river or sea water for local residents, taking into account the continuation or temporary suspension of aquaculture and fishing activities during construction.
- Specifically for Bach Long Vi storm shelter, measures for breaking sedimentary rocks before dredging must be designed in detail and implemented following environmentally safe and sustainable approaches, while also applying mitigation measures to impacts on underwater ecosystems within the Bach Long Vi MPA.

5.1.1.2. For fishery logistics works, embankments, fishing ports/anchorages

- To minimize the risk of structural failure (embankments, wharves, etc.) during construction, the detailed design must include comprehensive geological and hydrological surveys of the area.
- The design process for embankments and wharves should analyze the impact of the structures on sediment transport, erosion, and deposition, and provide appropriate design solutions.
- When designing logistics facilities or shoreline embankments, material selection must be carefully considered to ensure durability, load-bearing capacity, and resistance to marine or riverine conditions (salinity, waves, wind, etc.).
- The design of embankments should account for their ability to resist subsidence and storm surges, especially in areas with significant waterway traffic.
- Design access ladders with handrails along embankments to ensure safe access and water use for local communities, while still allowing vessels to enter and exit ports or storm shelter anchorages.
- Design wastewater collection and drainage systems to serve facilities at fishing ports and storm shelter anchorages.
- When designing works for the expansion of Lach Hoi port, calculations should minimize vegetation clearance (such as mangroves and floodplain trees along the Ma River).
- Designs for structures in the expanded Lach Hoi port must consider minimizing vegetation clearance (mangroves, floodplain trees along the Ma River).
- Landscaping within the expanded port area should ensure appropriate green spaces.
- Administrative buildings should be designed to maximize natural lighting, and water and electrical equipment should be energy efficient.

- Materials in public areas, such as restrooms, washbasins, and showers, should be carefully selected to ensure long-term durability during use.

5.1.1.3. *For auxiliary works for wastewater and solid waste collection and treatment for port*

- Select locations for WWTPs and technical pipelines that avoid areas prone to landslides, flooding, or weak soil.
- Design wastewater collection and drainage systems; waste storage facilities serving fishing port/storm shelter structures must ensure aesthetics, minimize odors, and be easy to operate.
- Treatment facilities within WWTPs at fishing ports must comply with Vietnamese National Standards (QCVN 01:2021/BXD). This standard requires that WWTPs invested in subprojects (with capacities ranging from 300–600 m³/day) must have an ecological buffer zone of at least 15 m for treatment facilities using mechanical, physico-chemical, and biological methods, which are enclosed and equipped with odor collection and treatment systems. Specifically:

Work item	Minimum distance (m) from the WWTP with a capacity of 200 - 5000 m ³ /day
Wastewater pumping stations	25 m
WWTP (A treatment facility using mechanical, physico-chemical, and biological methods, constructed as an enclosed system with an integrated odor collection and treatment system).	15 m

- The design process should propose technology suitable for the characteristics of the influent wastewater and ensure compliance with the effluent standards. The subprojects have selected biological treatment technology and designed enclosed treatment tanks to minimize odor generation and better control sludge from the WWTP
- In addition, the design process should calculate and propose the required operational personnel at the port/anchorage management board, ensuring they have the appropriate expertise and experience to operate the waste treatment facilities of each subproject.
- Use Larsen sheet piles to reinforce and protect the slopes of excavation pits/trenches to prevent landslides and erosion when digging to depths of 3 meters or more for WWTPs and pumping stations if constructed underground.
- Prepare an Operations Manual and an Emergency Response Plan to address potential incidents/risks that may occur in the wastewater collection and treatment system of the fishing ports.

5.1.2. *Mitigation measures in the preparation period*

5.1.2.1. *Mitigation measures due to land acquisition activities - applicable to 6 subprojects*

The Resettlement Plan (RP) has been developed for the project based on the base design, and the RP report also provides specific measures for compensation, assistance, and resettlement for affected persons. The RP establishes mechanisms for project information disclosure, public consultation and participation, as well as a grievance redress mechanism (GRM). Compensation and assistance for affected households are based on the following principles:

- All affected people who own assets or reside within the project land area must be fully compensated for their losses before land is acquired for construction. People who lose

income and/or housing will be provided support to reinstate livelihoods based on eligibility criteria determined by the project in consultation with those affected. If, by the end of the project, livelihoods are proven not to have been reinstated to pre-project levels, additional measures will be provided.

- Methods used to assess losses in WB-financed projects are based on full replacement costs. For this project, losses include land, structures, and other assets, and these replacement costs will be assessed as follows: Full replacement cost of land includes the value of land determined according to prevailing market prices plus administrative fees. For houses and other affected structures, valuation is based on the market price of construction materials and labor costs to build replacement houses of equivalent or better quality and size than the affected ones.
- Mitigation of unavoidable economic and social impacts due to land acquisition or restriction of land use will be achieved by: (a) timely compensation at replacement cost for lost assets, and (b) supporting displaced persons in efforts to improve, or at least reinstate, their livelihoods and living standards, under practical conditions, to pre-displacement levels or prevailing levels prior to project implementation, whichever is higher.
- To ensure that all complaints and grievances of affected persons regarding any aspect of land acquisition, compensation, and resettlement are addressed in a timely and satisfactory manner, and that all available channels for affected people to resolve grievances are in place, a clearly defined grievance redress mechanism must be established. All PAPs (Project-Affected People) may submit any inquiries to the implementing agencies regarding their rights. PAPs are not required to pay any fees related to seeking grievance resolution.

Preliminary estimates of compensation and support costs for PAPs have been prepared and are included in the RP based on (a) current provincial regulations regarding compensation, assistance, and resettlement, and (b) a rapid replacement cost assessment conducted to support the process.

Compensation and assistance plans for resettlement and livelihood restoration for each subproject are detailed in the RP report.

Mitigation for relocation of graves:

Approximately 60 graves will be displaced under the Kien Giang subproject. These graves are owned by local people and will be relocated to the local's cemetery. However, during the implementation of the project, there may be additional finding of graves, especially derelict graves. Therefore, relocation of graves will be carried out as follows:

- The affected graves will be relocated based on full consultation with affected households to ensure local people's customs and procedures. Compensation for affected graves includes all costs related to a) land for burial, b) excavation, c) relocation, d) renovation, e) construction of new tombs and f) other necessary related costs following people's customs and habits.
- In case of unidentified owners of the affected graves, notification on the relocation will be disclosed publicly (on TV, popular newspapers) several times to search for the owner of the grave. Within a prescribed period, if no owner shows up, the grave will be relocated by a specialized unit in consultation with the Commune People's Committee. The geographical location and condition of the graves (with detailed photographs), relocation procedure and the new location of the graves shall be carefully documented for later use by the owner. During the relocation process, the PMU shall promptly notify affected households so they have proper preparation in terms of spiritual activities and

the compensation shall be made to the affected households as stipulated in the project's RP and ESMP.

- Consultation with households whose graves have to be relocated: During project preparation, households whose graves had to be relocated were consulted with project-affected households. Affected households have been generally informed about the project's policies, implementation procedures, grievance redress mechanism, and expected location for the grave locations. The consultation process will continue during the detailed measurement survey of the project.

5.1.2.2. Mitigation measures for the impact of residual UXO- applicable to 6 subprojects

UXO and residual mines will be cleared immediately after the compensation and site clearance, and before any land leveling or dredging activities. The project owner will contract an authorized agency to safely clear and destroy any UXO or mines found at the construction and expansion sites of the Lach Hoi, Lach Bang, Tam Quan, Khanh Ho, Kien Giang, and Bach Long Vi subprojects.

The UXO clearance plan must be communicated to the local community before clearance begins. No construction activities will be allowed before UXO clearance is completed and the site is handed over to the PMU.

The project also allocates a budget of approximately VND 24.7 billion for UXO and residual explosive clearance prior to commencement, specifically for each subproject as follows:

- Lach Hoi subproject: VND 6.9 billion
- Lach Bang subproject: VND 5.3 billion
- Tam Quan subproject: VND 7.8 billion
- Khanh Hoa subproject: VND 0.6 billion
- Kien Giang subproject: VND 2.3 billion
- Bach Long Vi subproject: VND 1.7 billion

5.1.3. Mitigation measures for the impacts during the construction phase

5.1.3.1. General Impact Mitigation Measures – applicable to 6 subprojects

The proposed mitigation measures for the construction phase include: (i) Environmental and Social Codes of Practice (ESCOP), (ii) Worker Code of Conduct, and (iii) Labor Management Procedures (LMP).

Subproject-specific mitigation measures will be presented for each subproject, along with supplementary plans (in the annex).

Relevant elements will be incorporated into the Terms of Reference (TORs) for Consultancy Services and/or Civil Works Contracts as guided below. In addition, the PMU and the Construction Supervision Consultant (CSC) will be responsible for coordinating activities among different contractors working simultaneously, sharing construction sites and access routes, etc., to ensure that construction works are implemented in a synchronized manner while controlling environmental and social impacts and risks.

1. Environmental and Social Code of Practice (ESCOP)

The ESCOP will be applied to all civil works contracts and, therefore, will be included in the relevant sections of the construction contract and bidding documents. Note that, in addition to the ESCOP, the bidding documents for each specific civil works package will also include

relevant subproject-specific mitigation measures and plans tailored to the natural conditions and location of the civil works under that package.

The following table lists mitigation measures in the form of Environmental and Social Codes of Practice (ESCOP) to control and minimize the common negative impacts listed below:

- i. Dust and emissions
- ii. Noise and vibration
- iii. Wastewater management
- iv. Management of general solid waste
- v. Hazardous waste management
- vi. Impacts on biological resources;
- vii. Risks of erosion, sedimentation, and localized flooding
- viii. Traffic safety risks
- ix. Impacts on existing infrastructure and related services
- x. Community health and safety
- xi. Occupational health and safety risks
- xii. Social impacts
- xiii. Impacts on cultural and historical resources and the procedures for chance finds.

Table 5.1. Environmental and Social Codes of Practice (ESCOPs)

In addition to the mitigation measures listed below, contractors are also required to use clean water, electricity, fuel, and construction materials efficiently to meet the requirements set out in the WBG ESHG and ESS3 regarding pollution control, energy efficiency, and the conservation of natural resources.

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
1. Dust, and gas emissions	<u>Avoidance</u> • Compliance with the law: Contractors must fully comply with Vietnamese regulations concerning ambient air quality and emission limits from vehicles and machinery. • Dust control planning: Before construction, contractors must develop a detailed dust control plan, including technical and organizational measures to ensure a safe working environment and avoid causing inconvenience to the surrounding community. • Approval of construction equipment: The list of equipment and construction vehicles must be submitted to the supervision consultant for inspection and approval before being brought to the site. • Advance notice: Inform the local community and fishermen about the construction schedule in advance. <u>Mitigation</u> <i>For construction and excavation activities:</i> • Conduct construction in phases and clean the site before excavation. • Spray water to reduce dust at least twice a day, increasing to three times daily in residential areas, schools, and temples during hot, dry weather. • Compact and water soil after filling it to limit dust generation. • Transport excavation materials according to regulations; do not dump them indiscriminately. <i>For transportation activities:</i>	• Environmental Protection Law No. 72/2020/QH14 • Decree No. 06/2021/ND-CP dated January 26, 2021, detailing certain provisions on quality management, construction execution, and maintenance of construction works • Circular No. 82/2024/BCA dated November 15, 2024 of the Ministry of Public Security, stipulating certification of technical safety and environmental protection for motor vehicles, specialized motor vehicles, and motor vehicle parts in import, production, assembly, renovation, and inspection under the management scope of the Ministry of Public Security • QCVN 05:2023/BTNMT: National technical regulation on ambient air quality • TCVN 6438-2018: Road vehicles — Maximum allowable limits of exhaust emissions • World Bank EHS Guidelines	• Implementation: Contractor • Supervision: PMU, CSC, IESMC

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	• Cover all material and waste transport vehicles; do not overload. • Water along transport routes about 40 meters from the construction site at least twice a day on sunny days. • Clean up any spilled soil and debris immediately. • Set up wheel washing stations at the entrance and exit of the construction area. • Enforce a maximum speed limit of 5 km/h within the construction site. • Avoid transporting materials and dumping waste on main roads during peak traffic hours (6–8 a.m. and 5–6 p.m.). For material disposal sites: • Fully cover material disposal sites with tarpaulins to limit dust spread by wind and maintain aesthetics at ports. • Locate disposal sites away from prevailing winds and sensitive structures. • Burning of solid waste (e.g., wood, rubber, oily rags, empty cement bags, paper, plastic, bitumen, etc.) at the construction site is strictly prohibited. For machinery and equipment: • All vehicles/machinery must be inspected and have quality and environmental protection certification. • Regularly clean and maintain equipment. • Do not idle machines when not in use. <u>Mitigation</u> • Deploy personnel and supporting equipment: Assign workers to collect materials and waste at the end of each workday or shift. Provide sufficient personal protective equipment such as masks or dust respirators when dust concentrations exceed permissible levels.		

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	- Limit construction to the site: Avoid extending construction activities into areas that could affect nearby residents or sensitive structures. <u>Remediation (if any)</u> - Environmental and health remediation: If dust affects public health or causes damage to property (e.g., trees, roofs, equipment), the contractor is responsible for remediation according to regulations.		
2. Noise, vibration	(i) Noise and vibration from construction machinery: <u>Avoidance</u> - Compliance with regulations: Adhere to Vietnamese laws on noise and vibration. - Construction planning: Prepare a reasonable construction schedule, avoiding night work in residential areas, temples, and schools. - Advance notice: Inform the local community and fishermen about the construction schedule in advance. <u>Mitigation</u> - Use low-noise equipment and install silencers or mufflers on engines and compressors. - Install soundproofing for noisy equipment enclosures and vibration isolators for mechanical devices. - Limit operating hours of noisy equipment. - Avoid simultaneous operation of high-noise and high-vibration machinery, especially during peak hours at ports or near existing residential areas. - Conduct construction primarily during daytime (6:00–18:00); if night work is necessary (21:00–6:00), notify local authorities and the community.	- Environmental Protection Law No. 72/2020/QH14 - QCVN 24:2016/BYT – National technical regulation on noise — permissible exposure limits at the workplace - QCVN 27:2016/BYT – National technical regulation on vibration — allowable values at the workplace - QCVN 26:2010/BTNMT – National technical regulation on noise - QCVN 27:2010/BTNMT – National technical regulation on vibration - World Bank EHS Guidelines	- Implementation: Contractor - Supervision: PMU, CSC, IESMC

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	• Provide full personal protective equipment (PPE) for workers operating noisy equipment (e.g., pile drivers, concrete sprayers, etc.). • If required or upon complaints regarding noise pollution, carry out noise and vibration monitoring to adjust construction methods and implement timely mitigation measures. <u>Remediation (if any)</u> • Coordinate with local authorities to address and provide support if construction activities significantly affect public health or living conditions. (ii) Vibration during the concrete pile driving process: <u>Avoidance:</u> • Use vibratory or hydraulic hammers instead of diesel hammers to reduce vibrations during pile driving; select a suitable hammer size with appropriate load capacity based on site-specific geological conditions; avoid large hammer use near sensitive receptors; • Ensure the use of pile driving equipment with appropriate load capacity according to the local geological conditions to avoid excessive impact forces. • Schedule pile driving during times that will have minimal impact on surrounding structures, such as during daylight hours or off-peak times. • Establish reasonable construction periods to reduce the long-term impact on the surrounding environment. <u>Mitigation:</u> • Perform pile driving in smaller, designated areas and divide the construction into separate sections to reduce the concentration of vibrations at one point. • Avoid driving multiple piles close together simultaneously, especially in areas with existing structures nearby.		

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	<u>Compensation:</u> For structures at high risk of damage, consider reinforcement measures such as installing retaining walls, bracing, or shock-absorbing layers to protect them from the impact of vibrations.		
3. Wastewater Management	(i) Domestic Wastewater <u>Avoidance</u> - Prioritize hiring local labor to reduce generation of domestic wastewater. - Provide septic toilets on-site, at least 200 m away from worker camps. <u>Mitigation</u> - Install at least one mobile septic toilet or construct a septic toilet at each construction site; mobile toilets must be located at least 200 m from worker camps. - Wastewater from kitchens and washing areas in camps must be treated before discharge into the environment through drainage channels and sedimentation pits. - Regularly clean drainage ditches around the camps weekly. - Contract with qualified units for collection, transportation, and treatment of domestic wastewater according to regulations. - After construction, dismantle and reinstate the site, and properly treat the sanitation system. <u>Remediation</u> - If domestic wastewater causes environmental pollution or affects the community, the contractor is responsible for remediation and compensation according to regulations. ii) Construction Wastewater	- Environmental Protection Law No. 72/2020/QH14 - Decree No. 08/2022/ND-CP dated January 10, 2022, detailing certain provisions of the Environmental Protection Law, amended by Decree No. 05/2025/ND-CP dated January 6, 2025 - Circular No. 02/2022/TT-BTNMT dated January 10, 2022, providing detailed guidance on the Environmental Protection Law, amended by Circular No. 07/2025/TT-BTNMT dated February 28, 2025 - QCVN 08:2023/BTNMT – National technical regulation on surface water quality - QCVN 14:2025/BTNMT – National technical regulation on domestic and urban wastewater from concentrated residential areas (replacing QCVN 14:2008/BTNMT from September 1, 2025)	- Implementation: Contractor - Supervision: PMU, CSC, IESMC

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	<u>Avoidance</u> - Do not stockpile construction materials, waste, or mix concrete within 50 m of rivers, seas, or water sources. - Maintain construction equipment in designated areas to avoid hazardous wastewater generation. <u>Mitigation</u> - Wash water from vehicles, construction tools, and foundation pits must be settled before discharge into the environment. - Arrange temporary sedimentation pits at appropriate locations. - Waste oils and grease from equipment must be collected and treated as hazardous waste. - Store fuels and oils on impermeable surfaces, under a roof, and at least 25 m away from drainage flows. - Vehicle and equipment maintenance, including oil changes or greasing, must only be conducted in designated areas. Use trays to contain rags and materials used for maintenance; waste must be collected and disposed of according to hazardous waste regulations. - Wash water from vehicles entering and leaving the site must be collected into sedimentation tanks, then passed through sand and oil separation filters before discharge. - Regularly dredge drainage channels and sedimentation pits to ensure treatment efficiency. - Transport dredged materials and generated waste to sites agreed upon with local authorities.	- QCVN 40:2025/BTNMT – National technical regulation on industrial wastewater (replacing QCVN 40:2011/BTNMT from September 1, 2025) - World Bank EHS Guidelines	

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	<u>Remediation</u> • If construction wastewater affects water sources or community living conditions, the contractor is responsible for treatment and compensation. iii) Rainwater Runoff <u>Avoidance</u> • Do not locate temporary material storage near rivers or seas. • Cover easily washed-away materials with geotextile fabric or soil/sand bags. <u>Mitigation</u> • Reinforce construction areas and internal roads with crushed stone or a proper drainage system. • Arrange drainage ditches and sedimentation pits on-site; regularly dredge pits (once a week or as needed) to prevent soil and waste from entering drainage systems and causing blockage or localized flooding. • Clean up spilled materials, oils, and grease to prevent runoff into the environment. • Limit or avoid excavation and earthwork on rainy days to prevent pollution runoff. <u>Remediation</u> • If rainwater runoff causes flooding or water pollution, the contractor must carry out remediation according to regulations.		
4. Domestic Solid Waste Management	<u>Avoidance</u> • Prepare a solid waste management plan before construction, including procedures for storage, classification, collection, transportation, and treatment.	• Environmental Protection Law No. 72/2020/QH14 • Decree No. 08/2022/ND-CP dated January 10, 2022, detailing certain provisions of the Environmental	• Implementation: Contractor • Supervision: PMU, CSC, IESMC

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	• Register and obtain all required waste treatment permits according to legal regulations. • Prioritize the use of environmentally friendly materials that are easy to recycle and reuse. • Calculate cleared area reasonably to limit waste generation from undergrowth and vegetation. <u>Mitigation</u> • For domestic solid waste: • Provide classified trash bins (organic, inorganic, recyclable) in living areas, canteens, and sanitation areas. • Collect waste daily, especially organic waste, to avoid odor and pests. • Contract with qualified units for domestic waste treatment. • For construction solid waste: • Reuse broken bricks, soil, and rocks as fill materials. • Sort steel and iron for scrap sale or recycling. • Stockpile in designated areas with hard surfaces and roofs to prevent dust dispersion or runoff. • Do not illegally dump construction waste; install warning signs and surveillance cameras if necessary. • For demolition and clearing waste: • Allow local communities to collect valuable plants before clearing. • Collect and reuse inert waste (rocks, soil, broken bricks) for filling. • Do not bury or burn plant biomass on-site. • For dredged material and excess excavated soil:	Protection Law, amended by Decree No. 05/2025/ND-CP dated January 6, 2025 • Circular No. 02/2022/TT-BTNMT dated January 10, 2022, providing detailed guidance on the Environmental Protection Law, amended by Circular No. 07/2025/TT-BTNMT dated February 28, 2025 • World Bank EHS Guidelines	

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	• Precisely determine excavation areas to avoid removing topsoil in green areas. • Use excavated soil for site leveling or planting; do not transport off-site unless necessary. • Store excavated soil in designated planting areas, with a maximum height of 1.5 m. • Manage according to a separate plan to prevent environmental dispersion. Details in the Appendix – Dredged Material Management Plan. • Additional mitigation measures: • Provide large-capacity (250 L) covered, water-tight bins with labeled waste classification on-site. • Sort waste at the source and concentrate it in temporary storage areas. • Contract qualified units for collection, transportation, and treatment in accordance with regulations. • Cover outdoor materials and provide temporary storage with roofs to prevent wind or rain dispersion. • Arrange material stockpile areas at each subproject, with each area approximately 100–200 m², impermeable surface, fencing, and signage. • Inspect and maintain equipment and machinery to ensure good condition and renew registration before expiry. • Major maintenance or repair of excavators is not permitted on-site; such activities must be conducted at specialized maintenance workshops. <u>Remediation</u> • If solid waste causes environmental or community impacts, the contractor is responsible for remediation and compensation according to regulations.		

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
5. Hazardous waste management	<u>Avoidance</u> • Legal compliance: The contractor must fully comply with Circular No. 02/2022/TT-BTNMT, amended by Circular No. 07/2025/TT-BTNMT, regarding hazardous waste (HW) management. • Hazardous waste treatment contract: Sign a contract with a licensed unit authorized to collect, transport, and treat hazardous waste according to legal regulations. • Training and communication: Organize training for workers on identifying, responding to, and handling hazardous waste, including emergency response procedures for chemical spills. • Safe chemical storage: Chemicals and fuels must be stored on impermeable surfaces, under roofing, with containment walls and warning signs, at least 20 m away from worker camps, and located downwind from prevailing winds. <u>Mitigation</u> • Equipment maintenance: Machinery and construction vehicles must be regularly maintained at workshops or maintenance centers off-site to minimize hazardous waste generation. • Control of hazardous materials: Do not use unapproved materials such as lead-based paint, asbestos, etc. Handling of materials containing hazardous substances must be performed by trained and certified personnel. <i>Hazardous waste storage and classification:</i> • Hazardous waste must be classified, clearly labeled, and stored in dedicated containers with lids (capacity 120 L). • Construct a hazardous waste storage facility of at least 10 m², with impermeable flooring, roofing, walls, and drainage channels.	• Environmental Protection Law No. 72/2020/QH14 • Decree No. 08/2022/ND-CP dated January 10, 2022, detailing certain provisions of the Environmental Protection Law, amended by Decree No. 05/2025/ND-CP dated January 6, 2025 • Circular No. 02/2022/TT-BTNMT dated January 10, 2022, providing detailed guidance on the Environmental Protection Law, amended by Circular No. 07/2025/TT-BTNMT dated February 28, 2025 • World Bank EHS Guidelines	• Implementation: Contractor • Supervision: PMU, CSC, IESMC

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	<i>Management of used oils and grease:</i> • Collect and store used oil and grease separately in sealed containers under cover, away from ignition sources. • Oil changes and filtration must only occur in designated areas. • Waste oil may be sold to licensed recycling units or returned to the manufacturer. <u>Mitigation Measures for Spills</u> <i>Emergency response:</i> • The person detecting the spill must ensure safety and immediately notify the supervising engineer and PMU. • Use sawdust, sandbags, or shovels depending on the scale of the spill. • Do not discharge chemicals into the drainage system; contaminated soil must be treated according to hazardous waste procedures. <i>Incident reporting:</i> • The contractor must prepare a detailed report on the cause, consequences, remedial actions, and preventive measures. • Submit the report to the Supervision Consultant, PMU, and Department of Agriculture & Environment (if required). <u>Remediation (if any)</u> • Environmental damage remediation: If hazardous waste incidents cause environmental pollution or affect public health, the contractor is responsible for remediation and compensation according to regulations.		

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
6. Impact on biological resources	(i) Vegetation and Trees <u>Avoidance</u> - Minimize the area of disturbance, especially in locations with trees or vegetation cover. - Do not stockpile materials or waste in areas with trees or vegetation; only stockpile on bare soil. - Do not use chemicals to clear vegetation. - Do not cut down trees outside the approved construction area. - If the construction route interferes with trees, consider relocating them to another position for protection. - Do not burn waste in a way that damages vegetation. <u>Mitigation</u> - Reduce the area of clearing by proper planning; allow local communities to harvest valuable plants before construction. - Install temporary protective fencing to safeguard trees that need to be preserved before construction. ii) Wildlife <u>Avoidance</u> - Do not hunt, trap, poison, feed, or harm any animals (birds, frogs, snakes, etc.). - Do not buy or sell wildlife for food. - Do not keep birds or animals in worker camps. - Do not burn waste in ways that damage or affect habitats.	- Law on Environmental Protection No. 72/2020/QH14; - Law on Biodiversity No. 32/VBHN-VPQH dated 10/12/2018; - ESS6	- Implementation: Contractor - Supervision: PMU, CSC, IESMC

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	<u>Minimization</u> • Regularly monitor construction activities to detect and prevent risks to wildlife. • Identify and protect undisturbed areas throughout the construction process. Temporary protective fencing will be installed where necessary to effectively protect the project area's biological resources. <u>Mitigation Measures</u> • If wildlife is found within the construction area, coordinate with competent authorities for appropriate protection. • Organize training for workers on wildlife identification and resource protection. <u>Remediation (if any)</u> • If construction causes ecosystem damage or loss of biological resources, the contractor must coordinate with the owner and relevant authorities to assess the damage and implement compensation according to the Biodiversity Law and Environmental Protection Law.		
7. Sedimentation, erosion, landslides and flooding	<u>Avoidance</u> • Inspection and improvement of drainage system: Before site leveling, thoroughly inspect the existing drains/ditches within and around the construction site to ensure effective rainwater drainage capacity. • Proper stockpiling of materials: Construction materials and wastes must be neatly stockpiled at least 10 meters away from existing ditches or water sources to avoid the risk of infiltration into the drainage system.	• Law on Environmental Protection No. 72/2020/QH14; • QCVN 18:2021/BXD – National Technical Regulation on Safety in Construction Works; • QCVN 08:2023/BTNMT – National Technical Regulation on Surface Water Quality; • TCVN 4447:2012 – Earthworks – Construction and Acceptance.	• Implementation: Contractor • Supervision: PMU, CSC, IESMC

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	<u>Mitigation and Minimization</u> • Regular cleaning: Drains and culverts inside and around the construction site must be regularly cleared of soil, rocks, and waste to prevent clogging. • Frequent dredging: Periodically dredge existing drains/ditches to maintain drainage capacity. • Leveling and compaction: After depositing materials in temporary stockpiles, leveling and compaction must be carried out to limit the risk of materials being washed away by rainwater. • Reinforcement of deep pits/ditches: For pits or ditches deeper than 2 meters, shoring and reinforcement of walls/sides must be applied to prevent collapse and reduce risks of landslides and occupational accidents. <u>Remediation (if any)</u> • In the event of damages to the community, the contractor is responsible for compensating for losses caused by landslides that affect housing, agricultural land, or technical infrastructure works.		
8. Traffic Management	(i) For Road Traffic <u>Avoidance</u> • Prepare a proper traffic coordination plan; avoid transporting materials during peak hours (7:00–8:00, 11:00–13:00, 16:00–18:00). • Identify transport routes that avoid sensitive areas such as schools, hospitals, markets, pagodas/churches (if any). • Use only vehicles with valid registration and certified technical safety. <u>Minimization</u> • Install traffic signs, fences, and signal lights at construction site entrances/exits.	• Law on Road Traffic No. 35/2024/QH15 dated June 27, 2024; • Law on Construction No. 50/2014/QH13 dated June 18, 2014, as amended and supplemented by Law No. 62/2020/QH14 dated June 17, 2020; • Decree No. 06/2021/ND-CP dated January 26, 2021 on detailed regulations on quality management, construction, and maintenance of construction works;	• Implementation: Contractor • Supervision: PMU, CSC, IESMC

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	• Arrange convex mirrors and warning lights at the site gate for night safety. • Cover transported materials tightly; do not load higher than 10 cm above the truck sideboards. • Spray water to reduce dust; collect spilled soil and debris daily. • Provide designated pedestrian routes, with signage and temporary walkways if sidewalks/roadways are occupied. • Place speed limit signs within 200 m of the construction site. • Avoid long parking or encroachment of vehicles onto the roadway. <u>Mitigation</u> • Assign trained staff (security guards or workers) to regulate traffic at busy intersections. • Ensure adequate lighting at night within the construction site and along transport routes. • Develop an emergency response plan in case of traffic accidents. <u>Remediation (if any)</u> • In case of accidents or damage to traffic infrastructure, the contractor is responsible for repair and compensation in accordance with regulations. (ii) For Waterway Traffic <u>Avoidance</u> • All waterway vehicles must be registered, have license plates, and valid operation permits. • Operators must hold valid boat/ship driving certificates. • No construction equipment shall be placed outside the project boundaries.	• Circular No. 10/2021/TT-BXD dated August 25, 2021 of the Ministry of Construction, replacing all previous regulations on quality management of construction and maintenance of construction works; • QCVN 18:2021/BXD – National Technical Regulation on Safety in Construction; • ESS4 (World Bank Environmental and Social Standard 4).	

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	<u>Minimization</u> • Provide sufficient signal lights, life buoys, firefighting equipment, and 24/7 VHF communication devices. • Install buoys and signal lights marking the construction boundary. • Carry out works within the inside edge of the boundary buoys, avoiding obstruction to existing waterway traffic. • Do not conduct construction during adverse weather conditions (thunderstorms, whirlwinds, fog, etc.). <u>Mitigation</u> • Develop a maritime safety plan and submit it to the competent authority for approval. • Coordinate in advance with local medical stations for emergency support. • Install warning signs and signal lights at dredging locations along the channel. • Prepare an emergency response plan for contractors in case of incidents or waterway traffic accidents. <u>Remediation (if any)</u> • In case of collision, sinking, or disruption to waterway traffic, the contractor is responsible for remediation and compensation.		
9. Impact on existing infrastructure and services	<u>Avoidance</u> • Coordinate early with infrastructure management units (water supply, electricity, telecommunications, internet, drainage, etc.) before commencement to: • Identify the location of existing underground systems (to avoid accidental excavation).	• Decree No. 06/2021/ND-CP dated January 26, 2021 on detailed regulations for quality management, construction, and maintenance of construction works; • Decree No. 144/2021/ND-CP on administrative sanctions in the fields	• Implementation: Contractor • Supervision: PMU, CSC, IESMC

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	• Prepare interruption plans in case of temporary shut-off/activation. • Establish a focal point for rapid incident response. • Assign a dedicated technical staff in charge of public utilities and infrastructure management at the beginning of the project. • Do not use heavy machinery (excavators, bulldozers) near underground systems unless directly supervised on site. • Require the project owner or design consultant to provide underground utility maps before construction. • Clearly stipulate the timing of coordination with infrastructure units (e.g., at least 30 days prior to commencement). <u>Minimization</u> • Use locating devices (detector or ground penetrating radar, if necessary) to precisely identify underground cables and pipelines before excavation. • Install protective barriers or temporary warning signs around excavation pits containing existing pipelines/cables, with nighttime flashing lights or reflectors. • Stop construction immediately if existing infrastructure is damaged. Identify the cause and propose remedial measures. • Prohibit untrained workers from performing tasks near technical infrastructure such as water supply pipelines, substations, or underground cables. <u>Mitigation</u> • Develop a <i>Service Disruption Plan</i> for each type of service if shut-off is unavoidable, including: start–end time; affected areas; temporary or alternative supply measures (clean water, temporary Wi-Fi, generators, etc.); and contact points for incident handling.	of security, social order and safety; prevention and control of social evils; fire prevention and fighting; rescue and relief; and prevention of domestic violence; • QCVN 18:2021/BXD – National Technical Regulation on Safety in Construction; • World Bank Environmental, Health, and Safety (EHS) Guidelines.	

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	• Post public notices at community points (health stations, commune/ward People's Committee offices, households, schools, etc.) at least 5 days in advance, in addition to direct notifications. • Provide alternative water supply to affected residents if service interruption lasts more than one day. • Assess the level of impact (number of households, healthcare facilities, schools, etc.) to prioritize support. • Clearly specify forms of notification (paper-based, electronic, loudspeaker, etc.). <u>Remediation (if any)</u> • Sign a tripartite agreement (project owner – contractor – infrastructure management unit) on responsibilities for compensation, repair, and restoration in case of damage to existing systems. • Maintain an incident logbook recording all damages to infrastructure, including: date and time; description of damage; cause; corrective measures; completion time of repair; confirmation minutes signed by the supervising engineer and infrastructure management unit.		
10. Community Health and Safety	<u>Avoidance</u> • Do not disturb or cause nuisance to the community during construction activities. • Restrict night-time construction, particularly near residential areas, schools, hospitals, pagodas/churches (if any). • Establish regular communication channels with local authorities and community representatives. • Coordinate with local health agencies to prepare a disease prevention plan for workers.	• Decree No. 06/2021/ND-CP dated January 26, 2021 detailing a number of provisions on quality management, construction, and maintenance of construction works; • Decree No. 167/2013/ND-CP on administrative penalties for violations related to social security, order, and safety issues;	• Implementation: Contractor • Supervision: PMU, CSC, IESMC

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	• Provide information to the community at least 5 days in advance on construction schedules, service disruptions, detour routes, and blasting/demolition activities (if any). <u>Minimization</u> • Install fences, reflective ropes, and warning signs at excavation pits and open trenches; ensure adequate lighting at night on the construction site. • Limit vehicle speed within 200 m of the site to 20 km/h to reduce dust and noise. • Place noise-generating machinery away from residential areas, ensuring noise levels do not exceed 70 dBA. • Apply static compaction methods when working near residential areas or weak structures to minimize vibration. • Spray water to control dust and collect spilled materials on a daily basis. <u>Mitigation</u> • Maintain an information board at the site providing full contact details, construction schedule, and safety warnings. The board must clearly state the contact person's name, phone number, email (if available), and office hours for receiving community feedback. • Provide Vietnamese copies of ESCOPs and environmental safety documents to the community and workers. • Establish a Community Grievance Logbook, updated at least once a week. • Respond to community inquiries within 5 working days; if an extension is required, notify the reason and the new deadline. <u>Remediation (if any)</u> • If construction causes serious impacts on community health (e.g., dust, noise, disease outbreaks), the Contractor must coordinate with the Project Owner	• Decision No. 96/2006/QD-TTg on clearance of unexploded ordnance (UXO); • Circular No. 146/2007/TT-BQP of the Ministry of National Defense: Guidance on the implementation of Decision No. 96/2006/QD-TTg; • Circular No. 09/2019/TT-BXD: Guidance on Decree No. 18/2019/ND-CP on management of construction investment costs, including provisions related to UXO clearance costs; • Official Letter No. 5972/BQP dated November 13, 2006: Ministry of National Defense's guidance on the implementation of Decision No. 96/2006/QD-TTg in relevant localities and line ministries; • QCVN 18:2021/BXD – National Technical Regulation on Safety in Construction; • ESS4, ESS10.	

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	and local authorities to address and compensate in accordance with regulations.		
11. Operational Health and Safety	<u>Avoidance</u> • Organize training on Environment, Health and Safety (EHS), HIV/AIDS and communicable disease prevention, and prevention of gender-based violence (GBV) and sexual harassment within 2 weeks from the commencement date (applicable for contracts $\geq$ 6 months). • Keep training records and workers' signed commitments for inspection and supervision purposes. • Provide workers with training on EHS rules before they start any contract work. • Require workers to sign a Code of Conduct committing not to cause public disturbance in the local area. • Establish an agreement between the contractor and local authorities to prevent social evils (alcohol abuse, prostitution, gambling, etc.). • Do not allow untrained workers to perform work near technical infrastructure or hazardous areas. • Implement security and access control measures for workers' camps. • Workers' camps must have a security fence at least 2 m high made of appropriate materials. • Control access to camps: allow only workers, camp staff, and visitors with work-related purposes. • Visitors must obtain prior approval from the camp manager before entering. • Ensure adequate lighting during both daytime and nighttime. <u>Minimization</u>	• Decree No. 06/2021/ND-CP dated January 26, 2021 on detailing a number of provisions on quality management, construction works execution, and maintenance of construction works; • Decision No. 96/2008/QD-TTg on clearance of unexploded ordnance (UXO); • QCVN 18:2021/BXD – National Technical Regulation on Safety in Construction Works Execution; • ESS2 – Labor and Working Conditions; • World Bank's Environmental, Social, Health and Safety (ESHS) Guidelines	• Implementation: Contractor • Supervision: PMU, CSC, IESMC •

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	• Provide adequate personal protective equipment (PPE) appropriate to each task: masks, hard hats, safety shoes/boots, gloves, safety glasses, etc. • Ensure safe electrical installations in offices and on site: no cables lying on the ground or in water; electrical ends must have plugs; outdoor electrical panels must be placed in protective enclosures. • Equip and periodically inspect fire-protection equipment, portable fire extinguishers, and first-aid kits (first-aid bags, medicine cabinets) at camps and site offices. • Workers' camps must have adequate clean water supply, electricity, and sanitation; provide at least one toilet compartment per 25 workers, with separate facilities for men and women. • Provide beds with mosquito nets to reduce dengue risk. • Keep camps, kitchens, bathing/washing areas, and toilets clean regularly; provide waste bins and ensure daily waste collection. Specify cleaning frequency (e.g., daily cleaning, weekly inspections). • Keep drainage ditches around camps cleared periodically. <u>Mitigation</u> • Suspend all construction activities in the event of storms, accidents, or incidents. • In case of chemical or fuel leaks: check injured persons, provide first aid and transfer to medical facilities; do not flush chemicals into the drainage system; contain/absorb spills using sawdust or sand, or remove contaminated topsoil if necessary. • Provide emergency-response training for workers, especially for fire/explosion, chemical incidents, and natural hazards.		

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	- After any incident, prepare a detailed report and submit it to the supervising engineer, the Project Management Unit (PMU), and relevant authorities if required. <u>Remediation (if any)</u> - If occupational accidents or incidents affect workers' health, the contractor is responsible for treatment, medical support, and compensation in accordance with law and labor contracts.		
12. Social Impacts	<u>Avoidance</u> - Notify the community at least 2 weeks prior to commencement of construction. - Register a complete list of temporary workers with the local authorities. - Prioritize the use of local labor for unskilled works to create employment and reduce potential conflicts. - Provide training for workers on environment, health and safety (EHS), as well as local culture. - Develop and require workers to sign a Code of Conduct compliance commitment. <u>Minimization</u> - Restrict nighttime construction; if night work or service interruptions (e.g., electricity, water supply) are unavoidable, notify the community at least 2 days in advance. - Install temporary covers (e.g., wooden planks) over open trenches/pits not yet reinstated to ensure safe passage. - Provide orientation for migrant workers on local customs and practices to avoid cultural conflicts. - Conduct training to raise road safety awareness among local residents.	- Decree No. 144/2021/ND-CP on administrative penalties in the fields of security, social order and safety; prevention of social evils; fire prevention and fighting; rescue and relief; and domestic violence prevention. - Decree No. 167/2013/ND-CP on administrative penalties for violations related to social security, order, and safety. - ESS2 (Labor and Working Conditions) and ESS4 (Community Health and Safety). - World Bank's Environmental, Social, Health and Safety (ESHS) Guidelines.	- Implementation: Contractor - Supervision: PMU, CSC, IESMC

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	<u>Mitigation</u> • Establish a grievance redress mechanism to receive feedback from the community and respond within 5 working days. • Provide information in user-friendly language and appropriate formats (e.g., leaflets, community meetings). • Maintain notice boards at construction sites with contact details, construction schedule, and hazard warnings. • Cooperate with commune/ward police to conduct regular inspections of worker camps if violations are suspected. <u>Remediation (if any)</u> • If construction activities cause service interruptions or adversely affect community livelihoods, the contractor must coordinate with the project owner and local authorities to address the issue and provide compensation in accordance with regulations.		
13. Impacts on PCRs and Chance Find Procedures	<u>Avoidance</u> • Prior to construction, review the area for potential cultural relics, archaeological remains, cemeteries, or isolated graves. • Select construction routes that avoid areas identified as having cultural or historical value. • Provide training for workers on recognizing signs of chance finds and the procedures to follow. <u>Minimization</u> • If relics are discovered during construction, the Contractor shall follow the procedure below: • Immediately stop all activities in the area of chance finds.	• Law on Cultural Heritage No. 28/2001/QH10. • Law on Amendments and Supplements to the Law on Cultural Heritage No. 32/2009/QH12. • Decree No. 98/2010/ND-CP on amendments and supplements. • ESS8 – Cultural Heritage.	• Implementation: Contractor • Supervision: PMU, CSC, IESMC

E&S issues	Mitigation measures	Regulations of Vietnam and the World Bank	Responsibility
	- Record a preliminary description of the location and existing status of the relics. - Secure the discovery site and assign guards if necessary. - Notify the supervising engineer, the project owner, the local authorities, and the competent agencies within 24 hours. <u>Mitigation</u> - Specialized agencies shall assess the value of the discovery based on criteria such as aesthetics, historical significance, scientific value, social and economic importance. - If the relics cannot be relocated or have high value, the project owner must adjust the design to ensure preservation. - Construction may only resume after written approval is obtained from the competent authority. <u>Remediation (if any)</u> - If construction causes damage to or loss of cultural–historical relics, the Contractor shall be responsible for restoration (if possible) and compensation in accordance with the Law on Cultural Heritage.		

The Labour Code of Conduct, Labour Management Procedures (LMPs) presented below, will be applied to the entire project (6 subprojects) and will therefore be incorporated into the relevant sections of any consultancy or construction tender or contract documents.

2. Worker's Code of Conduct

Workers' Code of Conduct

The Workers' Code of Conduct shall address, but not be limited to, the following measures:

1. Compliance with laws and regulations

- All workers must comply with the laws and regulations of the Socialist Republic of Viet Nam.
- The list of workers must be registered with the local authorities in accordance with current regulations.
- Children under 18 years old are not permitted to work under the Project.

2. Civilized behavior and respect for the community

- Behave properly when interacting with the local community, respecting local customs, practices, and traditions.
- Do not cause disturbance, disorder, or engage in fighting (physical or verbal) within or near the community.
- Workers residing in temporary camps, when visiting local communities, must conduct themselves in a manner consistent with the Code of Conduct.

3. Prohibited behaviors and restricted items

- Prohibit the use or possession of illegal substances, weapons, and firearms (except for authorized security personnel).
- Prohibit pornography, gambling, and alcohol consumption during working hours.
- Prohibit hunting, fishing with explosives/chemicals, trading wildlife, or keeping animals (particularly birds).
- Prohibit cutting trees, collecting firewood, or harvesting plants beyond approved areas.
- Prohibit disturbing architectural/historical sites, burning waste, or clearing vegetation without authorization.

4. Hygiene, safety, and environmental protection

- Maintain personal hygiene and living areas to appropriate standards.
- Smoking is only permitted in designated areas.
- Do not wash clothes, clean vehicles, or maintain equipment in rivers/streams or unauthorized locations.
- Do not dispose of garbage or construction waste indiscriminately; prevent the spread of pollutants such as oil or grease.
- Toilets must be used only in designated places.
- Do not work without personal protective equipment such as boots and helmets.

5. Disciplinary measures

- Any violation of the Code shall be subject to disciplinary action, ranging from a warning to termination of the labor contract, depending on the severity of the violation.

- Any construction worker, office staff, contractor's employee, or any other person involved in the project found violating prohibitions shall be subject to disciplinary measures, which may range from a simple reprimand to dismissal, depending on the severity of the violation.

4. Labor management process (LMP)

A Labor Management Procedure (LMP) was developed as a stand-alone document for addressing the impacts on and of labor and working conditions of the project. The LMP identifies the main labor requirements and risks associated with the project and help the PMU and Contractor to determine the resources necessary to address project labor issues. The LMP will enable different project-related parties, for example, staff of the project management unit, contractors and sub-contractors and project workers, to have a clear understanding of what is required on a specific labor issue. The LMP is a living document, which is initiated early in project preparation, and is reviewed and updated throughout development and implementation of the project. The LMP has 12 chapters. Chapter 1 served as Introduction. An overview of labor use in the project is presented in Chapter 2. Key potential labor risks are listed in Chapter 3. Legislative Framework governing labor employment in Vietnam is discussed in Chapters 4 and 5. Implementation Arrangements, Age Requirement, Policies and Procedures and Timing of labor requirements follows in the subsequent chapters. Grievance Redress Mechanism and Contractor Management are presented in the last two chapters 10 and 11 respectively, while Chapter 12 relates to primary supply workers. *Details are presented in the Project's LMP.*

5.1.3.2. Mitigation measure for site-specific impacts due to the dredging process – Applied to Tam Quan, Khanh Hoa, Kien Giang and Bach Long Vi subprojects

Subprojects with dredging activities such as Tam Quan, Khanh Hoa, Kien Giang, and Bach Long Vi will generate negative impacts on aquatic life and cause deterioration of water quality due to dredging operations. To manage potential environmental and social impacts as well as health and safety risks during dredging, including material transportation, the Contractor shall comply with the following requirements:

Planning and approval

- The Contractor shall prepare a detailed Contractor's Dredged Material Management Plan (C-DMMP), based on the project's detailed design and DMMP (Annex 1). The C-DMMP must include dredged volumes; physical, biological, and chemical characteristics of dredged material; dredging methods and schedules; transportation, disposal, and pollution control processes; and risk mitigation measures at disposal sites. This plan must be approved by the Project Owner, updated as necessary, and regularly supervised by the CSC throughout implementation.
- Prepare construction schedules for each location, taking into account water levels, currents, weather conditions, community recommendations, and schedules of related packages.
- Avoid construction during floods, high tides, or adverse weather, especially when vessels need to dock for storm shelter.
- Consider cumulative risks from simultaneous dredging activities in adjacent subprojects (if any) to adjust schedules and construction methods accordingly.

Public consultation and notification

- Consult affected communities and local authorities regarding dredging activities.
- Notify dredging plans at least two weeks prior to commencement.

- Discuss with local residents regarding water intake and seed stocking periods for aquaculture, with possible adjustments to dredging schedules.
- Work with the Project Owner and CSC to maintain regular communication with communities throughout implementation.
- Establish a feedback and grievance mechanism for environmental and social issues at the local level, with clear focal points and defined resolution timelines.

Equipment and workforce

- Operators of dredging equipment must be properly trained and certified.
- Provide adequate PPE, especially life jackets for workers working over water.
- Assign supervisors for each shift to provide emergency response when needed.

Waterway traffic and safety

- Comply with approved waterway traffic control measures under the detailed design.
- Install warning signs, buoys, and signal lights on dredging equipment to ensure safety, especially at night.
- Clearly demarcate dredging corridors when moving equipment to different river sections.

Waste and incident management

- Limit dredging during high tides to reduce the spread of sediments and pollutants.
- Do not use suction dredging methods that stir up the seabed, due to associated environmental and social risks.
- Do not overload dredged materials on barges or transport vessels.
- Store oils and lubricants safely in sealed, covered containers to prevent leakage into water bodies.
- Maintain adequate spill response equipment, especially for oil containment.
- Relocate equipment to safe shelter prior to heavy rains, floods, or storms. Upon completion, remove all equipment and materials from the construction site.

Dredged material disposal site management

- Install full mitigation measures such as embankments, outlets, drainage channels, warning signs, and containment dikes before transporting sediments to disposal sites.
- Disposal sites must have a leachate collection and treatment system before discharge into the environment.
- Comply with monitoring, transportation, storage, and disposal procedures for dredged materials as specified in the C-DMMP and construction methods.
- If pipelines are used for slurry transport, warning signs must be installed along the pipeline.
- Conduct regular monitoring at disposal sites. Any leakage or overflow incidents must be promptly addressed before continuing storage.
- Maintain an operation logbook for the disposal site, recording volumes, time, and condition of dredged materials.

Disposal site incident control

- Disposal site design must take into account risks such as erosion, flooding, subsidence, and natural disasters.
- Establish an overall incident control plan for the project, covering dredging, transportation, and disposal incidents.
- Form an emergency response team of at least three members.
- Provide a hotline / accessible communication channel for communities to report incidents quickly.

5.1.3.3. Mitigation measure for site-specific impacts due to vibration to current structures by pile driving activities – Applied to Lach Hoi, Tam Quan and Kien Giang subprojects

Mitigation measure for site-specific impacts due to vibration to current structures by pile driving activities for construction of embankments and ports as following:

- Avoidance

- Conduct detailed geological surveys and Standard Penetration Test (SPT) to understand soil conditions and proximity to existing structures.
- Use vibratory or hydraulic hammers instead of diesel hammers to reduce vibration.
- Select a suitable hammer size with appropriate load capacity based on site-specific geological conditions.
- Avoid using large hammers near sensitive receptors such as homes, schools, and hospitals.
- Phase construction activities and schedule pile driving during daylight or off-peak hours to minimize impact.
- Ensure the detailed design and contractor's construction method account for risks to nearby structures.
- Secure construction insurance prior to commencement to cover potential damages to surrounding properties.

- Minimization (Mitigation)

- Drive piles in small clusters and avoid simultaneous driving of adjacent piles.
- Install fencing and warning signs around the construction site.
- Monitor vibration levels continuously and stop work if thresholds are exceeded.
- Use high-tech equipment to reduce vibration and follow approved slope construction methods.
- Conduct regular equipment inspections and provide safety training for workers.

- Remediation

- Reinforce vulnerable structures using bracing, retaining walls, or damping layers.
- Strengthen riverbanks before dredging if needed, with construction methods approved by authorities.

- Offset

- Notify affected households at least two weeks in advance and obtain their consent.

- Temporarily relocate households if property damage is likely, ensuring proper consultation and compensation.

5.1.3.4. Mitigation measures for site-specific impacts in the construction of Lach Hoi subproject

The specific impacts during the construction phase of the Lach Hoi subproject include: (i) loss of riparian vegetation cover in the port expansion area; (ii) disruption to the operation of the existing Lach Hoi fishing port; (iii) impacts on several sensitive sites. The mitigation measures for these specific impacts are presented below:

(i) Mitigation measures for impacts caused by the loss of riparian vegetation cover in the port expansion area

- Develop a vegetation clearing plan to ensure safety during the operation of the existing port.
- Limit the scope of clearing, conducting it only within the necessary construction area.
- Mark and protect clusters of trees that can be preserved.

(ii) Mitigation measures for impacts disturbing operation of the existing Lach Hoi fishing port

Upgrading the fishing port may affect the operation of the existing port. However, consultations with stakeholders indicate that the locality has experience in arranging upgrading and dredging activities simultaneously with maintaining the safe operation of fishing vessels and port facilities. The key mitigation measures include:

- *Consultation and inter-agency coordination prior to construction.* The project owner/contractor will consult with stakeholders such as the waterway police, port management board, sub-department of fisheries, and local communities to fully understand port operations and coordinate suitable construction activities.
- *Public disclosure, grievance mechanism, and risk communication.* Information on construction scope, schedule, and grievance mechanism will be posted at easily accessible points within the fishing port to ensure transparency and timely resolution of emerging environmental and social issues. Weather updates and disaster warnings will be broadcast regularly through the port's public address system to help fishermen proactively respond.
- *Access management and port security.* Control entry into the construction area, particularly where it adjoins berthing and cargo handling activities of fishing vessels. Vessels or organizations that do not comply with port regulations will not be allowed to access the construction area.
- *Phased construction and spatial separation.* Construction will be implemented in phases, with clear barriers separating construction zones from fishing port operation areas both onshore and offshore.
- *Signage and identification signals.* Install signs, flags, and lighting in movement and mooring areas so that fishermen, traders, and residents can recognize construction boundaries, especially at night.
- *Post-construction restoration.* Conduct appropriate restoration of completed areas before moving on to subsequent construction phases to minimize prolonged impacts on the environment and surrounding communities.
- *Maintenance of waterway traffic:* Coordinate with maritime authorities to provide updates on channels, buoys, and wharves to ensure safe vessel access to the port throughout the construction period.

- *Environmental incident monitoring and response.* Maintain on-duty staff, hoist warning signals in the event of storms or tropical depressions; respond immediately to accidents or environmental pollution incidents occurring within the port area.

(iii)(Mitigation measures for impacts on sensitive receptors

For areas with PCRs

- ***Avoidance***
 - Early consultation and notification: the contractor must inform local communities at least 2 weeks before commencing construction near memorial sites.
 - Awareness raising and worker training: implement compliance with the Code of Conduct (COC) for workers, with particular emphasis on appropriate behavior and language when working near spiritual or religious sites.
 - Appropriate site planning and scheduling:
 - + Do not stockpile materials, waste, or construction equipment within a 100m radius of memorial sites.
 - + Avoid construction activities on the 1st and 15th days of the lunar month and during holidays/festivals to prevent disruption of spiritual or community events.
- ***Minimization***
 - Control of dust, noise, and waste:
 - + Spray water to reduce dust during hot and dry conditions.
 - + Restrict noisy activities and construction during ceremonies or religious service hours.
 - + Minimize the volume of materials and waste temporarily stored near memorial sites.
 - Traffic management and access:
 - + Install warning signs and assign traffic controllers at the entrance to memorial sites when necessary.
 - + Provide safe access routes for people visiting the memorial.
- ***Remediation***
 - Reinstate, clear, and clean the site after construction is completed.
 - Rehabilitate landscaping if construction activities affect the surrounding environment of the memorial.

For schools along the main transportation routes

- ***Avoidance***
 - Appropriate construction scheduling: arrange construction activities outside of school hours to minimize noise, vibration, and traffic disturbance. Adjust construction and transport schedules to avoid peak school hours (7:00–8:00, 11:00–11:30, 13:00–13:30, 16:30–17:30).
 - Adjustment of construction schedule: for special school events such as examinations, opening ceremonies, or school activities, the contractor must reschedule construction and transport to avoid interference.
- ***Minimization***

- Limiting truck traffic during peak hours: reduce the number of trucks departing construction sites during times when students are arriving or leaving school.
 - Information sharing with schools: regularly update schools (e.g., Quang Tien Secondary School, Quang Tien Kindergarten) on construction progress, transport changes, and emergency response measures.
 - Driver training: organize training for drivers on traffic safety around schools, including limiting horn use, reducing speed, and exercising caution when passing school gates.
 - Traffic management and speed control: deploy personnel to guide traffic at intersections near schools during peak hours (7:00–7:30, 11:00–11:30, 13:00–13:30, 16:30–17:30), and install speed limit signs and reflective barriers along school areas.
- **Mitigation**
- Strengthened communication: promptly inform schools of emergency response measures and schedule changes.
 - Support for students and schools: in case of student health issues or traffic accidents, provide adequate medical and financial support mechanisms.
- **Compensation**
- Repairing school facilities: if construction damages school property (fences, gates, trees, etc.), the contractor is responsible for repair or compensation as agreed with the school.
 - Supporting affected students: in cases where students are injured or experience health impacts due to traffic, the contractor must provide medical and financial support.

For neighboring aquatic product processing enterprises/establishments

- **Avoidance**
- Early notification and coordination: the contractor must notify nearby facilities/enterprises at least 2 weeks before construction, allowing them time to adjust production and operations accordingly.
- **Minimization**
- Worker awareness raising: organize training sessions for workers on proper conduct, particularly to avoid disturbances or conflicts with workers at nearby processing facilities.
 - Traffic coordination and port safety:
 - + Install warning signs, directional signs, and traffic controllers within the existing fishing port to ensure safety for both construction and enterprise operations.
 - + Assign workers to clean up spilled materials daily on internal port roads to prevent obstruction of transport vehicles carrying raw materials and products.
 - + Noise and dust control: install barriers to reduce noise and dust; schedule construction activities to avoid peak production and goods-handling hours of enterprises.
- **Mitigation**
- Worker behavior monitoring: strictly supervise construction workers' behavior to prevent disturbances affecting workers of nearby enterprises/facilities.
- **Compensation**

- Support for processing enterprises: if construction disrupts production or causes damage to seafood processing facilities, the contractor must take responsibility for repair or compensation in agreement with the enterprises.

5.1.3.5. Mitigation measures for site-specific impacts in the construction of Lach Bang subproject

The specific impacts during the construction process of the Lach Bang subproject include: (i) disturbance to the operation of the existing Lach Bang fishing port; (ii) disturbance to the operation of the Duy Xuyen ferry terminal, creating risks to ferry passengers; (iii) impacts on the production and business activities of some seafood processing and fishery logistics facilities; (iv) impacts on aquaculture activities on the Bang river. The mitigation measures for these specific impacts are presented below:

(i) Mitigation measures for disturbance to the operation of the existing Lach Bang fishing port

Upgrading the fishing port may affect the operation of the existing port. However, stakeholder consultations indicate that the local community already has experience in arranging port upgrading and dredging activities while maintaining safe vessel operations and port functionality. The main mitigation measures include:

- Avoidance

- Inter-agency consultation and coordination before construction: the project owner/contractor will consult with stakeholders such as the waterway police, port management board, fisheries sub-department, and the local community to understand port operations and coordinate appropriate construction schedules.
- Information disclosure and risk communication: post information on construction scope, duration, and grievance mechanisms at easily accessible points within the port. Regularly broadcast weather information and disaster warnings through the port's loudspeaker system to help fishermen proactively respond.
- Maintaining existing port operations: do not carry out construction activities or stockpile machinery and materials in areas currently under operation.
- Construction outside of peak port activity hours: avoid periods of high vessel density (from 4:00 to 6:00).

- Minimization

- Access management and port security: control entry to construction areas, especially those adjacent to berthing and cargo loading/unloading zones of fishing vessels. Vessels

or organizations that do not comply with port regulations are not allowed access to the construction site.

- Phased construction and spatial separation: implement construction in segments, with clear fencing between construction zones and active port operations both onshore and offshore.
- Waterway traffic coordination: cooperate with maritime authorities to update information on channels, buoys, and docks to ensure safe vessel navigation in and out of the port throughout construction.
- Signage and identification signals: install signs, flags, and lighting systems in movement and berthing areas so fishermen, traders, and local people can clearly identify construction zones, especially at night.
- Environmental incident monitoring and response: establish duty shifts and warning signals in case of storms or tropical depressions; provide on-site response to accidents or environmental pollution incidents occurring within the port.

- **Restoration**

- Post-construction restoration: appropriately rehabilitate completed areas before moving on to the next construction phase, in order to minimize prolonged impacts on the environment and surrounding communities.

(ii) Mitigation measures for impacts on nearby enterprises (fuel stations, fishery logistics facilities)

- **Avoidance**

- Early notification: The contractor must notify nearby facilities/enterprises at least 2 weeks before construction so they have time to adjust operations.
- Awareness and training: Train workers on codes of conduct to avoid conflicts with local laborers.
- Phased construction: Implement construction in segments to minimize disruption to the entire port and business facilities.
- No storage of flammable materials near fuel stations to reduce fire and explosion risks.
- Construction outside peak hours to avoid obstructing production and cargo handling activities.

- **Minimization**

- Dust and noise control: Use barriers, water spraying, and standard-compliant equipment to reduce dust and noise.
- Traffic management: Install signs, assign traffic controllers, clean up spilled materials daily to avoid blocking transport of raw materials and products for processing facilities.

- **Restoration**

- Reinstate ground and access roads after construction to ensure normal operation of the facilities.

(iii) Mitigation measures for disturbances to Duy Xuyen ferry terminal operations

- **Avoidance**

- Notify the ferry terminal at least 2 weeks before starting construction.
 - Reasonable construction scheduling: Avoid in-water works during peak hours (early morning, late afternoon) when passenger volume is high.
 - Designate fixed mooring areas for machinery to avoid blocking the main ferry route.
 - Provide advance notice to the community and the ferry terminal operator regarding the construction schedule, especially when large equipment will be mobilized.
- **Minimization**
- Waterway traffic coordination:
 - + Install warning signs, signal lights, and assign guides at the intersection between the ferry route and the construction zone.
 - + Establish a safe corridor for ferries to pass through.
 - Reduce collision risks:
 - + Limit the speed of construction vessels near the ferry terminal.
 - + Deploy support boats to regulate traffic when necessary
- **Restoration**
- Clean up the water surface and clear navigation channels after construction to ensure ferry operations return to normal.

(iv) Mitigation measures for impacts on aquaculture activities on the Bang River

- **Avoidance**
- No crossing through aquaculture areas: Waterway transport routes for machinery should only access from the river mouth, avoiding sections with fish/shrimp/oyster cages (located 400–500m upstream).
 - Localized construction: Underwater works should only be carried out within the existing port area to limit wider impacts.
 - No concentration of construction machinery near aquaculture areas.
- **Minimization**
- Control oil leaks and conduct regular maintenance of waterborne equipment (barges, piling vessels, canoes).
 - Equip with oil spill response materials (booms, absorbents).
 - Construction only in favorable weather, avoiding heavy rains that could wash pollutants downstream.
 - Utilize existing revetments/embankments: Crab-claw shaped revetments help reduce waves, erosion, and pollution spread to aquaculture areas.
- **Restoration**
- Clean up and collect waste after construction, ensuring no residual materials or oil remain on the water surface.

5.1.3.6. Mitigation measures for site-specific impacts in the construction

of Tam Quan subproject

Apart from the specific impacts related to dredging activities as mentioned in Section 1.1.3.2, the specific impacts during the construction process of the Tam Quan subproject include: (i) disturbance to the operation of the existing Tam Quan fishing port; (ii) impacts on waterway traffic on the Tam Quan River within the project area; (iii) impacts on sensitive receptors; (iv) impacts on aquaculture activities within the project area; (v) risks of embankment erosion due to extreme weather. The mitigation measures for these specific impacts are outlined below:

(i) Mitigation measures for disturbance to the operation of the existing Tam Quan fishing port

Upgrading fishing ports may affect the operation of existing fishing ports. However, consultation with stakeholders indicated that the local authorities already have experience in arranging port upgrading and dredging activities while maintaining safe vessel operation and port functions. The main mitigation measures include:

- Avoidance

- Inter-agency consultation before construction: Coordinate with the waterway police, port management board, fisheries sub-department, and local community to clearly understand port operations and coordinate construction accordingly.
- Information disclosure and risk communication: Post construction information, schedule, and grievance mechanism; broadcast weather updates via the public loudspeaker system.
- Maintain existing port operations: Do not carry out construction or stockpile machinery and materials in active operation areas.
- Construction outside peak hours: Avoid periods with high vessel density (1:00–4:00 a.m. and 6:00–9:00 a.m.).

- Minimization

- Port access and security management: Control entry to the construction area, especially areas adjacent to vessel berthing and unloading activities. Prohibit access by vessels or organizations that do not comply with port regulations.
- Phased construction and spatial separation: Carry out construction in segments, with clear fencing separating construction zones from active port areas.
- Waterway traffic coordination: Coordinate with maritime authorities to provide updates on channels, buoys, and berths to ensure safe vessel movements during construction.
- Signage and identification signals: Install warning signs, flags, and lighting in movement and berthing areas to alert fishermen, traders, and local people of the construction zone, especially at night.
- Monitoring and emergency response: Organize on-duty shifts and hoist warning signals during storms or tropical depressions; promptly handle on-site accidents or environmental incidents if they occur in the port area.

- Restoration

- Post-construction restoration: Clean up and reinstate completed areas before moving to the next construction phase.

(ii) Mitigation measures to impacts on waterway traffic on the Tam Quan River

- Avoidance

- Consultation and preparation of safety and emergency response plans before construction:
 - + Develop a maritime and inland waterway safety plan and submit it to the competent authorities for approval.
 - + Coordinate in advance with local healthcare facilities to ensure readiness to respond in case of incidents.
 - + Establish an early warning system: Connect with the meteorological station and local authorities to update weather conditions and proactively adjust construction during storms, squalls, or rough seas.
 - + Fully equip rescue devices: lifeboats, lifebuoys, signal lights, communication and first-aid equipment on all construction vessels.
 - + Assign clear responsibilities and conduct regular training for workers on emergency response procedures for waterway traffic incidents.
- Publicly announce construction information and safety warnings through mass media.
- Construction outside peak hours: Avoid construction during periods of high vessel density (1:00–4:00 a.m. and 6:00–9:00 a.m.).
- No construction under adverse weather conditions: Suspend construction during thunderstorms, squalls, fog, or rough seas to ensure safety.

- Minimization

- Strict compliance with regulations on construction vessels and inland waterway traffic:
 - + Vessels must be registered, have license plates, and valid operation permits in accordance with regulations.
 - + Operators must hold the legally required navigation certificates.
- Install a warning system and delimit the construction area:
 - + Provide buoys, signal lights, and warning signs at construction, dredging, and navigation channel areas.
 - + Construction vessels must operate strictly within the area demarcated by buoys. Absolutely no movement beyond the designated waters to avoid collisions and obstruction of waterway traffic.
 - + Do not place equipment or materials outside the project boundary or in areas at risk of obstructing waterway traffic.
 - + Apply a phased construction approach: Reduce the river surface area occupied at each stage
- Equip safety and communication devices:
 - + Fully equip signal lights, lifeboats, lifebuoys, and fire-fighting equipment.
 - + Use and periodically inspect VHF communication devices operating 24/24 on channel 9.
- Compliance with construction and safety plans:
 - + Regularly check communication devices to ensure uninterrupted operation.

- + Assign traffic sentries throughout the construction process.
- + Relocate construction vessels and machinery to safe positions during adverse weather conditions or storms.
- **Restoration**
 - Clean up and reinstate the site: After each construction phase, dismantle equipment and clear the channel.
 - Update the signaling system: Reinstall buoys and warning signs to ensure safe waterway traffic after construction.

(iii) Mitigation measures to the impact of sensitive receptors

For PCR areas (An Loc Temple):

- **Avoidance**
 - Consultation and early notification: the contractor needs to notify the residential community of Cong Thanh village and Tam Quan Bac ward at least 2 weeks before construction in the area near An Loc Temple.
 - Propagation and training of workers: Enforce compliance with the Code of Conduct (COC) with employees, with a special emphasis on appropriate behavior and language when working near areas of faith
 - Reasonable space and construction time:
 - + Do not gather materials, waste or construction equipment within a radius of 100m around the temple
 - + Avoid construction on Full Moon Day, First Day, and New Year's holidays so as not to disrupt spiritual or community activities
- **Mitigation**
 - Dust, noise and waste control:
 - + Spray water to reduce dust in hot and dry conditions.
 - + Limit loud noise activities and construction activities on holidays and religious hours
 - + Minimize the volume of materials and waste temporarily stored near the temple.
 - Organize traffic and access:
 - + Install warning signs, arrange navigators at the entrance of the temple when necessary
 - + Provide a safe passage for people to reach the temple.
- **Restoration**
 - Reinstate, clean and sanitize the site after completing the construction work
 - Create a landscape if it affects the space around the Temple.

(iv) Mitigation measures to impacts on aquaculture activities in the Tam Quan sub-project area

Mitigation measures for temporary impacts on aquaculture households are as follows:

- **Avoidance**
 - Early notification and public consultation: The project owner, in coordination with the local authorities, shall notify the construction plan at least two weeks in advance and discuss with local people regarding water intake and seed stocking times, avoiding

overlap with peak construction periods.

- Limit water intake from the construction area: Aquaculture households shall take water from the upper reaches of the Tam Quan River or the Dai Ong Khéo River, far from the construction site.

- *Minimization*

- Phased construction in small sections (100–200m): Reduce the affected area and allow the aquatic environment to recover between phases.
- Use construction equipment with suitable capacity and volume to minimize disturbance to the riverbed while still ensuring construction progress.
- Install buoys to demarcate the construction area: Mark the construction zone to warn of potential pollution risks and ensure waterway traffic safety.
- Use silt curtains in dredging areas near water intake points: Enclose the construction zone with silt curtains to limit the spread of turbidity and pollutants, helping to protect aquatic organisms and maintain water quality for aquaculture.
- Construct protective barriers around water intake areas for ponds: Install temporary silt curtains around aquaculture areas to prevent silt and pollutants from entering intake points, thereby reducing impacts on input water quality.
- Adjust aquaculture seasons: Agree with local people on water intake and seed stocking times to avoid peak construction periods.
- Monitor water quality: Track turbidity, TSS, and other water quality parameters at water intake points for aquaculture, applying appropriate measurement methods when necessary.
- Utilize existing water treatment processes of aquaculture households: Ponds that use filtration, sedimentation, disinfection, and water quality testing systems before water intake help reduce risks from raw water sources.

- *Restoration*

- Restore water flow after construction: Clean up and dismantle equipment to ensure stable water flow after each dredging phase.
- Post-construction monitoring: Monitor water quality at aquaculture water intake points to ensure no prolonged impacts remain.

- *Compensation*

- Provide compensation for damages if any: In cases where impacts cannot be avoided, the project will compensate households for income losses caused by aquaculture disruptions.
- Participate in livelihood restoration programs: Severely affected households will be supported through livelihood recovery programs under the project's Resettlement Plan.

(v) Mitigation measures for embankment erosion risks due to extreme weather

- *Avoidance*

- Construction planning and preparation:
 - + Develop construction schedules and methods suitable to hydrological, weather, river flow, and flood conditions at different times of the year.
 - + Prepare flexible construction plans that can be adjusted in response to forecasts of extreme weather such as storms, floods, or prolonged heavy rains.

- + Establish emergency response plans for severe storms or abnormal tidal surges.
- + Work with the project owner and supervision consultant to maintain regular communication with local authorities and communities during construction planning and implementation.
- Avoid construction during the storm season (September–December) to minimize risks from heavy rains, tidal surges, and storms.
- Suspend construction during storm forecasts or extreme weather and immediately deploy protective measures for the site.
- Apply phased construction methods, ensuring completion of each section (bottom, body, slope, crest of the embankment) before moving to the next, avoiding unfinished structures being exposed to adverse weather.
- **Minimization**
 - The contractor shall carefully review the technical design to ensure that: (i) detailed designs incorporate comprehensive geological and hydrological surveys of the area; (ii) embankment designs include drainage pipes through the structure to discharge rainwater and reduce groundwater pressure behind the embankment during prolonged rainfall.
 - Construction must strictly follow the approved design, particularly parameters on slope gradient, drainage structures, and materials used.
 - Minimize disturbance to the riverbed and ground surface to avoid undermining foundation stability
 - Install warning signs at hazardous locations such as strong currents, high erosion risks, or deep excavation zones.
 - Implement closed and synchronized construction of embankment components to ensure structural stability and waterproofing.
 - Strengthen on-site supervision and risk response: detect early signs of erosion for timely intervention.
 - Increase monitoring during the rainy season, particularly at unfinished embankment sections.
 - Regularly inspect the site to identify early signs of cracking or erosion and promptly plan reinforcement.
 - Maintain frequent coordination with local authorities and communities to ensure two-way communication throughout the construction process.
- **Restoration**
 - Carry out reinforcement at points showing minor erosion after storms or floods to ensure long-term durability of the embankment.
- **Compensation**
 - In cases where construction causes erosion affecting residential houses, the contractor is responsible for compensating damages or reinstating the site to its original condition.

5.1.3.7. Mitigation measures for site-specific impacts in the construction of Khanh Hoa subproject

In addition to the specific impacts related to dredging activities as described in Section 1.1.3.2, the specific impacts during the construction phase of the Da Bac subproject include: (i) Disruption to the operation of Da Bac fishing port; (ii) Safety risks and disruption to inland

waterway traffic; (iii) Impacts on aquaculture activities within the project area; (iv) Impacts on sensitive receptors. Mitigation measures for these specific impacts are presented below:

(i) Mitigation measures for disruption to the operation of Da Bac fishing port

Upgrading fishing ports may affect the operation of existing ports. However, consultations with stakeholders indicate that the local community already has experience in arranging port upgrading and dredging activities while maintaining safe vessel operations and port management. Key mitigation measures include:

- Avoidance

- Inter-agency consultation prior to construction: Coordination with waterway police, port management board, fisheries division, and local communities to understand port operations and plan construction accordingly.
- Information disclosure and risk communication: Posting construction information, timelines, and grievance mechanisms; broadcasting weather updates via loudspeakers.
- Construction outside peak hours: Avoiding hours with high vessel density (1–4 am and 6–9 am) to prevent waterway traffic conflicts.
- Suspension of dredging during storms or rough seas to ensure safety for vessels seeking shelter in Cam Ranh Bay.
- Phased construction by component: Building new berths (pier-type berths, community fishing berths) first, followed by the renovation of existing berths (shore-connected berths, logistics service berths) to avoid full interruption of port operations.

- Minimization

- Access and port security management: Controlling access to construction zones, especially areas adjacent to berthing and cargo handling operations. Prohibiting non-compliant vessels or organizations from entering construction zones.
- Phased construction and spatial separation: Constructing in sections with clear barriers between construction areas and active port operations.
- Waterway traffic coordination: Collaborating with maritime authorities to provide updates on navigation channels, buoys, and berths to ensure safe vessel movements during construction.
- Signage and signaling: Installing signs, flags, and lighting in construction and mooring areas for clear identification, especially at night.
- Proper placement of materials and equipment to avoid obstructing internal port roads and logistics facilities.
- Secure mooring of floating construction equipment (barges, floating cranes, pile-driving vessels) at locations that do not block main navigation routes.
- Sequential dredging in small sections (phased construction) along channels, turning basins, and berthing areas to limit large-scale impacts.
- Environmental incident monitoring and response: Establishing on-site duty teams, raising warning signals during storms or tropical depressions, and implementing immediate response to accidents or pollution incidents within the port area.

- Restoration

- Cleaning and reinstating completed areas before moving to the next phase.

- Reinstating internal roads, drainage systems, and yards affected during construction.

(ii) Mitigation measures for impacts on inland waterway traffic in Cam Ranh Bay

- Avoidance

Consultation and preparation of safety and emergency response plans for waterway traffic incidents prior to construction:

- Developing a maritime and inland waterway safety plan and obtaining approval from competent authorities.
- Coordinating with local medical facilities to be prepared for emergencies.
- Establishing early warning and emergency response systems: Connecting with meteorological stations and local authorities for weather updates and adjusting construction accordingly during storms, squalls, or rough seas.
- Equipping full rescue facilities: lifeboats, life jackets, signal lights, communication and first-aid devices on construction vessels.
- Clear assignment of responsibilities and regular training for workers on waterway traffic emergency response procedures.
- Public disclosure of construction information and safety warnings via mass media.
- Construction outside peak hours: Avoiding high vessel density times (1–4 am and 6–9 am).
- No construction under adverse weather: suspending activities during thunderstorms, squalls, fog, or rough seas to ensure safety.

- Minimization

- Compliance with regulations on construction vessels and waterway traffic:
 - + Vessels registered, marked, and licensed according to regulations.
 - + Operators holding proper navigation certificates.
- Installation of warning systems and delineation of construction areas:
 - + Providing buoys, signal lights, and warning signs at construction and dredging sites and navigation channels.
 - + Restricting construction vessel operations within buoy-marked areas. Absolutely no movement outside designated zones to prevent collisions and obstructions.
 - + No placement of equipment or materials outside project boundaries or in areas with traffic risks.
 - + Sequential construction in sections to minimize occupation of water surface at any given time.
- Provision of safety and communication equipment:
 - + Equipping vessels with signal lights, lifeboats, life jackets, and fire-fighting devices.
 - + Using and regularly inspecting 24/7 VHF radios on channel 9.
- Compliance with construction and safety plans:
 - + Regular inspection of communication equipment for uninterrupted operation.
 - + Assigning traffic guards during construction.

- + Relocating construction machinery and vessels to safe zones under adverse weather conditions.

- **Restoration**

- Cleaning and reinstating the site: Dismantling equipment and clearing channels after each construction stage.
- Updating navigation aids: Reinstalling buoys and signs to ensure safe waterway traffic after construction.

(iii) Mitigation measures for impacts on aquaculture activities in Cam Ranh Bay

Temporary mitigation measures for aquaculture households include:

- **Avoidance**

- No construction in aquaculture zones: Navigation channels, turning basins, and berthing areas will be located at least 300 m away from aquaculture cages/rafts (lobster, fish).
- Construction outside water intake periods of farmers: Scheduling construction to avoid times when farmers draw seawater into cages/rafts.
- Consultation and agreement with farmers on water intake and stocking schedules to avoid overlap with peak construction activities that may affect water quality
- Early notification of construction plans to local communities to allow adjustments in aquaculture activities.

- **Minimization:**

- Sequential construction in small sections to limit suspended solids (TSS) dispersion.
- Using standard construction equipment to prevent oil leakage and pollutant release.
- Regular monitoring of water quality during construction, focusing on TSS, $\text{NH}_4^+\text{-N}$, and DO levels.
- Using buoys to mark construction zones and prevent collisions between construction vessels and aquaculture cages/rafts.
- Minimizing simultaneous operation of dredging equipment to reduce seabed disturbance and pollutant spread.
- Applying national technical regulation QCVN 02-19:2014/BNNPTNT on veterinary hygiene, environmental protection, and food safety for brackish-water shrimp farming.
- Close coordination among PMU, contractors, authorities, and communities to balance dredging requirements and livelihood protection.

- **Restoration**

- Cleaning up debris and waste after each construction phase to prevent residual water pollution.
- Reinstating water quality in construction zones by monitoring and adjusting construction schedules if prolonged water degradation is detected.

- **Compensation**

- In unavoidable impact cases, the project will provide compensation for households losing income due to disrupted aquaculture operations.
- Severely affected households will be supported with livelihood restoration programs developed based on preliminary surveys during project preparation (details in the Resettlement Plan).

(iv) Mitigation measures for impacts on sensitive receptor

For PCRs located along main transport routes (Nguyen Trai St., 30/4 St., Nguyen Trong Ky St.) of the subproject, including Nam Hai Da Bac Mausoleum (~50 m), Tu Van Pagoda (~80 m), and Ba Ngoi Parish (~60 m):

- Avoidance

- Advance notice of construction: Informing local residents, particularly around pagodas and churches, at least 2 weeks before construction to allow preparation and adjustment.
- Protecting pedestrian access: Ensuring safe and convenient access routes for local people to pagodas/churches.

- Minimization

- Traffic warning and guidance: Installing warning signs and assigning traffic guides at entrances to pagodas/churches to ensure safety and prevent congestion.
- Noise and waste minimization: Reducing waste and spilled materials on transport routes, and limiting noise during religious events (1st and 15th lunar days for pagodas/mausoleums, weekends and other holidays for churches).

- Mitigation

- Water spraying on main transport routes: Spraying water, especially on hot and dry days, to reduce dust and improve environmental conditions around pagodas/churches.
- Minimizing nuisance behavior: Strict enforcement of codes of conduct for workers on language and behavior, particularly near pagodas/churches, to maintain sacred and peaceful environments.

- Compensation

- If any damage occurs to religious facilities, structures, or local living environments due to construction, full compensation will be provided in accordance with the law to protect the rights of affected residents and communities

For schools along main transport routes (Cam Linh Primary School, Tran Hung Dao High School, Nguyen Trong Ky Secondary School):

- Avoidance

- Proper scheduling of construction: Carrying out works before or after school hours to avoid noise, vibration, and traffic disruption.
- Traffic guidance: Deploying staff during peak hours (7:00–7:30; 11:00–11:30; 13:00–13:30; 16:30–17:30) during peak construction periods to prevent congestion and minimize disruption.

- Minimization

- Reducing truck traffic during peak hours: Limiting trucks leaving construction sites during peak hours to prevent congestion and protect students and teachers.
- Warning signs and speed limits: Installing traffic warning signs, speed restrictions, and reflective barriers along school routes to ensure student and community safety.

- Mitigation

- Water spraying within 100 m of schools: Spraying water at least 3 times daily on hot and dry days to reduce dust and improve environmental quality for students and surrounding communities.

- Compensation

- If any damage or excessive disruption to school facilities or learning activities occurs, full compensation must be provided in accordance with regulations.

5.1.3.8. Mitigation measures for site-specific impacts in construction of Kien Giang subproject

In addition to the specific impacts related to dredging activities as mentioned in Section 1.1.3.2, the specific impacts during the construction phase of the Kien Giang subproject include: (i) Impacts on sensitive receptors. The mitigation measures for these specific impacts are presented below:

(i) Mitigation measures for impacts on sensitive receptors: PCRs (Nga Bat Shrine, Ong Bon Shrine)

- Avoidance:

- Notify the shrine areas at least 2 weeks before the start of construction to allow the community sufficient time to prepare and adjust religious activities.
- Avoid carrying out construction works on days when religious events take place, particularly on the 1st and 15th days of the lunar month, as well as during festivals, if any, to prevent disruption of rituals.

- Minimization:

- Signage and speed limits: Install warning signs and speed limit signs for trucks traveling near shrine areas, and ensure sufficient lighting at night to protect the safety of local people and road users.

- Mitigation:

- Dust control: Spray water on the construction site at least three times per day during dry and windy days to prevent dust, especially around shrine areas, in order to improve air quality and maintain a clean environment for the community.
- Cleaning and site restoration after construction: Upon completion of construction, carry out cleaning and restoration of the site, ensuring no leftover materials, waste, or traces of construction remain.

- Compensation:

- Compensation for damages (if any): If damage or impacts occur to the shrines or religious activities during construction, compensation must be provided fully and in accordance with regulations to protect the rights of the community and religious organizations.

5.1.3.9. Mitigation measures for the site-specific impacts during construction of Bach Long Vi subproject

In addition to the specific impacts related to dredging activities as mentioned in Section 1.1.3.2, the specific impacts during the construction phase of the Bach Long Vi subproject include: (i) Disruption of existing activities at Bach Long Vi Port; (ii) Safety risks for vessels and fishermen when entering and leaving the Bach Long Vi Port area; (iii) Risks of pollution and waterway traffic safety during transportation of materials from the mainland; (iv) Impacts on the marine environment and ecosystem due to the potential spread of pollutants generated from dredging activities; (v) Environmental pollution risks at the disposal site No. 01; (vi) Impacts on sensitive receptors.

(i) Mitigation measures to the disturbance of existing activities at Bach Long Vi Port

During the upgrading of the port and the dredging of the locks, fairways and turnaround areas, the existing activities of the port are still maintained. Therefore, in order to limit and minimize disturbances and affect existing activities, some of the main measures applied include:

- Avoidance

- Early consultation and notification:
 - + Consult stakeholders (MPA Management Board, Port Authority, Commune People's Committee, local residents) prior to construction.
 - + Notify the construction schedule and waterway traffic arrangements to port operators and fishermen at least two weeks before construction.
 - + Publicly disclose project information, contractor details, and grievance redress mechanisms at the port area.
- Maintain existing port operations: Keep the existing 75m-long berth operational to ensure vessel access during construction.
- Implement dredging sequentially in sections (navigational channel, turning area, anchorage), avoid simultaneous large-scale dredging to maintain vessel movements.
- Suspend construction during rough seas or adverse weather (storms, thunderstorms, etc.) to avoid obstructing vessels seeking shelter.
- Arrange vessel traffic routing into and out of the basin to avoid construction zones and prevent disruption of port operations.

- Minimization

- Construction equipment shall only operate at dredging sites, without moving freely within the basin, minimizing water surface occupation.
- Install a warning and guidance system around construction areas: buoys, signs, signal lights, and guides to direct vessels away from construction zones.
- Minimize the number of active equipment simultaneously to reduce disruption of port traffic
- Onshore works (new berth, breakwater, mooring posts, buoys) must follow a reasonable schedule to avoid disrupting passenger and cargo operations.
- Designate separate mooring areas for construction equipment to avoid occupying berths for local vessels.
- Arrange temporary mooring locations for vessels inside and outside the basin on calm days when construction takes place near the port entrance.
- Closely supervise construction activities to ensure compliance with mitigation measures and schedule, minimizing disruption to port operations.

- Restoration

- Clean up and remove equipment after each construction stage, clearing the navigational channel and turning area.
- Update maritime signaling systems and safety signs to ensure safe navigation after construction.

(ii) Mitigation measures for safety risks to vessels and fishermen at Bach Long Vi Port

- Avoidance

- Conduct construction sequentially, avoiding simultaneous works at the port entrance to maintain the main navigation route
 - Suspend construction during rough seas or storms, ensuring vessels can safely enter for shelter. Construction equipment must be dismantled and relocated to safe shelter areas without obstructing vessel access.
 - Arrange vessel traffic routing into and out of the basin to avoid construction areas, preventing waterway traffic conflicts.
 - Designate temporary mooring points outside the basin during dredging at the port entrance, preventing vessels from mooring near the breakwater under rough sea conditions.
 - Provide early notification to vessel owners and fishermen regarding construction schedules, particularly at the port entrance, to allow for voyage adjustments.
 - *Emergency Preparedness*
 - + Develop emergency response plans for waterway incidents, including collisions, capsizing, or vessel malfunction, plans for evacuation, rescue, and asset protection.
 - + Prepare emergency materials and equipment: oil containment booms, absorbent materials, lifeboats, first aid kits, and emergency communication devices.
 - + Establish an emergency response team including Port Authority, local authorities, and Bach Long Vi Marine Protected Area representatives. Members must be trained every 6 months on emergency response and firefighting.
 - + Conduct regular training for workers, supervisors, and support forces on evacuation, rescue, and water incident response procedures.
 - + Coordinate with authorities and local government to ensure rapid response, particularly for oil spills or serious maritime accidents.
 - + Establish emergency contact points on-site and at the Port Authority office for timely incident reporting and management
 - Equip all construction vessels with full safety devices: lifeboats, life buoys, fire-fighting equipment, and VHF communication operating 24/7. Regularly inspect incoming/outgoing vessels to ensure safety compliance.
 - Regularly disseminate waterway safety regulations and safe navigation guidance to fishermen and vessel owners.
- **Minimization**
- Install a waterway traffic signage and guidance system:
 - + Directional signs for vessel movement, berthing areas, mooring zones, and speed limits within the basin.
 - + Display construction zone maps at the port.
 - + Provide lighting, signal flags, and warning buoys at construction areas and navigation channels.
 - Clearly separate construction zones:
 - + Onshore works fenced to avoid affecting port operations.
 - + Underwater works cordoned off with ropes and floating buoys.
 - Deploy guides and patrol boats to direct vessel traffic and monitor construction

equipment operations.

- Limit the number of active equipment simultaneously, particularly at the port entrance, to reduce disruption and collision risks.

- Restoration

- Clean up and remove equipment after each construction stage, especially at the port entrance, to clear channels and ensure vessel safety.
- Update maritime signaling systems to ensure vessels can clearly identify navigation routes post-construction.

(iii) Mitigation measures for risks of pollution and waterway traffic safety during transportation of materials from the mainland

Transportation of construction materials from mainland through Dinh Vu Por to Bach Long Vi Island involves a limited number of trips but may still pose pollution and safety risks if safety measures are not strictly followed. The project will apply the following measures:

- Avoidance

- Develop a marine transport route from the mainland port to the island, approved by the maritime transport authority of Hai Phong.
- Regularly monitor weather conditions and transport only in favorable conditions, avoiding days with storms, high waves, poor visibility, or rough seas.
- Notify the Bach Long Vi Port Authority before transportation so that port operations can be arranged.

- Minimization

- Transport vessels must be certified and licensed for maritime safety.
- Cargo loads must comply with vessel capacity limits; overloading is strictly prohibited.
- Captains and crew must have seafaring experience; captains must hold appropriate licenses and experience on the Hai Phong – Bach Long Vi route.
- All transported materials must be securely covered to prevent dispersion into the marine environment.
- Vessels must be equipped with full safety devices: navigation systems, 24/7 VHF communication, emergency response equipment, lifeboats, life buoys, and fire-fighting devices.
- Captains and crew must strictly comply with maritime safety regulations, including speed, safe distances, maritime signals, and communication.
- Emergency Preparedness:
 - + Develop response plans for incidents such as collisions, engine failures, capsizing, or oil spills.
 - + Prepare emergency equipment: containment booms, absorbent materials, first aid kits, and emergency communication devices.
 - + Conduct regular training for crew on rescue, evacuation, and emergency response procedures.
 - + Coordinate with Border Guards, Fisheries Surveillance, Coast Guard, Inland Waterway Authority, and Port Authority for timely incident response.

- + Establish emergency communication channels between transport vessels, project owner, contractor, and authorities.

- Restoration

- In case of oil spills or accidents, immediately implement containment, collection, and treatment measures in accordance with regulations.
- Report and evaluate incidents, draw lessons, and adjust transport procedures for future trips.

(iv) Mitigation measures for dredging impacts on the marine environment and ecosystem

To prevent impacts from dredging on the marine environment and ecosystem, in addition to full compliance with measures described in Section 1.1.3.2 of Chapter 5, the project must also implement specific measures to prevent vessel collisions within the port and between vessels and construction equipment, which could increase risks of sinking, oil leakage, and other impacts on the marine ecosystem:

- Avoidance

- Dredging must be conducted sequentially in small areas inside the port. Surround dredging sites with soft barriers using buoys and warning signs.
- Suspend dredging at night, during rough seas, high tides, or adverse weather to allow vessels to safely shelter while minimizing pollutant dispersion outside the MPA.
 - + During suspension, dredgers (grab dredgers, barges, etc.) must be relocated to designated shoreline areas with warning signs and night lighting.
 - + Conduct monitoring of seawater quality, dredged materials, and biological indicators in and outside the port to track aquatic life development and design appropriate preventive measures.
 - + Plan transport routes and disposal sites appropriately, located on the southern side of the island, away from the strictly protected zones of the Marine Protected Area.

- Minimization

- Use appropriate dredging equipment to avoid excessive rock fragmentation and bottom sediment disturbance.
- Immediately load dredged materials onto barges after lifting, avoiding long storage in the basin
- Do not overload barges or transport vessels, ensuring safety and avoiding spillage.
- Do not store oil/lubricants on barges or dredging equipment; oil-contaminated materials must be collected and handled by licensed entities.
- Dredging operators must be trained and certified, under supervision of the Construction Supervision Consultant (CSC).
- Provide full PPE to workers, especially life jackets for water-based activities; assign supervisors per shift for emergency response.
- *Emergency Preparedness Plan:*
 - + Develop emergency response plans for vessel collisions, engine failures, capsizing, or oil spills, approved by authorities.
 - + Suspend dredging and move equipment to designated shoreline safety zones during adverse weather; such zones must have warning signs and night lighting.

- + Conduct regular crew training on rescue, evacuation, and incident response.
- + Coordinate with Border Guards, Fisheries Surveillance, Coast Guard, Inland Waterway Authority, and Port Authority for timely incident response.
- + Establish emergency communication channels between transport vessels, project owner, contractor, and authorities.

- Restoration

- Collect and clean up spilled materials and waste after each construction stage, avoiding long-term impacts on water quality.
- Restore water and seabed quality by adjusting construction schedules if signs of prolonged degradation appear.
- Submit periodic environmental monitoring reports to authorities and the Marine Protected Area Management Board.

(v) Mitigation measures for environmental risks at dredged material disposal site No. 01

The Bach Long Vi subproject plans 03 disposal sites with a total capacity of about 65,000 m³. Site No. 01 is located outside the sea dike on the eastern side of the island, within the development zone. The area has bedrock, no vegetation cover, a lower elevation than the dike road (by 1.2–1.5 m), and is about 50 m away from the Marine Protected Area's restoration zone. It has low conservation value, already zoned as commercial service land in the island reclamation plan, and has been licensed by the MAE and approved by Hai Phong City People's Committee. To control and minimize potential environmental risks during disposal at Site No. 01, particularly risks of material washout into the sea during high tides or adverse weather, the following measures must be applied:

- Prioritize the use of Sites No. 02 and 03 first; Site No. 01 shall only be used once the other sites are filled.
- At Site No. 01, disposal shall only cover 80% of the area not subject to tidal inundation; the remaining 0.8 ha at risk of flooding shall only be used when necessary and with strict controls.
- Construct strong rock gabion retaining walls around Sites No. 1 and 2 to prevent tidal intrusion and material dispersion into intertidal zones, especially near the Marine Protected Area's restoration zone.
- Retaining walls must be completed before disposal begins and inspected regularly during construction. Wall height must be at least equal to disposal elevation (1.5m), ensuring overflow prevention, erosion control, and stability of dredged materials.
- No disposal during high tides or rough seas to avoid washout into the marine environment.
- Conduct regular monitoring at the disposal site to ensure no material washout.
- Conduct periodic monitoring of seawater and dredged material quality, particularly near the Marine Protected Area's restoration zone. If environmental parameters exceed thresholds, disposal methods must be adjusted immediately.
- Strictly comply with the approved Dredged Material Management Plan (DMMP), including provisions on transportation, storage, pollution control, and site safety.



Form. The retaining wall made of supported gabion boxes

(vi) Mitigation Measures for Impacts on Sensitive Receptors

The project construction area and the transportation route for materials from the project site to the disposal sites pass through several sensitive receptors, including Tran Hung Dao Temple and the Whale Shrine (about 50m from the subproject site); the beach (about 120m from the subproject site); Bach Long Pagoda (located along the transportation route to Disposal Site No. 02); and the tidal flat (about 500m from the fishing port and about 20m from Disposal Site No. 1). To minimize impacts on these sensitive receptors, the following measures shall be applied:

For PCRs (Physical Cultural Resources):

- *Consultation and early notification:* The project owner/contractor shall notify the management boards of the temples, shrines, pagodas, and the local community at least two weeks before construction begins.
 - + Awareness and worker training: Enforce compliance with the Code of Conduct (COC) among workers, with special emphasis on appropriate behavior and language when working near these areas.
 - + Warning signs and speed limits: Install warning signs and speed limits for trucks traveling near temples, pagodas, and shrines, ensuring adequate lighting at night.
- *Proper arrangement of construction space and time:*
 - + Do not stockpile materials, waste, or equipment within 100m of Tran Hung Dao Temple or the Whale Shrine.
 - + Avoid or minimize material transport during religious events, especially on the 1st and 15th days of the lunar month and on festival days, if any.
- *Traffic management and access:*
 - + Provide safe and convenient access for local people visiting memorial sites during construction.

- + Arrange signage and traffic coordinators at the entrance to the memorial areas to ensure safety and proper guidance.
- *Control of dust, noise, and waste:*
 - + Regularly spray water within 100m of temples, pagodas, and shrines during dry or hot days.
 - + Limit activities that generate excessive noise, especially during sensitive times such as holidays or religious ceremonies.
- *Site restoration and cleaning after construction:*
 - + After construction, restore, clean, and return the site to its original state, ensuring the sanctity of the area.
 - + Assign workers to sweep regularly during material transport; spilled materials must be cleaned up immediately.
 - + Plant additional trees or improve landscaping if the surrounding environment of temples, pagodas, or shrines is affected.

For the tidal flat and beach:

- *Early notification and coordination:* The contractor shall notify the Bach Long Vi Marine Protected Area Management Board, local authorities, and communities at least two weeks before the port upgrading works commence.
- *Awareness and worker training:* Provide training to workers on the COC, especially regarding proper conduct to avoid disturbances or conflicts with local residents and tourists at the beach.
- *Control of noise, dust, and working hours:* Install barriers against noise and dust; schedule construction activities reasonably to avoid peak hours when many people use the beach.
- *Control of water quality and waste materials at disposal sites:* Strictly monitor water quality and manage dredged materials at Disposal Sites No. 1 and 2 to prevent waste materials from being washed away into surrounding areas, which could negatively impact the tidal flat environment and the ecosystem of the Bach Long Vi MPA

5.1.4. Mitigation measures during the operation phase

5.1.4.1. Mitigation measure for generic operational impacts – applicable to 6 subprojects when operating fishing ports/storm shelter anchorages

The general impacts during the operation phase of the 06 subprojects include: dust and air emissions; noise, wastewater, solid waste, environmental risks and incidents; traffic impacts and risks (both waterway and roadway); degradation of surface water quality; and impacts on aquatic life. The mitigation measures for these impacts are presented below:

a) Dust and Air Emission Mitigation Measures

Control of dust and air emissions from vessels, trucks, and other vehicles transporting and handling aquatic products:

- Avoidance

- Design parking lots and access roads to be wide and well-organized to avoid traffic congestion during peak hours.

- Install clear traffic instructions and regulations at the port, requiring drivers to disembark, switch off engines, and park only in designated areas.
- Vessels must travel at regulated speeds and dock properly to avoid disorder and negative impacts on water quality.

- Minimization

- Fully pave all internal roads and arrange regular cleaning staff to minimize dust generation.
- Sweep and spray roads twice daily to control dust within the port area.
- All vehicles must comply with speed, traffic safety, and environmental sanitation regulations to reduce emissions and prevent congestion or disorder.
- Vessels and vehicles must comply with national technical standards on exhaust emissions (NO_x, SO_x, etc.).
- Encourage the use of low-sulfur fuels, alternative fuels, or less-polluting fuel blends.
- Conduct regular maintenance of vessels and vehicles to ensure operational efficiency and emission reduction.
- Minimize engine idling during loading/unloading operations.
- Reduce VOC emissions from fuel storage and transport activities by using suitable equipment.
- Install sprinkler systems in grass areas and gardens for irrigation, maintaining humidity and improving the local microclimate.

In addition, there are additional management measures for the 06 subprojects during operation:

- Ensure green space accounts for approximately 20% of the subproject area.
- Install sprinkler systems in green spaces to maintain humidity and improve the microclimate.

Control of Odors in Aquatic Product Collection and Sorting Areas

- Avoidance

- Design and locate new facilities rationally to minimize the distance between transport vehicles and storage areas.
- Unload aquatic products promptly upon arrival at the port to avoid prolonged storage and odor emissions from decomposition.
- Use sealed containers or specialized covered vehicles for transporting aquatic products and waste to prevent odor dispersion.

- Minimization

- Clean seafood sorting houses regularly (1–2 times/day) to reduce odors from organic compounds and animal fats/oils.
- Wash sorting houses and reception areas with high-pressure cleaning systems to limit fishy odors.
- Ensure frequent ventilation of sorting houses and cold storage facilities to reduce odor accumulation.

- Install air extraction and odor filtration systems in sorting, preliminary processing, and cold storage areas.
 - Enhance forced ventilation in sorting houses and cold storage with industrial fans or mechanical ventilation systems.
 - Prohibit the disposal of waste such as fish scales, fish intestines, shrimp shells, etc. into drains, rivers, or service areas to prevent air and water pollution.
 - Train staff to handle operations promptly and properly to minimize odor generation.
- **Compensation**
- Plant green belts around port areas to absorb odors and improve the microclimate.

Control of Odors from Solid Waste Collection Areas and WWTPs

- **Avoidance**
- Prohibit the disposal of spoiled aquatic products into drains, rivers, or the sea, as this causes pollution and degrades the port's landscape.
 - WWTPs must be constructed as closed systems with odor collection and treatment systems, and surrounded by a minimum 15-meter ecological buffer zone in compliance with QCVN 01:2021/BXD for mechanical, physicochemical, and biological treatment facilities.
 - Design solid waste storage areas separately from main operational areas to limit odor dispersion.
 - Wastewater pumping stations must be underground reinforced concrete structures with submersible pumps to minimize odors and maintain aesthetics.
- **Minimization**
- Regularly collect generated solid waste, ensuring no accumulation at the port.
 - Waste containers awaiting collection must have tight lids and be cleaned after each use.
 - Regularly clean and spray deodorizing agents at waste collection areas.
 - Apply biological agents to minimize odors and pests.
 - Plant greenery to improve landscapes and limit odor dispersion to residential areas.
 - Port management authorities must contract licensed companies for waste transport in accordance with regulations.
 - Install tightly sealed manhole covers and regularly dredge sediment, maintaining related equipment.
- **Mitigation**
- Install forced ventilation systems in waste treatment areas to improve air circulation and reduce odor accumulation.
 - Immediately address any wastewater leakage or waste overflow incidents, applying chemical or biological deodorization measures.
 - Upgrade the wastewater collection and drainage system if persistent odor issues are detected.
 - Construct sludge treatment facilities and equipment in accordance with approved designs to ensure effective operation.

- Conduct quarterly air quality monitoring to assess and control odor levels.
- Install odor collection and treatment systems in WWTPs (WWTPs), using centrifugal fans, humidification towers, and biofilters.
- Install and operate odor collection and treatment systems at the five WWTPs, specifically:
 - + At odor emission points in the WWTP of the Lach Hoi subproject: air is extracted by a 600 m³/h fan to an activated carbon adsorption tower and a primary absorption tower with NaOH solution.
 - + At odor emission points in the WWTP (Hai Binh Ward side) of the Lach Bang subproject: air is extracted by a 600 m³/h fan to an activated carbon adsorption tower and a primary absorption tower with NaOH solution.
 - + At odor emission points in the WWTP (Hai Thanh Ward side) of the Lach Bang subproject: air is extracted by a 120 m³/h fan to an activated carbon adsorption tower and a primary absorption tower with NaOH solution.
 - + At odor emission points in the WWTP of the Khanh Hoa subproject: air is extracted by a 1,200 m³/h fan to an activated carbon adsorption tower and a primary absorption tower with NaOH solution.
 - + At odor emission points in the WWTP of the Kien Giang subproject: air is extracted by a 1,200 m³/h fan to an activated carbon adsorption tower and a primary absorption tower with NaOH solution.
 - + Emissions from these five centralized WWTPs, after treatment, must comply with QCVN 19:2009/BTNMT – National Technical Regulation on Industrial Emissions for Inorganic Substances and Dust (for Ammonia, ammonium compounds, H₂S – Column B; Kp=1; Kv=0.6), and with QCVN 20:2009/BTNMT – National Technical Regulation on Industrial Emissions of Certain Organic Substances (for methyl mercaptan) before discharge into the environment through exhaust ducts.

b) Noise Impact Mitigation Measures

Technical measures for equipment and vehicles

- All vehicles operating within the fishing port must undergo registration as required by regulations; conduct periodic inspections and maintenance of equipment, vehicles, and machinery to ensure that their operation does not generate noise levels exceeding the permissible standards.
- Encourage ship owners and transport units to equip vessels and trucks with silencers, especially for large-capacity vehicles frequently operating at the port.
- Require that engines be switched off when vehicles are parked or vessels are moored at the port.
- Prioritize the use of low-noise equipment, install noise barriers, or situate noisy facilities far from sensitive areas.

Operational management measures

- Restrict operations during rest hours (midday and night).
- Require engines to be turned off when vessels dock and during cargo handling waiting times.
- Install traffic signs in the port to limit speed to 10 km/h and provide noise-reduction operational guidance.

Infrastructure design measures

- Locate reception, sorting, and service facilities away from existing residential areas to minimize noise impacts on local communities.
- Establish green buffer zones around port areas to absorb and reduce noise transmission to residential areas.
- Minimize intersections between transport routes and residential areas when vessels and vehicles enter or leave the fishing port/anchorage.

Training and awareness raising

- Organize regular training sessions for fishermen, drivers, and port staff on noise impacts and mitigation measures.

c) Mitigation Measures for generated wastewater

Control of domestic wastewater, wastewater from onshore service areas, and wastewater from vessels operating in the water area in front of the port:

For Lach Hoi Subproject

All wastewater (including domestic wastewater, wastewater from onshore service areas, and wastewater from vessels operating in the water area in front of the port) generated during the operation phase will be collected and conveyed to a WWTP with a capacity of 300 m³/day (02 modules, each 150 m³/day), using aerobic technology and closed treatment tanks. Treated wastewater will meet the national technical regulation on seafood processing wastewater (QCVN 11-MT:2015/BTNMT, Column B, K_q=1.2, K_f=1.1) before discharge into the Ma River at discharge point coordinates (VN2000): X = 2187536.629; Y = 594373.529 (central meridian 107°45', zone 30).

For Lach Bang Subproject

All wastewater generated during the operation phase will be collected to 02 wastewater treatment plants:

- 01 WWTP (Hai Binh ward) with a capacity of 300 m³/day (02 modules, each 150 m³/day), aerobic technology, and closed tanks. Treated effluent will meet QCVN 11-MT:2015/BTNMT (seafood processing wastewater, Column B, K_q=1.2, K_f=1.1) before discharge into the Lach Bang River at discharge point coordinates (VN2000, central meridian 107°45', zone 30): X = 2146810.951; Y = 581828.205.
- 01 WWTP (Hai Thanh ward) with a capacity of 60 m³/day, aerobic technology, and closed tanks. Treated effluent will meet QCVN 11-MT:2015/BTNMT before discharge into the Lach Bang River at discharge point coordinates (VN2000, central meridian 107°45', zone 30): X = 2147123.544; Y = 582257.040.

For Tam Quan Subproject

All domestic wastewater generated at the storm shelter anchorage will be collected and treated by 06 mobile toilets, each with a 1,200-liter septic tank and a 900-liter water tank, to collect crew wastewater during anchorage. A licensed company will be contracted for collection, transport, and treatment in accordance with regulations, with no discharge to the environment.

For Khanh Hoa Subproject

All wastewater generated will be collected to a WWTP with a capacity of 600 m³/day (02 modules, each 300 m³/day), aerobic technology, and closed tanks. Treated effluent will meet QCVN 40:2011/BTNMT (industrial wastewater, Column B, K_q=1.0, K_f=1.0) before discharge into Cam Ranh Bay at discharge point coordinates (VN2000, central meridian 108°15', zone

30): X = 1316876.137; Y = 596820.566.

For Kien Giang Subproject

All wastewater generated will be collected to a WWTP with a capacity of 600 m³/day (02 modules, each 300 m³/day), aerobic technology, and closed tanks. Treated effluent will meet QCVN 40:2011/BTNMT before discharge into the Cai Lon River at discharge point coordinates (VN2000, central meridian 107°45', zone 30): X = 1091699.101; Y = 566312.581.

For Bach Long Vi Subproject

All domestic wastewater generated at the storm shelter anchorage, the Port Management Board office area, and service area (65 m³/day on peak days) will be collected and treated through septic tanks with 03 compartments, total capacity 150 m³. The Port Management Board has contracted a licensed unit to periodically collect, transport, and treat the sludge in compliance with regulations, with no discharge of residues into the environment.

Ballast water mitigation measures (applied to all 6 subprojects):

- Require fishing vessels to install oil–sludge separation equipment before ballast water discharge, ensuring residues are collected and treated at the port.
- Establish ballast water reception facilities at the port and contract licensed companies for collection and treatment in accordance with Decree 58/2017/ND-CP and Circular 41/2017/TT-BGTVT.
- Conduct periodic ballast water quality checks on vessels (every 6–12 months) to detect and address pollutants and invasive species.
- Provide communication and training for fishermen on ballast water handling procedures, raising awareness of marine environmental protection.
- Encourage application of the Ballast Water Management (BWM) Convention requirements for large-capacity or inter-provincial fishing vessels.

d) Solid Waste Mitigation Measures

Management of ordinary solid waste:

Avoidance

On vessels

- Establish a system for collecting and handling solid waste generated from fishing vessels during operation and anchorage, in accordance with national regulations.
- Food-related waste transported to the port must be managed under local regulations to protect human and animal health³⁷.
- Strictly prohibit the discharge of solid waste from vessels while anchored at the port, in compliance with MARPOL and national regulations.

On land

- The Management Boards of the six fishing ports/anchorages must strictly manage and minimize waste generated during sorting and receiving of fish, improving the environment at sorting houses and across the port.

³⁷ Countries have specific regulatory requirements for the handling of food waste originating from international voyages. The goal of most of these regulations is to prevent the cross-border spread of infectious diseases.

- Port operators must provide adequate facilities for wastewater and solid waste reception and management to meet the needs of the port and the vessels it serves.
- The provision of waste reception facilities must be coordinated with local authorities, in line with commitments under the MARPOL Convention by port states.
- Port operators must prepare environmental incident prevention, control, and response plans. Fuel suppliers must develop emergency response plans for oil spills to prevent large-scale dispersion that could cause significant harm to the natural environment and human health.

Mitigation (Minimization)

- Contract with licensed units with full competence to collect, transport, and treat all daily domestic solid waste at the 06 ports, in compliance with the Law on Environmental Protection and relevant guiding documents.
- Each subproject must designate a solid waste collection area with at least one day's storage capacity, ensuring compliance with technical requirements for waste storage facilities.
- Domestic solid waste at fishing ports (including from staff at the operation area and from fishermen/traders/visitors in public areas) shall be collected into 12 covered bins of 120 liters each, with mandatory segregation: food waste, recyclable/reusable waste, and other domestic waste.
- Sludge from wastewater treatment processes at the 05 WWTPs must be collected, transported, and treated by licensed contractors in compliance with regulations.
- Sludge from the drainage and rainwater systems at the 06 ports must be dredged, collected, and treated by licensed contractors every 6 months.
- Recyclable and reusable solid waste must be collected at designated places and handled once per week in accordance with regulations.
- Fishery by-products from the sorting process must be collected into 02 bins of 500 liters each. Traders must collect them daily and transfer them to processing units for animal feed production.

Hazardous waste management:

- The Port Management Boards must collect hazardous waste and periodically transfer it to licensed, competent units for collection, transportation, and treatment in compliance with regulations.
- Hazardous waste must be collected and stored in a designated hazardous waste storage warehouse within each subproject's waste collection facility. The warehouse must comply with current standards, with specific requirements as follows:
 - + Concrete floor, partitioned compartments, roof cover, and warning signs for hazardous waste areas.
 - + Raised curbs (10 cm) and a containment sump (40 × 40 × 40 cm) to prevent liquid spills.
 - + Equipped with full emergency response and fire prevention/firefighting equipment.

Collection and storage plan:

- Waste such as oily rags, broken neon lamps, used batteries, accumulators, and bottles/containers must be segregated in accordance with hazardous waste management

regulations. They must be stored in specialized containers within the hazardous waste warehouse.

- Packaging waste from green space maintenance activities (fertilizers, pesticides) must be collected after use and stored in the hazardous waste warehouse.

e) Measures to Mitigate Impacts on Water Quality and Aquatic Life

- Mitigating impacts on water quality:

- Implement ballast water control measures as described in section (c) above.
- Implement solid waste and hazardous waste control measures as described in section (d) above, to prevent their release into water bodies.
- Effectively operate WWTPs at each subproject, ensuring treated wastewater meets standards before discharge into receiving rivers/seas.
- Ensure seafood sorting and receiving areas are equipped with oil–grease traps and trash screens to prevent organic waste from entering water bodies.
- Particularly, rainwater runoff from areas with potential oil leakage or hazardous materials (fueling or fuel transfer points) must pass through oil separators for sedimentation and oil removal before discharge into receiving waters.
- Fishing vessel owners must comply with MARPOL and national regulations on oil, sludge, and wastewater management during operations. For example: oily waste and wastewater should be collected in barges, trucks, or centralized collection systems and tanks; wastewater with toxic chemicals from large-scale tank cleaning must be collected for onsite or appropriate treatment before discharge; incompatible wastes must not be mixed in the collection system; treatment methods must be based on wastewater characteristics.

- Water quality monitoring:

- Establish a periodic surface water monitoring program in front of the port.
- Track indicators such as turbidity, suspended solids, oil and grease, dissolved oxygen, etc., for timely management adjustments.

- Mitigating impacts on aquatic life:

- Limit fishing port operations to the designated water area in front of the wharf (36 m wide, 400 m long), avoiding widespread impacts on the river/sea ecosystems of each subproject.
- Prohibit direct wastewater discharge into rivers; all wastewater must be treated to meet standards before release into receiving waters.
- Control chemical use in preservation and cleaning activities to avoid impacts on aquatic organisms.
- Conduct awareness campaigns for fishermen and port staff on protecting water quality and aquatic ecosystems.
- Collect packaging and food leftovers from operations; prohibit indiscriminate littering into surrounding areas or rivers/seas.
- Raise awareness among local residents on vessel maintenance to prevent oil leakage into rivers/seas.
- Comply with fishery development planning and sustainable aquatic resource

management of the 5 project provinces/cities.

e) Measures to Mitigate Impacts on Traffic at the Port Area

Ensuring road traffic safety

- Avoidance

- Design port internal transport infrastructure rationally from the outset, including separate lanes for trucks, motorcycles, and pedestrians to avoid conflicts.
- Schedule operating hours for different vehicle types to avoid peak-hour congestion.
- Enforce vehicle weight checks for inbound and outbound cargo to prevent overloading, road damage, and ensure safety.
- License and strictly control cargo transport vehicles, ensuring they meet technical and safety standards.

- Mitigation/Minimization

- Deploy traffic controllers at critical points (port gates, intersections of internal roads) during peak hours when fishing vessels land their catch (4:00–6:00 am).
- Organize awareness campaigns on road and waterway traffic laws for residents and vehicle operators.
- Require drivers to be trained in safe driving skills, especially those transporting cargo from the port.
- Provide organized parking and waiting areas to reduce disorderly parking that obstructs traffic.
- Enforce speed limits and install clear signage within the port area to minimize accident risks.
- Install CCTV surveillance at critical points (port gates, intersections of internal roads) to detect violations in real time.
- Conduct periodic inspections to assess traffic safety and promptly adjust management measures.
- Relevant authorities such as the Port Authority, Transport Inspectors, Police, and local government must closely coordinate in managing and ensuring traffic safety at the port area.

Ensuring waterway traffic safety

- Avoidance

- Install appropriate waterway traffic signs at high-density traffic areas.

- Mitigate/Minimize

- Raise public awareness of vessel maintenance. Raise awareness of safe seafood transport: strict compliance with waterway traffic safety, no overloading, etc.
- Clearly regulate waterway routes and operating schedules for different vessel groups to reduce conflicts.
- Conduct regular technical inspections of vessels operating at the port.
- Deploy waterway traffic control forces at complex intersections during peak hours.

f) Measures to Mitigate and Prevent Risks and Incidents

Possible incidents during fishing port operation include: traffic accidents, occupational accidents, environmental incidents, and natural disasters/extreme weather events. Mitigation measures for these incidents are presented below:

f.1. Traffic Accident Incidents

Measures to Mitigate Waterway Traffic Accidents

- Avoidance

Measures to prevent traffic accidents from the outset:

- Provide formal training and issue professional certificates for all crew members and vessel operators, including rescue, emergency response, and safe navigation skills.
- Provide safety instructions for crew members on emergency situations such as fire, explosion, sinking, or storms.
- Install waterway traffic signs and signals in areas with high vessel density or complex hydrological conditions
- Establish coordination and traffic routing procedures at fishing ports and storm shelter anchorages to avoid congestion and collisions.
- Regularly maintain and inspect watercraft (fishing vessels, canoes, boats), especially engines, electrical systems, and safety equipment such as life buoys, life jackets, and firefighting tools.
- Equip vessels with modern communication systems such as VHF, radar, and GPS devices to monitor movement and avoid collisions at sea.

When a waterway traffic accident occurs at fishing ports or storm shelter anchorages, prompt and accurate response is essential to ensure safety and minimize damage. The following steps should be taken to mitigate and address such accidents:

- Mitigation

- Check the condition of people and vessels: determine the number of injured, missing, or drowning-risk persons. Inspect the accident vessel to assess its condition and damage.
- Secure the accident area: establish a safety zone around the accident site to prevent additional hazards from passing vessels.
- Organize rescue: use rescue boats or canoes to bring injured persons safely ashore. Ensure sufficient life buoys, life jackets, and rescue equipment are available.
- Provide first aid on site: apply immediate measures such as artificial respiration, bleeding control, wound bandaging, and transfer to medical facilities if necessary.
- Notify relevant authorities immediately: contact rescue agencies, Port Authority, border guard forces, and other related bodies for timely assistance.

- Remediation

- Record the situation: provide detailed accident information to investigators, including time, location, vessel, initial cause, and number of people affected.
- Identify accident causes: authorities investigate whether accidents stemmed from technical failures, human error, or adverse weather.
- Correct the incident: if the vessel is damaged (engine failure, hull damage), take temporary measures to tow it to a repair site.

- Evaluate the accident and improve procedures: review operational processes, safety systems, and crew training to prevent recurrence.

Measures to Mitigate Road Traffic Accidents

- Avoidance

- Ensure access roads to fishing ports and storm shelter anchorages are built and maintained in good condition. Roads must be upgraded and regularly maintained to prevent deterioration and reduce accident risk
- Install clear, visible, and adequate traffic signs, especially for speed limits and high-risk areas (slopes, sharp curves)
- Set appropriate speed limits for each area, particularly around ports and storm shelters. Conduct regular inspections and strictly manage vehicles entering the area to ensure safety
- Provide safe driving training and road safety awareness programs for cargo drivers and workers.
- Design transport infrastructure with adequate visibility and turning radius, meeting technical standards to eliminate accident-prone spots.

- Minimization

- Maintain designated parking areas for vehicles to prevent illegal parking, congestion, or traffic obstruction.
- Establish a traffic coordination system to prevent congestion, especially during peak periods when vessels dock or storms occur.
- Ensure risk mitigation measures during adverse weather, particularly storms or heavy rain, such as warning lights, anti-skid systems, and requiring vehicles to reduce speed.
- Develop emergency response plans for road traffic accidents, including rescue and relief procedures, to enable quick handling and damage reduction.
- Install traffic surveillance cameras at intersections and critical points to detect early violations and incidents.
- Conduct regular inspections of vehicle technical conditions, especially brakes, lights, and tires, for all vehicles entering the port.
- When a road traffic accident occurs near fishing ports or storm shelter anchorages, prompt and accurate handling is essential to ensure safety and minimize damage. The following steps should be taken for each case:

- Mitigation

- Deploy rapid response teams at the port area to handle traffic accidents immediately.
- Stop vehicles at once: drivers must stop safely and activate hazard warning lights.
- Protect the accident scene: for serious accidents, use warning signs and hazard lights to halt traffic and secure the site, avoiding secondary accidents.
- Assess injury status: do not move victims unnecessarily. If spinal, head, or serious injuries are suspected, do not move them until professional rescue arrives—unless the site is unsafe.
- Provide first aid: basic measures such as bleeding control, keeping victims warm, or artificial respiration if needed.

- Call an ambulance and medical rescue team to transport victims to hospital promptly.
- Notify authorities: immediately call traffic police, port security, or other relevant bodies to handle the incident.
- Provide detailed information: report accurate location, time, vehicle conditions, and victim status to assist responders.

- Remediation

Measures to address post-accident consequences:

- Investigate accident causes: authorities determine whether caused by driver error, technical failure, or road conditions.
- Record the accident: prepare reports with participation from relevant parties as a basis for further action.
- Clear the site: after investigation, remove damaged vehicles, repair or clean roads if necessary.
- Restore traffic: implement traffic flow control and guide vehicles safely.
- Evaluate the accident: reassess road safety measures, operations, and infrastructure to improve prevention.
- Update lessons learned: integrate findings into traffic management plans and regular driver/port staff training.

Risk of falling overboard and drowning for vessel operators/fishermen

- Avoidance

- Vessels must have high stability: ensure vessels are designed for stability, especially when sailing in rough seas or high waves. Anti-capsize systems must be regularly inspected and maintained.
- Design vessels with clear and accessible emergency exits.
- Install handrails and guardrails: provide sturdy handrails or guardrails in hazardous areas to help fishermen move safely and prevent slips.
- Ensure dry, non-slippery decks by using anti-slip coating or rough surfaces to reduce fall risks during rain or waves.
- Provide spacious, unobstructed working areas on vessels, docks, and storm shelters for safe, easy movement.
- Establish pre-departure safety checks, including lifesaving equipment, communications, weather conditions, and crew health.
- Require voyage and safety logs to monitor unusual situations and improve operations after each trip.
- Assign tasks clearly and supervise closely, especially during bad weather or offshore trips.
- Update and monitor weather conditions, particularly storm seasons, to prevent sailing in dangerous situations.
- Provide regular training for fishermen and vessel operators on safety skills, vessel stability, and basic rescue techniques. Raise awareness on drowning risks and personal protective equipment.

- Equip vessels with early-warning systems for instability, such as horns, warning lights, or electronic devices suited to vessel type.

- **Minimization**

- Life jackets: all crew, vessel operators, and fishermen must wear life jackets at all times while working on board, especially near ports or in bad weather.
- Safety harnesses: provide harnesses for crew working in hazardous conditions with strong waves or winds.
- Safety shoes and gloves: provide anti-slip footwear and gloves for safe movement and reduced fall risk.
- Adequate lighting: ensure full lighting in work areas on vessels and around ports at night to reduce slip and collision risks.
- Emergency communications: radios or satellite phones for contacting rescue agencies in emergencies.
- First aid/rescue stations near ports: maintain nearby stations or teams at fishing ports and storm shelters for quick response.
- Emergency transport: provide ambulances, lifeboats, and necessary medical supplies for injuries or drowning cases.
- Personal locator beacons (PLBs): supply for crew working alone or in dangerous conditions, especially offshore vessels.
- Individual first-aid kits: equip each crew member, especially offshore, with basic supplies for small injuries.
- Encourage installation of man-overboard alarms on large fishing vessels or enclosed cabins if technically and financially feasible.

- **Mitigation**

Emergency measures to reduce harm when falling overboard/drowning occurs:

- Conduct regular rescue drills for fishermen and vessel operators, including rescue techniques, lifesaving equipment use, and basic first aid.
- Rescue victims: if someone falls overboard, use rescue boats/canoes or throw flotation devices for support.
- Establish rapid response procedures, including assigning rescuers, deploying flotation equipment, and contacting rescue forces.

- **Remediation**

- Record and report incidents promptly for investigation and procedural improvement.
- Hold debriefings with crew after each incident to update safety protocols.
- Conduct periodic risk assessments and update safety management and protective equipment accordingly.
- Provide psychological support and health recovery for crew after serious accidents to restore working capacity and reduce long-term mental impacts.

Incident: Fishing vessels docking beyond the design capacity

- **Avoidance**

- The technical infrastructure and environmental treatment facilities of the fishing port shall be designed to accommodate the maximum number of vessels on peak days in accordance with the approved design.
- The breakwaters shall be designed in segments based on the vessel capacity, ensuring minimization of vessel congestion when berthing.
- Develop a vessel traffic management plan based on fishing seasons and catch volumes, in order to forecast peak periods and adjust port operations accordingly.
- Designate additional temporary mooring areas or buffer zones outside the port to regulate vessels exceeding the design capacity.

- *Minimization*

- The port management authority shall assign staff to guide vessels in and out during peak days, ensuring order and limiting delays or security issues.
- Establish a pre-registration system for vessels before docking, particularly during peak seasons, to control traffic flow and allocate berthing positions appropriately.
- Apply information technology (e.g., port management software) to monitor vessel arrivals in real time, supporting efficient coordination.
- Enhance communication and early warnings for fishermen through loudspeakers, SMS, or electronic boards at the port to prevent congestion.
- Organize vessel traffic by size, type of activity, and berthing time to optimize port space and usage.

- *Mitigation*

- Deploy a rapid response team at the port, including security staff, coordinators, and technical support teams to handle emerging situations.
- Arrange for vessel rotation or temporary mooring outside the port, combined with announcements of estimated docking times to reduce immediate pressure.

- *Remediation*

- Review and periodically update the vessel traffic management plan based on actual operations and catch growth trends.
- Collect and analyze data after each peak period to adjust designs, operational procedures, and vessel reception capacity in the future.

f.2. Measures for Prevention and Mitigation of OHS Accidents

- *Avoidance*

- Develop a fishing port management regulation that enhances capacity on occupational health, safety, and community protection for the port authority, fishermen, service providers, and traders.
- The port's operation and maintenance system must include functions to respond to potential impacts on occupational health and community safety caused by air pollution, noise, fire, explosion, traffic accidents, port security, structural collapse, landslides, or subsidence due to extreme weather.
- Design a reasonable port layout, with clear separation between mechanized equipment operation zones and pedestrian zones to avoid collisions
- Establish a pre-shift safety inspection system, including checking equipment, work

areas, and worker health conditions.

- Provide clearly marked emergency exits, adequate safety signage, and arrange first-aid stations at strategic points within the port.
- Conduct regular occupational safety training, first-aid, and emergency response drills for all workers and port staff.

- **Minimization**

Minimization measures for accidents caused by mechanized equipment such as cranes, forklifts, etc.)

- Ensure all workers operating mechanized equipment are properly trained and certified for safe operation.
- Conduct periodic inspection and maintenance of mechanized equipment.
- Use personal protective equipment (PPE): Operators must wear helmets, safety shoes, gloves, etc.
- Apply standard operating procedures (SOP): Workers must follow prescribed steps to avoid mistakes during operations
- Install warning systems when mechanized equipment operates near pedestrian areas.

Minimization measures for accidents caused due to unsafe working conditions

- Ensure safe working conditions: Work areas must be designed, constructed, and maintained safely, with adequate lighting, non-slippery floors, and no hazardous obstructions.
- Conduct periodic risk assessments to promptly detect and address potential hazards.
- Provide safety information and guidance: All workers must receive clear instructions on safe working procedures and safety signage at work sites.
- Establish a rapid feedback system when unsafe conditions are detected.

Minimization (for occupational health and disease risks)

- Conduct regular health check-ups for all workers to detect early occupational diseases and ensure workers are fit for duty.
- Provide adequate PPE suited to the port environment, including dust masks, gloves, anti-slip boots, waterproof and chemical-resistant clothing to protect workers from hazards such as dust, humidity, chemicals, and pathogens, thereby preventing diseases like pneumonia, poisoning, or dermatitis.
- Health education: Organize training sessions on health protection, disease prevention, and proper nutrition for workers.

Minimization (for environmental accident risks at the port)

- Maintain a clean, well-ventilated work environment, free of dust and harmful substances.
- Provide fire and explosion prevention equipment: Ensure that areas with risks (such as fuel or chemical storage) are equipped with adequate firefighting systems and are inspected regularly.
- Disaster prediction and response: Establish measures such as drainage systems, equipment protection, and evacuation plans in case of storms, high waves, or other

disasters.

- Establish and implement a hazardous chemical and material management procedure at the fishing port, including classification, storage, transportation, and safe use of common substances such as:
 - + Diesel, FO/DO fuel oils, and lubricants for engines and mechanized equipment;
 - + Industrial detergents and disinfectants such as chlorine and formalin for cleaning ship holds and processing areas;
 - + Refrigerants such as ammonia or glycol used in cold storage systems;
 - + Industrial solvents such as acetone and xylene from ship repair activities;
 - + Flammable/explosive chemicals such as LPG and gasoline stored at fuel depots.

The procedure must ensure clear warning signs, safe isolation zones, adequate firefighting equipment, and regular staff training on chemical spill response and emergency handling.

- Remediation

- Conduct regular rescue drills, including rescue techniques, use of life-saving equipment, and on-site first aid.
- Protect victims: use rescue boats, flotation devices, and mobilize local forces.
- Establish a rapid response team at the port to handle occupational accidents.
- Provide an internal emergency communication system for quick incident notification.

f.3. Mitigate and Response Measures for Environmental Incidents

f.3.1. Oil Spill Response Measures

Oil spill response in fishing vessel operations must comply with Decision No. 12/2021/QĐ-TTg dated March 24, 2021 of the Prime Minister, supplemented with practical measures and international guidelines.

- Avoidance

- Prohibit discharge of oily wastewater or oil-contaminated materials into rivers or receiving waters.
- Train fishermen in safe vessel operation to prevent oil leaks from engines and fuel systems.
- Conduct periodic inspection of fuel systems, engines, and oil tanks on fishing vessels to detect leakage risks.
- Prohibit use of old vessels that fail to meet fuel safety and environmental standards.

- Minimization

- Develop, submit, and obtain approval of an oil spill response plan, and implement it effectively once issued
- Invest in equipment and materials to gradually improve self-response capacity of the port and waterborne transport.
- Organize annual training and at least biannual drills for staff and response forces.
- Sign agreements/contracts with competent agencies/units for oil spill response support.
- Equip each fishing vessel with a basic oil spill response kit (booms, absorbent materials, buckets, etc.). Equipment should be adapted by vessel type (e.g., offshore

vessels with absorbents; nearshore vessels sharing equipment via fishing teams or the port).

- Organize oil spill response training specifically for fishermen, suited to their vessel conditions.
- Map coastal ecological sensitive areas for priority protection during oil spills.

- **Mitigation**

- Proactively deploy response activities, mobilizing resources promptly and effectively when spills occur.
- Immediately notify authorities of spill location, scale, and cause, and begin on-site response:
 - + Ensure site safety; mobilize all available resources to contain oil; deploy booms to prevent spread.
 - + Use available means such as absorbents, buckets, etc., to collect oil.
 - + Mobilize local communities to assist in response.
 - + Pump remaining fuel in the affected vessel to another storage vessel to ensure safety during the response process. During the transfer, measures must be implemented to prevent any oil spillage

- **Compensation**

- If it is determined that the port response is ineffective or the oil spill incident may cause more serious consequences, promptly report to the provincial/city People's Committee for direct response guidance.
- Coordinate with relevant local authorities to monitor and assess the effectiveness of oil spill remediation efforts.
- Temporarily store and safeguard the collected oil for reuse or to ensure compensation for damages caused by the spill. The handover of collected oil should be based on the agreed compensation amount with the vessel owner.
- Upon completion of remediation activities, report to the competent authorities on the situation and results of the incident response.
- Assess environmental damage after the incident in accordance with the guidelines of the Ministry of Natural Resources and Environment.
- Implement compensation for damages in accordance with the provisions of the Law on Environmental Protection.

f.3.2. Fire and explosion prevention and response

Prevention and response to fire/explosion incidents in fishing port and vessel operations must comply with current laws, particularly the Law on Fire Prevention and Fighting, Decree 136/2020/ND-CP, and national technical standards.

- **Avoidance**

- Train fishermen and port staff in fire prevention and firefighting skills.
- Comply with national fire safety standards at fishing ports, landing sites, anchorage areas, and vessels.
- Equip port warehouses, offices, and logistics facilities with fire/explosion prevention systems in compliance with national standards (fire extinguishers, fire alarms,

hydrants, firefighting boats/canoes, etc.).

- Provide portable fire extinguishers suitable for fishing vessels (e.g., ABC powder, CO₂), ensuring capacity to handle initial incidents.
- Clearly designate no-fire, no-smoking, no-welding areas at the port and on vessels.
- Conduct periodic inspections of electrical, fuel, and flammable systems on vessels and at the port.

- Minimization

- The fire water supply system includes both indoor and outdoor firefighting water systems (at offices and storage warehouses).
- For buildings within the fish port, fish wharf, or mooring areas with a volume > 5,000 m³, two fire hydrants must be installed in easily visible and accessible locations, with a water flow rate of 2.5 liters/second per hydrant. Additionally, warehouses should be equipped with foam fire extinguishers.
- Establish emergency response procedures in case of fire or explosion on vessels or at the port.
- Mobilize on-site personnel and coordinate with the local fire prevention and firefighting police

- Compensation

- Assess environmental damage after fire/explosion.
- Compensate damages as required by the Law on Environmental Protection.
- Restore sites and manage waste generated after the incident.

f.3.3. Response measures for water supply, drainage, and wastewater treatment failures

- Avoidance

- Develop a maintenance plan: There should be a plan for regular maintenance and inspection of the water supply, drainage, and wastewater treatment systems to promptly detect signs of damage or system degradation.
- Inspect the quality of pipeline materials: Use high-quality materials for the piping system, such as stainless steel or corrosion-resistant plastic that can withstand pressure and harsh environments.
- Inspect system structure: Ensure that joints, valves, and other system components are not loose, damaged, or corroded.
- Comply with all design, construction, operation, maintenance, and servicing requirements of the wastewater treatment system.
- Design the water supply and drainage systems clearly separate from the wastewater treatment system to prevent cross-contamination in case of incidents.
- Choose the locations for wastewater treatment stations and technical pipelines to avoid areas prone to erosion, flooding, or weak soil foundations.
- Train wastewater treatment operators on the system's operation and maintenance program.
- Design WWTPs for continuous operation; include shut-off valves at component tanks to increase storage capacity, ensuring maximum retention time in case of incidents.

- Minimization

- Regularly monitor the operation of machinery and the condition of treatment tanks; prepare backup equipment for machinery prone to failure, such as wastewater pumps, blowers, sludge pumps, etc.
- Arrange motors/pumps in all modules with one active unit and one standby unit (operating alternately) to ensure the system remains functional during incidents.
- Provide a backup power supply for the centralized wastewater treatment station.
- Assign personnel to operate and supervise the wastewater treatment system according to the trained procedures.
- Install leak or abnormal pressure warning systems on main pipeline sections.
- Establish rapid inspection procedures following heavy rainfall, high tides, or nearby construction activities.

- Mitigation

- Design and arrange emergency tanks with appropriate capacity at each wastewater treatment station to temporarily store wastewater in case of emergencies
 - + Lach Hoi: 150 m³
 - + Lach Bang (Hai Binh): 150 m³
 - + Lach Bang (Hai Thanh): 60 m³
 - + Khanh Hoa Major Fishery center: 442 m³
 - + Kien Giang Major Fishery center: 442 m³
- In case the wastewater treatment station experiences machinery or equipment failure and cannot continue operation, immediately close the discharge valves. Wastewater should be stored in the emergency tank to identify the cause and location of the incident. Only discharge treated wastewater that meets standards into the environment.
- When an incident occurs, wastewater treatment station operators must notify the management department, isolate the affected module, and ensure that wastewater from the faulty module is not discharged into the environment. Wastewater generated from project activities should be stored in the emergency tank, while treatment continues normally in the remaining modules.
- After resolving the incident, pump all wastewater from the tanks in the affected module back to the equalization tank for continued treatment to meet standards before discharge into the environment.
- Keep emergency supplies ready, such as shut-off valves, replacement pipes, and water pumps, for rapid on-site response.
- Establish a rapid response team at the fish port to handle environmental incidents related to wastewater.

- Remediation

- Conduct rapid environmental impact assessments after incidents and report to authorities.
- Restore affected systems and areas, including sludge removal, disinfection, and water quality testing.

f.4. Measures for Natural Disaster and Severe Weather Incidents

f.4.1. Response to storms, floods, and high tides causing port infrastructure damage and operational disruption

- Avoidance

- Strong structural design: Build the fish port, mooring areas, and technical infrastructure with durable, corrosion-resistant materials suited for river and marine environments, ensuring they can withstand strong winds, high waves, and heavy rain.
- Upgrade dikes, revetments, and port facilities: Ensure wharves, breakwaters, and protective structures can resist high tides and flooding, particularly in coastal areas prone to storms and large waves.
- Enhance drainage systems: Make sure the port and mooring area drainage can quickly remove water during heavy rain or high tides.
- Design mooring areas to safeguard vessels during extreme weather.
- Install early warning systems: Track weather changes and water levels to provide timely alerts.
- Develop a disaster prevention plan: Prepare a detailed plan for the fish port and mooring areas, including concrete measures to reduce risks to people and property during natural disasters, and update it regularly

- Minimization

- Establish an emergency communication system between the fish port and relevant authorities to coordinate response efforts.
- Regularly assess and update risk levels: Conduct studies and update information on the impacts of natural disasters.
- Weather forecasting and storm updates: Monitor information from specialized forecasting agencies to implement early response plans.
- Train staff on emergency response: Provide skills for evacuation, asset protection, and basic rescue during storms, floods, or high tides.
- Strengthen safe mooring measures: Ensure vessels are securely and safely moored when warnings are issued.
- Set up rescue and evacuation stations: Establish and maintain stations equipped for evacuation and rescue in case of incidents. Evacuation points should be clearly marked and easily accessible.
- Inspect, maintain, and equip protective devices: Ensure fishing boats, rescue boats, and transport equipment function properly in severe weather. Provide all necessary lifesaving equipment, life jackets, and protective gear.

- Mitigation

- Move vessels out of hazardous areas: Conduct this before the storm arrives or during high tides, relocating vessels to safe locations.
- Activate warning and evacuation systems according to the established plan.
- Mobilize on-site personnel to assist with evacuation and protect property.
- Set up temporary assembly areas for vessels and fishermen after evacuation.

- Remediation

- Reinstate damaged infrastructure after natural disasters: Repair dikes, revetments, wharves, and drainage systems.
- Assist fishermen in resuming production activities after storms or floods.
- Assess damages and prepare reports for authorities to request support.
- Carry out environmental cleanup, waste collection, and treatment of polluted water following natural disasters.

f.4.2. Response to riverbank/coastal erosion incidents affecting anchorage and port areas

- Avoidance

- Design of mooring areas to prevent erosion: Ensure mooring areas are located in positions less affected by waves, high tides, and currents to reduce the risk of erosion from the outset.
- Coordinate vessel mooring activities according to terrain and erosion risk: Arrange the number and position of moorings to avoid putting pressure on vulnerable shoreline areas.
- Construct dikes and shoreline protection structures: Build and maintain protective works such as breakwaters, stone or concrete revetments, and other coastal protection structures to minimize the impact of waves and high tides, thereby preventing shoreline erosion.

- Minimization

- Improve port and mooring infrastructure: Upgrade port facilities and mooring areas to enhance resilience against erosion.
- Conduct periodic erosion risk assessments: Regularly monitor and carry out studies on the erosion potential of mooring areas and fish ports to implement timely mitigation measures.
- Apply monitoring technology and early warning systems for erosion risks: Use devices such as wave meters, GPS systems, satellite imagery, and geotechnical sensors to track terrain changes, forecast erosion risks, and issue early warnings, enabling proactive responses.
- Develop an emergency response plan for erosion incidents: Establish a contingency plan for the fish port and mooring areas, including erosion warning procedures, vessel relocation schemes, asset protection measures, and support for affected vessels.
- Awareness, training, and erosion response drills: Conduct communication campaigns, training sessions, and regular drills to raise awareness, improve response capacity, and enhance coordination among fishermen, port staff, and stakeholders during erosion incidents.
- Implement vessel relocation upon erosion warnings: Ensure there is a plan to move vessels out of high-risk erosion areas when warnings are issued. Prompt response measures can help minimize damage.

- Remediation

- Restore coastal ecosystems after erosion (e.g., mangrove planting, coral reef rehabilitation if applicable).
- Port management to coordinate with authorities and local agencies to assist with vessel

repairs, restore operations, and stabilize fishermen's livelihoods after incidents.

5.1.4.2. Site-specific mitigation measures during operation – Applicable to the Bach Long Vi subproject

a) Mitigation measures for impacts on the marine ecosystem of the Bach Long Vi Marine Protected Area during operation

- Avoidance

- Integrate regulations on MPA protection into the vessel operation licensing procedures at the port.
- Plan shipping routes to avoid ecologically sensitive areas.
- Coordinate with the Management Board of Bach Long Vi MPA to inspect and control vessel movements, particularly to restrict entry into strictly protected zones.
- Prohibit vessels from anchoring, berthing, or fishing within the MPA.
- Prohibit vessels from discharging waste or ballast water into the sea around the MPA.
- Establish an ecological buffer zone between the MPA and exploitation areas.

- Minimization

- The Port Management Board monitors vessel operations and cooperates with specialized agencies to track the growth and development of aquatic species within the MPA.
- Provide training and equip necessary tools and devices for prompt response in case of oil spills within the MPA.
- Regularly disseminate information to fishermen and sailors on compliance with MPA protection regulations.
- Establish an early warning system for pollution risks or environmental incidents.
- Promote inter-sectoral and inter-regional cooperation in MPA management.

- Restoration

- Restore ecosystems after incidents or adverse impacts.
- Rehabilitate affected habitats (e.g., coral reef replanting, mangrove restoration, restocking of aquatic breeding grounds).

b) Mitigation measures for impacts on aquatic species

- Avoidance

- Regularly monitor the condition of disposal sites, especially disposal areas No. 01 and 02 of the Bach Long Vi subproject, to prevent the spread of materials into the MPA, particularly after storms. If retaining walls show signs of erosion or degradation, reinforcement must be done immediately.
- Strictly monitor vessel activities in and around the harbor basin to minimize and prevent illegal discharges into the sea.

- Minimization

- Coordinate and support competent agencies in conducting periodic monitoring and assessments of aquatic species growth and development in the harbor basin and surrounding MPA areas.
- Regularly and promptly deploy response measures in case of oil spills from vessels

passing through or entering the harbor basin.

- Continuously raise awareness among fishermen and sailors about marine environmental protection and aquatic species conservation regulations.

- **Restoration**

- Rehabilitate affected habitats if oil spills or waste discharges occur that impact aquatic species.

c) Mitigation measures for sedimentation impacts in the harbor basin during operation

- **Avoidance**

- Maintain navigation channels and designated turning basins for vessels to prevent sudden changes in current flow within the harbor basin.
- Design port structures in line with hydrodynamic characteristics to reduce sediment accumulation.

- **Minimization**

- Regularly conduct hydrographic surveys to plan periodic dredging activities.
- Periodically monitor sediment quality in the harbor basin.
- When large amounts of sediment accumulate in the basin, implement a detailed dredging plan, with special attention to managing and disposing of dredged materials to avoid impacts on the marine ecosystems.

5.1.5. Minimize cumulative impact

Cumulative environmental impacts may arise from various individual activities during the project's implementation, and often cannot be effectively addressed with measures at a single time or specific location. Therefore, the development and implementation of mitigation measures need to be considered at multiple levels — from the sub-project level, the overall project level, to the regional or national level. Some measures can be applied directly on-site, while others require inter-sectoral, inter-regional coordination or higher-level policies to ensure long-term and sustainable effectiveness.

• **In the technical design phase:**

- Integrate climate change resilience and rising sea levels into each aspect of the technical design phase for the SFDP project.
- Enhance green permeable spaces along the coastal/river embankment line and reinforce coastal protective forests or mangrove areas (if applicable), maintain open water areas, design for storm protection, water retention basins for drought control and irrigation, flood prevention materials, and permeable materials for water retention basins.
- Calculate the elevation, hydraulics, and drainage direction, considering climate change and natural drainage factors.
- Propose high-permeability materials and structures for transportation infrastructure such as perforated concrete, grassed parking lots on docks/fishing ports, etc.
- Improve rainwater and wastewater drainage capacity with reliable materials suitable for extreme weather conditions.
- Encourage the increased use of green materials and clean technologies with low emissions and noise — especially in areas near sensitive ecosystems such as coral reefs and seagrass beds. Prioritize the selection of construction materials that absorb dust, reduce volatile organic compound (VOC) emissions, and employ noise-limiting

construction technologies to minimize impacts on the natural environment.

- Design roofing, particularly in outdoor working areas such as fishing ports, mooring areas, and fishery inspection zones. The arrangement of roofing, ventilated rest areas, and insulating materials will ensure safe working conditions during operation.
- Design systems to collect and treat leakage water from vessels at mooring areas to prevent water quality degradation.

● ***For the project construction phase:***

Coordinate with local specialized management units to:

- Raising fishermen's awareness of regulations and practices in the use of waterways/land
- Monitor and comply with the speed and behavior of drivers/vessels
- Raise fishermen's awareness of socio-economic development opportunities and social issues related to risks through the project's programs and trainings in the area.
- Appoint traffic regulators in the construction area of ports/anchorage areas to avoid storms.
- To raise people's awareness of regulations and practices on the protection of aquatic life and aquaculture and fishing activities.
- Ensure that emissions from each individual project are minimal.

Some measures in this phase go beyond the scope of individual projects and need to be implemented at a higher level:

- Regional/sectoral planning considering emissions, the carrying capacity of rivers/seas, and pollution control requirements.
- Establish inter-regional information-sharing mechanisms: Even if the sub-projects do not have direct hydrological connections, it is still essential to share information regarding the construction schedule, vessel density, and environmental status to minimize peak time overlaps, support early warnings, and share lessons learned.
- Strengthen independent environmental monitoring: It is necessary to mobilize an independent environmental monitoring unit (IEMC) for the entire project, ensuring close coordination between the relevant units involved in the project to share information, experiences, and methods for effectively identifying and addressing cumulative impacts. The IEMC should conduct periodic assessments and provide recommendations for adjusting mitigation measures based on actual implementation, contributing to improving the environmental protection effectiveness throughout the project's implementation.
- Recommend the application of digital technology in monitoring: Consider the use of cameras, environmental sensors, and vessel tracking systems to support real-time monitoring of air quality, water quality, and maritime traffic density, depending on the specific conditions of each locality.

● ***For the project operation phase:***

Comply with the strategic planning on environmental protection in the project area, including:

- Environmental protection areas and landscapes along rivers/seas near the port construction/mooring areas.
- No-construction zones: Coastal protection corridors, inland waterway protection corridors in river/sea areas, as specified in Clause 1, Article 79 of the Law on Marine and Island Resources and Environment No. 82/2015/QH13...

- The area of coastal/river protective forests that need to be maintained and protected.

Some measures during the operational phase also require coordination at the national or inter-regional level:

- Integrating guidelines from the National Climate Adaptation Plan for the period 2021–2030: Implementing measures to enhance resilience, reduce disaster damage, improve local environmental management capacity, while creating conditions for localities to share practical lessons.
- During operation, measures to protect outdoor workers, such as roofing, flexible working hours, and appropriate protective equipment, should be implemented to reduce harm from heat stress and extreme weather.
- Increasing investment in social infrastructure in subproject areas: Water supply, waste management, internal regional transportation, healthcare, and education.
- Supporting alternative livelihoods for affected fishermen: Implementing vocational training programs, supporting livelihood transition, providing access to preferential credit for households affected by changes in waterways, water quality, or restricted fishing areas.
- Improving access to public services: Enhancing communication, simplifying administrative procedures, and assigning staff to assist in subproject areas to ensure that people can easily access public services such as vessel registration, insurance, healthcare, and education.
- Establishing community feedback mechanisms: Developing systems to receive and address public feedback on environmental, traffic, and livelihood issues, ensuring transparency and timely adjustments.
- Organizing periodic training: Collaborating with local authorities to conduct training sessions on waterway traffic safety, environmental protection, disaster risk management, and sustainable livelihood development for fishing communities. Cumulative impact management in infrastructure projects is not only a technical requirement but also an essential part of the sustainable development strategy. Mitigation measures need to be designed flexibly, suitable for each phase and level of implementation, with the ability to connect the field and policy.
- Instead of focusing solely on individual solutions, projects should take a systemic, interdisciplinary, and inter-regional approach to managing cumulative impacts. Effective coordination among stakeholders, from implementing units to state management agencies and local communities, will be key to ensuring overall effectiveness, minimizing environmental risks, and promoting sustainable livelihood development in the context of increasingly complex climate change.

5.2 ROLES AND RESPONSIBILITIES OF ESMP IMPLEMENTATION

5.2.1. Institution

The tables and figures below summarize the roles and responsibilities of key stakeholders and their relationships in the implementation of the environmental protection plan.

- The contractor is responsible for implementing mitigation measures. Measures will be included in the bidding documents and costs will be included in the construction bidding packages.
- CSC is responsible for day-to-day monitoring of the implementation of mitigation measures, and the costs that will be included in the service contract with CSC.

- The Independent Social Environment Monitoring Consultant (IESMC) is responsible for periodic monitoring of the social environment, including assisting PMU in environmental monitoring and monitoring, training on environmental and social safety implementation, and reporting on the implementation of environmental protection plans through monitoring reports.

The organizational chart for the operation of environmental protection works during the preparation and construction phases of the Project is presented in the following figure:

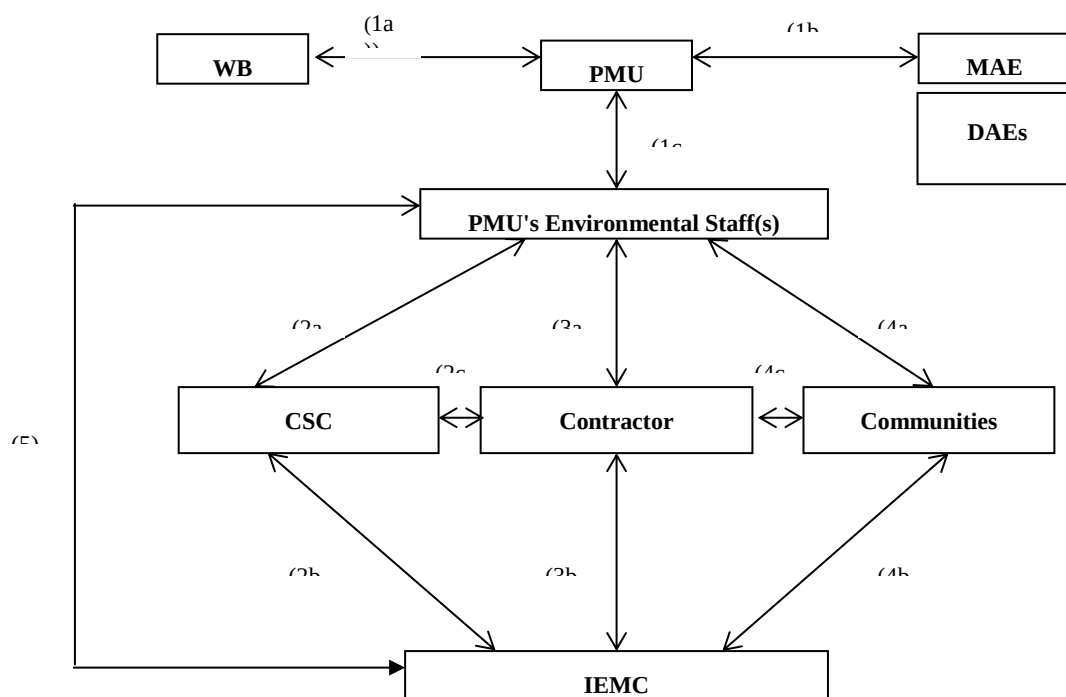


Figure 5.1: Organizational chart of ESMP implementation

5.2.2. Roles and Responsibilities

The roles and responsibilities of the key stakeholders are outlined in the Table below.

Table 5.2. Roles and responsibilities of key stakeholders

Unit	Environmental and social responsibility
Investor/ Project Management Board	Responsible for overall supervision of the implementation of the Project, including E&S compliance. Concretely (i) Closely coordinate with local authorities in community participation in the implementation of the Project (ii) Ensure that the detailed design of the project adequately incorporates the environmental impact mitigation measures proposed in the ESMP (iii) Monitor and ensure the full integration of ESMP requirements into bidding documents and contract agreements. (iv) Establish and effectively operate an E&S management system to support the implementation of ESMP (v) Acting as the focal point for coordinating and representing the implementation of the ESMP with the Department of Agriculture and Environment (DAE), MAE, and the World Bank. (vi) Implement and monitor measures and actions in the ESCP, and compile ESCP progress reports as part of project monitoring

Unit	Environmental and social responsibility
Investor's and Environmental and Social Officer (ESO)	Responsible for overseeing the implementation of the project's ESMP. Specifically, ESO will be responsible for: (i) Monitor the integration of ESMP requirements into detailed technical designs, construction and installation bidding documents, and contractual documents. (ii) Monitoring the integration of ESMP and RP requirements into terms of reference, bidding documents for Construction Supervision Consultants (CSCs) and Independent Environmental and Social Monitoring Consultants (IESMC); (iii) Provide input and participate in the CSCs and IESMC consultant selection process (iv) Review of monitoring reports submitted by IESMC and CSC (v) Supervise, monitoring, and recommending corrective action for violations, with the professional support of IESMC (vi) Field inspections to confirm compliance or recommend corrective actions as necessary (vii) Coordinate with the E&S staff at each sub-project to handle E&S and resettlement issues of each subproject. (viii) Consolidate the content of E&S compliance and implementation in the report to the relevant agencies and the World Bank.
Technical and E&S team at each sub-project	Responsible for supervising the implementation of assigned sub-projects, including compliance with environmental and social regulations (i) Assign a full-time officer in charge of E&S at each subproject (ii) Coordinate closely with local authorities to promote community participation in the implementation process (iii) Review reports submitted by the CSC and IESMCs related to the subproject (iv) Supervise and monitor the implementation of ESMP at each subproject (v) Field inspections to confirm compliance and propose remedial solutions with the assistance of CSC and IEMC (vi) Proposing solutions and handling of socio-social problems and resettlement arising from the sub-project; and (vii) Preparation of periodic reports on the social environment to be submitted to the PMU
Independent Environmental and Social Monitoring Consultant (IESMC)	IESMC is the independent monitoring unit, responsible for supporting the PMU in ensuring compliance with the project's E&S requirements. Specifically: - Support the PMU in establishing and operating the E&S management system. - Organize training for the PMU, CSC, Contractors, and relevant stakeholders on the project's E&S management requirements, to raise awareness and strengthen implementation capacity. - Conduct regular field visits to assess compliance with the ESMP, RP, and LMP; and propose corrective and improvement measures when necessary. - Monitor the implementation of recommended corrective measures to ensure that E&S issues are fully addressed and resolved on schedule. - Arrange and organize training sessions to raise awareness on Gender/Labor influx for all Contractors, CSC teams, and PMU staff. The cost of this training is included in the consulting service contract. - Carry out periodic environmental quality monitoring in accordance with the approved monitoring plan. Prepare the consolidated periodical monitoring reports on the implementation of the project's E&S requirements.

Unit	Environmental and social responsibility
Construction Supervision Consultant (CSC)/ Environmental Supervisor (ES)	The CSC is responsible for regular supervision on the contractor's compliance with E&S requirements during the construction phase. Specifically: - Assign qualified E&S officers to oversee the contractor's implementation of E&S mitigation measures and ensure compliance. - Support the PMU in reporting and maintaining close coordination with the local community. - Carry out daily on-site E&S monitoring, record emerging issues, and propose timely corrective actions. - Follow up and verify the implementation of recommended corrective measures to ensure that E&S issues are fully addressed in a timely and effective manner. - Prepare monthly E&S monitoring reports and submit them to the PMU.
Contractors	The contractor is responsible for implementing environmental, social, health, and safety (ESHS) requirements in accordance with the ESMP and related documents. Specifically: - Appoint ESHS staff and designate a focal point for receiving and addressing grievances. - Prepare the Contractor's ESMP (C-ESMP) for each construction package and submit it to the PMU and CSC for review and approval prior to the commencement of construction. - Ensure all necessary construction permits are obtained in compliance with current regulations (e.g., traffic control permits, fire safety permits, etc.) before starting construction. - Implement mitigation measures identified in the ESMP, C-ESMP, bidding documents, etc. - Conduct training to ensure that all staff and workers understand the procedures and their responsibilities under the environmental management program. - Maintain effective communication with the community and local authorities to address issues related to construction and ESHS. - Report to the PMU, the Technical/Environmental-Social teams at each subproject, and the CSC on progress, challenges, incidents, and corrective actions. - Coordinate with competent authorities and stakeholders to handle E&S incidents if they occur.
Local Communities	- Participate in environmental and social monitoring activities on a voluntary basis.
Ministry of Agriculture and Environment Provincial Departments of Agriculture and Environment	- Monitor compliance with Government environmental requirements. - Monitoring and inspection of environmental assurance activities within the project area - Inspect and handle cases of violations. - To guide and train ward/commune-level officials responsible for local economic management. - Coordinate with stakeholders, participate in research, investigation and resolution of arising environmental incidents.

5.3 ENVIRONMENTAL COMPLIANCE FRAMEWORK

5.3.1. Environmental and Social Responsibility of PMU/Detailed Design Consulting

During the preparation of TORs for consulting services and bidding documents for construction, the PMU will also work closely with consultants to ensure that: i) contract package division and cost estimates include the implementation of the ESMP, including independent monitoring services, environmental sampling/monitoring and compliance monitoring, reporting, etc.; ii) ESCOPs and relevant general as well as site-specific mitigation measures are incorporated into the bidding documents; iii) environmental monitoring and included in the scope of work assigned to the construction supervision consultant.

At the detailed design stage, the PMU will coordinate closely with detailed design engineers to ensure that green/landscape, environmentally friendly solutions, and relevant mitigation measures proposed in the ESIA/ESMP are reviewed and integrated into the technical design where appropriate.

During construction, the PMU will work closely with the supervision consultant to monitor contractors' compliance and report to relevant authorities. The PMU will also instruct the supervision consultant and contractors on actions to be taken in case of issues, incidents, or accidents, etc.

The PMU will assign at least one qualified staff member as an Environmental Officer (EO) and at least one qualified staff member as a Social Officer (SO) throughout project implementation.

- The EO will monitor environmental issues and oversee the subproject's safety compliance. The EO will be supported by the independent environmental supervision consultant, dedicated ES officers at each subproject, environmental officers of the construction supervision team, as well as the contractors.
- The SO will monitor and coordinate the social/resettlement aspects of the Project. The SO will be supported by the independent resettlement supervision consultant, social officers of the construction supervision team, as well as the contractors.

5.3.2. Environmental Responsibility of Contractors

The contractor is responsible for implementing measures to control and mitigate adverse impacts arising from construction activities. The mitigation measures specified in the ESMP must be fully applied to prevent impacts on the local community and the environment throughout the construction phase.

When remedial measures cannot be effectively implemented during construction, the contractor must carry them out during the completion stage (and prior to issuing the completion acceptance certificate).

The contractor's responsibilities include, but are not limited to, the following tasks:

- Comply with relevant legislative requirements on environmental management, community health, and safety.
- Perform the work within the scope of the contract requirements and other bidding clauses
- Assign a representative of the construction team to participate in site supervision organized by the Environmental Supervisor (ES) of the CSC.
- Implement remedial actions under the instructions of the Environmental Officer (EO), Social Officer (SO) of the PMU, and the Environmental Supervisor (ES) of the CSC.
- In case of non-compliance or non-conformance, conduct investigation and propose mitigation measures, as well as implement corrective actions to minimize E&S impacts;

- Suspend construction activities when they generate adverse impacts beyond the guidance provided by the EO and ES. Propose and implement corrective activities or apply alternative construction methods, if necessary, to mitigate environmental impacts. Failure to comply may result in suspension of construction or other penalties until the issue is satisfactorily resolved as required by the EO of PMU and ES of CSC
- If the contractor proposes to use raw material sources not mentioned in the subproject ESIA, the contractor shall report to the CSC and PMU and coordinate with them to conduct an environmental assessment of these sources to evaluate their compliance with national environmental requirements. Only compliant sources may be used under this project.
- The contractor shall be responsible for implementing remedial measures at its own cost. The contractor will also be liable for paying damages arising from non-compliance with the ESMP and/or applicable environmental regulations.

5.3.3. Contractor's Environmental and Social Management Plan (C-ESMP)

After signing the contract, the contractor will be required to prepare and submit a Contractor's Environmental and Social Management Plan (C-ESMP) for each contract package and submit it to the CSC and PMU for review and approval.

The objective of the C-ESMP is to provide guidance for environmental and social management of proposed works/activities at the Project construction sites. This is to ensure that contractors – as well as subcontractors (if any) – carry out their work with the minimum possible environmental impacts. The C-ESMP will detail how the contractor will mitigate impacts from construction activities and record the contractor's responses for inspection, supervision, verification, internal review, and corrective actions or improvements of environmental compliance conditions. The C-ESMP must be site-specific and include details of control measures to be implemented on-site to minimize any potential environmental impacts from proposed works/activities. If proposed works/activities in the C-ESMP are modified in the Contract, the contractor shall revise the C-ESMP to reflect such changes or modifications.

The contents of the C-ESMP must include the following:

- (i) Applicable policies/regulations, providing a definition of the contractor's environmental policy and a statement of commitment to implementing the C-ESMP.
- (ii) A brief description of the document; Date of issuance; Revision status; Distribution list; and details of staffing and access.
- (iii) Applicable laws and regulations related to the requirements in the Project ESMP. Identification of contractor permits, licenses, and approvals relevant to the C-ESMP.
- (iv) Details of how the environmental and social impacts identified in the subproject ESIA will be managed on-site, including: 1) specific measures to mitigate impacts during construction; 2) ESCOP; 3) the Contractor's ESMP to be developed after contractor selection and prior to construction commencement; and 4) the Contractor's Dredging Management Plan, which the contractor is required to prepare.
- (v) Detailed environmental and social training that all contractor staff (including subcontractors) must undertake. At a minimum, all contractor personnel working at project sites must: i) be familiar with and understand the C-ESMP for the works; ii) be aware of their environmental responsibilities and legal obligations on-site; iii) comply with the workers' Code of Conduct; and iv) participate in health, safety, and emergency response training.
- (vi) Specific capacities, support mechanisms, and resources necessary for adequate implementation of the C-ESMP. The detailed environmental responsibilities of all contractor

staff, including subcontractors working on-site, with appropriate knowledge, skills, and training for specific tasks, shall be defined.

(vii) The contractor shall be responsible for preparing monthly environmental–social reports, as part of the Progress Report required in the bidding documents, including ad-hoc reports if any, for submission to the project owner. The contents of these reports may include the following details:

- Implementation of the Contractor’s C-ESMP in compliance with the agreed program.
- Difficulties encountered in implementing the C-ESMP and recommendations for future improvement.
- Identification of non-compliances and non-conformances, with proposed corrective actions.
- Reports from subcontractors related to C-ESMP implementation, including minutes of meetings and discussions organized by the contractor.

5.3.4. Responsibilities of the Contractor's Safety and Environment Officer (C-ES)

The contractor is required to appoint a qualified individual as the Contractor’s Environmental and Safety Officer (C-ES) at the construction site. The C-ES must be trained in environmental management and possess the necessary skills to communicate environmental management knowledge to all relevant staff involved in the contract. The C-ES shall be responsible for monitoring compliance with the contractor’s ESMP and environmental technical specifications. The responsibilities of the C-ES include:

- Conducting on-site environmental monitoring to assess the contractor’s ESHS performance, equipment, and construction methods related to pollution control, as well as the adequacy of mitigation measures implementation.
- Monitoring compliance with environmental protection solutions, pollution prevention methods, control measures, and contractual requirements.
- Supervising the implementation of environmental impact mitigation measures.
- Preparing report on E&S data and site environmental conditions.
- Investigating complaints and recommending corrective actions as required.
- Advising the contractor on environmental improvement, awareness, and proactive implementation of pollution prevention solutions.
- Proposing appropriate mitigation measures to the contractor in cases of non-compliance and conducting additional monitoring as instructed by the PMU’s ES/ESO and the CSC.
- Reporting environmental issues to the contractor, ESO and ES (from PMU and CSC), submitting the contractor’s ESMP implementation reports to the PMU’s ESO, CSC’s ES, and other relevant agencies as required.
- Maintaining detailed records of on-site activities related to environmental matters.
- Utilizing or appointing qualified staff to implement required actions and measures to ensure labor-related issues are addressed, such as occupational health and safety (OHS) specialists to manage OHS matters.
- Preparing the Contractor’s Labor Management Procedures (LMP) and Contractor’s ESMP (C-ESMP), including OHS provisions, applicable to contracted workers under the project.
- Submitting the contractor’s LMP and C-ESMP to the PMU/CSC for review and approval before mobilizing staff to the project site.

- Supervising subcontractors' works, including their compliance with the contractor's LMP and C-ESMP.
- Keeping employment records for contracted workers (including subcontractors), including documentation verifying minimum working age as stipulated in the LMP.
- Providing regular training for contracted workers on topics including, but not limited to, occupational health and safety, social risks such as GBV, SEA/SH, and the Code of Conduct to maintain good relations with local communities.
- Requiring primary suppliers to identify and address risks related to child labor, forced labor, GBV, SEA/SH, and OHS for their workers.
- Establishing and implementing a grievance mechanism for contracted workers based on the GRM outlined in this LMP, ensuring that worker complaints are addressed promptly, and reporting the status of grievances and resolutions to the CSC and PMU. This grievance mechanism shall be part of the contractor's LMP.
- Ensuring that all contractors and subcontractor workers understand and sign the Code of Conduct before commencing work.
- Taking all necessary measures to address risks of sexual exploitation and abuse (SEA) and sexual harassment (SH) as stipulated in the contractor's LMP/C-ESMP and ensuring full compliance with these measures.
- Reporting incidents at the construction site and labor/OHS implementation status to the PMU in a timely manner.

Incident Reporting

Contractors shall notify the Construction Supervision Consultant and the Project Owner of any incidents listed below within the agreed timeframe:

- Any violation of national laws, regulations, or international agreements.
- Any serious accidents or fatalities.
- Significant impacts resulting in personal property damage, such as traffic accidents, damage to houses/roads, or other incidents.
- Severe surface water/groundwater pollution.
- Failures of dikes/embankments at temporary disposal sites causing serious environmental pollution.
- Any fire incident linked to worker behavior or labor influx.
- Any complaints related to sexual harassment, child abuse, or other child-related incidents.
- Complaints received regarding pollution or damage.

5.3.5. Responsibilities of the Independent Environmental and Social Monitoring Consultant (IESMC)

Independent Environmental and Social Monitoring Consultant (IESMC) will be contracted by the PMU to provide several environmental protection training courses for relevant parties and to carry out environmental inspections. The IESMC will perform monitoring tasks, including:

- Providing support to the PMU in establishing and operating the environmental and social management system (EMS), coordinating with the CSC team to train Contractors on the Project's ESHS management requirements.

- Organizing training courses and implementing capacity building activities for the PMU, CSC, Contractors, and relevant stakeholders on ESHS during Project implementation. This includes conducting training sessions to raise awareness on Gender/Labor Influx issues for Contractor staff, CSC staff, and PMU officers.
- Carrying out random field inspections to certify compliance or propose timely corrective/improvement actions.
- Assessing environmental quality in areas affected by construction activities (including site observations, reviewing environmental quality data provided by the CSC, reviewing other available documents, and conducting additional sampling if necessary)
- Reviewing the Contractor's environmental compliance, including the implementation of mitigation measures and related documentation
- Reviewing the compliance of the PMU and CSC with the ESMP
- The IESMC will also provide guidance and technical support to the PMU and EO regarding environmental and social issues.

5.3.6. Responsibilities of a Construction Supervision Consultant (CSC)

During the construction phase, the CSC, qualified as required by the PMU, will carry out regular environmental supervision. The CSC will assign Environmental and Social (ES) staff, who will be responsible for inspecting and supervising all construction activities to ensure that the mitigation measures set out in the ESMP are properly implemented and that the Project's adverse E&S impacts are minimized. The CSC will recruit a sufficient number of Environmental Supervision Engineers with adequate knowledge of environmental protection and construction project management to perform the required tasks and supervise the Contractor's implementation. Specifically, the CSC's ES staff will:

- Review and assess, on behalf of the PMU, whether the construction design meets the requirements of mitigation measures and impact management under the ESMP
- Review and approve C'ESMPs
- Coordinate with the PMU's Environmental Officer (EO) in reviewing environmental compliance at proposed new material and quarry sites, and advise the PMU on whether these extraction sites qualify for Project use
- Verify and confirm with the PMU's environmental monitoring procedures, including parameters, monitoring locations, equipment, and monitoring results
- Supervise the Contractor's implementation of the C-ESMP, including enforcement, proposing timely additional measures to improve mitigation efforts, and providing corrective guidance.
- Prepare monthly reports on the Contractor's ESHS compliance status.
- Review payment requests related to environmental mitigation costs, if any.

5.3.7. Compliance with laws and contractual requirements

Construction activities will comply not only with the contractual requirements on pollution control and environmental protection but also with the laws on pollution control and environmental protection of the Socialist Republic of Viet Nam.

All reports on construction methods submitted by the Contractor to the CSC for approval will also be sent to the ES for review to determine whether pollution control and environmental protection measures are adequately included.

The ES will also review the progress of work items to check for any violations of relevant environmental laws, thereby preventing potential breaches.

The Contractor will periodically provide copies of relevant documents to the E&S staff of PMU and CSC. These documents shall at least include Construction Progress Reports, updated Construction Method Statements, applications for permits/registrations under environmental protection laws, and all valid permits/registrations. The Contractor's on-site E&S staff (C-ES) and the CSC's ES will also have the right to access the Site Logbook upon request.

Upon receipt of these documents, the SEO and ES will advise the PMU's Environmental Officer (EO) and the Contractor on cases of non-compliance with laws and contractual requirements on environmental protection and pollution control, in order to guide subsequent actions. If the SEO and ES conclude that a permit/registration application or any preparatory work for pollution control and environmental protection may not comply with the method statement or may potentially lead to violations of pollution control and environmental protection requirements, they will provide recommendations to the Contractor and the PMU.

5.3.8. Environmental complaints and sanctions system

The bidding documents will require the Contractor to arrange an Environmental, Social, Health, and Safety (ESHS) Performance Security in the amount of 1–3% of the contract value. In the event of serious non-compliance, environmental pollution, or social issues that the Contractor fails to remedy within the permitted timeframe, funds from the ESHS Performance Security will be used to pay a third party mobilized by the PMU to resolve these issues.

On the other hand, if CSC/IESMC/PMU detect non-compliance by the Contractor with the ESMP and environmental regulations during site supervision, up to 2% of the Contractor's monthly interim payment will be withheld. The Contractor will be granted a grace period (determined by CSC / PMU) to correct the violation. If the Contractor satisfactorily implements corrective actions within the grace period (confirmed by CSC / PMU), no penalties will be applied, and the withheld funds will be released to the Contractor. However, if the Contractor fails to carry out the necessary corrective measures within the grace period, the Contractor shall bear the costs of engaging a third party to rectify the damage (deducted from their payments).

In the event that IESMC/CSC/PMU fails to detect the Contractor's non-compliance with environmental regulations, these units shall be responsible for covering the costs of remedying the violations.

Based on this Environmental and Social Compliance Framework, which includes the penalty system, CSC will develop a detailed penalty system for environmental and social non-compliance and submit it to the PMU for approval and implementation.

5.3.9. Reporting mechanism

The PMU is responsible for conducting internal supervision of the implementation of the reporting regime. In addition, the PMU will hire an independent monitoring agency (EMA) to carry out independent monitoring of the implementation of the Resettlement Plan (RP) and to assess the living standards of those affected during and after the completion of resettlement.

Both internal and independent monitoring will be regular (monthly for internal monitoring and six months for independent monitoring). A final project assessment of the implementation of the resettlement is mandatory and a report will be prepared to confirm whether the ESF's objectives are being achieved. Tools for monitoring and reporting on ESMP implementation are summarized in the Table below.

Table 5.3. Reporting Mode

No.	Report prepared by	Submit to	Reporting frequency
1	Contractors	PMU	Once before commencement and monthly during construction
2	Construction supervision consultancy	PMU	Weekly, monthly
3	Community Monitoring	PMU	Upon receiving complaints regarding the implementation of the Project's safety instruments
4	IESMC	PMU	Every three months (quarterly)
5	PMU	WB	Every six months (biannually)

5.4 ENVIRONMENTAL MONITORING PROGRAM

5.4.1. Construction phase

Monitoring and environmental observation during the construction phase of the Project's work items are presented in the table below. Environmental management and monitoring will be carried out by the Project Owner (Agricultural Project Management Unit) with the support of consultants or service providers.

a. Monitoring of ambient air quality, noise, and vibration

- Sampling locations:
 - Lach Hoi subproject: 01 location at Tran Hung Dao Street, Quang Tien Ward, Thanh Hoa Province, opposite Lach Hoi Fishing Port
 - Lach Bang subproject: 01 location at Lien Hung Residential Group, Hai Binh Ward, Thanh Hoa Province, opposite Lach Bang Fishing Port
 - Tam Quan subproject: 01 location at the intersection of Ham Tu Street and Nguyen Chi Thanh Street, Tam Quan Bac Ward, Binh Dinh Province
 - Khanh Hoa subproject: 01 location at the intersection of Ba Thang Tu Street and Nguyen Trong Ky Street, Cam Linh Ward, Khanh Hoa Province
 - Kien Giang subproject: 01 location at the residential road of Nga Bat Hamlet, Tay Yen A Commune, Kien Giang Province
 - Bach Long Vi subproject: 01 location at the coastal road junction, near Bach Long Vi fish sauce workshop, Hai Phong City.
- Monitoring parameters: TSP, noise, vibration, SO₂, CO, NO₂.
- Frequency: once every 03 months.
- Applicable standards:
 - QCVN 05:2023/BTNMT – National Technical Regulation on Ambient Air Quality.
 - QCVN 26:2010/BTNMT – National Technical Regulation on Noise
 - QCVN 27:2010/BTNMT – National Technical Regulation on Vibration.

b. Monitoring of solid waste and hazardous waste

- Segregation, classification, and collection of domestic solid waste, common solid waste, and hazardous waste in accordance with the Law on Environmental Protection and other related regulations.
- Periodic transfer of domestic solid waste, common solid waste, and hazardous waste to competent, licensed units for collection, transportation, and treatment in compliance with regulations.

c. Monitoring seawater quality

- Khanh Hoa subproject (investment in the construction of a key fishing port at the Khanh Hoa Major Fishery Center):
 - Sampling locations: 02 locations (01 to the northeast, about 100 m from the residential jetty embankment and dredging site; 01 to the southwest, about 100 m from the residential jetty embankment and dredging site).
 - Monitoring parameter: TSS.
 - Frequency: once per week during the dredging construction phase.
 - Applicable standard: QCVN 10:2023/BTNMT – National Technical Regulation on Seawater Quality – Coastal Waters.
- Bach Long Vi subproject (upgrading the fishing port combined with storm shelter anchorage for fishing vessels on Bach Long Vi Island):
 - Sampling locations: 02 locations (01 to the northeast, about 100 m from the dredging site; 01 to the southwest, about 100 m from the dredging site).
 - Monitoring parameter: TSS.
 - Frequency: once per week during the dredging construction phase.
 - Applicable standard: QCVN 10:2023/BTNMT – National Technical Regulation on Seawater Quality – Coastal Waters.

d. Monitoring of dredged materials

- Locations: 02 samples at each subproject with dredging activities (04 subprojects: Tam Quan, Khanh Hoa, Kien Giang, Bach Long Vi).
- Monitoring parameters: Salinity, pH, As, Hg, Cd, Cu, Pb, Zn, Cr.
- Frequency: once every 03 months.
- Applicable standard: QCVN 43:2017/BTNMT.

e. Monitoring erosion and sedimentation

- Locations: at the construction sites of the subprojects.
- Frequency: continuous during the construction phase.
- Method: observations by specialists/technical staff.
- Responsibility: CSC (according to construction supervision duties) and the Project Owner.

5.4.2. Operational phase

After completing the construction of the project's components, the Project Owner will hand over the ports to the Port Management Board for management, operation, and maintenance in accordance with regulations. The operation and management units shall comply with annual

environmental mitigation measures and monitoring requirements in line with environmental protection regulations.

a. Wastewater quality monitoring

a.1. Automatic and continuous wastewater monitoring

- Sampling location: 01 location at the discharge point of the WWTP with a capacity of 600 m³/day at the Kien Giang Major fishery center construction investment Subproject.
- Monitoring parameters: Flow (inlet and outlet), pH, temperature, TSS, COD, Ammonium.
- Data transmission: Direct transmission to the Department of Agriculture and Environment of Kien Giang Province as required by law.
- Applicable standard: QCVN 40:2011/BTNMT – National Technical Regulation on Industrial Wastewater (Column B, Kq=1.0 and Kf=1.0).

a.2. Periodic monitoring of treated wastewater quality

- Sampling locations: at 04 discharge points of WWTPs:
 - 01 at the WWTP of the Thuy Tan fishing port subproject
 - 01 at the WWTP of the Lach Hoi fishing port upgrading and repair subproject;
 - 01 at discharge point of the WWTP in Hai Thanh ward, Lach Bang fishing port upgrading and repair subproject;
 - 01 at discharge point of the WWTP in Hai Binh ward, Lach Bang fishing port upgrading and repair subproject.
- + Monitoring parameters: Indicators in accordance with QCVN 11-MT:2015/BTNMT – National Technical Regulation on Seafood Processing Wastewater (Column B, Kq=1.2 and Kf=1.1).
- + Frequency: Once every 3 months.
- + Applicable standard: QCVN 11-MT:2015/BTNMT – National Technical Regulation on Seafood Processing Wastewater (Column B, Kq=1.2 and Kf=1.1).
- Monitoring at 02 discharge points of WWTPs at the Kien Giang and Khanh Hoa subprojects:
 - 01 at the WWTP of the fishing port subproject at the Khanh Hoa major fishery center;
 - 01 at the WWTP of the fishing port subproject at the Kien Giang major fishery center.
- + Monitoring parameters: Indicators in accordance with QCVN 40:2011/BTNMT – National Technical Regulation on Industrial Wastewater (excluding parameters already monitored automatically).
- + Frequency: Once every 3 months.
- + Applicable standard: QCVN 40:2011/BTNMT – National Technical Regulation on Industrial Wastewater (Column B, Kq=1.0 and Kf=1.0).

b. Solid waste and hazardous waste monitoring

- Classification, segregation, and collection of domestic solid waste, ordinary solid waste, and hazardous waste in accordance with the Law on Environmental Protection and other relevant regulations.

- Periodic transfer of domestic solid waste, ordinary solid waste, and hazardous waste to licensed and qualified units for collection, transportation, and treatment in compliance with regulations.

c. Erosion and sedimentation monitoring

- Sampling location: At fishing port areas and surrounding areas.
- Monitoring frequency: Continuous during operation.

5.5 TRAINING AND CAPACITY BUILDING PROGRAM ON ENVIRONMENTAL MANAGEMENT

The table below provides a sample training program on safeguard policies. The training programs will be developed and conducted by a Technical Assistance Group to implement safeguard policies for the PMU. The PMU/IESMC, with support from the Technical Assistance Group, will provide training for environmental and social staff of contractors, CSCs, and other groups.

- Trainee groups: PMU management staff and environmental-social officers, Construction Supervision Consultants (CSCs), construction contractors, PMU procurement officers, representatives of stakeholders, and local communities in the project area.
- Training schedule: Training will be organized at least one month before the implementation of the first construction contract. Subsequent training sessions may be adjusted to align with the construction schedule of project components.
- Training frequency: The basic training programs outlined in the table below will be delivered every 6 months, with content updated and tailored to the components under implementation. Training for PMU staff is expected to continue during the initial years of the Project. Three-day training sessions for CSCs and contractors are also expected to be held twice a year for at least 2 years.

Table 5.4. Training program, capacity building in environmental management

I. SUBJECTS	PROJECT MANAGEMENT UNIT
Course Name	Environmental/social monitoring and reporting regime
Attendees	Managers, officials in charge of environmental and social issues;
Training Frequency	Immediately after the project takes effect, but at least one month before the first bidding package starts. The next course will be planned upon request.
Training Period	1 day
Training content	<i>General environmental/social management related to the project includes:</i> • Requirements of the World Bank and the Department of Agriculture and Environment, Ministry of Agriculture and Environment • Defining the roles and responsibilities of the PMU in environmental and social management. • Coordination with competent authorities and relevant stakeholders. • Reporting and decision-making mechanisms for arising environmental/social issues. <i>Environmental monitoring for the Subproject includes:</i> • Requirements for environmental and social monitoring. • Tracking and implementing mitigation measures.

I. SUBJECTS	PROJECT MANAGEMENT UNIT
	• Community participation in environmental and social assessment. • Guidance and supervision of contractors, CSC, and community representatives in carrying out environmental/social monitoring. • Templates used in the environmental/social monitoring process. • Risk response and control. • Guidance and supervision of contractors and CSC regarding grievance management. • Procedures for receiving and submitting grievance forms. • Mechanisms for monitoring and addressing complaints. • Other identified issues.
Implementation responsibilities	IESMC, with the help of the Technical Support Team to implement safeguard policies and the PMU
II. SUBJECTS	CSC, CONTRACTOR, WARD/COMMUNE REPRESENTATIVE, COMMUNITY REPRESENTATIVE
Course Name	Implementation of impact mitigation measures
Attendees	CSC, construction engineer, construction manager. Employees in charge of environmental and social issues, contractors; Representatives of local governments; Representatives of residential areas/neighborhoods
Training Frequency	Immediately after awarding the contract to the contractor with updated information on the requirements
Training Period	2 days of training for CSC and contractors, and 1 day of training for others
Training content	• Overview of environmental/social monitoring • Environmental/social monitoring requirements - Regulations of the World Bank and Vietnamese legislation - Compliance and performance evaluation criteria • Roles, responsibilities, coordination, and reporting procedures between the PMU, CSC, and contractors • Content and methods of environmental monitoring • Identification of risks and impacts; emergency response procedure • Introduction of monitoring forms (site diaries, incident reports, compliance checklists) and instructions on how to complete them • Instructions on proper storage and submission of reports • Grievance redress mechanism - Procedures for receiving, handling, and responding to grievances - Roles of contractors and CSCs in supporting grievance resolution on site • Preparation and submission of reports • Other identified issues
Implementation responsibilities	Independent Environmental and Social Monitoring Consultant (IESMC); with the help of the Technical Assistance Team for the implementation of safeguard policies and the PMU.
III. SUBJECTS	COMMUNITY/WORKERS
Course Name	Environmental safety and sanitation
Attendees	Representatives of workers (team leaders) working directly for the

I. SUBJECTS	PROJECT MANAGEMENT UNIT
	components of the project
Training Frequency	When appropriate
Training Period	One day of presentation and one day of presentation at the construction site
Training content	• Summary of safety issues and environmental overview. • The main issues require the attention of the community and construction workers to reduce safety risks (roads, waterways, equipment, machinery, etc.) as well as reduce pollution (dust, emissions, oil spills, waste management...); Personal safety when working at high altitudes, near power sources, underwater, etc • Management of safety and environmental sanitation at construction sites and at workers' camps ○ Regulations on the use of labor protection (PPE), fire protection, first aid, etc ○ Occupational hygiene, garbage and wastewater treatment • Mitigation measures applied at construction sites and at workers' camps • Safety measures for electricity, mechanics, transportation, air pollution • Emergency handling methods: incident reporting process, escape diagram, emergency phone number • Rights and responsibilities of workers in environmental protection and occupational safety • Mitigation measure for E&S and monitor the implementation of other issues once identified. • Contractor Code of Conduct
Implementation responsibilities	contractors, for all workers before construction Independent Environmental and Social Monitoring Consultants (IESMC), during periodic monitoring sessions

5.6 ESTIMATE THE COST OF ESMP IMPLEMENTATION

5.6.1. Expenses for environmental monitoring and monitoring

According to the local environmental monitoring unit price, the estimated cost of monitoring the environmental quality of the project is shown in the table below:

Table 5.5. Estimation of sampling and analysis costs during the construction phase

No.	Description	Unit	Number of monitoring sessions	Number of samples in batch ¹	Unit Price	Amount	
						(1 USD = 25,000 VND)	
					VND	VND	USD
1	Lach Hoi fishing port upgrading and expansion subproject						
	Air, noise, vibration	sample	8	1	1,500,000	12,000,000	480
2	Lach Bang fishing port upgrading and expansion subproject						

No.	Description	Unit	Number of monitoring sessions	Number of samples in batch ¹	Unit Price VND	Amount (1 USD = 25,000 VND)	
						VND	USD
	Air, noise, vibration	sample	8	1	1,500,000	12,000,000	480
3	Tam Quan storm shelter and fishing port construction investment subproject						
	Air, noise, vibration	sample	12	1	1,500,000	18,000,000	720
	Sediment	sample	12	3	1,500,000	54,000,000	2,160
4	Khanh Hoa Major Fishery Center construction investment subproject						
	Seawater	sample	12	2	3,500,000	84,000,000	3,360
	Air	sample	12	1	1,500,000	18,000,000	720
	Sediment	sample	12	2	1,500,000	36,000,000	1,440
5	Kien Giang Major Fishery Center construction investment subproject						
	Air, noise, vibration	sample	12	1	1,500,000	18,000,000	720
	Sediment	sample	12	2	1,500,000	36,000,000	1,440
6	Bach Long Vi storm shelter and fishing port construction investment subproject						
	Seawater	sample	8	2	3,500,000	56,000,000	2.240
	Air, noise, vibration	sample	8	1	1,500,000	12,000,000	480
	Sediment	sample	8	2	1,500,000	24,000,000	960
7	Report Preparation (3 months/3 years)	Report	12	1	20,000,000	240,000,000	9.600
TOTAL						620.000.000	24.800

5.6.2. Cost of independent environmental monitoring

According to the project implementation schedule (from 2026 to 2029) and requires periodic IESMC mobilization. The cost of Independent Environmental and Social Monitoring (IESMC) is estimated in the following table:

Table 5.6. Estimate the cost of independent environmental monitoring

(Exchange rate: 1 USD = 25,000 VND)

No	Description	Unit	Quantity	Unit Price (VND)	Amount (VND)	Amount (USD)
1	Expert remuneration	Man-month	90	30,000,000	2,700,000,000	108,000
2	Accommodation, per diem allowance	Man-day	450	700,000	315,000,000	12,600
3	Travel costs	Man-trip	120	5,500,000	660,000,000	26,400
4	Stationery and Communications	month	120	3,000,000	360,000,000	14,400
	Sum				4,035,000,000	161,400

Note: Independent environmental and social monitoring mobilization experts need to be inclusive of environmental, social, and gender areas to align with the environmental and social issues of the project

5.6.3. Estimation of training costs

According to the project implementation progress and the requirements for periodic mobilization of IESMC and CSC as well as the expected number of bidding packages. The estimated cost of the training program on environmental/social monitoring management competencies is presented in the following table:

Table 5.7. Estimation of training costs

(Exchange rate: 1 USD = 25,000 VND)

Training content	Target	Unit	Amount	Unit Price		Amount
				VND	VND	USD
A. Capacity-building training program on safeguard policy (conducted by IESMC)						
I. Training on environmental reporting and monitoring						
PMU	Environmental Officer; management officer in charge of the environment	Courses	4	As part of the cost to IESMC		
II. Implementation of mitigation measures						
All work items	Construction Supervision Consultant (CSC); construction engineer, site manager (2 times/1 pack x 14 packs)	Courses	28	As part of the cost to IESMC		
III. Environmental safeguard and sanitation						
All work items	Worker supervisors (Team Leaders/Foremen) (2 sessions per package × 14 packages)	Courses	28	As part of the cost to IESMC		

Training content	Target	Unit	Amount	Unit Price		Amount
				VND	VND	USD
B. Training on Gender, GBV/Labor influx (conducted by IESMC)						
All work items	Workers, CSC teams, and PMU staff (2 sessions per package × 14 packages)	Courses	28	30,000,000	840,000,000	36,236

5.6.4. Summary of ESMP implementation costs

The table below provides an estimated cost for implementing the Environmental and Social Management Plan (ESMP). The ESMP implementation costs³⁸ will include: (i) costs for implementing mitigation measures by the contractor, (ii) monitoring costs by the CSC, (iii) costs for the Independent Environmental Monitoring Consultant (IESMC), (iv) costs for environmental quality monitoring, and (v) costs for safety management training for the Project Management Unit (PMU), including technical support for implementing safety policies and training programs. The costs for implementing mitigation measures during construction will be part of the construction contract, while the costs for monitoring the contractor's Environmental and Social Management Plan (CESMP) by the Construction Supervision Consultant (CSC) will be included in the construction supervision contracts. Costs for PMU activities related to the ESMP are covered by the PMU's project management budget.

It should be noted that community participation in ESMP implementation is entirely voluntary, for the benefit of both the community and the project owner. Therefore, community members participating in ESMP monitoring will not receive wages.

The table below provides estimated costs for environmental-social quality monitoring and IESMC activities (in line with national practices) for reference purposes. However, final costs will be updated during the detailed design phase.

Table 5.8. Summary of ESMP implementation costs

Content	Project ESMP implementation costs	
	VND	USD
Mitigation during construction	As part of contracts	
Monitoring compliance with safety policies during construction	As part of the cost of hiring a Construction Supervision Consultant (CSC)	
Dedicated unit for environmental safety policies of the PMU	As part of the costs for the PMU	
Environmental quality monitoring (conducted by IESMC)	620,000,000	24,800
Independent Environmental and Social Monitoring Consultant (IESMC)	4,035,000,000	161,400

³⁸Exclude costs for the implementation of the RP and independently monitor the implementation of the RP.

Content	Project ESMP implementation costs	
	VND	USD
Environmental and social training (conducted by IESMC)	As part of the costs for IESMC	
Training on Gender, GBV/Labor influx (conducted by IESMC)	840,000,000	36,236

5.6.5. Project-level complaint settlement mechanism

Within the framework of Vietnamese law, citizens who make complaints have the right to protection. As part of the overall implementation of the project, the complaint resolution mechanism (GRM) will be developed by the EO, SO of the PMU, according to the procedure, the responsible person and contact information will be prepared. It will be easy to ensure that complaints will be handled and resolved at the lowest level as quickly as possible. This mechanism will provide a framework in which complaints about environmental and safety issues can be handled, complaints can be resolved, and disputes can be resolved in a timely manner. The GRM will be launched before the start of construction.

During the development process, the Complaint Resolution Mechanism (GRM) will also be managed by contractors under the supervision of CSC. Contractors will inform affected communities and communes of the availability of a complaint settlement mechanism to resolve complaints and problems related to the sub-project. This will be done through a public consultation and information disclosure process under which contractors will regularly communicate with the affected community and relevant agencies. Meetings will be held at least quarterly, monthly, project fact sheets will be published, announcements will be posted in local media, and announcements of upcoming activities will be posted. Contractors should provide contact information for any complaints when contractors communicate construction progress to the local community.

All complaints and corresponding actions taken by contractors will be recorded in the sub-project monitoring report. Claims and claims for damages can be made in the following ways:

- Verbally: directly to CSC and/or the contractor's security guard or representative at the regional office.
- In writing: by handing over or sending a complaint to specific addresses.
- By phone, fax, e-mail: to the CSC, security guard or the contractor's representative.

Upon receipt of the complaint, CSC and the Contractor's safety officer or representative will register the complaint in the complaint file and will record the facts related to the complaint thereafter, until the complaint is resolved. Immediately after receiving the complaint, it is necessary to copy the complaint into 4 copies. The original will be kept in the file, a copy will be kept by the contractor safety officer, a copy will be sent to CSC, and the final copy will be sent to the PMU within 24 hours of receiving the complaint.

The information documented in the complaint will include:

- Date and time of complaint.
- The complainant's name, address, and contact details.
- A short description of the complaint.
- Actions are taken to resolve the complaint, including who to contact and detect at each stage of the complaint settlement process.
- The date and time when the complainant were contacted during the settlement process.

- Final decision of the complaint.
- The date, time and manner in which the complainant was notified.
- Signature of the complainant when the decision is issued.

Small complaints will be resolved within a week. Within two weeks (and weeks thereafter), a written response will be sent to the complainant (by hand, fax, e-mail) outlining the procedures to be carried out and the process by date.

The main goal is to solve the problem as quickly as possible by the simplest means, involving as few people as possible and at the lowest possible level. Only if the problem cannot be solved at the simplest level and / or within 15 days, then other authorities will step in. Such a situation may arise, for example, when a claim for damages is made, the amount payable cannot be settled, or the causes of the damage are identified.

Complaint and complaint settlement procedures shall be carried out as follows:

Level 1 – People's Committee of commune/ward

The affected household shall submit its complaint to one of the officials of the commune/ward People's Committee, through the village/hamlet head or directly to the commune People's Committee, in writing or orally. The officer(s) of the commune/ward People's Committee or the village head shall notify the ward/commune People's Committee of the complaint. The People's Committee of the commune/ward will work directly with the affected households and will come up with a plan to settle the complaint within 5 working days after receiving the complaint. The Secretariat of the People's Committee of the commune/ward is responsible for making records and recording all complaints that are being resolved. After the People's Committee of the commune/ward issues a settlement decision, the household can continue to complain within 30 working days. In case the second decision has been issued and the above-mentioned household is still not satisfied with that decision; such household may lodge a complaint with the provincial-level People's Committee.

Second level – Provincial People's Committee

Upon receiving complaints from households, the Provincial People's Committee will have 30 working days to resolve the case. The Provincial People's Committee is responsible for compiling and archiving records of all complaints sent. After the Provincial People's Committee issues a decision, households can complain within 45 working days. In case a second decision has been issued but the household is still not satisfied with that decision, it has the right to lodge a complaint with the People's Court within 45 working days. After that, the Provincial People's Committee will have to deposit the compensation money into an account.

Third Level - Courts

In case the complainant initiates a lawsuit to the commune or provincial People's Court, and the Court shall settle in favor of the complainant. The complaint settlement decision must be sent to the complainant and related parties and publicly posted at the head office of the relevant People's Committee. The complainant will receive such decision after 3 days from the date of complaint settlement results at the ward and commune levels and 7 working days for communes and provinces.

The GRM Officer will need to coordinate with the above levels to maintain a database of complaints related to the Project from relevant parties, including information such as the content of the complaint, the source of the complaint and the date of receipt of the complaint, etc. the full name and address of the complainant, the handling plan and existing status, including complaints received orally and in writing. In case of necessity, the GRM Officer may contact the complainant directly and instruct them to carry out the project's formal complaint settlement process.

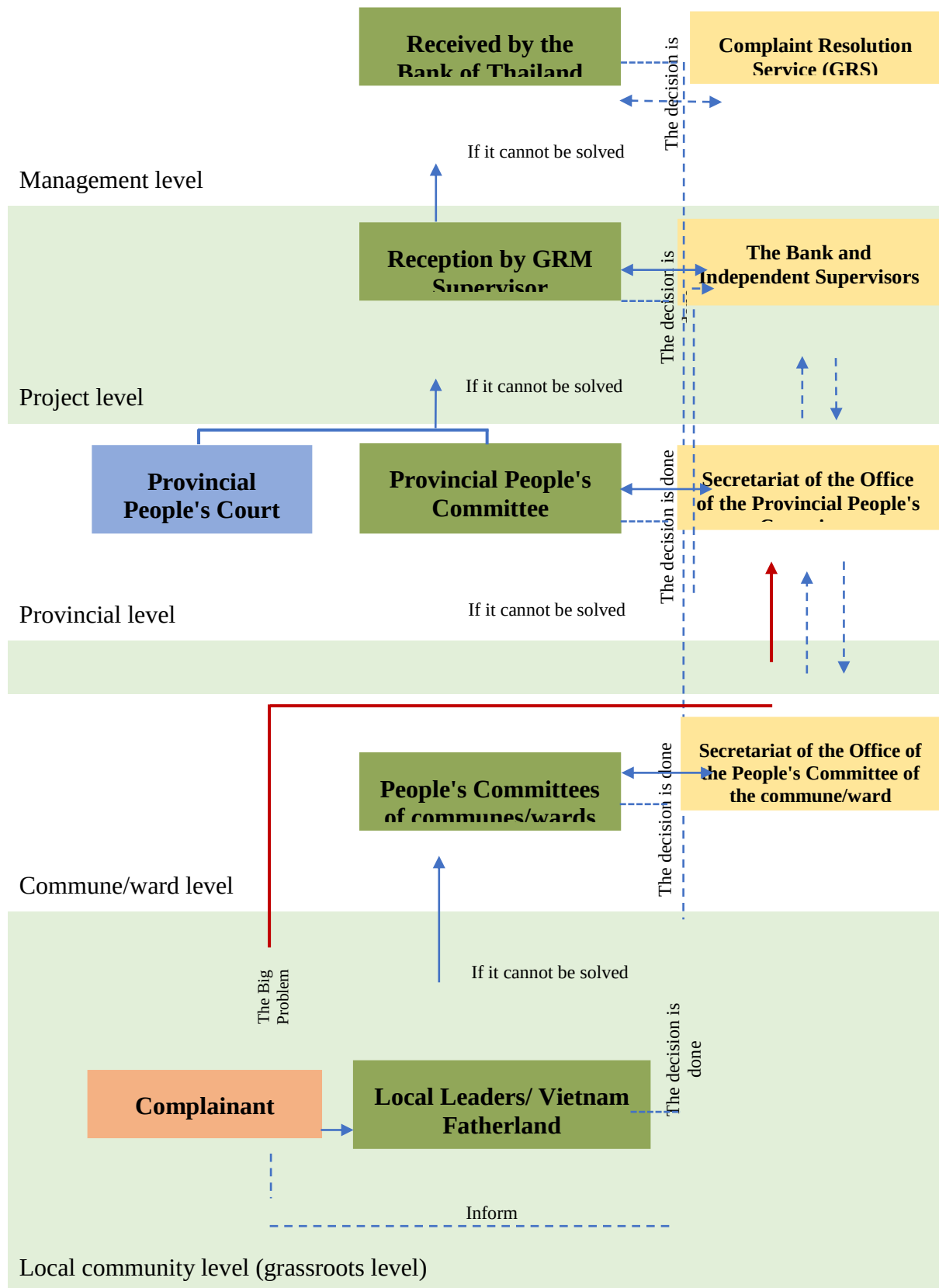


Figure 5.2: Complaint process of the project

Grievance mechanism for workers: Project workers (all three types: direct workers, contract workers, and main supply workers) can directly submit their grievances to the GRM for workers. Members of this GRM will be trained to handle worker complaints, including

workplace grievances, effectively and reasonably, in compliance with national labor regulations and the World Bank's Environmental and Social Standard 2 (ESS2).

Complainant	GRM Functions	Timeframe
Workers or labor unions will submit their complaints to GRM for Workers through one of the communication channels.	• Refer worker-related complaints to the worker's GRM. • Registration, classification, and analysis of complaints. • Convene the GRM for a workers' meeting to analyze and resolve the complaint. • Provide written feedback to the complainant/contractor. • Provide guidance with recommendations to contractors to improve working conditions/labor management issues.	10 days

World Bank Grievance Mechanism: Individuals and communities who believe that a subproject supported by the World Bank adversely affects their lives can submit their grievances to the existing subproject-level grievance mechanism or directly to the World Bank's Grievance Redress Service (GRS). This mechanism ensures that submitted grievances are reviewed promptly to address issues related to the subproject. Individuals or organizations affected by a subproject may also submit complaints to the World Bank Inspection Panel to determine whether any harm has occurred or could occur due to non-compliance with World Bank policies and procedures. Complaints can be submitted at any time when the issue is of concern to the World Bank, and the Bank's management is responsible for responding. For more information on how to submit a complaint to the World Bank Grievance Redress Service (GRS), please visit www.worldbank.org/grs. For more information on submitting a complaint to the World Bank Inspection Panel, please visit www.inspectionpanel.org.

CHAPTER 6. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

6.1 Summary of Public Consultation process

The WB's Environmental and Social Standard 5 (ESS5) and the Environmental and Social Standard 10 (ESS10) requires the consultation, notice to affected people and local authorities of socio-environmental issues in the course of project preparation. Public consultation for the ESIA report must also comply with the requirements of Point a, Clause 3, Article 26 of Decree 08/2022/ND-CP of the Government detailing a number of articles of law on Environmental Protection.

The public consultation must be implemented with the purpose: (i) share information about items and expected activities of the project to local community and related parties; and (ii) Collect comments and concerns from local authority and community about site-specific characteristics and environmentally sensitive issues in the project area (including 8 project communes and wards). On that basis, community concerns will be included in the Environmental and Social Impact Assessment report and project solutions.

Consultation with ward/communal PCs and local community in project area

Direct consultation with the Commune/Ward People's Committee, communities and stakeholders is carried out from December 2023 to February 2024 including the following main contents:

- Overall introduction of the project, investment items of the project, identification of residential quarters/groups in the project area.
- Introduction to the basic requirements of the World Bank's ESF.
- Existing status of environmental hygiene works in wards and outstanding issues.
- Potential environmental and social impacts and risks of the project on local communities
- Solutions proposed by the community to limit environmental impacts and issues during project implementation.
- Comments on the construction of the works.

Participants in public consultation meetings include:

- PMU's representative;
- ESIA consultant's representative;
- Representative of communal PC;
- Representative of local departments, agencies
- Head/deputy head of village
- Representatives of affected households

6.2 Public consultation results

The results of public consultation will be presented in Section 6.2, and the results of stakeholder consultation will be presented in Section 6.3 below

Table 6.1. Results of public consultation in the project area

Time, venue	Participant		Community Inputs/Comments	Project owner's feedbacks
	Male	Female		
1. Lach Hoi Subproject 21/2/2024 Quang Tien Ward, Sam Son city (which is now Sam Son Ward, Thanh Hoa Province)	9	2	1. Mr. Nguyen Van Truong_ Trung Thinh residential group - The rehabilitation and construction of Lach Hoi port will create a source of income for people, which is the wish of local people for a long time. - The existing Lach Hoi port is in small scale, only accommodate small boats. We hope that the Party and the government will soon invest in upgrading the fishing port into a Grade I port to help develop the local economy. - The storm shelter lock is currently heavily sedimented. Vessels that want to enter or exit the storm shelter lock must wait for water to come on board before entering. We hope that the investment should soon start to ensure the safety of vessels and boats to avoid storms when the rainy season is coming. - People have received information about upgrading the fishing port and have had many dialogues with authorities at all levels. - Upgrading the port will facilitate fishing development, income and stable working with the sea. 2. Mr. Trinh Tu Ngoc_ Trung Thinh residential group - Local people totally agree with rehabilitation and expansion of fishing ports and dredging of channels to avoid storms. We hope that the project will be implemented soon to generate income for people as well as develop local fisheries. - Consecutive construction method should be applied to minimize impacts such as loss of security and order, infectious diseases, ... - Currently in the port area there are about four businesses, attention should be paid for traffic diversion, avoid conflicts with operation of the business' transport as well as local people's means coming to do business and trade seafood. - In the past, people in Quang Tien ward went to sea a lot, but in recent years the number of people's boats has decreased, and the marine profession has	We acknowledged comments of the community; Regarding the investment scope of the Lach Hoi Subproject, adjustments have been made compared to the initial proposal. Specifically, the Subproject will not include dredging works for the storm shelter channel. This activity will be undertaken by another project implemented by the local authorities. Therefore, no impacts related to dredging activities in this area are anticipated. With respect to potential impacts on several enterprises currently operating at the existing port, this ESIA report has assessed these impacts and proposed corresponding mitigation measures in Chapter 5 – ESMP. We would continue to coordinate closely with local authorities throughout the project preparation and implementation process to ensure the quality and progress of the project. We would like to commit to seriously implementing environmental impact mitigation measures proposed in the project's ESIA, EIA report.

Time, venue	Participant		Community Inputs/Comments	Project owner's feedbacks
	Male	Female		
			gradually been eroded, partly because the fishing port infrastructure has degraded and cannot meet the anchoring needs of large vessels 3. Mr. Ngo Huu Chung, Trung Thinh residential group - The entrance and exit channels for boats are not guaranteed, traffic in the port area also faces many difficulties due to the old port design, only small cars can enter the port to load and unload seafood. The project will be implemented soon so that people can feel secure in developing the marine economy. - When designing the project, it is necessary to take into account ensuring maritime safety, specifically arranging buoys and signposts so that vessels can enter and exit the port conveniently. 4. Mr. Nguyen Van Thao_Trung Thinh residential group - People have been living and attached to fishing for a long time, but in recent years the number of people participating in fishing has decreased, partly because the port infrastructure has degraded and cannot meet the anchoring needs of big boats. - Without investment in fishing ports, the marine industry will be lost, so we hope that the Party and the state will soon invest, and upgrade modern fishing ports combined with tourism.	
2.1. Lach Bang Subproject 16/1/2024 Hai Binh Ward, Nghi Son Town (which is now Hai Binh Ward, Thanh Hoa Province)	16	5	1. Mr. Nguyen Huu Binh_Deputy Chairman of Ward People's Committee - Construction in the North and East sides of the project do not affect people's livelihood. - For dredging areas, it will affect the process of anchoring fishing vessels, so during dredging, attention should be paid to: + Subdivision and channelization during construction. + Arrange appropriate dredging time. + Dredging, dredging wherever you go is done.	We acknowledged comments of the community. Regarding the investment scope of the Lach Bang Subproject, dredging works for the storm shelter channel are not anticipated to be included. This activity will be carried out under another project implemented by the local authorities. Therefore, no impacts related to dredging activities in this area are expected. We would continue to coordinate closely with local authorities throughout the project

Time, venue	Participant		Community Inputs/Comments	Project owner's feedbacks
	Male	Female		
			- The garbage collection area is located in the total area of the fishing port. In 2011, a pier was built for the Me island management board, so this area was left aside. - Environmental sanitation of the construction site in the fishing port must be regularly cleaned to ensure hygiene and safety for the fishing port. 2. Mr. Dinh Xuan Hieu_Deputy Secretary of the Party Committee - Local government and local people strongly agree with the policy of upgrading Lach Bang fishing port. Currently, the project has degraded and sedimented a lot, so it is in need of attention from the Party and the state. - The port investment is very important to the people of Hai Thanh ward in general and Nghi Son town in particular. When completed, the project will boost the local economy and people's lives will be better, with accessibility to the offshore to cling to the sea and protect our country's maritime territory. - During the construction process, there will be a large number of workers from other places, so it is recommended that construction contractors coordinate with local authorities to ensure security and order and prevent infectious diseases through sexually transmitted infection.	preparation and implementation process to ensure the quality and progress of the project. With respect to social impacts related to labor influx, these have been assessed in Chapter 4 of this ESIA report; and We would like to commit to seriously implementing environmental impact mitigation measures proposed in the project's ESIA, EIA report.
2.2. Lach Bang Subproject 16/1/2024 Hai Thanh Ward, Nghi Son Town (which is now Tinh Gia ward, Thanh Hoa Province)	14	4	1. Mr. Ho Van Dung_Deputy Chairman. Ward People's Committee - The local government and people are very excited and hope that the project to upgrade Lach Bang fishing port will be invested and built. - Regarding the scope of investment of an additional 90m of embankment in Hai Thanh ward, we completely agree with the policy, when the project is implemented, it will be very convenient because there is no need for site clearance. - Note that dredging will have an environmental impact on 23 aquaculture households. Currently, 19 households have signed to move to Me Island, while 4 households are not eligible to relocate to the island. 2. Mr. Do Xuan Chung_Chairman of Ward People's Committee	We acknowledged comments of the community; Regarding the investment scope of the Lach Bang Subproject, dredging works for the storm shelter channel are not planned to be included. This activity will be undertaken by another project implemented by the local authorities. Therefore, no impacts related to dredging activities in this area are anticipated. We would continue to coordinate closely with local authorities throughout the project preparation and implementation process to ensure the quality and progress of the project.

Time, venue	Participant		Community Inputs/Comments	Project owner's feedbacks
	Male	Female		
			- I hope the project will be implemented soon so that people will have a project to use, and the completed project will make anchoring and sheltering from storms convenient. Loading and unloading goods of fishing vessels will also be easier and more convenient. - The project in Hai Thanh ward does not have an impact on land acquisition of households, so it will be very convenient for the project to be implemented on schedule. - Note that during the construction process, it is necessary to ensure traffic safety and environmental sanitation at the construction site because the construction location has many vehicles participating in traffic of people.	We would like to commit to seriously implementing environmental impact mitigation measures proposed in the project's ESIA, EIA report.
3. Tam Quan Subproject First time: 19/1/2024 Second time: 28/2/2024 Tam Quan Bac Ward, Hoai Nhon Town (which is now Hoai Nhon Bac ward, Binh Dinh Province)	16	16	- We agree with the location of the investment project proposed by the project owner. The needs of vessels entering and leaving the port are large, so renovating and upgrading the port to increase the port's mooring capacity is very necessary, in accordance with local realities. - We agree with the negative impacts of the project on the natural environment, socio-economics and community health identified by the project owner in the project's impact assessment report. However, the construction of the subproject includes the complete dredging of Ro island. Currently, there are about 23 households with main livelihood is fishing. The complete dredging of Ro Islet requires the relocation of all living households, directly affecting the lives and livelihoods of the people. The community recommends that if moving to a new resettlement location, it must ensure life and convenience for making a living in fishing as currently. The resettlement site should be located near the river and the sea to do business in accordance with living habits. - Complete dredging of Ro isalnd will generate a very large amount of waste, requiring a large disposal site. Whose land does the dumping location belong to, how many disposal sites are there, how large is the area, have the people agreed to the dumping location or not, and what is the compensation plan and land acquisition for dumping?	Mr. Pham Ngoc Sao to be project owner's representative to acknowledge comments from local community for revising the EIA, ESIA. Regarding the investment scope of the Tam Quan Subproject, adjustments have been made compared to the initial proposal. Specifically, the Subproject will not include dredging works at Con Ro after evaluating alternative options (as mentioned in Chapter 3). Therefore, no resettlement will be required due to dredging activities under this Subproject. Regarding impacts related to dredged material, these have been assessed, and corresponding mitigation measures are proposed in Chapter 5 – ESMP of this ESIA report. The Tam Quan Subproject will utilize two dredged material disposal sites located close to the Subproject area, ensuring convenience in terms of environmental, social, and cost considerations.

Time, venue	Participant		Community Inputs/Comments	Project owner's feedbacks
	Male	Female		
			- The project implementation area has a large number of boats entering and exiting and operating, so when constructing, the project owner is requested to have a construction plan for each subdivision and transportation plan in a way that does not affect mobility. Moving and anchoring people's boats. - It is recommended that the project must commit that the process of transporting waste and dredging of the project must not pollute the living environment of people living along the waste transport route, and vehicles transporting waste must be covered. Cover with tarpaulin according to regulations, do not rush or overtake carelessly, spillage during transportation must be cleaned up immediately, not to pollute the environment. - During project construction, if vehicles carrying materials, machinery, or waste cause damage to roads and local infrastructure, the project owner must direct the construction contractor to repair and compensate the road, the facilities are returned to the locality as - Payment of land compensation, resettlement, and infrastructure for people and localities must be completed before starting the project. - Project owners need to pay attention to the problem of dust generation and limit it to the lowest level so as not to affect people's lives, activities and production. - This is a development project in the province, so we fully agree and support it. We hope the project will be implemented soon. However, the project owner must notify the people and local authorities of the plan at the appropriate time. construction time for project items so that people can plan for aquaculture. During the project construction process, the project owner must appoint supervisory staff to be regularly present at the site to ensure the quality and progress of the project. - It is recommended that project owners must coordinate with local authorities to notify officials and workers who temporarily reside or are temporarily absent from the locality. Construction contractors must comply with the law,	These disposal sites are described in Chapter 1 of this ESIA report. We would continue to coordinate closely with local authorities throughout the project preparation and implementation process to ensure the quality and progress of the project. We would like to commit to seriously implementing environmental impact mitigation measures proposed in the project's ESIA, EIA report.

Time, venue	Participant		Community Inputs/Comments	Project owner's feedbacks
	Male	Female		
			ensure security and order when working in the locality, and must not cause gambling or social evils that negatively affect local children and youth. - Project owners need to prioritize recruiting local people as workers throughout the construction process.	
Subproject Khanh Hoa 19/1/2024 Cam Linh Ward, Cam Ranh city (which is now Cam Linh ward Khanh Hòa Province)	8	5	- Local people and local authorities completely agree and highly support the upgrading of Da Bac fishing port to Grade I, which will help develop the ward in general and the Cam Ranh city in particular. - Currently, people's main income source is from fishing and aquaculture, so investing in upgrading ports is very important to help improve and stabilize people's income sources. - During the construction process, environmental impacts and social impacts on the residential community directly engaged in production and business in the fishing port area cannot be avoided. It is recommended that the PMU and construction contractors need to have mitigation measures for the environmental impacts on local people. - During construction, a large number of vehicles and machinery will be involved in construction. This will make traffic condition in the port area worse. It is recommended that during construction, reasonable construction plan should be applied, no construction activities during peak hours when people are producing and doing business. - Currently, in front of the fishing port area, there are many households doing spontaneous aquaculture. When dredging is carried out, it will affect the water environment, leading to households raising fish in cages and will be directly affected, so it is necessary to have a plan to relocate these households to a safe area so as not to cause economic damage to the households. - It should be noted that, during the construction process, it is necessary to ensure environmental hygiene in the construction site area, ensure security and order, and comply with fire prevention and fighting at the construction site.	We acknowledged comments of the community; With respect to impacts on informal aquaculture households resulting from dredging activities in the navigation channel and the water area in front of the port, these impacts have been assessed in Chapter 4 of this ESIA report; and We would continue to coordinate closely with local authorities throughout the project preparation and implementation process to ensure the quality and progress of the project. We would like to commit to seriously implementing environmental impact mitigation measures proposed in the project's EIA report.

Time, venue	Participant		Community Inputs/Comments	Project owner's feedbacks
	Male	Female		
Subproject Kien Giang 26/1/2024 Tay Yen A commune, An Bien district, Kien Giang province (which is now Tay Yen Commune, An Giang Province)	21	10	- Kien Giang major fishery center construction investment project in Tay Yen A commune is of great interest to the people and local authorities. This is a large project and the impact on people in the commune is also very large. - When implementing port construction in Tay Yen A commune, about 128 households with 525 people will be affected and had to be relocated and resettled, so the impact on people's lives was very large, it is recommended that competent authority should study the living habits of river and sea occupations of households to have a plan to restore livelihoods as well as arrange resettlement sites suitable to people's livelihood conditions to ensure a stable subsistence for people in their new place of residence. - Local people want to receive the resettlement site's land plot before starting construction, to avoid the case where the resettlement site has not been completed yet and people have to hand over their houses and land to the project, making the household's life very difficult. - Attention should be paid to the relocation of 100 affected graves. Local people should be informed about the location and be ensured accessibility to these graves. - Environmental impact of waste disposal sites should be carefully studied to avoid environmental pollution to neighboring production areas of surrounding households. - During the design process, there needs to be a plan to minimize the impact of land acquisition, especially in the construction area where the Ba Chua Xu temple needs to be protected. - Contractors and PMU need to coordinate well with local authorities throughout the construction process. Ensuring traffic safety and security and order. - Construction of resettlement site should be in line with payment of compensation and support for affected households - There should be support for training and job placement for affected people.	We acknowledged comments of the community. Impacts related to land acquisition for the implementation of the Kien Giang Subproject have been assessed in a separate document (Resettlement Plan) as well as in Chapter 4 of this ESIA report. Based on the approved investment scope of the Subproject, it is expected that approximately 60 graves will remain buried within household gardens, in accordance with local customs and traditions. The impacts associated with the relocation of these graves have also been assessed in a separate document (Resettlement Plan) and in Chapter 4 of this ESIA report. We would continue to coordinate closely with local authorities throughout the project preparation and implementation process to ensure the quality and progress of the project. We would like to commit to seriously implementing environmental impact mitigation measures proposed in the project's ESIA, EIA report.

Time, venue	Participant		Community Inputs/Comments	Project owner's feedbacks
	Male	Female		
			- During the construction process, it is necessary to ensure environmental hygiene in the construction site area, ensure security and order, and comply with fire prevention and fighting at the construction site. - Prioritize the use of local labor during the construction process to help people in the project area increase their income and stabilize their economic life.	
Subproject Bach Long 20/1/2024 Bach Long Vi District, Hai Phong city (which is now [Bach Long Vi Special Administrative-Economic Zone, Hai Phong Province)	8	3	- We agree with the policy of implementing the investment project proposed by the project owner. The needs of vessels entering and leaving the port are large, so renovating and upgrading the port to increase the port's mooring capacity is very necessary, in accordance with local realities. - Currently, the Bach Long Vi port area has been degraded and heavily silted, so boats entering and leaving the port face many difficulties, especially during the stormy season. - According to the design survey, the current disposal siteing location is a tidal area. This location belongs to the ecological restoration sub-zone of Bach Long Vi marine protected area, so it is necessary to carefully study the impacts on the environment and the environment. Have a plan to handle environmental incidents during the dumping of construction waste. - It is recommended that the investor and the design consultant carefully study the plan to control and treat waste at the proposed dump site to avoid affecting the surrounding marine environment. - It is necessary to have appropriate measures to dredge and transport waste from the port to the expected disposal site to avoid affecting the depth of the port.	We acknowledged comments of the community; The selection of dredged material disposal sites for the Bach Long Vi Subproject has also been assessed by analyzing alternative options (as mentioned in Chapter 3) and consulting relevant stakeholders (as described in Section 6.3 below). Impacts related to dredged material have been assessed, and corresponding mitigation measures are proposed in Chapter 5 – ESMP of this ESIA report. The Bach Long Vi Subproject will utilize three dredged material disposal sites located close to the Subproject area, ensuring convenience in terms of environmental, social, and cost considerations. These disposal sites are described in Chapter 1 of this ESIA report. We would continue to coordinate closely with local authorities throughout the project preparation and implementation process to ensure the quality and progress of the project. We would like to commit to seriously implementing environmental impact mitigation measures proposed in the project's ESIA, EIA report.

6.3 Results of stakeholder consultation:**Table 6.2. Results of stakeholder consultations for each subject**

No.	Comments from stakeholders	Responses from the Project Owner
I	Lach Hoi fishing port upgrading and expansion subproject	
1.1	People's Committee of Quang Tien Ward, Nghi Son Town, Thanh Hoa (December 29, 2023)	
	Is the investment policy for the project to upgrade Lach Hoi fishing port clear to local community and authority?	We have known about the investment policy to build Hoi port and hope the project will soon be invested in and built.
	Please share the existing status of the fishing port area?	Currently, the Port area has been covered with silt, affecting the entry and exit of vessels. It is recommended to dredge the anchorage area to ensure smooth entry and exit of vessels.
	The port construction site is located adjacent to the Memorial for Southern People Relocated to the North (currently under construction) and several seafood processing businesses. It is necessary to ensure that construction activities maintain environmental hygiene, traffic safety, and public security	With respect to potential impacts on the Memorial for Southern People Relocated to the North (approximately 200 meters from the subproject area) and several enterprises currently operating within the existing port, this ESIA report has evaluated the impacts and proposed appropriate mitigation measures, which are detailed in Chapter 5: Environmental and Social Management Plan (ESMP)
	What should be noted for the dredging and construction of the storm shelter areas?	Regarding the investment scope of the Lach Hoi Subproject, adjustments have been made compared to the initial proposal. Specifically, the Subproject will not include dredging works for the storm shelter channel. This activity will be undertaken by another project implemented by the local authorities. Therefore, no impacts related to dredging activities in this area are anticipated.
	What are the mitigation measures for environmental impacts on storm shelter areas when carrying out dredging activities?	
	Is there any other disposal site in the commune to accommodate the dredged material from dredging activities?	
	What is the existing status of businesses operating in the port??	In the port, there are 4 production and business companies, establishments and shops selling goods serving fisheries logistics, so it is recommended to arrange and have a construction plan to ensure trade and travel of people. people are advantageous.
	Mitigation measures when transporting materials for construction?	The main road has many schools and offices, so when transporting materials to serve the construction site, it is necessary to pay attention to transporting on another route (Nguyen Sy Dung Street) to minimize

No.	Comments from stakeholders	Responses from the Project Owner
		environmental impact as well as traffic safety.
	Is the local labor source willing to participate in project construction?	There is a very abundant labor force in our province, ready to participate in projects when needed.
	How many people participate in port services? What issues should be kept in mind when construction?	Currently, there are about 1,760 workers serving fisheries at Hoi port. When constructing and upgrading the port, be careful not to greatly affect people and businesses.
	What to note when the port upgrade project is implemented? Are there any notes on the environmental and social impacts of local projects?	Contractors coming to carry out construction need to notify local authorities to coordinate with the Port Management Board and construction contractors to help solve arising environmental and social issues smoothly.
II	Lach Bang fishing port upgrading and expansion subproject	
2.1	People's Committee of Hai Binh Ward, Nghi Son Town, Thanh Hoa (December 29, 2023)	
	Is there local consensus and support for the implementation of the project to upgrade and expand Lach Bang fishing port?	Local authority and local people acknowledged well about the project investment and fully support the implementation of the project.
	When dredging of the channel, the anchoring of boats will be affected. Do local authority have suggestions or recommendations for mitigation such impact?	During the construction process, it will affect the anchoring of people's boats. During the dredging process, it is necessary to arrange, arrange and have a construction plan to ensure that vessels can enter and exit the port smoothly.
	What is the existing status of the fishing port's anchorage area?	The port anchorage area mainly anchors fishing vessels to buy seafood, vessels carrying goods and gasoline to serve the fishing grounds.
	What should we pay attention to regarding waste during construction to ensure the environment as well as minimize the impact of dust pollution?	Construction waste needs to be disposed of in the correct location specified by the project.
	According to the design of the project, upgrading the fishing port does not require a disposal site, but in some situations where it is necessary to dump or temporarily store waste, is there any location for a disposal site in the locality?	In the ward, there is Dong Tay 1 waste disposal site, with an area of about 3 ha and a depth of 1m to 1.5m. The disposal site location is about 1km from the project.
	When dredging channels, in addition to affecting the mooring of boats, does it also affect other activities in the port area?	During the dredging process, avoid affecting the environment, especially spontaneous aquaculture businesses on Lach Bang river.
	What should you pay attention to when trucks carrying dredged and construction waste pass through residential areas?	Vehicles carrying construction waste and dredged waste need to be covered to minimize spillage on the road.

No.	Comments from stakeholders	Responses from the Project Owner
	When implementing construction, there will be contractors coming to do the construction and there will be contractors' workers coming to carry out the construction. What should the local side pay attention to when project construction activities are implemented?	When starting construction, it is necessary to notify and inform local authorities and people to have relocation plans as well as protect and support aquaculture households.
2.2.	People's Committee of Hai Thanh Ward, Nghi Son Town, Thanh Hoa (December 28, 2023)	
	The implementation of upgrading the local Lach Bang fishing port and have people received the information yet? Do you agree with the plan to upgrade the fishing port?	We acknowledged about the plan for fishing port expansion in Hai Thanh ward and strongly support. When building the embankment, people and local authorities were very excited. When completed, it will help anchor boats more conveniently.
	Dredging the channel will affect the anchoring process and affect some local aquaculture households. Please share the existing status of aquaculture on these channels?	Currently, 19/23 oyster farming households on the channel have signed a relocation record to Me island. The remaining 4 households are small-scale and do not qualify to relocate to Me island, so they disassembled themselves when they left. Implement dredging.
	According to the design of the project, upgrading the fishing port does not require a waste disposal site, but in some situations where it is necessary to dump or temporarily store waste, is there any location for a waste site in the locality?	In Hai Thanh ward, there are 2 locations to dump waste including Dot Tien pagoda area and Ba Lang parish church.
	What is the existing status of the anchorage and storm shelter?	Currently, the berthing area (a place to shelter from storms) has been heavily silted up. Vessels and boats often run aground when the water recedes, making it difficult for people to anchor and shelter from storms..
	What should localities pay attention to when implementing project construction? Advantages and difficulties during project implementation.	Before starting construction, it is necessary to notify local authorities and people to have a plan to relocate assets on the channel. During the construction process, there is no problem with land or site clearance, which is very convenient for project construction implementation. The locality will coordinate with the fishing port management board and notify people and construction contractors to ensure security and order, environmental sanitation and traffic safety.
	2.2. Lach Bang Port Management Board (December 28, 2023)	
	what is the existing status of the fishing port in Hai Thanh Ward?	Hai Thanh port was built in 1997 and came into operation in 2003. Currently, the project

No.	Comments from stakeholders	Responses from the Project Owner
		has degraded due to lack of funding to carry out rehabilitation and repair.
	Dredging the channel will affect the anchoring process and affect a number of aquaculture households as well as households doing business at the port. What suggestions do the PMU have to minimize the above impacts?	During the process of dredging and building the port, it will affect the mooring of people's boats, so the project needs to have a suitable construction plan to not affect the mooring and trade process
	What is the current traffic, electricity, and fire prevention infrastructure in the port?	Currently, the transport and port infrastructure cannot meet the anchoring and trading needs of the people, especially in the past 3-4 years, the fishing port area has been seriously silted up. leading to large vessels not being able to dock, they have to move to other ports to load, unload and transport goods.
	How about water supply in the port area?	Currently, the port's wastewater treatment system has degraded, causing water stagnation as well as affecting the operation of the fishing port.
	Is the ability to anchor and load and unload goods of fishing vessels favorable?	Loading and unloading capacity of the port: Because the port is designed for small vessels to anchor, it is difficult for large vessels to anchor here.
	Is the current fisheries logistics service in the port developing? What difficulties and problems do people have in doing business and trading?	For fisheries logistics services: In the port area, there are small businesses specializing in purchasing, producing, processing and making ice to serve people.
	Does the locality have any suggestions or recommendations to minimize environmental and social impacts during the construction process?	Regarding construction time: Construction should be done from April to June, this is the time when many people go to the beach so construction will be quicker.
III	Tam Quan storm shelter and fishing port construction investment subproject	
3.1.	People's Committee of Tam Quan Bac Ward, Hoai Nhon Town, Binh Dinh (January 2, 2024)	
	Please tell us what is the existing status of fisheries in the ward? Does the anchorage and storm shelter area meet the needs of mooring vessels?	In Hoai Nhon town, there are about 2,300 offshore fishing boats. Investment in an anchorage area is very necessary. We hope the project will be implemented soon. The dredging and construction of a boat mooring embankment system is highly supported by the people and local authorities Currently, the seaport has been filled with sediment, large vessels often have difficulty entering and leaving the port, so dredging the channel is very necessary. The main income of the people is mainly from seafaring and aquaculture, so investing

No.	Comments from stakeholders	Responses from the Project Owner
		in fishing ports brings a lot of economic value to the locality and people.
	What are local proposals and recommendations related to the investment items of the project?	When surveying and designing, it is necessary to invest in additional routes to and from the port to make trade and travel more convenient
	According to the design, the Ro Islet area will be dredged with a very large, dredged volume, so it is necessary to have disposal sites to store all this dredged material. Are there any local disposal sites?	In the ward, there are many dump sites that can be dumped. According to the survey, there are 6 dump sites near the project construction area with an area of about 64 ha. When dredging, priority is given to using the suction method to minimize unnecessary environmental impacts on people and the project area.
	The aquaculture profession of the people in the ward is very developed. Please tell us what the existing status of the people's aquaculture is?	Currently, people's aquaculture is facing many difficulties, pandemics, and falling prices have led to a decrease in aquaculture area, and current disposal sites are included in the town's overall planning. Hoai Nhon, so when implementing site clearance, it will be convenient
	What do localities pay attention to when contractors come to carry out construction? What are the measures to minimize environmental and social impacts?	When the contractor arrives to carry out construction, it is necessary to notify and coordinate with the people and local authorities about the progress and implementation plan of the project. During the dredging process, it is necessary to ensure and comply with measures to minimize environmental impacts on people.

3.2. Tam Quan Fishing Port Management Board (January 3, 2024)

	What is the existing status of the anchorage area and navigation channel at Tam Quan fishing port?	Currently, the Tam Quan fish anchorage area is heavily silted up. When the tide recedes, the water level drops to low (1-1.5m), so people's mooring of boats faces many difficulties. In the Tam Quan river mouth area, the shipping channel is narrow and often sedimented, so vessels entering the port face many difficulties. We hope to invest in dredging this area.
	Does the implementation of upgrading Tam Quan fishing port support the implementation of the project on the part of the Port Management Board? The benefits that the project brings when invested	Currently, Hoai Nhon town has been fully planned, so investing in project construction is very convenient. The project has high consensus from local authorities and local people
	Please tell us what is the existing status of fisheries in the area? Does the anchorage and storm shelter area meet the needs of mooring vessels?	In the port area, there are about 1,800 - 2,000 fishing vessels anchored, of which 1,500 are tuna weighing vessels, and over 500 vessels are fishing with draw nets. Currently, net

No.	Comments from stakeholders	Responses from the Project Owner
		fishing vessels when docked at the port have a load of 30-50 tons, so when they arrive at Tam Quan port, they cannot dock but have to go to other fishing ports to load and unload goods.
	What should the Port Management Board note when the contractor comes to carry out construction? What are the measures to minimize environmental and social impacts?	During the construction process, please note: transporting dredged waste or transporting construction materials will increase the number of vehicles participating in traffic, causing damage to residential roads or pollution. Dust and gas emission... During the dredging process, it will also affect the mooring of people's boats. It is recommended that when implementing construction, there should be measures to minimize environmental impacts, as well as affecting the mooring, parking and docking of vessels entering and leaving the port. Pay attention to construction in locations that have been pre-silted so as not to affect people's anchoring
IV. Khanh Hoa Major Fishery Center construction investment subproject		
4.1. People's Committee of Cam Linh Ward, Cam Ranh city, Khanh Hoa (Date 4/1/2024)		
	How will the upgrading of Da Bac fishing port help promote the local economy?	When upgrading the Da Bac fishing port, it will help promote the local economy in general and the Cam Ranh city is separate.
	What is main source of income for local people where the project is implemented?	People's main income from fishing and aquaculture.
	What should be noted for environmental impact mitigation during construction?	During the construction process, minimize environmental impacts on aquaculture households near the fishing port area.
	During the construction process, will traffic in the fishing port area be affected?	During the construction process, traffic density will increase, putting pressure on roads and areas entering and exiting the fishing port.
	What should be noted to ensure environmental and social safeguard in construction?	During construction, it is necessary to ensure fire safety, security and order.
	What are the opinions of aquaculture households in the port are when dredging is implemented?	People engaged in aquaculture want to relocate to areas planned for aquaculture.
	How is site clearance in the phase 1?	Currently, phase 1 of the project is under construction. The site clearance progress has been basically completed. So far, there is still 1 Vinh Khuong vesselbuilding enterprise that has not handed over the site for the project.
	What are the measures to reduce traffic congestion in the fishing port area?	For vehicles participating in traffic, it is necessary to arrange appropriate

No.	Comments from stakeholders	Responses from the Project Owner
		construction time to reduce traffic congestion
4.2.	Da Bac Fish Port Management Board, Cam Linh Ward, Cam Ranh city (Date 4/1/2024)	
	What is the existing status of Da Bac fishing port?	Currently, the fishing port has a cargo lock with a length of 140m and only serves small vessels and aquaculture households. Therefore, large vessels cannot dock at the port because the wharf cannot ensure the capacity of the port. The anchorage capacity as well as the port area has been exposed to a lot of sun.
	Currently in the port there are many rental kiosks, how is the environmental sanitation here?	Environmental sanitation is not guaranteed, the port area's infrastructure has degraded, so investment in new construction is urgently needed.
	What should be noted when dredging to avoid affecting aquaculture households in the port area?	Currently, in front of the port area, there are many households engaged in aquaculture (spontaneous activities), so when implementing construction and dredging, it is necessary to have measures to reduce environmental pollution and avoid affecting people's aquaculture production.
	What should be noted in construction process?	Before starting construction, it is necessary to notify the port management board, local authorities and people. During construction, it is necessary to speed up the progress and consecutive construction method shall be applied to avoid affecting the loading and unloading of people's goods.
	What should be noted to ensure environmental hygiene and traffic safety in the port area during construction?	The construction area needs to be neat and clean. Construction time starts from 8:00 a.m. to 10:00 a.m. and in the afternoon from 2:00 p.m. to 4:00 p.m. because this is the time when people complete their business activities at the port.
V.	Kien Giang Major Fishery Center construction investment subproject	
5.1.	People's Committee of Tay Yen A commune, An Bien district, Kien Giang province	
	What are opinions of people and authority of Tay Yen A commune where new Kien Giang major fishery center will be constructed? Do they agree with the investments? What will the project bring to the locality when completed?	The Kien Giang major fishery center construction investment project in Tay Yen A commune is of great interest to the people and local authorities. This is a large project and the impact on people in the commune is also very large.
	Do local authorities have any comments for the project's compensation and site clearance plan so that it can be implemented smoothly?	When constructing the port in Tay Yen A commune, about 128 households affected and had to be relocated and resettled, so it had a huge impact on people's lives. It is recommended that competent agencies research the living habits of river

No.	Comments from stakeholders	Responses from the Project Owner
		and sea occupations of households to have a plan to restore livelihoods as well as arrange resettlement sites suitable to people's livelihood conditions to ensure a stable and long-term life for the people. in a new place.
	In the project area, there are affected households and also many graves. Are there any difficulties in relocating these graves?	The project needs to pay attention to the relocation of about 100 graves in the project area, which need to be notified and arranged in a convenient location so that people can access easily.
	When constructing the port, many households will be relocated, requiring a resettlement site. What should be noted when building resettlement sites? Are there any difficulties and advantages need to be noted.	It is necessary to carefully study and assess the environmental impact of waste disposal sites to avoid environmental pollution to neighbouring production areas of surrounding households.
	What is the income restoration program for affected people?	Income restoration program is showing all resettlement site construction and compensation and support for affected households. The resettlement site must be built before people hand over their land to the project. The resettlement site must be located near the area of relocated households and must be connected to the surrounding area so that people can quickly restore and stabilize their livelihoods.
	Any notes for contractor in construction?	During the construction process, it is necessary to ensure environmental hygiene in the construction site area, ensure security and order, and comply with fire prevention and fighting at the construction site.
VI.	Bach Long Vi storm shelter and fishing port construction investment subproject	
6. 1.	Management Board of Bach Long Vi Nature Reserve (February 27, 2024)	
	The subproject to build and upgrade fishing ports and storm shelters is invested and built on Bach Long Vi island district, this is a sensitive location because there is a marine protected area, the Management Board can discuss more thoroughly about the construction investment location as well as the marine conservation area on the island?	Bach Long Vi Marine Protected Area has been established by the Prime Minister's decision with a total reserve area of 27,000 ha, of which the strictly protected area is 2.5 ha, the ecological recovery area is 4.5 ha, divided The development area is 6.8 ha, the sea area outside the reserve is 9.6 ha and the protection belt is 3.2 ha. With the goal of preserving and sustainably developing animal and plant species such as abalone, snails, lobsters, Spotted babylon snail pearl oysters.....
	What benefits will the Bach Long Vi fishing port and storm shelter upgrading project bring to the locality and residential community?	Regarding the investment policy of the project to upgrade the shelter anchorage area, it has received high support from the people and nine local authorities. The upgrade helps to avoid storms and transport

No.	Comments from stakeholders	Responses from the Project Owner
		goods on the island conveniently and quickly
	Currently, where can the Board implementing regulations on marine conservation be referred to?	Decree No. 26/2019/ND-CP dated March 8, 2019 clearly stipulates conservation activities for endemic flora and fauna species in the red book.
	When implementing construction, what issues should contractors pay attention to so as not to affect the marine environment?	When investing in construction, there will be activities to wash away machinery and equipment, so when implementing construction, it is necessary to have measures to prevent and collect wastewater to avoid overflowing into the project's conservation area.
	According to the design of the project, there is a waste disposal site next to the upgraded port construction area. This is a location close to the tidal flat. Does this location affect the marine protected area? Notes when implementing waste disposal activities in this area	The arrangement of waste disposal sites also needs to be carefully considered and calculated before leveling to avoid overflowing into the sea, affecting the landscape as well as polluting the sea water environment.
	Has the boundary of the marine reserve been marked yet? What are the propaganda activities to the local community on the island so that people can know which areas need to be strictly protected?	Currently on the island there is no system of buoys or warning signs marking the boundaries of the conservation area, however conservation activities are regularly maintained by the management board, propaganda activities and mobilization of people to carry out conservation activities. present nature conservation measures on the island.
	Do the Board's marine conservation activities conflict with people's fishing activities?	Currently, conservation activities are still in conflict with people's fishing activities because the current island area has not completed the infrastructure, especially the mooring arrangement for people's boats is still limited. The anchorage is frequently subject to sedimentation.
6.2.	The People's Committee of Hai Phong City, with guidance from the Department of Natural Resources and Environment of Hai Phong City	
	The 2024 announcement regarding the addition of three onshore dredged material disposal sites on Bach Long Vi Island falls within the management authority of the City People's Committee	Details regarding the dredged material disposal sites have been incorporated and updated in Chapter 1 of this ESIA report.
	The Agricultural Project Management Board, under the Ministry of Agriculture and Rural Development, has been authorized to dispose of dredged material from the Subproject on Upgrading and Repairing the Fishing Port, combined with the Storm Shelter Area for fishing vessels on Bach Long Vi Island, at three designated onshore locations. The total dredged	Details regarding the dredged material disposal sites have been incorporated and updated in Chapter 1 of this ESIA report

No.	Comments from stakeholders	Responses from the Project Owner
	material is estimated at approximately 51,550 m ³ (equivalent to around 74,750 m ³ in loose volume)	
	Dredging disposal: Only dispose of dredged material after completing all environmental protection, traffic safety, and other legally required procedures. Coordinate with the contractor to construct stable containment dikes, and obtain confirmation from the Department of Natural Resources and Environment before disposal. Do not exceed permitted disposal elevations. Construction compliance: Follow the requirements in Article 5 of Decree No. 57/2024/ND-CP (20 May 2024) on dredging in seaport and inland waterway areas. Notify relevant authorities (Hai Phong Inland Waterways Authority, Department of Natural Resources and Environment, Bach Long Vi District People's Committee) of construction schedule, progress, scale, types and number of vessels, and implementation methods. Environmental management: Comply with Articles 5 and 6 of Decree No. 57/2024/ND-CP regarding dredged material management and environmental protection. Hand over disposal sites and dredged material volumes to Bach Long Vi District People's Committee and implement measures to prevent environmental pollution. Report to the Department of Natural Resources and Environment as required. Mineral discoveries: Report any minerals found during dredging to the Department of Natural Resources and Environment for guidance. Unauthorized mineral exploitation under the guise of dredging is strictly prohibited.	Potential impacts and risks related to the dredged material disposal sites have been evaluated in Chapter 4 of this ESIA report, and appropriate mitigation measures have been proposed in Chapter 5: Environmental and Social Management Plan (ESMP)

6.4 Information Disclosure

The first draft of the ESIA, SEP, LMP, and ESCP in Vietnamese will be disclosed locally in the communes within the project area and at the Project Management Unit, expected in December 2023 and February 2024, for public consultation. Based on the ESIA content, local residents can access project information and provide their feedback/comments on environmental and social issues. The final draft of the ESIA and the final drafts of the SEP, LMP, and ESCP in English will be published on the WB's external website, expected in September 2025, for public consultation. The final ESIA in both Vietnamese and English will be disclosed locally at project sites and on the WB website.

PUBLIC CONSULTATION AND STAKEHOLDER CONSULTATION PHOTOGRAPHS

Subproject 1. “Construction of Thuy Tan fishing port”



Working with representatives of the People's Committee of An Tan commune, Thai Thuy district



Working with representatives of Thai Thuy District People's Committee



Public consultation meeting at Thuy Tan fishing port



Public consultation meeting in An Tan commune, Thai Thuy district



Photos of interviews with employees of SHC Enterprise exploiting sand, gravel, and construction materials



Photos of interviews with households in Thuy Tan fishing port area, Thai Thuy district

Subproject 2. "Construction and expanding Lach Hoi fishing port"



Working with Thanh Hoa Fishing Port Management Board, Thanh Hoa province



Consultation with the People's Committee of Quang Tien Ward, Sam Son city, Thanh Hoa province



Working with the People's Committee of Quang Hung ward, Thanh Hoa city, Thanh Hoa province.



Meeting with the residential community of Trung Thinh residential group, Quang Tien ward, Sam Son city



Public consultation meeting at Quang Tien ward, Sam Son city.



interviews with households on the way to the waste disposal site in Quang Hung ward, Sam Son city

Subproject 3. Lach Bang fishing port upgrading and expansion subproject



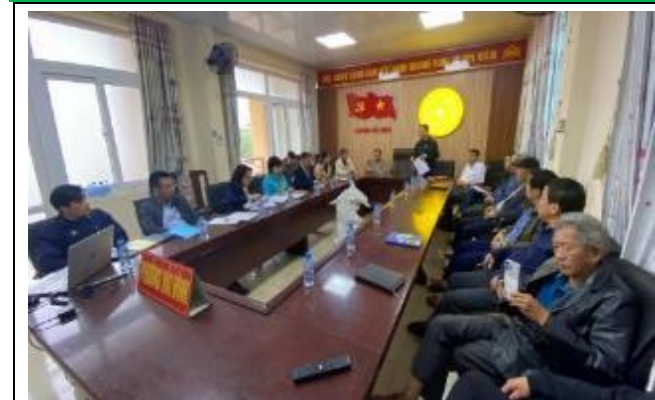
Working with Representative of Hai Binh Ward People's Committee, Nghi Son Town



Working with representatives of the People's Committee of Hai Thanh Ward, Nghi Son Town..



Public consultation meeting in Hai Thanh ward, Nghi Son town.



Public consultation meeting in Hai Binh ward, Nghi Son town.



Working with the Head of Lach Bang fishing port
Lach Bang fishing port, Nghi Son town..



Working with cadastral officials, Hai Thanh ward,
Nghi Son town.

Subproject 4. “Construction of Tam Quan fishing port and storm shelter”



Working with the People's Committee of Tam Quan
Bac ward, Hoai Nhon town



Working with Tam Quan Fishing Port Management
Board, Binh Dinh



Working with representatives of the fisheries union
of Tam Quan Bac ward, Hoai Nhon town

Subproject 5. Construction of Khanh Hoa major fishery center



Meeting with representatives of Da Bac Cam Ranh fishing port management board



Meeting with representatives of the People's Committee of Cam Linh ward, Cam Ranh city



Interviews with fishermen at the boat anchoring area at Da Bac Fishing Port

Subproject 6. "Construction of Kien Giang Major Fishery Center"



Meeting with representatives of the People's Committee of Tay Yen A commune, An Bien district



Consultation with relevant parties at the People's Committee of Tay Yen A commune, An Bien district



Public consultation meeting at the People's Committee hall of Tay Yen A commune, An Bien district



group discussion in Tay Yen A commune, An Bien district



Interviewing households next to the proposed resettlement site at Nga Bat Hamlet, Group 4, Tay Yen A Commune, An Bien District

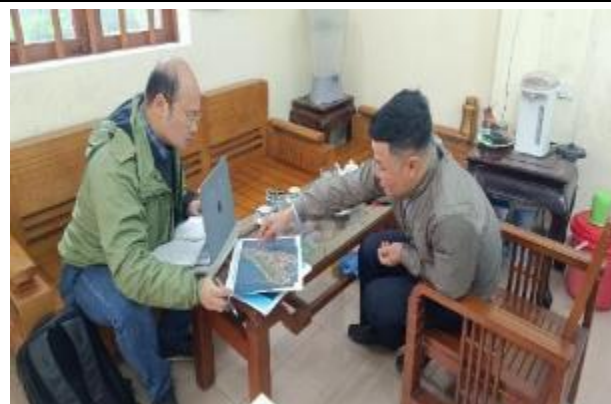


Interviewing households in Nga Bat Hamlet, Group 4, Tay Yen A Commune, An Bien District

Subproject 7. “Construction and upgrading Bach Long Vi fishing port and storm shelter”



Working with representatives of the Conservation Management Board of Bach Long Vi district



Public consultation with Bach Long Vi Island district government



Public consultation meeting on Bach Long Vi Island district



Working with the Department of Infrastructure Economics of Bach Long Vi Island district



Group discussion with fishermen on Bach Long Vi Island



Group discussion with fishermen on Bach Long Vi Island



Working session with the land administration officer of Tam Quan Bac Ward.



Public consultation meeting at the People's Committee of Tam Quan Bac Ward, Hoài Nhơn Town



Public consultation meeting in Thien Chanh 1 Quarter, Tam Quan Bac Ward.

CONSLUSION AND RECOMMENDATION

The project will serve as a driving force for the development of Vietnam's port, industrial, and maritime transport provinces/cities into modern, smart, and sustainable hubs of regional significance in Southeast Asia. It aims to establish a modern international logistics service center integrating maritime, air, expressway, and high-speed rail transport, as well as an international center for training, research, application, and development of science and technology in maritime industries, oceanography, and the marine economy.

Implementation of the project help to materialize the master plan for the system of fishing ports and storm shelter anchorage areas for fishing vessels in coastal and island areas with favorable natural conditions and high concentrations of fishing vessels. It will meet the demand for anchorage and logistic services for fishing vessels and gradually develop towards industrialization and modernization. The project will form key international exchange hubs, driving the development of seafood industrial zones, coastal economic zones, and major fisheries centers (in Hai Phong, Khanh Hoa, and Kien Giang) linked to key fishing grounds. This will create attractiveness and momentum for the fisheries sector to develop efficiently and sustainably.

The project will invest in infrastructure for marine exploitation, such as the construction and upgrading of key fishing ports, fishing ports, and regional storm shelter anchorage areas for fishing vessels, facilitating marine exploitation activities, particularly offshore fishing. This will enhance exploitation efficiency, reduce post-harvest losses, and protect the environment. Most of these positive impacts are expected to be realized during the operational phase of all six subprojects.

On the other hand, some negative environmental and social impacts and risks may arise during the construction and operation of the facilities provided under the six subprojects. These include increased dust, noise, air emissions, vibrations, solid waste and wastewater generation, degradation of surface water quality, impacts and risks to aquatic species, effects on aquaculture, fishing activities, vegetation loss, habitat disturbance, increased traffic safety risks, damage to existing infrastructure (waterways, water supply, etc.), and disruptions to related services, which may heighten the risks of flooding, sedimentation, and localized erosion, as well as health and safety concerns for the public and workers. These impacts are expected to range from low to significant and can be managed through the Environmental and Social Management Plan (ESMP) and the Dredging Material Management Plan (DMMP) proposed for this project.

APPENDICES

APPENDIX 1. DREDGED MATERIAL MANAGEMENT PLAN (DMMP)

The DMMP (Dredged Material Management Plan) is developed during the feasibility study (FS) phase. The DMMP will be updated by the Detailed Design Consultant, then included in the bidding documents and contracts for the construction packages involving dredging activities at the 6 sub-projects, along with the IESMC, worker code of conduct, and other mitigation measures in the ESMP. After signing the contract, the Contractor will prepare their own Contractor's DMMP (C-DMMP) based on the DMMP in the contract and submit it to the Investor/Monitoring Consultant for approval before implementation.

In addition, this DMMP proposes measures to mitigate the impact on water quality/organisms through the selection of dredging methods and procedures; mitigation measures and environmental quality monitoring programs.

Introduction

The SFDP project includes 6 sub-projects, each of which will have dredging activities to create shipping channels, fishing port piers, and storm shelter anchorage areas.

In addition, this DMMP proposes measures to mitigate water quality/organisms impacts through the selection of dredging methods and procedures; mitigation measures and environmental quality monitoring programs.

Overall, the above infrastructure investment items will have positive impacts. However, negative environmental and social impacts will also occur during the construction phase of the projects. In particular, for the dredging and embankment works at the port piers/storm shelter anchorage, the land clearing and dredging process will generate a large volume of excavated and dredged materials to be disposed of (approximately 467,151 m³). The details are as follows.

Table 1: Earthwork, and Dredged Material Volumes from Project

No.	Subproject	Excavated soil volume (m ³)	Dredged volume (m ³)	Backfill volume (m ³)	Excavated soil volume reused for on-site filling (m ³)	Excavation volume, material to be disposed of (m ³)
		2	3	4	5	6=2+3-5
1	Lach Hoi subproject	16,040	0	0	0	16,040
2	Lach Bang subproject	14,914	0	0	0	14,914
3	Tam Quan subproject	119,653	523,224	0	334,406	308,471
4	Khanh Hoa subproject	7,973	69,333	7,973	6,012	71,294
5	Kien Giang subproject	12,459	5,432	163,338	12,459	5,432
6	Bach Long Vi subproject	0	51,000	0	0	51,000
	Total	171,039	648,989	171,311	352,877	467,151

Therefore, this Dredged Material Management Plan (DMMP) has been prepared to fully manage the impacts and risks during the dredging process and the construction of the project's infrastructure items.

The DMMP includes the following main contents:

- i. Scope and method of dredging operations
- ii. Key characteristics of the river/sea conditions that need attention
- iii. Volume and nature of the dredged material
- iv. Description of the expected disposal sites and dredged material transportation plans
- v. Environmental and social impacts and risks of dredging activities on rivers/seas
- vi. Mitigation plans for environmental and social impacts and risks
- vii. Environmental monitoring and surveillance plan
- viii. Reporting requirements.

1. Dredging scope and method

1.1 Dredging scope

Lạch Hới Sub-project and Lạch Bạng Sub-project:

No dredging activities.

Tam Quan Sub-project:

Dredging of the anchorage area and channel with an area of 32.5 ha, with an estimated dredging volume for the anchorage and channel of approximately 523,224 m³, including:

- Dredging of the anchorage area: Divided into 3 dredging zones, including:
 - Anchorage for vessels L=24-35m, channel width B=40m, dredged bottom elevation -4.5m;
 - Anchorage for vessels L=20-24m, channel width B=35m, dredged bottom elevation -3.7m;
 - Anchorage for vessels L=17-20m, channel width B=30m, dredged bottom elevation -3.2m.
- Dredging of the channel leading to the anchorage:
 - Section of the channel outside the estuary: length 1200m, channel width B=50m, dredged elevation -5.0m;
 - Section of the river channel B=40m, dredged bottom elevation -4.5m, minimum curve radius R=200m. The slope of the dredged channel is m=7.

Khánh Hoà Sub-project:

Dredging of the water area, turning basin, and shipping channel, with a dredging volume of 69,333 m³. The width of the water area in front of the pier ranges from 15-30m, with the dredged bottom elevation ranging from -2.6m to -5.7m. The shipping channel is arranged with a width of 60m (for the main channel) and 32m (for the branch channel leading to the local pier).

Kiên Giang Sub-project:

Dredging of the water area in front of the pier, with a width of 36m and a dredged bottom elevation of -5.5m. The estimated dredging volume is 5,432 m³.

Bạch Long Vĩ Sub-project:

Dredging of the shipping channel and turning basin covering an area of 3.3ha, with a dredged bottom elevation of -2.9m, ensuring safe navigation for fishing vessels up to 35m in length and providing anchorage for 405 vessels. The dredging volume is 55,828 m³.

1.2. Dredging method

- Before dredging, a survey should be conducted to clear unexploded ordnance and obstacles.
- The dredging area should be marked with buoys.
- Depending on the geological conditions of the dredging area, an appropriate construction method should be selected: a suction dredger or a grab dredger combined with a barge to transport the dredged material to a disposal site. The disposal site must be precisely identified to meet environmental requirements.
- The dredging process and the transportation of dredged material must comply with legal regulations, ensuring the material is disposed of at the approved location.

The main equipment expected to be used for dredging at each subproject with dredging activities are shown in the table below:

Table 2: List of Construction Equipment and Machinery for Dredging

No.	Machines/Equipment	Quantity (pcs)	No.	Machines/Equipment	Quantity (pcs)
1	30 Ton Floating Crane	1	8	360CV Tugboat	1
2	Canoe	1	9	150CV Tugboat	1
3	25T Crane	3	10	Bending Cutter	5
4	Electric Welding Machine	5	11	Concrete Compressor	5
5	50T Crane	3	12	Grab bucket digger	1
6	10 ton dump car	5	13	1200CV Tugboat	1
7	Barge	5			

2. Main characteristics of current river/sea status and related activities

Before developing the construction methods, the contractor needs to carefully review the technical documents of each sub-project related to dredging activities for creating the shipping channel and turning basin, including the Environmental and Social Impact Assessment Report. The following characteristics should be considered when preparing the Contractor's Dredged Material Management Plan (C-DMMP):

Tam Quan subproject:

The Tam Quan storm shelter anchorage is located 2.2 km from the sea mouth. The SFDP subproject will be implemented on an area of 115 ha, aiming to develop Tam Quan storm shelter anchorage into a regional anchorage area, of which 10.74 ha is the existing land of Tam Quan fishing port, and the remaining 104.26 ha is expansion area. The expansion area includes: 97.09 ha of water surface of the Tam Quan River, 5.01 ha of unused land, 1.11 ha of public land (existing roads), and 0.93 ha of non-agricultural production and business land.

The Tam Quan storm shelter area is part of the lower reach of the Tam Quan River. In this area, the river is approximately 250m-450m wide (in the project area, 2.2km from the river mouth, the width of the river near the mouth is smaller, around 150-200m). The water quality of the river is quite good, and the water traffic in this area is busy, especially during storms, with many large boats gathering in the area. Additionally, sand mining activities are still ongoing on the Tam Quan

River, particularly near the confluence of the Tam Quan River and the Đãi Ông Khéo river branch. The Tam Quan river mouth remains narrow and prone to siltation, making it difficult and unsafe for vessels to enter and exit. Along both sides of the river are many households from Tam Quan Bac ward, with a high population density, and near the river mouth, one side is lined with the Tam Quan embankment.

In the northern, western, and southwestern areas of the storm shelter anchorage, around 80 households are engaged in aquaculture, situated 30–100 m from the dredging area. Aquaculture mainly relies on natural water sources from the Tam Quan River or Dai Ong Khéo River.

Khánh Hoà subproject:

Cam Ranh Bay in this area has a width of approximately 1.5 km. The water quality in the bay shows slight signs of pollution in terms of ammonium parameters (mainly due to aquaculture activities taking place around the subproject area).

Currently, there are more than 30 households engaged in aquaculture (mainly lobster and fish farming) within the project area, located about 300 m north of the dredging site. However, these farming activities are spontaneous and not within the officially permitted aquaculture zones of the subproject area. During subproject implementation, it is necessary to develop support measures and create conditions for occupational transition for these households, as they had invested and conducted aquaculture activities prior to the project investment decision.

Kiên Giang subproject:

The Cai Lon River in this area has a width of about 500m-600m (the section at the subproject area, 8 km from the river mouth, the width of the river section near Rach Gia Bay is larger at 800-1000m. The water quality of the river is quite good, and the waterway traffic activity in this area is not high, with a concentration of large boats, mainly during storms.

Bach Long Vĩ subproject:

The land allocated for the construction of subproject components (29.48 ha) is currently non-agricultural land (including 0.42 ha for public use, with the rest being water area used as a port, access areas, mooring, and storm shelter for ships, surrounded by a wave barrier and a ship entrance channel). The basin (docking area) is about 150m-800m wide, and the entrance channel is approximately 80m wide. The basin is surrounded by a protective embankment, with a concrete road on top. Since the port and docking area have been in use since 1992, the docking basin has suffered from serious sedimentation and needs to be upgraded and dredged to facilitate safe and efficient passage for ships seeking shelter during storms. The entire area is within the jurisdiction of the Bach Long Vi fishing port and the docking area for fishing boats and is managed by the Bach Long Vi Port Management Board, so no households need to be relocated or displaced.

3. Characteristics and composition of dredged materials

the project owner coordinated with the environmental monitoring unit, the Center for Analysis and Technology Transfer in Environmental Engineering under the Institute of Agricultural Environment (certified by VIMCERTS 082), to conduct surveys, measurements, and sample collection for baseline environmental analysis in the sub-project area. The environmental sampling was carried out on January 15, 2024. Results of field surveys and environmental monitoring show that:

Tam Quan subproject:

Surface sediments: The analysis results show that the concentrations of heavy metals in the sediments are much lower than the permissible limits specified in the National Technical Regulation on Sediment Quality (QCVN 43:2017/BTNMT). Therefore, the surface sediments dredged from the sub-project area are non-hazardous and not contaminated with heavy metals.

Dredged material: The sub-project monitored and analyzed 24 samples of dredged material along the Tam Quan storm shelter anchorage (from Con Ro area to the mouth of the storm shelter). The

analysis results show that the dredged material consists mainly of poorly mixed sandy soil with a loose structure. The concentrations of heavy metals and pesticides in the dredged material are within the permissible limits of QCVN 43:2017/BTNMT – National Technical Regulation on Sediment Quality. Therefore, the dredged material in the sub-project area is still of acceptable quality, with no signs of pollution.

Khanh Hoa subproject:

Surface sediments: Analysis results show that heavy metal concentrations in sediments within the project area are significantly lower than the permissible limits set in QCVN 43:2017/BTNMT - National Technical Regulation on Sediment Quality. Therefore, the dredged sediment from the subproject is classified as non-hazardous and free from heavy metal contamination. The dredged material can be used for planting perennial trees, landscaping, or site leveling, depending on local needs. If not reused, the dredged material will be collected, transported, and disposed of at designated temporary disposal sites approved by local authorities.

Dredged material: The analysis results of dredged material show that heavy metal indicators comply with the permissible limits under QCVN 43:2017/BTNMT - National Technical Regulation on Sediment Quality. This confirms that the dredged material in the project area remains in good condition with no signs of contamination. As a result, the dredged material can be used for planting perennial trees, urban landscaping, or site leveling, depending on local demand. Otherwise, it will be collected, transported, and disposed of at temporary storage areas approved by local authorities.

Kien Giang subproject

Surface sediment: The analysis results show that the concentrations of heavy metals in the sediments in the subproject area are much lower than the permissible limits specified in the National technical regulation on sediment quality (QCVN 43:2017/BTNMT). Therefore, the volume of sediments dredged from the subproject component is non-hazardous and not contaminated with heavy metals. The measured salinity ranged from 0.63‰ to 0.68‰, which are within the low threshold and do not affect crops, including rice and vegetables

Dredged material: The analysis results of three dredged material samples (at depths of 20cm to 50cm) show that the heavy metal parameters are all within the permissible limits according to QCVN 43:2017/BTNMT - National technical regulation on sediment quality. The results indicate that the quality of the dredged material in the subproject area is still quite good, with no signs of pollution. Therefore, the volume of dredged sediments from the subproject component is non-hazardous and not contaminated with heavy metals.

Bach Long Vi subproject:

Surveys show that the sediment in the dredging area is mainly sedimentary bedrock and sandy soil generated from the long-term storm shelter activities of fishermen. The analysis results indicate that the concentration of heavy metals in the sediments in the area is much lower than the permitted limits defined in the National Technical Regulation on Sediment Quality (QCVN 43:2017/BTNMT). The sediment in the dredged area is assessed as non-hazardous and not contaminated with toxins such as heavy metals.

4. Dredged material disposal sites

The volume of excavated soil and surplus dredged material generated during the construction will be taken to waste disposal/disposal sites to avoid environmental impacts and to facilitate future resource utilization. Based on considerations such as the volume of materials, characteristics/contents, transport distance, and the current state of the project area, the disposal sites for the excavated soil and surplus materials for each subproject have been selected as follows:

Table 3. Disposal sites for surplus dredged materials for each subproject

No.	Subproject	Volume of excavated soil and surplus materials to be disposed of (m ³)	Area of the disposal site (ha)	Capacity (m3)	Transportation distance (Km)
2	Lach Hoi subproject	16,040	The volume to be disposed of primarily consists of excavated soil and construction debris. Therefore, these two subprojects will contract with the relevant authorities to collect, transport, and process the materials.		
3	Lach Bang subproject	14,914			
4	Tam Quan subproject, site 1	308,471	2.47	130,000	0.4
	Tam Quan subproject, site 2		2.4	120,000	0.5
5	Khanh Hoa subproject, site 1	71,294	2.64	52,800	0.5
	Khanh Hoa subproject, site 2		0.5	12,000	0.3
6	Kien Giang subproject	5,432	Utilize the land within the port area of the project (for later phase).		
7	Bach Long Vi subproject, site 1	55,828	4.0	55,000	0.5
	Bach Long Vi subproject, site 2		0.48	12,000	1.3
	Bach Long Vi subproject, site 3		0.65	9,000	0.7

The table below lists and describes the existing status of the disposal sites for each subproject.

Name, capacity of the site	Location	Description of existing status
1. Lach Hoi subproject: There is no disposal site as there is no dredging activity.		
2. Lach Bang subproject: There is no disposal site as there is no dredging activity.		
3. Tam Quan subproject		

Name, capacity of the site	Location	Description of existing status
Tam Quan Disposal Site 1 - Area: 2.47 ha - Capacity: 100,000 m³	- Location: Dong-Tay Cong Stone Area, Tam Quan Bac Ward, Hoai Nhon Town, Binh Dinh Province - Adjacent areas: Bordered by Cong Thach residential area (north and west), and Tam Quan River with Dinh Thach–Cong Thach Road (south and east). - Transport distance: 0.4 km from the construction site to the disposal area.	- The site consists of agricultural land, mainly aquaculture ponds, in the densely populated Cong Thach residential area. - According to the planning by the PC's of Hoai Nhon District, the disposal site area Tam Quan planned for fishing infrastructure; land acquisition is underway. - The area includes abandoned rice fields and ponds (2–3m deep), to be filled and raised by 1–2m.  location of the dredged material disposal site.  Existing status of the dredged material disposal site
Tam Quan 2 disposal site - Area: 2.4ha - Capacity: 120,000 m³	- Location: Cong Thach neighborhood, Tam Quan Bac Ward, Hoai Nhon Town, Binh Dinh Province. - Adjacent areas: Bordered by Tran Quoc Toan Street (north and west), Tam Quan River (south), and Cong Thach residential area (east). - Transport distance: 0.5 Km from construction site to disposal area	- The site includes abandoned and active aquaculture ponds in Cong Thach residential area. - As per Hoai Nhon District PC's planning, the area is designated for a resettlement zone linked to the fishing port (Zone B); land acquisition is underway. - Ponds are 2–3m deep; after filling, elevation will be raised by 1–2m above current ground level.

Name, capacity of the site	Location	Description of existing status
		 location of the dredged material disposal site  Existing status of the dredged material disposal site
4. Khanh Hoa subproject		
- Khanh Hoa 1 disposal site - Area: 2.64 ha - Capacity: 52,800m³	• Location: Within Da Bac Port, Cam Linh Ward, Cam Ranh City, Khanh Hoa Province. • Adjacent areas: Bordered by household fish ponds (north and east, separated by port fence), Vinh Khuong shipbuilding workshop and Da Bac port warehouses (south), and an empty plot within the port (west). • Transport distance: 0.5 Km from construction site to disposal area	• The site currently includes an unused fish farming pond; land recovery is completed, and the area has been used to store dredged materials from Da Bac Port. • Located within Da Bac Port, the temporary disposal site poses no risk of dredged material dispersal outside the port area. • The site is planned for future infrastructure development under the Khanh Hoa large-scale fisheries center. Ponds are 2–3m deep and will be filled to match the current surface level.  Location of the disposal site

Name, capacity of the site	Location	Description of existing status
		 Existing status of the disposal site
- Khanh Hoa Disposal Site 2 - Area: 0.5 ha - Capacity: 12,000m³	• Location: Within Da Bac Port, Cam Linh Ward, Cam Ranh City, Khanh Hoa Province. • Adjacent areas: Bordered by Nguyen Trai Street and port warehouses (north); the access channel into Da Bac Port surrounds the site on the south, east, and west. • Transport distance: 0.3 Km from construction site to disposal area	• Current status: The water surface lies within Da Bac Fishing Port and is used to store dredged materials from the water area, turning basin, and service wharf channel. The area will be leveled to match the existing elevation after filling. • Future use: Once filled, the temporary disposal site is planned for development into facilities such as parking areas and service buildings for the Khanh Hoa Major Fisheries Center.  Location of the site  Existing status of the site
6. Kien Giang subproject		
Kien Giang Disposal site - Area: 0.6 - Capacity: 12,000 m³	• Location: Nga Bat Hamlet, Tây Yên A Commune, An Biên District, Kiên Giang Province. Transport distance: Within the project's land area; no external transport required.	The location is within the Kien Giang subproject area (land reserved for later development)

Name, capacity of the site	Location	Description of existing status
		phase).  Existing status of the site
6. Bach Long Vi subproject		
Disposal site No. 01: - Area 4.0 ha (length 433 m, width, average 100 m). - Capacity: 55,000m³	• Location: Near the concrete road encircling Bach Long Vi Island, including part of the eastern tidal flats adjacent to the sea. • Transport distance from project area: about 0.5 km. • Transport route: Materials will be moved by 10-ton trucks via a 3.5-meter-wide concrete road around the island, suitable for such vehicles (see image below).  (photographed at the location of the disposal site 01)	• Current condition: The area consists of exposed base rock with no vegetation and lies 1.2–1.5 meters below the dike road surface. It is not regularly flooded, except during high tides or extreme weather. • Planning and approval: The site lies between the island's coastal development zone and the ecological restoration zone of the Bach Long Vi MPA. It has low conservation value and is designated for commercial service use in the island's sea reclamation plan, approved by the MARD and Hai Phong City People's Committee³⁹.  Location of disposal site No. 01 Bach Long Vi Island has not yet determined the average tidal line, so approximately 20% of the reservoir area may fall within the tidal flat zone.

³⁹ Document No. 2397/UBND-MT dated 30/10/2024 of Hai Phong City approves the location for dumping dredged materials for the subproject of upgrading and repairing fishing ports combined with storm shelter anchorages for fishing vessels on Bach Long Vi Island.

Name, capacity of the site	Location	Description of existing status
		 Status of disposal site area No. 1

5. Summary of potential social and environmental impacts and risks

5.1 General impacts

Chapter 4 of the Environmental and Social Impact Assessment Report has analyzed and evaluated in detail the environmental and social impacts of dredging activities in each Sub-project with dredging activities, including:

Dredging and dredged material transport activities:

- Noise generated from dredging equipment.
- Dust, exhaust gases, and wastewater from dredged materials and about 467,151 m³ of dredged material.
- Disturbance to the water area, increased turbidity, affecting aquatic life and activities involving water for aquaculture.
- Disruption of waterway traffic and increased risks to waterway traffic safety.
- Safety and health risks for workers and the community.
- Risks of accidents and incidents.

Dumping activities:

- Risks of spilled materials around the dumping area.
- Risks of flooding the surrounding area due to water drainage from the dredged material disposal site.
- Safety risks for the community.

5.2 Impacts and risks at material storage sites

In general, dredged and excavated materials are relatively large (with about 467.151 m³), requiring a considerable land area for storage and disposal. The Project has identified 08

Material Storage Sites for the storage and disposal of such materials. At any single Material Storage Sites, there will be the following main potential socio-environmental impacts and risks:

Spill and Erosion risks. When the dump is significantly higher than the surrounding ground, dredged material may spill downslope into the surrounding areas, filling up vacant or production land, cover vegetation or infrastructure, affecting people's livelihood and agricultural production activities; Barren soils exposed to air and wind may also lead to increases in erosion potentials.

Localised flooding risks. Materials disposed of at the Material Storage Site may interrupt existing drainage pattern. Rainwater will overflow on top of the materials then run downslope to the surroundings and may cause localised flooding. On the other hand, after the wet material is pumped into the Material Storage Site, leakage water will be drained out. It may contain high turbidity thus it would cause water quality reduction of the receiving water bodies, affecting the growth of aquatic species;

Leakage wastewater generation and impacts. After being pumped from the barges to a Material Storage Site, the wet dredged materials will settle down gradually and water will be drained from the material. *Leakage water will flow out of the dump following gravity.* Experience from other river dredging projects shows that the ratio of sandy mud - water in the dredged material is 8:2, which means water make up 20% total dredged volume. This proves that the leachate volume is quite large. If not controlled properly, leakage water may cause localised flooding at the surroundings of the Material Storage Sites. This leakage water may contain relative high turbidity (fine materials from dredged materials), causing sedimentation in the drains and receiving water bodies. On the other hand, as discussed in Chapter 3, salinity in sediments of Truong Giang River varies with locations (lower in the middle section, higher near the estuaries) and by seasons (higher in dry season than flood season). Therefore, it dredging is taking place in dry season, it is possible that leakage water from Material Storage Sites may be brackish or even be saline when the sediments from the two ends of the river, especially the ending section are disposed off at the site. The heavy metals in sediment into the water during dredging may be liberated during dredging, however, no major impacts are expected with this regard, given the fact that the contents of pollutants in the sediments are well-below applicable limits.

Safety risks to local communities. As the barges would be parked at some distance from the final Material Storage Sites, pipelines would be installed for leading the materials to the Material Storage Sites. The pipelines themselves and the wet materials when flowing out of the pipes would pose safety risks to local communities, such as people hitting the pipes for some reasons or failures of pipes leading to accidents to the people being present nearby. After being disposed off, it would take sometimes for the materials/ground at the final Material Storage Site to become stable after most of the moisture/water is drained from the dredged materials. If someone walk into the unstable disposal areas, accidents such as shrinking or even drowning may happen.

6. Impact and Risk Mitigation Plan

In the course of construction, Contractor will comply with requirements and follows environmental and social impact mitigation measures stated in Environmental and Social Code of Practice (ESCOP), Worker Code of Conduct, requirements on environmental and social impact mitigation for dredging and embankment activities specified. The dredging, Contractor will comply with measures and requirements prescribed in this **DMMP**, including the following requirements and this DMMP Annex.

6.1 Personnel arrangements

In the bidding documents, the Contractor shall recommend at least 2 officers who have degree, certificates and experience to take charge of safety, environment and health for the Package which is under the Contractor's responsibility. These officers must be mobilized and work during contract period to conduct the monitoring, prepare reports for their assigned tasks. The Contractor shall create favorable conditions for these officers to participate in training courses that are beneficial for their tasks held by the Project.

6.2 Design of Material Storage Sites

Construction methods at the dredged material storage area: The dredged material storage area will be enclosed with sandbags (or a geotube structure) and/or dredged sand, with the embankment height at the approved design level; primary sedimentation pits and water collection pits will be created during the filling process. The water drained from the dredged material will flow through temporary drainage channels to the sedimentation pit before being released into the receiving water body.

6.3 Mitigation Measures to be Implemented by Dredging Contractors

❖ General mitigation measures – applicable to all subprojects with dredging activities

In order to manage the potential socio-environmental impacts and health and safety risks of the dredging process including transportation and disposals of materials, the Contractor are required to implement and/or comply with the following requirements during the execution of the dredging contracts:

- The mitigation measures specified in detail design and technical specifications of the bidding documents, including dredging method, transportation process and Material Storage Sites. The Contractors are not allowed to proposed alternating dredging method, especially the use of suction pumps to blow liquid muds from river bed directly to the Material Storage Sites, that may lead to more potential adverse environmental and social impacts and risks;
- All ESHS (environmental, social, health and safety) terms and conditions in the bidding documents/contracts including ESCOP, the Worker's Codes of Conducts;
- Assign staff to be in charge of ESHS aspects including GRP.
- Plan dredging to avoid flood season, especially from September to November when floods from rivers/seas while high tides can rise due to storms on some days.
- Under the coordination of the PMU and CSC, conduct consultations with local communities and authorities, the people potentially affected by dredging such as those doing aquaculture, fish catching or using waterway for transport when preparing the contractor's detail construction schedules. Discuss and make agreements with local people on the time taking water and seed into aquacultural ponds. The contractor may agree to avoid or stop dredging at certain hours of the day so as people can take water river if they wish.
- Coordinate with the PMU to inform local community and authorities along each specific sections of the river about dredging plan at least two weeks before commencement.
- Prepare Contractor's DMMP and submit to Construction Supervisors to review and approve. Update the C-DMMP every six months or when when there are arisen issues to be addressed.
- Prepare Contractors Emergency Preparedness plan in case of waterway traffic incidents and accidents:
- Register the transportation routes, equipment, construction period to relevant functional agencies, which will be a base for inspection, monitoring of dredging activities,

transportation and disposal.

- Operators of Pontoon, Excavators, and Barges must be trained with relevant certificates to be verified by the CSC.
- Provide adequate relevant PPEs for the workers to use and enforce the use, especially wearing lifevests when working in the water. Assign monitors for each working shift for timely rescue in case of emergency;
- Provide training for the Workers on ESHS rules before starting actual physical works in the contracts. Brief them on ESHS weekly;
- Implement all measures specified in the Waterway Traffic Control prepared as part of the approved Detail Design before dredging is started. Warning signs must be installed and maintained during construction, including buoys on the water surface and signs on the river banks according to the approved plans.
- Re-establish/zoning the dredging corridor with buoys when the Pontoon and barges moves to the next river section for dredging in order to minimise waterway traffic safety risks, especially collision between dredging equipment with local boats and fish catching tools.
- Signal lights are provided on the Pontoon and the barges.
- Carry out monitoring and observations on the disturbed water areas. Carry out daily water Turbidity Monitoring at the dredging area. Agree with the CSC on the thresholds on water turbidity. Halt the dredging when turbidity reached thresholds or harms to aquatic species is observable until water turbidity is recovered to an acceptable level. Limit the dredging at peak tide so as to reduce the bottom sludge and pollutant spreading in water.
- Oil and lubricants stored in the barges and Pontoon will be kept minimal and in water-tight and closed containers, at covered and bound area to ensure no leakage of oils into the riverwater. Materials contaminated with oils and lubricants will be stored in a safe containers for collection by licensed hazardous waste treatment dealers.
- Check, maintain equipment and machinery to ensure they are in good conditions and extend registries before expiry dates.
- Large maintenance or repair of excavators at the dredging/construction site is not allowed. These should be done at maintenance workshop .
- Overloading dredged materials on the barges, storage chambers or any transportation means is not allowed.
- Move the Pontoon, excavators and barges to safe shelters before flood season arrives. Cover, protect these construction equipment to prevent leakage of fuels or being blown by storm winds.
- Remove safely all equipments and materials that are introduced on water and riverside before completion of the dredging works.
- Accommodations on riverside with adequate clean water, electricity, and sanitation facilities and adequate basic auxiliaries for the health and safety of the workers should be provided by the Contractor. Register the labours with local authorities.
- Facilitate inspections by IESMC and authorities.
- Prepare contractor's log books with records on ESHS performance, and monthly ESHS implementation reports.

In addition, the contractor should:

- Prepare specific construction methods in each river section that fit the current status of the river in terms of flow, sediment degree, impact of tides and flooding flow, etc.
- Set up construction schedule for each location with consideration into: (i) water level, flow level, weather conditions; (ii) recommendations of local people and authorities on their demand of using water and surface water for aquaculture and fishing activities and (iii) construction schedule for other packages which share the same construction site, inclusive of transportation route and Material Storage Site. Mitigation of safety risks for workers and construction equipment: avoid adversely natural conditions such as storms, flood, natural disasters.
- Work with the Project Owner, supervising consultant to regularly communicate with local authorities and communities in the course of preparing construction plan and throughout the implementation phase.
- The Contractor shall be responsible for repairing, compensating for any damages caused by the construction activities at the Contractor's cost.
- Avoid impacts mangroves and duckweed, in some coastal sections, which are significant to the environment and biodiversity.
- Disturbance to the ground and on riverbed is kept at minimal;
- When storm is forecasted, dredging or embankment lining activities will be limited, site protection measures are implemented; all construction activities will be halted in stormy weather;
- Operate dredging at acceptable low speed in intervals to allow sedimentation;
- Provide warning signs at dangerous areas, for example, underwater flows, high erosion potentials, or deep excavation;
- The contractor should dig and retain the existing vegetation to cover the surface of the dredged material after completion at the Material Storage Sites.

❖ Measures to minimize specific impacts caused by dredging.

Subprojects with dredging activities such as Tam Quan, Khanh Hoa, Kien Giang, and Bach Long Vi will generate negative impacts on aquatic life and cause deterioration of water quality due to dredging operations. To manage potential environmental and social impacts as well as health and safety risks during dredging, including material transportation, the Contractor shall comply with the following requirements:

Planning and approval

- The Contractor shall prepare a detailed Contractor's Dredged Material Management Plan (C-DMMP), based on the project's detailed design and DMMP. The C-DMMP must include dredged volumes; physical, biological, and chemical characteristics of dredged material; dredging methods and schedules; transportation, disposal, and pollution control processes; and risk mitigation measures at disposal sites. This plan must be approved by the Project Owner, updated as necessary, and regularly supervised by the CSC throughout implementation.
- Prepare construction schedules for each location, taking into account water levels, currents, weather conditions, community recommendations, and schedules of related packages.
- Avoid construction during floods, high tides, or adverse weather, especially when vessels need to dock for storm shelter.

- Consider cumulative risks from simultaneous dredging activities in adjacent subprojects (if any) to adjust schedules and construction methods accordingly.

Public consultation and notification

- Consult affected communities and local authorities regarding dredging activities.
- Notify dredging plans at least two weeks prior to commencement.
- Discuss with local residents regarding water intake and seed stocking periods for aquaculture, with possible adjustments to dredging schedules.
- Work with the Project Owner and CSC to maintain regular communication with communities throughout implementation.
- Establish a feedback and grievance mechanism for environmental and social issues at the local level, with clear focal points and defined resolution timelines.

Equipment and workforce

- Operators of dredging equipment must be properly trained and certified.
- Provide adequate PPE, especially life jackets for workers working over water.
- Assign supervisors for each shift to provide emergency response when needed.

Waterway traffic and safety

- Comply with approved waterway traffic control measures under the detailed design.
- Install warning signs, buoys, and signal lights on dredging equipment to ensure safety, especially at night.
- Clearly demarcate dredging corridors when moving equipment to different river sections.

Waste and incident management

- Limit dredging during high tides to reduce the spread of sediments and pollutants.
- Do not use suction dredging methods that stir up the seabed, due to associated environmental and social risks.
- Do not overload dredged materials on barges or transport vessels.
- Store oils and lubricants safely in sealed, covered containers to prevent leakage into water bodies.
- Maintain adequate spill response equipment, especially for oil containment.
- Relocate equipment to safe shelter prior to heavy rains, floods, or storms. Upon completion, remove all equipment and materials from the construction site.

Dredged material disposal site management

- Install full mitigation measures such as embankments, outlets, drainage channels, warning signs, and containment dikes before transporting sediments to disposal sites.
- Disposal sites must have a leachate collection and treatment system before discharge into the environment.
- Comply with monitoring, transportation, storage, and disposal procedures for dredged materials as specified in the C-DMMP and construction methods.

- If pipelines are used for slurry transport, warning signs must be installed along the pipeline.
- Conduct regular monitoring at disposal sites. Any leakage or overflow incidents must be promptly addressed before continuing storage.
- Maintain an operation logbook for the disposal site, recording volumes, time, and condition of dredged materials.

Disposal site incident control

- Disposal site design must take into account risks such as erosion, flooding, subsidence, and natural disasters.
- Establish an overall incident control plan for the project, covering dredging, transportation, and disposal incidents.
- Form an emergency response team of at least three members.
- Provide a hotline / accessible communication channel for communities to report incidents quickly.

Particularly for the dredging activities of the Bach Long Vi Sub-project, the following specific impact mitigation measures must be implemented:

(i) Mitigation measures for dredging impacts on the marine environment and ecosystem

To prevent impacts from dredging on the marine environment and ecosystem, in addition to full compliance with measures described in Section 1.1.3.2 of Chapter 5, the project must also implement specific measures to prevent vessel collisions within the port and between vessels and construction equipment, which could increase risks of sinking, oil leakage, and other impacts on the marine ecosystem:

- Avoidance

- + Dredging must be conducted sequentially in small areas inside the port. Surround dredging sites with soft barriers using buoys and warning signs.
- + Suspend dredging at night, during rough seas, high tides, or adverse weather to allow vessels safe sheltering while minimizing pollutant dispersion outside the Marine Protected Area.
- + During suspension, dredgers (grab dredgers, barges, etc.) must be relocated to designated shoreline areas with warning signs and night lighting.
- + Conduct monitoring of seawater quality, dredged materials, and biological indicators in and outside the port to track aquatic life development and design appropriate preventive measures.
- + Plan transport routes and disposal sites appropriately, located on the southern side of the island, away from the strictly protected zones of the Marine Protected Area.

- Minimization

- + Use appropriate dredging equipment to avoid excessive rock fragmentation and bottom sediment disturbance.
- + Immediately load dredged materials onto barges after lifting, avoiding long storage in the basin
- + Do not overload barges or transport vessels, ensuring safety and avoiding spillage.

- + Do not store oil/lubricants on barges or dredging equipment; oil-contaminated materials must be collected and handled by licensed entities.
- + Dredging operators must be trained and certified, under supervision of the Construction Supervision Consultant (CSC).
- + Provide full PPE to workers, especially life jackets for water-based activities; assign supervisors per shift for emergency response.
- **Emergency Preparedness**
 - + Develop emergency response plans for vessel collisions, engine failures, capsizing, or oil spills, approved by authorities.
 - + Suspend dredging and move equipment to designated shoreline safety zones during adverse weather; such zones must have warning signs and night lighting.
 - + Conduct regular crew training on rescue, evacuation, and incident response.
 - + Coordinate with Border Guards, Fisheries Surveillance, Coast Guard, Inland Waterway Authority, and Port Authority for timely incident response.
 - + Establish emergency communication channels between transport vessels, project owner, contractor, and authorities.
- **Restoration**
 - + Collect and clean up spilled materials and waste after each construction stage, avoiding long-term impacts on water quality.
 - + Restore water and seabed quality by adjusting construction schedules if signs of prolonged degradation appear.
 - + Submit periodic environmental monitoring reports to authorities and the Marine Protected Area Management Board.

(ii) Mitigation measures for environmental risks at dredged material disposal site No. 01

The Bach Long Vi subproject plans 03 disposal sites with a total capacity of about 65,000 m³. Site No. 01 is located outside the sea dike on the eastern side of the island, within the development zone. The area has bedrock, no vegetation cover, a lower elevation than the dike road (by 1.2–1.5 m), and is about 50 m away from the Marine Protected Area's restoration zone. It has low conservation value, already zoned as commercial service land in the island reclamation plan, and has been licensed by the Ministry of Agriculture and Rural Development (now Ministry of Agriculture and Environment) and approved by Hai Phong City People's Committee. To control and minimize potential environmental risks during disposal at Site No. 01, particularly risks of material washout into the sea during high tides or adverse weather, the following measures must be applied:

- + Prioritize the use of Sites No. 02 and 03 first; Site No. 01 shall only be used once the other sites are filled.
- + At Site No. 01, disposal shall only cover 80% of the area not subject to tidal inundation; the remaining 0.8 ha at risk of flooding shall only be used when necessary and with strict controls.
- + Construct strong rock gabion retaining walls around Sites No. 1 and 2 to prevent tidal intrusion and material dispersion into intertidal zones, especially near the Marine Protected Area's restoration zone.
- + Retaining walls must be completed before disposal begins and inspected regularly

- during construction. Wall height must be at least equal to disposal elevation (1.5m), ensuring overflow prevention, erosion control, and stability of dredged materials.
- + No disposal during high tides or rough seas to avoid washout into the marine environment.
 - + Conduct regular monitoring at the disposal site to ensure no material washout.
 - + Conduct periodic monitoring of seawater and dredged material quality, particularly near the Marine Protected Area's restoration zone. If environmental parameters exceed thresholds, disposal methods must be adjusted immediately.
 - + Strictly comply with the approved Dredged Material Management Plan (DMMP), including provisions on transportation, storage, pollution control, and site safety.



Form. The retaining wall made of supported gabion boxes

6.4 Preparation of C-DEMP by Contractor

After signing the contract, Contractor must prepare and submit Contractor's-DMMP (C-DMMP) along with construction schedules and technical plans. The C-DMMP should be prepared based on the structure of this annex, detailing the activities that the would implement in order to meet the ESHS management aspects that can be described by principles in the ESMP/ Bidding documents. Special attentions should be paid to

- Contruction methods diferientating between dredging the riverbed with riverside excavation, describe equipment and labour used.
- Detailing Dredging, transporation and disposal procedures.

Allocation of dredged / excavated material to each of the three Material Storage Sites based on additional information on sediment quality of the river and soil quality at the Material Storage Sites which would become available during detailed design.

6.5 Requirements for Storage Activities and Material Storage Site Management

Storage Process

The Contractor will detail in their C-DMMP all arrangements for connecting the barges which may have to park at some distance with the Material Storage Sites (typically, several hundred meters while it is technically feasible to transfer the materials from the barges to Material Storage Site at distance of up to two kilometers; the actual distance from where the barge can park to each Material Storage Sites will be determined during detailed design.

If the pipes are installed to connect the barge with the Material Storage Site (the liquid muds will be pumped through this pipeline, the C-DMMP will include mitigation measures including warning signs along the pipelines.

All approved mitigation measures including embankments, outlets, drainage ditches, warning signs, and fences if required for the Material Storage Sites will be established before disposal is started.

Pumping of materials into cells and drainage of leakage water will follow the procedures and sequence set out in the C-DMMP and/or construction plan.

Carry out regular monitoring at the Material Storage Sites. Leakage, overflow will be fixed immediately before the disposal is allowed to be continued.

Material Storage Site Management

The Project will comply with the regulations stated in “**Article 8. Regulations on Dredged Material Management**” under Decree No.57/2004/ND-CP dated May 20, 2004 by the Government regarding the management of dredging activities in seaport waters and inland waterway waters (Circular 8).

The dredged material is stored at sites approved by the Provincial People's Committee (PPCs). After the completion of the project, the project owner/the PMU is responsible for handing over the material storage area to the PPCs, or to an organization or individual authorized by the PPCs for management. With 0.5 millions cubic meters of demolition, excavations and dredging materials, the materials will be stored in designated cell appropriately designed and managed to suit the characters of the materials. Along with project implementation, the PPCs plan to re-distribute/auction the stored materials for beneficial usage in accordance with current national legislations. Alternative, at project closing, the stored materials may still be stored at the site (levelled to the surrounding ground elevation), the PMU would hand over the sites to the PPCs for future beneficial use in accordance with the provincial land use plan.

Incident control

- The design of Material Storage Sites must consider the incidents as erosion, flooding, subsidence, natural disasters, storms.
- Set up a general incident control plan for the subproject, including incidents related to the dredging, transportation and disposal at selected Material Storage Sites.
- Establish an incident response team of at least 3 people to be ready to respond when an incident occurs.
- Create hotline/communication channels that are favorable among parties and accessible among communities so as to rapidly report in case of incidents.

8. Environmental Monitoring and Safety Plan

8.1 Environmental monitoring plan

- Locations: 02 samples at each subproject with dredging activities (04 subprojects: Tam Quan, Khanh Hoa, Kien Giang, Bach Long Vi).
- Monitoring parameters: Salinity, As, Hg, Cd, Cu, Pb, Zn, Cr.
- Frequency: once every 03 months.

- Applicable standard: QCVN 43:2017/BTNMT.

8.2 Compliance Monitoring Plan and Reporting Requirements

Contractor shall be responsible for complying requirements and taking mitigation measures mentioned in ESIA, ESMP and DMMP and preparing monthly report. Environmental, social, safe and health compliance reports will be developed according to the Project's forms in the process of implementing, following requirements stated in the bidding documents so as to submit the Project Owner/supervising Consultant for review and approval. The report will cover

- The package's working scope
- Status of C-ESMP and C-DMMP and other environmental related documents submitted to the Project Owner
- Construction schedule implemented in the month, construction site and working volume completed
- Mitigation measures taken in the month
- Arising and existing issues
- Environment, social, safety and health training participated

Stakeholders' inspecting and monitoring activities

Construction supervising consultant shall be responsible for daily monitoring the Contractor's compliance and preparing monthly monitoring report. Independent Environmental and Social Monitoring Consultant will conduct quarterly monitoring during construction phase.

APPENDIX 2. BASELINE ENVIRONMENTAL ANALYSIS RESULTS

(Attached in separate appendices)

APPENDIX 3. AGREEMENT ON DISPOSAL SITES

(Attached in separate appendices)

APPENDIX 4. MINUTES OF THE COMMUNITY CONSULTATION MEETING
(Attached in separate appendices)