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BINH DUONG PROVINCE PEOPLE'S COMMITTEE

SEWERAGE PROJECT MANAGEMENT UNIT OF BINH DUONG PROVINCE (BDSPMU)

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

OF

BINH DUONG WATER ENVIRONMENT IMPROVEMENT PROJECT

January 2020

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ABBREVIATIONS

AHHs/AHs	Affected Households
BDSPMU	Sewerage Project Management Unit of Binh Duong
BIWASE	Binh Duong Water, Sanitation and Environment joint stock Company
BOD	Biological Oxygen Demand
CSC	Construction Supervision Consultant
DARD	Department of Agriculture and Rural Development
DPI	Department of Planning and Investment
DOF	Department of Finance
DONRE	Department of Natural Resources and Environment
DOT	Department of Transport
DOC	Department of Construction
DOIC	Department of Information and Communication
DOLISA	Department of Labor- Invalids and Social Affairs
EMP	Environmental Management Plan
EIA	Environmental Impact Assessment
ES	Environmental Staff
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESS	Environmental and Social Standard
FS	Feasibility Study
GDP	Gross Domestic Product
GRM	Grievance Redressal Mechanism
JICA	Japan International Cooperation Agency
HH	Household
IEMC	Independence Environmental Monitoring Consultant
IOL	Inventory of Losses
IT	Information Technology
LMP	Labor Management Plan
MOLISA	Ministry of Labor, Invalids and Social Affairs
MONRE	Ministry of Natural Resources and Environment
NGO(s)	Non-Government Organization(s)
NR/NH	National Road
O&M	Operation and Maintenance
ODA	Official Development Assistance
PCR	Physical Cultural Resources

PMU	Project Management Unit
PPC	Provincial People Committee
PR	Provincial Road
Pre-FS	Pre-Feasibility Study
PWU	Provincial Women Union
QCVN	Vietnam National Technical Regulations
RAP	Resettlement Action Plan
RPF	Resettlement Policy Framework
ROW	Right of Way
SEA	Sexual Exploitation and Abuse
SEP	Stakeholder Engagement Plan
SH	Sexual Harassment
TCVN	Vietnam National Technical Standard
THC	Total Hydrocarbon
TOR	Terms of Reference
UXO	Unexploded Ordnance
US$	US Dollar
VND	Vietnamese Dong
WB	The World Bank
WEIP	Water Environment Improvement Project
WWTP	Wastewater Treatment Plant
WPC	Ward Peoples' Committee
WU	Women's Union

EXECUTIVE SUMMARY

Project background

The Binh Duong Water Environment Improvement Project (WEIP) will be implemented in Thuan An city, Di an city and Tan Uyen town of Binh Duong province. The project development objectives are: (i) to increase access to improved wastewater services; and (ii) reduce pollution to the environment caused by municipal wastewater in selected areas of Binh Duong province. The project's objectives will be achieved through: (i) Constructing of sewer collection system and wastewater treatment plan (WWTP) for Tan Uyen town and expansion of the sewer collection system and WWTP for in Thuan An city and Di An city; and (ii) building wastewater management plan, implementing post investment property management programs/plans in urban sewerage sector in Binh Duong. The project will be implemented from 2021 to 2027 with total fund of VND 7,118,399,257,000 (equivalent to US$ 305,905,000).

WEIP includes 02 components: Component 1 - Expanding municipal services for wastewater and drainage management: (1) Sewage collection and network expansions, including sewage pumping stations for Tan Uyen town, Thuan An and Di An cities; (2) Constructing a WWTP for Tan Uyen town; Upgrading the existing WWTPs for Thuan An and Di An cities and Component 2: (1) Developing integrated urban water management in the project areas, and 2) Implementation support, capacity and institutional development: (1) Developing integrated urban water management in the project areas; (2) Implementation support, capacity building, and coordination for COVID-19 response. (3) Site clearance, Land acquisition and compensation.

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: Assess and manage environmental and social risks and impacts; ESS10: Participation of stakeholders and information disclosure; ESS2: Labor and working conditions; ESS3: Effective use of resources and pollution prevention and management; ESS4: Health and community safety; ESS5: Land acquisition, restrictions on land use and involuntary resettlement; ESS6: Biodiversity conservation and sustainable management of living natural resources; ESS8: Cultural heritage and ESS10: Stakeholder engagement and information disclosure. The Environmental and Social Impact Assessment (ESIA) document is prepared according to ESF. ESIA includes the proposed works for Component 1of the project.

Project description

WEIP includes the following items: (1) Sewage collection and network expansions, which will increase the coverage to more than 54,000 households. Total primary and secondary wastewater collection and transmission network is 122.53 km sewage collection D200-D1200 in three areas: (i) Tan Uyen town: 71.26 km sewage collection D200-D1200, 27.2 km of pressured pipe D100-D800, 07 pumping stations, 10 collecting pits, 212.5 km of D100-D150; (ii) Thuan An city: 19.97 km sewage collection D200-D600, 4.07 km of pressured pipe D100-D350, 1 pumping stations, 5 collecting pits, 85 km of D100-D150; and (iii) Di An city: 31.3 km sewage collection pipes D200-D700, 16.02 km of pressured pipe D100-D450, 4 pumping stations, 7 collecting pits, 60.05 km of D100-D150; (2) Construction of WWTPs, includes (i) Constructing a WWTP with 1st stage capacity of 20,000 m^3/day for Tan Uyen town; and improving drainage capacity for the 1.3 km downstream of Suoi Tre canal by widening, dredging and embanking to be 14.5-16.0 m wide, 4.0-6.5 m high, and constructing4-m wide of concrete road both sides; and (ii) Upgrading the existing Thuan An and Di An WWTPs with additional treatment capacity of 20,000 m^3/day for each. Each work item will be constructed within 18 to 30 months (expected starting from quarter III/2021 to March 2027).

Social and environmental bases

In September and November 2020, 15 air samples, 12 surface water samples, 6 groundwater samples, 12 wastewater samples, 6 soil samples, and 15 sediment samples were tested and analyzed to evaluate the background environment quality in the project area. Results of field surveys and environmental monitoring show that the quality of the air, surface water, groundwater, soil and sediment is still quite good.

As the project works are implemented in three areas of Binh Duong province: Tan Uyen town, Di An and Thuan An cities, the sewer system, pumping stations and collection pits works are mainly located in residential areas and mostly on the traffic roads. Some sensitive receptors consist of: households and business shops along roads constructed wastewater collection system, 22 schools, 04 markets, 03 clinic centers, 09 temple/churches/ pagodas in Tan Uyen town and 21 schools, 3 market, 18 temples/pagodas in Di An city and 6 schools, 01 monastery, 3 temples/pagodas/ soil-grave in Thuan An city.

Work items of new Tan Uyen WWTP with area of 9.7 ha and Suoi Tre canal improvement with length of 1.5 km are in Uyen Hung ward, Tan Uyen town, which is located in the agricultural land, far from the residential area. The expansion of Thuan An and Di An WWTPs are located within boundary of two existing WWTPs. There are no sensitive structures have been observed around these areas.

Environmental and Social Impacts and Risks

ESIA has identified the negative impacts and potential risks of the project. Most impacts are temporary, local and reversible due to medium scale construction. These impacts can be mitigated by applying appropriate technology and specific mitigation measures, and contractors must closely monitor and consult with local people.

❖ ***Generic impacts***

Dust, exhaust gas, noise, vibration, wastewater, solid waste, traffic pressure from construction activities and daily life of workers, social risks and impacts related to labor influx, community health and safety. These impacts can be considered as low to substantial for each facility and can be minimized.

❖ ***Site-specific impacts***

Land acquisition impact: Expectedly, the project will affect 94 households, no households will have to displace. Data on acquisition of land, on-land assets, crops and trees will be updated in the Project's Resettlement Action Plan.

Impacts on travel condition and traffic safety: construction of sewer pipelines will be taken place on the existing roads in the urban and semi-urban area. The main impacts may happen on installation of sewer pipeline of D350-D1100, include i) Tan Uyen (89km D350-D1100): PR747, PR746, PR 745, DR418, DR409, To Vinh Dien and Nguyen Tri Phuong streets; ii) Thuan An (25km D200-D600): Cau Tau, Nguyen Huu Canh, Nguyen Chi Thanh streets, PR745 and Binh Nham 2 road; and iii) Di An (32km D200-D600): Nguyen Thi Tuoi, Bui Thi Xuan, Nguyen Dinh Thi streets, PR743A and national road NR1A. Construction activities will add to the road a number of vehicles, machineries, and equipment, and temporarily encroach road surface and excavation for installing sewers will narrow traffic lanes, leading to increases in traffic density on these roads. This might cause additionally traffic jams and related accidents in the areas therefore assessed as substantial, temporary during construction phase and could be mitigated via good construction and management practices.

Impacts on business activities and household accessibility: Installed sewer pipelines are located on existing roads where business activities taken, and household located along the roadsides.

These includes business shops of domestic necessities and foods such as biscuit, candy, fruits, vegetables, etc., and small coffee stores, clothes or IT shops, etc. The construction activities will cause impacts on these business shops and households due to increased levels of dust, noise, and block access roads. The installation of sewer pipelines is proposed to be carried out in successive manner of about 100 m each section, the impact is assessed as temporary and moderate, and can be mitigated.

*Impact on existing infrastructure and services***:** Many roads or street sections could be affected during excavation, ditches preparation for sewer pipeline constructions along the existing road which may need to remove road surface temporarily. Other urban technical infrastructure including water supply pipeline, telecommunication cables, and electrical cables and poles could be happened. This impact is mitigable via adequate survey and technical consideration, good construction methods and good coordination with local public service utility.

Impacts on irrigation drains at Tan Uyen WWTP site: new Tan Uyen WWTP (9.7 ha)is located on agricultural lands in Uyen Hung commune. Currently, 4 irrigation drains are located in this cultivation area in which two drains will be affected permanently since they locate within the site area, other two run outside of the site area, which are supplying water for about more than 20 ha (including the site area of WWTP) agricultural lands around the Tan Uyen WWTP site area. These drains could be affected by being spilled and blocked with leveling materials during construction of the WWTP, but this impact is assessed as low, short-term and could be mitigated.

Impacts on agricultural activities at Tan Uyen WWTP site: The site area of Tan Uyen WWTP and Suoi Tre canal improvement is adjacent to agricultural lands, includes cultivated crops, fruit trees or vacant lands. Surrounding agricultural cultivation activities could be affected by temporary block of irrigation drains, scattered raw material/excavated soils, deal concrete, spill of oil/fuel, discharged wastewater without any pre-treatment. These impacts are assessed as temporary and at low and mitigated.

Safety and disturbance issues to staffs at the existing WWTPs: The upgrading existing Thuan An and Di An WWTPs will be implemented within the boundary of the existing WWTPs. The mobilization of construction workers and equipment, establishment of worker camps, arrangement of construction site (with auxiliary areas, material storage yards…) may create safety risks for staffs and create burden for existing infrastructures at the existing WWTPs. The risks could be mitigated through appropriate site design, separated entrances, good worker management, and they are assessed as temporary, at low level and mitigable.

Impact of dredging process to water quality, aquatic life and downstream users: Suoi Tre canal is directly connect to Dong Nai river. Construction activities in Suoi Tre canal will disturb the bottom sludge layer and cause negative impacts on water quality by increasing TSS and turbidity in Suoi Tre and Dong Nai river. Due to the flow of Suoi Tre canal is quite small during the dry season and applying the segment-blocking and dried construction method, the impact is assessed as low and mitigated.

Impacts due to excavated sludge: The estimated volume dredged material generated during construction of Suoi Tre canal is moderate, about 66,105 m^3. According to the results of sediment quality analysis, sludge on Suoi Tre canal are neutral in pH value, not saline, all other analyzed heavy metals meeting the allowed standards. Therefore, this generated amount of dredged material is assessed not polluted and can be used for planting trees or disposed at landfill site as normal construction waste.

Odors from dredged materials: odor will be emitted from dredging and rehabilitation of 1.3 km of canals. The total volume of sludge dredged is about 66,105m^3. Bad odor may arise from the dredging activities due to the decomposition organic compounds and biomass contained in the dredged sludge. Exception from three households located at a distance of about 20 m from the

canal banks at downstream, there is no other residential area located within a distance of 250 m from the canal. This impact is assessed as low level.

Impacts on PCRs and sensitive receptors: There is no intangible cultural heritage within the project influence areas. The project will not encroach any physical cultural resources (PCRs). The project will affect a number of sensitive receptors are located 5-50 m distant, which include includes 22 schools, 04 markets, 03 clinic centers, 09 temple/churches/pagodas in Tan Uyen town and 21 schools, 3 market, 18 temples/pagodas in Di An city and 6 schools, 01 monastery, 3 temples/pagodas/ soil-grave in Thuan An city. Dust, noise, vibration, traffic accidents during the construction process will affect the learning, teaching and travel on people around these sites. This impact is assessed to be moderate and mitigable.

Mitigation measures

❖ ***Generic impacts***

The detailed environmental and social mitigation measures for each impact source, respectively during project phases, include: (i) general impact mitigation measures (ESCOPs); (ii) site-specific impact mitigation measures; and (iii) measures to minimize impacts on sensitive receptors.

❖ ***Site-specific impacts***

Social impacts: (i) Mitigation measures are taken for impacts from land acquisition in the Project area and shown detail in RAP; and (ii) construction options which require the smallest land acquisition area are prioritized. And (iii) appropriate implementation of LMP.

Impacts on travel condition and traffic safety risk: Prepare appropriate traffic management plan. Coordinate with local traffic authorities to implement traffic diversion schemes. Provide signs advising road users that construction is in progress. Construction activities on the surface the streets should be implemented section by section. Arrange and provide alternative access roads with safe and easy access (if needed). Employ flag persons to control traffic at the construction sites. Restriction of using too many pieces of construction equipment at interchanges at rush hour. Limit transporting materials during the rainy season and avoid overloading. Install night lighting of all construction sites. Repair damaged pavement of local road.

Impacts on business activities and household accessibility: Consult and inform with shop owners and household at least two weeks before construction starts to agree on and provide temporary access (if needed). Apply appropriate construction methods to avoid as much as possible to intervene existing roads. Deploy staff to guide the traffic during loading and unloading of construction materials. Provide adequate compensation for any obliviously impacts. Avoid storing raw materials or waste adjacent to of businesses or shops. Cleaning up construction areas at the end of the day. Resolve immediately any inconvenience caused by project activity

Impacts on public infrastructure and services: Undertake prior consultation and contingency planning with local authorities about the consequences of a service failure or disconnection. Coordinate with relevant utility providers to establish appropriate construction schedules. Proper compensation for the damages on infrastructure and services. Providing the temporary/alternative service provisions for any interruptions.

Impacts on irrigation drain: The excavation or levelling activities must be scheduled with consideration of the harvest time. Fully compensate or give alternative water transfer to ensure the water supply/drainage in the surrounding cultivation areas. Appropriate management of pollution sources from construction activities. Regularly check the affected on-field irrigation drains. Immediately fix up damages caused to irrigation drains if it happens.

Impacts on surrounding agricultural land: Informing the community of the construction

schedule at least one week before the construction. Arrange drainage and sediment pit around the construction sites. Disposal of solid wastes, construction waste into canals, agricultural field is prohibited. The placement of construction equipment/vehicles on the agricultural field will not allowed. All activities of contractor are only allowed within site boundary.

Safety issues, disturbance to workers of existing WWTPs: Coordinate, consult, and inform the management units of the existing Thuan An and Di An. Provide fence around construction sites to separate construction areas. All activities of contractor are only allowed within the construction site boundaries. Provide adequate safety warning and maintain light during nighttime. Use separated entrances for construction activities. Any impacts existing facilities contractors need to fully compensate.

Impacts on water environment, aquatic life and downstream use: Excavation activities must be carefully scheduled to avoid the rainy season. Strictly follow proposed construction method, the dredging activities of Suoi Tre is proposed section by section with dried dredged condition. Strictly prohibit contractors to discharge waste into canal and Dong Nai river. Strictly prevent hazardous waste, waste oils or particularly greasy rags from entering the flow. Do not gather construction materials as well as machinery and equipment near the canal.

Impacts due to excavated sludge: Excavation activities of the canal must be carefully scheduled to avoid the rainy season. Reuse for leveling demand of project works or other activities as much as possible. Dredged sludge needs to be transported to and disposed at South Binh Duong SWP Complex. Contractor need to prepare and implement dredged material management plan.

Odors from dredged materials: On-site location for temporary gathering of sludge must be to the tail end of the wind, far from residential areas. Dredged sludge needs to be transported to and disposed at South Binh Duong SWP Complex. Avoid as much as possible to temporary storage of the excavated materials. The specialized vehicles will be mobilized to transport the excavated sediments to the complex.

Impacts on sensitive structures: Inform people of construction time; Do not transport, use high-noise machinery and build items that emit a lot of dust and noise through the sensitive area during major religious holidays/study time. Spray sufficient water to suppress dust during dry and windy days. Provide safety measures as installation of fences, barriers warning signs, lighting system against traffic accidents. Prohibit gathering of construction materials within 100m in front of the sensitive objects. Cleaning up construction areas at the end of the day, especially construction around the sensitive structures. Immediately address any issue/problem caused by the construction activities. Reinstate and provide adequate compensation for any impacts which will be identified causing by the construction activities.

Environmental and social management plan

The WEIP ESMP includes measures to minimize negative impacts, roles and responsibilities for ESMP implementation, supervisors, environmental compliance framework, reporting organization, and control program. environment, capacity building program and ESMP implementation costs. Estimated cost is about USD 112,387.

During the construction process, ESMP requires the participation of a number of stakeholders and agencies, each with a unique role and responsibility, including the BDSPMU, Department of Natural Resources & Environment of Binh Duong province, Contractor, Construction supervision consultant (CSC), Independent environmental monitoring consultant (IEMC) and local community.

Community consultation and Information dissemination

Community consultation: Public consultation activities were conducted in 3town/City in 17 wards/communes of Binh Duong province in September and October 2020. The consultation was

conducted with representatives of government agencies and union organizations. such as: Representatives of People's Committee, Vietnam Fatherland Front Committee, Women's Union, households affected by the project. The local authority and people in the commune/ward in the construction area are completely in agreement on the implementation of the project, which will bring about socio-economic and environmental benefits. However, 17 affected wards/communes all require environmental sanitation during construction, ensure traffic safety and travel condition, control of dust and reinstate any damages on infrastructure. The draft ESIA in Vietnamese was published at the offices of 17 wards/communes/town/cities and the BDSPMU in December 2020 to conduct public consultation. The final draft of ESIA in Vietnamese will be published at the offices of 17 wards/communes and the DBSPMU in January 2021, prior to appraisal. The final version of ESIA in English will be published on the internal website and widely available in xxx 2021.

CHATER 1.PROJECT DESCRIPTION

1.1. PROJECT BACKGROUND

Binh Duong province belongs to the South-east region, 30 km from the center of Ho Chi Minh city along National Highway 13, and located in the Southern key economic region (including 8 provinces and cities: Ho Chi Minh city, Dong Nai and Binh Duong, Ba Ria - Vung Tau, Binh Phuoc, Tay Ninh, Long An and Tien Giang provinces). Binh Duong province is located between the Saigon and Dong Nai Rivers, with a natural area of 2,694.43 km² (share of 0.83% of the country's area, about 12% of the Southeast region), which takes place as the regional road transport focal points connecting the trans-Asia road, NH1K, NH.1A road and is the gateway of the Ho Chi Minh City to the central and the northern regions and vice versa.

Binh Duong is one of the provinces with the highest economic growth and the most dynamic industrial development of the country. Having a high economic growth rate, in 2018 the province's gross domestic product increased by about 9% / year, the average GDP per capita was VND 130.8 million / person. Average annual budget revenue increased by about 10%, of which the budget revenue in 2017 was VND 46,500 billion, ranking 4th in contributing to annual national budget (excluding environment tariff).

The Southern Binh Duong region consists of Thu Dau Mot city, Thuan An city, Di An city, Tan Uyen town and Ben Cat town, with having fast socio-economic development, being a cluster of 5 densely populated urban areas, with many large industrial zones. The Southern Binh Duong urban area covers an area of 688.8 km², share of 25% of the total province's area, but currently has a population of about 2.12 million people share for over 82% of the provincial population with a total budget revenue accounting for more than 90% of the province, with very high socio-economic development speed and urbanization rate in the last 15 years with rapid speed of urbanization that the urban infrastructure construction cannot catch up with.

Along with the comprehensive and rapid socio-economic development, the fast increase of urban population density leads to the generation of lots of wastes that need to be treated such as solid waste, exhaust gas and domestic wastewater. In the meanwhile, the task of constructing drainage and domestic wastewater treatment system in the area must be solved, in order to ensure urban sanitation, beauty and to protect the clean water source of the Southeast region's largest river basin, i.e. the Dong Nai River, which supplies more than 3 million cubic meters of clean water a day to Ho Chi Minh City, Binh Duong Province and Dong Nai Province today.

Since 2007, in order to protect urban areas from pollution by domestic wastewater and to protect the clean water supply source from Dong Nai river basin, Binh Duong province has borrowed ODA capital to implement 04 domestic wastewater collection and treatment projects for Thu Dau Mot City, Thuan An city, Di An city and Di An - Thuan An - Tan Uyen area with total capacity is around 70.000 m^3/day and night. However, it is estimated by Binh Duong's DONRE, the total domestic wastewater of Binh Duong province is 307 thousand m^3/day (equivalent to 112 billion m^3/year), and south of Binh Duong areas is 275 thousand m^3/day. Meanwhile, the investment infrastructure for the current wastewater treatment of Binh Duong can only handle about 25% of the urban wastewater volume, which are generated in the Southern of Binh Duong, the remain volume is about 205 thousand m^3/day, without any treatment, have been discharged directly to the combined drainage system, to canals then to Saigon and Dong Nai rivers, with an average pollution load of 46 tons of BOD_5/day taken place as the main water pollutant sources.

The project will directly and indirectly benefit more than 570,000 residents of Thuan An, Di An and Tan Uyen urban areas in the Southern Binh Duong region, benefiting from wastewater. People will benefit from improved urban infrastructure, that extends access to wastewater

treatment and improves river water quality, in turn, to improve public health. Provincial and City People's Committees also benefit directly from technical assistance and capacity development activities to improve project management and O&M. Water sector managers. Moreover, the improved water quality of the Dong Nai River benefits the people and the economy, which depends on water from the river, especially more than 10 million people in Dong Nai, Binh Duong and Ho Chi Minh City using drinking water from the Dong Nai River.

The project has implementing scope as collecting and treating wastewater in Tan Uyen town and extending the collection system and treatment facilities in Thuan An and Di An cities. This project with the scope of implementation of wastewater collection and treatment is Tan Uyen town and the remaining basins have not been collected wastewater from Thuan An and Di An factories; together with the project using the residual capital of the Southern Binh Duong Water Environment Improvement Project phase II using Japan International Cooperation Agency (JICA)'s fund; and the wastewater collection and treatment project for Ben Cat area will form a synchronous and relatively complete wastewater collection system for the South Binh Duong area including Thu Dau Mot, Thuan An, and Di An cities; and Tan Uyen and Ben Cat towns.

The wastewater treatment projects have been managed by the Wastewater Project Management Board, meanwhile the storm water drainage projects implemented by the Agriculture and Rural Development Project Management Unit of Binh Duong Province, all of them will contribute to improve drainage and wastewater treatment facilities for Binh Duong province and control flooding and mitigate environmental pollution

1.2. PROJECT OBJECTIVES

The project development objectives are: (i) to increase access to improved wastewater services; and (ii) reduce pollution to the environment caused by municipal wastewater in selected areas of Binh Duong province.

The project's objectives could be achieved through:

- Constructing of sewer collection system and WWTP for Tan Uyen town and expansion of the sewer collection system and WWTP for in Thuan An city and Di An city
- Building wastewater management plan, implementing post investment property management programs/plans in urban sewerage sector in Binh Duong

1.3. PROJECT LOCATION

Binh Duong is a province in the Southeast region, located in the core area of the southern key economic region, with a natural area of 2,694.43 km² (accounting for 0.81% of the country's area), keep a distance to Ho Chi Minh 30km via National road (NR) No.13.

- Bordering with Binh Phuoc province to the North.
- Bordering with Ho Chi Minh city to the South.
- Bordering with Dong Nai province to the East.
- Bordering with Tay Ninh province and Ho Chi Minh city to the West.

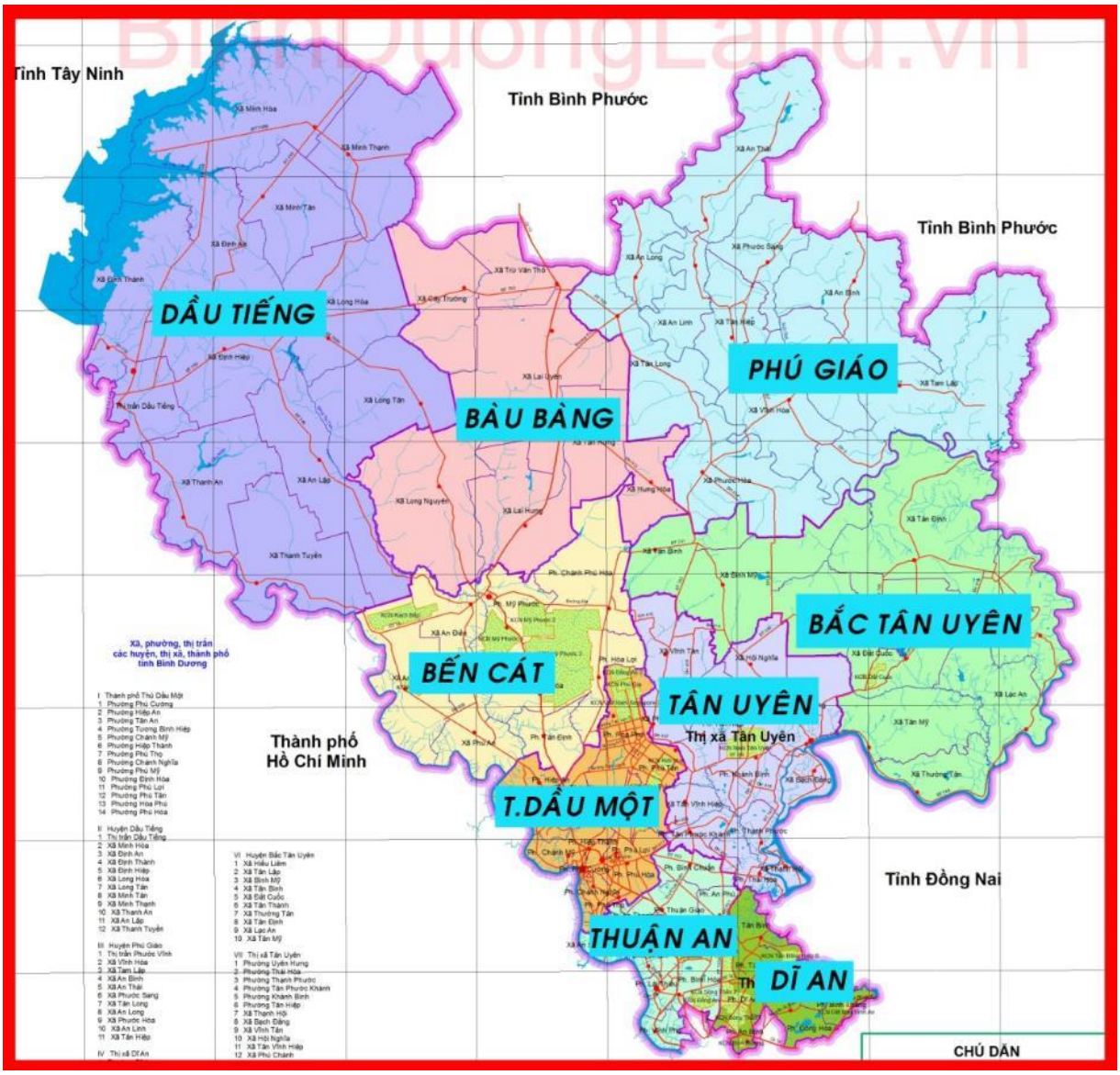


Figure 1.1. Administrative map of Binh Duong province.

The project will be implemented in Tan Uyen Town, Thuan An and Di An cities, including 09 communes/wards of Tan Uyen town (Khanh Binh, Tan Hiep, Tan Phuoc Khanh Hoi, Hoi Nghia, Uyen Hung, Tan Binh Hiep, Thach Phuoc, Phu Chanh, Vinh Tan wards) and 03 wards of Thuan An city (Vinh Phu, Binh Nham, Hung Dinh), and 05 wards of Di An city (Tan Binh, Binh An, Binh Thang, Dong Hoa, and An Binh). The locations of project siting in the Binh Duong urban areas could be presented in the below figure:

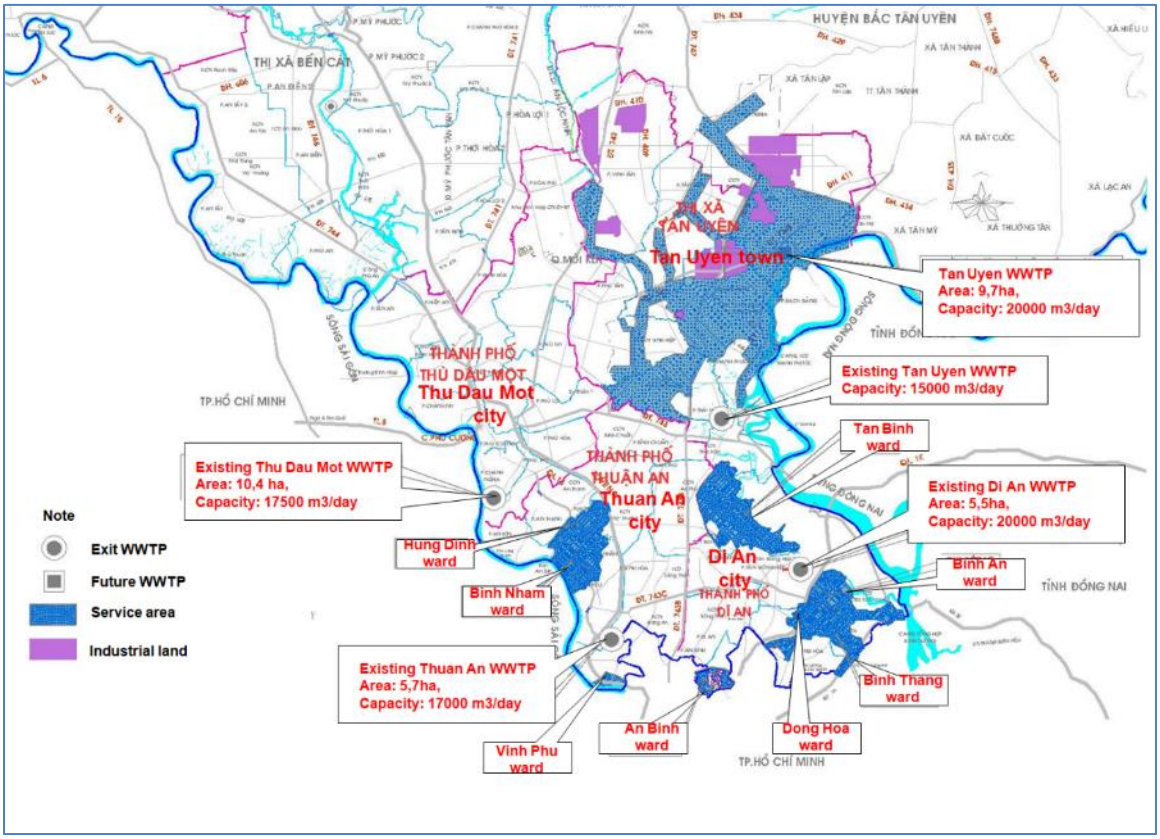


Figure 1.2. Scope of the project.

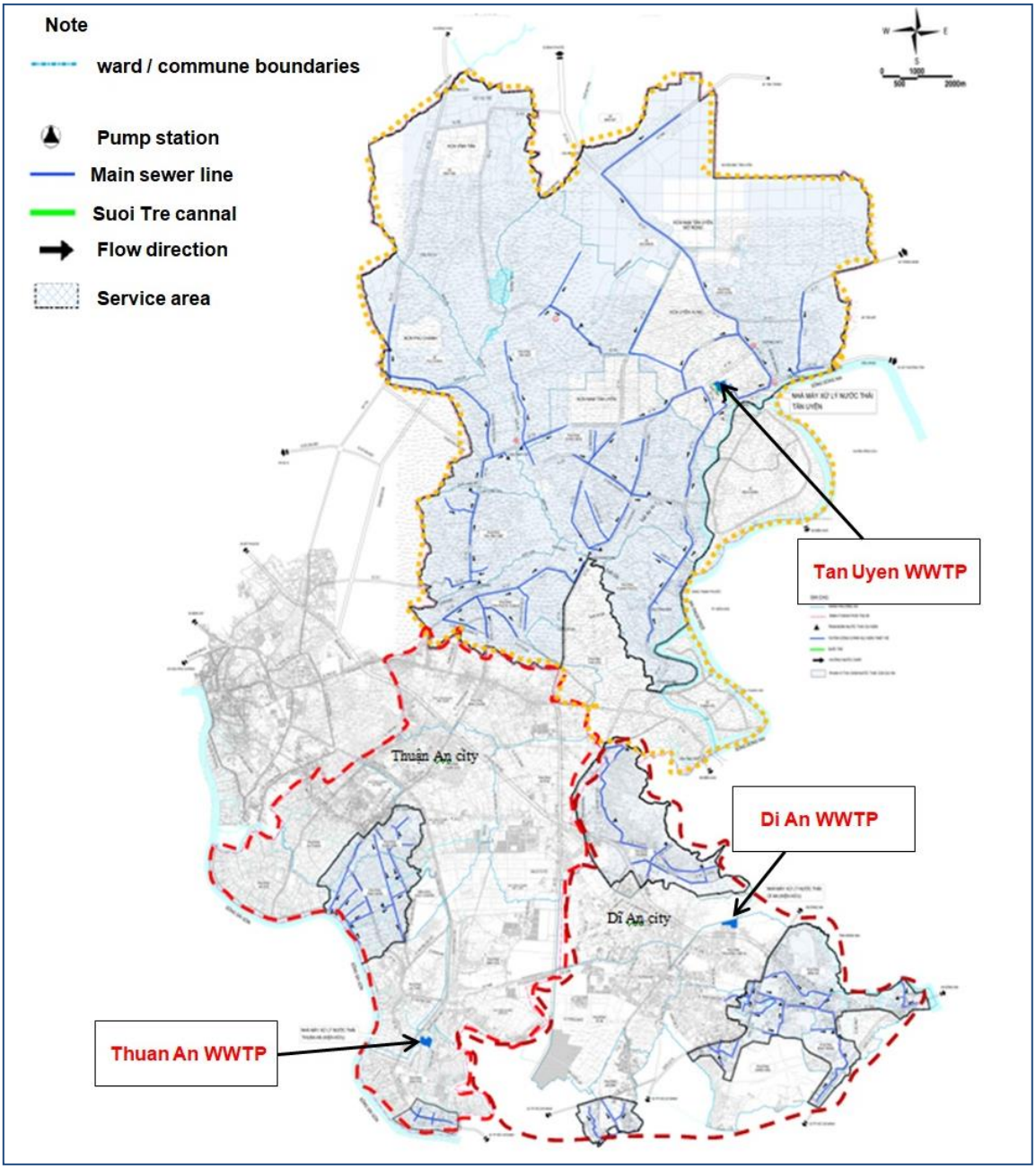


Figure 1.3. The project areas.

1.4. PROJECT COMPONENTS

The proposed project is structured in two main components. A summary of activities to be financed under each component is provided below:

Table 1.1.Summary of the project investments

No.	Component/work items	Investment scale	Brief description
I	**Component 1: Expanding municipal services for wastewater and drainage management (IBRD Loan: US$192.223 million; Counterpart Fund: US$19.222 million)**		
1.1	Sewage collection and network expansions, including sewage pumping stations for Tan Uyen town, Thuan An and Di An cities	These investments will increase the coverage to more than 54,000 households. Total primary and secondary wastewater collection and transmission network is 122.53 km Sewage collection D200-D1200 in three areas:	Pipeline with D>200 m: will be on the road surface, and D<150m will be placed on the pavement if it is possible. Pipeline material: uPVC with D ≤ 300 (OD315) and HDPE with D > 300
		Tan Uyen town: 71.26 km sewage collection D200-D1200 (include D350-D1200: 31.76 km, D200-300: 39.5 km), 27.2 km of pressured pipe D100-D800, 07 pumping stations, 10 collecting pits, 212.5 km of D100-D150	- Covered areas:9 wards - No current sewage collection system, rainwater and wastewater are discharged directly into canals and streams and then flowing into Dong Nai River - Roads (where the system placed): high traffic density, crowded residential areas and business shops, W=10 – 30 m
		Thuan An city: 19.97 km sewage collection D200-D600 (include D400-D600: 3.2 km, D200-300: 16.77 km), 4.07 km of pressured pipe D100-D350, 1 pumping stations, 5 collecting pits, 85 km of D100-D150	- Covered areas: 3 wards - No current sewage collection system in 2/3 wards, rainwater and wastewater are discharged directly into canals and streams and then flowing into Sai Gon River - The 1/3 ward has a system to partially collect wastewater to the current Thuan An WWTP - Roads: (i) local roads (W=8-10 m): less traffic, low residential density; (ii) NH.13 (W=30 m): high traffic and residential density
		- **Di An city:** 31.3 km sewage collection pipes D200-D700 (include D400-D700: 6.98 km, D200-300:24.32m), 16.02 km of pressured pipe D100-D450, 4 pumping stations, 7 collecting pits, 60.05 km of D100-D150	- Covered areas: 5 wards - No current sewage collection system in 3/5 wards, rainwater and wastewater are discharged directly into canals and streams and then flowing into Dong Nai river - 2/5 wards have a system to partially collect wastewater to the current Di An WWTP - Roads: W=5-30m, traffic congestion during peak hours, especially on NH1A, PR743A
1.2.	Constructing a WWTP for Tan	**Tan Uyen town:** - Constructing a WWTP with 1st stage	- Location: agriculture land (9.7 ha) - Receiving source: Suoi Tre canal and

No.	Component/work items	Investment scale	Brief description
	Uyen town; Upgrading the existing WWTPs for Thuan An and Di An cities	capacity of 20,000 m³/day for Tan Uyen town; - Improving the drainage capacity in downstream of Suoi Tre canal: open canal BxH = (14.5-16)x(4-6.5) m, L=1.3km, concrete road on both sides of canal B = 4 m	finally discharge to Dong Nai river
		Thuan An city: Upgrading the existing Thuan An WWTP with additional treatment capacity of 20,000 m³/day	- Location: in existing Thuan An WWTP, the shortest distance to residential areas is about 50m, adjacent to Ong Bo, Cau Mieu and Vinh Binh canals - Receiving source: Vinh Binh and finally discharge to Sai Gon river
		Di An city: Upgrading the existing WWTP for Di An city with additional treatment capacity of 20,000 m³/day	- Location: in existing Di An WWTP, the shortest distance to residential areas is about 50 m, near the North-South rail and the Tan Dong Hiep quarry -Receiving source: Cai Cau canal and finally discharge to Sai Gon river
II	**Component 2: Implementation support, capacity and institutional development (IBRD Loan: US$4.240 million; Counterpart Fund: US$31.654 million)**		
2.1.	Sub-component 2A: Developing integrated urban water management in the project areas (Counterpart Fund: US$ 1.289 million)	Assisting the newly established BDSPMU under the Provincial People's Committee to develop integrated urban water management strategies of the South Binh Duong region; to develop risk-based integrated drainage and inundation management strategy based on an inundation risks map Conducting a series of trainings on integrated urban water management and nature-based solutions to enhance both technical and official persons' capacity. Female participation will be required in all training activities, which would lead to increased participation of women in flood control and prevention related activities.	
2.2.	Sub-component 2B: Implementation support, capacity building, and coordination for COVID-19 response (IBRD loan: US$ 4.240 million; Counterpart Fund: US$ 10.125 million)	The activities under this sub-component include: (i) M&E and technical support to achieving the indicators (ii) Construction supervision and contract management. Which will be financed by both counterpart funds (surveys, designs, appraisal etc.) and IBRD (i.e. for construction supervision, independent environmental and social monitoring, financial audit and project M&E). The component will also coordinate the COVID-19 response in the province as pertains to conducting IEC activities to raise awareness on hand washing and hygienic practices to increase resilience to COVID-19 and other waterborne communicable diseases as well as employment generation opportunities in the province	
	Sub-component 2C: Site clearance, Land acquisition and compensation (Counterpart Fund: US$ 20.240 million	The activities are directly related to the compensation, land acquisition and site clearance that required for project implementation. These include: Consultancies on preparation of compensation, land acquisition and resettlement planning; Implementing compensation, support and site clearance; and preparing and implementing livelihood restoration program.	

Wastewater treatment technology

Characteristics of intake wastewater

Constructing a WWTP for Tan Uyen town and upgrading the existing WWTPs for Thuan An and Di An cities. The treated wastewater will meet Vietnamese National Standard on Treated Wastewater Quality QCVN 14: 2008/BTNMT (Column A).

Table 1.2. Untreated and treated wastewater quality

No.	Indicators	Unit	Untreated wastewater*	Treated wastewater(column A, QCVN 14:2008/BTNMT)
1	pH	-	5-9	5-9
2	BOD_5 (20°C)	mg/l	200	30
3	TS)	mg/l	225	50
4	NH_4^+	mg/l N	30	5
5	NO_3^-	mg/l N	35	30
5	PO_4^{3-}	mg/l P	6,5	6
6	Total Coliforms	MPN/100 ml	10^5- 4x10^6	3000

** Source: FS report. QCVN 14:2008/BTNMT– National Wastewater Quality - column A (table 1): Wastewater quality allowed to discharge to water bodies.*

The above listed indicators are main indicators, other indicators, such as $N\text{-}NH_4^+$, $N\text{-}NO_3^-$, $P\text{-}PO_4^3$, total oil and grease need to lower or equal to the value at QCVN 14:2008/BTNMT (column A).

Treatment technology of proposed WWTPs:

Wastewater will come through physio-chemical treatments then to ASBR bio-treatment unit. The WWTP has an odor treatment unit to treat the smelly gases generated from the intake, regulating pond, sludge compaction unit, sludge drying unit and ASBR biological tanks. The residual activated sludge from ASBR tank will be led to the sludge thickening and holding units, then to centrifugal compaction machine.

Wastewater Treatment Processes: The wastewater treatment process will be combined physical, chemical and ASBR biological treatment processes described below.

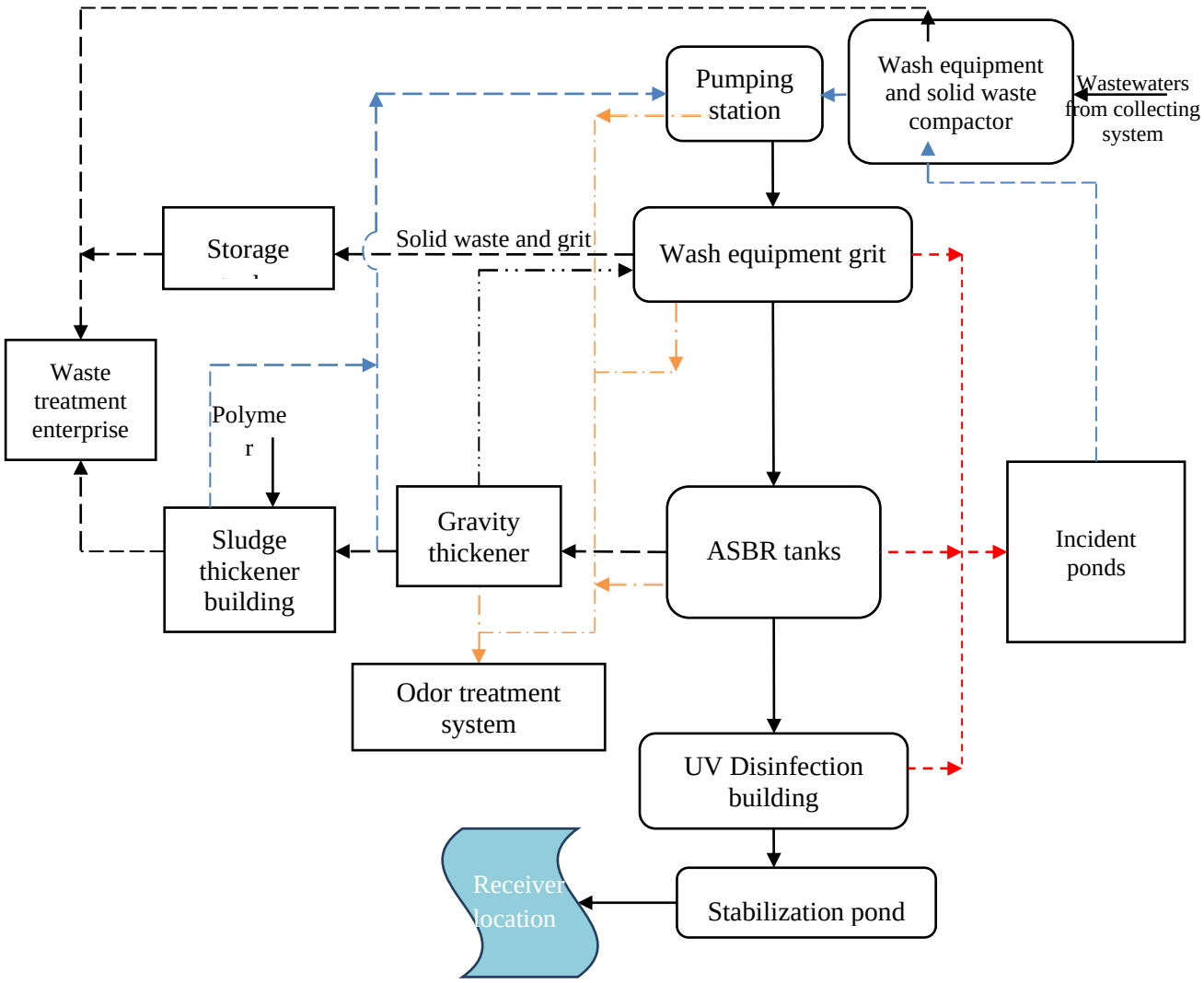


Figure 1.4. Wastewater treatment processes.

Wastewater generated from households will be collected to the collection pipelines to be transported to the WWTPs where garbage will be screened, sand will be sedimented and scums are removed. After that, wastewater will come through physio-chemical treatments and then to be treated at ASBR bio-treatment unit. Finally, treated water will be disinfected by UV ray, led to stabilization pond and discharged into discharging points. The final discharging points include: i) Tan Uyen WWTP: discharge to Suoi Tre Canal (600m), then to Dong Nai river; ii) Di An: discharging to T4 canal and Cai Cau stream, then through the Tan Van stream to the Dong Nai river. The distance from the discharge point to the Cai Cau stream is about 10 m and to the Dong Nai river is 7400m and iii) Thuan An WWTP discharged to Vinh Binh canal, and finally to Sai Gon river (2km)

The three WWTPs have an odor treatment unit to treat the smelly gases generated from the intake, regulating pond, sludge compaction unit, sludge drying unit and ASBR biological tanks. Sludge from the intake and residual activated sludge from ASBR tank will be led to the sludge thickening and holding units, then to centrifugal compaction machine. It is estimated that at operating capacity of 20,000 m^3/day, each day 1,142 kilograms of dry sludge will be generated from each WWTP. The sludge amount generated by using drying machine from three WWTPs will be transported in specialized trucks every three days to the existing South Binh Duong Solid Waste Treatment Complex for composting or brick production. This complex is located in Ben

Cat town, Binh Duong province, owned and being operated by BIWASE with the distance to Tan Uyen WWTP and Thuan An, Di An WWTPs is 25 km and 36 km respectively.

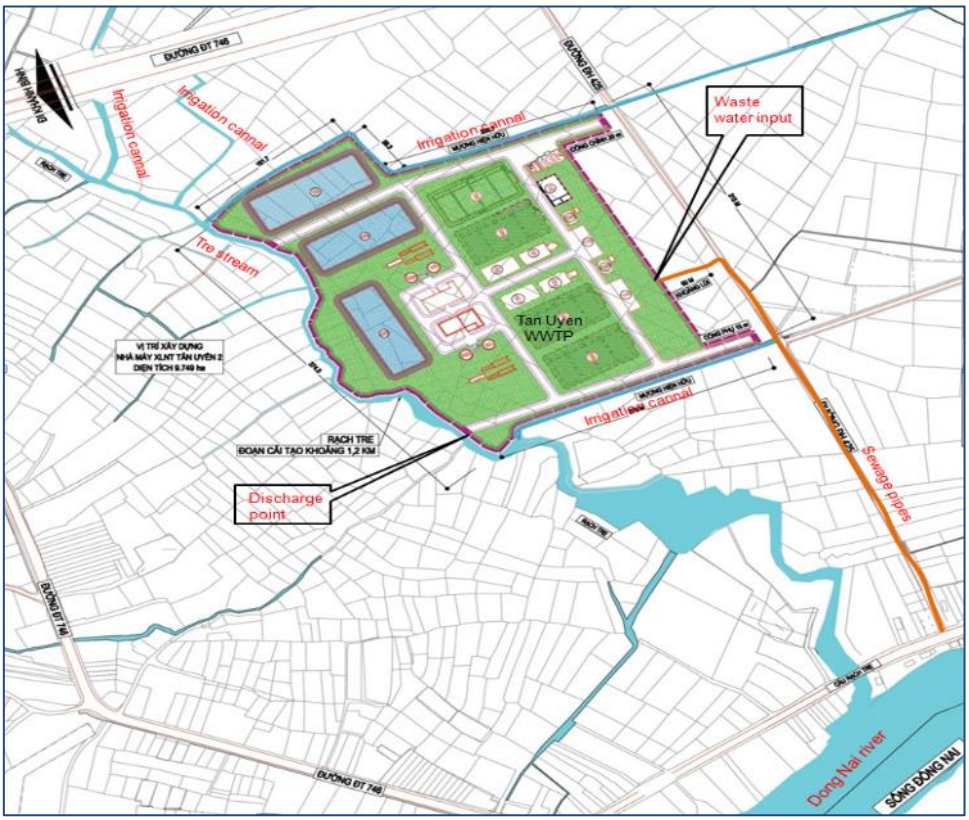


Figure 1.5. Layout of Tan Uyen WWTP.

Figure 1.6. Layout of Thuan An WWTP.

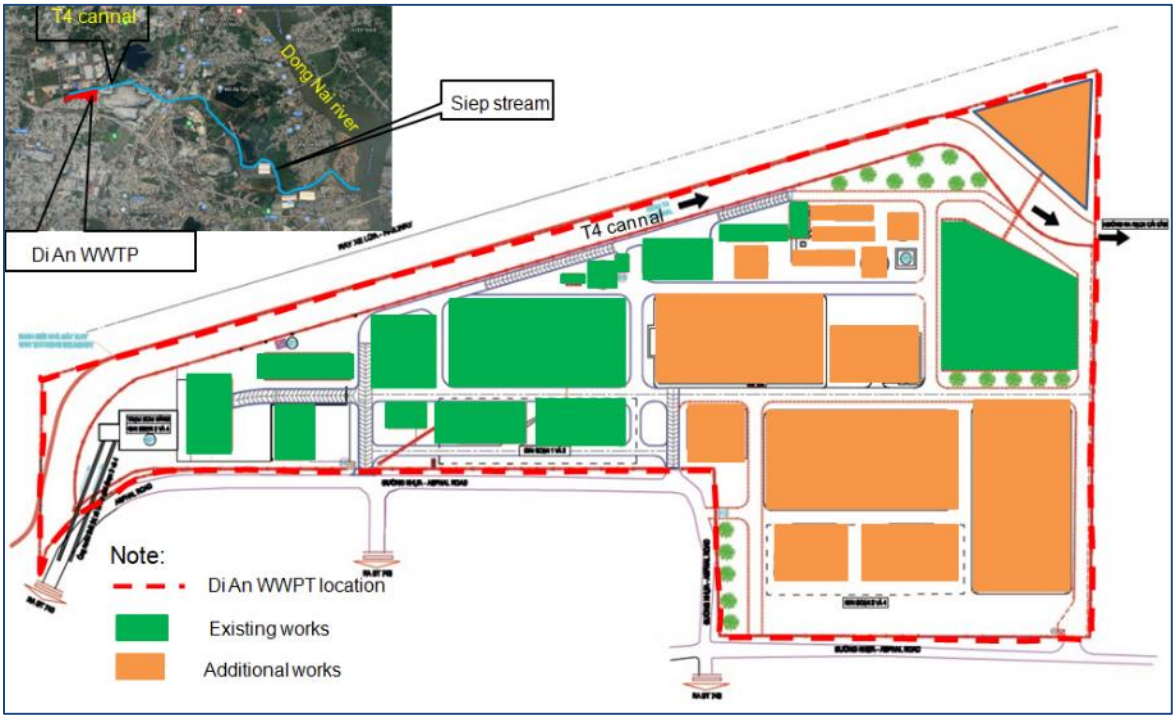


Figure 1.7. Layout of Di An WWTP.

1.5. PROJECT AREA OF INFLUENCE

During the environmental and social impact assessment of the project, it is important to define the area for which environmental and social impacts are considered. Binh Duong Water Environment Improvement Project (WEIP) will include new construction of a WWTP in Tan Uyen town, expansion the capacity of 2 existing WWTPs in Di An and Thuan An cities, improvement the downstream of Suoi Tre canal, construction of pumping stations and wastewater collection system in 9 wards in Tan Uyen town (including Khanh Binh, Tan Hiep, Tan Phuoc Khanh, Hoi Nghia, Uyen Hung, Tan Vinh Hiep, Thanh Phuoc, Phu Chanh, Vinh Tan), 3 wards in Thuan An City (Vinh Phu, Binh Nham, Hung Dinh wards), 5 wards in Di An City (Binh An, Binh Thang, Tan Binh, Dong Hoa and An Binh wards).

The project area of influence will extend beyond its actual location mainly through the discharge of treated wastewater flows. Dong Nai river, Suoi Tre canal can receive additional suspended particulate generated from construction activities of Tan Uyen wastewater treatment plant, improvement of Suoi Tre canal. In addition, the affected area will also be considered along the transportation routes of raw materials/waste to/from the construction sites such as national highway No13 (NH13, provincial road 747, 746, NH No1A, NH1K and internal routes of wards. These areas may be affected by exhaust gas, dust, material spillage, traffic congestion, and traffic accident risk during operation of transportation vehicles.

Moreover, the project will not cause adversely affect outside the city, natural ecological zones such as Can Gio Mangrove Forest, Cat Tien National Park, and Bu Gia Map National Park (as these areas are far away. construction works of the project from 60-150 km).

During operation period, downstream of Dong Nai River, and Saigon River from the discharge points of the WWTP are areas that can be affected since they will take place as the receiving water bodies, the impacts could be more serious in case of WWTP malfunction. The appropriate

operation of WWTPs will contribute to enhance the water quality in the downstream areas of Dong Nai and Sai Gon river and reduce the water usage conflict in these areas.

As the project turn into operating phase, the beneficiary areas include wards/communes in Tan Uyen town, and Thuan An and Di An cities since the collected wastewater will not discharge directly into the environment then enhancing the sanitation condition of these areas.

The project area influence also includes sensitive receptor at downstream of WWTP. It includes Tan Hiep water supply plant (WTP) located downstream of the Tan Uyen WWTP. The WTP takes raw water from Dong Nai river. And its water intake is about 2 km distant from the intersection of Suoi Tre and Dong Nai river; and about 2.5 km distant from the discharge point of Tan Uyen WWTP at Suoi Tre canal.

Figure 1.8. The location of raw water intake work of Tan Hiep water supply plant.

1.6. CONSTRUCTION METHODS

The Binh Duong Water Environment Improvement Project includes several work items, the construction plan and method will be based on each type of works item, technical specifications of construction items, site-specific conditions.

Construction methods: Before construction, the project information will be disclosed to local people, affected people, local authorities, and stakeholders. The detail construction schedule and methods will be prepared as agreement and involvement of relevant stakeholders such as affected people, traffic management agencies, communities, BDSPMU, constructors or design consultants. The detail and appropriate construction methods will be proposed in the tender documents.

1.6.1. Construction of WWTPs

(1) Construction of Tan Uyen WWTP:

Site-clearance: Compensate the land, crops, trees and physical structures on land for affected households and conduct site clearance.

Site establishment:

Establishment of worker camps (with appropriate sanitation facilities), auxiliary areas, material storage areas on the construction site with appropriable water, power supply, and basic facilities.

Ground leveling:

- Ground leveling from current evaluation of 2m to 4.6-5m
- Removal of the weathered soil layer, ground leveling in layers at the thickness of 200mm, compacted with K=0.95

Reinforced concrete: pre-casted, construction by pre-boring method.

Constructed by spot concrete pour method

- For foundation of the bored holds is < 3m in depth will be constructed by open excavation methods
- All works items with a foundation depth is larger than 3m are constructed according to the digging method with reinforcement of the pit wall by steel sheet pile combined with anti-splash system.

Construction of internal roads and other facilities: such as drainage system, water supply, power supply and communication system:

Green trees:

Land scape and green belt will be provided

Site restoration:

Remove all unused material, waste, worker camps and vegetable recovered at the locations of worker camps, auxiliary areas.

(2) Construction of Thuan An and Di An WWTP:

Site establishment:

(2) Construction of Thuan An and Di An WWTP:

Site establishment (worker camps and auxiliary areas): Establishment of worker camps auxiliary areas, material storage areas within the boundary of existing WWTPs, and utilize available facilities of these WWTPs

Ground levelling: not require

Reinforced concrete: pre-casted, construction by pre-boring method.

Constructed by spot concrete pour method

For foundation of the bored holds is < 3m in depth and constructed by open excavation methods

All works items with a foundation depth is larger than 3m are constructed according to the digging method with reinforcement of the pit wall by steel sheet pile combined with anti-splash system

Site restoration:

Remove all unused material, waste, worker camps and vegetable recovered at the locations of worker camps, auxiliary areas.

1.6.2. Construction of pumping stations

Excavation activities: use a trailer to dig the depths of the soil as required by the pump station. Using the open excavation method, reinforcing the pecans by steel sheet pile.

Concrete activities: using pre-casted concrete

1.6.3. Construction of sewer system

Location of sewer pipes

Wastewater collection pipes will be arranged according to the actual sidewalk and roadbed of the intervened roads. Only pipes with D150 could be arranged on the sidewalk to collect wastewater from households, while pipes with diameter ≥ D200 will be placed mainly under the roadbed.

In case of arranging wastewater collection and transmission pipes on roads with sidewalks wide enough for underground works: to place 3m away from the edge of people's houses

If located under the roadbed: about 1.5m from the edge of the sidewalk. Household collection pipes will be placed in the sidewalk about 0.5 - 1 m from the edge of the house, then connected to the level 1-2 pipes at appropriate locations.

Excavation works and installation of pipes

Before digging ditches on the surface of asphalt pavement, cutters are used to cut the road surface to avoid affecting the remaining pavement during digging.

Excavation method: applying the open excavation method, using reinforced with steel sheet pile. Remove the concrete layer on the road surface, the dig the gravel layer, proceed to pile steel or other reinforcing measures to keep the pit wall stable, then dig the soil layer to the specified depth.

Open excavation of the ditch sections to install the pipes which will be carried out within the specified time. The maximum length of section on the road allowed to dig at the same time will not more than 100m. After installing pipes, fittings, sand filling, re-establishing the road surface, pavement, and road surface need to be completed to move to dig the next section.

Excavated material will be transported to the designed disposal areas or reuse for grounding leveling in other worker items of the project, if any. The excavated material will not allow to spill onto the road surface.

For the excavation section at the junction or intersection, the road surface will be left with the remaining width of at least ≥ 2.5m to have a way for residents to cross, or to build a temporary iron overpass for vehicles. 2.5 tons of safe passage and temporary bridge surface width ≥ 2.5m.

Land and sand filling work

The soil and sand filling around structures will be carried out after the concrete is of enough strength

When compacting the material layers on both sides of the sewer pipe must use a compactor or table compactor and implemented at the same time on both sides of the pipe to avoid moving the pipe until the thickness of the material layer on top of the pipe is large. More than 50cm can be used for heavier equipment. The layers above must use vibrating roll of suitable weight for application.

Re-establishing the status: reinstate the road surface as per preconstruction status.

Connect into the sewer pipes:

- On the connection network: provide waiting boxes to connect to D150 or branch pipeline (D200-D300)
- The sewage drainage pipe of the people's house from the septic tank (or directly without the septic tank) is discharged into the box in front of the house, and then connected to the D150 collection pipe and then connected to the main conveying pipe ≥ D300) or branch conveying pipe (D200-D300).
- -The sewage drainage pipe of the household from the septic tank (or directly without the septic tank) is discharged into the box in front of the house, and then connected to the branch conveying pipe (D200-D300)

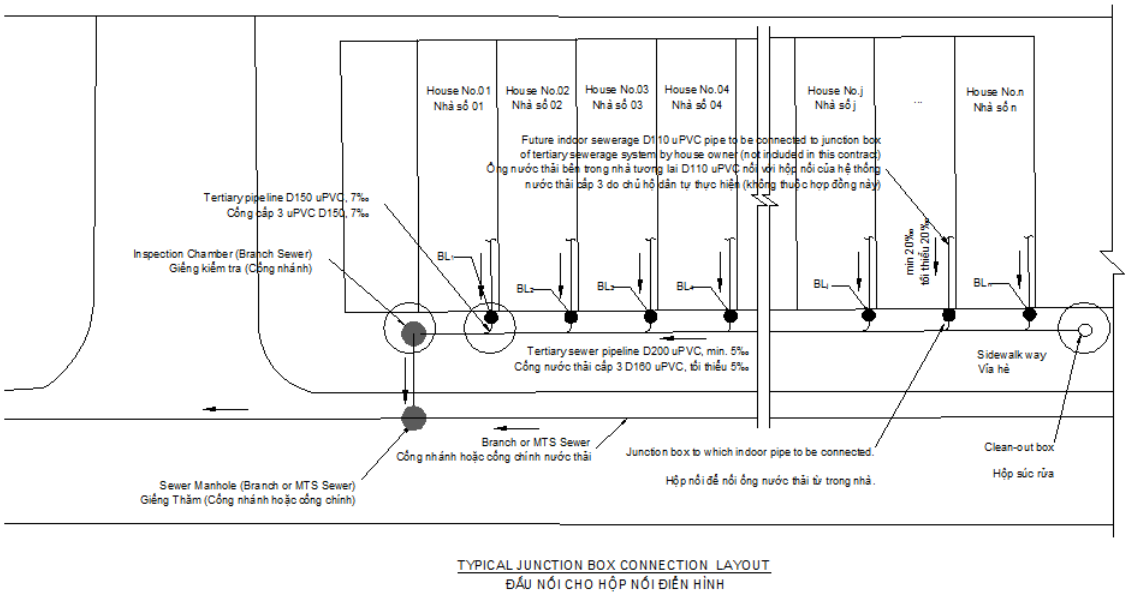


Figure 1.9. Connection from households to the sewer pipe.

1.6.4. Construction of Suoi Tre canal improvement

Site preparation:

- Establishment of worker camps (with appropriate sanitation facilities), auxiliary areas, material storage areas on the construction site with appropriable water, power supply, and basic facilities.
- Mobilization of equipment
- Identified the locations to temporary storage excavated material on the site

Removal of the weathered soil layer, ground leveling in layers at the thickness of 200 mm, compacted with K=0.95

Excavating the canal bed: will be implemented section by section

- Construction will be implemented in certain section from 50-100 m;
- Block the water flow at both ends of the section using melaleuca piles or sand sacks closed / dropped into the canal at the beginning and end of the implementation segment;
- Use the pump to dry the water in the area the blocked;

- Using pumps to diverse the flow on Suoi Tre canal
- Dredging the canal bed;
- Waste sludge is gathered at the identified temporary location in the construction site then transport to disposal areas.

Embankment:

- Installation of reinforced concrete piles (D250x250, L = 11.7m) with 2m section in length for each pile on along both sides of the canal bed.
- Cover the canal bed with geotextile, then place the gabion with 300m in thick and 4-6.5m in width;
- Stable the by soil cement pile (D400, L-6m). The roof has slope m = 1: 1.25, covered with geotextile, the macadam layer with 100mm, pour mortar layer of 50mm, M75, then knitted reinforced concrete with 150mm

Construction of road on the both side of canal

- Cover the canal banks with geotextile, then apply appropriate soil to level up to design elevation, compact with coefficient K> = 0.95. Then spread the gravel grade 2 macadam with 20cm in thick, put K> = 0.95 compacted. Lay the plastic layer (0.282kg/m^2) on top of the macadam gravel layer, then pour concrete with grade 250.15cm thick

1.7. DEMAND OF CONSTRUCTION MATERIALS, MACHINERIES AND RESOURCES

1.7.1. Equipment and vehicles demand

The types and number of equipment and vehicles will be mobilized on the sites depending on requirement of construction methods, activities and schedule. The demand of construction equipment, vehicle could be estimated as be below table

Table 1.3. List of mobilized equipment, machines

No.	Type of equipment, machines	Tan Uyen WWTP	Tan Uyen sewer pipelines and pumping station	Suoi Tre canal	Thuan An WWTP	Thuan An sewer pipelines and pumping station	Di An WWTP	Di An sewer pipelines and pumping station
1	Excavator, 1.25 m3	2	9	1	2	3	2	5
2	7T Truck,	7	9	3	5	3	5	5
3	Bulldozer 110cv	3	2	1	2	2	2	2
4	Road roller	3	-	1	2	-	2	-
5	Watering machine	2	5	1	2	2	2	2
6	Water pump 5cv	-	-	1	-	-	-	-
7	Pile presses	4	-	1	2	3	4	4
8	Concrete mixer 250 liter	2	9	2	1	3	2	5
9	Stamping machine 1KW	2	9	2	1	3	1	5
10	Toad compactor	3	9	1	1	3	1	5
11	Roller	3	-	1	1	-	1	-

(Source: FS, 2020)

1.7.2. Human resources and worker camps

Total number of mobilized workers and technical staff are estimated as 300 people on three implementation location of Tan Uyen town, Di An and Thuan An cities. Depending on construction progress, the number of workers to be mobilized at each construction site is varied from 10-90 people, plus with around 30% of local labors for simple construction works.

Estimated the labor personnel is shown in the following table:

Table 1.4. Estimated workers and staff demand for the project

No.	Construction items	Workers	Technical staffs
Tan Uyen town			
1	Tan Uyen WWTP (20.000 m³/day)	16	4
2	Sewer collection system	90	30
3	Pumping stations	38	15
4	Suoi Tre canal improvement	10	4
Thuan An city			
1	Expansion of Thuan An WWTP (20.000 m³/day)	15	4
2	Expansion of sewer collection system and Thuan An city	30	10
3	Pumping stations	12	4
Di An city			
1	Expansion of Di An WWTP (20.000 m³/day)	15	4
2	Expansion of sewer collection system	50	15
3	Pumping stations	24	8

(Source: FS, 2020)

Worker's camp:

Tan Uyen WWTP and Suoi Tre canal: establishment of worker camps (with appropriate sanitation facilities), auxiliary areas, material storage areas on the construction site with appropriable water, power supply, and basic facilities.

Thuan An and Di An WWTPs: establishment of worker camps auxiliary areas, material storage areas within the boundary of existing WWTPs, and utilize available facilities of these WWTPs.

Pumping stations: provide a small-scale camp at every station to ensure the safety, worker could hire local houses for living.

Construction of sewer collection system: worker could hire houses in the areas for living.

1.7.3. Earthwork volumes

The quantity of earthwork, mainly excavation and filling, during construction phase of the project activities are shown in the below table:

Table 1.5. Earthwork volumes

Construction Items	Volume					
	Removed material *(m^3)*	Topsoil removal *(m^3)*	Purchased soil *(m^3)*	Excavation *(m^3)*	Filling *(m^3)*	Residual soil to be disposed *(m^3)*
Tan Uyen town	**445,952**	**19,500**	**275,770**	**1,120,414**	**1,075,214**	**355,327**
Construction of sewer collection system	445,952	-	-	1,003,645	778,980	240,074
Pumping stations	-	-	-	9740	998	8190
Tan Uyen WWTP in Tan Uyen with capacity of the first phase is 20.000 m³/ day	-	19,500	275,770	40,925	295,235	40,959
Suoi Tre canal	-	-	-	66,105		66,105
Thuan An City	**84,767**	**-**	**-**	**280,758**	**202,535**	**80,058**
Expansion of sewer collection system	84,767	-	-	250,618	197,315	55,353
Pumping stations	-	-	-	2460	267	2055
Expansion of Thuan An WWTP with the capacity is 20.000 m³/day	-	-	-	27,680	4,953	22,650
Di An City	**257,688**	**-**	**-**	**441,722**	**325,537**	**108,799**
Expansion of sewer collection system	257,688	-	-	409,042	319,994	82,015
Pumping stations	-	-	-	5000	590	4134
Expansion of Di An WWTP with the capacity is 20.000 m³/day	-	-	-	27,680	4,953	22,650
Total (I + II+III)	**788,407**	**19,500**	**275,770**	**1,842,894**	**1,603,285**	**544,185**

Source: FS, 2020.

The volume of unused is estimated based on the differences between the excavated volumes and the volume reusable for refill, which will be transported to disposal sites

1.7.4. Demand for construction materials

The volume of construction materials could be estimated as the below table

Table 1.6. Estimated construction material demand

Construction items	Volume				
	Embank soil *(m^3)*	**Macadam** *(m^3)*	**Sand** *(m^3)*	**Steel** *(ton)*	**Cement** *(ton)*
Tan Uyen town	1,075,214	1,146,100	207,109	4,723	1,213,453
Construction of sewer collection system	778,980	1,115,309	187,098	1,220	4,303

Pumping stations	998	2,826	2,646	463	377
Construction of WWTP in Tan Uyen with capacity of the first phase is 20,000 m³/day	295,235	12,654	11,099	1,616	5,110
Suoi Tre canal	-	15,312	6,266	1,424	1,203,663
Thuan An City	202,535	258,486	45,301	1,268	2,056
Expansion of sewer collection system	197,315	254,092	43,122	397	1,172
Pumping stations	267	744	714	122	101
Expansion of Thuan An WWTP with the capacity is 20,000 m³/day in Thuan An City	4.953	2,750	1,465	849	783
Di An City	325,537	474,328	70,216	1,628	2,927
Expansion of sewer collection system	319,994	469,970	67,155	515	1920
Pumping stations	590	1608	1,596	265	224
Expansion of Di An WWTP with the capacity is 20,000 m³/day in Di An City	4,953	2,750	1,465	849	783
Total (I + II+III)	1,603,285	1,878,914	322,626	7,619	1,218,435

Source: FS, 2020.

1.7.5. Construction material supply source:

Construction materials will be bought by the contractors from the existing borrow pits in Binh Duong and Dong Nai provinces. Other construction materials will be purchased from dealers/suppliers in Binh Duong province. Final selection of supply sources will be depended on the technical specification of supplied material. The contractors will be required to include all relevant operating documents of proposed material sources in the tender documents. The licensed construction material sources could be listed in the below table:

Table 1.7. Existing borrow pits and quarries

Material	Pits/ Quarries	Description	License Status
Filling materials: soil	For investments in Tan Uyen: Tan My borrow pit	Located in Tan My Commune, Bac Tan Uyen district, about 5-30km from construction site Soil exploited belongs to sedentary earth layer-generated from decomposition of lava. High, indefinite reserve. Easy to exploit. Soil is delivered to construction's site by truck on asphalt road	Exploiting by Dong Hoa Company Limit under license issued by the Binh Duong PPC at Decision No 50/QĐ-UBND dated 06/08/2013
Rock and crushed stones	For investments in Di An and Thuan An: Nui Nho quarry	Located in Binh An Ward, Di An city Exploitation capacity is one million cubic meter per year; has 30 screen disintegrators with a capacity of 150 – 250 tons per hour; provide rocks for production of concrete and asphalt Open cast mining by rock bursting technique, delivered to construction's site by truck on asphalt road in average distance of 5-30 km.	Exploiting by Da Nui Nho JSC under license issued by the Binh Duong PPC at Decision No 14/QĐ-UBND dated 06/06/2014

Material	Pits/ Quarries	Description	License Status
Rock and crushed stones	For investments in Tan Uyen: Hoa Tan An quarry	Located in Thuong Tan commune, Bac Tan Uyen district Exploitation capacity 0.5 million m^3/year, screen disintegrators with a capacity of 150-250 ton/hour Open cast mining by rock bursting technique, delivered to construction's site by truck on asphalt road in average distance of 5-30 km	Managed by Hoa Tan An JSC. with license No.08/GP.UBND dated 15/8/2011 Binh Duong PC
Sand	All construction site: Song Nai river sand mine	Located in territory of Tan Hung, Tam Phuoc Commune of Long Thanh District and Long Tan, Dai Phuoc Commune of Nhon Trach District, Dong Nai province. About 5 – 25 km to construction sites Exploited capacity: 1 million m^3/year.	Exploited by licensed Dong Nai Sand Exploitation Company
Steel, pile	For all	Suppliers on the provinces which will be transported to the construction sites	
Cement, brick, paint etc.	For all	Suppliers on the provinces which will be transported to the construction sites	

1.7.6. Fuel demand

Fuel demand for construction activities could be estimated in the below table:

Table 1.8. Estimated fuel demand

Construction items	**Estimated fuel demand** (Diesel oil**)**	
	Liter	**Kg**
Tan Uyen		
Tan Uyen WWTP	3360	2890
Suoi Tre canal	1480	1273
Sewer collection system	5460	4696
Pumping stations	460	396
Di An city		
Thuan An WWTP	2240	1926
Sewer collection system	4210	3621
Pumping stations	230	198
Thuan An city		
Thuan An WWTP	2240	1926
Sewer collection system	2780	2391
Pumping stations	180	155

Main supply sources will be purchased on the project areas

1.7.7. Water and electricity supply

Electricity Supply: Power sources: from the existing national grid line 22kV in South Binh Duong, which will be used for domestic purpose of workers, operation of construction equipment and water pumping for Suoi Tre canal construction site.

Thuan An and Di An WWTPs: utilizing the existing supply systems.

Tan Uyen WWTP: connect with electricity grid in Uyen Hung commune.

Water supply:

-Tan Uyen town: Water supply for construction activities: about 5 m^3/day, use water from Suoi Tre canal or from next to households.

Domestic water: the demand for domestic water is estimated about 15.4 m^3/day on the site. Use bottle water and use water from water supply system in the project areas (South Tan Uyen water supply company and Tan Hiep water plant).

-Thuan An and Di An:

In the WWTP areas: the demand for domestic water is estimated about 14.6 m^3/day. Utilize the available systems in the existing WWTPs.

1.8. TRANSPORTATION ROUTES AND DISPOSAL SITE

1.8.1. Construction material transportation routes

The section below describes the routes from quarries, pit and shops to the construction sites, while the disposal site and the routes to the disposal site are described in section 1.8.2

Table 1.9. Construction material transportation routes

No	Sites	Pit/ Quarry	Distance	Routes	Routes status
Tan Uyen town					
1	WWTP	Tan My borrow pit	15 km	Pit → PR746 →construction site	Asphalt road, 10-30 m wide, traffic is crowded
		Hoa Tan An quarry	15 km	Quarry →PR746 →construction site	
		Other construction material shops	5-10 km	PR 746 → DR425 → construction site	Asphalt road, 8-30 m wide, traffic is crowded
2	Suoi Tre canal	Hoa Tan An quarry	15 km	Mine → PR746 →Construction site	Asphalt road, 10-20 m wide, traffic is crowded
		Other construction material shops	5-10km	PR746→ DR425→construction site	Asphalt road, 10-30 m wide, traffic is crowded
3	Sewer system	Construction material shops	5-10 km	Transport routes could be on the PR746, PR745 and PR747 PR745→PR746→ via internal transport streets within implemented areas → construction site PR746 → PR747 → via internal transport streets within implemented areas → construction site	Asphalt road, 8-20 m wide, traffic is crowded
5	Pumping station	Construction material shops	5-10km		
Di An city					

No	Sites	Pit/ Quarry	Distance	Routes	Routes status
1	WWTP	Nui Nho quarry	3 km	Quarry → My Phuoc – Tan Van road → Di An WWTP	widen road 35-40 m wide, traffic is crowded
		Construction material shops	3-5 km	Suppliers → My Phuoc – Tan Van road → Di An WWTP	Widen road, 35-40 m wide, traffic is crowded
2	Sewer system	Construction material shops	3-5 km	Transport routes could be on the My Phuoc – Tan Van road, PR743A, NR-1K, and NR-1A Suppliers → Bui Thi Xuan street → construction site in Tan Binh commune Suppliers → My Phuoc – Tan Van road → internal roads in communes → construction site Suppliers → NH1K → PR743A → construction sites Suppliers → NH1A →construction sites	Widen road, 55-40m wide, traffic is crowded
3	Pumping station	Construction material shops	3-5 km		
Thuan An city					
1	WWTP	Nui Nho quarry	12 km	Nui Nho quarry→PR743B →Thuan An WWTP	Widen road,15-20 m wide, traffic is crowded
		Construction material shops	3-5 km	Suppliers→ Binh Duong avenue →construction site of Thuan An WWTP	Widen road, 25 m wide, traffic is crowded
2	Sewer system	Construction material shops	3-5 km	Transport routes could be on the Binh Duong avenue, NR13, PR743B, PR745 Nguyen Van Tiet and Nguyen Huu Canh streets NR13→PR745→ internal roads in Binh Nham and Hung Dinh communes → construction sites PR743B → Nguyen Trai street → PR745 → construction sites in Binh Nham and Hung Dinh wards. NR13 → Nguyen Huu Canh street → construction sites in Vinh Phu ward (Binh Nham, Hung Dinh) NR13 → construction sites (Vinh Phu ward)	Widen road, 8-30 m wide, traffic is crowded
3	Pumping station	Construction material shops			Widen road, 8-30 m wide, traffic is crowded

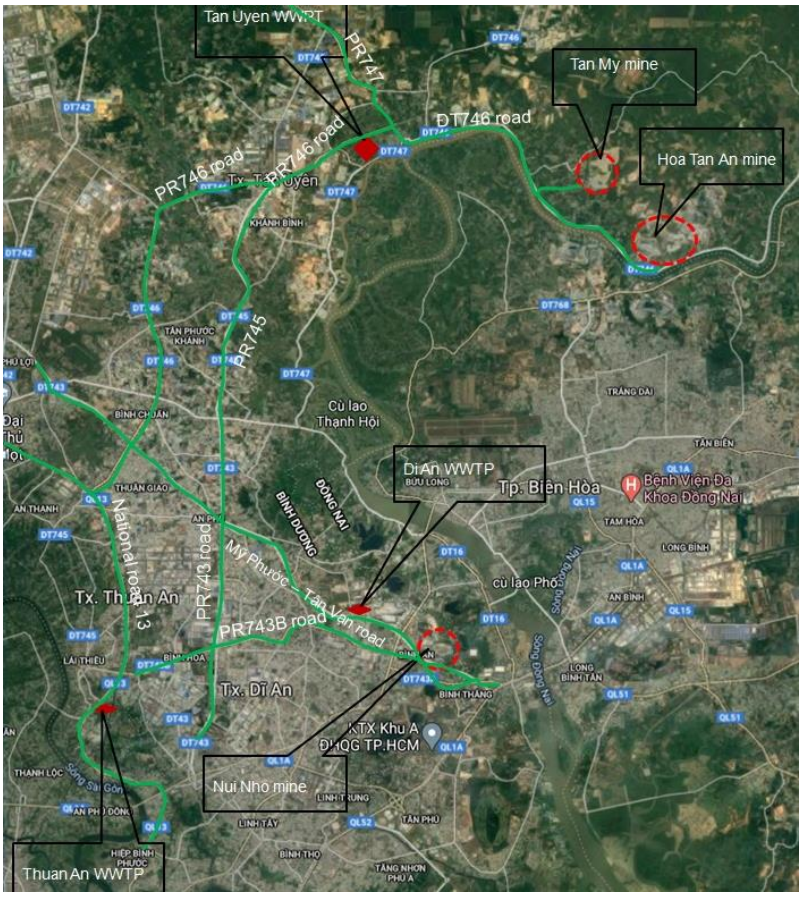


Figure 1.10. Construction material transport routes.

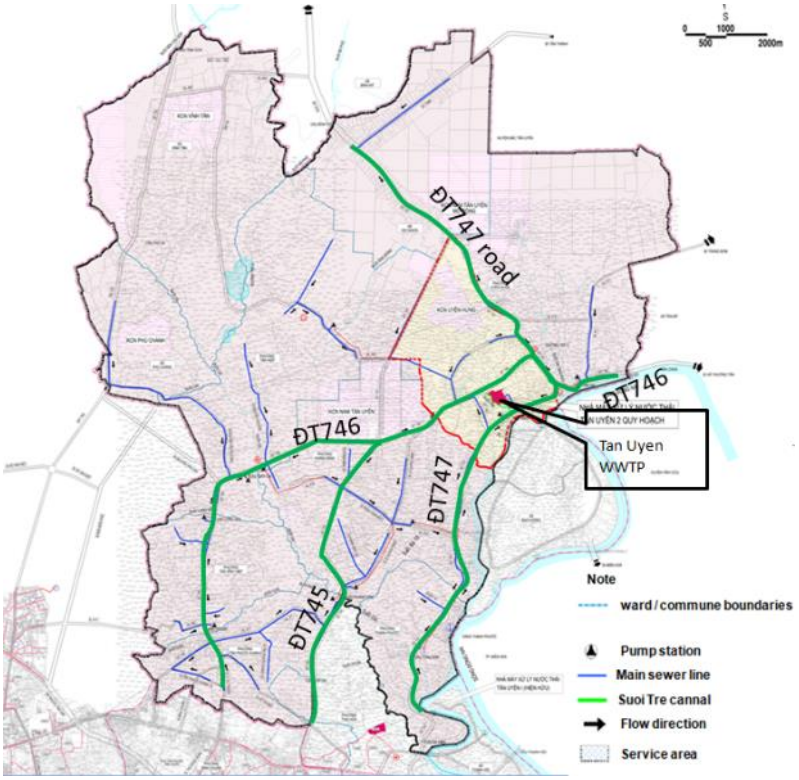


Figure 1.11. Construction material transport routes in Tan Uyen town.

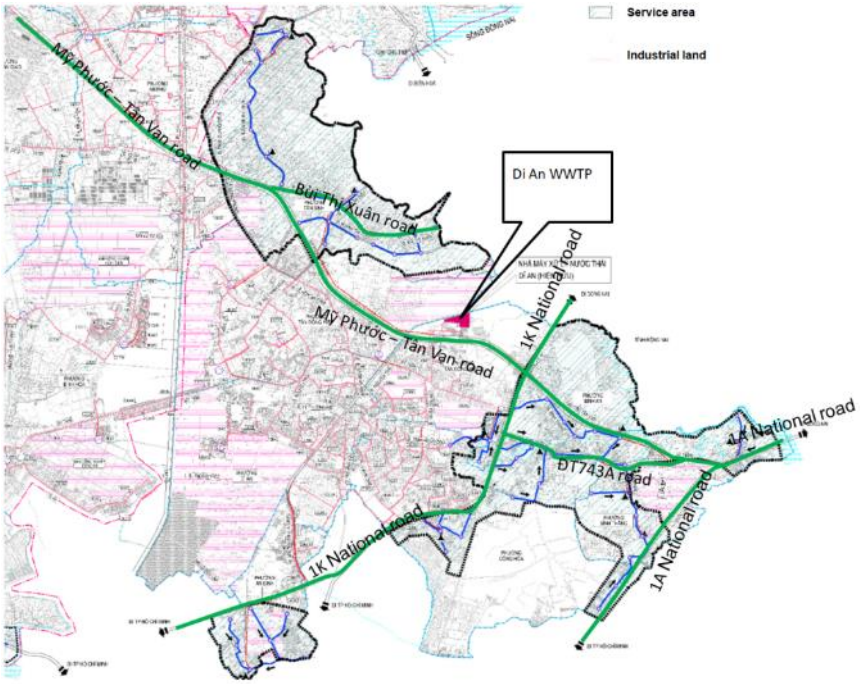


Figure 1.12. Construction material transport routes in Di An city.

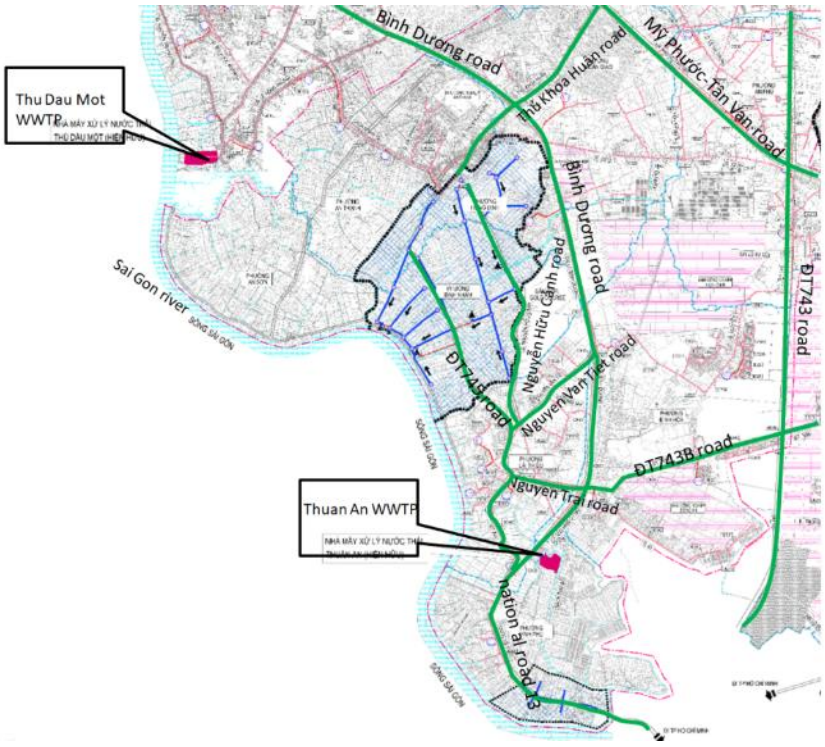


Figure 1.13. Construction material transport routes in Thuan An city.

1.8.2. Disposal sites and routes to disposal sites

Total excavation volume under project is estimated about1,842,894 $m^3$with a large volume will be reused for leveling purposes, and about544,185 m^3 of excavated materials will be disposed

and transported to the South Binh Duong Solid Waste Treatment Complex for covering municipal wastes in landfill cells. Excavated materials will be transported on paved roads to final disposal sites on properly covered trucks capacity 10 or 15 tones.

Construction waster transport routes:

Table 1.10. Construction waste transport routes

No.	Construction items	Distance	Trucks capacity	Route	Route Status
	Tan Uyen town				
1	WWTP	25 km	10-15 ton truck	PR745→PR747→R741→the South Binh Duong Solid Waste Treatment Complex (SWT)	Wide road,20-25 m, traffic is crowded
2	Suoi Tre canal	25 km	10-15 ton truck	PR745→PR747→PR741→the South Binh Duong SWT Complex	Wide road, 20-25 m, traffic is crowded
3	Sewer system	15-25 km	5-10 ton truck	PR742→PR741→the South Binh Duong SWT Complex	Wide road, 15-20 m, traffic is crowded
4	Pumping station	15-20 km	5-10 ton truck		
	Di An city				
1	WWTP	40 km	10-15 ton truck	PR743→Tan Phuoc My Van road→ PR741/PR742→the South Binh Duong SWT Complex	Wide road, 20-25 m, traffic is crowded
2	Sewer system	35-40 km	5-10 ton truck		
3	Pumping station	35-40 km	5-10 ton truck		
	Thuan An city				
1	WWTP	36 km	10-15 ton truck	NR13 → PR741 →the South Binh Duong SWT Complex (Chanh Phu Hoa Ward, Ben Cat Town, Binh Duong province)	Wide road,20-40 m, traffic is crowded
2	Sewer system	30-40 km	5-10 ton truck		
3	Pumping station		5-10 ton truck		

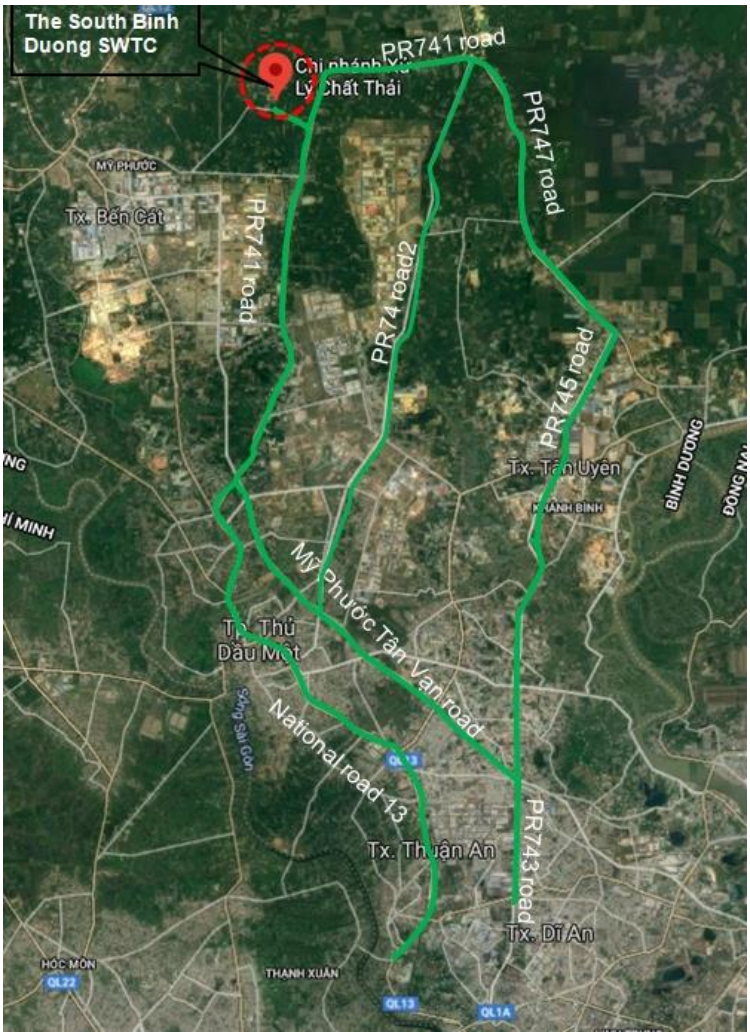


Figure 1.14. Unused material/waste transport routes.

The South Binh Duong Solid Waste Treatment Complex (hereinafter referred to the Complex) has land area of 75ha. It is located at Quarter 1B, Chanh Phu Hoa ward, Ben Cat town, Binh Duong province. The Complex has been licensed with Binh Duong PPC and the Ministry of Natural Resources and Environment (MONRE), as the following documents:

- Business Registration Certificate No 3700145694 dated 7/2/2006 issued by Binh Duong Provincial Department of Planning and Investment. The 10th Revision dated of this Certificated was dated 19/11/2012;
- Decision No 237/QĐ-BTNMT dated 02/03/2005 by MONRE approving environmental impact assessment(EIA) report of the project "Southern Binh Duong's Solid Waste Treatment Complex"
- Decision No 2449/QĐ-BTNMT dated 28/12/2011 by MONRE approving the EIA report of the project "Investment of a New Industrial Wastes Incinerators in South Binh Duong's Solid Waste Treatment Complex"
- Decision No 541/QĐ-UBND dated 18/02/2011 by Binh Duong PPC approving the project "Raising capacity of South Binh Duong's Solid Waste Treatment Complex by 420 ton/day";

- Decision No 171/QĐ-BTNMT dated 07/02/2013 by MONRE approving the EIA report of the project "Raising capacity of Southern Binh Duong's Solid Waste Treatment Complex by 420 ton/day"
- Decision No. 43/QĐ-BTNMT dated 08 January 2016 of MONRE approving EIA for the project "Increasing the Capacity of the Nam Binh Duong Solid Waste Treatment Complex"
- Hazardous Wastes Management License No: 5-7-8.028.VX (original) dated 19/10/2012 by MONRE;

The complex has a treatment capacity of 1,575 tons/day for domestic waste; 1000 tons/day for normal industrial waste; 600 tons/day for hazardous waste. The technical facilities in the complex include: 3 compost processing lines with a total capacity of 1,260 ton /day (420 tons/day/1 line); an incinerator + industrial waste drying system 11,500 kg/hour; treatment system for distillation, solvent recovery 200 liters/hour; packaging washing system; solidification system (concrete mixer) 40 tons/day; industrial wastewater treatment station 250 m3/day; brick production plant 120,000 bricks/day, unburnt bricks 1,000 bricks/day; producing PO oil from nylon 40 tons of raw materials/day. According to the action plan, the complex will operate until the end of 2030.

This Complex is currently managed by BIWASE, which will be operation unit of this project facilities (including two existing Thuan An and Di An WWTPs and sewers collection system).Currently, the sludge generated from operation of Thuan An WWTP and Di An WWTP has also been transported to the complex for disposal. And as noted above, the Complex has sufficient capacity to handle waste and sludge generated from construction activities and operation phase from project facilities. However, the unused excavated soil from project could be reused for leveling purpose of other activities or projects.

1.9. RELEVANT PLANS AND PROJECTS

1.9.1. Relevant plans

a) Binh Duong development master plan from 2021 to 2030

The project supports for achievement of objectivities setting in the Prime Minister's Decision No. 462/QĐ-TTg dated April 7, 2020 approving the Planning objectives of Binh Duong province for the period 2021-2030, with a vision to 2050, as: Ensuring the linkage, comprehensive, effective exploitation and use of the existing infrastructure system trans sectors and districts, regions in the province, meeting the requirements of environmental protection, natural resource management, biodiversity conservation, climate change adaptation.

b) General development master plan of Thuan An to 2020, with a vision to 2030;

Decision No.1071/QĐ-UBND dated 12/4/2010 of Binh Duong PC on approving the General development master plan of Thuan An to 2020 with a vision to 2030.

The location of WWTP have been identified and approved in the development master plan of Thuan An city. The location of existing WWTP of Thuan An city which also pointed out on the master plan maps, scale 1/2000. The proposed locations of WWTP Thuan An are in the vacant areas of existing WWTP which also identified in the master plans.

c) General planning of Di An urban area to 2020 with a vision to 2030;

Decision No. 2481/QĐ-UBND dated 23/6/2009 of Binh Duong PC on approving the Development master plan of Di An city to 2020 and vision to 2030.

The location of WWTP have been identified and approved in the development master plan of Di An city. The location of existing WWTP of Di An city which also pointed out on the master plan map, scale 1/2000. The proposed location of WWTP in Di An are in the vacant areas of existing WWTP which also identified in the master plan

d) General plan of Nam Tan Uyen urban area development to 2030, with a vision to 2050

Decision No.186/QĐ-UBND dated 13/7/2012 of Binh Duong PC on approving the General plan of Nam Tan Uyen urban area development to 2030, with a vision to 2050

The location of proposed Tan Uyen WWTP which has been agreed with local authorities and updated in the development master plan of Tan Uyen town.

e) General Development Master Plan of Binh Duong urban areas up to 2020 and vision to 2030

Decision No. 1701/QĐ-UBND dated 26/6/2012 of Binh Duong PC on approving the General Development Master Plan of Binh Duong urban areas up to 2020 and vision to 2030. The main objectives for period of 2020-2030: 100% of urban areas will be facilitated with centralized domestic WWTPs and all domestic and industrial wastewater will be treated to meet column A, Vietnam technical standards of wastewater before discharging to environment. Thus, the construction of Tan Uyen WWTP and expansion of Di An and Thuan An WWTPs, construction of wastewater collection systems will support to achieve the development master plan.

f) Support to National Strategies and Development plans:

- Support to implement the Adjustment of Vietnam urban and industrial drainage orientation to 2025 and a vision to 2050 under Decision No 589/QĐ-TTg dated 06/04/2016 of Prime Minister, which requires the secondary urban areas such as Di An and Thuan An need to achieve target of collection and treatment of 50% of total urban domestic wastewater volume and the third grade urban area as Tan Uyen need to collect and treat about 20% of its urban domestic wastewater.
- Implementing the Environmental protection action plans for the Dong Nai river system approved by the Decision No. 187/2007/QĐ-TTg dated 3/12/2007 of Prime Minister, which require about 70% of the urban areas along the Dong Nai river will be facilitated by the WWTPs;
- The implementation of this project is in line with the provincial policy to encourage localities to complete and synchronize the collection and treatment system of Decree No. 80/2014 / ND-CP dated August 6, 2014 of the Government. Drainage and wastewater treatment cover

g) Binh Duong 's Environmental protection action plans period 2016 – 2020

Implementing the Environmental protection action plans for Binh Duong province period from 2016-202 have been issued by the Decision No.3450/QĐ-UBND dated 28/12/2015 of Binh Duong PPC, which focus on construction and upgrade the wastewater treatment facilities in Thu Dau 1 cities, Thuan An, Di An and Tan Uyen urban areas

h) Support to National Strategies and Development plans:

- Support to implement the Adjustment of Vietnam urban and industrial drainage orientation to 2025 and a vision to 2050 under Decision No 589/QĐ-TTg dated 06/04/2016 of Prime Minister, which requires the secondary urban areas such as Di An and Thuan An need to

achieve target of collection and treatment of 50% of total urban domestic wastewater volume and the third grade urban area as Tan Uyen need to collect and treat about 20% of its urban domestic wastewater.

- Implementing the Environmental protection action plans for the Dong Nai river system approved by the Decision No. 187/2007/QĐ-TTg dated 3/12/2007 of Prime Minister, which require about 70% of the urban areas along the Dong Nai river will be facilitated by the WWTPs;
- The implementation of this project is in line with the provincial policy to encourage localities to complete and synchronize the collection and treatment system of Decree No. 80/2014/ND-CP dated August 6, 2014 of the Government. Drainage and wastewater treatment cover

1.9.2. Relevant projects

The relevant projects could be summarized as the below table:

Table 1.11. Relevant projects

No.	Project name	Financial source	Implementation phase	Project features	Project status
1	Southern Binh Duong Water Environment Improvement Project, phase I	JICA	Started in 2007 and operating since2013	Construction of: (i)a WWTP with the capacity of 17,000 m^3/day in Thu Dau Mot city; (ii) the collection system covered a part of Phu Hoa, Phu Loi, Phu Cuong, Hiep Thanh, Phu Tho, Chanh Nghia communes	By June 2020, reached 56% of connection coverage, with 7300 customers / total of 13,100 connection boxes and the capacity of the plant under operation is about 15,000 m^3 day, reaching 85% of the designed capacity
2	Southern Binh Duong Water Environment Improvement Project, phase II	JICA	Started in 2012 and turned into operating in 2017	- Thu Dau Mot city: construction of collection system for remaining parts of Phu Hoa, Phu Loi, Phu Cuong, Hiep Thanh, Phu Tho, Chanh Nghia, An Thanh, Thuan Giao - Thuan An City: construction of Thuan An WWTP with a capacity of 17,000 m^3/ day.; and (ii) wastewater collection system in Thuan An, Lai Thieu, An Phu, Binh Hoa communes, a part of Thuan Giao, Vinh Phu communes	By June 2020, Thuan An area reached 27% of the connection coverage, with 5,190 customers / a total of 19,500 connections boxes already being installed. Thuan An WWTP capacity reaches approximately 10,000 m^3/day, achieving more than 59% of the designed capacity
3	Drainage and wastewater treatment project in Di An area, Binh Duong	WB	Started in 2016 and turned into operating in 2018	Construction of (i) Di An WWTP with capacity of20,000 m^3 / day; and (ii) collection system in Di An, An Binh, Tan Dong Hiep, Dong Hoa communes	By June 2020 treatment capacity has reached more than 41%.The connection coverage of nearly 10% with 2,300 customers / 3,300 connection boxes already

No.	Project name	Financial source	Implementation phase	Project features	Project status
	province				being installed.
4	Drainage and wastewater treatment project in Di An - Thuan An - Tan Uyen area	ORIO fund of the Netherlands	Started in 2016 and turned into operating in 2019	Tan Uyen 2 WWTP with capacity of 15,000 m³ / day Collection system in Binh Chuan, Thuan Giao and An Phu wards of Thuan An and Thai Hoa ward of Tan Uyen	By June 2020, Di An area will have nearly 5% of connections coverage, with 400 customers / total 8,900 connection boxes having been installed
5	Wastewater collection and treatment project for Ben Cat area	Drive program - the Netherlands	Project preparation from 2019	Collect and treat wastewater for Ben Cat area with the processing capacity of 15,000 m³ / day	Under project preparation phase, it is planned to be implemented from 2020 and turned into operating from 2024

1.10. PROJECT IMPLEMENTATIONARRANGEMENT

1.10.1. Project implementing schedule

- Project preparation phase: from 2020 to Q1/2021
- Project implementation phase: Q2/2021 to 2027.

1.10.2. Project budget

The total investment of the project is: USD **305.956.000**. In which

- IBRD loan: **VND 5,446,871,898,000**, equivalent to USD 234,073,000, accounting for 79.43% of total investment, including pre-tax construction and installation costs.
- Counterpart fund: **VND 1,410,525,167,000**, equivalent to USD 60,616,000, accounting for 27.76% of total investment, including tax expenses, project management unit costs, consultancy expenses, site clearance, bombs and mines clearance and financial costs.

Table 1.12. Investment budget of the project

No	Project item	Budget (USD)	
		IBRD loan	Counterpart fund
I	**Component 1: Expanding municipal services for wastewater and drainage management**	192,222,806	19,222,281
1.1	Sewage collection and network expansions, including sewage pumping stations	146,982,165	14698,217
1.2	Construction of WWTPs	45,2403,641	4,524,064
II	**Component 2: Implementation support, capacity and institutional development**	4,240,231	31,653,904
2.1	Sub-component 2A: Developing integrated urban water management in the project areas	-	1,289,214

No	Project item	Budget (USD)	
		IBRD loan	Counterpart fund
2.2	Sub-component 2B: Implementation support, capacity building, and coordination for COVID-19 response	4,240,231	10,125,120
2.3	Sub-component 2C: Site clearance, Land Acquisition and compensation	-	20,239,570
III	**Contingency**	**37,609,670**	**9,739,422**
	Total (VND)	**234,072,707**	**60,615,607**
	Grand total	**234,0731,000**	**60,616,000**
	Share (%)	**79.43%**	**20.57%**

1.10.3. Implementing agencies

- Line Agency: People's Committee of Binh Duong province
- Project's owner: Binh Duong Sewer Project Management Unit
- Address: 11Ngo Van Tri, Phu Loi ward, Thu Dau Mot city, Binh Duong province.
- Tel: 0274 3.840055 Fax: 0274 3.827738
- Email: bdspmu2019@gmail.com

Project's management and implementation: Project's owner directly manages the implementation of the project

Responsibilities of relevant stakeholders:

a) Vietnam government and The World Bank

The Government of Vietnam and the World Bank will manage and oversee project implementation by: Overseeing and managing the project implementation; accelerating and support disbursement of ODA funds; solving any problems that arise beyond the authority of the project owner.

b) Line Agency: People's Committee of Binh Duong province

The People's Committee of Binh Duong province is the project owner agency that will perform the tasks and powers as prescribed in Article 36 of Decree 56/2020/ND-CP dated May 25, 2020;

c) Project Executive Agency:

The Binh Duong Water Environment Improvement Project is proposed to be implemented in 3 cities/towns of Binh Duong province, including Thuan An, Di An cities, and Tan Uyen town. This is an important project of the province that needs to be directed to ensure progress and fulfill project objectives. In accordance with Article 36, Decree 56/2020 / ND-CP dated 25/5/2020 of the Government, the Provincial People's Committee will establish a Steering Committee for Binh Duong Water Environment Improvement Project.

1.11. ESIA PREPARATION METHODS

The ESIA is conducted according to the regulations of relevant WB's ESS and complied with Law on Environment Protection, the legal policies of GoV. The purpose of ESIA is to determine the importance of environmental and social considerations during decision making. At the same time, it will also propose appropriate mitigation measures for implementing the project activities.

1.11.1. Method of social impact assessment

The target of the social impact assessment is conducted at the same time with the environmental assessment of the project, with two goals. The first considers the potential impacts of the project, negative and positive, based on the execution plan of the project. The second looks for from design of methods for solving potential negative influences and suggests community development activities that concerned with development targets of the project. Determining negative influences, conducting consultation with the locality, governmental organizations, relevant of the project will be conducted in order to affected people shall be compensated and supported satisfactory and timely, at least socioeconomic activities of them restoring back to the pre-execution status of the project. In addition, in the long term, it ensures their lives will not get worse, are considered because of the project.

As part of the social assessment, ethnic minorities (ethnic minorities) living in the project area, if any (according to the Bank's ESS7), consultations are informed in advance with appropriate ways to identify support the community when implementing projects.

To ensure that, all potential impacts can be identified during project preparation, the SAs are conducted through consultations with various parties involved in the project. An important part of the concern is the household level, the potentially affected people by the project (both positive and negative). The evaluation techniques employed for this SA include 1) review of secondary data, 2) field observations; 3) focus group discussions/community meetings, 4) in-depth interviews, and 5) household surveys.

1.11.2. Methods of environmental impact assessment

In the process of research, survey and reporting ESIA, the consultant has used a combination of research methods later.

(a) Rapid assessment method

Rapid assessment method issued by the World Health Organization (WHO) in 1993. The basis of rapid assessment methods is based on the nature of raw materials, technologies, laws of the processes in nature and level of experience to the pollution load.

In Vietnam, this method was introduced and applied in several ESIA studies; perform the relatively accurate calculation of pollution emissions in conditions of limited instrumentation, analysis. In this report, the pollution emission coefficient is taken according to guidelines of the World Bank environmental assessment (Environmental Assessment Sourcebook, World Bank, Washington D.C. 8/1991).

(b) Construction methods of impact matrix

Preparing the correlation between the impact of project activities on each issue and each environmental component is expressed on the impact matrix. On that basis, it orients the content detailed impact study.

(c) Comparative method

Method of comparison was to assess the quality of the environment, the quality of the effluent, pollutant load ... because of comparison with the norms and standards related environment, the regulations of the MONRE, Ministry of Health as the research and experimentation related.

(d) Description of environmental systems

Identify the components of the project's environmental impact. Identify a full line of waste, the environmental issues involved in service work of detailed assessment.

(e) Method of enumeration

Used widespread (since the national environmental protection Agency established in some countries - NEPA) and bring many positive results due to the many advantages presented approach clear, supply acute during system analysis and system evaluation. It includes two main categories: Listing describes the environmental components needed research along with information about the measurement, prediction, and assessment. Simply listing the components necessary to study the environment likely to be affected.

(f)Methods of community consultation

This method is used during interviews with local leaders and people to collect the necessary information for the ESIA of the project. It also introduces the potential benefits and negative impacts of the project on the environment and life. On that basis, it synthesizes feedback on the project and aspirations of the local people.

On the other hand, in each commune in projects conducting engagement with the community and those affected directly or indirectly by the activities of the projects to exchange, direct interviews with local officials and residents on the socio-economic development, farming traditions, and sanitation conditions.

(g)Methods of synthesis and analysis of information, data

This method aims to identify, evaluate natural and socioeconomic conditions in the project implementation area through the data and information gathered from various sources such as the Statistical Yearbook, socioeconomic situation report, the environmental status of the region and the work involved.

(h)Field survey method

Field surveys are required when conducting social-environmental impact assessments to determine the status of the project implementation area, nearby stakeholders, and surveys to select locations for taking a sample, survey the status of water supply, drainage, electricity...

The consulting agency has conducted topographic and geological surveys and collected hydro-meteorological documents to serve the design in accordance with the current standards of Vietnam. These survey results are used to assess the natural conditions of the project area.

(i) Professional solution

Base on the knowledge and experience of environmental impact assessment experts of the consultant and the scientific research unit other.

CHAPTER 2. LEGAL FRAMEWORK AND INSTITUTIONS

The project's ESIA will be carried out in accordance with the World Bank and the Government's environmental assessment procedures. Specifically, the ESIA of the Project will be subject to comply with the current Law on environment protection of the Government of Vietnam; and Environmental and Social Policy (ESF) including Environmental and Social Standards (ESSs) of the World Bank (WB) as follows:

2.1. LEGAL DOCUEMNTS AND TECHNICAL STANDARDS IN VIETNAM

❖ ***Laws***

- Law on Environmental Protection No. 55/2014/QH13 issued by the National Assembly of Vietnam on June 23, 2014, effective from July 2015. This law provides for environmental protection activities; policies, measures, and resources to protect the environment; rights, obligations, and responsibilities of agencies, organizations, households, and individuals in environmental protection;
- Law on Irrigation No. 08/2017/QH14 passed by the National Assembly on June 19, 2017;
- Law on Occupational Safety and Hygiene on No. 84/2015/QH13 dated June 25, 2015;
- Law on Construction No.50/2014/QH13 passed by the VII National Assembly on June 18, 2014;
- Land Law No.45/2013/QH13 issued by the National Assembly on November 29, 2013 prescribing the regime of land ownership, powers and responsibilities of the State in representing the entire-people owner of land and uniformly managing land, the regime of land management and use, the rights and obligations of land users involving land in the territory of the Socialist Republic of Vietnam;
- Law on Natural Disaster Prevention and Control No.33/2013/QH13 issued by the National Assembly on June 19, 2013, provides for natural disaster prevention and control activities; rights and obligations of agencies, organizations, households and individuals engaged in natural disaster prevention and control activities; and the state management of, and assurance of resources for, natural disaster prevention and control.
- Law on Water Resources No. 17/2012/QH13 issued by the National Assembly on Jun 21, 2012, providing for the management, protection, exploitation and use of water resources, as well as for the prevention, control and remedy of harmful effects caused by water within the territory of the Socialist Republic of Vietnam;
- Biodiversity Law No. 20/2008/QH12 issued by the National Assembly on November 13, 2008, stipulating biodiversity conservation and sustainable development. This Law provides for the biodiversity conservation and sustainable development; rights and obligations of organizations, households and individuals in the biodiversity conservation and sustainable development;
- Law on Road Transport No. 23/2008/QH12 dated November 13, 2008;
- Law on Children No. 102/2016/QH13passed by the 13th National Assembly of the Socialist Republic of Vietnam dated April 5, 2016;
- Law on Chemicals No. 06/2007/QH12 passed by the 12th National Assembly of the Socialist Republic of Vietnam dated November 21, 2007;

- Law on amendment and supplement of a number of articles of Law on Fire Prevention and Fighting No.40/2013/QH13 passed by the 13th National Assembly of the Socialist Republic of Vietnam dated November 22, 2013.
- Law on Complaints No. 02/2011/QH13 issued on November 11, 2011;
- Law on Cultural Heritages No. 10/VBHN-VPQH issued on July 23, 2013;

❖ ***Decrees***

- Decree No.40/2019/ND-CP dated May 13, 2019 of the Government on amendments to decrees on guidelines for the law on environment protection
- Decree No. 19/2015/ND-CP dated February 14, 2015 of the Prime Minister detailing the implementation of a number of articles of the Law on Environmental Protection;
- Decree No.16/2016/ND-CP dated March 16th, 2016, on management and use of official development assistance (ODA) and concessional loans granted by foreign sponsors;
- Decree No.155/2016/ND-CP dated Nov 18, 2016, of the Government issued, provides regulations on penalties administrative violations against regulations on environmental protection;
- Decree No.03/2015/NĐ-CP date January 6, 2015 of the Government on environmental damage assessment
- Decree No. 32/2015/ND-CP dated March 25, 2015 on management of construction investment costs;
- Decree No.46/2015/NĐ-CP dated May 12, 2015, on quality control and maintenance of construction works
- Decree No.59/2015/NĐ-CP dated June 18, 2015, on construction project management;
- Decree No.38/2015/ND-CP dated April 24, 2015, of the Government on the management of waste and discarded materials;
- Decree No.18/2015/ND-CP dated February 14, 2015, of the Government issued, provides regulations on environmental protection planning, strategic environmental assessment, environmental impact assessment, and environmental protection plan;
- Decree No.80/2014/NĐ-CP date Aug 06, 2014 of the Government on the drainage and treatment of wastewater
- Decree No. 43/2014/ND-CP dated May 15, 2014 by the Government detailing the implementation of some articles of the Land Law 2013.Decree No.44/2014/ND-CP dated May 15, 2014, of the Government issued, provides regulations on the land pricing methods and the land price bracket;
- Decree No.47/2014/ND-CP dated May 15, 2014, of the Government issued, provides regulations on compensation, support, and resettlement upon land recovery by the State;
- Decree No.25/2013/ND-CP dated March 29, 2013, of the Government on charge for environmental protection of wastewater
- Decree No.120/2008/NĐ-CP dated Dec 01, 2008, of the Government on River Basin Management;
- Decree No. 201/2013/ND-CP dated November 27, 2013 of the Government detailing implementation of a number of articles of the Law on Water Resources;
- Decree No. 67/2012/ND-CP of the Government amending and supplementing a number

of articles of the Government's Decree No. 143/2003/ND-CP dated November 28, 2003, detailing the implementation of Articles of the Ordinance on exploitation and protection of irrigation works;

❖ ***Circulars***

- Circular No.25/2019/TT-BTNMT dated Feb 15, 2020of the MONRE on elaborating some articles of the government's decree no. 40/2019/ND-CP dated May 13, 2019 on amendments to decrees on guidelines for the law on environmental protection and providing for management of environmental monitoring services
- Circular No.76/2017/TT-BTNMT dated December 29/12/2017 of the MONRE on regulations on assessment of the receiving capacity of wastewater, the load capacity of river and lake water sources
- CircularNo.36/2015/TT-BTNMT dated June 30, 2015, of the MONRE on the management of hazardous wastes
- Circular No. 27/2015/TT-BTNMT dated May 29, 2015 of MONRE on strategic environmental assessment, environmental impact assessment and environmental protection plans;
- Circular No. 27/2015/TT-BTNMT dated May 29, 2015 of MONRE on strategic environmental assessment, environmental impact assessment and environmental protection plans;
- Circular No.36/2014/TT-BTNMT dated June 30, 2014, of the MONRE on land pricing method compilation of and adjustment to land price lists
- Circular No.37/2014/TT-BTNMT issued by the MONRE dated June 30, 2014, detailed regulations on compensation, support, and resettlement upon land acquisition by the State
- Circular No.30/2014/TT-BTNMT dated June 02, 2014, on applications for land allocation, lease, repurposing
- Circular No. 32/2013/TT-BTNMT dated October 25, 2013 of MONRE on promulgation of national technical regulations on environment;
- Circular No.19/2011/TT-BYT of the Ministry of Health guiding the management of labor hygiene, laborers' health and occupational diseases
- Circular No.22/2010/TT-BXD of the Ministry of Construction on occupational safety in construction
- Circular No.13/2007/TT-BXD dated December 31, 2007, providing guidance on some articles of Decree No. 59/2007/ND-CP on solid waste

❖ ***Decisions***

- Decision No. 13/2016/QĐ-UBND dated 16/6/2016 of Binh Duong PC on regulating on environmental project in Binh Duong province
- Decision No. 52/2012/QD-TTg of November 16, 2012, on employment and vocational training support policies for laborers subject to agricultural land recovery;
- Decision No. 3733/2002/QD-BYT dated Oct 10, 2002, promulgating 21 labor hygiene standards, 05 principles and 07 parameters for labor hygiene;
- Decree No.80/2014 / ND-CP dated August 6, 2014 of the Government on Drainage and treatment of wastewater;

- Decision No.589/QĐ-TTg dated 06/04/2016 of Prime Minister on Adjustment of Vietnam urban and industrial drainage orientation to 2025 and a vision to 2050;
- Decision No.187/2007/QĐ-TTg dated 3/12/2007 of Prime Minister on Environmental protection action plans for the Dong Nai river system

❖ ***Applicable norms and standards***

- QCVN 01-1:2018/BYT: National technical regulation on Domestic Water Quality;
- QCVN 03:2015/BTNTM: National technical regulation on allowable limits of some heavy metals in the soils
- QCVN 05:2013/BTNMT: National technical regulation on ambient air quality
- QCVN 06:2009/BTNMT: National technical regulation on hazardous substances in ambient air
- QCVN 07:2009/BTNMT: National technical regulation on hazardous waste thresholds
- QCVN 08-MT:2015/BTNMT: National technical regulation on surface water quality;
- QCVN 09-MT 2015/BTNMT: National technical regulation on underground water quality;
- QCVN 14:2008/BTNMT: National technical regulation on domestic wastewater;
- QCVN 18:2014/BXD: National technical regulation on safety in construction
- QCVN 26:2010/BTNMT: National technical regulation on noise;
- QCVN 24:2016/BYT National technical regulation on noise;
- QCVN 27:2010/BTNMT: National technical regulation on vibration
- QCVN 38:2011/BTNMT: National technical regulation on surface water quality to protect aquatic
- QCVN 43:2012/BTNMT: National technical regulation on sediment quality.
- TCVN 6705:2009 - Normal solid wastes - Classification;
- TCVN 6706:2009 - Hazardous wastes – Classification;
- QCVN 07:2009/BTNM: National technical regulation on hazardous waste thresholds.
- TCVN 7957:2008 - Drainage and sewerage - External networks and facilities - Design standard.
- QCVN 04-05:2012/BNNPTNT - National technical regulation on hydraulic structures - The basic stipulations for design;
- In addition, other standards related.

❖ ***Legal documents provided by the Owner***

- Minutes of agreement on the location of the Tan Uyen WWTP2 dated September 19, 2019 between the People's Committee of Tan Uyen Town, the Urban Management Office, the Division of Natural Resources and Environment, the People's Committee of Uyen Hung Ward, the Management Board Binh Duong wastewater specialized project
- Decision No.1886/QD-UBND dated July 13, 2012 of the People's Committee of Binh Duong province approving the general planning on urban construction of Nam Tan Uyen up to 2030, with a vision to 2050;

- Decision No.2481/QD-UBND dated June 23, 2009 of the People's Committee of Binh Duong province approving the general planning on construction of Di An urban area up to 2020, with a vision to 2030;
- Decision No.1071/QD-UBND dated 12/4/2010 of the People's Committee of Binh Duong province approving the general planning on construction of Thuan An urban area up to 2020, with a vision to 2030;
- Decision No.3450/QD-UBND dated December 28, 2015 of People's Committee of Binh Duong province promulgating "Environmental protection plan of Binh Duong province for the period of 2016 - 2020"
- Survey and agreement minute on the location of sewer pipeline, pumping stations in Thuan An city area (expansion) dated November 18, 2020 between the People's Committee of Thuan An city, the Department of Investment Management Thuan An City, Binh Duong Wastewater Specialized Project Management Unit
- Survey and agreement minute on the location of sewer pipeline, pumping stations in Di An city area (expansion) dated November 19, 2020 between the People's Committee of Di An city, Department of Urban Management Di An City, Binh Duong Wastewater Specialized Project Management Unit

2.2. RELEVANT INTERNATIONAL TREATIES AND AGREEMENTS

Vietnam is signatory to a number of international agreements and conventions relating to environmental management, community rights and ethnic minorities. The international conventions are not always translated into national legislation. Some of the key agreements are listed in **Error! Reference source not found.**.

Table 2.1. International agreements relevant to environmental and social issues

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 especially as Waterfowl Habitat (Ramsar Convention), 1982	Joined in 1989	The conservation and sustainable utilization of wetlands, i.e. to stem progressive encroachment on and loss of wetlands now and in the future, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value.
Kyoto Protocol, 1997	Signed in December 1998	Sets international guidelines on restrictions of GHG emissions in order to prevent climate change; Project will emit green-house gases from power generation through heavy fuel combustion
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

Agreements/Conventions	Status	Objectives/Relevance
		animals and plants.
Stockholm Convention on Persistent Organic Pollutants, 2001	Signed in July 2002	UNEP called for global action to be taken on POPs which is defined as chemical substances that persists in the environment, bio-accumulation in the food chain and cause adverse impact on human health.
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
Intended Nationally Determined Contribution (INDC) to the UNFCCC	Signed in June 1992	Sets national intention on restrictions of GHG emissions in order to prevent climate change

Vietnam is signatory to certain ILO Conventions, the details for which are provided in Table 2.2. Vietnam, which has now ratified 6 out of the 8 ILO Fundamental Conventions, becomes the 167th ILO Member State to ratify Convention No. 98 and the 20th State in the Asia and Pacific region to do so.

Table 2.2.Vietnam Ratification to ILO Conventions

Convention	Date	Status	Note
C029 - Forced Labor Convention, 1930 (No. 29)	05 Mar 2007	In Force	
C098 - Right to Organize and Collective Bargaining Convention, 1949 (No. 98)	05 Jul 2019	Not in force	Effective 05 Jul 2020
C100 - Equal Remuneration Convention, 1951 (No. 100)	07 Oct 1997	In Force	
C111 - Discrimination (Employment and Occupation) Convention, 1958 (No. 111)	07 Oct 1997	In Force	
C138 - Minimum Age Convention, 1973 (No. 138) Minimum age specified: 15 years	24 Jun 2003	In Force	
C182 - Worst Forms of Child Labor Convention, 1999 (No. 182)	19 Dec 2000	In Force	

2.3. THE WORLD BANK'S ENVIRONMENTAL AND SOCIAL POLICY

2.3.1. Environmental and social standards (ESS)

The objective of the World Bank Environmental and Social Framework (ESF) is to support Borrowers in the development and implementation of projects that are environmentally and socially sustainable, and to enhancing the capacity of Borrowers' environmental and social frameworks to assess and manage the environmental and social risks and impacts of projects. To this end, the Environmental and Social Standards (ESSs) are designed to avoid, minimize, reduce or mitigate the adverse environmental and social risks and impacts of projects.

The project environmental risks and impacts would mainly be related to the implementation and operation of investments under component 1. The typology of investments included expansion of sewerage network including sewer pipes and pumping stations, construction and upgrading of the wastewater treatment plants (WWTPs) and rehabilitation of one drainage canal. These moderate scale physical infrastructure investments will be implemented in urban and semi-urban areas. This implies an environmental baseline with low sensitivity that is characterized by varying degrees of modification.

Environmental and Social standards (ESS) applied to the project

- ESS1: Environmental assessment and management, and social risks and impacts.
- ESS2: Labor and working conditions
- ESS3: Efficient Use of Resources, Pollution Prevention and Control
- ESS4: Community Health and Safety
- ESS5: Land Acquisition, Restrictions on Land Use, and Involuntary Resettlement
- ESS6: Biodiversity Conservation & Sustainable Management of Living Natural Resources
- ESS8: Cultural Heritage
- ESS10: Stakeholder Engagement and Information Disclosure

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

ESS is applied to the project as the project interventions will cause adverse environmental and social impacts and risks. In accordance with ESS1 and the national regulation, the Project owner has prepared an Environmental and Social Impact Assessment (ESIA) to cover these impacts and risks. The ESIA described institutional framework, the project and baseline conditions, identified and assessed the potential environmental and social impacts and risks, and proposed mitigation measures. The ESIA identified and assessed the potential direct, indirect and cumulative E&S impacts and risks in the project life cycle, from pre-construction, construction and operation phases.

The proposed project will bring about positive environmental impacts on the city and Dong Nai river basin by reducing environmental pollution caused by municipal wastewater in selected area of Binh Duong province.

The potential negative environmental and social impacts are assessed as mostly small to moderate at this stage and associated with the proposed physical investments. These include commonly known construction impacts and risks, such as: (i) safety risk relating to UXO; (ii) increased level of noise, dust and vibration; (iii) pollution risks to soil and water environment due to generation of waste, wastewater, and a considerable amount of excavated/dredging

materials; (iv) impacts to aquatic life due to dredging process; (v) local flooding during the construction of canal embankment; (vi) traffic disturbance and traffic safety risks; (vii) disturbance to daily socio-economic activities to the local people within project area; (viii) health and safety issues to the community and construction workers, and labor influx; (ix) social impacts associated with land acquisition, social connectivity, construction disrupting businesses, agriculture activities. The main issues generated during the operation of the project includes environmental pollution due to odors and noise from the WWTPs, generation of a moderate amount of sludge from sewage systems and three WWTPs, and worker health and safety risks due to exposure to hazardous chemicals and pathogens; water pollution of Dong Nai and Saigon rivers due to failure or malfunction of the WWTPs. These impacts are long-term, minor to moderate and manageable. The implementing agencies have limited knowledge and experience in applying ESF.

An Environmental and Social Management Plans (ESMP) has been included as an integral part of the ESIA to: (i) ensure compliance with the applicable provincial and national laws, regulations, standards, and guidelines; (ii) ensure that there is sufficient allocation of resources within the project budget for implementation of ESMP-related activities; (iii) ensure that environmental risks associated with the project are properly managed; (iv) respond to emerging and unforeseen environmental issues not identified in the project ESIA; (v) provide feedback for continual improvement in environmental performance.

The Environmental Social Commitment Plan (ESCP) has been prepared and include a requirement that the province will complete the ESIA including the ESMP in accordance with ESS1 during project preparation and implementation and to the satisfaction of the World Bank. In addition, the ESCP set out other activities to be carried out by the province during project implementation and could be adjusted during the project life keeping with the evolution of E&S risk and impacts.

❖ *ESS2: Labor and working conditions*

The purpose of this standard is to enhance occupational health and safety, encourage fair and equal treatment for workers, and protect workers including vulnerable people like women and the disabled. disability, children (of legal working age), migrant workers, contract workers, community workers, provide workers with accessible tools to raise workplace concerns job.

The project workforce will include direct worker (who directly employ by PMU), contracted worker (recruited by third parties such as contractors or consultants),and primary suppliers. The project is not likely to engage community workers, as civil works will be the responsibility of contractors. As the PMU is a government entity where laws and regulations have been followed, trade unions and official grievance redress mechanisms exist, minimal risks related to ESS2 for direct project workers are foreseen.

With contracted workers as specified in the ESS2 include staffs and workers who involve in the project implementation such as contractors, sub-contractors, consultants, suppliers (estimated at 300-350 workers during peak period) would be mobilized, some of them may come from other localities. The main risks would relate to health and safety at both construction sites and site accommodations. The labor management procedures (LMP) have been prepared with the guidance in ESS2 to identify the main labor requirements and risks associated with the project and to determine the resources necessary to address project labor issues. The main measures from labor management procedures (LMP) will be taken place as a part of ESMP of the project and include in the bidding documents to ensure that all identified labor risks and mitigation measures will be implemented by relevant stakeholders in compliance with ESS2.

The main primary supplier of the project would be sand suppliers and other construction materials would be bought from suppliers in Binh Duong or other provinces. The number of

project primary workers is expected to be limited, with much of the work being done mechanically. ESS2 monitoring requirements, included in the ESMP, will also cover primary supply workers.

❖ *ESS3: Resource Efficiency and Pollution Prevention and Management*

The risks and impacts related to the use of raw construction materials and energy, release of pollutants, waste generation, the management of disposed dredged materials and potential other hazardous wastes, impact on community, have been assessed, and mitigation measures proposed during project preparation. Moreover, the project invests to construction three WWTPs, which also may create the risk of pollution during operation period such as generated sludge, discharge effluent, odor, incidents etc., which need to appropriate management. The Environmental and Social Assessment (ESA) process covered the risks and potential impacts on human and the environment, taking into account the standards measures in the World Bank Group Environment, Health, and Safety Guidelines, including an ESMP proposing site-specific mitigation measures to address the site-specific impacts during construction and operation. The mitigation measures will be incorporated into detailed design; construction bidding/contractual documents and C-ESMPs for implementation by the Contractor; and operation manual for operators.

During preparation, the Green House Gas (GHG) analysis has been conducted for physical investments under component 1. It is estimated that the wastewater collection and treatment activities have net emissions of -1,089,066 tCO2-eq over the economic lifetime of the project, representing a reduction in GHG emissions. These reductions are allocated proportionally between the investments in Tan Uyen, Thuan An, and Di An.

❖ *ESS4: Community health and safety*

This standard is enabled to ensure the optimal handling of risks and potential impacts on residential communities in construction areas. The project is implemented on a large area and in quite densely populated locations which are under rapidly urbanization process so the impacts on public health and safety are substantial and need to be closely managed.

The aspects of community health and safety that need to be considered traffic safety for workers and communes in the intervened roads during construction of sewer pipelines, as well as community health issues and safety risks at the construction sites, hazardous substances related to the operation of the WWTP, and overall public security and safety, including GBV/SEA related to the influx of workers and security personnel. These risks and issues were assessed as part of the ESA process and mitigation measures developed and incorporated as part of ESMP for application during detail design, bidding, construction. and operation.

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

This ESS is active since implementation of project will involve in land acquisition, it is expected to acquire about 992,360 m^2 of which 911,869m^2 of agricultural land; 355$m^2$of residential land; and 80,136 m^2 of the other land (such as transportation, irrigation and none-used). According to the estimation, there are totally 94 households with 339 people will be affected by permanent land acquisition for construction of Tan Uyen WWTP, Suoi Tre canal improvement and pumping stations. Estimated total area of temporary land acquisition to construct work items for the project is about 699,000 m^2. The temporary land acquisition serves mainly in construction phase of sewage collection and network expansions, including sewage pumping stations for Tan Uyen town, Thuan An, and Di An cities.

The land acquisition may impact local people and communes by reducing income, impacts are expected to be more insignificant since some part of acquired agricultural land is vacant land, some areas are cultivated fruit trees, timber trees. Land acquisition may also cause temporary economic impacts, and restrictions to access to livelihood activities.

The RPF will be prepared in compliance with the relevant World Bank's SES - ESS5: Land acquisition, restrictions on land use, involuntary resettlement and the Vietnam's laws and regulations. Land acquisition and resettlement will be compliance with the Resettlement Policy Framework (RPF), which will be prepared to establish the resettlement principles, eligibility requirements for compensation, valuation methods, describe the legal and institutional framework, organizational arrangements, mechanisms, and community consultation and participation, and grievance redress mechanism to be applied to the project during the project implementation. Resettlement Action Plan (RAP) will be prepared in compliance with the approval RPF and submitted to the World Bank for approval before construction activities will be started.

❖ *ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources*

The ESS is applied since the improvement of drainage capacity in downstream of Suoi Tre canal, site clearance for Tan Uyen WWTP, discharge of waste water from Tan Uyen, Thuan An, Di An WWTP to Dong Nai river, Saigon river during operation phase, which may cause impacts on aquatic species, plants and animals in this area. However, the environmental assessment found that the environmental baseline of the project areas is characterized by a low sensitivity with varying degrees of modified habitats, ranging from complete surface sealing and absence of vegetation to highly modified patches of intra-urban habitats, the project locations are sitting in the rapid urbanization area. Moreover, it is also noted that the current status of the flora and aquatic organisms in the Suoi Tre canal area and the Tan Uyen WWTP construction area is poor, there are no endemic species, mainly crops of the people, so the impact here is trivial. During the operation, wastewater collected and treated will improve river water quality, contributing to the improvement of aquatic ecosystems on these rivers. Given the location and environmental setting of the project, minor impact on biodiversity is anticipated. The ESA includes measures to avoid, mitigate, minimize or compensate for the disturbance or negative biological impacts through the siting of the works, engineering design or construction practices.

❖ *ESS8: Cultural Heritage*

The report considers the impact of construction activities of the project on tangible and intangible cultural resources in Binh Duong province and in the project area of influence. The proposed project does not require land acquisition or relocation of any sites with cultural values. The ESIA has screened to identify the cultural resources (including graves and cultural heritage) available within the area of influence of the project, preliminarily assessed the extent to which the project interventions may cause impacts to these known existing structures. As the project is expected to involve substantial volume of earth works at the, along the sewerage pipelines, WWTPs and the canal, a chance finds procedure has been included as part of the ESMP.

❖ *ESS10: Stakeholder Engagement and Information Disclosure*

This policy is intended to support the decision-making of the borrower and the bank by allowing the borrower to access information on the environmental and social aspects of the project on the website by the local language, easy to understand and intuitive. The Bank ensures that environmental and social protection documents related to the project, as well as preparation procedures related to the subprojects, are presented in a timely manner prior to the appraisal. According to the information access policy, it requires information dissemination in both English and native languages (Vietnamese) and meets World Bank standards.

Project stakeholders are defined as individuals, groups or other entities who: (i) are impacted or likely to be impacted directly or indirectly, positively or adversely, by the Project (also known as 'affected parties'); and (ii) May have an interest in the Project ('interested parties'). They include individuals or groups whose interests may be affected by the Project and who have the potential to influence the Project outcomes in any way.

Project-affected parties: Project-affected parties includes those likely to be affected by the project because of actual impacts or potential risks to their physical environment, health, security, cultural practices, well-being, or livelihood, include: People who will be physically or economically displaced by the project, Project beneficiaries, People residing in the project areas, People who will benefit from project related employment or business opportunities

Other interested parties: the interested parties include individuals, groups, or organization with an interest in the Project, due to either the project location, its characteristics, its impacts, or matters related to public interest, include Project Management Unit (PMU), provincial authorities and branches (PPC, CPC, WPCs), the agency responsible for monitoring and management of environment and natural resources (DONRE), the agency responsible for monitoring and management of irrigation and flood risk management and natural disasters (DARD), the agency responsible for urban planning and construction management (DOC), the department of transport (DOT) is responsible for planning, Companies in charge of power supply, water supply, waste water and drainage in Thuan An, Di An Cities and Tan Uyen town. There is a need to strengthen coordination of these fragmented institutional structures and consolidate the operations and maintenance strategy as part of an integrated flood management system. Also, collaboration with local administrations will be crucial for ensuring project management and implementation to required standards. In addition, other interested parties include mass media, research institutes/academies, local/international NGOs.

A stakeholder engagement plan (SEP) has been developed for this project to ensure transparency and meaningful consultation with the affected and interested parties. Stakeholder engagement and consultations will be conducted throughout the project cycle. Regarding public disclosure, the E&S instruments prepared have been disclosed locally and made available in the Borrower's website and Bank's external website.

❖ ***Legal Operational Policies***

OP 7.50: Project on International Waterways

The Policy is applicable to this project because some of the proposed activities involve discharging treated wastewater to various tributaries to the Saigon river which is shared between Vietnam and Cambodia.

All proposed investments fall within Binh Duong province and the treated effluent will be discharged into canals or different tributaries of the Saigon River.[1] Vietnam is the lowest downstream riparian of Saigon River, which is considered an international waterway as defined in paragraph 1 of the Policy. The Saigon River originates in Cambodia and meets the Dong Nai River downstream of Binh Duong province. Dong Nai river, before it meets the Saigon rivers, is considered a tributary that runs exclusively within Vietnam in accordance with the Policy. The exceptions to the notification requirements set forth in paragraphs 7(a) and 7(c) of the Policy are applicable for the works proposed on the Saigon and Dong Nai rivers within this project. Accordingly, an exception to the notification requirement based on paragraph 7 (c) was approved on December 16, 2020.

2.3.2. Other policies

❖ World Bank Group Environmental, Health, and Safety Guidelines[2]

[1] A map with the locations of the proposed investments in relation to Saigon River and Dong Nai River is provided in Annex 2 to this memo.

2The EHS Guidelines can be consulted at www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines.

- World Bank-financed projects should also consider the World Bank Group Environmental, Health, and Safety Guidelines (known as the "EHS Guidelines"). The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice.
- The EHS Guidelines contain the performance levels and measures that are normally acceptable to the World Bank Group and are generally considered to be achievable in new facilities at reasonable costs by existing technology. The environmental assessment process may recommend alternative (higher or lower) levels or measures, which, if acceptable to the World Bank, become project- or site-specific requirements. This subproject should conform to the general EHS Guidelines and industry specific EHS Guidelines on Water and Sanitation.

2.4. GAP ANALYSIS BETWEEN THE GOV AND THE WB'S ESF

The application of environmental assessment policies in Vietnam, as well as various efforts directed to policy harmonization between the GoV and donors, has gradually narrowed the gap between the two systems. However, significant differences remain between the GoV's environmental policies and the ESF of the World Bank. These differences and proposed gap filling measures are described in the table below:

Table 2.3. Summary of the World Bank (WB) ESA and National EIA Processes and proposed gap mitigation for the Project

EA Process Stage	WB (stipulating in the ESF and ESSs)	Viet Nam (stipulating in Decree 40/2019/ND-CP, Circular 25/2019/TT-BTNMT	Gap Filling Measures
Objectives	Starting October 2018, the WB applies the Environment and Social Framework (ESF) describing 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. The WB will assist Borrowers in their application of the ESSs to projects with WB support.	- Investment projects are required to submit EIA or IEE for approval	- To be eligible for WB financing, the WB ESF will be applied.
Screening	- The WB will classify all projects into one of four classifications: high risk, substantial risk, moderate risk or low risk. - In determining the appropriate risk classification, the WB will take into account relevant issues, such as the type, location, sensitivity, and scale of the project; the nature and magnitude of the potential E&S risks and impacts; and the capacity and commitment of the Borrower (including any other entity responsible for the implementation of the project) to manage the E&S risks and impacts in a manner consistent with the ESSs. - Other areas of risk may also be relevant to the delivery of E&S mitigation measures and out comes, depending on the specific project and the context in which it is being developed. These could include legal and institutional considerations; the nature of the mitigation and technology being proposed; governance structures and legislation; and considerations relating to stability, conflict or security. The WB will disclose the project's classification and the basis for that classification on the WB's website and in project documents	- Categories are indicated in annexes I and II of Decree 40/2019/ND-CP. - Prescriptive, fixed regulated in Annex I and II– List of projects subject to requirements of SEA and EIA report submittal and approval. - Normally the project owners self-screen the project based on the categorization indicated in Decree 40/2019 ND-CP and consult the Provincial Department of Natural Resources and Environment (DONRE) or Vietnam Environment Administration (VEA) for the appropriate classification and EA report requirement of the project, such as: - Project falls into Annex I: SEA is required; - Project falls into Annex II: EIA or EPP required.	- Since the Project is classified as "substantial risk", use the national laws and specific WB's ESS as agreed with WB will be applied.

EA Process Stage	WB (stipulating in the ESF and ESSs)	Viet Nam (stipulating in Decree 40/2019/ND-CP, Circular 25/2019/TT-BTNMT	Gap Filling Measures
ESA instrument	- Depending on the project risks and impact, a range of instruments and procedures required to meet the ESSs' objectives, these include: ESIA; ESMF; ESMPs, sectoral & regional ESIA; SESA; hazard or risk assessment; environmental and social audit; cumulative impact assessment; and social and conflict analysis. The WB provides general guidance for implementation of each instrument. - Based on information provided by the Borrower, the WB will conduct E&S due diligence for all projects requesting for WB support. - The Borrower will be required to prepare, submit, and disclose the Environmental and Social Commitment Plan (ESCP) and the Stakeholder Engagement Plan (SEP) to WB before appraisal.	- The type of ESA instruments such as SEA, EIA or EPP is decided based on Annex I and II of Decree 40/2019/ND-CP.	- Preparation of an ESIA, RPF, RAPs, ESCP, SEP, and LMP for the Project will be required to meet the ESSs1, 2, 3, 4, 5, 6, 8, and 10 while an EIA will be prepared to meet GOV requirements.
Scope and clearance	- The WB will require the Borrower to carryout appropriate E&S assessment (ESA) of subprojects, and prepare and implement such subprojects, as follows: (a) high risk subprojects, in accordance with the ESSs; and (b) substantial risk, moderate risk and low risk subprojects, in accordance with national law and any requirement of the ESSs that the Bank deems relevant to such subprojects. - If the WB is not satisfied that adequate capacity exists on the part of the Borrower, all high risk and, as appropriate, substantial risk subprojects will be subject to prior review and approval by the WB until it is established that adequate capacity exists. - If the risk rating of a subproject increases to a higher risk rating, the WB will require the Borrower to apply relevant requirements of the ESSs in a manner agreed with the WB.	- TORs for EIA are not required. - Normally after consultation with the local DONRE or VEA for the EIA category, the project owner will proceed with EIA report preparation.	- The ESIA, RPF, ESCP, SEP and LMP for the Project will be submitted to WB for clearance. - To comply with GOV requirements, the EIA or the project will be submitted to GOV for approval.

EA Process Stage	WB (stipulating in the ESF and ESSs)	Viet Nam (stipulating in Decree 40/2019/ND-CP, Circular 25/2019/TT-BTNMT	Gap Filling Measures
	The measures and actions agreed will be included in the ESCP and monitored by the WB. - The WB helps Borrower draft the TOR for ESA report and identify the scope of ESA, procedures, schedule and outline of the ESA report. - For high risk project, the ESS1-10 applied. - For substantial, moderate, and low risk, the national system can be applied with some specific ESSs as deem necessary by WB. - WB prior clearance is required if the implementing agency do not have adequate capacity to ensure effective implementation of the required mitigation measures		
Public consultation, stakeholder engagement, and grievance redress mechanism (GRM)	- During the ESA process, the Borrower consults project affected groups and local NGOs about the project's environmental aspects and takes their views into account. - In line with ESS10, preparation of a Stakeholder Engagement Plan (SEP), information disclosure, and establishment and operations of a GRM are required to ensure adequate consultation and transparency. - ESS2 also require the preparation of the labor management procedures (LMP) and an establishment and operation of a GRM for project workers. - If ethnic minority is presence and adversely impacts, free, prior, and meaningful consultation (FPIC) is required. - For meaningful consultations, the Borrower provides relevant project documents in a timely manner prior to consultation in a form and language that are understandable and accessible to the group being consulted.	- The project owner shall consult with the People's Committee of communes, wards and towns (hereinafter referred to as communes) where the project is carried out, with organizations or community under the direct impact of the project; research and receive objective opinions and reasonable requests of relevant entities in order to minimize the negative effects of the project on the natural environment, biodiversity and community health. - The People's Committee of the commune where the project is carried out and the organizations under direct impact of the project shall be consulted. The project owner shall send EIA reports to the People's Committee of the commune where the project is carried out and organizations under the direct impact of the project together with the written requests for opinions. Within 15 working days, from the date on which the EIA reports are received, the People's	- Conduct ESIA and RPF consultation as per GOV regulation considered the WB requirements regarding the ESIA, RPF, ESCP, SEP, and LMP during consultation. The results from consultation will be incorporated into the ESIA, RPF, SEP, LMP, and ESCP.

EA Process Stage	WB (stipulating in the ESF and ESSs)	Viet Nam (stipulating in Decree 40/2019/ND-CP, Circular 25/2019/TT-BTNMT	Gap Filling Measures
	- Minutes of the public meetings are included in the reports.	Committee of the commune and organizations under the direct impact of the project shall send their responses if they do not approve the project. - The consultation with the community under the direct impact of the project shall be carried out in the form of community meeting co-chaired by project owner and the People's Committee of the commune where the project is carried out together with the participation of representatives of Vietnamese Fatherland Front of communes, socio-political organizations, socio-professional organizations, neighborhoods, villages convened by the People's Committee of the commune. All opinions of delegates attending the meeting must be sufficiently and honestly stated in the meeting minutes.	
Disclosure	- The WB will disclose documentation relating to the E&S risks and impacts of high risks and substantial risks projects prior to project appraisal. Once the WB officially receives the report, it will make the EA report in English available to the public through the World Bank external website.	- After an EIA report is approved, the project owner shall formulate, approve and publicly display its EMP at the office of the commune-level People's Committee of the locality in which consultation of the community is made for people's information, examination and oversight. (Article 16, Decree 40/2019).	- Follow GoV requirements and WB requirements. - The ESIA, RPF, RPs, ESCP, SEP, and LMP will be publicly disclosed as per requirements on the relevant ESSs.
Independent Expert	- For high risk and complex project, the Borrower may be required to retain independent ESA experts not affiliated with the project to carry out ESA. - For high risk projects, especially those related to dam safety, the Borrower should also engage an advisory panel of independent, internationally recognized environmental	- Not regulated in Vietnam policies. - Project owner shall make, or hire an institution meeting the conditions provided in Clause 1, Article 13 (Decree 18/2015) to prepare an EIA report. Project owner or consulting service provider must fully meet the following conditions: (i) Having staff members in	- Risk of the proposed Project substantial and dam safety will not be involved. The Project will not require any independent experts.

EA Process Stage	WB (stipulating in the ESF and ESSs)	Viet Nam (stipulating in Decree 40/2019/ND-CP, Circular 25/2019/TT-BTNMT	Gap Filling Measures
	specialists to advise on aspects of the project relevant to ESA. - Experts/consulting firm will be selected through bid process under strict observation of the WB.	charge of EIA must obtain at least Bachelor's degrees and Certificate in EIA consultancy; (ii) Having specialist staff members related to the project obtaining at least Bachelor's degrees; (iii) Having physical-technical foundations and special-use devices for measuring, taking, processing, and analyzing environmental samples, which meet technical requirements. In case of unavailability of qualified special-use devices, having a contract to hire a capable institution.	
Clearance procedure	- Review responsibility is internal to the WB. If the ESA report is satisfactory, the WB will issue its clearance memo. If the ESA report needs to be improved the WB will issue a conditional clearance with the understanding that the Borrower will revise the EA to satisfy the WB for the final clearance.	- The Ministry of Natural Resources and Environment shall assess and approve the EIA reports on projects prescribed in Appendix III of this Decree, except for projects subject to national defense and security secrets. - Ministries, ministerial agencies shall assess and approve the EIA reports on projects under their competence in approval for investment, except for projects in Appendix III of this Decree; - The People's Committee of the province shall assess and approve EIA reports on projects in the province, except for projects prescribed above. - The appraisal will take place no later than working 45 days at MONRE level and 30 working days at DONRE level and 5 working days at district level for after receipt of a full eligible EIA or EPP.	- GoV's approval of the EIA and RPF will be required. - WB's review and clearance of the ESIA, RPF, RPs, ESCP, SEP, and LMP will be required prior to project appraisal
Number and language of ESIA required for	- Number of copies not specified. - Language requirement: English for Vietnam - No requirement for feasibility survey: the WB does not advance discussions on any investments without the	- The project owner must submit seven copies of EIA report and one copy of the Feasibility Study documents to the appraising agency (MONRE) for appraising process	- Follow the GoV requirements and WB requirements

EA Process Stage	WB (stipulating in the ESF and ESSs)	Viet Nam (stipulating in Decree 40/2019/ND-CP, Circular 25/2019/TT-BTNMT	Gap Filling Measures
appraisal	preparation by the Borrower of the minimum required technical studies that prove the investments are feasible from socio-economical and technical point of view.		
Content of ESIA report	- According to the ESS1 - Due attention will be given address labor and working conditions as well as community health and safety	- EA report should be in line with Circular 25/2019/TT-BTNMT	Prepare 2 documents: one follow GOV requirement and one follows WB requirement.
ESA supervision	- During project implementation, the WB supervises the project's environmental aspects on the basis of the environmental provisions and the Borrower's reporting arrangement agreed in the loan agreement and described in the other project documentation, to determine whether the Borrower's compliance with environmental covenant (primarily with EMP) is satisfactory. If compliance is not satisfactory, the WB will discuss with the Borrower action necessary to comply.	- The local DONRE is entrusted to supervise the environmental compliance of the project. - By the end of project construction stage, the Environmental Management Agencies will coordinate with Construction Management Agencies to supervise the compliance of environmental management activities stated in EIA study.	- Follow the ESCP and the approved ESIA, RPF, RPs, SEP, and LMP of the Project.

CHAPTER 3. NATURAL, ENVIRONMENTAL AND SOCIO-ECONOMIC CONDITIONS

3.1. NATURAL ENVIRONMENT CONDITIONS

3.1.1. Topographical and geological conditions[3]

Topographical characteristics

Binh Duong is a transitional region, a plateau province with weak wavy terrain from high to low, from 10m to 15m above the sea level. The land of Binh Duong is relatively flat, descending from North to South. In general, Binh Duong has many different terrain areas: low mountain terrain with weak wave, flat terrain, alluvial valley, etc. There are some low mountains such as Chau Thoi mountain (Di An city), Cau mountain (also called a Lap Vo mountain) in the Dau Tieng district, etc. and some low hills.

The topographic survey in the project area was carried out by Water Supply, Sewerage and Environment Joint Stock Company (WASE) in September 2020, the results are as follows

(i) Thuan An city

Thuan An city is located in the transition area between highlands and plains, this is the last area of low and gentle hills. Topography is inclined from the northeast to southwest with elevation varying from 4 - 26m and gradually lower towards the Saigon (2 - 3m high).

(ii) Di An city

Di An city has a flat terrain, occupying 85% of the area with an average elevation of 34-38m, while the remaining 15% is in the East-North region and a part of the South is more complicated. The terrain slopes in the East from 18m down to about 2-3m, the East - North with the elevation of 5-6m, the North is lowland with the elevation of 2-3m.

(iii) Tan Uyen town

Tan Uyen town has elevation from 0.45 - 47.8 m, gradually lower towards the Dong Nai river The construction area of the WWTP has elevation from 1.8 - 3.3 m, gradually lower towards Suoi Tre canal. The Suoi Tre canal area has an elevation from 0.45 to 3.5 m.

Generally, the terrain of Tan Uyen, Thuan An and Di An is quite complicated, it is necessary to invest pumping stations to direct wastewater to WWTPs. Especially, the construction area of the Tan Uyen WWTP is low, so it requires leveling to avoid flooding during operation.

Geological characteristics

The geological survey in the project area was carried out by WASE in September 2020, the results are as follows:

(i) Tan Uyen town

The deepest borehole is 35m. The surveyed area is classified into 15 soil layers; the results are described as below:

Table 3.1.Soil characteristics in Tan Uyen

[3]Topography and geography survey reports of the project, 2020.

Layer	Thick (m)	C (kg/cm^2)	Soil characteristics
K	0.5-1		Covering layer (soil rock layer and mixed) Not stable and heterogeneous
Layer 1	3-6.3	0.4	Clay, yellowish gray - greenish gray - dark gray, very soft to soft.
Layer 2	2-6	1.1	Clay – half clay, reddish brown - green gray - yellow gray, with soft state
Layer 3	2.5-11.6	1.4	Clay – half clay, yellow brown - red brown - yellow gray - green gray, hard plastic state
Layer 3a	4	1	Clay, yellow gray - green gray, soft to very soft.
Layer 4	4.1	0.6	Clay, greenish gray, soft state
Layer 5	1.2-2.1	0.8	Clay, greenish gray, soft state
Layer 6	5-8.1	2	Sand and dust, coarse, medium coarse, yellowish brown - greenish gray, medium tightness
Layer 7	3-8.6		Sand and gravel, yellow brown - red brown - green gray - white gray, medium tightness
Layer 8	3-4.6	1.8	Clay loam, in yellowish gray - white gray color, hard plastic state
Layer 9	2.6-3	1.4	Clay sand, in pink gray - yellow brown - white gray color, plastic condition
Layer 10	0.7		Clay, in greenish gray - white gray color, hard state
Layer 11	1.0		Clay sand, in golden brown color, hard state
Layer 12	0.6		Quartz stone, pebble, and gravel, in white gray - pink gray color

The above table shows that geological in Tan Uyen project area is good condition; excavated soil can be utilized for ground leveling to minimize the amount of additional soil needs for leveling. The surface soil layer needs to be removed during leveling.

(ii) Thuan An city

The area is adjacent to the National road 13 to the East, is the red soil, laterite, that can resist the high loading while in dry state, and low loading while in wet state and dominates this area. In general, soil load capacity R> 2 kg/cm^2 in high areas and R = 0.5 - 1.0 kg/cm^2 in low areas (Saigon riverside area).Based on the survey data during field survey of in 11 boreholes at the WWTP construction site, the geologic characteristics of the area is divided into 10 soil layers. The results are described as follows:

Table 3.2.Soil characteristics in Thuan An

Layer	Thick (m)	Soil characteristics
Layer 1	0.3-1.9	Mixed compositions of clay, sand, plants
Layer 2	9.7-18.9	Mud mixed with plants, dark gray, greenish gray
Layer 2a	3	Clay mixed with gray-white, yellow-brown color, soft plastic state
Layer 3	3.0-7.1	Clay is greenish gray, reddish brown, yellow brown, hard plastic state
Layer 3a	2.3-5.0	Clay-gray mixed with white-gray, yellow-brown, reddish-brown, hard plastic state
Layer 4	17-49	Sand mixed with yellowish brown, white gray, pink brown quartz stones
Layer 5	3	Clay has yellow brown, white gray, hard state
Layer 6	2.7-6.5	Clay mixed with yellow brown, white gray, pink brown color, hard plastic state
Layer 7	2.0-6.15	Sand mixed with yellowish brown, rose brown, gray white quartz gravel

(iii) Di An city

The geology in Di An city is almost covered by ancient alluvial with the composition of medium coarse particles (clay-loam or clay layers affected by felarit process; therefore, some places are mixed with laterite gravel). It is accumulated fora long time, thickness; the geological age is from Pleistocene – Miocene. The bedrock foundation is not deep.

The construction area in Di An is good geological engineering condition. The compressive strength is over 2 kg/cm^2. In some places, under the top layer is a thick rock bed. The lower-land area in the East- South near the Dong Nai river and the East of Tan Binh ward is weak geological engineering foundation.

Based on the data recorded during field survey in 07 boreholes at the WWTP construction site and the test results of 34 undisturbed samples, geologic characteristics of this is area divided into 05 layers. The results are described as follows:

Table 3.3.Soil characteristics in Di An

Layer	**Thick** *(m)*	**Soil characteristics**
Layer 1	7	sub-clay layer, gray-brown gray, soft plastic state
Layer 2	3-7	clay - silt mixed with gravel, white gray - red brown, hard plastic state to half to hard
Layer 3	3	sand mixed with powder, little gravel, white gray color, medium tight state
Layer 4	3-5	clay-sub-clay layer mixed with a little fine sand, yellowish-green gray color
Layer 5	8.5	hard Granite base rock

The above geologic data in Thuan An and Di An show that project location is sufficient for construction works.

Hydrogeological conditions

Hydrogeology of Binh Duong province is relatively simple, underground water is mainly fresh water with 05 main aquifers, including 04 pore waters and 01 fissure aquifer. The pore aquifers include upper middle Pleistocene, lower Pleistocene layer; the middle Pliocene layer and the lower Pliocene layer; The fissure aquifer is in the Mesozoic (MZ) rock. Generally, the aquifers are not deep, ranging from 20 to 100m, which is convenient for exploitation.

- Tan Uyen town: Underground aquifer is available at the depth from 34.5m to 35.0m. Water level is from 1.8 - 2.5 m. Results of testing samples have shown with water at mildly corrosive to concrete and metal (HK1) and 02 water samples are not corrosive to concrete and metal (HK2; HK3).
- Thuan An and Di An: According to Binh Duong DONRE, underground water exists in four upper Pleistocene aquifers (qp2-3), lower Pleistocene aquifer (qp1), aquifer Middle Pliocene (n22), lower Pliocene aquifer (n21), after 20-40m. Water is low hardness of 0.05-1.72 mgeq/l, pH from 4.4-5.2. Generally, the quality of groundwater in these areas is rather good, but the weak permeability layer which is prone to be polluted by pollutants seeping into the ground. In the construction process, this should be noted to avoid littering, wastewater, hazardous waste indiscriminately causing groundwater pollution.

3.1.2. Climate and meteorological conditions

The project area is located in the tropical monsoon zone with typical 2 seasons in a year. The rainy season starts in May to October with southwest monsoon. The dry season starts from November to April of the next year with northeast monsoon. The climate characteristics of Binh Duong are as follows:

Temperature

The annual average temperature is about 27.7^0C to 28^0C. The highest annual temperature is in April and May, about 30.5^0C. The lowest temperature is in January with about 25.3^0C. The highest day temperature is sometimes up to 39.3^oC and lowest from 16^oC-17^oC (at night) and 18^oC in the early morning. The average temperature in Binh Duong is relatively high, which directly affects the metabolism and dispersion of pollutants in the atmosphere. With a high heat base, the faster the chemical reaction occurs and the shorter is the pollutant retention time. Variation of temperature values will affect the evaporation of organic solvents, the temperature exchange and the labor's health.

Humidity

The average relative humidity over the years (from 2015 to 2018) is about 82.753%. In general, the air humidity is relatively high, about 71.6 - 85.5% on average and varies by season. The humidity is brought mainly by the West-South monsoon during the rainy season, so the lowest humidity usually occurs between the dry season and the highest in the middle of the rainy season. Air humidity is less changeable during the year. The high air humidity creates favorable conditions for microorganisms to spread into the air rapidly, to spread and metabolize airborne pollutants causing environmental pollution and being a microclimate factor affecting on the body's heat exchange process and labor health.

Sunshine

In Binh Duong, the number of sunny hours increases during the dry season and decreases in the rainy season. The total number of sunny hours in 2017 is 2,206.3 hours. April has the

highest number of sunny hours with 298 hours. The month with the least number of sunny hours is December with only108 hours.

Rainfall

In the early months of the rainy season, heavy showers often appear. The months from July and September are usually long rainy within1-2 days. Especially, there are not impacts by storms recorded in Binh Duong. The average annual rainfall ranges from 2104.4 to 2483.8 mm. The highest rainfall is in September with about 741.6 mm. The lowest rainfall is in January to March with 0 - 35 mm. Rainfall is mostly occupied with more than 90% in June to November.

In the project area, there are some flooding points during rainy season. There are 3, 20 and 36 flooding points in Tan Uyen, Thuan Anand Di An, respectively. The flooding points are mainly located on roads without sewers or drainage culverts.

Evaporation

The annual average evaporation in Binh Duong is about 1,300 - 1,450 mm, the daily average is 2.6 mm, the highest value is 8.0 mm, and the lowest is 0.3 mm. In contrast to the rainy regime, the highest evaporation occurs in the middle of the dry season, and lowest in the middle of the rainy season

Storm and wind

❖*Wind*

The wind regime is relatively stable, not directly affected by storms and tropical depressions. In the dry season, the prevailing winds are mainly from the East, East - North. In the rainy season, the popular winds come from West, West - South. Minimum wind speed is about 0.51m/s, average wind speed is about 0.7m/s, maximum wind speed observed is 12m/s, usually from West, West – South.

❖*Storm*

There is not any storm in the area, but there are some impacts due to hurricanes like in 2018 caused cyclones and heavy rain.

3.1.3. Hydrological conditions

Binh Duong province borders with Saigon river to the west and Dong Nai river to the East. They are water supply systems as well as drain water for the whole province. In which, Saigon River is considered a tributary of the Dong Nai river system.

Dong Nai river system has a basin area of 36,530 km², mainly located in the Central Highlands and Southeast, including several big rivers such as Dong Nai river, La Nga river, Be river, Saigon river, Vam Co river...

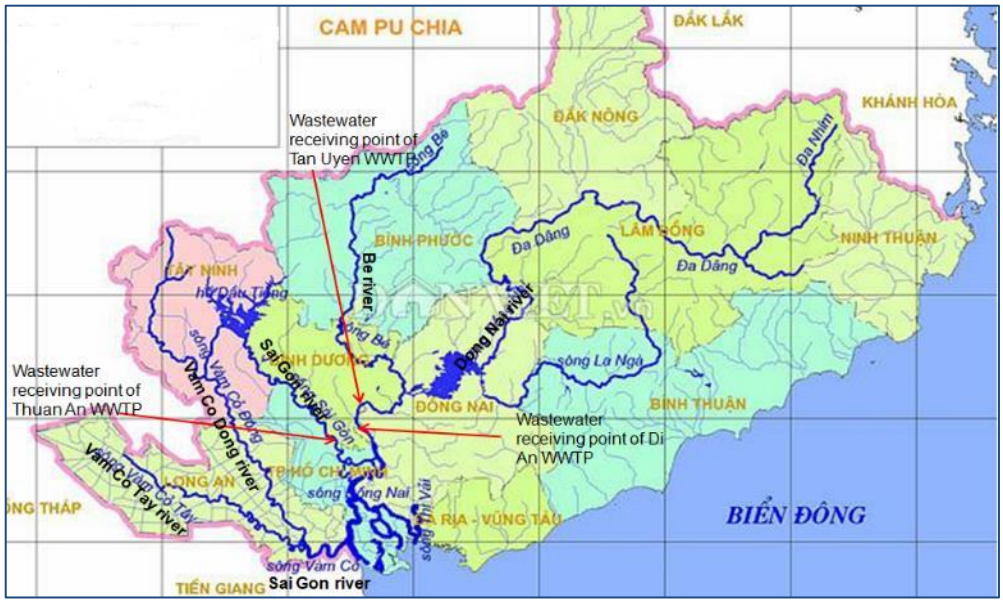


Figure 3.1. Diagram of Dong Nai river catchment.

(i) Dong Nai river

Dong Nai River flows through areas of Tan Uyen and Di An. The discharge point of Tan Uyen WWTP is 750m far from Dong Nai river, the discharge point of Di An WWTP is about 8km far from Dong Nai river.

Dong Nai river system has a basin area of 36,530 km², mainly located in the Central Highlands and Southeast region, including some large rivers such as Dong Nai River, La Nga River, Be River, Sai Gon River, Vam Co River, etc.

Dong Nai River is about 586 km long, originating from the Lam Vien plateau at an altitude of + 1770m, is the confluence of the two rivers Da Dung and Da Nhim. This is the largest inland river in Vietnam and has the third largest basin in the country followed the Mekong river and Red river. At the boundary of Vinh Cuu district - Dinh Quan district, Dong Nai river joins with La Nga river, flows through many waterfalls and rapids, and finally the Tri An lake - waterfall. Having crossed Tri An lake and then Hieu Liem ferry station, the boundary of Vinh Cuu district, Dong Nai province and Tan Uyen town of Binh Duong province, Dong Nai river continues to merge with Be river. Dong Nai river continues to merge with Sai Gon river at the junction of Thanh My Loi ward - District 2 - TP. Ho Chi Minh City, from this point the river has a very large flow, with wide and deep riverbed, which is convenient for large ships/vessels to travel and convenient for the construction of central ports.

Dong Nai river water source is supplied for many provinces and cities such as Lam Dong, Binh Phuoc, Dac Nong, Dong Nai, Binh Duong, Tay Ninh and Ho Chi Minh City and parts of Binh Thuan and Long An provinces. In addition, a number of water transfer projects from the Dong Nai River to the coastal provinces of Ninh Thuan, Binh Thuan, and Ba Ria Vung Tau have been being planned. About 20 million people are estimated to use water of Dong Nai River for production, transportation, services and domestic use, contributing over 65% of the national industrial GDP, this river is really the main blood vessel for economic and social development of the most dynamic region in the country.

Dong Nai river bends into large curves on Da Lat plateau, especially on Di Linh plateau, but in general the river flows in a quite special direction from the Northeast – Southwest until Bien Hoa city, after it merges with Be River, the river turned to the typical Northwest – Southeast direction.

Several reservoirs and dams have been created on the branches of the Dong Nai river system such as Don Duong is 165x 10^6 m³, Tri An is 2,540x 10^6 m³, Mo Waterfall is 1,250x 10^6 m³, Ham Thuan is 737x 10^6 m³

In terms of morphology: Dong Nai river flows through Binh Duong province is divided into two sections: (i) Single river section is from Hieu Liem to Uyen Hung junction, (ii) the second section is from Uyen Hung to Buu Long junction through Bach Dang and Rua islets. The curvature coefficient is 1.79 at the average level. Dong Nai river has large variation in the width. It is about 176m at the behind of Tri An dam and is 412mat Tram 1 wharf. Details are shown in the following Table

Table 3.4. Variable width of Dong Nai river

Location	**Distance** *(km)*	**River width** *(m)*
Tri An Dam	0	240
Tri An dam – Hieu Liem ferry	1,16	210
Hieu Liem ferry- Ba Co pumping station	5,12	150
Ba Co pumping station – Suoi Sau outlet	5,44	181
Suoi Sau outlet – Ben Do ward 3, Thuong Tan commune	4,24	176
Ben Do ward 3, Thuong Tan commune, Thuong Tan 2	4,6	233
Thuong Tan 2 pumping station - Thuong Tan 1 pumping station	3,96	209
Thuong Tan 1 pumping station - Tan My 2 pumping station	1,63	257
Tan My 2 pumping station - Tan My 1 pumping station	1,24	292
Tan My 1 pumping station - Bach Dang pumping station	5,42	244
Bach Dang pumping station - Tan An pumping station	5,51	262
Tan An pumping station - Tram 1 ferry	8,63	412
Total	46,95	

Source: Report on discharging wastewater into water source, Di An WWTP, 2018

The flooding time of Dong Nai River starts quite late compared with the rainy season. In some places, the flood season occurs in July-October, floods usually happen with 2-4 months later than the rainy season, the flood season usually occurs in August-September where have highest rainfall.

Dong Nai River has a rich amount of water. The annual water flow is about 22 billion m^3/year. The average flow module of the Dong Nai River is 40.6 l/s-km². Dong Nai river is regulated by Tri An hydropower plant, average discharge in flood season is 669 m^3/s; In the dry season, the total volume of water in the dry season reaches 3169 million m^3, the average discharge is 242 m^3/s. The smallest flow is about 45.93 m^3/s (in January), the largest is 1054.33 m^3/s (in October)

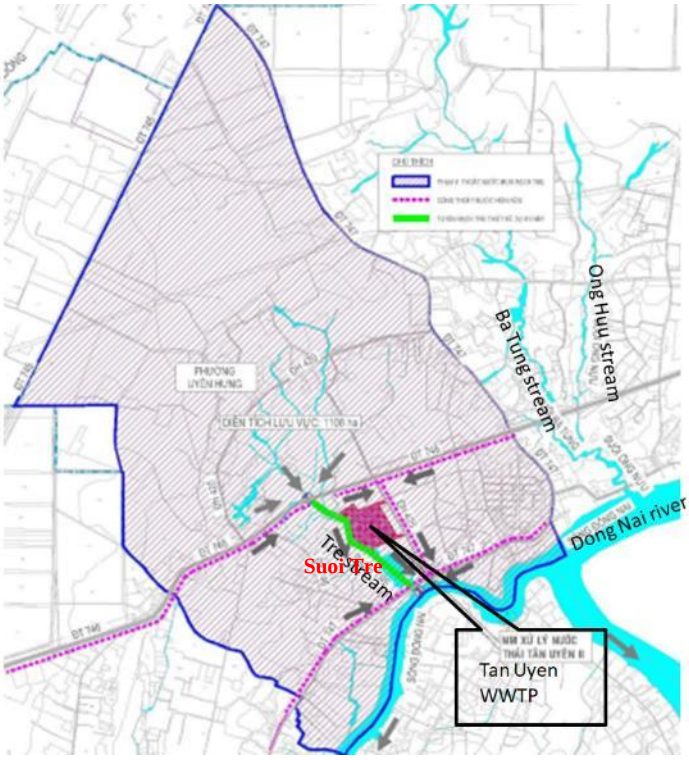


Figure 3.2. River diagram in Tuan Uyen area.

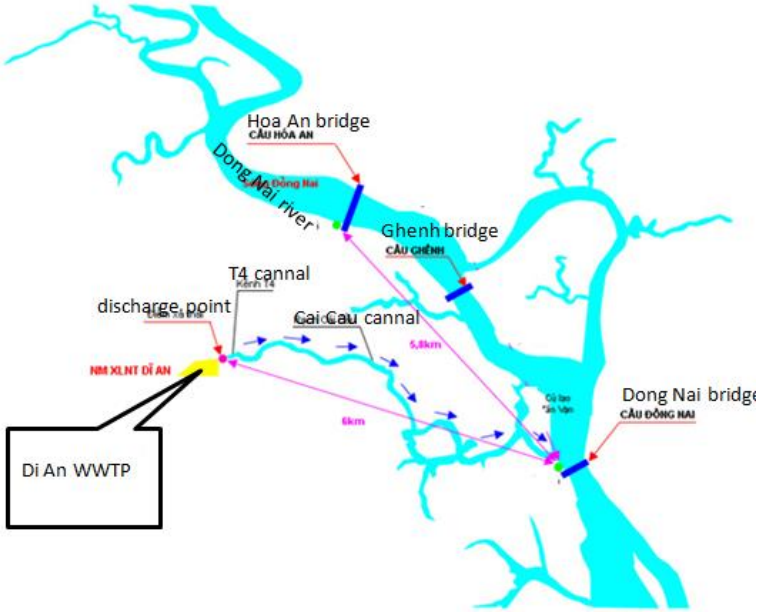


Figure 3.3. River diagram in Di An area.

(ii) Sai Gon river

The receiving water source of the wastewater treatment system is the Saigon River, about 2.3 km from the discharge point of Thuan An WWTP. Sai Gon river is a tributary of Dong Nai river. Sai Gon river originates from Cham canal, with a relative height of about 150m, located in Loc Ninh district, Binh Phuoc province, and flows through the natural boundary between Binh Phuoc and Tay Ninh provinces, and through Dau Tieng lake, then continues through Binh Duong province which is the boundary between Binh Duong and Ho Chi Minh

City, merging with the Dong Nai river into the Dong Nai River System, an then flowing into the sea. The section from Dau Tieng reservoir to Binh Phuoc Bridge flowing through Binh Duong province of Saigon River has a length of about 106.55 km. The average volume of the Saigon River is about 2.96 billion m^3. The flow regime of Saigon River after Dau Tieng reservoir is regulated by Dau Tieng project. Amplitude of average water level of Sai Gon river is 1,8 – 2,0 m in rain season and 2-2.5m in dry season.

Average flowrate of Sai Gon river is about 54 m^3/s, the lowest flow rate is 31 m^3/s, and the highest flowrate is 1580 m^3/s.

Figure 3.4. River diagram of Thuan An area.

In this project, Sai Gon river will be the body receiving source for the Thuan An WWTP through Cau Mieu canal.

(iii) Other canals and streams in the project area

Di An city

- Cai Cau – Suoi Siep canal is shallow at the starting point with the width of 3-8 m, and is extended at the connecting with the Dong Nai river with width of 50-60 m. It is influenced by the semi-diurnal tide regime of Dong Nai river. The flowrate of Cai Cau canal is 2 m^3/s.
- Treated wastewater of Di An WWTP will flow from T4 box culvert to T4 canal to Cai Cau canal and then discharging into Dong Nai river.

Thuan An city

- Lai Thieu canal is the largest canal in Thuan An city, it flows through Lai Thieu town. There are many canals that flow into Lai Thieu canal before discharging into the Saigon river, e.g. Cau Mieu, Cau Ong Bo, Cung, Binh Hoa, and D canals. These canals are the main drainage system of this town.

- Vinh Binh River is located at the southern end of Lai Thieu area. Vinh Binh river is also connected with Cau Ong Bo, Cung, D, and Binh Hoa canals through Kinh river,

connected with Xi Mang canal through Chuoi canal and then flowing into Saigon river. Vinh Binh river has 1.7 km long, class VI river.

Tan Uyen town

Suoi Tre canal: Suoi Tre canal downstream from the south of the road PR746 flows into Dong Nai river and drain for the basin of about 1,108 ha in Uyen Hung ward. Currently, the stream bed is quite narrow, only about 5-10m. There are existing box culverts intersecting PR746 road to leading water from Suoi Tre canal to Dong Nai river with the cross section of $8m^2$.

(iv) Tidal regime

Dong Nai river and Saigon river are affected by the semi-diurnal tide regime of the East Sea. This is the irregular semi-diurnal regime reflected through the fluctuations described as follows:

- Daily fluctuation: 2 times a day with high tide and 2 times of low tide.
- Moon fluctuation: there are 2 times of ebb tide in a month (from 27th of previous month to 5th of following month and from 13th-18th in lunar calendar) and 2 times of low tide (7th-12th and 19th -24th in lunar calendar).

(v) Inundation status

There are currently numerous flooding points. Frequently flooded areas are mainly located on roads without sewers or not sufficiently calculated for drainage basins in Thuan An, Di An, Tan Uyen urban areas… The inundation reasons are mainly due to:

- The rapid urbanization rate, concretization reduces natural permeability rate, increases surface runoff or amount of water to be drained.
- The increase of rainfall and rainfall intensity is related to climate change.
- Sea level rises due to climate change; leveling at the downstream of the Dong Nai river system; The ring dike systems loses the ability to regulate tidal in low-lying areas; flood discharge from upstream reservoirs.
- The drainage system has not met the urban drainage demand. Canals and drainage systems have not been dredged and maintained regularly.
- The inundation depth in the project area is from 0.2 -1.5 m, inundation is common from 0.3 to 0.5 m, lasting for 1-3 hours.

3.1.4. Natural resources

a) Current land use

The total natural land area of Binh Duong province is 269,464 ha, of which 194,799 ha is agricultural land, 10,532 ha is forestry land, 37,055 ha is specialized land, and 13,689 ha is residential land. Land use status in Tan Uyen, Thuan An, Di An are shown in the Table below:

Table 3.5. Land use status in Tan Uyen town; Thuan An, Di An cities

No	Town/city	Total area *(ha)*	Agricultural land *(ha)*	Forestry land *(ha)*	Specialized land *(ha)*	Residential land *(ha)*
1	Tan Uyen	19.176	11.479	74	5.333	1.247
2	Thuan An	8371	2706	-	3263	1908
3	Di An	6005	976	-	2903	1792

Source: Statistic report of Binh Duong province, 2018

b) Surface and groundwater resources[4]

Surface water sources in Binh Duong are from rivers, streams, canals and reservoirs. The river/canal density is from 0.7 km - 0.9 km/km^2 in upstream and reduced to 0.4 - 0.5 km/km^{2}at downstream. The total annual water flow of major rivers in the province is about 17,753.27 million m^3. Besides, the province has 07 reservoirs with a total capacity of up to 1,138 million m^3.Binh Duong province issued surface water exploitation licenses with total volume of 131,180m^3/day. The total reserve of exploiting underground water potential in the province is about 2,180,000 m^3/day and night, equivalent to about 797 million m^3/year.

c) Mineral resources[5]

In Binh Duong province, there are 86 mineral deposits and mineral manifestations, including: 7kaolines; 34 clay mines for production of brick and tile; 32 stone mines; 10 sand mines; 3 gravel pebbles mines; in addition, there are some gold and some small peat spots.

d) Forest resources[6]

The area of forest and forestry land is 10,289.03 ha including 1.723.09 ha of natural forest land, 8.565.94 ha of planting forest land and 560.91 ha of other forestry land. It accounts about 3.82% of the total natural area, decreasing by 4,848.97 ha compared to 2010 due to the conversion of production forestland to rubber land. Currently, natural forest is mainly young regenerating forests, scattered in the North. Natural forests in Binh Duong have invaluable resources or timber commercial value, but they have their values in natural view and contribute in biodiversity conservation, environmental improvement and landscape creation, and tourism development support. There is no forest area in the project area.

e) Biological resources[7]

Aquatic organisms

Phytoplankton:

- Saigon river: phytoplankton species are found in 04 main groups including *Cyanobacteria, Bacillariophyceae, Chlorophyceae, and Euglenophyceae*. In which, the group of Chlorophyceae accounts for the highest number of species (29 species, accounting for 45.31% of the total number of recorded species) and the least number of species of diatoms (Bacillariophyceae) has 9 species (0.9 %). In terms of quantity, the *Cyanobacteria* group dominates with 40.67% of the number of individual/liter.

[4]Binh Duong environmental status report period 2011-2015

[5]Binh Duong environmental status report period 2011-2015

[6]Binh Duong environmental status report period 2011-2015

[7]The information provided in the EIA of Di An and Thuan An WWTPs

The density of phytoplankton is valid from 384,270 - 741,330 individuals/liter. The presence of phytoplankton shows that freshwater signs organic pollution.

- Dong Nai river: Phytoplankton has 81 species of algae, belonging to 5 different branches; of which, the Chlorophyta has the highest species composition, with 42 species, accounting for 51.9%; followed by Cyanophyta, with 21 species accounting for 25.9%; The lowest is Dinophyta, only one species is recorded, accounting for 1.2% respectively. The density of phytoplankton in the project area is relatively high, ranging from 15,088 to 150,027 cells/liter. The abundance of blue and green algae shows that the surface water environment here has been greatly affected by human activities.

Zooplankton:

- Saigon river includes 5 branches, 18 species and 2 plankton larvae. The Rotifera branch dominates the species composition (11 species, accounting for 55%) and the Amoebozoa branch and the Ostracoda branch recorded the lowest number of species (1 species, with 5%). Presence of 2 zooplankton larvae (accounting for 10%). The predominance of the *Rotifera species* shows that this is a freshwater environment, which also shows the characteristics of water environment rich in organic nutrients and high turbidity.
- Dong Nai river: a total 49 species belonging to 7 groups. The Rotifera group has the richest species composition with more than half of the recorded species (29 species; accounting for 59.2%), the remaining groups have the few species from 1-5 species / group. The floating fauna recorded here is freshwater species.

Benthos:

- Saigon River: 2 species of the Mekong River Delta in Annelida, divided equally by 2 groups Polychaeta (1 species, 50%) and Oligochaeta (1 species, 50%). The dominant species is Limnodrilushoffmeisteri, which accounts for more than 98% of the individual population. This shows that the polluted water environment is quite high.
- Dong Nai river: 14 species of 5 layers, 3 branches. In which, Class Bivalvia, Class Polychaeta, Class Oligochaeta and Class Insecta, all recorded 3 species accounting for 21.4%. With the lowest number of species was the Class Gastropoda, only one species was recorded. One species of larvae is also recognized.

Terrestrial flora and fauna

There are no plants and animals on roads which sewers will be built in Tan Uyen town, Di An and Thuan An cities. Thuan An and Thuan An WWTPs are constructed on existing areas with a few types of vegetables and lotus, etc. Animals are mainly domestic animals such as dogs, cats, ducks, chicken and some insects such as locusts, grasshoppers, etc.

Tan Uyen WWTP is placed on agricultural land with cultivating crops such as rice, crops, melaleuca, citrus, lemon, etc. There are no endemic or rare plants.

In Binh Duong province, there has 166 fish species, belongs to 35 families of 13 orders. Perciformes dominates the most in families, genera, species including 15 families, 22 genera, 28 species (28% of total species), second is Siluriformes with 8 families, 17 varieties, 26 species (26%), followed by the common carp (Cypriniformes) including 2 families, 21 genera, 25 species (25%). Cypriniformes has only 2 families, of which the family Cyprinidae has the largest number of breeds and species (20 genera, 24 species). The fish fauna of the Dong Nai River is similar to the fish fauna of the lower Saigon River and the inland waters of Ho Chi

Minh City. The fish species components here is relatively evenly distributed in both seasons, the number of species in the rainy season is equivalent to that in the dry season.

There are not rare and precious species or species listed in the Red List to be protected, invasive or migratory species in the project area.

Table 3.6. Ecosystem of the proposed items

No	Area	Fauna	Flora
1	Tan Uyen WWTP	- Terrestrial species namely birds, frogs, amphibians, insects.	agricultural lands with mainly rice, crops, cajuput, grapefruit, oranges, tangerines
2	Suoi Tre canal	- As a drainage channel, poor animal - Animals are mainly rodents, insects	bamboo, banana …
3	Di An WWTP	- Existing plant premises - Animals are mainly rodents, insects	grass, self-grown vegetables
4	Thuan An WWTP	- Existing plant premises - Animals are mainly rodents, insects	grass, self-grown vegetables

3.1.5. Climate change in Binh Duong province[8]

In 2016, the Ministry of Natural Resources and Environment has built the climate change and sea level rise scenarios for Vietnam with 4 Representative Concentration Pathways (RCP) scenarios which are built as follows:

- RCP8.5: High greenhouse gas concentration scenarios
- RCP6.0: The scenario of high average greenhouse gas concentration
- RCP4.5: Low average greenhouse gas concentration scenarios
- RCP2.6: Low greenhouse gas concentration scenarios

The use of climate change scenarios is recommended by the Ministry of Natural Resources and Environment as follows:

The RCP4.5 scenario can be applicable for design standards for non-permanent constructions and short-term plans.

The RCP8.5 scenario should be applied to permanent structures, long-term plans.

Calculation results with different scenarios have shown that Binh Duong is strongly influenced by climate change, as follows:

- Average annual rainfall increases over the years from 2154.95 mm (2020) to 2199.28 mm in 2070.
- Average temperature increases over the years from 26,94^{0}C in 2020 to 27,91^{0}C in 2070.

Current status of climate change and natural disasters in Binh Duong province:

- Comparison with the period of 1980-2010, currently the annual average temperature is about 0.49 ^{0}C higher than the average temperature of many years, the total annual

[8] Climate change and solutions of increase the ability for facing the climate changes, Binh Duong DONRE.

rainfall decreases with about 8.9 mm, the dry season rainfall is insufficient. The weather is hot and dry in some places. This proves that climate change has partially influenced the climate of Binh Duong province.

- The highest soil salinity boundary in the province is 2 ‰, the land area with salinity from 1‰ - 2‰ is limited to a small part of the section adjacent to the Saigon river of Thuan An city (Binh Nham, Binh Hoa, Lai Thieu, Vinh Phu), some areas such as Ba Lua port, Chanh My, the section adjacent to the Saigon River, have salinity of approximately 1‰.In general, the salinity in the water is still not high, does not affect production and daily life.
- Due to the impacts of climate change, the high tide level of rivers in the last months of the year is getting higher and higher and appears earlier than the annual average, causing inundation in many areas of Thuan An city and Thu Dau Mot city along the Saigon River
- To narrow agricultural land due to inundation, reducing crop yields due to increased extreme weather events, increasing the risk of forest fires
- The provincial industrial infrastructure is almost not affected by inundation and sea level rise. However, the increase in temperature and natural disasters will affect the comfort, usefulness, load capacity, durability and safety of infrastructure works.

3.2. ENVIRONMENTAL QUALITY IN THE PROJECT AREAS

In September 2020, the Consultant cooperated with Phuong Nam Science, Technology and Environmental Analysis Company Limited (certified with VIMCERT 039) to conduct survey and sampling of air, water, wastewater, soil and sediment at the project area. Sampling locations and results are detailed in Appendix 2.

3.2.1. Air environment

Air quality: 15 ambient air samples (KK1-KK15) were taken in the project site (5 samples in each town/cities). The parameters were monitored including CO, SO_2, NO_2, TSP, PM_{10}, $PM_{2,5}$, NH_3, H_2S, noise. Sampling time was from 14-16/9/2020. The analyzed results compared with QCVN 05:2013/BTNMT and QCVN 26:2010/BTNMT show that the air quality in the project area within the allowable limits. According to monitored results, the ambient air quality is still good condition in all project implementation locations.

3.2.2. Water environment

Ground water quality

Underground water quality: There are 6 ground water samples (NN1-NN6) taken in the project site (2 samples in each town/cities). The parameters were monitored including temperature, pH, Permanganate index, TDS, Hardness, NH_4^+, NO_2^-, NO_3^-, Cl^-, Fe, Mn, As, Coliform, E. *coli*. Sampling time was from 14-16/9/2020.

The analyzed results compared with QCVN 09-MT:2015/BTNMT show that the groundwater quality in the project area within the allowable limits, excepted the Coliform criteria in the area of Thuan An city, Di An exceeded the limit from 1.3 to 3 time. The main reason of underground water pollution could come from the directly discharge wastewater and solid waste to environment, and coliform enters the soil and water then finally to underground water.

Surface water quality:

Surface water quality: There are 12 surface water samples (NM1-NM12) taken in the project site (4 samples in each town/cities). The parameters were monitored including temperature, pH, Dissolved oxygen, TSS, BOD_5, COD, NH_4^+, NO_3^-, Cl^-, grease, coliform. Sampling time was from14-16/9/2020. The analyzed results compared with QCVN 08-MT:2015/BTNMT show that the surface water quality at some points is polluted due to TSS exceeded from 1.06-1.5 time (samples in Suoi Tre canal, Dong Nai river in Tan Uyen; Siep canal and Dong Nai river in Di An; the treated wastewater receiving channel of Thuan An WWTP); COD exceeded from 1.2-1.5 time at almost positions of sampling; BOD_5 at all positions exceeded the standard from 1.06- 2 times. The reasons are due to directly discharge wastewater and solid waste to environment, then construction of WWTPs are quite necessary in urban areas.

3.2.3. Wastewater characteristics

Domestic wastewater: There are 12 domestic wastewaters samples (NT1-NM15) taken in the project site (5 samples in each town/cities). The parameters were monitored including: Temperature, pH, TSS, BOD_5, COD, NH_4^+, NO_2^-, NO_3^-, T-N, T-P, PO_4^{3-}, Cl^-, Pb, Cd, Fe, Cu, Zn, Mn, Total grease, Coliform. Sampling time was from14-16/9/2020. The analyzed results compared with QCVN 14:2008/BTNMT show that the wastewater quality is polluted by BOD_5, the samples have exceeded the standard from 2.6- 4.1 times, TSS exceeded the standard from 1.5 to 2.8 times; Coliform exceeded from 3.6 to 360 times.

Wastewater discharged directly to the streams, rivers resulting in increased pollution situation on the Dong Nai and Saigon rivers, reducing water quality, spreading diseases. Therefore, the investment in construction of wastewater collection and treatment system is an urgent issue

3.2.4. Soil/sediment

Soil

Soil quality: There are 6 soil samples (Đ1-Đ6) taken in the project site (2 samples in each town/cities). The monitored parameters were including pH, saline, As, Cd, Cr, Cu, Pb, Zn. Sampling time was from 14-16/9/2020. The analyzed results compared with QCVN 03 – MT:2015/BTNMT show that the soil quality is under the allowable standard. The soil is not salty. The soil quality is still good condition which can reuse for tree planting, or leveling purposes for other activities to reduce the demand of soil disposal.

Sediment

Sediment quality: There are 15 sediment samples (TT1-TT15) taken in the project site (5 samples in each town/cities) and 6 additional samples have been taken on Suoi Tre canal (TT1-1,2 to TT3-1,2) on 11/11/2020. The monitored parameters were including pH, saline, As, Cd, Cr, Cu, Pb, Zn. Sampling time was from 14-16/9/2020 and 11/11/2020. The detail locations, results are included in appendix 2

The analyzed results compared with *QCVN 43:2015/BTNMT* show that the sediment quality is under the allowable standard. The sediment is not salty. The sediment quality in all sampling location on the Suoi Tre canal, is still good condition which can reuse for tree planting, or leveling purposes for other activities to reduce the demand of soil disposal

3.3. SOCIO-ECONOMIC CONDITIONS IN THE PROJECT AREAS

3.3.1. Economic conditions

Binh Duong Province is one of the fastest growths, the most dynamically developing industry of the country. It has high economic growth. In 2018, the total products of the province had increased by about 9%/year, GRDP is 130.8 mil.VND per capita. The average budget revenue increases by about 10% annually, of which the budget revenue in 2017 was 46,500 billion VND, the annual budget payment to the State is ranked 4th in the country (excluding royalties).

(1) Tan Uyen town

In recent years, Tan Uyen always keeps high growth. In 2019, the amount of industrial production and building of the town estimated at about 24,450 Bil.VND, increased 12.16% in comparison with 2018); the trading - service value estimated up 10,600 bil.VND; increased 20.7%; the production value of agriculture, forestry and fisheries estimated up 602 bil.VND, increased 1,01%. The total food product converted to rice is 14,027.1 tons. The annual crop acreage is about 6788 ha, perennials area is 3875.9 ha. Total cattle are 10,416 pigs, 885,279 poultry, 3607 buffalos, and cows. The aquaculture area is 85,9 ha, with a production estimated of 2133.5 tons.

The average income per capita of the town estimated at 110 mil.VND/year, increased 16.8% in comparison with 2018 (as per total GRDP is 132 Mil.VND/person/year, increased 10% in comparison with GRDP in 2018), achieved 100% as the Solution of the Town People Committee assigned. The total budget payment to the State in 2019 is 2,774 Mil.VND, of which, the new revenue is 1,796 Bil.VND. Total budget expenses in the year are 1,139 Bil.VND.

(2) Thuan An city

Thuan An is a central industrial town of Binh Duong, with 3 industrial areas is Viet-Singapore area (479.8 ha), Dong An area (138.7 ha), Viet Huong area (36 ha) and 02 industrial groups are Binh Chuan (69.43ha) and An Thanh (31.97ha). Total enterprises in the town area till early of 2019 is 5,470 companies, increased 1,042 companies in comparison with 2018. The economic structure of the town is restructuring to increase of service, at the end of 2015 with industry about 70.5%, with high growth. In which, the average value of industrial production achieves 10.54 trading, and service about 29.2%, agriculture about 0.3%. The total budget revenue in the area in 2019 is 4,039.21 Bil.VND, of which total state budget-balancing revenues 3,946.48 Bil.VND, total state budget expenditures are 1,57.3 Bil.VND.

- Industry: The industrial productions in the area in 2019 estimated achievement is 226,140 Bil.VND (fixed price in 2010), growth up 8 % over the same period. The industrial production of domestic companies increased 8%, foreign-invested units increased 8%.
- Trading, service: at the end of the year, there are 5 supermarkets, 4 trading centers in the town. In addition, there are some mobile phone Shops, convenience shops like the Green department store, Vinmart, etc. develops in many places in the town. In total, in the area have 27 markets, in which 2 markets are Lai Thieu and Bung are managed by the ward committee, 24 markets managed by private. The estimated total retails of goods and service revenue in 2019 are about 65,886 Bil.VND, growth up 21.6% in comparison with 2018.

- Agriculture: the planting area is 92.3 ha, the area of a perennial plant is 1,156.81 ha, cattle of 161 buffaloes, 10144 pigs, and 87500 ducks and chickens.

(3) Di An city

In 2019, the value of agriculture - trading, service - agriculture of Di An city has done respectively is 98,358 Bil.VND – 94,953 Bil.VND – 23.049 Bil.VND, equivalent to 100.24% - 100.18% - 100.2% year planning. The cultivated area is 82.78 ha (of which, the annual area is 41.34ha, the perennial area is 41.44 ha). Total pig cattle are 1493 pigs, 8463 poultries, 901 buffalos, and cows. The aquaculture area is 11.06 ha, productions of 25.29 tons.

The total new budget revenue is 3,293.289 Bil.VND, achieved 90.33%; Total state budget expenditures are 1,413.265 Bil.VND, achieved 109.32%. Besides that, the planning, management of building and investment to urban, technical infrastructure; land clearance and compensation, land acquisition for developing the projects, etc. and social policy is interested in timely, effectively. As per evaluation, for recent years, economy of Di Anh town had been developing continuously %/year; value of trading – service increases 36.4% average; the economic structure of the town is restructuring in accordance with the direction of industry - trading, service and agriculture.

3.3.2. Social conditions

(1) Population

The population of Binh Duong till the end of 2019 are approximate 2,504,384 people, with a population density of 900 people/km², in which Thuan An city is a locality with the highest density, accounting for 608,360 people; Di An city has 480,813 people, Tan Uyen town has 379,386 people.

Binh Duong is the 7th crowded province of the country, which the province with a high mechanically increased population, over 50% of the population in Binh Duong is migration. According to the statistical data, the population in Binh Duong Province in 1999 was over 716,000 people; in 2009 over 1,482,000 people; and in 2019 about 2,504,384 people; the population increase of the period of 1999-2009 is 7,54%; 2009-2019 is 5,05%. The population forecast to the year 2030 is about 3,500,000 people with the average population increase is about 3.4%.

Tan Uyen town

Tan Uyen town with an area is about 192,5 km², and the population in April of 2019 is 379,386 people. The administration units contain 12 wards with the administrative center of the town locates in the Uyen Hung ward. Over the town has 217 poor households, accounting for 0.83% total population in the area; 128 near-poor households, accounting for 0.49% resident of the local. In the year 2019 had arranged occupation for about 15,695 laborers.

In the area of the Tan Uyen WWTP and in downstream of Suoi Tre canal, belonging to the land of 47 households are agricultural-doing households (growing rice, harvest, grapefruit, oranges, etc.) with the average income is about 11,250,000 VND/person/year.

Thuan An city

Thuan An city with a total natural area is about 83.71 km^2, with the average population in 2019 are 608,360 people, the average population density is 7,210 people/km^2. Thuan An city has 10 commune-leveled administrative units, including 9 wards: An Phu, An Thanh, Binh Chuan, Binh Hoa, Binh Nham, Hung Dinh, Lai Thieu, Thuan Giao, Vinh Phu, and An Son commune. The town has 1,273 poor households and 454 near-poor households.

Di An city

Di An city in the south of Binh Duong Province, has 7 administrative units including wards: An Binh, Binh An, Binh Thang, Di An, Dong Hoa, Tan Binh, Tan Dong Hiep. Di An city has an area of 60.10 km². The population of Di An city in April of 2019 is 480,413 people (about 157,198 households), the average population is 8002 people/km2. The average population increase in 2009-2019 is 4.69% year, the population outside the town is 316,629 people, accounting for 65.9%. Now the town still has 357 poor households and 234 near-poor households. In the year 2019, has arranged occupation for 2186 laborers, training career for 172 rural laborers.

(2) Education

Tan Uyen town

Having 12/12 communes and wards have been keeping and satisfying standard for anti-illiteracy, universal primary education, universal secondary education and satisfying the standard for high school. The rate of pupils finishing the primary school achieved 100%, regarding the secondary school level, class 9 achieved 89.6%; high school achieved 98.76%; graduated education achieved a rating of 78.51%. The town has 26/37 schools achieved the national standard, accounting for 70.27% numbers of public schools in the area, including nursery school are 08 schools, the primary school are 11 schools, the secondary schools are 06 schools and high school is 01 school).

Thuan An city

The city has 10/10 communes and wards have achieved standard for anti-illiteracy, universal primary education, universal secondary education and for high school. In the school year of 2019- 2020, over the education sector had prepared timely about infrastructure for the school year opening day according to the regulations. The town has raised up fast about mechanically increased population. Every year always has pupils from other locality coming, therefore the demand for school, class, and teachers increases day after day.

The rate of class -5 pupils had finished the primary program achieved 100 %, the rate of pupils who graduated the secondary school achieved 96.71%, the rate of pupils who graduated the high school achieved 98.14%. Total schools that satisfied the national school are 37/55, accounting for 67.27%.

Di An city

The city has 7/7 wards certified achieving the standard for anti-illiteracy, universal primary education. Over the city has 42 public schools, in which 33 schools are certified achieving national school (account for 78.5%) with 2855 officials. Total pupils at all levels are 72,278 pupils. Besides the public schools, the locality also has 219 private nursery groups, nursery schools, with 23,888 children.

(3) Medical sectors

Tan Uyen town

Over the town has 01 medical center; 02 local general clinics; 10 clinics managed by the State; 01 general hospital; 06 private clinics; 73 medical practice shops and 332 private pharmacy practice shops. It is basic to satisfy the demand on healthcare for people in the town;

The programs about national targets on medical carried out have achieved in comparison with the planning; the rate of children under 5 years who are malnutrition is accounting for 2.65%,

reduced 0.3% in comparison with the previous year; continue to keep 100% commune medical stations having doctor; over the town have 12/12 communes, and wards achieved the national criteria on medical.

The frequent diseases are dengue (715 cases); the hand - foot - mouth disease (420 cases); measles (260 cases), pandemic flu as AH5N1, AH7N9. In addition, there is appeared cases of chemical poisoning through the air (196 cases).

Di An city

The city has 1 general hospital with 80 hospital beds, 11 general clinics, 50 specialized clinics, 7 traditional medicine clinics, 6 maternity homes, and 16 medical service points. The wards also have medical stations, all medical stations have doctors. The quality of healthcare examination is step by step better, the effectiveness of treatment is improved. In addition, Di An city has 90 private medical facilities, where activates quite effectively, contribute to protection for community healthcare. In the year has examined and treated for 264,090 disease cases, treated timely for 328 outbreaks of dengue fever. The number of children having vaccination fully achieved 96.26%, the children from 18 to 24 months have injected preventing measles-rubella achieving 75%.

The frequent diseases are dengue (1986 cases); the hand - foot - mouth disease (1494 cases); chicken pot (269 cases).

(4) Traffic accident, explosion, order security, and society

Tan Uyen town

The violates about order security, society still happens with 94 cases, society's vices like gambling, prostitution, drugs… still happening in the area. In the year also happened 30 cases of serious traffic accidents in the wards of Uyen Hung, Khanh Binh, Thai Hoa, Tan Vinh Hiep, Vinh Tan, Thanh Hoi, and Phu Chanh. It happened 126 the fires (in which, 13 big fires) caused damages to assets. Happened 5 drowning cases in the locality in the wards of Tan Hiep, Thanh Hoi, Uyen Hung, Tan Vinh Hiep causing damage to humans.

Thuan An city

The violates about order security, society still happens with 96 cases, society's vices like gambling, prostitution, drugs… still happening in the area. In the year also happened 402 cases of serious traffic accidents, caused damages to assets and humans. Happened 5 the fires, caused damage to assets in the city area.

Di An city

The propaganda of traffic order in the locality is paid attention, contributing to improving the awareness of traffic law of people. Increasing overcoming many roads and signal boards in order to ensure safety. The wards are frequently to deploy reminding households to execute the traffic law, do not trade and encroach on the road, etc. The roads happen traffic accidents frequently like National road 1A, PR 743 road, national road 1K, the industrial areas, inter-urban roads, rails. In the locality happened traffic accidents which account for the high rate are Di An, Tan Dong Hiep. The rest wards account for a less rate.

(5) Ethnic issues

Over the province has 24 ethnic groups, with a total population of 6,694 households, accounting for 28,266 people. The most crowded is the Kinh group, accounting for 97% population; the ethnic groups like Hoa accounting for 2.07%; Khmer group accounting for 0.21%; the Tay, the Cham, the Muong, the Nung, the Stieng, etc. accounting for 0.72%. The

ethnic minority (EM) are almost live interleaving with the Kinh overall the province area, especially two the ethnic minority living concentrated is the Cham in the hamlet Hoa Loc, Minh Hoa commune, Dau Tieng district and the Hoa ethnic living in the Thu Dau Mot city, Thuan An city and Dau Tieng district.

Almost EMs lives by producing small handicraft production, service trading, agricultural production. Some people are staff, officials, teachers. On average, each EM household uses 306.50 m^2 residential land and 2.32 ha cultivated land. The educational level of EMs is increased. Over the province has 293 ethnic minority people who had graduated from the professional intermediate level, 321 people have the college level and 583 people have the university level.

To support the EMs holding the State regulations, every year, the province has organized the courses on propaganda, dissemination of law, attracting over 8,000 EM people joining. Organize the training courses for planting, feeding rubber trees, cashew, pepper, cassava, livestock, and poultry, etc. in order to help ethnic people increase income from agricultural activities, improves and upgrades the living quality.

For poor and near-poor households, the Province had done many policies for unsecured loans such as loaning for production and business, loaning for investment on rural freshwater structures, loaning for changing traffic vehicles, loaning for studying.

Parallel with support to direct conditions for people, the province still has been investing projects, programs supporting productions such as Phuoc Hoa irrigation structure, Dau Tieng district, rural roads, electricity system, post, and Telecommunication till to commune; opening the job training course (take latex from rubber trees, cooking, take care of ornamental plants, haircut - curling…); instructing agricultural technique, supporting materials and technology to people developing agriculture stably durably.

The construction area of sluiceway, extending the capacity of the Di An and Thuan An WWTPs has not to do a land acquisition. The construction area of Tan Uyen WWTP, drainage channel in downstream of Tre stream, pumping station has not any EM households affected by land acquisition.

3.4. INFRUSTRUCTURE CONDITIONS

3.4.1. Traffic and transportation conditions

(1) Tan Uyen town

At present, Tan Uyen town has 2 kinds of transportation: road and waterway.

The traffic system in the town area contains 04 provincial roads (PR 742, PR 746, PR 747 A, PR 747B) with a length of 62.25km, asphalted 100%; 21 district road with a length of 74.62km, had asphalted 80% and 756 commune roads with the length of 435km, harnessing 100%.

The Dong Nai waterway passing through Tan Uyen town with a length of 18 km is the national waterway, achieved the class-3 standard.

(2) Thuan An city

Thuan-An city area has national road No 13 passing through (about 13 km), 4 province roads are PR745 (with a length of 9.7km), PR743B (with a length of 3.3km), PR746 (with a length of 4.5 km), PR743 (with a length of 15km), My Phuoc- Tan Van road (with a length of 6.7 km), and the road HL9 with a length of 5.4 km

National road No.13 is the main traffic axis in the overall socio-economic province of Binh Duong which connect to the Southeastern provinces and the Central Highlands, the section running through Thuan An is about 13 km long, 35- 40m, the traffic volume is very high.

PR746 connects with national road No. 13 to connect Di An city with Tan Uyen town, about 20 meters wide, with heavy traffic on the section of My Phuoc - Tan Van road to Thuan An with Thu Dau Mot, Ben Cat town, Di An city, is an important traffic axis, 30m wide road, crowded traffic.

PR743B road connects Thuan An city with Di An, connects with National road No.1K, forming a traffic axis connecting Thuan An districts in Binh Duong province and other provinces / cities (Dong Nai, Ho Chi Minh). Road is 25 m wide, heavy traffic volume.

The water transport route on Sai Gon river passing through the Tan Uyen town is about 13.3 km.

(3) Di An city

The traffic system in the area is quite developed, the inter-roads connecting to the province roads form the various traffic system, convenient for people to travel and transport goods.

Road: Di An city has 3 national roads passing through with a total length of 12.97 km is the national road No.1A, the Asian Highway and the NR No. 1K. The NR No. 1K connecting Bien Hoa – Di An city – Thu Duc (HCM city), the part passing through the Di An city has a total length of 5.7km, with 4 lanes. This is an important road in transporting materials and goods for the projects.

The NR No. 1A (avenue Hanoi – Bien Hoa) is the most important road of the Southern, connecting Southern to other regions in the country, passing through the southeast corner of the Di An city with a total length of 3.8 km from Dong Nai to the National University. Now there are 4 lanes with a high traffic flow.

The province road PR 743 raises from the intersection Tan Van (National road 1A) with National road No 1A, Tan Dong Hiep ward – Thuan An – Thu Dau Mot with a total length of 13 km. The road surface is paved asphalt on the 9-11 m width. This road has the wastewater collection channels going along. This is the central road, connecting from Binh Duong port to the NRNo.1A, into the center of the town. It has a big significance in the socio-economic development of the Di An city as well as Binh Duong province. The part passing through the Di An city is divided into many zigzag parts. Due to road segments have different building forms, some parts have fee collection, meanwhile other parts have no.

Almost roads in the residential area with a small road boundary (3 - 5 m), with weak quality, missing the drainage/supply water systems. The new residential areas have the roads 8-12m wide, with walk-side and built with high quality. Many parts had been investing with the road bases is higher than houses, so the drainage of rainfall for residential houses is quite difficult. Have too many road junctions which opposite of each other, cause the traffic to quite complex, less traffic safety.

Rail: The North-South rail route now passes through Di An city to HCM city. The part passing through the town has a total length of 9km, on this part has the Song Than general station and Di An passenger station. In addition, there is an internal rail of Di An wagon factory going from Di An to the factory with total length of 1.5km. The rail routes at present cause difficulty in road traffic of Di An city due to the rail passing through many roads which with a higher and higher flow of passenger and vehicle day after day.

Riverway: Riverway, channel-way in Di An is about 7.5km. The Dong Nai river passing through Di An with a width of 200m and 1km long now uses being the ports, harbors with Binh Duong port (DASO) and harbors for wooden products, building materials, etc. These ports, harbors lay on 2 sides of the Dong Nai bridge, so very convenient for the road-waterway combination. However, on both sides of the bridge, the vehicle flow is quite high, so caused stuck frequently. The Binh Duong port is the container port specialized. The ground of the port is overload about the warehouse now.

3.4.2. Water supply condition

The capacity of water supply over Binh Duong Province is 460,000 m^3/day. The surface water treatment in Sai Gon and Dong Nai rivers is operating to supply water for consumers, the plants use the groundwater source as the back-up when needed. 99.62% of people living in urban area can access to clean water

Table 3.7.Current water supply capacity of water systems

No.	Name of plants	Capacity *(m^3/day)*	Scope of supply	Water source
1	Di An Water Supply Enterprise	200,000	- Di An city and Thuan An city area - Binh Duong province. - Part of Thu Dau Mot City - Binh Duong province. - And some neighborhoods.	Dong Nai river water
2	Complex Area Water Supply Enterprise	150,000	- The whole Binh Duong New City and the Industry - Service - Urban Complex Area of Binh Duong. - Ben Cat Town area - Binh Duong province. - And some neighborhoods.	Dong Nai river Water
3	Thu Dau Mot Water Supply Enterprise	35,000	- Thu Dau Mot City area - Binh Duong province. - Part of Thuan An City - Binh Duong Province. - And some neighborhoods.	Sai Gon river water
4	Tan Uyen Water Supply Enterprise	20,000	- The area of Tan Uyen Town and Bac Tan Uyen district –Binh Duong province. - And some neighborhoods.	Dong Nai river water
5	Bau Bang Water Supply Enterprise	30,000	- Bau Bang district - Binh Duong province. - And the surrounding areas.	Phuoc Hoa irrigation reservoir water
6	Chon Thanh Water Supply Branch	20,000	- Chon Thanh district area - Binh Phuoc province - And some neighborhoods	Phuoc Hoa irrigation reservoir water
7	Dau Tieng water plant	2,000	- Dau Tieng district area - Binh Duong province. - And some neighborhoods.	Ground water

No.	Name of plants	Capacity *(m³/day)*	Scope of supply	Water source
8	Phuoc Vinh water plant	3,000	- Phu Giao district area - Binh Duong province. - And some neighborhoods	Giai spring water

Therefore, in the past years, the clean water quantity in the Binh Duong province is developed strongly, since 2010, the quantity of water supply in the prince area is 132,901 m³/day-night, then up to 2019, then the quantity of water supply is 425.116 m³/day-night, the rate of growth achieved 24%/year.

3.4.3. Solid waste collection and treatment

Domestic solid waste

Binh Duong has 80 garbage trucks with capacity from 4 -15 ton, and 05 hook lifts (in which having 15 tanks); 03 transit stations and 01 closed pressing station. Besides the waste collection units of companies/public enterprises, to collect domestic waste from households. The province has about 50 private waste-collection groups and about 70 waste-collection units, which collect waste from organizations, manufacturing - trading facilities. The solid collection rate has achieved 90%.

Binh Duong has currently invested the Nam Binh Duong solid waste treatment Complex Area with 08 burry holes, with a total area of 25.9 ha, the receiving capacity of 416,000 tons/hole; 01 compost production chance with the capacity of 1000 tons, in which making compost about 420 tons, burying 520 tons and recycling about 60 tons (mainly is plastic). The recycling rate of domestic solid waste has achieved 48%, help to mitigate burry or open burning of waste. The complex Area put into operating since 2004, and its capacity will be estimated to fulfill by the year of 2030.

Hazardous waste and industrial waste

Based on the synthetic data, Binh Duong discharges about 5,280 tons of industrial solid waste every day, of which 342 tons is hazardous waste. Recyclable waste shares 65% total generated waste.

The collection, transportation of industrial and hazardous waste is quite complex. There are about 250 units to collect solid industrial waste, which including units owning practice certificate on hazardous waste management; the units trading scrap materials (who are the most difficult objects) and some manufacturing units (collecting some special waste like paper, plastic serving for manufacturing demand of the units). In 250 units aforesaid, 63% units h locates in the province area, the rest locates in the adjacent areas like Ho Chi Minh City, Dong Nai, Binh Phuoc, Long An, and Ba Ria Vung Tau. Currently, 100% industrial and hazardous solid waste is collected and treated.

There are 48 units who have the practice certificate on other hazardous waste management, of which there are 12 units having office locates in the province area, the rest comes from adjacent areas like Ho Chi Minh City, Dong Nai, Binh Phuoc, Long An, Ba Ria Vung Tau, Tien Giang, Kien Giang and Tay Ninh.

The activities of industrial and hazardous solid waste treatment

Industrial solid waste which are re-usable, recycling is classified by owners and re-sell to the companies/waste trading facilities and sell out to other material manufacturers. Industrial

wastes that cannot be reused are now partly burned at the provincial solid waste treatment complex, hazardous waste treatment companies, partly transferred to industrial waste landfills in Dong Nai and Ba Ria - Vung Tau.

Binh Duong has 8 units registering for hazardous waste management, of which there are 2 units registering to treat the special hazardous waste (01 treating re-cycling acid-lead battery and 01 unit washing and recycling drums); the rest 06 units registering to treat much waste with the popular usage technology in Vietnam includes burring technology, light bulb treatment, re-cycling battery, washing drums, recycling solvent, recycling viscous, harnessing, etc. of which total capacity of furnace in the province area achieved 263.6 tons/day. Specially, the Nam Binh Duong solid waste treatment Complex Area (with area of 75 ha, now expanding up to 100 ha) has invested many machines, equipment, and achieves capacity to treat normal waste is 356.8 tons/day; the capacity of treating hazardous waste achieves 135 tons/day; the safety burry hole for hazardous waste; the industrial and hazardous waste furnace with approximate 220 tons/day and invested into the recycling-brick manufacturing chance from non-hazardous silt and waste ash with the capacity of 120,000 pcs of burnt brick/day and 1,000 m^2 unburnt self-paving bricks/day.

3.4.4. Electricity supply status

The electricity supply is the national grid through the 220/110 kV station. The commercial electricity productions are enough to serve for domestic and manufacture. The average commercial electricity per capita about 4,695 kWh/year, the rate of people using electricity achieved 99.93%. The province has invested the public illumination system; step by step underground lighting electricity system on a number of main axes and main streets in Binh Duong Industrial - Service - Urban Complex. The centralized inter-urban road is 100% illuminated, applied new technology to save electricity.

3.4.5. Status of drainage, collecting and treating urban wastewater[9]

Status of rainy drainage system:

The status of rainy drainage system in Binh Duong province now are basically satisfied with the building investment in urban area, mainly concentrates in the main areas namely Thu Dau Mot city, Thuan An city, Di An city. The new administration area of Binh Duong city and the residential area which built basically. However, these systems have not been designed for whole system, just only for local and small scale under each small-scale project, leading to the situation in some areas. local inundation when there is heavy rain. Some sluiceways are built according to the traffic project, have not followed the master planning that leading to the dimensions, the depth level of sluices is not suitable, have not collected rainy water from small basin discharged out. The same is the intersection 550 and provincial road PR.743, some parts on the road PR.741 or road PR.744.

The new urban planning area have invested completely the infrastructure, however, there are many the drainage systems outside have not been invested according to the planning. Therefore, still happened submerged locally or rainy water flowed over on the road.

For some other areas like Dau Tieng town, and Tan Uyen town, the drainage systems have not invested much. Now only some main roads have the sluiceways. The remaining are mainly without drainage system the run-off flows over on the terrain and infiltrated by itself.

[9]FS report, 2020.

For some industrial zones, in basically, now within the boundary of industrial zones have invested the complete drainage system, however, the connection system for runoff drainage to outside then has not invested completely yet.

Status of collection and treatment system for wastewater:

At present, there are 4 systems of collection and treatment for waste water have come to operation in Thu Dau Mot city, Di An city, Thuan An city and the adjacent area between Tan Uyen (Thai Hoa ward) - Thuan An (Binh Chuan ward and An Phu ward) have the collection and treatment system of wastewater with the kinds of separate-formed drainage. The other area of Binh Duong province has not the separate drainage system, and directly discharge to river or canals.

The Thuan An city WWTP: serves for treating domestic water in the Thuan An city, includes 340,798.5 m of D110-1000 sewer pipes. This is the area having many industrial areas so concentrating many labors. After 3 operation years (until June 2019), the average operation capacity is about 10,000 m3/day (accounting for 57% the design capacity), and the rate of connection about 27% with 5,190 consumers/total 19,500 connection boxes. The sewer collection system covers in Lai Thieu, An Phu, Binh Hoa commune, part of Thuan Giao and Vinh Phu areas. According to the current connection progress, Thuan An WWTP is forecasted to operate at full capacity by the year of 2023, so it is necessary to consider increasing the processing capacity of the plant in the period of 2021-2025 to meet the demand. sewage treatment bridges in the region

The Di An city WWTP: serves for treating domestic water in the Di An city, includes 306,580m of D110-1200 sewer pipes. This is the area having many industrial areas so concentrating many labors. After 1.5 operation years (until June 2019), the average operation capacity is about 8,500 m3/day (accounting for 42.5% the design capacity), and the rate of connection about 10% with 5,309 consumers/total 26,000 connection boxes. The sewer collection system covers Di An, An Binh, Tan Dong Hiep and Dong Hoa wards. According to the current connection progress, Di An WWTP is forecasted to operate at full capacity by the year of 2023-2024, it is necessary to consider increasing the processing capacity of the plant in the period of 2021-2025 to meet the regional wastewater treatment needs.

Tan Uyen town area: Only Thai Hoa commune has a domestic wastewater collection and treatment network with a capacity of 15,000 m^3 / day and night, with 36.8 km of D200-D600 pipe. In other areas, there are no systems to collect and treat wastewater, wastewater discharges directly to receiving sources of rivers, streams or self-infiltration.

The industrial areas have the separate industrial wastewater collection and treatment systems before discharging into the receiving source.

3.5. EXISTING ENVIRONMENTAL AND SOCIAL CONDITIONS INTHE PROJECT AREA

3.5.1. Tan Uyen town

a) Tan Uyen WWTP

The area of Tan Uyen WWTP locates in zone 3, Uyen Hung ward, Tan Uyen town, with area of 9.7 ha, surrounded by road DR425 (on the North), Tre stream (the West, Southwest), and other agricultural areas (Figure 3.5). The road DH425 bordered with the expansion plant is the 7-10m in width and is an access road for the plant construction. In the southeast and northwest, there are 04 small irrigation drains with the depth of about 1.0 m, width of 1.0 m,

irrigating for agricultural area at and nearby the plant location. Among those, two drains locate outside the project area and will not be acquired or leveled. The other two drains leading water in the area of acquisition will be filled, but because this land will be acquired for WWTP, there is no agricultural production activities so there is no need to rebuild these branches. The Suoi Tre canal runs nearby the Southwest area of the plant, with the width varied from 2 – 10 m, with the natural soil bank, on both banks mainly is agricultural area.

The area of the Tan Uyen WWTP is the inundate area, about 2.0m lower than the road DR425, The area of the Tan Uyen WWTP is the inundate area, about 2.0m lower than the road DR425, inclined toward the Tre stream. The final discharge point of Tan Uyen WWTP to Suoi Tre canal is about 600 m distant to Dong Nai river. No other sensitive receptor is observed at the site

b) Suoi Tre canal

The downstream of Suoi Tre canal rehabilitated under the project has the length of 1.3 km. It is located in the area of zones 3 and 8 in Uyen Hung ward; with the starting point intersects with PR746; and the end point intersects with Dong Nai river (Figure 3.5). It is the main drainage canal covering an area of 1,108 ha, belonging to Uyen Hung ward, and will receive the treated wastewater from the proposed Tan Uyen WWTP. The water level in the stream is low with a high turbidity.

This downstream is the existing agricultural area, inundated with low elevation with 2.0 m, running along the agricultural area proposed for construction of the Tan Uyen WWTP. At the intersection with PR746, the stream has the width from 2-3 m, and it becomes wider and has the width of about 5-10 m at the intersection with Dong Nai river. The land area at the two sides of Suoi Tre are low. Therefore, when having a big rain, the area will be flooded, and water then drains to the Dong Nai river.

The main area of Suoi Tre canal is annual and perennial crops planted by some households such as bamboo, banana, tram, and rice. At the end part of Suoi Tre canal, there are 03 households at the address 195C, group 3, zone 8. These three HHs built their house nearby the Suoi Tre canal (20 m), might affected by bad smell, or affected safety during construction time.

The downstream area of Suoi Tre canal will be improved becoming to the drainage channel with the width of 14.5 to 16 m, concreting on both sides with the width of 3m.

There are not any other sensitive structures around Suoi Tre canal. The access road to the site is existing road PR746 and DR425.

c) The wastewater collection routes

- The sewer system along the PR 747 through Uyen Hung, Khanh Binh, Thanh Phuoc, Hoi Nghia ward; PR 746 through Uyen Hung, Khanh Binh, Tan Hiep, Tan Phuoc Khanh, Tan Vinh Hiep ward, a part of PR746B(Tan Lap ward), PR742(Vinh Tan ward):

This is the part with a high traffic density, residents living along two sides, the surface is paved asphalt, with the width from 12 to 25 m. Both sides have technical infrastructures like drainage system, electrical system.

- The sewer pipes along Nguyen Khuyen and Nguyen Tri Phuong road (Tan Hiep ward), To Vinh Dien, Vo Thị Sau road (Tan Phuoc Khanh ward), Le Quang Dinh, Trinh Hoai Duc road (Khanh Binh ward) and other traffic road connecting other ward/communes:

These are the area with small road with 5-10 m width, no pavements. The residential area lives along two sides. Along the road have many business points, offices and some companies, small factories

The sensitive structure and locations: 22 schools, 04 markets, 03 clinic centers, 09 temple/churches/ pagodas (Appendix 6)

Figure 3.5. Location of the WWTP and surrounding objects.

Figure 3.6. The location map of Suoi Tre canal and surrounding structures

3.5.2. Di An city

(a) Di An WWTP

The expansion unit of Di An WWTP is located in in the premise of the existing Di An WWTP, addressed at No.39 – Road No.10, Dong An street block, Tan Dong Hiep ward– Di An city- Binh Duong province. Area of new construction is around 4393 m^2. The Di An

WWTP is near the North-South rail in the North, near the Tan Dong Hiep quarry in the East, in the South and West near the Dong An residential area. The shortest distance from the structures of the plant to the Dong An residential area is about 50.0 m.

The access road to the plant is My Phuoc – Tan Van road, coming into the road inside the Dong An residential area then to the plant. This route has a crowded traffic density. The roads in the Dong An residential area to the plant have been already paved with asphalt, with a width of 4.0m. At present the residents are living, the route is quite good, the traffic density is less.

There are no sensitive structures in the project area.

Figure 3.7. Di An WWTP and surrounding objects.

(b) The sewer system

- The sewer along the NR1A, PR743A (Binh Thang, Binh An wards):

These areas include roads from 10-50m wide. The surface is paved asphalt. The road is crowded, the traffic flow is density. The traffic jam happens frequently, especially in the peak hours.

- The sewer system is along Nguyen Thi Tuoi, Pham Van Dieu, Bui Thi Xuan, Huynh Thi Tuoi streets (Tan Binh ward), Binh Thung (Binh An ward), Le Trong Tan, An Binh, Tran Thi Vung, Ho Tung Mau, Be Van Dan, Nguyen Dinh Thi (An Binh ward), and inter traffic roads in Dong Hoa Binh Thang wards:

The roads are without hard separators, the residential area is crowded along two sides, the traffic density is quite high. The road is paved asphalt, 5-10m width.

The sensitive points 21 schools, 3 market, 18 temples/pagodas.

3.5.3. Thuan An city

(a) Thuan An WWTP

The additional unit of Thuan An WWTP is constructed in the land area located in the premise of the existing Thuan An WWTP, on the national road No.13, Vinh Phu ward, Thuan An city, Binh Duong Province. Area of new construction is around 6327 m^2. The Thuan An WWTP is

near the Vinh Binh channel in the North, near the Ong Bo channel and Rach Mieu bridge in the East, in the South near the residential area No.135, and in the West near the Nam Long residential area. The shortest distance from the structures of the plant to the Nam Long residential area is about 50.0 m.

The position of the plant is near the Sai Gon river (is the receiving source of wastewater), nearby the Mieu bridge channel, which is the discharge point of the plant to the Sai Gon River. The Rach Mieu bridge is about 30.0 m wide, and the Vinh Binh channel is about 45.0m, with much water hyacinth.

The access road to the plant is national road No.13. This road has a crowded traffic density. There are no sensitive structures in the project area.

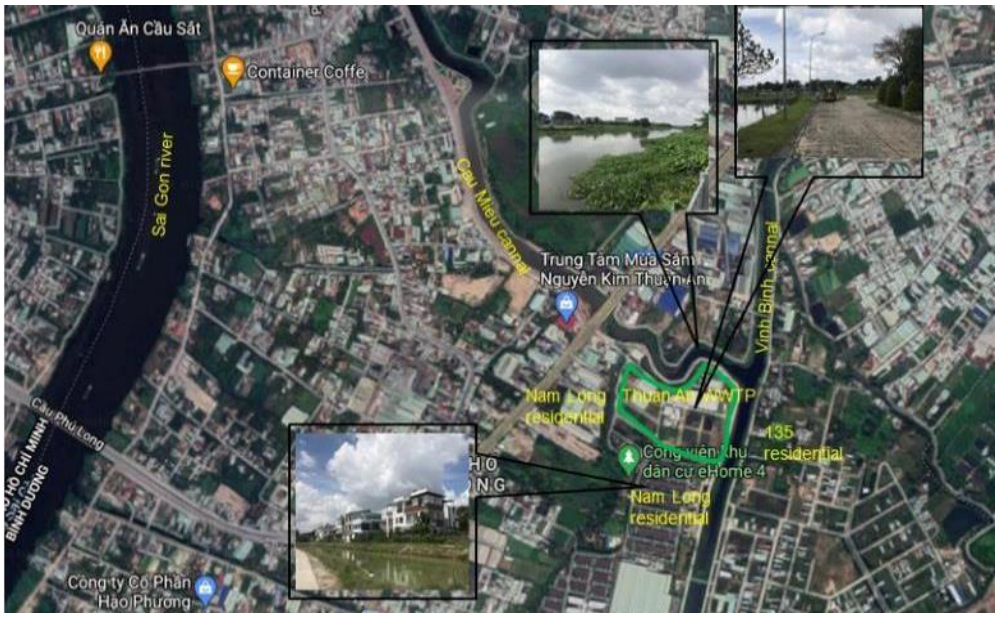


Figure 3.8. Thuan An WWTP and surrounding structures.

(b) The sluiceway collecting wastewater

The sluiceNR13: the high traffic density, the resident concentrated on both sides. The road is paved asphalt, 30-35m wide. There are some technical infrastructures like drainage system, electrical system in both two sides.

The sewer system collecting wastewater located along the streets of Nguyen Chi Thanh, Nguyen Huu Canh road, Cau Tau, Binh Nham 07, Binh Nham 04, Binh Nham 02, The road along the Sai Gon river, August Revolution road (Binh Nham Hung Dinh wards): The road is with a width from 8-10m, less traffic, little residential density. Almost the road is paved asphalt, excepting some parts along the Sai Gon riverbanks are still earth road. The environmental condition is rather good.

Sewer system along the branch roads in Vinh Phu ward is small, about 3.0m wide, crowded residents, medium traffic density.

The sensitive structures and locations on the route:6 schools, 01 monastery, 3 temples/pagodas/ soil-grave (Figure 3.15).

3.6. CULTURAL RESOURCES

3.6.1. Physical cultural structures

Binh Duong owns about 175 pagodas and monastery, 112 village temples and hundreds of religious beliefs, worship places.

At present, Binh Duong has 54 classified-culture historical sites, of which 12 national-level sites and 42 provincial-level sites with many various kinds and diverse like history, art-architecture, archeology, and landscapes. These culture sites are archaeological sites Cu Lao Rua, My Loc, Doc Chua (Tan Uyen), Ba Lua archaeological site (Thu Dau Mot) Ba Ky bay (Ben Cat), Phu Long temple (Lai Thieu), Tan An temple, Phu Cuong temple (Thu Dau Mot), Long Hung temple, Tan Trach temple (Tan Uyen); Hung Long Pagoda, Long Tho pagoda, Long Hung pagoda, Hoi Khanh pagoda, Chau Thoi pagoda. In addition, Binh Duong has a famous revolutionary stronghold like the War zone D, the War zone Long Nguyen, Iron Triangle, Thuan An Hoa, and the most famous is Phu Loi prison built by Ngo Dinh Diem and American imperialism in 1957.

However, these monuments and works are far from the construction sites of the project items (about from 5 to 30km).There are no cultural resources in the project area.

3.6.2. Intangible cultural resources

Through the time establishing villages, producing, and fight for national liberation have formed many special festivals like festivals for dedicating the temple, pagodas, temples, craft ancestors, family. The dedications are the time for people praying for the peaceful village, prosperous country, and lush crops, as well as denoting the people's hearts to an ancestor with meritorious in building, protecting country home, and on the traditional on remembering about their origin.

In addition, Binh Duong also has festivals associated with the local monuments, belief bases such as the Ong Bon festival, Ky Yen festival, the procession festival in Thien Hau pagoda. In which, the Ba pagoda festival yearly in the middle of January, the lunar calendar is typical, that many people enthusiastically participating. The festivals are the important parts, bringing back the specialties about culture in Binh Duong.

- The Ba Thien Hau pagoda festival is not only people in Binh Duong known but also well known by people in other regions. It locates in Thu Dau Mot city, the pagoda is established by the Chinese in the 19th century. This is the temple to worship Thien Hau Thanh Mau. The festival is organized on 14th and 15th January (lunar calendar).
- The Mieu Ong Bon festival, organized two times for worshiping yearly, in the spring is on the 2nd January, and in the Autumn on the 4th July, lunar calendar. The Mieu Ong festival is associated with the ancestor who doing a cup and bowl. They respect their immigration places, set up a temple to take the name of the Land God (Ong Bon) in general, and worship the Saints who protect their profession. In Binh Duong, might name out some Palaces worshiping Ong Bon of the Vuong family such as *Phuoc Vo temple,* which located in Chanh Nghia ward, Thu Dau Mot city, was built in 1885; *Ngoc Hu Cung* locates in Lai Thieu town, was built in 1971s; *Phuoc Tho Duong* locates in Hung Dinh commune, Thuan An city or *Phuoc Nghia Duong* locates in Tan Phuoc Khanh Ward, Tan Uyen town.
- Ky Yen Festival: the temples in Binh Duong Province always have a big and secondary Ky Yen festival yearly, which means pray for peace, called for Tutelary

God, or Ong God. This is the most important festival of the year. It is lengthened from1.5 to 3 days. Ky Yen Festival is usually to organize on 12 or 13, or 16, when the moon days.

Other intangible cultural works such as the Lacquerware profession in Tuong Binh Hiep ward, Thu Dau Mot city, Binh Duong province is the national intangible cultural heritage, Amateur Music in Binh Duong and some northern provinces which recognized a Cultural Heritage by the UNESCO...

However, there is no intangible and tangible cultural heritage within the area of influence of the project.

3.7. THE SENSITIVE STRUCTURES

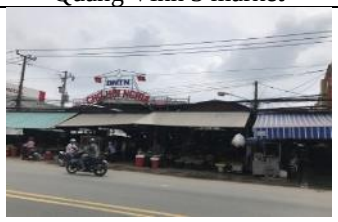
There are several sensitive structures located near the project are. However, none of them is impacted by land acquisition. The detail description of each structure is showed in Table 3.8.

Table 3.8. Typical works around the recommended items

Index	Name of works/pictures	Dist. to the site (m)	Description
Tan Uyen town			
1	 Huynh Van Nghe high school	10 m	Nearby the road PR747 (Uyen Hung ward), next to sewer pipes, The total number of classes is 22. The school has about 45 teachers, with over 700 students Open schedule from Monday to Saturday, from 6h:30 – 7h 30, to 11 -12h and 17h The distance to the site: 10 m to the wall of school
2	 Le Thi Trung secondary school	10-20 m	Nearby the road PR747 (Uyen Hung ward) next to sewer pipes The total number of classes is 26. The school has about 60 teachers, with over 950 students Open schedule from Monday to Saturday, from 6h:30 – 7h 30, to 11 -12h and 17h The distance to the site: 10-20 m to the wall of school
3	 Uyen Hung B primary school	10-20 m	Nearby the road PR746B (Uyen Hung ward) next to sewer pipes The total number of classes is 24. The school has about 35 teachers, with over 500 students Open schedule from Monday to Saturday, from 6h:30 – 7h 30, to 11 -12h and 17h The distance to the site: 10-20 m
4		10 m	Close to the Nguyen Khuyen street (Tan Hiep ward) next to sewer pipes The total number of classes is 22. The school has about 33 teachers, with over 450 students Open schedule from Monday to Saturday, from 6h:30 – 7h 30, to 11 -12h and 17h The distance to the site: 10 m to the wall of school

	Tan Hiep primary school		
5	 Tan Hiep secondary school	30 m	Close to the Nguyen Khuyen street (Tan Hiep ward) next to sewer pipes The total number of classes is 32. The school has about 55 teachers, with over 950 students Open schedule from Monday to Saturday, from 6h:30 – 7h 30, to 11 -12h and 17h The distance to the site: 30 m to the wall of school
6	 Chuon Chuon Ot kindergarten	20 m	Close to the road DR409 (Tan Hiep ward) next to sewer pipes The total number of classes is 8. The school has about 24 teachers, with about 220 babies Open schedule from Monday to Saturday, and from 6h:30; 7h 30, to 11 -12h and 17h The distance to the site: 20 m to the wall of school
7	 Khanh Binh primary school	10-20 m	Close to the road DR418 (Khanh Binh ward) next to sewer pipes, and The total number of classes is 28. The school has about 50 teachers, with over 870 students Open schedule from Monday to Saturday, from 6h:30 – 7h 30, to 11 -12h and 17h The distance to the site: 10-20 m to the wall of school
8	 Khanh Binh secondary school	5-10 m	Close to To Vinh Dien street (Tan Phuoc Khanh ward) next to sewer pipes The total number of classes is 24. The school has about 55 teachers, with over 680 students Open schedule from Monday to Saturday, from 6h:30 – 7h 30, to 11 -12h and 17h The distance to site: 5-10 m to the wall of school
9	 Tan Phuoc Khanh B primary school	5-10 m	Close to Vo Thi Sau street (Tan Phuoc Khanh ward) next to sewer pipes The total number of classes is 24. The school has about 60 teachers, with over 850 students Open schedule from Monday to Saturday, from 6h:30 – 7h 30, to 11 -12h and 17h The distance to the site: 5-10 m to the wall of school
10	 Tan Phuoc Khanh secondary school	5-10 m	Close to Ly Tu Trong street (Tan Phuoc Khanh ward) next to sewer pipes The total number of classes is 27. The school has about 65 teachers, with over 750 students Open schedule from Monday to Saturday, from 6h:30 – 7h 30, to 11 -12h and 17h The distance to the site: 5-10 m to the wall of school

11	 Tan Phuoc Khanh A primary school	5-10 m	Close to DR405 (Tan Vinh Hiep ward) next to sewer pipes The total number of classes is 24. The school has about 60 teachers, with over 850 students Open schedule from Monday to Saturday, from 6h:30 – 7h 30, to 11 -12h and 17h The distance to the site: 5-10 m to the wall of school
12	 Nguyen Quoc Phu secondary school	10-20 m	Close to HL405 (Tan Vinh Hiep ward) next to sewer pipes The total number of classes is 27. The school has about 60 teachers, with over 700 students Open schedule from Monday to Saturday, from 6h:30 – 7h 30, to 11 -12h and 17h
13	 Tan Vinh Hiep B primary school	5-10 m	Close to To Vinh Dien street (Tan Phuoc Khanh ward) next to sewer pipes The total number of classes is 24. The school has about 55 teachers, with over 680 students Open schedule from Monday to Saturday, from 6h:30 – 7h 30, to 11 -12h and 17h The distance to the site: 5-10 m to the wall of school
14	 Tan Vinh Hiep A primary school	20 m	The distance to the site: 10m to the wall of school Nearby the road PR746 (Tan Vinh Hiep ward) next to sewer pipes The total number of classes is 30. The school has about 70 teachers, with over 850 students Open schedule from Monday to Saturday, from 6h:30 – 7h 30, to 11 -12h and 17h The distance to the site: 20m to the wall of school
15	 Phu Chanh primary school	5-10 m	Nearby the road PR742 (Phu Chanh commune) next to sewer pipes The total number of classes is 24. The school has about 58 teachers, with over 7650 students Open schedule from Monday to Saturday, from 6h:30 – 7h 30, to 11 -12h and 17h The distance to the site: 5-10 m to the wall of school
16	 Hoa Huong Duong kindergarten	5-10 m	Close to the road Khanh Binh 05 (Khanh Binh ward) next to sewer pipes The total number of classes is 15. The school has about 65 teachers, with over 450 students Open schedule from Monday to Saturday, from 6h:30 – 7h 30, to 11 -12h and 17h The distance to the site: 5-10m to the wall of school

17	 Khanh Binh kindergarten	5-10 m	Close to Le Quang Dinh street (Khanh Binh ward) next to sewer pipes The total number of classes is 15. The school has about 65 teachers, with over 450 students Open schedule from Monday to Saturday, from 6h:30 – 7h 30, to 11 -12h and 17h The distance to the site: 5-10 m to the wall of school
18	 Baby world kindergarten	5-10 m	Close to the road Ly Tu Trong (Tan Phuoc Khanh ward) next to sewer pipes. Open schedule from Monday to Saturday, from 6h:30 – 7h 30, to 11 -12h and 17h The distance to the site: 5-10 m to the wall of school
19	 Quang Vinh 3 market	25 m	Nearby the road PR747 (Hoi Nghia commune) next to sewer pipes Open schedule everyday from 7h-17h Many shops around the market gates People concentrate much in the early morning, before lunch and diner The distance to the site: 25 m to the wall
20	 Hoi Nghia market	5-10 m	Nearby the road PR747 (Hoi Nghia commune) next to sewer pipes Open schedule everyday from 7h-17h Many shops around the market gates People concentrate much in the early morning, before lunch and diner The distance to the site: 5-10 m to the wall
21	 Tan Hiep market	5-10 m	Close to the road HL409 (Tan Hiep ward) next to sewer pipes Open schedule everyday from 7h-17h Many shops around the market gates People concentrate much in the early morning, before lunch and diner The distance to the site: 5-10 m to the wall
22	 Khanh Binh market	5-10 m	Close to the road Le Quang Dinh (Khanh Binh ward) next to sewer pipes Open schedule everyday from 7h-17h Many shops around the market gates People concentrate much in the early morning, before lunch and diner The distance to the site: 5-10 m to the wall
23	 Tan Uyen town medical center	20-25 m	Nearby the road PR747 (Uyen Hung ward) next to sewer pipes Open schedule everyday from 7h-17h It is about 10000m^2 With about 87 beds, 200 doctors and staffs The distance to the site: 20-25 m to the wall

24	 Hoi Nghia medical station	20 m	Nearby the road PR747 (Hoi Nghia commune) next to sewer pipes Open schedule everyday about 20 m from the construction site Small scale at commune level, with treat simple disease case
25	 Tan Hiep medical station	10-15m	Close to the road Nguyen Khuyen (Tan Hiep ward) next to sewer pipes, and Open schedule everyday about 10-15 m from the construction site Small scale at commune level, with treat simple disease case
26	 Buu Lien pagoda	5-10 m	Nearby the road PR746B (Hoi Nghia) next to sewer pipes Open schedule depends on the special days The people only visit during weekend or special holiday, the visitors only stay there in short time about 5-10 m from the construction site
27	 Ky Hoan pagoda	5-10 m	Close to the road HL418 (Khanh Binh ward) next to sewer pipes, Open schedule depends on the special days The people only visit during weekend or special holiday, the visitors only stay there in short time about 5-10 m from the construction site
28	 Hoi Nghia parish church	40 m	Nearby the road PR746B (Hoi Nghia) next to sewer pipes Open schedule depends on the special days ; it takes at 6h45 (from Monday to Friday), at 17h (Saturday) and 19h (Sunday) The people only visit during weekend or special holiday, the visitors only stay there in short time about 40 m from the construction site
29	 Ben San church	10-15 m	Nearby the road PR746 (Tan Hiep ward) next to sewer pipes, and Open schedule depends on the holidays it takes at 6h45 (from Monday to Friday), at 17h (Saturday) and 19h (Sunday) about 10-15 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
30	 Binh Hoa temple	5-10 m	Close to Nguyen Huu Canh road (Uyen Hung ward), next to sewer pipes about 5-10 m from the construction site Open schedule depends on the special days The people only visit during weekend or special holiday, the visitors only stay there in short time

31	 Binh Chanh temple	5-10 m	Nearby the road PR747 (Khanh Binh ward), next to sewer pipes about 5-10 m from the construction site Open schedule depends on the special days The people only visit during weekend or special holiday, the visitors only stay there in short time
32	 Loi Loc temple	5-10 m	Close to the road To Vinh Dien (Tan Phuoc Khanh ward), next to sewer pipe Open schedule depends on the special days about 5-10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
33	 Ngoc Khanh monastery	5-10 m	Close to the road Ly Tu Trong (Tan Phuoc Khanh ward)), next to sewer pipes. about 5-10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
34	 Martyrs cemetery	10-20 m	Nearby the road PR747 (Khanh Binh ward) next to sewer pipes. The people only visit during special holiday, the visitors only stay there in short time The distance to the site: 10-20 m to the wall
35	 Tin Tin nursery group	5-10 m	Nearby the road PR747 (Khanh Binh ward) next to sewer pipes. The people only visit during special holiday, the visitors only stay there in short time The distance to the site: 5-10 m to the wall
Di An city			
36	 Tan Binh secondary school	10-15 m	Close to Nguyen Thi Tuoi street (Tan Binh ward) next to sewer pipes The total number of classes is 32. The school has about 55 teachers, with over 950 students Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17 More than 10 m from the construction site
37	 Doan Thi Diem primary school	5-10 m	Close to Binh Thung street(Binh An ward) next to sewer pipes The total number of classes is 24. The school has about 45 teachers, with over 480 students Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h 5-10 m from the construction site

38	 Binh An high school	10-20 m	Close to Binh Thung street (Binh An ward) next to sewer pipes The total number of classes is 34. The school has about 65 teachers, with over 1200 students Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h about 10-20 m from the construction site
39	 Binh An secondary school	40 m	Nearby the road PR743A (Binh An ward) next to sewer pipes The total number of classes is 30. The school has about 50 teachers, with over 770 students Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h about 40 m from the construction site
40	 Binh Thang secondary school	10-15 m	Close to the alley on the road 30 April (Binh Thang ward) next to sewer pipes The total number of classes is 28. The school has about 60 teachers, with over 680 students Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h about 10-15 m from the construction site
41	 Bui Thi Xuan primary school	5-10 m	Close to the road Bui Thi Xuan (Tan Binh ward) next to sewer pipes, and The total number of classes is 10. The school has about 20 teachers, with over 350 students Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h about 5-10 m from the construction site
42	 Tan Binh primary school	5-10 m	Close to the road Nguyen Thi Minh Khai (Tan Binh ward) next to sewer pipes, The total number of classes is 30. The school has about 95 teachers, with over 980 students Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h about 5-10 m from the construction site
43	 Hoa Sen Do nursery school	5-10 m	Close to the road Bui Thi Xuan (Tan Binh ward) next to sewer pipes, The total number of classes is 9. The school has about 25 teachers, with over 250 babies Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h about 5-10 m from the construction site
44	 Mam Xanh nursery school	5-10 m	Close to the road Binh Thung (Binh An ward) next to sewer pipes, Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h The distance to the site: 5-10 m to the wall

45	 Tuoi Tien 2kindergarten	5-10 m	Close to the road Bui Thi Xuan (Tan Binh ward) next to sewer pipes Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h about 5- 10 m from the construction site
46	 Hoa Thien Phu kindergarten	30 m	Located near the sluiceway across the district road in Tan Binh ward next to sewer pipes, Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h about 30 m from the construction site
47	 Sao Mai kindergarten	5-10 m	Close to the road Nguyen Thi Tuoi (Tan Binh ward) next to sewer pipes Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h about 5- 10 m from the construction site
48	 Huong Ngoc Lan kindergarten	5-10 m	Close to the road Tan Thieu (Tan Binh ward) next to sewer pipes Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h about 5- 10 m from the construction site
49	 Anh Binh Minh kindergarten	5-10 m	Close to the road Nguyen Thi Minh Khai(Tan Binh ward) next to sewer pipes Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h about 5- 10 m from the construction site
50	 Anh Cau Vong kindergarten	60 m	Nearby the sluiceway on the road Huynh Thi Tuoi (Tan Binh ward next to sewer pipes Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h about 60 m from the construction site
51	 Hoa Sen kindergarten	5-10m	Close to the road Dao Su Tich (Binh Thang ward) next to sewer pipes. Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h about 5- 10 m from the construction site

52	 Bup Sen kindergarten	5-10 m	Close to the road Nguyen Dinh Chieu (X. Binh Thang) next to sewer pipes Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h about 5- 10 m from the construction site
53	 Sao Mai kindergarten	5-10 m	Close to the road To Vinh Dien (Dong Hoa ward) next to sewer pipes Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17 about 5- 10 m from the construction site
54	 Mimosa kindergarten	5-10 m	Close to the road An Binh (An Binh ward) next to sewer pipes Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h about 5- 10 m from the construction site
55	 Son Ca kindergarten	5-10 m	Close to the road An Binh (An Binh ward) next to sewer pipes Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h about 5- 10 m from the construction site
56	 Mai Vang kindergarten	5-10 m	Close to the road Be Van Dan (An Binh ward) next to sewer pipes Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h about 5- 10 m from the construction site
57	 Tan Binh market	10-15 m	Close to the road Bui Thi Xuan (Tan Binh ward) next to sewer pipes, Open schedule everyday from 7h-17h Many shops around the market gates People concentrate much in the early morning, before lunch and diner The distance to the site: 10-15 m to the wall
58	 Tan Lap market	5-10 m	Close to the road Tan Lap (Binh Thang ward) next to sewer pipes. Open schedule everyday from 7h-17h Many shops around the market gates People concentrate much in the early morning, before lunch and diner The distance to the site: 5-10 m to the wall

59	 Binh An market	5-10 m	Nearby the road PR743A (Binh An ward) next to sewer pipes, Open schedule everyday from 7-17 h The distance to the site: 5-10 m to the wall
60	 Thien Binh pagoda	5-10 m	Close to the road Bui Thi Xuan (Tan Binh ward) next to sewer pipes Open schedule depends on the special days about 5- 10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
61	 Co Linh pagoda	5-10 m	Close to the road 30 April (Binh Thang ward) next to sewer pipes Open schedule depends on the special days about 5-10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
62	 Phap Hanh Tung Lam pagoda	5-10 m	Close to the road Dao Su Tich (Binh Thang ward) next to sewer pipes Open schedule depends on the special days about 5-10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
63	 Duc Hoa pagoda	10-15 m	Nearby the protection road for the raw water pipe (X. Binh Thang) next to sewer pipes, Not require land acquisition Open schedule depends on the special days Open schedule depends on the special days about 10-15 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
64	 Huynh Mai pagoda	5-10 m	Nearby the protection road for the raw water pipe (X. Binh Thang) next to sewer pipes, Open schedule depends on the special days about 5-10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
65	 Phap Tri pagoda	5-10 m	Nearby the protection road for the raw water pipe (X. Binh Thang) next to sewer pipes, Open schedule depends on the special days about 5-10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time

66	 Truc Lam pagoda	5-10 m	Close to the road Tran Dai Nghia (Binh An ward) next to sewer pipes. Open schedule depends on the special days about 5-10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
67	 Tan Hung pagoda	5-10 m	Close to the road Tan Hoa (Dong Hoa ward) next to sewer pipes Open schedule depends on the special days about 5-10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
68	 Binh An temple	5-10 m	Nearby the road PR743A (Binh An ward) , next to sewer pipes Open schedule depends on the special days about 5-10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
69	 Temple of Phat Mau	5-10 m	Close to the road Bui Thi Xuan (Tan Binh ward), next to sewer pipes. Open schedule depends on the special days about 5-10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
70	 Tan Quy temple	5-10 m	Close to the road Tan Hoa (Dong Hoa ward), next to sewer pipes Open schedule depends on the special days about 5-10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
71	 Binh Thang temple	5-10 m	Close to the road 30 April (Binh Thang ward), next to sewer pipes Not require land acquisition Open schedule depends on the special days about 5-10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
72	 Trung Buu temple	5-10 m	Nearby the protection road for the raw water pipe (Dong Hoa ward), next to sewer pipes Open schedule depends on the special days about 5-10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time

73	 Binh Duong temple	5-10 m	Close to the road Be Van Dan (An Binh ward), next to sewer pipes Open schedule depends on the special days about 5-10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
74	 Nghia Son church	50 m	Nearby the sluiceway on the QL1A (Binh Thang ward), next to sewer pipes Open schedule depends on the special days about 50 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
75	 Grave cemetery	5-10 m	Close to the alley on the road 30 April (Binh Thang ward), next to sewer pipes Open schedule depends on the special days about 5-10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
76	 Worship hall Dao Su Tich	5-10 m	Close to the road Dao Su Tich (Binh Thang ward), next to sewer pipes Not require land acquisition Open schedule depends on the special days about 5-10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
77	 Ngu Hanh Tan Hoa shrine	5-10 m	Close to the road To Vinh Dien (Dong Hoa ward), next to sewer pipes Not require land acquisition Open schedule depends on the special days about 5-10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
Thuan An city			
78	 Binh Nham primary school	10-15 m	Close to the road August revolution (close to Binh Nham 04) (Binh Nham ward) next to sewer pipes, The total number of classes is 30. The school has about 95 teachers, with over 980 students Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h about 10-15 m from the construction site
79	 Hoa Cuc 2 kindergarten	30 m	August revolution (Binh Nham ward) next to sewer pipes. The total number of classes is 16. The school has about 95 teachers, with over 450 students Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h about 30 m from the construction site

80	 Hoa Mai 2 kindergarten	5-10 m	Close to the road Cau Tau (Hung Dinh ward) next to sewer pipes, The total number of classes is 12. The school has about 65 teachers, with over300 students Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h about 5-10 m from the construction site
81	 Hoa Cuc 6 kindergarten	5-10 m	Close to QL13 (Vinh Phu ward) next to sewer pipes, Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h The distance to the site: 5-10 m to the wall
82	 Hoa Cuc 8 kindergarten	5-10 m	Close to QL13 (Vinh Phu ward) next to sewer pipes Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h The distance to the site: 5-10 m to the wall
83	 Vinh Phu 17A kindergarten	5-10m	Close to Vinh Phu alley 17A (Vinh Phu ward) next to sewer pipes Open schedule from Monday to Saturday, and from 6h:30 – 7h 30, to 11 -12h and 17h The distance to the site: 5-10m to the wall
84	 Ngoc Minh monastic	5-10 m	Close to QL13 (Vinh Phu ward) next to sewer pipes Open schedule depends on the special days about 5-10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
85	 Phuoc Loc Tho pagoda	5-10 m	Close to the road August revolution (close to Binh Nham 04) (Binh Nham ward) next to sewer pipes Open schedule depends on the special days about 5-10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time
86	 Bung parish church	60m	Nearby the sluiceway Nguyen Huu Canh road (Hung Dinh ward), next to sewer pipes, Open schedule depends on the special days about 60 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time

87	 Quach Lam soil-grave	5-10 m	Close to Vinh Phu alley 17A (Vinh Phu ward next to sewer pipes, Open schedule depends on the special days about 5-10 m from the construction site The people only visit during weekend or special holiday, the visitors only stay there in short time

CHAPTER 4. ANALYSIS OF ALTERNATIVES

The proposed project contributes to achieve the objectives of provincial development plans and in line with the regional development plans/policies, including:

i) Decision No. 187/2007/QĐ-TTg dated 3/12/2007 of Prime Minister on approving the scheme on environmental protection in the basin of Dong Nai river system up to 2020 which require about 70% of the urban areas along Dong Nai river will be facilitated by the WWTPs;

ii) Implementing the Environmental Protection Action Plan of Binh Duong Province period from 2016-2020 which focuses on construction and upgrade the wastewater treatment facilities in Thu Dau Mot cities, Thuan An, Di An and Tan Uyen urban areas;

iii) Support to implement the General Urban Planning Project of Binh Duong province to 2020 and a vision to 2030 stated in the Decision No. 1701/QĐ-UBND dated 26/6/2012 of Binh Duong PPC; and

Support to implement the Adjustment of Vietnam urban and industrial drainage orientation to 2025 and a vision to 2050 under Decision No 589/QĐ-TTg dated 06/04/2016 of Prime Minister, which requires the secondary urban areas such as Di An and Thuan An need to achieve target of collection and treatment of 50% of total urban domestic wastewater volume and the third grade urban area as Tan Uyen need to collect and treat about 20% of its urban domestic wastewater.

During the impact assessment for the project, the analysis of alternatives is an important stage in the process of environmental and social assessment. This analysis activity includes the description, identification and comparison of design alternatives which are important to support the decision-making choice of construction activities in the Project area. Accordingly, the selected activity is expected to be the fewest and lowest negative impacts while meeting feasible technical solutions and cost-benefits applied for the project. Further, alternative analysis practice will also minimize adverse impacts and maximize positive impacts in terms of environmental and social aspects.

The results of analyses are presented below.

4.1. "WITHOUT PROJECT" ALTERNATIVE

The Region and City-wide Analysis for the Binh Duong Water Environment Improvement Project have been taken to verify that the selected project components represented the priority urban infrastructures for improvement in the city and region. The analysis criteria comprised: (i) inclusion in Provincial/City Development Plans; (ii) living condition improvement; (iii) meet the future demand of urban expansion; (iv) Accessibility to urban services; (iv) Specific Environmental impacts/benefits; (v) Enhance the Climate change adaptation capacity and vi) reduce the pollutant pressure to the importance water courses (Dong Nai and Sai Gon rivers).

Background of alternative analyses for "With the Project" and "Without the Project"

- Binh Duong Province has 2.4 million people and is the seventh largest populated province in Vietnam. And about 77.2% of Binh Duong population lives in urban areas, more than double the national average of 31.3%, due to fast economic growth and high rates of immigration.
- Urbanization has grown 41.4% in the 2014-18 period compared to a national urban

growth of 9.8%. The province is an employment hub for the region that attracts many immigrant workers for its thriving industrial economy. Then wastewater generation is increasing rapidly with its continued rates of urbanization. But currently the wastewater collection and treatment capacity are only able to meet 50% of the current total wastewater treatment demand.

- Besides, domestic wastewater generated from cities and towns are discharged into the Dong Nai river and Sai Gon river with limited or no treatment. The total BOD5 total load directly discharged to Dong Nai River and Sai Gon River is estimated as 46 ton/day[10], which may create negative impacts for downstream water intake purposes. In this extend, the impacts could be separated for the wide region and long-term consequences.

If the project is not implemented, Binh Duong Province will face the challenges of inadequate urban sewerage infrastructures, water pollution, conflicts on water management and water use purposes, sanitation issues as the results of population growth and urbanization progress. It is estimated that about 60,000m^3 of urban wastewaters will be discharged directly to environment daily without any treatment, together the with storm run-off water finally reach to the Saigon and Dong Nai rivers that supply water to millions of inhabitants of Binh Duong, Dong Nai provinces and Ho Chi Minh city. And the untreated wastewaters could generate many serious sanitation, public health issues, which are also the sources of many types of waterborne communicable diseases.

Table 4.1 describes in more details the comparison between the "with" and "without" project options.

Table 4.1. Analysis of "With" or "Without" the Project

Environmental and Social Considerations	WITHOUT PROJECT	WITH PROJECT
Environmental issues		
Water quality	About 60,000m^3/day of untreated domestic wastewater in Tan Uyen town, Di An and Thuan An cities will be directly discharged into water environment i.e. Dong Nai river and Sai Gon river, contributing to degraded water quality of these water sources and threatening security of downstream water use.	Minor impacts by the construction activities. These impacts are assessed to be temporary and manageable. About 60,000m^3/day of domestic wastewater will be collected and treated to meet the allowable national regulations of QCVN 14-2008/BTNMT (column A). This will help reduce pollutant load to receiving water bodies of Dong Nai and Sai Gon rivers and help ensure water security on the downstream of these rivers.
Air quality	Air environment would become worse due to bad odor from generated wastewater Environmental pollutions and infectious diseases would not be improved, but more serious timely; affecting on living quality of the local	Domestic wastewaters will be collected, leading to reduction of malodor emission in the urban areas. Air pollutions during the construction phase due to excavation, levelling and material transport activities will be depending on localities and times

[10] Feasibility study report of the project

Environmental and Social Considerations	WITHOUT PROJECT	WITH PROJECT
	residents.	ranging from low to moderate. But these will be temporary, localized and could be mitigated There will be malodor emission around the WWTPs during operation phase. However, it could be minimized and controlled by applying reasonable technologies and management methods.
Solid wastes	No impacts	There will be moderate amounts of domestic and construction solid wastes generated during construction phase. Operation phase will generate moderate amounts of sludge wastes from WWTPs, pump stations and manholes. Depending on the monitored quality, these solid waste amounts would be used for growing trees, ground levelling or treated at the Nam Binh Duong solid waste treatment site.
Drainage capacity and flooding reduction	Flooding situation could occur in the riparian areas of Suoi Tre canal	Improvement (widening and embankment) for 1.2 km downstream of Suoi Tre canal could help to reduce the flooding situation for riparian lands along Suoi Tre canal.
Social Issues		
Conflict on water use purposes	The water of Saigon and Dong Nai rivers is being used as raw water sources for water supply serving millions of inhabitants in Binh Duong, Dong Nai provinces and Ho Chi Minh city. Without the project interventions, there are about 60,000 m^3/day of untreated domestic wastewaters additionally discharged into the rivers. This may be an important reason causing the increase in conflict of water use purpose at downstream of the rivers.	Reduce the conflict of water use purpose at the downstream areas. The construction/upgrading of WWTPs to treat about 60,000 m^3/day of domestic wastewaters will contribute to reduction of pollution discharged to Dong Nai and Sai Son Rivers and enhance the water quality at downstream section of the rivers.
Urban infrastructure and services	Inadequate wastewater treatment in the second-grade urban areas of Di An and Thuan An and the third-grade urban area of Tan Uyen Insufficient wastewater collection system/services provided for a larger number of people in Thuan An, Di An cities and Tan Uyen town	The project will provide the wastewater collection system to crowded areas in Tan Uyen, Thuan An and Di An, it is estimated that about 54,000 households could have opportunity to access with the urban services. The collection network cover 9 wards in Tan Uyen town (Khanh Binh, Tan Hiep, Tan Phuoc Khanh, Hoi Nghia, Uyen Hung, Tan

Environmental and Social Considerations	WITHOUT PROJECT	WITH PROJECT
		Vinh Hiep, Thanh Phuoc, Phu Chanh, Vinh Tan), 3 wards in Thuan An city (Vinh Phu, Binh Nham and Hung Dinh), and 5 wards in Di An city (Binh An, Binh Thang, Tan Binh, Dong Hoa and An Binh). As the results from site survey, almost benefit communes are low-income areas or rapidly experiencing urbanization process, which have been facing with many environmental issues.
Land acquisition and resettlement	No land acquisition and involuntary resettlement required	The project would acquire about 992,360 m^2 of which 911,869 m^2 of agricultural land; 355m^2 of residential land; and 80,136 m^2 of the other land (such as transportation, irrigation and none-used).
Transport safety risk	No transport disturbance, congestion and risks of traffic safety during construction period	Transport disturbance, congestion and traffic safety will be increased, but it is very short time (only during construction phase) and could be managed through appropriate mitigation actions
Household accessibility and roadside business	Household accessibility and roadside business will not be affected	Household accessibility and roadside business will be affected, but it is very short time (only during construction phase) and could be managed through appropriate mitigation actions
Sanitation and public health	Sanitation and public health will be more serious as the consequence of discharge untreated wastewater to environmental	By providing the urban wastewater services for 54,000 households which could help to reduce surface water, soil, underground water pollution and resulted in improve sanitation and public health.

In conclusion, the proposed project will contribute to reducing environmental pollutions, contribute to the improvement of the water environment of Dong Nai and Saigon rivers, which are the main raw water sources of water supply for Binh Duong and other provinces, ensuring water security and complying with national/provincial environmental protection strategies/plans. The social and environmental impacts during the project implementation would be temporal, local and mitigatable.

4.2. "WITH PROJECT" ALTERNATIVE ANALYSES

4.2.1. Analysis of WWTP locations

The selected location of Tan Uyen WWTP was based on the approved General Construction of Nam Tan Uyen Master Plan to 2030, vision to 2050 (at Decision No. 186/QD-UBND dated July 13th, 2012 of the Binh Duong Provincial People's Committee). There were no other proposed options for the location of Tan Uyen WWTP to be analyzed.

Also, for Thuan An and Di An WWTPs, the project only proposes to upgrade capacity of the two existing WWTPs, which are currently under operation phase. The land areas proposed for construction of new upgrading items are free lands located within the boundaries of the WWTPs' site areas. No additional land acquisition is needed. Therefore, there were no other proposed options for the locations of Thuan An and Di An WWTPs to be analyzed.

4.2.2. Analysis of alternatives for wastewater treatment technology

Presently, there are many domestic wastewater treatment technology methods, the following methods were considered:

- Chain of biological lakes: To treat domestic wastewater to meet Column B standards; demand of land area is large because it has to build a chain of several lakes; simple operation with low cost.
- Biological filtration: To treat domestic wastewater to meet Column B standards; not able to treat nitrate (N); with relatively low operation cost.
- Traditional aerotank with activated sludge (CAS): Treated wastewater meets Column B standards; not able to treat nitrate (N); with moderate operation cost.
- Anaerobic sequencing batch reactor (ASBR): Treated wastewater meets Column A standards; able to treat nitrate (N) and phosphorus (P); with moderate operation cost.
- Circulating oxidation ditch (OD): Treated wastewater meets Column A standards; able to treat nitrate (N) and phosphorus (P); with moderate operation cost.

In the above methods, only the two later methods (ASBR and OD) may ensure the treated outputs meeting the Column A of QCVN 14:2008/BTNMT, the national standard for treated wastewater discharging into watercourse used for water supply purpose. These methods may meet the technical requirements of the project for the output treated wastewater to be discharged into the receiving Dong Nai and Saigon rivers, thus will be further considered to be analyzed.

The results of analysis on environmental, social, economic, technical aspects for these two options is shown in the table below:

Table 4.2. Comparison of technological options for wastewater treatment technology

No.	Comprised Indicators	Alternatives	
		Option 1: OD	**Option 2: ASBR**
I	**Technical and Economic considerations**		
1	Treated wastewaters output	Meet the QCVN 14:2008/BTNMT (Column A)	Meet the QCVN 14:2008/BTNMT (Column A)
2	Average fuel consumption	570 KWh (Higher)	340 KWh (Lower)
3	Operation and maintenance cost (estimated by K=1, in comparison with the most	(0.4-0.5)/1.0 (Higher)	(0.3-0.4)/1.0 (Lower)

No.	Comprised Indicators	Alternatives	
		Option 1: OD	**Option 2: ASBR**
	complicated technology - A2O[11])		
4	Investment cost (for treatment capacity of 20,000 m³/day)	Estimated 300 mil.VND/m³ (Higher)	Estimated 260 mil.VND/m³ (Lower)
II	**Environmental considerations**		
1	Compliance with the allowable discharging standards	Meet	Meet
2	Treatment efficiency	- P + N removal process is to be incorporated in the main process. System can be upgraded. - Treatment efficiency of COD, BOD5 and SS is high, ranging from 85 to 95%. - Volume of generated sludge is high	- P + N removal occurs naturally because of anaerobic and sedimentation treatment section. - Treatment efficiency of COD, BOD5 and SS is high, ranging from 85 to 95%. - Volume of arising sludge is medium
3	Possibility of odor control	Medium Odor control is more difficult than ASBR due to OD require the larger open surface of wastewater storage facilities	High Odor control is relatively good because the all facilities are closed with a roof, and odor control device will be installed
4	Requirement for primary treatment and adding chemical	No	No
5	Operation experience of the project's owner	Not yet	Solid experiences
III	**Social considerations**		
1	Land acquisition requirement	15 ha (Higher)	9.7 ha (Lower)
	RECOMMENDATION	**Not be selected**	**To be selected.**

Conclusion: Results of comparison in the above table show that the option-2 has more advantages than the option-1. In detail, the option 2 has smaller land acquisition, lower investment cost, lower operation cost, easier to control odor, using smaller energy, and especially familiar with project's owner (the two existing WWTPs also have the same technology process). Meanwhile, the remaining aspects also meet all the environmental protection requirements and project objectives. Therefore, ASBR technology is recommended to be selected option for the project.

[11]The estimation of operation and maintenance cost is calculated based on the operation of anaerobic-anoxic-oxic (A2O) wastewater treatment technology – Which is considered as the most complicated and treatment efficiency technology

4.2.3. Analysis of options for disinfection of treated wastewater

There are two technical options considered for disinfection of treated wastewater to QCVN 14:2008/BTNMT (Column A) before discharging to the receiving environment. The considered options are:

- **Option 1**: Using chemical substance (chlorine, chlorinate substance)
- **Option 2**: Applying the physical process (ultraviolet ray)

The effectiveness and environmental consideration of these option could be summarized in the below table:

Table 4.3. Comparison of disinfection options

Considered factors	**Option 1: Using chemical substance**	**Option 2: Applying the physical process**
Compliance with the QCVN 14:2008/ BTNMT	Compliance	Compliance
Requirement for primary treatment and adding chemical	Chlorine, chlorinate substances,	Not required chemicals, but applying ultraviolet ray (UV),
Environmental impacts	Negative impacts due to the treated wastewater may contain chlorinated residues and derivatives	No negative impacts
Applied condition	Normal application in many WWTPs	Normal application in many WWTPs
Selection options	**Not be selected**	**To be selected**

In conclusion, **option 2** is environmentally better, thus, it is selected for disinfection of treated wastewater.

4.2.4. Technical and technological options for embankment of Suoi Tre canal

Analysis of embankment structure: proposed technical structures are typical embankment for three options:

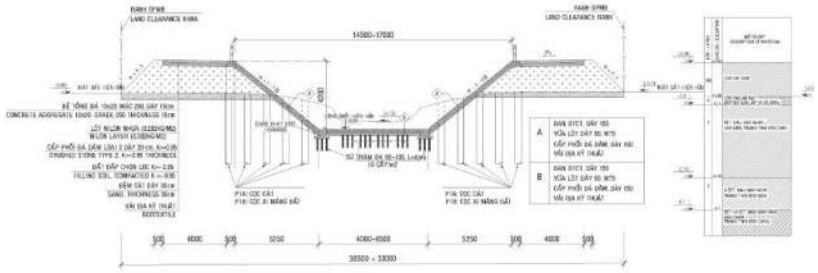
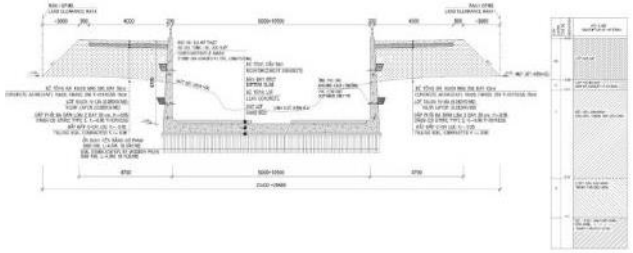
i) Option 1 - Concrete trapezoidal type, slope coefficient = 1.2 m reinforced with soil concrete piles,

ii) Option 2 - Concrete trapezoidal type, slope coefficient = 1.2 m, reinforced with concrete wall,

iii) Option 3 - Rectangular type – reinforced with concrete.

A description and alternative analysis of the technical, environmental, social and economic of Suoi Tre canal embankment is presented in the table below.

Table 4.4. Alternative analysis of Suoi Tre canal embankment

No.	Criteria	Option 1 Concrete trapezoidal type, slope coefficient=1.2 m, reinforced with soil concrete piles	Option 2 Concrete trapezoidal type, slope coefficient m= 1.2 m, reinforced with concrete wall	Option 3 Rectangular type – reinforced with concrete
	Technical and economic aspect			
1	Typical cross section			
2	Technical specifications	- Bottom= 4 ÷6,5 m, - Btop= 14,5 ÷17 m - Structure: Soil concreted reinforce pile	- Bottom= 4 ÷6,5 m, - Btop= 14,5 ÷17 m - Structure: Soil concreted reinforce wall	- Bstream= 8 ÷ 10,5 m - Structure: Concrete reinforce wall
3	Investment cost	168 Billion VND (7.28 million USD)	170 Billion VND (7.37 million USD)	169.8 Billion VND (7.36 million USD)
Social and Environmental consideration				
4	Drainage capacity	More efficiency both min and max water level	Meet requirement	Meet requirement
5	Land acquisition	2.74 ha	2.74 ha	2.04ha
6	Safety during operation	More safety	More safety	High risks of safety due to vertically slope of canal banks
RECOMMENDATION		**To be selected**	**Not be selected**	**Not be selected**

All three proposed options ensure the drainage capacity for the downstream of Suoi Tre canal. Among those, option 1 and 2 are safer as they both have the trapezoidal type for the canal. However, the option 1 is considered as the most optimization option with having lowest total investment cost, and highest drainage efficiency for both min and max water level as well as harmonizing with surrounding landscape. Therefore, the **option 1 is selected**.

CHAPTER 5. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

The chapter aims to qualitatively and quantitively identify potential impacts and risks on environment, society and human health during the project implementation; then accordingly, to propose appropriate mitigation measures for the project's negative impacts. The scope of the project's environmental and social impact assessment covers the interventions under the first component on "Expanding municipal services for wastewater and drainage management"

5.1. POTENTIAL POSITIVE IMPACTS

a) Supporting to implement the national, regional and provincial development plans

The proposed project supports to achieve the overall provincial development plans and in line with the regional development plans/policies, including:

- The scheme on environmental protection in the basin of Dong Nai river system approved by the Decision No. 187/2007/QĐ-TTg dated 3/12/2007 of Prime Minister, which require about 70% of the urban areas along Dong Nai river will be facilitated by the WWTPs;
- The Environmental protection action plans for Binh Duong province period from 2016-2020 which focus on construction and upgrade the wastewater treatment facilities in Thu Dau Mot cities, Thuan An, Di An and Tan Uyen urban areas;
- General development master plan of Binh Duong province to 2020 and a vision to 2030 stated in the Decision No. 1701/QĐ-UBND dated 26/6/2012 of Binh Duong PPC, which targeted about 70% of domestic wastewater will be collected and treated by the year of 2020 and oriented to 2030; and
- Adjustment of Vietnam urban and industrial drainage orientation to 2025 and a vision to 2050 under Decision No 589/QĐ-TTg dated 06/04/2016 of Prime Minister, which requires the second-grade urban areas such as Di An and Thuan An need to achieve target of collection and treatment of 50% of total urban domestic wastewater volume and the third grade urban area as Tan Uyen need to collect and treat about 20% of its urban domestic wastewater.

b) Improvement of sanitation, health and living conditions for local residents

The proposed project will provide wastewater collection systems to crowded areas in Tan Uyen, Thuan An and Di An. About 54,000 households could have opportunity to access the urban services. The drainage systems cover 9 communes in Tan Uyen town (Khanh Binh, Tan Hiep, Tan Phuoc Khanh, Hoi Nghia, Uyen Hung, Tan Vinh Hiep, Thanh Phuoc, Phu Chanh, Vinh Tan), 3 communes in Thuan An city (Vinh Phu, Binh Nham and Hung Dinh), and 5 communes in Di An city (Binh An, Binh Thang, Tan Binh, Dong Hoa and An Binh). As the results from site survey, almost benefit communes are low-income or rapidly urbanization, which have been facing with many environmental problems. Thus, collection of wastewaters at these communes could bring great public health improvement, reduce waterborne diseases for local people.

In addition, the improvement (widening and embankment) of 1.2 km downstream of Suoi Tre canal could help to reduce flooding for riparian lands along this canal.

c) Improvement of water quality and reduction of water use conflicts in downstream of Dong Nai and Saigon rivers

The waters of Saigon and Dong Nai rivers are being used as raw water sources for water supply to serve millions of inhabitants living in Binh Duong and Dong Nai provinces and Ho Chi Minh City. The proposed project will collect about 60,000 m^3/day of domestic wastewaters in Tan Uyen, Di An and Thuan An to treat meet the allowable national standards of QCVN 14:2008/BTNMT (Column A)[12]before discharging into the receiving water sources finally to Dong Nai and Saigon rivers. This will contribute to enhance the water quality at the downstream of these rivers.

5.2. TYPES AND SCALES OF POTENTIAL IMPACTS AND RISKS

A range of technical investigations was carried out for identified environmental issues to determine impacts that the project may have on characteristics of the surrounding environment for each project's components. Potential impacts were assessed according to the project phases including pre-construction, construction, and operation. Impacts from accidents or unforeseen circumstances were also identified. The nature of each type of impact will depend on the nature, extent and location of activities undertaken, and duration of these activities. Construction camps are semi-permanent and must be removed at the completion of construction phase. Types and scales of the project potential negative impacts are summarized in the table below.

[12]QCVN 14:2008/BTNMT is National technical regulation on domestic wastewaters – Column A regulates the allowable maximum values of pollutant concentrations contained in domestic wastewater to be discharged to receiving water sources which are used for domestic water supply purpose.

Table 5.1. Level of negative impacts from project implementation

Work items	Physical elements			Biological elements		Social elements				Others				Note
	Air, noise, vibration	Soil, water	Solid waste, dredged sludge	Forest, natural ecosystem	Fish, aquatic species	Land acquisition, resettlement	Native ethnic groups	Cultural resources	Livelihood, disturbance to residential community	Localized flooding, traffic, safety	Impacts from outside project area	UXO	Soil erosion	
TAN UYEN TOWN														
1. New construction of Tan Uyen WWTP - New construction of Tan Uyen WWTP with capacity of 20,000 m^3/day in Uyen Hung commune, Tan Uyen town, total area of 9.7 ha of agricultural land, 22 affected households, no household need to be relocated. Embankment elevation from 2.8 to 5.6 m. Unused excavation materials to be disposed are estimated of 40,959 m^3 **Sensitive impact receptors:** no receptors located within 300 m														
Preparation	M	L	L	N	N	M	N	N	M	M	N	M	M	Small and medium scale works with small and medium impacts
Construction	M	M	M	N	L	N	N	N	L	M	L	N	M	
Operation	M	L	M	N	L	N	N	N	L	N	L	N	N	
2. Sewer collection system Length= 25 km of D200-D600, provided connection to 2034 households and 250km of connection pipe, located on the existing roads/street with have high traffic volume and many roadside activities. Unused excavation material to be disposed 240,074 m^3														
Preparation	L	L	L	N	N	N	N	N	L	N	N	L	N	Small and medium scale works with small and medium impacts
Construction	M	M	M	N	N	L	N	L	M	M	M	N	M	
Operation	L	N	L	N	N	N	N	N	L	N	N	N	N	
3. Pumping station Number of pumping station: 12 stations, with operating capacity from 739 -48417 m^3/day, average area is 450 m^2. Acquired land is 3889 m^2 on the vacant land. Unused excavation material to be disposed 8190 m^3.														
Preparation	L	L	L	N	N	M	N	N	L	N	N	L	N	Small and medium scale works with small and medium impacts
Construction	L	L	L	N	L	N	N	N	L	M	M	N	M	
Operation	M	N	L	N	N	N	N	N	L	N	N	N	N	

Work items	Physical elements			Biological elements		Social elements				Others				Note
	Air, noise, vibration	Soil, water	Solid waste, dredged sludge	Forest, natural ecosystem	Fish, aquatic species	Land acquisition, resettlement	Native ethnic groups	Cultural resources	Livelihood, disturbance to residential community	Localized flooding, traffic, safety	Impacts from outside project area	UXO	Soil erosion	
4. Suoi Tre canal improvement L=1,130 m, drainage catchment is 1108 ha. Acquired land is 1,6ha, 29 household will be affected, Unused excavation material to be disposed: 66.105 m^3														
Preparation	L	L	N	N	N	M	N	N	M	N	N	M	N	Small and medium scale works with small and medium impacts
Construction	M	M	M	L	L	L	N	N	N	M	L	N	M	
Operation	N	N	N	N	L	N	N	N	N	N	N	N	L	
Di An City														
1.Expansion of the existing Di An WWTP - Expansion of the existing Di An WWTP to an additional capacity of20,000 m^3/day, located within the existing Di An WWTP, no land acquisition requirement, Unused excavation material to be disposed 22,650 m^3 **Sensitive impact receptors:** no receptors														
Preparation	L	L	L	N	N	N	N	N	N	M	N	N	N	Small and medium scale works with small and medium impacts
Construction	M	M	M	N	L	N	N	N	L	M	K	N	N	
Operation	M	L	M	N	L	N	N	N	L	N	L	N	N	
2. Sewer collection system in Di An and 04 pumping stations Length = 48 km of D200-D600 located on the existing roads/street with have high traffic volume and many roadside activities. Unused excavation material to be disposed 82015m^3														
Preparation	L	L	L	N	N	N	N	N	L	N	N	N	N	Small and medium scale works with small and medium impacts
Construction	M	M	M	N	L	N	N	L	M	M	M	N	M	
Operation	L	L	L	N	N	N	N	N	L	N	N	N	N	
III. Thuan An city														
1. Expansion of the existing Thuan An WWTP - Expansion of the existing Thuan An WWTP to an additional capacity of20,000 m^3/day, located within the existing Thuan An WWTP, no land acquisition requirement,														

Work items	Physical elements			Biological elements		Social elements				Others				Note
	Air, noise, vibration	Soil, water	Solid waste, dredged sludge	Forest, natural ecosystem	Fish, aquatic species	Land acquisition, resettlement	Native ethnic groups	Cultural resources	Livelihood, disturbance to residential community	Localized flooding, traffic, safety	Impacts from outside project area	UXO	Soil erosion	
Unused excavation material to be disposed 22,650 m^3 **Sensitive impact receptors:** no receptors														
Preparation	L	L	L	N	N	N	N	N	N	M	N	N	N	Small and medium scale works with small and medium impacts
Construction	M	M	M	N	L	N	N	L	L	M	N	N	N	
Operation	M	L	M	N	L	N	N	N	L	N	L	N	N	
2. Sewer collection system in Thuan An Length = 25 km of D200-D600 located on the existing roads/street with have high traffic volume and many roadside activities. Unused excavation material to be disposed 55.353m^3														
Preparation	L	L	L	N	N	N	N	N	L	N	N	N	N	Small and medium scale works with small and medium impacts
Construction	M	M	M	N	L	N	N	L	M	M	M	N	M	
Operation	L	L	L	N	N	N	N	N	L	N	N	N	N	
Notes: (1) The following criteria are used to assess the level of impacts: None (N) – No impacts; Low (L) – Small work, small impacts, localized, reversible, temporary; Medium (M) – Small works in sensitive/urban areas, medium-scale with medium impacts, reversible, able to be mitigated and managed, localized, temporary; High (H) – Medium-scale works in small sensitive/urban areas, large-scale works with significant impacts (social and/or environmental), many of which are irreversible and require compensation. Both M and H require monitoring and implementation of mitigation measures as well as an appropriate institutional capacity in terms of safety. (2) Most impacts of small and medium scale works are localized and temporary and can be mitigated through the application of technical solutions and good construction management practice with strict supervision, inspection and consultation with the local community.														

5.3. IMPACTS AND RISKS IN PRE-CONSTRUCTION PHASE

5.3.1. Impacts by land acquisition and resettlement

Scope of land acquisition

The project will permanently acquire about 128,270 m^2 lands, of which, 120,715 m^2 is agricultural land, 605m^2 is residential land and the remaining 6,950 m^2 is public land (including transportation land, irrigation land and other unused land) managed by Uyen Hung and Vinh Phu community people committees.

An estimated total area of temporary land acquisition during construction phase of the wastewater collection networks of the project will be about 700,070 m^2. These areas of temporary land acquisition will be primarily used for construction of access roads and gathering materials, and mainly public and unused lands, such as roads, irrigation lands, etc. The table below summarizes land types and areas acquired by the project.

Table 5.2. Summary of land acquisition by Binh Duong WEIP

No.	Investment item	Permanent acquisition land (m^2)				Temporary acquisition land (m^2)
		Total area	Residential land	Agricultural land	Public land	
1.1	Sewage collection system and sewage pumping stations	**4,270**	250	3,660	360	699,570
1.2	Tan Uyen WWTP	**97,000**	55	91,855	5,090	0
	Thuan An WWTP	**0**	0	0	0	0
	Di An WWTP	**0**	0	0	0	0
1.3	Dredging Suoi Tre canal	**27,000**	300	25,200	1,500	500
Total		**128,270**	**605**	**120,715**	**6,950**	**700,070**

Source: RAP report, 2020

Affected households

The permanent land acquisition will affect 94 households with 339 persons, of which 69 households will lose less than 20% (10% for vulnerable households) of their agricultural land. The number of severely affected households who will be acquired of 20% and 10% (for vulnerable households) or more of their productive land is 22 and 3, respectively. There are 07 vulnerable households affected by the project, of which 02 households are headed by a single woman with dependents; 01 is certified as poor household and 04 households are classified war invalids and families of martyrs by MOLISA. Among 25 severely affected households:

- 3 households will lose from 20% (10% for vulnerable households) to 30% of their productive land.

- 3 households will experience land loss of 30% to 70% of their productive land.
- 19 households will lose more than 70% of their total productive land.

Impacts on houses and structural works: Inventory of Losses (IOL) result shows that there are 7 AHs partially affected structures include temporary huts (used as animal shelters or equipment storage), B40 net fences, brick fences, drilled wells, plastic irrigation systems which are set up on agricultural land for agricultural production. However, no household has to demolish houses and/or relocate. There is no household belonging to an ethnic minority.

Impacts on trees and crops: There are 11,064 affected trees, including: 2,610 fruit trees (grapefruit, orange, tangerine, lemon, etc.); 8,374 timber trees (acacia auriculiformis, padauk, bamboo, etc.); 80 ornamental trees and about 77,592m^2 of crops affected by the project

Impacts on livelihood: There are about 25 severely affected households who will experience acquisition of 20% and 10% (for vulnerable households) or more of their productive land. The loss of a larger percentage of productive land may lead to change the livelihood and reduce household income. However, the impacts on livelihood are expected to be insignificant since some part of acquired agricultural land is vacant land, some areas are cultivated fruit trees, timber trees, Ornamental trees and crops of the households. Some households have built huts and other structures on their land to look after and serve crops.

To mitigate impacts from land acquisition, a Resettlement Action Plan (RAP) was prepared including compensation and support policies. All affected households will be compensated at replacement costs and severely affected HHs will be supported for livelihood restoration.

5.3.2. Risks related to unexploded ordnances (UXOs)

Binh Duong province as well as Vietnam national wide were bombed during the war. Most of the project areas have been much affected by human activities including extensive urban development, and UXOs have already been cleared. However, there can be remaining UXOs from the war time, which can be encountered during excavation. Consequences can be serious, causing injuries, losses of human life and assets in the project areas.

The investments in Tan Uyen i.e. Tan Uyen WWTP, Suoi Tre canal, several booster pumping stations, and collection pits will be implemented in the new locations which may be threatened by the risks of unexploded ordnances (UXOs). Meanwhile, the expansion of Thuan An and Di An WWTPs will be implemented within boundary of the existing WWTPs, where were already carried out the UXOs clearance before during the first phase construction of the WWTPs. Also, the wastewater collection pipes will be constructed on the existing traffic roads, thus UXOs clearance must be implemented before during construction of the roads. Therefore, it is evaluated that there is no risk of UXOs remained at the construction sites of Thuan An and Di An WWTPs and wastewater collection pipes. The UXO risk in the project area is assessed moderate.

5.4. IMPACTS AND RISKS IN CONSTRUCTION PHASE

5.4.1. Generic impacts and risks

a) Impacts on air quality

Impacts on air quality in the project area associated with the construction phase will include: i) dust from backfilling, excavation, transporting of construction materials; ii) emissions from equipment using gasoline, diesel, kerosene (e.g., NO_x, CO, SO_2, VOC).

Dust emitted from excavation and backfilling

Amounts of dust and other air pollutants generated by earthworks and operation of construction equipment is expected to generate a short-term and temporary increase in ambient dust. The amount of dust could be released from these activities depends on volume of material excavated, backfill, and also depends on the number of machines and trucks working on the site. The estimation of air pollutants from construction activates has been undertaken based on the emission factor and planned activities of the project.

Table 5.3. Emission coefficient from construction*(unit: g/m^3)*

No.	Pollution source	Emission co-efficient
1	Dust from soil excavation and backfill	1 - 100
2	Dust from material handling (sand, rock, etc.)	0.1 - 1
3	Dust from transportation of materials	0.1 - 1

(Source: WHO, 1993)

According to the estimated volumes of soil excavation and backfill to be carried out at the construction sites and construction period varies from 18 month to 24 months, the total volume and load of dust generated could be quantified as in the Table 5.4.

Table 5.4. Dust load from soil excavation and backfill activities

	Construction items	Excavated soil volume*	Filling soil volume*	Excavated and filling soil total*	Total dust volume emitted	Dust generated load
		(m^3)	*(m^3)*	*(m^3)*	*(kg)*	*(g/s)*
I	**Tan Uyen town**					
1.1	Sewer collection system	1,003,645	778,980	1,782,625	180,045,125	0.0724
1.2	Pumping stations	9740	998	10,738	1,084,538	0.0105
1.3	Construction of WWTP in Tan Uyen	40,925	295,235	336,160	33,952,160	0.0466
1.4	Suoi Tre canal	66,105	0	66,105	667,6605	0.0003
II	**Thuan An City**					
2.1	Expansion of sewer collection system	250,618	197,315	447,933	45,241,233	0.0182
2.2	Pumping stations	2460	267	2,727	275,427	0.0002
2.3	Expansion of Thuan An WWTP	27,680	4,953	32,633	3,295,933	0.0013
III	**Di An City**					
3.1	Expansion of sewer collection system	409,042	319,994	729,036	73,632,636	0.0296
3.2	Pumping stations	5,000	590	5,590	564,590	0.0054
3.3	Expansion of Di An WWTP	27,680	4,953	32,633	3,295,933	0.0013

(Source: FS, 2020).

Table 5.4 shows that the amount of dusts generated would be the most in Tan Uyen WWTP and along Tan Uyen sewer collection system construction site areas. This is due to new WWTP construction and large areas of sewer collection system coverage with large volumes of filling and excavation would take place under these construction items. Tan Uyen WWTP is located in the agricultural area, no sensitive receptor identified around the construction site. The construction site of Tan Uyen wastewater collection system is spread over a wide area of the town, with 97 km of primary and secondary pipelines and 212.5 km of D100-D150 tertiary pipe network. Therefore, the emission load at a certain location would be insignificant. Main affected objects will be households living along the construction roads, road users and on-site construction workers.

Dust and air pollutants from operation of construction equipment

According to the estimated number of construction machines to be mobilized and average truck times/day in each construction site as mentioned in Chapter1, and based on the norms of fuel consumption as stated in the Circular No. 11/2019/TT-BXD[13] dated on December 26th, 2019 of Ministry of Construction, and the emission factors[14] by WHO for combustion of diesel fuel, the total volume of dust and air pollutants emitted from operation of construction machines/equipment could be calculated in Table5.5.

Table 5.5. Pollutants from construction machine operation

Construction items	DO demand		Exhausted gases (ton)				
	Liter	Kg	CO	SO_2	NO_2	HC	Dust
Tan Uyen							
Construction of WWTP in Tan Uyen	3360	2890	80.9	115.6	158.95	34.68	0.347
Suoi Tre canal improvement	1480	1273	35.6	50.9	70.02	15.28	0.153
Sewer collection system	5460	4696	131.5	187.8	258.28	56.35	0.564
Pumping stations	460	396	11.1	15.8	21.78	4.75	0.048
Di An city							
Expansion of Di An WWTP	2240	1926	53.9	77.0	105.93	23.11	0.231
Expansion of sewer collection system	4210	3621	101.4	144.8	199.16	43.45	0.435
Pumping stations	230	198	5.5	7.9	10.89	2.38	0.024
Thuan An city							
Expansion of Thuan An WWTP	2240	1926	53.9	77.0	105.93	23.11	0.231
Expansion of sewer collection system	2780	2391	66.9	95.6	131.51	28.69	0.287
Pumping stations	180	155	4.3	115.6	158.95	34.68	0.347

According to total dust and gas emitted from construction equipment operation, the average

[13] Circular No. 11/2019/TT-BXD dated on December 26th, 2019 of the Ministry of Construction guides to identify the unit price of working shift of construction machines and equipment.

[14]With the assumption that fuel used is diesel, emission factors per ton of fuel from internal combustion engines are as follows: CO (28 kg); SO_2 (40 kg), NO_2 (55kg), HC (12 kg) and dust (0.12 kg) (WHO).

pollution load can be calculated for any place using the Sutton Model (based on Gausses theory for point source of pollution) to calculate pollutant concentration. Results from the equation are considered as continuous emission and infinity; wind direction is perpendicular to pollution concentration line caused by operation of construction machines.

The concentration of pollutant at distance x from pollution source and in downstream of wind direction can be calculated as:

$$\mathbf{C_{(x)} = 0.8.E}\,(e^{\left[-(z+h)^2/2\sigma_z^2\right]} + e^{\left[-(z-h)^2/2\sigma_z^2\right]})/\sigma_z u \quad (2)$$

Where:

E: Loading of pollutant during specific period (mg/m.s), E in table 3.9 & 3.10

σ: Diffuse coefficient in direction z (m) is function of x under wind direction. While σ is identified by Slade formula with the stable atmosphere at level B that is: σ= 0,53.x0,73

x: distance from source to calculated point, follow wind direction;

u: Wind speed (m/s), this area has average wind speed of 0.7 m/s;

z: Elevation of calculated point (m), in this is 0,5 m.

h: Elevation of construction site compared with surrounding areas (m), considered in this calculation is: h = 0 m.

The applied atmospheric stability type is B – Unstable.

Assuming that air pollution from other sources and the effect of terrain in the project's implementation locations is ignored, calculated results of dust and gas emissions from soil excavation and backfill activities and machine operation from construction site are as follows.

Concentration of dust from downwind

Dust concentration at downwind from construction sites are shown in Table 5.6.

Table 5.6. Dispersed concentration of dust on surrounding areas(*Unit: mg/m^3*)

Main project activities	**Distance from emission sources (m)**				
	5	**10**	**15**	**20**	**25**
Tan Uyen town					
Construction of WWTP in Tan Uyen	0.1718	0.1650	0.1184	0.0752	0.0478
Suoi Tre canal improvement	0.1539	0.0978	0.0850	0.0650	0.0368
Sewer collection system	0.0978	0.0750	0.0478	0.0022	0.0010
Pumping stations	0.0825	0.0592	0.0376	0.0184	0.0009
Di An city					
Expansion of Di An WWTP	0.1184	0.0752	0.0581	0.0368	0.0020
Expansion of sewer collection system	0.0859	0.0825	0.0592	0.0376	0.0184
Pumping stations	0.0825	0.0592	0.0376	0.0184	0.0009
Thuan An city					
Expansion of Thuan An WWTP	0.1052	0.0881	0.0678	0.0022	0.0017
Expansion of sewer collection system	0.0759	0.0650	0.0473	0.0376	0.0184

Pumping stations	0.0825	0.0592	0.0376	0.0184	0.0009
QCVN 05:2013/ BTNMT	0.2				

Downwind air pollutant concentrations from construction machinery on construction sites

Table 5.7. Dispersed concentration of air pollutant from construction sites(*Unit: mg/m^3***)**

Indicator	WWTP		Suoi Tre canal improvement		Sewer pipe system		Pumping stations		QCVN05: 2013/BTNMT
	10m	20m	10m	20m	10m	20m	10m	20m	
Tan Uyen town									
CO	15	0.014	0.012	0.0097	0.0047	0.0039	0.0030	0.0030	30
SO_2	0.007	0.005	0.002	0.0004	0.0008	0.0006	0.0004	0.0001	0.35
NOx	0,4	0,24	0,15	0,09	0,08	0,065	0,08	0,065	0.2
Dust	0.02	0.02	0.001	-	-	-			0.3
Thuan An city									
CO	3,45	0,00322			0,00276	0,002231	0.0030	0.0030	-
SO_2	0,00161	0,00115			0,00046	0,000092	0.0004	0.0001	0.125
NOx	0,092	0,0552			0,00092	0,000299	0,08	0,065	0.1
Dust	0,0046	0,0046			0,00023	-	-	-	0.2
Di An city									
CO	5,25	0,0049			0,0042	0,003395	0.0030	0.0030	-
SO_2	0,00245	0,00175			0,0007	0,00014	0.0004	0.0001	0.125
NOx	0,14	0,084			0,0525	0,0315	0,08	0,065	0.1
Dust	0,007	0,007			0,00035	-			0.2

The calculated results show that all pollution values are meeting the allowable standards of QCVN 05:2013/BTNMT[15]. It is noted that the earthworks activities will not be the main sources of dust, however, due to almost construction sites of sewer collection system works items are located on the existing roads which have high traffic volume, thus secondary dust could be released from the construction surface which need to sufficiently manage. The affected objects could be listed as the below:

- Residential areas located along the intervened roads in Khanh Binh, Tan Hiep, Tan Phuoc Khanh Hoi, Hoi Nghia, Uyen Hung, Tan Binh Hiep, Thach Phuoc, Phu Chanh, Vinh Tan communes of Tan Tuyen town, Vinh Phu, Binh Nham and Hung Dinh communes in Thuan An city and Binh An, Binh Thang, Tan Binh, Dong Hoa communes in Di An city
- The road users will be major affected people including provincial roads 47, 746, 746B and 745, DR 411 and 409, and Nguyen Khuyen, Le Quang Dinh, Trinh Hoai Duc, Nguyen Tri Phuong, To Vinh Dien, Nguyen Thi Sau streets in Tan Uyen town; Nguyen Thi Toi, Phan Van Dieu, Bui Thi Xuan, Huynh Thi Toi, internal roads of several residential areas in Binh Thang and Binh An, Dong Hoa communes and Le Trong Tan , An Binh, Tran Thi Vung, Ho Tung Mau, Be Van Dan, Nguyen Dinh Thi in Di An City,

[15] QCVN 05:2013/BTNMT – National technical regulation for ambient air quality.

and Nguyen Chi Thanh, Nguyen Huu Canh, Cau Tau, Binh Nham 07, Binh Nham 04, Binh Nham in Thuan An city.

However, this impact is moderate because the construction will be done by section, short time (6-9 days per roads/streets) and it could be mitigated by appropriate mitigation measures.

Dust generation from unused soil and construction material, transport activities

Dust and air pollutants are generated from operation of transport vehicle mostly come from fuel consumption of vehicle and waste or material scattering during transportation. It is noted that truck 15 ton will be used to transport waste and material, the average transport route to borrow pits or mining areas is 10km and distance to disposal site is 13 km.

Table 5.8.Estimated fuel consumption for transport activities

Main Project activities	**Disposal of wastes**		**Transport of main construction materials**	
	Trips/day *(trip)*	**Total diesel consumption** *(lit/day)*	**Trips/day** *(trip)*	**Total diesel consumption** *(lit/day)*
Tan Uyen				
Construction of WWTP in Tan Uyen	5-15	855	10-19	1083
Suoi Tre canal improvement	1.0	57	2-5	285
Sewer collection system	5.1	291	12-15	855
Pumping stations	4	228		0
Di An city		0		0
Expansion of Di An WWTP	4.75	271	5-7	399
Expansion of sewer collection system	0.2	11	8-10	570
Pumping stations	1.9	108	1	57
Thuan An city		0		0
Expansion of Thuan An WWTP	7.0	399	6-9	513
Expansion of sewer collection system	0.4	23	12-15	855
Pumping stations	1.9	108	1	57

According to the calculated results from the above table, most transport demands are for the work items of Tan Uyen WWTP construction and sewer collection system improvement. The construction sites are scattered in the whole cities (primary and secondary wastewater collection and transmission network in three areas), the transport routes are also quite diversified. Construction material include stone, macadam, sand, steels, etc., which are supplied by difference sources and locations and the transport routes will also be scattered. Therefore, the dust and other air pollutants contribution from those activities is quite small scale. The main affected objects could be households and others public areas/buildings located along the main transport routes. But the impacts from this activity are quite minor due to very short time transportation in the scattered areas and mitigable.

Table 5.9. Air pollutant dispersal along the waste transport routes

Unit: mg/m^3

Indicator	WWTP		Suoi Tre canal improvement		Sewer pipe system		Pumping stations		QCVN05: 2013/BTNMT[16]
	10m	20m	10m	20m	10m	20m	10m	20m	
Tan Uyen									
CO	0.0626	0.0415	0.0165	0.0109	0.0494	0.0327	0.0033	0.0022	30
SO_2	0.0894	0.0592	0.0235	0.0156	0.0706	0.0468	0.0047	0.0031	0,35
NOx	0.1229	0.0815	0.0324	0.0214	0.0971	0.0643	0.0065	0.0043	0,2
Dust	0.0003	0.0002	0.0001	0.0002	0.0002	0.0043	0.0000	0.0000	0,3
Thuan An									
CO	0.0231	0.0153			0.0329	0.0218	0.0033	0.0022	30
SO_2	0.0329	0.0218			0.0471	0.0312	0.0047	0.0031	0,35
NOx	0.0453	0.0429			0.0647	0.0429	0.0065	0.0043	0,2
Dust	0.0001	0.0001			0.0000	0.0001	0.0000	0.0000	0,3
Di An									
CO	0.0296	0.0196			0.0494	0.0327	0.0033	0.0022	30
SO_2	0.0424	0.0281			0.0706	0.0468	0.0047	0.0031	0,35
NOx	0.0582	0.0386			0.0971	0.0643	0.0065	0.0043	0,2
Dust	0.0001	0.0001			0.0002	0.0001	0.0000	0.000	0,3

Table 5.10.Air pollutant dispersal along the material transport routes

Unit: mg/m^3

Indicator	WWTP		Suoi Tre canal improvement		Sewer pipe system		Pumping stations		QCVN05: 2013/BTNMT
	10m	20m	10m	20m	10m	20m	10m	20m	
Tan Uyen									
CO	0.0494	0.0327	0.0033	0.0022	0.0168	0.0111	0.0132	0.0087	30
SO_2	0.0706	0.0468	0.0047	0.0031	0.240	0.0159	0.0188	0.0125	0,35
NOx	0.0971	0.0643	0.0065	0.0043	0.0330	0.0219	0.0259	0.0172	0,2
Dust	0.0002	0.0001	0.0000	0.0000	0.0001	0.0000	0.0001	0.0000	0,3
Thuan An									
CO	0.0157	0.0104			0.0006	0.0004	0.0062	0.0041	30
SO_2	0.0224	0.0148			0.0009	0.0006	0.0089	0.0059	0,35
NOx	0.0308	0.0204			0.0012	0.0008	0.0123	0.0081	0,2
Dust	0.0001	0.0000			0.0000	0.0000	0.0000	0.0000	0,3
Di An									
CO	0.0231	0.0153			0.0013	0.0009	0.0062	0.0041	30
SO_2	0.0329	0.0218			0.0019	0.0013	0.0089	0.0059	0,35

[16] QCVN 05:2013/BTNMT – National technical regulation of ambient air quality.

Indicator	WWTP		Suoi Tre canal improvement		Sewer pipe system		Pumping stations		QCVN05: 2013/BTNMT
	10m	20m	10m	20m	10m	20m	10m	20m	
NOx	0.0453	0.0300			0.0026	0.0017	0.0123	0.0081	0,2
Dust	0.0001	0.0001			0.0000	0.0000	0.0000	0.0000	0,3

The calculated results show that all pollution values are meeting the allowable standards of QCVN 05:2013/BTNMT. Thus, the transport activities will not generate impacts on air quality along the transport routes.

Dust pollution from mixing of construction materials

During the construction process, mixing sand, cement, concreting, etc. also causes dust pollution in the construction site and adjacent residential areas (especially on sunny and hot days). From the monitoring results obtained at some locations about 10-100m from the construction site, at the end of the prevailing wind, the concentration of dust in the ambient air is varied from185-275µg/m^3, low than the permissible limit in the QCVN 05:2013/BTNMT. Construction sites are close to households or sensitive receptors will also not require mixing of construction materials, excluding Tan Uyen, Di An and Thuan An WWTPs which are located far from residential areas or within the boundary of existing WWTPs.

In conclusion, the impacts on air quality could be assessed as moderate. Main receptors are workers on the site, local households and road users. These potential impacts could be minimized by appropriate mitigation measures and Personal Protection Equipment (PPE).

b) Impacts by noise and vibration

**** Noise***

The main sources of noise are from: i) Operation of excavators, bulldozer, concrete mixing operation, and other construction equipment; ii) Construction and dismantling works items; and Operation of transport vehicles.

In fact, all equipment will not be mobilized at the same time. Noise levels from a point source such as a piece of construction equipment will attenuate by the distance. Which could be estimated the decrease by distance by the follow formula:

$$Lp=Lp(Xo) + 20log10(Xo/X)$$

Where:

- $L_p(X_o)$: noise level at a distance of 1.5m from the source (dBA);
- X_o = 1.5m;
- $L_p(X)$: noise level at the calculated position (dBA);
- X: calculated position (m).

Noise generation at sources and reduction by the distance are presented in Table 5.11.

Table 5.11.Noise generation at sources

No.	Vehicles and machinery	Noise level at 1m		Noise level at 20m	Noise level at 50m
		Range	Average		
1	Bulldozer		90.0	67.0	59.0

2	Roller	72.0-74.0	73.0	47.0	39.0
3	Excavator	72.0 - 84.0	78.0	52.0	44.0
4	Grader	80.0 - 93.0	86.5	60.5	52.5
5	Truck	82.0 - 94.0	88.0	62.0	54.0
6	Concrete mixer	75.0 - 88.0	81.5	55.5	47.5
QCVN 26/2010/BTNMT[17] applying for normal areas: 6 AM to 9PM is 70 dBA; from 9PM to 6AM is 55 dBA					
IFC Guideline (2007) applying to daytime level in residential, institutional, and educational facilities is 55dBA					
Ministry of Health (MOH) standard: Noise at the production area is 85 dBA for 8 hours of noise exposure					

Noise levels at 20m from noise sources are lower than Vietnamese requirements during daytime but higher than that during night-time, while the IFC 2007 guideline value will only be achieved at 50m. However, the noise level at the construction sites is low because it affects in only some households living along the intervened roads and workers on the site; short construction at daytime; all vehicles and equipment will be checked periodically, and noise can be minimized by labor protection equipment and noise protection devices.

**** Vibration***

During construction, machines such as compactors, excavators, bulldozers, transporters, rollers, etc. will be used for excavation, levelling, rolling the road surface and compacting. The operation of these devices will cause vibrations, but the level of vibration will also reduce by the distance.

Table 5.12. The vibration of machinery and trucks

Sources of vibration	**LV[18]at 1m (dB)**	**PPV at 1m** *(mm/s)*	**Sources of vibration**	**LV at 1m (dB)**	**PPV[19] at 1m** *(mm/s)*
Vibrating compactor	87	0.027	Roller	58	0.001
Bulldozer	87	0.027	Truck 10T	58	0.001
Trailer	87	0.027	Truck 15T	86	0.023
Paver	87	0.027	Irrigating machine	58	0.001
Concrete spreader	75	0.005	Pump 2HP	87	0.027
Concrete mixer	75	0.005			

Source: David A. Towers. 1995

The level of vibration (LV) reduction by the distance can be forecasted by applying the formula of Swiss Construction Association, which noted in the approved ESIA report of

[17]QCVN 26:2010/BTNMT – National technical regulation on noise.

[18]LV is Level of Vibration.

[19]PPV is Peak Particle Velocity.

Drainage and Wastewater Systems in Di An city– Binh Duong province by the World Bank in 2016. Due to the homogeneous feature of two project in term of technical specification, project location, social and economic condition, natural characteristics, the calculated results from Drainage and Wastewater Systems in Di An city– Binh Duong province will be used to assess the impacts by vibration from this project. The forecasted vibration at the different distance from the source are presented in Table 5.13.

Table 5.13. The vibration reduction by distance

Sources	Forecast of the vibration in the different distance from the sources (LV - dB)				
	3m	5 m	5.5 m	8.0 m	10 m
Trailer	72.7	66.0	64.8	59.9	57.0
Roller	43.7	37.0	35.8	30.9	28.0
Truck 15T	71.7	65.0	63.8	58.9	56.0
Vibrating compactor	72.7	66.0	64.8	59.9	57.0
Paver	72.7	66.0	64.8	59.9	57.0
Pump 2HP	72.7	66.0	64.8	59.9	57.0
Concrete mixer	60.7	54.0	52.8	47.9	45.0
Bulldozer	72.7	66.0	64.8	59.9	57.0
Concrete spreader	60.7	54.0	52.8	47.9	45.0
QCVN 27:2010/BTNMT[20]	**75.0**				

The region out the radius 3m from generated sources, vibration is in the permitted standard of QCVN 27:2010/BTNMT. Only sewer pipelines construction will locate close to residential areas with have several structures could be affected by vibration, but all of them are located more than 10m from construction site. None of receptors located close to the construction sites of three WWTPs and Suoi Tre canal improvement, pumping stations could be affected by vibration from construction activities.

The vibration impact is assessed at the low level because the vibration level is reach the allowed standard at 5m;the physical structure of houses along the roads will construct sewage system are mostly solid structures and semi-solid structures; vibration could cause impacts on workers at sites and could be managed through appropriate working schedules.

c) Impacts on water quality

The water pollution sources which would impact on surface water quality in the project area include: i) domestic wastewater; ii) runoff water, and iii) construction wastewater.

Domestic wastewater

The establishment of worker camps depends on the actual situation of each civil works items. The number of workers will be varied from 10 to 90 people at each construction site, in which, local labors would take about 30%. The number of workers will concentrate mostly during the first 18-month period of the construction phase.

- Only Tan Uyen WWTP and Suoi Tre canal improvement will need to establish worker camps on the site but they will be within the row of the site.
- For Thuan An and Di An WWTPs, worker camps will be located within the existing

[20] QCVN 27:2010/BTNMT – National technical regulation on vibration.

WWTPs which have been sufficient facilities, and workers will utilize the available facilities of the existing WWTPs;

- All construction items of sewer pipelines and pumping stations are quite small scope, no worker camp will not be implicated on the site; workers will be stay in rent houses which equipped sanitation facilities.

According to the TCXDVN33:2006[21], average water consumption level is 45 liters/day. The amount of wastewater generated is 100% of the water supply. The estimated domestic wastewater discharged from worker camps is showed in Table 5.14.

Table 5.14. Estimated domestic wastewater discharged from worker camps

No.	Construction items	People		Total discharge water per day (m^3)
		Workers	Technical staffs	
	Tan Uyen town			
1	Construction of WWTP in Tan Uyen	16	4	0.9
2	Construction of sewer collection system	90	30	5.4
3	Pumping stations	38	15	2.39
4	Suoi Tre canal improvement	10	4	0.63
	Subtotal			*9.32*
	Thuan An city			
1	Expansion of Thuan An WWTP	15	4	0.855
2	Expansion of sewer collection system	30	10	1.8
3	Pumping stations	12	4	0.72
	Subtotal			*3.375*
	Di An city			
1	Expansion of Di An WWTP	15	4	0.855
2	Expansion of sewer collection	50	15	2.925
	Pumping stations	24	8	1.44
	Subtotal			*5.22*
	Total			17.91

The domestic wastewater from workers usually contains suspended solids (SS), organic substances (BOD, COD), nitrogen and phosphorus-containing substances, as well as microorganisms that need to be controlled and treated before discharge to environment. Based on the load factors of urban wastewater discharged by WHO, 1993, Vol. "Quick assessment method", discharge load, concentration of pollutants in domestic wastewater are as follows:

Table 5.15. Typical compositions of domestic wastewater

No.	Pollutants	Unit	Concentration	QCVN 14:2008/BTNMT - Column B
1	BOD5	mg/l	562-675	50
2	COD	mg/l	900-1272	150
3	Suspended solids	mg/l	875-1812	100
4	Grease	mg/l	125-375	20

[21] TCXDVN 33:2006 –Water supply –Pipeline network and facilities – Designing standards.

5	Total Nitrogen (N)	mg/l	75-150	40
6	Ammonia	mg/l	30-60	-
7	Total Phosphorus (P)	mg/l	10-50	6
8	Coliform[22]	MPN/100ml	106,000– 109,000	3000-5000

Anticipated concentrations of pollutants such as BOD_5, ammonium, total phosphorus, TSS, oil and grease, Coliform in wastewater are quite high, that need to be controlled and treated before being discharged. if without proper treatment, it can directly affect the living environment of workers and people around the project area, causing epidemics and directly affecting the groundwater and surface water. However, the direct impact due to domestic wastewater is considered to be low because: i) worker camps on construction sites will only require for Uyen WWTP and Suoi Tre canal improvement; ii) locations of worker camps will be within the row of construction sites; iii) The nearest water body at the construction sites is within 200m, iii)the distance to Dong Nai river is about 600 m via Suoi Tre canal which will be close during construction phase; iv) this impact could minimized by appropriate mitigation measures.

Rainwater runoff

The rainwater runoff could wash many substances stay on sites. The runoff water quality depends on actual construction activities, site arrangement, management status of material, fuel, hazardous substances, domestic waste and wastewater. It usually contains high content of suspended mater from soil, construction material, sand that may cause increasing the turbidity of surrounding water bodies and pollute soil and ground water. However, construction sites of sewer pipelines and pumping stations are located on traffic roads, no worker camps, auxiliary areas, material storage areas will be presented, the runoff water quality mostly suspended mater which could entering the existing drainage system. The same situation of Di An and Thuan An WWTPs where sufficient drainage system is available. Thus, impacts by rainwater runoff will only calculated for Tan Uyen WWTP and Suoi Tre canal construction site. The amount of rainwater runoff on the project area is determined by the following formula:

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

Where:

- W: amount of rainwater runoff, m^3;
- Ψ: Surface runoff coefficient, $\psi = 0.2 – 0.95$, selecting $\psi = 0.2$ (because the project area has many trees, canals and cultivated land);
- q: Maximum daily precipitation in the calculated area, 136 mm;
- F: Calculated area (m^2), 97,000 m^2

With the surface area is 9.7 ha (97,000 m^2) for Tan Uyen WWTP, the rainwater runoff volume on this construction site is 23,280 m^3during construction period. Typically, the study by *WHO*[23] showed that N, oil, COD and TSS concentrations in runoff water are about 0.5 - 1.5 mg/l; 0.004 - 0.03 mg/l; 10 - 20 mg/l and 10-20 mg/l respectively. Rainwater runoff from the construction site can sweep away materials and soil, minerals on the surface, leaking grease... increasing the content of suspended solids, substances, organic matter, increasing turbidity, oil and grease in water, adversely affecting aquatic ecosystems. Without drains,

[22]Sources: Hoang Hue, 2002

[23]WHO, 1993 – Guidance for Environmental rapid assessment, Volume 2, part 1.

rainwater runoff can affect construction items such as damaging or destroying works in progress, etc. This impact is mainly on rainy season from June to October. However, this direct impact is assessed to be low because: i) the highest impacts happen mostly during excavation and levelling period, which will be implemented in the first phase and dry season; ii) after finishing ground levelling activities, the construction site will facilitate sufficient drainage system to avoid directly discharge water bodies; iii) there are no water bodies located next to construction sites; iv)the site management and worker camp keeping practices will also be proposed and implemented by the contractors.

Construction wastewater

Construction wastewater is generated mainly: (i) concrete if any; (ii) washing materials and construction equipment. As confirmed in the technical documents, there will be no concrete mixing stations will be established on the sites, the concrete will be purchased from licensee stations, thus construction wastewater will only be from washing materials and construction equipment. The maintenance and clean equipment on the site could discharge a certain volume of wastewater, but which will not allow.

The volume of wastewater used to wash construction equipment is quite small, it is estimated about 2 m^3/day for all construction sites, since the construction of sewer pipelines and pumping stations will not require equipment stay on the site long-time, construction of Thuan An and Di An WWTP are within the boundary of existing WWTP can use the available facilities. Construction wastewater usually contains high content of pH (usually pH>12), TSS and no hazardous substances. Therefore, this impact is assessed as low and mitigable.

d) Impacts from solid waste generation

Solid waste could be generated from: i) Construction refuse (soil, sand, stone)ii) domestic waste and garbage generated from workers' camps (organic waste, paper, carton box, fecal waste) and iii) hazardous waste.

d1) Construction waste

Solid wastes are generated from construction activities include soil, sand from excavation activities, iron debris and steel scrap; cement bags; wood debris, broken bricks...The volume of construction solid waste are calculated in Table 5.16.

Table 5.16: Estimated construction waste

No	Construction Items	Residual soil* (m^3)	Waste loss from construction material (m^3)[24]	
			Low loss level (0.005%)	*High loss level (0.01%)*
I	**Tan Uyen town**			
	Sewer collection system	240,074	65.12	130.2407
	Pumping stations	8,190	0.27	0.5472
	Tan Uyen WWTP	40,959	15.94	31.8988

[24]The level of loss of raw materials in accordance with the norms of construction materials is attached to Official Letter No. 1784/BXD-VP of August 16, 2007 and Official Letter 1776/BXD-VP dated August 16, 2007by MOC

No	Construction Items	Residual soil* (m^3)	Waste loss from construction material (m^3)[24]	
			Low loss level (0.005%)	*High loss level (0.01%)*
	Suoi Tre canal	66,105	1.07	2.1578
II	**Thuan An City**			
	Sewer collection system	55,353	14.8607	29.7214
	Pumping stations	2055	0.0729	0.1458
	Thuan An WWTP	22,650	0.21075	0.4215
III	**Di An City**			
	Sewer collection system	82,015	26.85625	53.7125
	Pumping stations	4,134	0.1602	0.3204
	Di An WWTP	22,650	0.21075	0.4215

(Source: FS, 2020)

These are non-hazardous wastes but need to be handled to avoid impacts on air, water qualities nearby residents/road users and surrounding environment. In addition, some types of solid waste such as rubble, scrap steel, cement bags, etc. can also be generated. These are reusable solid waste and can be salvaged or sold. Since, discharge of construction waste into the environment is low. This direct impact is assessed at insignificant because:

- Construction activities will be section by section, which could help to avoid aggregating unused material onsite.
- The residual soil could be utilized for ground levelling other work items within project or other areas.
- Other waste will be transported to South Binh Duong Solid Waste Treatment Complex, the contractors will be required to provide waste collection facilities on the sites;
- At the same time, this impact can be mitigated through the measures in ESCOPs.

d2) Domestic solid waste

Domestic solid waste generated from workers' camps contains organic wastes such as paper, plastics, cartons, food waste. Average generation of domestic solid waste is about 0.3 - 0.5 kg/person/day (*Vietnam National Environment Report 2011 – Solid waste*). The domestic solid waste generated from workers could be estimated in Table 5.17.

Table 5.17. Estimated domestic waste in the construction phase

	Construction items	Number of Workers	Estimated solid waste volume *(kg/day)*
	Tan Uyen town		
1	Tan Uyen WWTP	16	4.8 - 8
2	Sewer collection system	90	27 - 45
3	Pumping stations	38	11.4 - 19
4	Suoi Tre canal improvement	10	3 - 3

	Construction items	Number of Workers	Estimated solid waste volume *(kg/day)*
	Thuan An city		
1	Thuan An WWTP	15	4.5 – 7.5
2	Sewer collection	30	9 - 15
3	Pumping stations	12	3.6 - 6
	Di An city		
1	Di An WWTP	15	4.5 – 7.5
2	Sewer collection system	50	15 - 25
3	Pumping stations	24	7.2 - 12

The total amount of domestic solid waste of the project is on average 159 kg/day, with a construction period of 18 - 24 months, the total amount of domestic solid waste is from 74.4 to 99.55 tons. Although this type of waster is non-hazardous but if it is not appropriate handled which may create several environmental issues, such as:

- Entering the natural flow, irrigation canal or drainage system, causing flow to obstruct and facilitate flooding for all construction sites, specially for the construction of Tan Uyen WWTP and Suoi Tre canal improvement;
- High contain of organic ingredients, pathogens may impact on air, water and soil environmental quality

However, the direct impact of domestic waste is considered as low and can be mitigated because: i) The amount of waste generated on each site is small; ii) all construction sites are located within the urban areas where the collection system is available; iii) scope of impacts is quite small; iv) worker camps will be located far away from residential areas and water bodies.

d3) Hazardous waste

Sources of hazardous waste generated include: i) oil contaminated materials from the maintenance of construction machines; ii) asphalt removed from road surface, asphalt containers; iii) bags, tanks containing oil, asphalt, petrol and paint; iv) batteries, light bulbs, cartridges from office at the construction site. The volume of hazardous waste depends on the number of equipment/machineries, labor and volume of materials;

- In case the construction equipment, machines and vehicle are maintained on the site, estimated hazardous waste is about 5 kg/month/site).
- The asphalt road surface removed during road surface excavation for sewer pipe installation is about 8.3 m^3 in Tan Uyen town, 0.5 m^3 in Thuan An city and 1.5 m^3 in Di An city. In addition, some amounts of hot asphalt will be used to reinstate the road surface. As a petrochemical product, the main component of asphalt is bitumen, so it can be dangerous or adversely affect the environment and people health unless being stored and used properly in accordance with technical specifications. In particular, at high temperatures, the stored asphalt can pose the risk of fire, explosion or burns during transportation and use.
- The volume of bags, tanks containing oil, asphalt, fuel and paint are not large (about 15 kg/month for each site of WWTPs and very few on other construction site).

The hazardous waste is estimated very small volume but if not appropriated managed, it causes air, water and soil pollution; fire and explosion risk; and then affecting on human health and structures in the surrounding areas. This impact is low because:

- Construction equipment, machines and vehicle will not allow to be maintained on the site.
- Asphalt removed from road surface on during sewer pipe installation will be collected and transported to South Binh Duong Solid Waste Treatment Complex for treatment;
- Hazardous waste will be collected, managed and disposed in accordance with the regulations on hazardous waste collection and management.

e) Increased traffic and related accidents

Survey results show that many of the existing roads proposed for construction of the project's primary and secondary sewer lines have relatively high traffic density with heavy trucks. The excavation for installing sewers will narrow traffic lanes, leading to increases in traffic density on these roads. This might cause additionally traffic jams and related accidents in the areas.

The impacted roads include:

- Tan Uyen (89km D350-D1100): PR747, PR746, PR 745, DR418, DR409, To Vinh Dien and Nguyen Tri Phuong streets.
- Thuan An (25km D200-D600):Cau Tau street, Nguyen Huu Canh street, Nguyen Chi Thanh street, PR745 and Binh Nhan 2 road.
- Di An (32km D200-D600): Nguyen Thi Tuoi street, Bui Thi Xuan street, Nguyen Dinh Thi street, PR743A and national road NR1A.

Since the installation of primary and secondary sewers will need to use larger construction site areas, employ larger construction equipment, machines and vehicles, these impacts are assessed as substantial impacts and need to apply strict mitigation measures.

f) Risks of raw material supply

Total demands of raw material for the project include 1,603,285 m^3 of levelling soil, 1,878,914 m3 of macadam and 322,626 m^3 of sand. Among the three urbans, the construction items in Tan Uyen town have the highest raw material demand with 1,075,214 m^3 of levelling/embankment soil, 1,146,100 m^3 of macadam and 207,109 m^3 of sand. The soil, sand and macadam's sources for the project will obtained from licensed mines as provided in Chapter 1. Other construction materials such as steel, cement... will be bought from local suppliers in Binh Duong province. There could be some risks that project's contractors would not comply by choosing other cheaper illegal material sources. In that case, some unexpected impacts could be,

- Quality of materials would not meet the regulated technical standards;
- Quantity of materials would be insufficient, affecting the project progress;
- Environmental requirements would not be guaranteed when the materials are illegally exploited;
- Creating high burden for natural resources exploitation;
- There would be potential risks of labor accidents and traffic accidents when applying uncontrolled exploitation and transportation processes.

However, these indirect risks are assessed as "Low" and can be mitigated by using conditions of construction contracts with contractors and construction supervision.

g) Local flooding

Most construction activities will be implemented on or nearby the roads, mismanagement of construction materials, excavated soils and wastes on the sites could lead to suspended mater entering the drainage system which cause blockage and subsequently to flooding during rainy season. The excavation and construction of Suoi Tre canal requires dry condition, which needs to bock current water flow. This could create high risk obstructed drainage water flows in the surrounding areas and could be create localized flooding during raining season.

Additionally, the construction of sewer pipelines and pumping stations would have to pump out ground/rain waters from the dug wells and drains. These pumped waters would impact on the surrounding drainage system, create a risk of local flooding.

The flooding risk is assessed as low due to i) construction activities will not directly create intervention on the drainage system; ii) section by section construction method will help to reduce demand of construction material and disposal remaining on the sites, and also reduce volumes of pumped waters; iii) alternative flow will be provided during drying Suoi Tre canal for excavation and construction; iv) the risk of flooding could be controlled through fully consideration of rainy characteristic in the construction schedule and methods

h) Impact on existing infrastructure and services

Roads: Many roads or street sections could be affected during excavation, ditches preparation for sewer pipeline constructions along the existing road which may need to remove road surface temporarily. After completing the installation of the pipes, road surface shall be reinstated. The costs have been included in the total project cost.

Water supply: The pipelines for water supply at present mainly follows along the technical channel placed along the road. Therefore, the earthworks on the existing roads may need to remove or damage the water supply pipelines. However, it is noted that, the investor of the project is the water supply management entity with a lot of experience for execution to avoid the impacts on water supply, and if any issues arisen, these would be addressed promptly by them.

Other underground technical infrastructure: could be impacted during construction phase, such as telecommunication cables and electrical cables. As noted above, the installation of sewer pipelines will be conducted on the roads which are facilitated with a network of urban basic infrastructure, therefore, if appropriate survey has not been implemented and sufficient technical consideration has not been fully considered, the impacts could be significant. Moreover, the degradation of public facilities during construction period need to be fully compensated by the contractors prior to project commencement.

i) Impacts on urban landscape and beauty

Construction of the Tan Uyen WWTP and Suoi Tre canal improvement will lead to a change in the purpose of land use at the sites of these work items (e.g. agricultural land is occupied to be construction sites in the construction phase). These changes in land use purpose will affect the livelihoods of households owning agricultural land. Impacts related to livelihoods and resettlement will be mitigated in RAP report.

When the project's works are under construction, earth working, dredging on existing roads and transportation of materials, gathering of bulky construction material, heaps of excavated and backfilled material, gathering of construction machinery and construction waste will

cause negative impacts on the urban landscape. However, the impacts on urban landscape change is at low level because the construction time is expected within 6 months to 1 year, the environmental landscape will be recovered and even be better than before.

j) Workers health and safety risks

Construction activities of this project will not use heavy machinery; however, risks of occupational accidents still are potential in construction sites and cause to injuries and even lives of employees. The followings are key occupational health and safety (OHS) risks anticipated and assessed during the implementation of the project:

- Accidents due to falling: Incorrectly installed scaffolding, open walls, manholes on roadbeds, uninsured ladders and unprotected steel bars are the most common risks leading to labor accidents for construction workers.
- Falling objects: During construction process, heavy tools and equipment and supplies may fall from the high level and helmets are not effective. If the sites are not enclosed or something may fall from a crane out of the construction area, the pedestrians may also be hit by these objects.
- Accidents due to ditches and trenches: During excavation and construction of drainage system, collapse may occur. If excavated materials are too close to trenches, the material may fall back and cause serious injury.
- Physical injury due hard work: Back injuries caused by lifting heavy objects or improper posture.
- Risks of traffic accidents, labor accident, fire, explosion, short circuit and electric shock posed by the construction activities will also affect the safety of the community
- Lack of awareness on occupational health and safety requirements: lack of use of personal protective equipment (PPE) and safe workplace practices.
- Labor disputes over terms and conditions of employment includes demand for limited employment opportunities; labor wages rates and delays of payment; disagreement over working conditions; and health and safety concerns in work environment. In turn, there is also a risk that employers such as contractors/subcontractors may retaliate against workers for demanding legitimate working conditions, or raising concerns regarding unsafe or unhealthy work situations, or any grievances raised, and such situations could lead to labor unrest.
- Discrimination and exclusion of vulnerable/disadvantaged groups: Vulnerable/ disadvantaged groups of people may be subject to increased risk of exclusion from employment opportunities under the project. Such groups will include women and persons with disabilities. Lack of equal pay for equal work for men and women is also an issue in Vietnam. Sexual harassment and other forms of abusive behavior by workers will also have the potential to compromise the safety and wellbeing of the vulnerable groups of workers and the local communities, while adversely affecting project performance. This will also include potential sexual exploitation or harassment in recruitment or retention of skilled or unskilled female workers supported under the project.
- COVID-19 risk: The project will be implemented under the outbreak COVID-19 pandemic in the World, high risks of COVID-19 infection among workers who may come from other regions/cities/provinces or countries. Risk factors for worker exposure to COVID-19 include job duties that involve close contact with other workers, the community, and patients and healthcare workers in the health facilities

- Poor sanitation in workers camps will lead to the emergence of several diseases such as dengue fever, eye disease, gastrointestinal disease, etc. If not controlled this can spread to the community. In addition, infectious diseases such as HIV/AIDS, hepatitis A/B /C are also likely to spread due to workers' concentration in the construction site of Tan Uyen WWTP and Suoi Tre improvement and possible prostitution in the area.

In general, the risk on the workers is characterized by: i) the impacts are localized within the construction site and scattered in the local areas; ii) short construction period; iii) workers are provided with protective equipment, reasonable construction time and training on traffic safety and labor safety activities; iv) fuel is stored in areas near the camps and is regularly inspected to minimize the risk of fire and explosion; v) Training on fire prevention and fighting; vi) Communication on prevention of infectious and sexually transmitted diseases will be implemented; (vii) The contractors will have to follow Occupation Safety and Health rules, all workers will be introduced to working procedure with hazardous materials. Given the nature and scale of construction activities, these risks and adverse impacts are assessed as direct, moderate and mitigable.

k) Community health and safety risks

The activities of construction equipment, machinery, open holes, transport vehicles could lead to social disturbance, risks and noise during night-time. Intervention actions on the existing streets could also impacts on the accessibility of households living along there roads.

In addition, social evils and diseases transmission could negatively affect local residents as well as workers due to low living condition of worker which could leading to appearance of eye disease, skin disease, and respiration case in workers and then spreading out in the local communities will lead to overcrowding of the local health system, especially for commune health stations and district hospitals.

The main social problems could be listed as the below:

- Potential impacts of spreading infectious disease from employees/workers to local communities then create additional burdens to local health care system.
- People travel on the intervened roads may conflict with the workers, mobilized equipment, and exposing to the excavation holes…
- Moreover, construction sites could be also risk for local people when they illegal enter the site.

The surrounding residential areas will be the main impacted objects, thus the strictly control by the construction contractors and local authorities help minimize these types of impact.

The risks is low due to: i) there are many vacant land/building around all construction sites which could be utilized for the worker camp and borrow areas; ii) all construction locations are close to urban areas which almost safety and health care services are available with good quality and easy for any emergency cases; iii) locations to set up the worker camps are also convenient; iv) the mitigation measure to ensure people will not illegal entering the sites will be included in the civil work contracts; v) fence and traffic guidance will be provided on the construction site of sewer pipelines and pump stations.

l) Social risks and impacts related to labor influx

Risks of social conflict

Risks of social conflict relating to labor force are often involved in labor influx for construction activities with a number of workers hired. There are 3 worker camps with 15 –

30 workers in each camp will be established in the project area. Workers who are working for separated construction sites of sewer pipelines and pump stations will rent houses from local people. The labor influx on the sites could lead to social conflicts such as:

- Labor influx may cause social evils and diseases transmission could negatively affect security for local residents;
- Potential impacts of spreading infectious disease from employees/workers to local communities then create additional burdens to local health care system which also may create social conflicts.
- Potential conflict between workers and local communities because of differences of benefit.
- Cultural values conflict could be potentially impacted due to concentration of worker from outside with difference cultural beliefs;

However, the potential social conflict risks will be low due to i) only Tan Uyen WWTP and Suoi Tre improvement item have worker camps on the site which is located in the agricultural areas; ii) Binh Duong have experience in managing workers from different provinces who are working in industrial sectors; iii) Local people has acquainted the movement of influx of workers, local authorities also have experience for management of the immigrant labor; iv) project implementation located in the urban areas which have good public services and health systems.

Increase of illicit behavior and crime

Risks of illicit behavior and crime could be consequences of labor flux. The mobilization of workers is may lead to social disturbance, illicit behavior and crime due to discrepancy of income, work, customs etc. Besides, there are risks that the workers will participate into the social evils such as gambling or prostitution. However, the potential social impacts and risks will not be high in Binh Duong because a lot of workers from other provinces already have come for work in industrial sectors. Local people has acquainted the movement of influx of workers, local authorities also have experience for management of the immigrant labor.

Influx of additional population ("followers")

The workers from other provinces or other districts of Binh Duong province coming to work for project may bring their families which could cause further burdens on the social and service systems of the project cities and promote migration situation. However, the risks could be low due to the workers will be involved in the construction period of 18 moths to 24 months and contractors are encouraged to employ local labors.

Impacts on community dynamics

Binh Duong province has 2.4 million people and is the seventh largest populated province in Vietnam. About 77.2% of Binh Duong population live in urban areas, more than double the national average of 31.3%.Due to fast economic growth and high rates of immigration (30%), urbanization has grown 41.4% in the 2014-2018 period compared to a national urban growth of 9.8%. The province is an employment hub for the region that attracts many immigrant workers for its thriving industrial economy. Therefore, labor flux cause by the project will create quite minor or no impacts on community dynamics.

Increase of burden and competition for public service provision

The project activities will create additional demand on water and power supply and solid waste treatment which are managed by public sectors. However, the demand for electricity of

the project will not be concentrated in one location and it is supplied by connecting from the national grid through the 220/110 kV station. It is estimated that the demand of supplied water of project is small, about 18 m^3/day in three town/cities. The water will be supplied by BIWASE (as known as management agency of the project). Solid waste generated from the project activities will be collected every day by URENCO which is belong to BIWASE and transported to Nam Binh Duong Solid Waste Treatment Complex Area for treatment. Therefore, the competition for public service provision of the project will be minor.

Increased risk of communicable diseases and burden on local health services

The disease transmission could negatively affect local residents as well as workers due to low living condition. It could lead to eye and skin diseases, and respiration diseases, especially COVID-19 pandemic among workers and then spreading out in the local communities. This results to overcrowding of local health care systems.

Sexual exploitation and abuse/sexual harassment

The assessment of sexual exploitation and abuse (SEA)/sexual harassment (SH) shows that this risk is low because most works of the project will be implemented in urban areas where SEA/SH are easily controlled by contractors and local governments. Mitigation measures of these impacts are included in the ESMP and code of conduct (CoC) for contractors.

Child labor and school dropout

Based on the project characteristics, some unskilled labor could be mobilized. In this case, the child labors can be used for tasks that do not require high qualifications (according to Vietnam's regulations, child is under 15 years old). Due to limited knowledge, children can suffer from labor abuse that affect their psychology, health and ability to learn. The child labor may cause school dropout for working and earning money. However, the impact is assessed to be minor as: i) The experience with the Bank-financed and state budget projects show no cases of child labor or forced labor have been recorded; ii) the Bank and the Vietnam government have strong and comprehensive policies/requirements to protect children from child labor and other abuse; iii) According to the socio-economic survey results, no case of child labor or forced labor use was recorded in the project areas; vi) The Contractor has to commit not to hiring child labor for the project-related jobs and this commitment shall be one of the required conditions in bidding and contractual documents; v) The project owner will coordinate with local authorities and related units to strictly control the contractor's labor use.

Local inflation of prices

Implementation of the project shall need to mobilize a certain number of workers, technical staffs on the sites. The mobilized workers could cause increase in many personal demands (food, clothes, accommodation...) and resulted in local inflation of prices. However, the risks could be minor due to i) the construction sites located widely in three cities of Binh Duong province (Tan Uyen, Di An and Thuan An); ii) a small number of workers will be mobilized on the sites (about 120 people at highest demand period); iii) workers will be stay a short time on the sites; iv) the Binh Duong province has been considered as the most active city in Vietnam and supply could be much over all demands from workers.

Increased pressure on accommodations and rents

Experience from previous projects shows that the project towns can accommodate number of migrant workers so that pressure on accommodation and rent have not been occurred in the project areas. Contractors of the project, on the one hand can establish worker camps, rent local houses for workers in the project towns or prioritize to mobilize local workers to reduce demand of workers' accommodation.

5.4.2. Site-specific impacts and risks

5.4.2.1. Specific impacts and risk during construction of investments under Sub-component 1.1.

Investments under sub-component 1.1 includes: expansion of sewage collection and network (139.4 km of sewage collection pipe of D 200-1200) including sewage pumping stations for Tan Uyen town (11),Thuan An (01), and Di An (04) cities, with a focus on high density unserved urban areas.

The investments under sub-component 1.1 are of moderate scale. The site-specific impacts and risks include: (i) Traffic disturbance and safety risks; (ii) Interruption on business activities and household accessibility; (iii) Damage to public facilities; (iv) Impacts on urban landscape; and (v) Impacts on PCRs and sensitive receptors

a) Traffic disturbance and safety risk

As noted above, the construction activities e.g. material transportation, excavation, pipe installation will be taken place on the existing roads in the urban and semi-urban area. These activities will add to the road a number of vehicles, machineries, and equipment, and temporarily encroach road surface, causing increased traffic disturbance and safety risks for commuters. The main impacts objects could be listed in the below table:

Table 5.18. Summary impacts on traffic condition

Main intervened roads	Characteristic of intervened roads	Impact assessment
On the main routes of Tan Uyen Town, several connection roads with the suburban areas Provincial road (PR) 47, PR 746 and district road (DR) 411, and short section of PR 746B, DR 409, PR 745 Nguyen Khuyen, Le Quang Dinh, Trinh Hoai Duc, Nguyen Tri Phuong, To Vinh Dien, Nguyen Thi Sau	Mostly high traffic volume excludes several main roads next to industrial parks or core area of Tan Uyen town which are divided and good pavement roads. Other are mostly undivided, marrow roads with the surface condition is from poor to moderate, and many trucks operating on these roads.	Impact level: Substantial Traffic congestion caused by setting up the construction sites for installation of sewers on roads, especially on the primary sewer routes and with high traffic volume roads. Traffic conflict between traffic vehicles and between road users and construction equipment/machines/vehicles Traffic accident risk due to narrow, dusty road surface or due to reduce the visibility of road user
Nguyen Thi Toi, Phan Van Dieu, Bui Thi Xuan, Huynh Thi Toi and internal roads of several residential areas in Binh Thang Binh An, and Dong Hoa communes Le Trong Tan, An Binh, Tran Thi Vung, Ho Tung Mau, Be Van Dan, Nguyen Dinh Thi roads in An Binh commune	Traffic volume is varied from low to moderate, with dominated by cars or motorcycles. Several sensitive objects such as primary schools, secondary schools, traditional markets and business shops located.	
National road 1A, Nguyen Chi Thanh, Nguyen Huu Canh, Cau Tau, Binh Nham 07, Binh Nham 04,	High traffic volume on National road 1A, but only very short pile section on this road	

Binh Nham	Other roads have moderate traffic volume or location within residential areas with lower traffic volume	

The construction of primary and secondary sewer pipelines is carried out on relatively crowded roads, but it will be conducted in successive manner. The sewer pipelines will mostly conduct in the internal roads of residential areas which have lower traffic. The operation of transport vehicles on the main roads which may create risks of traffic conflict, but the transport demand is low (12-15 trips/day). The sewer pipes are scattered, within a large area of 03 cities/town. The impacts are assessed as substantial, temporary during construction phase and could be mitigated via good construction and management practices.

b) Interruption on business activities and household accessibility

Disruption of business activities:

Most of constructed sewer pipelines and pumping stations are located on existing roads where business activities are taken place along the roadsides. These includes business shops of domestic necessities and foods such as biscuit, candy, fruits, vegetables…and small coffee stores, clothes or IT shops, etc. The construction activities will cause impacts on these business shops due to increased levels of dust, noise, and block access roads. Incomes of these shops may be reduced or lost if the entrance is blocked or too dusty. Generally, it will be difficult for the affected businesses to attract the customer when construction takes place in front of their shops. However, it is proposed that the rolling construction method of about 100m each section will be applied for installation of the pipelines. This rolling construction will reduce the impact time and scope at each construction area. Therefore, this impact level is assessed as moderate.

Household accessibility:

During installation of the collection sewer lines, the occupation of a part of road surface will be needed causing congestion, hindering the transportation and living activities of local people. In addition, some pipelines in front of the local houses and offices affect the accessibility of local people However, the installation of sewer pipelines is proposed to be carried out in successive manner of about 100 m each section; thus the scale of construction site will be not large and time duration of impact will be shortened Therefore, the impact is assessed as temporary and moderate, and can be mitigated by management measures.

c)Impact on existing infrastructure and services

***Roads*:**

Many roads or street sections could be affected during excavation, ditches preparation for sewer pipeline constructions along the existing road which may need to remove road surface temporarily. In addition, the activities of transporting raw materials will increase the number of heavy trucks (estimated 12-15 trips per day), which may cause damage to roads.

The affected routes include: provincial roads 47 and 746, 746B, 745; district roads 411, 409; and many other streets: (i)in Tan Uyen town i.e. Nguyen Khuyen, Le Quang Dinh, Trinh Hoai Duc, Nguyen Tri Phuong, To Vinh Dien, Nguyen Thi Sau; (ii) in Di An city i.e. Nguyen Thi Tuoi, Phan Van Dieu, Bui Thi Xuan, Huynh Thi Tuoi, internal roads of several residential areas in Binh Thang and Binh An, Dong Hoa communes and Le Trong Tan, An Binh, Tran Thi Vung, Ho Tung Mau, Be Van Dan, Nguyen Dinh Thi in Di An City, and (iii) in Thuan An city i.e. Nguyen Chi Thanh, Nguyen Huu Canh, Cau Tau, Binh Nham 07, Binh Nham 04, Binh Nham

The roads which are excavated or damaged will need to be repaired to the existing conditions or better. In general, this impact is temporary and ends by the end of construction and assessed as Moderate.

***Other technical infrastructure**:*

The installation of sewer pipelines will be conducted on the roads which are facilitated with a network of urban technical infrastructure including water supply pipeline, telecommunication cables, and electrical cables and poles. During construction, if surveys and coordination are not conducted appropriately and adequately, and sufficient technical consideration has not been fully taken into account, damages to these technical infrastructures could be happened.

The impact is likely occurred however it will be short term ceasing with the end of construction period. This impact is mitigable via adequate survey and technical consideration, good construction methods and good coordination with local public service utility. Thus, the impact magnitude is assessed as short-term, and moderate.

d) Impacts on urban landscape

As mentioned, the construction activities will include roads or pavement excavation to install wastewater sewers and establishment of barrier fences. These activities will temporarily change the landscape, as well as affect the urban beauty. In addition, materials will also be transported and gathered on the sites. The construction activities will take place widely in 09 communes/wards in Tan Uyen, 05 wards in Di An, 03 wards/communes in Thuan An. Therefore, if the construction sites are not well managed; especially at the construction sites of the wastewater collection routes, where have narrow construction ground, the urbans' beauty will be negatively impacted. As these works are carried out in successive manner and scattered at various sites within 03 cities/towns, these impacts are assessed as moderate level. These impacts could be mitigated via the application of good site management practice.

The construction sites of pumping stations and wastewater collection pits are located in vacant lands with relatively large square areas, thus the impact on the urban landscape is low.

e) Impacts on PCRs and sensitive receptors

There is no intangible cultural heritage within the area of influence of the project.

The project will not encroach any physical cultural resources (PCRs), however, the construction activities will partially affect the operation of these works. The impacts include inconvenience in accessibility, dust, noise, exhaust gases and other sanitary and safety conditions, which may cause discomfort for people who come to visit the sites. Details are as follows:

For religious and belief works: The project's activities of raw materials transport and construction of wastewater sewers will cause impacts such as (i) temporarily obstructing the accessibility to the religious structures, (ii) increased levels of noise, dust and exhaust gases affecting the people who visit to structures, (iii) risks on traffic accident, (iv) social conflict between workers and visiting people,

- *In Tan Uyen town:* Buu Lien pagoda, Ky Hoan pagoda, Hoi Nghia parish church, Ben San church, Binh Hoa temple, Binh Chanh temple, Loi Loc temple, Ngoc Khanh monastery, martyrs' cemetery (with distances from 5 m - 40m to the construction sites of wastewater sewers).
- *In Di An city:* Thien Binh, Co Linh, Phap Hanh Tung Lam, Duc Hoa, Huynh Mai, Phap Tri, Truc Lam, Tan Hung and Nghia Son pagodas; Binh An, Phat Mau, Tan Quy, Binh Thang, Trung Buu Tu, Binh Duong and Dao Su Tich temples; and Ngu Hanh Tan Hoa

shrine (with distances5 m -50m to the construction sites).

- *In Thuan An city:* Ngoc Minh monastery, Phuoc Loc Tho pagoda, Bung parish church, Quach Lam Tho Mo religious house (with distances 5 m -60m to the construction sites).
- The construction of sewers to collect and transport raw materials will cause impacts (i) obstructing the entrance and exit of religious structures, (ii) Noise and dust affecting people going to the ceremony, (iii) the risk on traffic accidents, (iv) Conflict between workers and people who go to church.

For schools: The project's activities of raw materials transport and construction of wastewater sewers will cause impacts such as (i) temporarily obstructing entrance accessibility to the schools, (ii) noise, dust and exhaust gases affecting students, teachers and parents, (iii) risks on traffic accidents,

- *In Tan Uyen town:* Huynh Van Nghe high school; Uyen Hung B, Tan Hiep, Khanh Binh, Tan Phuoc Khanh B, Tan Phuoc Khanh, Tan Vinh Hiep A & B and Phu Chanh primary schools; Le Thi Trung, Tan Phuoc Khanh, Tan Hiep, Khanh Binh and Nguyen Quoc Phu secondary schools; Chuon Ot, Hoa Huong Duong, Khanh Binh and Baby World kindergartens (with distances 5-30 meters to the proposed construction sites).
- *In Di An town:* Mai Vang, Son Ca, Mimosa, Sao Mai, Hoa Sen, Anh Cau Vong, Anh Binh Minh, Huong Ngoc Lan, Hoa Thien Phu, Tuoi Tien, Mam Xanh, Hoa Sen Do kindergartens; Tan Binh, Bui Thi Xuan, Doan Thi Diem primary schools; Binh Thang, Binh An, Tan Binh secondary schools; and Binh An high school (with distances 5 m -60m to the proposed construction sites).
- *In Thuan An city:* Binh Nham, Hoa Cuc 2, Hoa Mai 2, Hoa Cuc 6and Hoa Cuc 8 primary schools(with distances 5-30 m to the proposed construction sites).

For markets: The project's activities of raw materials transport and construction of wastewater sewers will cause impacts such as (i) temporarily limiting business activities, (ii) noise, dust and exhaust gases affecting goods, traders and marketers, (iii) risks on traffic accidents, (iv) risks of social conflicts between workers and dealers/marketers,

- *In Tan Uyen:* Quang Vinh 3, Hoi Nghia, Tan Hiep, Khanh Binh markets (with distances from 5 to 25 meters to the construction sites).
- *In Di An:* Tan Binh and Tan Lap markets (with distances from 5 to 15 meters to the construction sites).

For medical centers: The project's activities of raw materials transport and construction of wastewater sewers will cause impacts such as (i) temporarily obstructing the accessibility to the health care centers, (ii) noise, dust and exhaust gases affecting staffs and visiting people, (iii) risks on traffic accidents.

- *In Tan Uyen:* Tan Uyen town Hospital, Health Care Center of Hoi Nghia ward, Health Care Center of Tan Hiep ward(with distances from 10 to 25 meters to the construction sites).

Vibrations impacts on PCRs and sensitive receptors

In addition to the aforesaid impacts, PCRs and sensitive receptors can be affected by vibration caused by excavation process for the installation of sewer pipelines. This vibration can cause the structures within 5m from emission sources to crack or collapse. For the tertiary sewer pipes which are small, located within the narrow alleys and excavation ditch is shallow, the equipment to be used mainly includes manual, portable equipment, so risk on structure

collapse/cracking due to vibration is not significant.

The expansion of the secondary and primary sewer pipe and pumping stations includes deep excavation (2-8 m) and require mobilization of heavy machine and pile driving work; thus, may cause crack or collapse to adjacent structures. As the secondary and primary pipes are installed in the roadbed, it is noted that more than 10 m distant to the main structures of adjacent sensitive receptors, which is beyond the area of influence (estimated 5-8 m).Some pagodas, schools have the gate and fences located from 5-10 m distant from the construction site and may be impacted during the excavation process, concretely:

- Tan Uyen:
    - *Schools:* Huynh Van Nghe high school; Tan Hiep, Tan Phuoc Khanh B, Tan Vinh Hiep B and Phu Chanh primary schools; Khanh Binh, Tan Phuoc Khanh secondary school; Hoa Huong Duong, Khanh Binh, Baby World kindergartens;
    - *PCRs:* Buu Lien, Ky Hoa pagodas; Binh Hoa, Binh Chanh and Loi Loc temples; and Ngoc Khanh monastery;
    - *Market:* Tan Hiep, Hoi Nghia and Khanh Binh markets.
- Di An:
    - *Schools:* Doan Thị Diem, Bui Thi Xuan, Tan Binh primary schools; Hoa Sen Do, Mam Xanh, Tuoi Tien, Sao Mai, Huong Ngoc Lan, Anh Binh Minh, Hoa Sen, Bup Sen, Sao Mai, Mimosa, Son Ca and Mai Vang kindergartens.
    - *PCRs:* Thien Binh, Co Linh, Phap Hanh Tung Lam, Huynh Mai, Phap Tri, Truc Lam, Tan Hung pagodas; Binh An, Phat Mau, Tan Quy, Binh Thang, Trung Buu Tu and Binh Duong and Dao Su Tich temples; and Ngu Hanh Tan Hoa shrine.
    - *Market:* Tan Lap and Binh An markets.
- Thuan An:
    - *School:* Hoa Mai 2, Hoa Cuc 6, Hoa Cuc 8 and Vinh Phu 17A kindergartens.
    - *PCRs:* Phuoc Loc Tho pagoda, Ngoc Minh monastery, and Quach Lam Tho Mo house.

If appropriate construction methods are not applied, the excavation for sewer pipe installation may cause soil subsidence and consequently the risk on cracking and collapse of the gate and fences. These risks could be prevented and reduced via applying good construction practices.

5.4.2.2 Specific impacts and risk during construction of investments under Sub-component 1.2 – Construction of WWTPs and upgrading Suoi Tre canal

Construction investments under component 1.2 includes:

- Constructing a new WWTP with 1stphase capacity of 20,000 m^3/day and upgrading 1.3 km downstream of Suoi Tre canal for Tan Uyen town;
- Upgrading the existing WWTP for Thuan An city with an additional treatment capacity of 20,000 m^3/day;
- Upgrading the existing WWTP for Di An city with an additional treatment capacity of 20,000 m^3/day.

**** Site-specific impacts and risks for the upgrading and construction of the WWTPs***

a) Impacts on irrigation drains at Tan Uyen WWTP site

The proposed site of new Tan Uyen WWTP (9.7 ha) is located on agricultural lands in Uyen Hung commune. Currently, the agricultural land includes cultivated crops, fruit trees or vacant lands. As the results from site survey and public consultation, there are 4 irrigation drains in this cultivation area, in which two drains will be affected permanently since they locate within the site area, meanwhile the other two run outside of the site area. These drains are supplying water for about more than 20 ha (including the site area of WWTP)agricultural lands around the Tan Uyen WWTP site area. According to the project's designs, the two drains located within the site area will be relocated with alternative drains for ensuring sufficiently irrigation for cultivation activities of the main remaining lands. Meanwhile, the other two drains which locate outside the site boundary could be affected by being spilled and blocked with leveling materials during construction of the WWTP. In addition, runoff stormwater can also carry materials, wastes and excavated soil to spill over these two irrigation drains. If appropriate mitigation measures are not applied, it will cause interruption and affect agricultural activities for surrounding agricultural land. As the drains locate outside the construction area, the impact could be mitigated by establishment of temporal drainage and embankment on site and implementing other material management measures during construction phase. Therefore, this impact is assessed as low, short-term and could be mitigated.

Figure 5.1. Irrigation drains in the at the boundary of Tan Uyen WWTP

b) Impacts on agricultural activities at Tan Uyen WWTP site

The site area of Tan Uyen WWTP is adjacent to agricultural lands in the Southeast and Northwest. The agricultural lands are used for cultivating mainly seasonal crops such as beans, vegetables, and melaleuca trees. The ground leveling to increase elevation from the existing of 2.8 m to 4 - 5.6 m requires a large amount of earthwork. Due to the large difference in elevation between the construction site area and surrounding areas, surrounding agricultural cultivation activities could be affected by temporary block of irrigation drains, scattered raw material/excavated soils, deal concrete, spill of oil/fuel, discharged wastewater without any pre-treatment and dumping solid wastes, especially during heavy rains with large overflows to the surrounding areas. Also, the earthwork and construction processes will generate dust that may spread into the surrounding environment and affect the crop quality and productivity.

These impacts are assessed as temporary and at low due to i) the remaining agricultural land area is small (only about more than 10 ha remained), and most of agricultural lands around Tan Uyen WWTP site are seasonal crops and vacant lands, ii) with the larger area of

construction site, all activities will be managed to implement within the site boundary, iii) separating fence will be provided around the construction site area

Figure 5.2. Cultivation activities on the agricultural land in Tan Uyen WWTP location.

c) Safety and disturbance issues to staffs at the existing WWTPs

The upgrading existing Thuan An and Di An WWTPs will be implemented within the boundary of the existing WWTPs. The mobilization of construction workers and equipment, establishment of worker camps, arrangement of construction site (with auxiliary areas, material storage yards, etc.,)may create safety risks for staffs and create burden for existing infrastructures at the existing WWTPs.

The disturbance and safety risk are likely to occur if appropriate measures are not conducted. The mitigation measures for these risks can be readily designed as the land areas for construction of upgrading facilities has been planned in previous period; it is possible to arrange other access gate the upgrading area to separate with the existing WWTPs. The risks therefore are assessed as temporary, at low level and mitigable.

**** Specific E&S Impacts and Risk during rehabilitation of Suoi Tre canal***

The improvement of Suoi Tre canal will be conducted for about 1.3 km downstream section, part from PR 746 to Dong Nai river. The improvement includes dredging from 0.5 to 1.0 m thick, expansion of existing canal bed from 2.0-10.0m to 14.5-16.0 m, concrete embankment at both sides, and construction of new on-bank roads on both sides.

a) Impact of dredging process to water quality, aquatic life and downstream users

Suoi Tre canal has been longtime playing as an urban drainage canal, with no valuated value neither biodiversity nor fish productivity. Due to the shallow and polluted water, fishes and other aquatic organisms living in Suoi Tre canal are only dominant with some local polluted environment-adapting species. Therefore, the impacts on aquatic life caused by improvement of the canal are not significant.

The construction activities in Suoi Tre canal will disturb the bottom sludge layer and cause negative impacts on water quality by increasing total suspended solids (TSS) and turbidity. Since the canal is directly discharging to Dong Nai river, the river water will be also negatively impacted by this TSS. Due to the flow of Suoi Tre canal is quite small during the dry season, and applying the segment-blocking and dried construction method (building temporary cofferdams at the two ends of each construction segment, and pumping water out to establish the construction site); and using pump and pipes to ensure alignment of the canal's flow. Therefore, the impact causing water quality degradation could be assessed as low if the construction is implemented during the dry season.

However, if the construction is implemented in the rainy season, the impact would be increased to moderate level due to (i) the canal flow is large in the rainy season, leading to much more difficultly to convert the canal flow, (ii) the activity of pumping rain water out from the construction site would cause enclosing a high TSS content source. Therefore, the construction of Suoi Tre canal is recommended to be implemented in the dry season.

Figure 5.3. Suoi Tre canal - the mount section and the proposed Tan Uyen WWTP's discharge point.

b) Impacts due to excavated sludge

The estimated volume dredged material generated during construction of Suoi Tre canal is moderate, about 66,105 m^3. According to the results of sludge quality analysis, all bottom sludge samples taken in Suoi Tre canal are neutral in pH value, not saline, and have all other analytical parameters of heavy metals meeting the allowed standards in accordance with QCVN 43:2015/BTNMT[25]. Therefore, this generated amount of dredged material is assessed not polluted and can be used for planting trees. The dredged sludge temporarily stored at the canal bank for about a few days to reduce the water content and then transported to the disposal site by truck. There would be some amounts of groundwater infiltrated to the construction site from surroundings. This ground water will be pumped out to the canal causing increased turbidity of the water canal. In addition, if not well managed, this amount of dredge material can follow rainwater flowing in to the Suoi Tre canal, surrounding agricultural area, or spill on the transportation roads causing unhygienic and negative urban beauty. This impact is assessed as at moderate level.

c) Impacts of odors generated from dredging activities

Bad odor may arise from the dredging activities due to the decomposition organic compounds and biomass contained in the dredged sludge, especially the impact may increase in hot weather. However, exception from three households located at a distance of about 20 m from the canal banks at downstream, there is no other residential area located within a distance of 250 m from the canal, the targets impacted by this bad odor are mostly on-site construction workers and along the sludge transport routes. This impact is assessed as low level.

d) Drainage capacity and localized flooding

When dredging the downstream section of Suoi Tre canal, it is necessary to block the canal's flow, this will create a risk of impacts on the drainage capacity at the downstream of Suoi Tre canal, causing local flooding for the riparian areas during heavy rains, especially if the

[25]QCVN 43:2015/BTNMT: National technical regulation on sediment quality.

construction is implemented in the rain season from May to October. Therefore, the construction and dredging of Suoi Tre canal should apply measures to ensure continuity the canal flow. In general, the construction phase should avoid the rainy season, and apply the rolling construction method with flow alignment by pumping. The impact level can be assessed as small.

e) Risks on local house cracking

The upgrading of Suoi Tre canal will include the Larsen pile driving and excavation activities requiring mobilization of excavators, rammers, compactors, rollers, etc. which will cause vibration impacts. The vibration will cause fracture in geological links and links between the structure with geological background, causing trembling and cracking even collapsing for the nearby infrastructures. According to the initial technical calculation, the risk on infrastructure cracking and collapse is within the radius of 5-10 m along Suoi Tre canal, there are only 03 residential houses which are located more than 20 m distant from the canal bank, which will be out of the area of the influence. Thus, the risk on structure collapse and cracking on the residential households is negligible. As a precautionary approach, the mitigation measures to prevent, avoid or compensate for this risk on infrastructure collapse/cracking will be included in the ESMP as the requirements for the contractors during the construction process.

5.5. IMPACTS AND RISKS IN OPERATION PHASE

5.5.1. Impacts and risks during operation of Sub-component 1.1

The investment under sub-component 1.1. include the expansion of the sewage collection networks and sewage pumping stations Tan Uyen town, Thuan An, and Di An cities.

a) Pollution risk due to broken and blocked pipelines

During operation, the risks of sewer pipelines being broken and leaked may cause odor and other groundwater and soil environmental pollution by organic substances and bacteria contained in the wastewaters. However, due to the primary and secondary sewers will be installed at depths from 2 to 8 m below the ground, the risk of being affected by human or vehicle activities causing breakage of sewers are relatively small. For tertiary sewers, due to the sewers will be installed at shallow depths, the risk of sewer cracking is higher, but only impact at small scopes in local residential areas.

In addition, sludge and sediment deposited on the sewer lines after a period of operation can obstruct the flows, cause wastewater spilling out into the environment affecting by bad odor and soil pollution at some points on the routes. Since the collection sewers are installed at high depth below the ground and sewer-dredging activities will be implemented frequently during the operation phase this risk is assessed as small level.

b) Noise from pumping stations

Noise generated from pump stations can be caused by operation of pumps and standby generators. Reference to the technical documents, noise levels generated from pumping stations during operation can be calculated for different distances as shown in following table:

Table 5.19. Noise levels caused by the operation of pumping stations

No.	Equipment	Noise level (dB)		
		1.5 m from equipment	40 m from equipment	100 m from equipment

1	Water pump	82	62.4	57.2
2	Generator	80 - 100	48 - 68	40 - 60
QCVN 26-2010/BTNMT		70	70	70

Notes: QCVN 26-2010/BTNMT: National technical regulations on noise.

Thus, the noise level arising from the operation of pumping stations will meet the permissible standard of QCVN 26-2010/BTNMT for residential areas at a distance of 40 meters or higher. As prescribed in chapter 1, all pumping stations are located in vacant lands with distance to the nearest residential area of greater than 40 m. Pumps will be installed deeply submerged underground, thus the noise levels are mostly exterminated in the air environment. Therefore, the daily impact on people's life is assessed to be very small. For the standby generator, it only works in case of power failure, thus noise impacts by the standby generators are also quite rare and small.

c) Incidents at the pumping stations

**** Stop operating of the pumping stations***

During operation, incidents e.g. pump breaks or power failure may occur leading to the interruption of the pump operation. In those cases, wastewater will be stagnated and potentially overflowed causing unsanitary conditions, especially at the environment around the pumping stations. However, due to the distances between pumping stations and residential areas are relatively far, the impacted targets are somehow reduced. This impact is assessed at medium level.

**** Explosion and fire risk at pumping stations***

Risks of explosion and fire at pumping stations may happen due to electricity short, equipment failures. The explosion and fire at pumping stations would cause dangerous for operation workers, and other people who goes or lives close to the stations. Therefore, fire and explosion preventing measures should be given during designing and operation of the pump stations. This impact is assessed at moderate level.

d) Impacts due to odor emission

As the proposed sewer pipes under the project is the separate system, thus there is not manhole along the road but only at the pumping stations. Bad odors may generate from manholes at pumping stations during the operation phase. Impacted objects are workers carrying out maintenance work at the pumping stations and commuters along these stations area. This impact is considered at moderate level and could be mitigated by design measures such as installation of exhaust fan and provisions of appropriate PPEs for workers.

e) Generation of sludge

It is expected that some small amounts of sludge could be sedimented at the manhole placed at the front of each pumping stations. If not periodically dredged, this amount of sludge will be accumulated timely and cause obstruct the flow of wastewater in the sewers. In addition, the decomposition of organic substances contained in wastewater may cause odors and other sanitary conditions affecting the community.

Referencing the data from operation phase of the existing Thuan An and Di An wastewater collecting systems, there has been no sludge sedimented at the pumping stations for being dredged since the operation started (for 3 years with Thuan An and for 1.5 year with Di An).Therefore, the sludge amount generated at the project's wastewater pumping stations and collection pits is very small, the impact therefore will be not significant.

f) Health risk to O&M workers

Workers who dredge sludge or repair pipes and pumping stations will have to perform work at depths 2-8 m below the ground, will face to be affected by exhausted gases from anaerobic decomposition of organic matters contained in the sludge and wastewater, such as CH_4, H_2S.... If not equipped well with labor safety equipment, the workers would face to a risk of toxic gas poisoning, affecting health or even death. As the work will be carried out by specialized workers, this risk can be occurred, but the live hood of the risk is low.

g) Waste generation at pumping stations

Domestic waste

Due to the number of staffs operating pumping stations is relatively small, only about 2 to 3 people per station, the amount of domestic waste generated is only about 1-1.5 kg/day. The impact from domestic waste is negligible.

Hazardous waste

Hazardous wastes generated from pumping stations would be mainly lubricants, oil-stained rags, broken lamps. Due to the small scale, the volume of generated hazardous wastes will be very small, estimated at about 10 kg/year. The impact is assessed as small level.

5.5.2. Impacts and risks during operation of Sub-component 1.2

The investments under subcomponent 1.2 include constructing and upgrading Tan Uyen, Di An, Thuan An WWTPs; and upgrading of Suoi Tre canal

5.5.2.1 Impacts and risks during the operation of upgrading/constructed WWTPs

a) Impacts on air environment

**** Offensive odor***

Odors from the wastewater treatment process are generated mainly from the treatment units where anaerobic decomposition takes place. Aerobic decomposition also generates odors but at lower levels. The units which possibly generate bad odors include the screener, the inlet wastewater collection tank, the sedimentation tank, ASBR tank and the sludge treatment area. It will be easy to install devices to collect and convey the bad odors to the odor treatment section. The main gases generated from anaerobic decomposition consist of H_2S, mercaptans, CO_2, CH_4, of which H_2S and mercaptans are the main factors giving rise to bad odors.

The wastewater treatment process is source of biological gases that can disperse with the wind about some tens, hundreds of meters. Sol gas may contain bacteria and fungus that could be the cause of diseases or allergy through respiration. Such biological gases would affect air quality of surrounding the WWTPs. For the project's WWTPs, the gases would be mostly generated from the balancing pond and the ASBR tanks. The table below shows the estimated content of bacteria dispersed in air environment according distances from the source of WWTP.

Table 5.20. Content of bacteria dispersed in air from WWTP

	Quantity of bacterium/1 m^3 air			
Distance	**0 m**	**50 m**	**100 m**	**>500 m**
End of windy direction	100 - 650	50 - 200	5 - 10	-
Head of windy direction	100 - 650	10 - 20	-	-

Source: 7th International Conference on Environmental Science and Technology – Ermoupolis. Odor emission in a small WWTPs, 2001

For Tan Uyen town, the WWTP is located fairly distantly from the residential areas (about 250m), thus the impact of odors is assessed at small level.

For Thuan An and Di An WWTPs, the nearest distance from the surrounding residential areas to the border of plant's site areas is just only about 50 m, but the distance is about 100 m to the real treatment facilities. These two existing plants already installed deodorizing systems, and planted trees within the site areas. The experience from existing actual operation shows that there is almost no odor distributed to the residential areas. Therefore, this impact is assessed to be small.

**** Exhaust gases from standby generator***

One generator 480 kVA will be installed at each WWTP to ensure alternative power supply for case that electricity could be off from national grid. Power generators will use DO as fuel. The operation of power generators could create dust and air pollutants.

The emission coefficients of power generators, which use DO fuel is in the below table:

Table 5.21. Emission coefficient of power generators (DO fuel, 0.5%S)

No	Air pollutant	Emission coefficient (kg/ton fuel consumed)
1	Dust	0.71
2	SO_2	1.00
3	CO	2.19
4	NO_x	9.62
5	THC	0.79

Source: Rapid assessment of pollutant volume, WHO, 1993.

Usually, when DO fuel is combusted at temperature of 200^0 C, total generated pollutant per 1kg of DO will be 38.6 m^3. With average fuel consumption factor is 35 kg/hour, the total volume of generated pollutant will be 1351 m^3/hour. The air pollutants from power generation could be estimated as below table:

Table 5.22. Volume and concentration of air pollutants generated from power generator in one WWTP

No	Pollutant	Emission coefficient *(kg/ton fuel)*	Pollutant volume		Pollutant concentration under normal conditions *(mg/m^3)*	Pollutant concentration under standard conditions *(mg/Nm^3)* *	QCVN 19:2009/BTNMT
			kg/h	*g/s*			
1	Dust	0,71	0.025	0.007	18.39	31.88	120
2	SO_2	1	0.035	0.010	25.91	44.90	300
3	CO	2,19	0.077	0.021	56.74	98.32	600
4	NO_x	9,62	0.337	0.094	249.22	431.90	600
5	THC	0,79	0.028	0.008	20.47	35.47	-

Note: QCVN 19:2009/BTNMT National technical regulations on industrial dust and air pollutant concentration, category B. The calculation factor Kp=1 and Kv=0.6. (*) standard condition is 25^0C, 1 atm.

The above calculated results show that the concentrations of dust and other parameters are meeting the allowable standards in accordance with QCVN 19:2009/BTNMT. In addition, the standby generators will be operated only in case the electricity broken. Therefore, this impact is assessed as negligible.

**** Noise from WWTPs***

Noise levels could be generated during the operation of the WWTPs mainly from the activities of pumping, aeration, transport vehicles. This could be a nuisance for workers and for residents in the close vicinity (a distance of 250 m for Tan Uyen WWTP, and 50 m for Di An and Thuan An WWTPs). The levels of noise calculated for the WWTP are specified in the Table below.

Table 5.23. Noise levels at different distances from the operation of WWTPs

	Equipment	Noise level (dB)		
		1.5 m from equipment	**40 m from equipment**	**100 m from equipment**
1	Mixer	87	66.7	63.5
2	Aeration equipment	88	67.1	63.7
3	Water pump	82	62.4	57.2
4	Sludge pump	83	65.8	60.9
5	Truck	76	64.5	59.5
6	Standby generator	80 -100	48 – 68	40 - 60
TCVN 3985-1999 QCVN 26-2010/BTNMT		85	70	70

Notes: - TCVN 3985-1999: Noise standards for the manufacturing area.
- QCVN 26-2010/BTNMT: National technical regulations on noise

Thus, the noise arising from the operation of the WWTP is within the permissible standard for residential areas at a distance of 40 meters or more as prescribed by QCVN 26-2010/BTNMT. There are no residential houses within this distance from the plant, and thus the impact on the community is no-existent.

During the site surveyed, it was said via communication with some local people that there would be a new residential area invested by the Vin Group which would be developed around the site area of Tan Uyen WWPT. However, currently there has been no approved detail master plan of the residential area for collection and considering. Based on the land fund of the area, the said residential area, if to be developed in the future, it must be located on the other bank of Suoi Tre canal, opposite side with the WWTP. In that case, the distance from the WWTP to the nearest residential houses must be larger than 40 m. The impact is assessed very low or not existent.

The noise can affect the workers at the WWTPs. However, due to the characteristics of operating work, the workers do not have to stay all time in in the noise-generating areas, the impact of noise on the workers is also limited. In general, this impact is assessed at a small level.

b) Impacts on receiving water sources bodies

- *Impacts on flow rate of receiving water sources*

Tan Uyen WWTP:

The proposed WWTP capacity is 20,000 m^3/day which will be discharged to Suoi Tre canal then finally to Dong Nai river.

For Suoi Tre canal, by improvement of 1.3 km section at downstream of the canal, the project will change permanently the flow and increase drainage capacity of the canal. Therefore, the impact is not considered.

For Dong Nai river, the discharged volume of Tan Uyen WWTP with an additional flow of 0.23 m^3/s is very small (only about 0.09%) in comparison with the existing average flow of the river of 242 m^3/s. The impact is not significant.

Di An WWTP: The proposed additional capacity of the WWTP is 20,000 m^3/day which will be discharged to T4 canal then to Siep canal (also named as Cai Cau canal) and finally to Dong Nai river. The distance from the discharge point at T4 canal to Siep canal is about 10 m, and from Siep canal to Dong Nai river is 7,400 m.

At present, the T4 and Siep canals are playing the role of drainage for a catchment of about 1,250 ha, including riparian areas along the provincial road 743A and Tan Dong Hiep A industrial park. The drainage capacity of these two canals were already upgraded to 2 m^3/s during the construction of first phase of Di An WWTP. The upgradation was designed ensure receiving including this expansion phase of the WWTP (with a combined capacity of 40,000 m^3/day). Therefore, the impact of changing the flow rate of T4 and Siep canals were considered and mitigated before and will no longer be considered in this project.

Similar with Tan Uyen WWTP, the impact of changing flow rate of Dong Nai river caused by the expansion of Di An WWTP is assessed as not significantly.

*Thuan An WWTP***:**

Ong Bo and Vinh Binh canals are receiving water sources for Thuan An WWTP and currently have drainage capacity of about 120 m^3/s. Therefore, an additional discharged flow of 20,000 m^3/day (equally 0.23 m^3/s) from the expansion phase of Thuan An WWTP will not significantly affect the flow of these canals.

For the Saigon River: the average flow of Saigon river is about 54 m^3/s. Therefore, the expansion of Thuan An WWTP also will not significantly affect the flow of the river.

- *Impacts on the water quality of receiving waters due to treated wastewater discharge*

Impact on quality of the receiving water sources during the WWTP's operation is assessed as positive impact. Currently, there is no wastewater collection and treatment system in the project's service areas of Tan Uyen town, Di An and Thuan An cities. Domestic wastewaters are being discharged directly into surrounding water environment and Dong Nai and Sai Gon rivers, putting a great pressure on the water quality of local surface water sources and the rivers. When wastewater collection and treatment systems come into operation, these water sources will not have to receive such current huge amounts of pollutants, specifically:

+ Dong Nai river will not have to receive a total of 40,000 m^3/day of untreated wastewater from Di An and Tan Uyen urban areas. The quality of treated wastewater will meet the allowable standards of QCVN 14:2008/BTNMT (Colum A) which helps to reduce about 7.2 tons of BOD_5, 8.1 tons of TSS and 1.12 tons of N per day to be discharged into Dong Nai river. By this nature, the water quality of Dong Nai river will be improved, creating a favorable living environment for aquatic species, a better water source for domestic water supply and other water uses in the downstream areas including Binh Duong province, Dong Nai province and Ho Chi Minh city. Especially, the project will contribute to ensure the security of raw water source for Tan Hiep water supply plant which locates just about 2 km downstream from Tan Uyen WWTP.

+ Sai Gon river will not have to receive a total of 20,000 m^3/day of untreated wastewater from Thuan An urban area. The quality of treated wastewater will meet the allowable standards of QCVN 14:2008/BTNMT (Colum A) which helps to reduce about 3.6 tons of BOD_5, 4 tons of TSS and 0.56 tons of N per day to be discharged into Sai Gon river. Via that way, the water quality of Sai Gon rive will be improved, creating a favorable habitat for aquatic species and improving the quality of other water uses in the downstream section of Thuan An WWTP.

- *Impacts on water quality due to storm water runoff*

When it rains, the stormwater runs off over the entire surface of the plant and it would take soil, sand, scum, grease falling into the river.

If this amount of stormwater is not well managed it then would cause negative impacts to surface water and aquatic life in the river. It is estimated that the stormwater runoff over the entire plant would be 2.16 m^3/s with about 2.8 kg of different contaminants. Because the surface area of the WWTPs are mostly the concrete tanks and concrete pipes which reduce absorptive ability, resulting in an increase in stormwater runoff on the surface, dragging down the dirt accumulation into the tank system of the plant. With volume of stormwater runoff of about 1.08 m^3/s, after 20 to 30 minutes, the content of contaminants in stormwater runoff on-site of the treatment plant is negligible. The level of impact is low.

c) Generation of sludge and solid waste

** Sludge*

According to Frank R. Sellman[26], the treatment of every 1 kg of BOD from the wastewater, an amount of about 2.24 kg of sludge (with moisture of 75-85%) would be generated. And according to the project's technical proposals, the designed concentration of BOD_5 contained in the input raw wastewater is 200 mg/l, and in the output treated wastewater is 30 mg/l. It could be calculated out the total amount of BOD to be treated at each project's WWTP (with capacity of 20,000 m^3/day) equally about 3,400 kg BOD/day, and the calculated total amount of generated sludge is 7,616 kg/day for each project's WWTP. These generated sludge amounts have high concentration of organic compounds and biomass which may cause bad odors and other risks of disease germs. This impact is assessed as long-term and at moderate**.**

** Domestic solid waste*

The amount of domestic solid waste discharged from activities of staff and workers of the WWTP is mostly of biodegradable organic matters such as food, fruit peel, tea residues and inorganic components such as plastic bags, cans, cardboard boxes. Each worker at the plant would generate about 0.5kg of solid waste a day. The experiences from Thuan An WWTP and Di An WWTP, show that to operate a 20.000m^3 capacity WWTP need 65-70 staffs and workers (included about 40 permanence staffs and 30 part-time staffs), and it is estimated that 30% of additional staff for operating 20.000m^3 of additional capacity in Thuan An and Di An WWTP will be hired. The generated domestic solid wastes are calculated about 35, 45, and 45 kg/day respectively for Tan Uyen, Thuan An and Di An WWTPs. The type of waster will be collected, transported and treated through available services in the urban areas. Thus, the impact can be considered low.

** Hazardous wastes*

Hazardous wastes generated from the operation of the WWTPs are mainly composed of waste oil, oily rags from maintenance (about 30 kg/year), fluorescent light bulbs (about 20 kg/year). Such types of wastes can be completely controlled during operation so as to mitigate possible impacts. The impact is assessed at small level.

d) Risks, incidents in operation phase

Accident discharges

During operation of the WWTPs, there might be incidents such as power broken, treatment works damages etc. that cause the system to stop working and cause the plants to directly discharge untreated wastewater into the environment. The discharges of untreated wastewater to the receiving waters can increase the content of organic pollutants, decrease the quality of the receiving waters. In order to assess the level of contamination by untreated wastewater on the receiving sources in case of accident discharges, it is necessary to determine the receiving ability of the receiving sources as regulated in the Circular No. 76/2017/TT-BTNMT[27] dated December 29th, 2017 by MONRE.

The impacts from operating incidents at the three WWTPs could be estimated as the below:

- Quality of intake and outlet wastewater during normal operation of WWTPs;

[26] Frank R. Sellman. 2003. Handbook of Water and Wastewater Treatment Plant Operations, CRC Press.

[27]Circular No. 76/2017/TT-BTNMT dated December 29th, 2017 by MONRE regulates on assessing the ability to receive wastewater, the pollution loads suffering capacity of river and lake water sources.

- Determine the capacity of receiving wastewater by Dong Nai river and Sai Gon river. (According to the guidance in 02/2009/TT-BTNMT 19/3/2009 regulatory assessment of wastewater receiving watercourses);
- Assessing the capacity to dilute the Nitrate, BOD_5, TSS, COD concentration in untreated of the wastewater receiving watercourses (Dong Nai river and Sai Gon river);
- Calculate duration (time) and distance will be needed to dilute the pollutants in untreated wastewater to lower concentration at baseline condition on the receiving watercourses

Calculated result could be summarized as the below (see the detail assessment in Appendix 5)

Tan Uyen WWTP: Based on the data on the volume of pollutants from the wastewater discharged into Dong Nai river. In this case Dong Nai river still have able capacity to dilute the Nitrate concentration in the wastewater but it will not be able to carry high volume of BOD_5, TSS, COD in untreated wastewater. Dong Nai river is still capable of receiving the Nitrate will be 22.2 days but it needs 40 hours to dilute BOD_5 concentration to meet the allowed value in standard. (QCVN 08-MT:2015/BTNMT column A2)[28] at the distance of 7.2km, therefore, it will cause negative impacts to the operation of *Tan Hiep supply water plant*, where raw water intake locates about 2.5 km downstream of the discharge point of the WWTP.

Di An WWTP: If occur in 1 day, 40,000 m^3 of untreated wastewater will be discharged directly into Dong Nai river. And Dong Nai river, in this case, still have capacity to dilute the Nitrate concentration in the wastewater but it will not be able to carry high volume of BOD_5, TSS, COD in untreated wastewater. By the time of 40-44 hours, BOD_5 concentration still meet the allowed value in standard (QCVN 08-MT:2015/BTNMT column A)at the distance of 7.92 km in downstream

Thuan An WWTP: If the incidents occur in 1 day,37,000 m^3 of untreated wastewater will be discharged directly into Sai Gon river. And Sai Gon river, in this case, still have capacity to dilute the Nitrate and TSS. By the time of 32 hours, BOD_5 concentrations till meet the allowed value in standard(QCVN 08-MT:2015/BTNMT column A**),** at the distance of 4.5 km in downstream.

Also, according to the calculation, because the water flow of Dong Nai and Saigon rivers is very large compared to the discharge flow of WWTPs, the dilution is very large (from 126 to 1052 times); therefore, in case of incident discharge (if any), the increases in concentration of pollutants such as BOD5, TSS, Nitrate only ranges from 0.2 to 12.4%. This increase of pollutants concentration would affect the quality of raw water supplied to Tan Hiep water supply plant located at a distance of about 2 km downstream of Tan Uyen WWTP on Dong Nai river. Depending on time (rainy or dry season) during the year, the dilution capacity varies, resulting in varying levels of impact, from small to medium.

h) Chemical leakage

For this project, a chemical-using method will be used for cleaning odors from waste gases. This method can remove different odor causing compounds by using three types of chemicals

[28] QCVN 08-MT:2015/BTNMT – National technical regulation on surface water quality. Column A2 is the water source for domestic water supply purpose, but need to apply appropriate treatment method, and other water use purposes including aquatic life protection, agricultural irrigation and others that need lower water quality.

such as oxidizing agent, acid and alkali solutions. Therefore, there would be a risk of chemical leakage into the environment during operation of the WWTPs. Due to the used chemicals are in the liquid phase, the spreading ability to surrounding areas is relatively low, only mainly impact on on-site workers. The impact is assessed at medium level.

i) Explosion/Fire incidents

Fire and explosion incidents could be caused by electric shock, lightning, or by humans such as smoking near flammable areas etc. If this incident occurs, damage to people and property would be caused. Therefore, fire and explosion prevention measures will be given specially attention. Medium impact level.

j) Working accidents

The probability of these risks depends on the awareness of workers on labor safety. The risk including electricity shock, fire/explosion exposure, or chemical leakage, fall into pond or conducting maintenance activities. The impacts could be injury, occupational diseases and even death. These impacts are anticipated to be low and only affect in the inner area of WWTP, because of i) plant will implement a number of preventive measures of this problem and safety training program for staff.; ii) at the high risk part of WWTP, the O&M activities will be conducted by relevant equipment and robot automatically; iii) the first aid equipment will be provided in the WWTP; iv) periodic occupational health care check will be implemented for all workers and staffs who are working in the WWTPs

5.5.2.2. Impacts and risks during operation of Suoi Tre canal

a) Impact on social connectivity and safety

There is agricultural land at the both sides of the upgraded section of the canal. This existing section of the canal is narrow and some few local people from one side bank pass through the canal to carry out agricultural activities on the other side. The increasing evaluation of canal bank and width could cause safety risks for local people who travel on the canal bank may drop/fall into the canal or they have to take long bypass route through the provincial road 747 (PR746). However, the risk and impact is at low level also: i) as observed from site survey, local people go to the site by motorcycle, thus canal bank will be concreted and more easy to travel by motorcycle; iii) the location of Suoi Tre canal is in the field, there are no farmer households living along the canal, thus very few people who need to cross the canal.

b) Damage of canal embankment

During the embankment operation, there is a risk on embankment subsidence due to: (i) heavy rain, great flood, weak foundation causing embankment erosion; (ii) construction of adjacent infrastructures could cause damage to the embankment. Any incidents of damage to embankments will directly affect the operation of the canal as it is the discharge canal for Tan Uyen WWTP. In addition, it will affect the quality infrastructures protected by the embankment system i.e. the inlet sewage collection pipes which are located under the two sides of the Suoi Tre canal. These impacts are long term, at moderate level, and could be mitigated by design and management measures.

c) Blockage of canal due to illegal waste discharge

As noted above, the canal will be designed to meet relevant Vietnamese technical standards and with the width of canal bed is 4.4m to 6m and currently flow capacity is $6m^3/s$. This risk of blockage of canal due to illegal waste discharge may not happen, but management unit

need to conduct period check on the canal to avoid any impacts on the normal flow of the canal and sure the drainage capacity of the canal.

5.6. CUMULATIVE IMPACTS

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones. The assessment methodology will be selected based on available information of relevant development projects and plans, strategy in the project area,

Geographic Scope:

Cumulative impacts are assessed for different items within the project and other related projects within a similar geographic area. This geographic area may vary, depending upon the issue area discussed and the geographic extent of the potential impact. As results from site survey and public consultation meetings, there is only on undertaking project to development basic infrastructures in Hung Uyen commune, Tan Uyen town. However, this project is indented to be completed at the end of 2020, before any civil works activities of project could be started.

Project Timing

In addition to the geographic scope, cumulative impacts also take into consideration the timing of related projects relative to the proposed subproject. For this analysis, other past, present, and reasonably-foreseeable future construction projects in the area have been identified based on the available information on the projects completed, being implemented, and to be executed in the city. The list of 14 relevant development activities and projects, which may implement during period from period of 2020 to 2025)have been identified and assessment for both construction and operation phase.

Valued Ecosystem Components (VECs)

A scoping has been conducted to identify the VECs for which cumulative impacts will be assessed and managed based on review of the recently completed and ongoing investments in the project to identify possible linkages and potential cumulative impacts of existing and planned projects. A list of potential VECs have been consulted with the affected communities and the local authorities. The final VECs and their rationales are described below:

- Water quality: Given the wastewater treatment activities, concurrent construction activities could result in increased erosion and subsequent sedimentation, with impacts to local drainages and/or storm drain capacity. But this type of impact of the project has been concluded is Low.
- Aquatic ecosystem: In general, project will contribute to improve water quality in Dong Nai and Sai Gon river, thus it will not create any cumulative impacts on the aquatic life.
- Air pollution: Construction of the subproject together with the identified cumulative projects located in the area would contribute additional dust and emissions to existing conditions in project area.
- Traffic and health safety: Given the heavy traffic on the roads and streets, additional vehicle travels as a result of multiple projects could exposed the community to the risks of traffic accidents and community health due to construction activities. These are the issues of concern by the local communities.

- Quality of life of the people in the project area: One of the key project objectives is to improve the lives of local communities through provision of basic services including collection of wastewater and wastewater treatment.
- Downstream water use: In general, project will contribute to improve water quality in Dong Nai and Sai Gon river by reducing the load of several pollutants will be discharge to these rivers, thus it will not create any cumulative impacts on downstream water use

Overview of the implemented projects

1) Southern Binh Duong Water Environment Improvement Project, phase I - Jica fund

The project started in 2007, covering Thu Dau Mot City, has been operating a wastewater treatment plant with a capacity of 17,000 m³ / day since 2013 for Thu Dau Mot area, so far, the plant has been operating to almost its full capacity and prepared for processing capacity increase.

2) Southern Binh Duong Water Environment Improvement Project, phase II - Jica fund

Construction was commenced by the end of 2012, the Jica funded project - phase II will be implemented in Thu Dau Mot City and Thuan An Town, the project's wastewater treatment plant has been operated a with a capacity of 17,000 m³ / day since 2017 for Thuan An area, so far the plant's capacity reaches approximately 10,000 m³ / day, achieving more than 59% of the designed capacity. By June 2020, Thuan An area reached 27% of the connection coverage, with 5,190 customers / a total of 19,500 connections boxes already being installed.

3) Drainage and wastewater treatment project in Di An area, Binh Duong province, WB fund

Construction commenced in June 2016, the project is implemented in the center of the town, which has operated a wastewater treatment plant with a capacity of 20,000 m³ / day from the end of 2018 and so far the treatment capacity has reached more than 41%.By June 2020, Di An area has the connection coverage of nearly 10% with 2,300 customers / 23,300 connection boxes already being installed.

4) Drainage and wastewater treatment project in Di An - Thuan An - Tan Uyen area

The project uses the ORIO fund of the Netherlands, the scope of implementation is in the area between Thuan An - Tan Uyen; including Binh Chuan, Thuan Giao and An Phu wards of Thuan An and Thai Hoa ward of Tan Uyen. The wastewater treatment plant has a designed capacity of 15,000 m³ / day, being put into operation by the end of the third quarter of 2019, and so far the treatment capacity reaches 25%.By June 2020, Di An area will have nearly 5% of connections coverage, with 400 customers / total 8,900 connection boxes having been installed.

5) Wastewater collection and treatment project for Ben Cat area

In 2019, Binh Duong province was preparing a project to collect and treat wastewater for Ben Cat area with the processing capacity of 15,000 m³ / day, using funds from the Drive program - the Netherlands. The progress of the project to collect and treat wastewater for Ben Cat area is from 2020 to 2024. The final discharge is to Sai Gon river.

6) Tan Hiep water supply plant

Tan Hiep water supply plant was built in 2008, turned into operation from 2010 with a design capacity: 120,000 m^3/day, served population: 38,950 people. The actual operating capacity of the plant is increasing from 2010 to 2017 by 30,000 m^3/day to 120,000 m3/day. The current

working capacity is equal to the design capacity. The factory takes raw water from Dong Nai river, the raw water intake point is about 2km downstream from the final discharging point of Tan Uyen wastewater treatment plant (intersecting with Tre stream and Dong Nai river) on Dong Nai river and it keep a distance of 2.5km from the discharging point of Tan Uyen WWTP on the Suoi Tre canal

7) Project on sluice gate for tide control in Binh Nham canal, Thuan An City

Project on sluice gate for tide control in Binh Nham canal, Thuan An City: With the task of protecting, controlling flood and preventing inundation due to the impact of flood discharge from Dau Tieng reservoir, the controlling of flood tide, supplying irrigation water for production, residential areas, technical infrastructure works belonging to Binh Nham ward, Thuan An City with an area of about 540.98 ha; Stormwater drainage for the basin from the Chom Sao - Suoi Don drainage route project with a total natural area of 1,596 ha; Combining to build a transport bridge with HL.93 load and transport roads connecting with the route along the Saigon river serving the economic, social and tourist development; Improve environmental pollution, creating beautiful architectural landscapes for the area. The project is expected to start construction in Quarters III-IV/2020 and will be completed in 2022.

8) Project for renovating and upgrading the drainage system of Binh Hoa, Thuan An City

Project of Improving and upgrading the drainage system of Binh Hoa, Thuan An City: With the task of water drainage for the land area of Vsip1 Area, Vietnam - Sing Residential Area, Binh Duong Boulevard basin... with a total area of 1,143 ha; Improving environment; Contributing to urban embellishment. It is expected that the project file will be approved in 2020, construction drawing design document will be approved, and construction commence in 2021 and the project will be completed by 2025.

9) Other projects in the 2021-2025 period

Also, in the period (2021-2025), the Agriculture and Rural Development Project Management Board will formulate and advise the Provincial People's Committee to approve the policy to carry out study on the projects of drainage, tide control and environment protection and urban embellishment such as:

- Project on sluice gates for tide control of Ba Lua, Vam Bung, Lai Thieu, Vinh Binh canals, Thuan An City.
- An Tay - Phu An embankment upgrading project - Ben Cat town.
- The project on drainage route of Bung Cu stream, Tan Uyen town. The project on dredging and reinforcing Suoi Cai, from Tho Ut Bridge to Ben San Bridge, Tan Uyen Town.
- Dredging project of Dong So stream, Bau Bang district and Ben Cat town.
- Project on reinforcing and upgrading embankments of canals under the drainage system of Song Than - Dong An industrial park and surrounding areas, Vinh Phu ward, Thuan An city.
- The project on drainage system of Tham Ro bridge system and the project on drainage system of Ong Thanh stream, Bau Bang district.

Cumulative impacts caused by the project are considered with development plans, development projects in the project areas. The relevant projects, actions, plans have been mentioned in Chapter 2 of the report. Results of cumulative impacts of the project in the general context of the project area can be summarized as follow.

5.6.1. During construction phase

The cumulative impacts of i) air pollution; ii) traffic safety and traffic congestion will be considered as additional value which could contribute to the current status to define weather the project will contribute to more serious environmental issues or not. According to the list of related projects above, only the 5th, 8th, and 9th projects can have cumulative impacts with Binh Duong WEIP during construction as there would be possibly some overlaps on time and location of construction activities. However, so far these two projects have not yet started the documentation and FS phase, thus there is no available detailed information for collection and assessment. In case all construction works are implemented simultaneously, the project would generate approximately 159 kg/day of domestic waste, 17.91 m^3/day of domestic wastewater, 483-644 kg/day of dust, 1,842,895 m^3/day of excavated soil; about 300 workers and 57-82 truck trips per day. If not properly managed, it would cause adverse impacts to urban aesthetic landscape, solid waste, wastewater and dust would impact to householders and visitors. However, the construction sites will be implemented in three different urbans; the construction phase is setup to be implemented in a long period of 45 months and only a limited number of construction sites to be implemented simultaneously. Therefore, this accumulative impact is relatively mitigated and assessed as moderate level.

The highest potential suffered areas are along roads including PR746, PR747, PR745, PR746B, DR411 (in Tan Uyen), and National road 1A, Nguyen Chi Thanh, Nguyen Huu Canh, Binh Nham 07, Binh Nham 04, Binh Nham (in Thuan An city).

Table 5.24. Traffic condition on the main intervened roads

Relevant construction Items	Main intervened roads	Current characteristic
Sewer pipelines and pumping station in Tan Uyen	On the main routes of Tan Uyen Town, several connection roads with the suburban areas Provincial road (PR) 747, PR 746 and district road (DR) 411, and short section of PR 746B, DR 409, PR 745 Nguyen Khuyen, Le Quang Dinh, Trinh Hoai Duc, Nguyen Tri Phuong, To Vinh Dien, Nguyen Thi Sau	Mostly high traffic volume excludes several main roads next to industrial parks or core area of Tan Uyen town which are divided and good pavement roads. Other are mostly undivided, marrow roads with the surface condition is from poor to moderate, and many trucks operating on these roads.
Secondary and Tertiary Sewer pipelines and pumping station in Di An	Nguyen Thi Toi, Phan Van Dieu, Bui Thi Xuan, Huynh Thi Toi and internal roads of several residential areas in Binh Thang and Binh An, Dong Hoa communes Roads of Le Trong Tan, An Binh, Tran Thi Vung, Ho Tung Mau, Be Van Dan, Nguyen Dinh Thi in An Binh commune	Traffic volume is varied from low to moderate, with dominated by cars or motorcycles. Several sensitive objects such as Primary schools, secondary schools, traditional markets and business shops located.
Secondary and tertiary sewer pipelines and pumping station in	National road 1A, Nguyen Chi Thanh, Nguyen Huu Canh, Cau Tau, Binh Nham 07, Binh Nham 04, Binh Nham	High traffic volume on National road 1A, but only very short pile section on this road

Di An		Other roads have moderate traffic volume or location within residential areas with lower traffic volume

5.6.2. During operation phase

VEC during the project's operation is determined to include (1) impacts on water quality of Dong Nai and Sai Gon rivers, (ii) living conditions of people in the project area, (iii) Water use downstream basin.

The project will cause affects to water quality in the watercourse where will take place as the final receive of treated wastewater from three WWTPs. The cumulative impacts of water quality, living conditions of the people in the project areas and water uses in the downstream areas will be considered as additional value could be contribute to the current status to define weather the project will contribute to more serious environmental issues or not.

5.6.2.1. Water quality

The operation of the WWTPs could lead to concentrate the wastewater from a wide urban areas in the final discharging points. The placement of several types of discarding points on the same received water bodies which could lead to increase the pressure for downstream and conflict of water usage purpose in the downstream areas.

During operation phase, most impacts will be on the receiving water bodies such as Dong Nai river and Sai Gon river which need to be considered, the main project is operating are:

- Thu Dau 1 wastewater treatment plant with a capacity of 17,000 m³/day in Thu Dau Mot city
- Tan Uyen 2 WWTP with capacity of 15,000 m³ / day
- Construction of Di An WWTP with capacity of 20,000 m³/day
- Construction of Thuan An wastewater treatment plant has been operated a with a capacity of 17,000 m³ / day.
- Ben Cat WWTP with capacity of 15,000 m³/day

After brought into operation phase, the project will contribute with an additional capacity of 60,000 m^3/day to the total wastewater treatment capacity of 144,000 m^3/day for Binh Duong province. The WWTPs are and will be discharged into Sai Gon river (Ben Cat WWTP, Thu Dau Mot WWTP and Thuan An WWTP) and into Dong Nai river (Tan Uyen WWTP, Tan Uyen 2 WWTP and Di An WWTP). The treated wastewater from all three project's WWTPs will meet QCVN 14:2008/BTNMT-Colum A (K=1,0) before discharged to the canals/rivers. Therefore, the water quality in these rivers will be improved and it is expected that no negative impact will happen during the WWTPs operation phase. The implementation of this project will help Dong Nai river (the section via Binh Duong province)stop receiving a total of 75,000 m^3/day of untreated wastewater, equally 12.75 ton/day of BOD_5, 15 ton /day of SS, 2.1 ton/day of Total nitrogen (TN), and 0.225 ton/day of Total phosphorus (TP). The Saigon river will stop receiving totally 69,000 m^3/day of untreated wastewater, equally11.73 ton/day of BOD5, 13.8 ton/day of SS, 1.9 ton/day of TN, and 0.207 ton/day of TP.

5.6.2.2. Living condition of people in the project area

Due to the strong socio-economic development and urbanization, Binh Duong has been attracting an abundant labor force to come in, leading to the increasingly generation of domestic wastewaters. These amounts of wastewater, if not being treated, can cause unsanitary conditions, affecting the living conditions of the local people, create many other

social and environmental issues such as disease sources, odors and degradation of surface and ground water sources, especially the two important main water sources of Dong Nai and Saigon rivers. The project will contribute an important part of the total amount of 144,000 m^3day of wastewaters to be collected and treated till meeting the allowable standards before being discharged into the environment, thereby improving the living environment and water quality for the projected areas and downstream of the rivers.

5.6.2.3. Downstream water use

In general, project will contribute to improve water quality in Dong Nai and Sai Gon river by reducing the load of several pollutants will be discharge to these rivers, thus it will not create any cumulative impacts on downstream water. By providing the WWT facilities to treat about 60,000 m^3 of wastewater daily, which could contribute to achievement the objectives of annual reduction of domestic wastewater pollution discharged to Dong Nai and Sai Son rivers and enhance the water quality and improve the water use quality for inhabitants in the downstream areas.

For Tan Hiep water supply plant (with capacity of 120 m^3/day)which uses the raw surface water source of Dong Nai river located about 2.5 km downstream of the discharge point of Tan Uyen WWTP: due to the discharged flow is quite small compared to the river flow in the dry season (0.23 m^3/s of the discharge flow versus 45.93 m^3/s), the dilution factor is quite large, with about 200 times), therefore, the change of the river water quality during accidental discharges (if any) is assessed to be very small. And according to the results of calculation as shown in Appendix 5, in case of the accidental discharge, the quality of Dong Nai river's water would be restored at the distance of 200 m downstream as it is before receiving the discharge volume, therefore the impact is assessed not significantly. On the other hand, each WWTP has been designed with an incident lake which could contain and store the wastewater about one day time at the WWTP before being discharged out into the ambient waters. Also, the break reparation period is assessed not so long, usually only taking one or two days. Therefore, the risk of discharging raw wastewaters out to the environment is assessed being negligible. However, to ensure the safety of water supply and other water use purposes downstream, in the event of a breakdown (if any), the WWTP operators needs to notify the water users downstream to have plans to closely monitor during the incident discharge.

5.7. INDUCED IMPACTS

The induced impacts can be considered as the project activities may take place as the driving forces for other activities will be developed or implemented, or create environmental and social change trend in the project areas such as change the land use status, promoting climate change mitigations or reduce the public healthcare cost…

Binh Duong Water Environment Improvement Project will include new construction of WWTP in Tan Uyen town, expansion the capacity of 2 existing WWTPs in Di An city and Thuan An, improvement the downstream of Suoi Tre canal, construction of pumping stations and wastewater collection system in 9 wards in Tan Uyen town (including Khanh Binh, Tan Hiep, Tan Phuoc Khanh, Hoi Nghia, Uyen Hung, Tan Vinh Hiep, Thanh Phuoc, Phu Chanh, Vinh Tan), 3 wards in Thuan An city (Vinh Phu, Binh Nham, Hung Dinh), 5 words in Di An city (Binh An, Binh Thang, Tan Binh, and a rest in Dong Hoa and An Binh wards). The project implementation area is quite scattered, then the induce impacts on change the land use status, reduce the public healthcare cost… will very minor. For the impacts of climate change: the rehabilitation of Suoi Tre canal has been designed with the calculation of drainage

capacity based on the rainfall volume in consideration of climate change for a frequency of 10-year cycle. This will ensure the drainage capacity for Suoi Tre canal in the future.

In additional, to mitigate damage caused by climate change and sea level rise, the Provincial People's Committee of Binh Duong has reviewed and supplemented solutions for every sector, agencies in the province to adapt to climate change and sea level rise into the provincial socio-economic and construction development plans. The project components were designed in compliance with these plans.

CHAPTER 6. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

Based on the assessments of the potential adverse environmental impacts and mitigation measures proposed in Chapter 5 of the report, this Chapter presents an Environmental and Social Management Plan (ESMP) for the Project. The ESMP identifies the measures to be carried out for the project, including environmental monitoring program and implementation arrangements, taken into account the needs to comply with the government's EIA regulations and WBG's ESF and ESSs , including Environmental, Health, and Safety (EHS) Guidelines of the WB.

This ESMP consists of main contents as follows:

- The measures to minimize the potential environmental impacts to be incorporated into the Feasibility Study and Detailed Design, and the mitigation measures to address the adverse impacts during pre-construction, construction, and operation phases together with implementation responsibilities;
- Environmental Monitoring Program;
- The project Compliance Framework, including environmental and social supervision arrangements, fines applicable to non-compliance;
- Capacity building programs;
- Cost estimation; and
- Grievance Redress mechanism.

6.1. MITIGATION MEASURES

6.1.1. General principals

This section identifies mitigation measures of the project impacts and risks during the pre-construction and construction (including measures integrated into detailed technical design, site clearance, ground leveling, construction, and restoration) and operation phases.

This section focuses on prosing appropriate mitigation measures in order to prevent, avoid or mitigate the negative impacts on human and natural environment in the project area of influence

Based on the negative impacts identified and analyzed in Chapter 5, the mitigation measures have been proposed for three phases of project implementation i.e. pre-construction, construction and operation. A hierarchy approach has been adopted during the development of mitigation measures:

- Anticipate and avoid risks and impacts;
- Where avoidance is not possible, minimize or reduce risks and impacts to acceptable levels;
- Once risks and impacts have been minimized or reduced, mitigate; and
- Where significant residual impacts remain, compensate for or offset them, where technically and financially feasible

Given that most of the key impacts will occur due to civil works and transportation of construction/waste materials, many of the potential negative impacts on physical, biological, and social environment could be mitigated through a set of general measures that are typically applied to most of construction subprojects to minimize impacts such as noise, dust, water, waste, etc. Since there are specific impacts, this also address the measures both during the construction and operation phases.

6.1.2. Measures to be integrated into feasibilities studies and detailed design

Project design including detailed design could produce long-term opportunities to avoid negative impacts on natural and socio- economic environments if environmental factors are not adequately considered. Typically, adverse impacts relating to project design include land acquisition and resettlement, encroachment on ecosystem, visual impacts (i.e. landscape disfiguration), localized flooding, and other risks. Some of these impacts have been mitigated by careful surveys, calculations and consultations with local governments in the conduct of the preliminary design. Key measures implemented at preliminary design stage to minimize the project's social and environmental impacts included the following:

For all works:

During the detailed engineering and preparation bid documents, the PMU and detailed design consultants shall update and include relevant generic measures (specified in Tables 6.1 of the ESIA) and site specific mitigation measures (as specified in Table 6.2 of ESIA) to reflect the measures in the form of "Incidentals to work items" or "specifications and BoQs" in case of works contracts.

i) Sewerage collection network expansion including pumping stations

- To mitigate impacts on local flooding, PMU and detailed design consultant shall ensure that detailed design will consider adequate temporary drainage to avoid potential flooding during construction
- To mitigate social disturbance and traffic risks, PMU will ensure that detailed design consider aspects on the transportation plan and construction time.
- To mitigate impacts on PCRs and sensitive receptors, PMU shall ensure that detailed design consider arranging temporary walkways to ensure safety and accessibility for those working or living on construction sites
- The pump stations located at public places will be designed with fences and warning signs to ensure safety and landscape beauty
- Minimize energy consumption on pumping by maximizing the use of ground gravity
- To mitigate the pollution due to the broken of blocked pipelines, following measures shall be taken into account during detailed design
    - Limit the sewer depth where possible by utilize the natural terrain
    - Minimize energy consumption on pumping by maximizing the use of ground gravity
    - Selecting high quality material of pipe to ensure the pipelines could maintain with high pressure (uPVC for D≤ 300 (OD315 and HDPE for D > 300) and the lifetime of these type of pile is over 50 year.

- Ensure sufficient hydraulic capacity to accommodate peak flows and adequate slope in gravity mains to prevent build-up of solids and hydrogen sulfide generation.
- Design collection pits and pumping stations covers to withstand anticipated loads and ensure that the covers can be readily replace if broken to minimize entry of garbage and silt into the system.
- The closed circuit television(CCTV) equipment for pipe inspection (including computer and peripheral equipment) need to be equipped for operation units to use for checking pipeline situation periodically (every 6 months);

ii) Upgrading and Construction of Wastewater Treatment Plans (WWTPs)

- In the designing phase, the safety distance for environmental sanitation was guaranteed in compliance with the regulation of QCVN 01:2008/BXD[29]. According to this regulation, the minimum distance allowable for buffer zone of the project's WWTPs (without sludge drying yard, drying mud by dewatering machines, equipping with odor treatment system) is 30m.
- Applied treatment technology to ensure treated wastewater meet the requirements of QCVN 14:2008/BTNMT, column A;
- Detention ponds will be provided within the WWTP to storage temporally untreated wastewater when incidents happen and WWTP stop operating.
- Since the wastewater discharge fee is included in the monthly water supply invoice, and the money recover (return) seem to be quite small and could not cover all O&M cost for WWTP, thus ensure a properly budget allocation for operating the WWTP during operation phase is quite importance issue. Any failure of budget allocation will strongly affect to properly operation of WWTP, and thereby affecting environment.
- Designing a corridor of green trees surrounding fences to create green landscapes planting shade trees around the administrative building to reduce the impacts of noise, and odor generation
- Maximize the use of energy/fuel efficiency or renewable energy in some parts or several equipment of the WWTP; Toilet, washing, and showers areas will be included in the administration building for the operators to use after working shifts. Designing the administrative building in a way to make full use of natural light to enhance energy/fuel efficiency and to use energy-saving water and electricity devices;
- Designing works generating a lot of odors such as intake works, temporary storage facilities and sludge dewatering, etc. in closed houses; designing pipe work collecting gases generated during the treatment process in odor treatment works.;
- Inclusion of an automatic monitoring system to monitor flow rate at intake and discharge point, flow, pH, COD, TSS and EC. Having an automatic monitoring system is critical as it allows timely detection of problems if encountered, to ensure the system is operated in a stable manner. At the same time, it also facilitates the monitoring of treated wastewater discharge by environmental management agency. Monitoring Data will be shared with the Binh Duong DONRE.
- An Emergency Response plan has been proposed to address the causes where there is some failure in the wastewater treatment system.

[29] QCVN 01:2008/BXD is Vietnam construction sector regulation of construction planning.

- Greening the WWTP sites and office building to save electricity on air condition etc.

iii) Suoi Tre canal improvement

- To enhance the drainage and flooding management capacity the technical design specifications need to ensure: i) taking in to consider the adequate drainage catchment areas; ii) the sufficient connections of both intakes and outlets locations to ensure the role of flooding regulating functions and avoid stagnant water;
- The design of the embankment has been calculated on the basis of surveys on hydrologic regimes (flood levels, flow regimes, etc.), topography and geology of the area to ensure the safety and effective operation of the embankment.
- The detailed design for canal dredging shall include the update of Dredged Material Management Plan (DMMP) with additional analysis of sediment quality, detailed information on the amount of generated sediment, requirements on contractor's dredging method, temporary storage of sludge, transportation and disposal that are appropriate and cost-effective.
- Detailed design will consider adequate temporary drainage to avoid potential flooding during construction.
- Creation facilities should be included in the design to enhance the public open space features and maximize the benefit of the provided public facilities. The harmony between the design and various features of the structure and pattern of the landscape should be taken place.
- To mitigate the impacts on social connectivity along improved Suoi Tre canal section, the cross bridges shall be included in the feasibilities studies (FS) and detailed design and their location will be considered in the detailed design to ensure optimal access of local people to their agricultural land at the two banks of the canal

6.1.3. Measures to mitigate impacts in Pre-construction phase

6.1.3.1. Land acquisition and resettlement

Land acquisition and resettlement will be compliance with project Resettlement Action Plan (RAP) which was prepared and submitted to the World Bank for approval before project appraisal. The RAP establishes the resettlement policies, eligibility requirements and entitlements of affected people for compensation, valuation methods; describe the legal and institutional framework, organizational arrangements, mechanisms, and community consultation and participation, and grievance redress mechanism (GRM) to be applied to the project during the project implementation.

The RAP was prepared in compliance with the relevant World Bank's ESF - ESS5: Land acquisition, restrictions on land use, involuntary resettlement and the Vietnam's laws and regulations. The basic guiding principles of the World Bank's resettlement policy are:

- Involuntary resettlement should be avoided where feasible, or minimized after exploring all viable alternatives in project design;
- Where resettlement cannot be avoided, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the people affected by the Project to share in benefits. Affected Persons should be meaningful consulted and should have opportunities to participate in planning and implementing resettlement programs.

- Affected Persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-project levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

PMU has worked closely with the project preparation consultant and resettlement specialists to avoid, minimize magnitude of land acquisition and to ensure that the scope of resettlement impact is mitigated in all work items or packages in the project.

The benefit policy applicable to households affected by the project will be subject to World Bank's Environmental and Social Standard 5 - Land Acquisition, Restrictions on Land Use and Involuntary Resettlement (ESS5), Vietnamese laws and regulations. The basic principles applied for preparation of this Resettlement Action Plan are that all eligible AHs of the project will be compensated at replacement cost and assisted with restoration measures to help them improve or at least maintain the living conditions as before the project, as the below:

(a) All PAPs residing, working, doing business or farming in the project areas before the project cut-off date will be provided with rehabilitation measures, sufficient enough for them to improve or at least maintain their living standards, income earning and production capacity the same as their pre-project conditions. Lack of legal rights to acquired land will not prevent PAPs from their entitlement to access such rehabilitation measures.

(b) All PAPs who have assets within or reside within the area of project land acquisition before the cut-off date are entitled to compensation for their losses as per this RAP. Those who have lost their income and/or subsistence will be eligible for livelihood rehabilitation assistance based on the criteria of eligibility defined by the project in consultation with the PAPs. If, by the end of the project, livelihoods have been shown not to be restored to pre-project levels, additional measures should be considered.

(c) Agricultural land that is lost will be compensated in cash at the full replacement cost. These PAPs will be assisted in their livelihood subsistence and restoration.

(d) Compensation for all residential, commercial, or other structures will be offered at the replacement cost, without any depreciation of the structure and without deduction for salvageable materials.

(e) Livelihood restoration program is vital to help severely affected households, vulnerable households improve or at least restore their income and living standard as equal to or better than pre-project level. Apart from financial support, vocational training is also provided to AHs.

Cost estimate for implementation of RAP for the project is about VND 553,523,000,000, (equivalent to US$ 23,787,000). This budget includes costs of compensation for land, structures, assets affected by the project, assistance and income restoration program, monitoring and evaluation, replacement cost survey, implementation management and contingency. Budget for implementation of site clearance will be allocated from counterpart fund of Binh Duong province.

6.1.3.2. Unexploded ordnance removal

Unexploded bombs and mines will be searched for removal right after completing the compensation for site clearance and before construction activities started on the sites. The UXO removal shall be conducted for new construction location of Tan Uyen WWTP, Suoi Tre canal improvement, and new pumping stations or in any new road where UXO screening has not yet been conducted previously. PMU will sign contract with an authorized agency for

removing UXO (the depth at least 5.0 m under the ground) at defined construction locations. The UXO clearance plan must be informed to local people before commencement of the clearance. No construction activities will be allowed before completion of the UXO and certified that the project areas are already been cleared issued for the PMU

6.1.4. Mitigation measures in construction phase

As discussed in Chapter 5, the potential impacts and main risks that may occur during the construction include: (i) impacts on air quality; (ii) impacts of noise and vibration; (iii) impacts on water quality; (iv) impacts due to solid wastes and hazardous waste (v);increase traffic and relative accident; (vi) risk of raw material supply (vii) local flooding; (viii) worker health and safety risk; (ix) impacts on public facilities; (x) impacts on urban landscape and beauty, (xi) community health and safety risk; (xii) social risk and relative to labor influx. In addition, some specific impacts by each work items such as sewer system construction and expansion, WWTPs construction and improvement, Suoi Tre canal improvement have also been identified.

Below are the mitigation measures to be implemented during the construction phase of the project and presented by category:

- General mitigation measures presented as in the Environmental and Social Codes of Practice (ESCOP). ESCOP will be applied to all bid packages by the contractors and supervised by the construction supervision consultant (or Engineer).
- Mitigation measure applicable to specific types of activities to be carried out; and site-specific mitigation measures to address site-specific potential impacts and risks
- Bidding documents and construction contracts of each bid package will include the entire ESCOP and specific mitigation measures by type of construction activity and location consistent with the work content in the bid package.
- The contractors will be required to prepare Site-Specific or Contractor's Environmental and Social Management Plan (S-ESMP or C-ESMP) and submit to the Construction Supervision Consultant (CSC) and the project Management Unit (PMU) for review and approval at least two weeks prior to construction commencement. The S-ESMP will be prepared to meet the mitigation requirements described in below.

6.1.4.1. Environmental and social Codes of Practice (ESCOP)

The mitigation measures for common negative impacts during the construction phase are presented in Tables in the form of Environmental and Social Codes of Practices (ESCOP). ESCOP will be included in all bidding documents and construction contracts of all bid packages to request the contractors to implement. ESCOP compliance will be supervised by the CSC in coordination with PMU.

ESCOP, together with relevant type-specific and site-specific mitigation measures will be included in the construction contract signed between the PMU and the Contractor. In addition, each contractor will be required to prepare Site-specific Environmental Management Plan (SEMP) to cover all measures that the contractor will carry out to address potential impacts and risks associated with the works that they are contracted to implement.

- Impacts on air quality;
- Impacts of noise and vibration;
- Impacts on water quality;

- Solid wastes generation.
- Increase traffic and relative accident;
- Risk of raw material supply;
- Local flooding control
- Worker health and safety risk
- Impacts on public facilities.
- Impacts on urban landscape and beauty
- Community health and safety risk
- Social risk and labor influx
- Chance finds procedures

Table 6.1. Environmental and Social Codes of Practices (ESCOPs)

Environmental & social issues	Mitigation measures	Vietnamese regulation/WB's EHS standard	Responsibility	Supervised by
1. Impacts on Air quality	- The Contractor is responsible for compliance with relevant Vietnamese legislation with respect to ambient air quality. Thee Contractor shall ensure that the generation of dust is minimized and is not perceived as a nuisance by local residents and shall implement a dust control plan to maintain a safe working environment and minimize disturbances for surrounding residential areas/dwellings. - The Contractor shall implement dust suppression measures (e.g. use water spraying vehicles to water roads, covering of material stockpiles, etc.) as required. - Material loads shall be suitably covered and secured during transportation to prevent the scattering of soil, sand, materials, or dust. - Exposed soil and material stockpiles shall be protected against wind erosion and the location of stockpiles shall take into consideration the prevailing wind directions and locations of sensitive receptors. - Dust masks should be used where dust levels are excessive; - Trucks carrying material wastes materials must be covered. All trucks should not subsist overloaded and fix with its body - Provision of wheel-wash stations at the ingress/ egress points on the construction sites of three WWTPs to clean construction vehicles which is moving out of the construction site from depositing soil dust on public road - Periodically wash the trucks used for transporting materials and construction wastes - Soil scattered on the paved road and public road due to over fill or fallout from the trucks should be removed immediately - Loading and unloading construction materials, waste need to schedule to avoid the rush hours and forbids during the nightie (from 22 pm – 6 am) at the section nearby the hospitals and residential areas	- TCVN 6438-2005: Road vehicles - Maximum permitted emission limits of exhaust gas - Decision No. 249/2005/QĐ-TTg of the Prime Minister, Regulation on Emission Roadmap dated 10 October 2005 for road transportation vehicles; - Decision No. 35/2005/QD-BGTVT on inspection of quality, technical safety and environmental protection - QCVN 05: 2013/MONRE: National technical regulation on ambient air quality; - WB's EHS standard	Contractor	PMU, CSC, IEMC

	- Vehicles mobilized on the construction sites must undergo a regular emissions check and get certified named: "Certificate of conformity from inspection of quality, technical safety and environmental protection" following Decision No. 35/2005/QD-BGTVT; - Burning of solid wastes or construction materials (e.g. wood, rubber, oil-based rag, emptied cement bags, paper, plastic, bitumen, etc.)shall be forbidden on site.			
2. Noise and vibration impacts	- The contractor is responsible for compliance with the relevant Vietnamese legislation with respect to noise and vibration. - All vehicles must have appropriate "Certificate of conformity from inspection of quality, technical safety and environmental protection" following Decision No. 35/2005/QD-BGTVT; to avoid exceeding noise emission from poorly maintained machines. - Measures to reduce noise to acceptable levels should be implemented, including: ▪ Selecting equipment with lower sound power levels ▪ Installing silencers for fans, if needed ▪ Installing suitable mufflers on engine exhausts and compressor components ▪ Installing acoustic enclosures for equipment casing radiating noise ▪ Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m^2 in order to minimize the transmission of sound through the barrier ▪ Barriers should be located as close to the source or to the receptor location to be effective ▪ Installing vibration isolation for mechanical equipment - Limiting the hours of operation for specific pieces of equipment or operations, especially mobile sources operating through community areas - Re-locating noise sources to less sensitive areas to take advantage of distance and shielding - Siting permanent facilities away from community areas if possible - Taking advantage of the natural topography as a noise buffer during facility	- QCVN 26:2010/BTNMT: National technical regulation on noise - QCVN 27:2010/BTNMT: National technical regulation on vibration; - Decision No. 35/2005/QD-BGTVT on inspection of quality, technical safety and environmental protection - WB's EHS standard	Contractor	PMU, CSC, IEMC

	design - Reducing project traffic routing through community areas wherever possible - Developing a mechanism to record and respond to complaints - Limit concurrent usage of several noise generate equipment apply for construction activities near by the noise and vibration sensitive receptors; - All works must be conducted during the hours of 07h00 to 19h00 - In case that, noise generation equipment needs to run during nighttime and holiday time nearby the above sensitive objects, the detail schedule will be considered and approved by supervisors before could be applied - Spread out the operation of construction equipment, especially for equipment that produces high vibration - Local communities must be informed about construction schedules and time through informal public consultation or any local people meetings and notice board			
3. **Impacts on water quality**	- The Contractors are responsible for controlling surface water quality when discharging it out of construction sites, in accordance with QCVN 08-MT:2015/BTNMT and QCVN 14:2008/BTNMT; - The contractor needs to undertake all mitigation stated under **"Solid Waste Management**" - Undertake earthworks where possible during dry season, to reduce the runoff water from the construction sites which lead to increase content of SS and pollutants in surrounding water bodies or block the exiting drainage system - Covering material storage areas should be implemented during rainy times, Temporary storage of construction waste on the sites will be no longer than 24 hours and it must be covered; - Perform concrete mixing on impermeable ground only, at least 20m far from any water sources. Collect wastes and wastewater containing cement at sedimentation traps and drainage ditches regularly to limit number of solids entering receptors; - All equipment shall be kept in good working order and serviced regularly. Leaking equipment shall be removed immediately from site and repaired - Maintain vehicles and replace oil at designated workshops only. Do not perform	- QCVN 14:2008/BTNMT: National technical regulation on domestic wastewater; - QCVN 08-MT: 2015/BTNMT: National technical regulation on surface water; - QCVN 40: 2011/BTNMT: National technical regulation on industrial wastewater; - WB's EHS standard	Contractor	PMU, CSC, IEMC

	these activities at sites; - Carry out concrete mixing on impermeable grounds only. Collect wastes and wastewater containing cement at the sedimentation traps and drainage ditches regularly to limit number of solids entering receptors; - Provide sedimentation pits and ditches at big construction sites; - Provide appropriate toilets for the workers; - Avoid carrying out excavation and backfilling in rainy weather; - Collect and transport materials and wastes generated during excavation and backfilling materials to designated sites for reuse or final disposal as soon as possible; - Collect and transport excavated soil out of construction sites within 24 hours. Dredged materials must be transported away from temporary disposal sites as soon as they are dry sufficiently; - Washing instruments/vehicles next to the water bodies is forbidden to avoid leaching of waste, sludge, soil, oil contaminated water - Maintain vehicles and equipment, including oil replacement or lubrication, at designated areas only. Ensure that no chemicals, petrol, oil, or grease are leaked into the soil, drains or water sources. Use trays to hold rags and materials used in maintenance. Collect and dispose wastes in accordance with hazardous waste management requirements. **Wastewater management**: - The Contractor must be responsible for compliance with the relevant Vietnamese regulations on wastewater discharges into surroundings. - Set up worker camps at least 100 meters away from surface water bodies - Portable or constructed toilets must be provided on site for construction workers. - Consider hiring local workers to reduce wastewater generation on site. - Provide septic tanks for collecting and treating wastewater from toilets. - Wastewater from kitchens, showers, sinks shall be discharged into a local sewerage system. - Wastewater from washing vehicles and construction equipment shall be collected into a settling pond before discharged into local drainage system.			

	- At completion of construction works, wastewater collection tanks and septic tanks shall be safely disposed of or effectively sealed off			
4. **Solid waste generation**	**Domestic solid waste management:** - Before construction, a solid waste control procedure (storage, provision of bins, site clean-up schedule, bin clean-out schedule, etc.) must be prepared by Contractors and it must be carefully followed during construction activities. - Before construction, all necessary waste disposal permits, or licenses must be obtained. - Measures shall be taken to reduce the potential for litter and negligent behavior with regard to the disposal of all refuse. At all places of work, the Contractor shall provide litter bins, containers and refuse collection facilities. - Domestic waste generated on the site shall be managed as the following steps: i) provide dustbins at work site; ii) waste category for reuse; iii) domestic waste and garbage from worker camps need to be collected by hygienic manner through service provision - Solid waste may be temporarily stored on site in a designated area approved by the Construction Supervision Consultant and relevant local authorities prior to collection and disposal through a licensed waste collector, for example, URENCO. - Garbage bins: need to meet the requirement of Ministry of Construction QCVN 07:2010/BXD as detail: i) volume of garbage bin will be 100 litters and no exceed 1m3; ii) garbage bin with coverage; iii) location of garbage bins will be every 100 meters; iv) waste standing on garbage bin will not allow to over 24h; v) daily clean the bins is required. - Daily waste shall be collected separately in garbage cans with lids, watertight to avoid odors, leaks, attract flies, mice and other pathogens - No burning, on-site burying or dumping of solid waste shall occur. - Recyclable materials such as wooden plates for trench works, steel, scaffolding material, site holding, packaging material, etc. shall be collected and separated on-site from other waste sources for reuse, for use as fill, or for sale. - Excavation soil need to collect, transported and disposed at the agreed disposal sites - If not removed off site, solid waste or construction debris shall be disposed of	- Decision No. 59/2007/ND-CP on solid waste management; - Decree No. 38/2015/ND-CP dated 24/04/2015 on waste and scrap management	Contractor	PMU, CSC, IEMC

	only at sites identified and approved by the Construction Supervision Consultant and included in the solid waste plan. Under no circumstances shall the contractor dispose of any material in environmentally sensitive areas, such as in areas of natural habitat or in watercourses. **Hazardous material storage and waste management** - Fuels and chemicals must be safely stored in areas with impermeable ground with roofs and surrounding banks, equipped with safety warning signs located at least 20m from the camps and at the end of prevailing winds; - Collect, store, and transported for treatment all hazardous wastes (road asphalt, waste oil and grease, organic solvents, chemicals, oil paints, etc.) in accordance with Circular No. 36/2015/TT-BTNMT on management of hazardous waste. - Store used and unused oil and petrol on impermeable grounds covered with roofs, with warning (flammable and danger) signs, and contained within surrounding fences for easy control and collection in case of leakage. Locate oil and petrol storage areas at least 25m from any ponds, lakes, rivers, and streams. Restrict accessibility to these temporary storages to only authorized persons - Collect and temporarily store used oil and grease separately in specialized containers and place in safe and fire-free areas with impermeable floors roofs, at a safe distance from fire sources. Sign contracts with for oil and grease to be delivered to suppliers/ manufacturers; - Ensure all storage containers are in good condition with proper labelling and weekly records on volume of used hazardous substances and generated waste - Do not use unapproved toxic materials, including paint containing lead, asbestos, etc.; - The removal of asbestos-containing materials or other toxic substances shall be performed and disposed of by specially trained and certified workers. - Used oil and grease shall be removed from site and sold to an approved used oil recycling company. - Do not perform any maintenance (change of oil and filter) of cars and equipment outside the designated area. - Used oil, lubricants, cleaning materials, etc. from the maintenance of vehicles and machinery shall be collected in holding tanks and removed from site by n approved specialized oil recycling company for disposal.			

	- Used oil or oil-contaminated materials that could potentially contain PCBs shall be securely stored to avoid any leakage or affecting workers - Unused or rejected tar or bituminous products shall be returned to the supplier's production plant. - Relevant agencies shall be promptly informed of any accidental spill or incident - Store chemicals appropriately and with appropriate labelling - Appropriate communication and training programs should be put in place to prepare workers to recognize and respond to workplace chemical hazards - Report all incidences of oil spills immediately and prevent any risks of oil spills - Prepare and initiate a remedial action following any spill or incident. In this case, the contractor shall provide a report explaining the reasons for the spill or incident, remedial action taken, consequences/damage from the spill, and proposed corrective actions. In the event that accidental leakage or spillage of diesel/chemicals/chemical wastes takes place, the following response procedures shall be followed immediately by the Contractor(s) + The person who has identified the leakage/spillage shall immediately check if anyone is injured and shall then inform the Contractor(s), Supervision Engineer and PMU; + The Contractor(s) shall ensure any injured persons are treated and assess what has spilled/ leaked; + Should the accidents/ incidents generate serious environmental pollution (e.g. spillage/leakage of toxic or chemicals, large scale spillage/leakage, or spillage/leakage into the nearby water bodies, the Contractor shall immediately inform PMU; + In such cases, the Contractor(s) shall take immediate action to stop the spillage/leakage and divert the spilled/leaked liquid to nearby non-sensitive areas; + The Contractor(s) shall arrange maintenance staff with appropriate protective clothing to clean up the chemicals/chemical waste. This may be achieved through soaking with sawdust (if the quantity of spillage/leakage is small), or sandbags (if the quantity is large); and/or using a shovel to			

	remove the topsoil (if the spillage/leakage occurs on bare ground); and + Depending on the nature and extent of the chemical spill, evacuation of the activity site may be necessary; + Spilled chemicals must not be flushed to local surface drainage systems. Instead, sawdust or sandbags used for clean-up and removed contaminated soil shall be disposed of by following the procedures for chemical waste handling and disposal already described; + The Contractor(s) shall prepare a report on the incident detailing the accident, clean up actions taken, any pollution problems and suggested measures to prevent similar accidents from happening again in future. The incident report shall then be submitted to the Supervision Engineer and PMU for review and keep in the records. The incident report shall also be submitted to DONRE, if required			
5. **Increase traffic and relative accident**	- The contractors need to prepare traffic management plan which will be agreed by local traffic management authorities before starting construction activities on traffic roads - Coordinate with local traffic authorities to implement traffic diversion schemes to avoid inconvenience to road users, ensure smooth traffic flow and avoid or minimize accidents, traffic hold ups and congestion - Install and maintain sign boards, fences, signal lights to direct traffic to ensure traffic safety. - Avoid mobilizing and place too many pieces of equipment on the traffic roads at the same time; - Trucks must be covered to prevent materials from dropping along the routes to cause dusts and accidents; - Provide signs advising road users that construction is in progress and that the road narrows to one lane using ones, specially on the construction sites of Sewer pipelines and pumping stations. - Construction activities on the surface of the construction sites of sewer pipelines and pumping stations streets should be implemented section by section to reduce temporary encroachment of road surface and reinstate the road surface immediately since construction activities completion on these sections. - Arrange and provide alternative access roads with safe and easy access for	- Law on traffic and transport No. 23/2008/QH12; - Decree 46/2016/ND-CP on administrative penalty for traffic safety violation - Law on construction No. 50/2014/QH13; - Circular No. 22/2010/TT-BXD on regulation on labor safety in construction	Contractor	PMU, CSC, IEMC

	pedestrian and for people with disability and mobility issues especially the areas in proximity of schools, households, business hospitals, shops in case that the roads could be blocked - Employ flag persons to control traffic at the construction sites for safety reasons when construction equipment is entering or leaving the work area at all construction sites - Set up traffic and maintain instruction signs and warnings to secure safety for people and means of transport during construction. - Put speed limit signs at a distance of 200m from the construction site. - Carefully cover materials on trucks. Do not load to a height of 10cm higher than the truck body so as not to spill out and scatter materials onto roads, giving rise to dust and endangering road users. - Collect spilt soils and materials at the construction site each day to avoid slippery incidents for vehicles. - Do not park vehicles in the roads longer than necessary. Do not allow construction vehicles and materials to encroach upon the pavements. - Water the roads to prevent dust, limit the speed of traveling trucks, do not allow flared horns, and do not dispose the waste and wastewater onto local residential areas. - Significant increases in number of vehicle trips must be covered in a construction plan previously approved. Routing, especially of heavy vehicles, needs to take into account sensitive sites such as schools, hospitals, and markets. - Installation of lighting at night must be done, if necessary, to ensure safe traffic diversion. - Avoid material transportation for construction during rush hours and only use vehicles with valid registration.			
6. **The risks of raw material supply**	- Project shall be purchased raw materials from local and available sources; - Procure raw materials only from DONRE authorized quarries/mines, the PMU and contractors need to secure of all necessary environmental permits and operation license before using these material sources; - Materials must be tested before signing subcontracts with suppliers to supply the materials;	- Law on material No. 60/2010/QH12 dated 17/11/2010. - Decree No. 15/2012/NĐ-CP dated 09/3/2012 on detail	Contractor	PMU, CSC, IEMC

	- Check the sufficient quantity of materials based on the demand of the project - The periodic check or monitoring should be implemented at the sites of the raw material supplies to ensure their compliance with environmental permits and operation license as well as relevant regulations, including the labor management compliance and traffic safety during material transportation.	some articles of Law on material. - Decree 40/2019/ND-CP dated May 13, 2019 of the Government on amendments to decrees on guidelines for the law on environment protection; - Circular No. 25/2019/TT-BTNMT dated Feb 15, 2020of the MONRE on elaborating some articles of the decree no. 40/2019/ND-CP dated May 13, 2019		
7. **Localize flooding control**	- Periodically and thoroughly remove soils, stones and wastes from drainage sewers and ditches inside and around the construction site. - Neatly gather materials and wastes so as to limit them being swept away by stormwater. - Carry out ground levelling and rolling after discarding materials at disposal sites. - Install supports to protect the walls where excavation is deeper than 2 m. - Check the existing drains within and surrounding the construction sites, improve before levelling to ensure rainwater can be drained properly; - Load construction material and wastes at least 10 m from any existing drainage ditches or water sources to minimize materials from entering the channels which may lead to sedimentation and blockage;	- TCVN 4447:1987: Earthwork – construction scope - Circular No.22/2010/TT-BXD on construction safety - QCVN 08-MT:2015/BTNMT – National technical regulation on surface water quality;	Contractor	PMU, CSC, IEMC

8. **Workers' health safety risks**	- Provide training in EHS to workers for raising their awareness of infectious diseases especially HIV/AIDS within 2 weeks prior to the commencement of packages for construction items lasting at least 6 months. - Provide training in first-aid skills and first-aid kit to workers and site engineer - Regularly exam worker's health to ensure occupational health - Provide workers with PPE such as masks, gloves, helmets, shoes/boots, goggles, safety belt, etc. and enforce wearing during working especially working at heights and in dangerous areas. - Limit or avoid working in extreme weather conditions, e.g. too hot, heavy rain, strong wind, and dense fog. - Provision of proper eye protection such as welder goggles and/or a full-face eye shield for all personnel involved in, or assisting, welding operations. Additional methods may include the use of welding barrier screens around the specific workstation (a solid piece of light metal, canvas, or plywood designed to block welding light from others). Devices to extract and remove noxious fumes at the source may also be required. - Special hot work and fire prevention precautions and Standard Operating Procedures (SOPs) should be implemented if welding or hot cutting is undertaken outside established welding work stations, including 'Hot Work Permits, stand-by fire extinguishers, stand-by fire watch, and maintaining the fire watch for up to one hour after welding or hot cutting has terminated. Special procedures are required for hot work on tanks or vessels that have contained flammable materials. - Safely install power lines at offices and in construction sites and do not lay connectors on the ground or water surface. Electric wires must be with plugs. Place outdoor electric panels in protection cabinets. - Provide sufficient lighting when carrying out construction activities at night. - Locate noise-generating sources and concrete mixing plants far enough from and downwind of residential areas and camps. - Store fuels and chemicals in areas with impermeable ground, roofs, surrounding banks, and warning signs at least 50 m far from and downwind of residential areas and the camps. - Provide training in firefighting to workers and fire-extinguishers for the	- Directive No. 02/2008/CT-BXD on labor safety and sanitation in construction agencies; - Circular No. 22/2010/TT-BXD on regulation on labor safety in construction - QCVN 18:2014/BXD: Technical regulation on safety in construction - World Bank Interim Notes on Construction of Civil Work	Contractor	

	camps. - Prepare an emergency plan for chemical/fuel spill incident risk before construction begins. - Provide the camps with sufficient supplies of clean water, power, and sanitary facilities. There must be at least one toilet compartment for every 25 workers, with separate toilets for males and females. Workers' beds must be provided with mosquito nets so as to prevent dengue fever. Temporary tents will be unacceptable. - Clean camps, kitchens, baths, and toilets and sanitize regularly, and keep good sanitation. Provide dustbins and collect wastes daily from the camps. Clear drainage ditches around the camps periodically. - Stop all construction activities during rains and storms, or upon accidents or serious incidents. - Contractors also need to develop specific procedures or plans so that adequate precautions are in place to prevent or minimize an outbreak of COVID-19, and it is clear what should be done if exposure risks increase for civil workers interacting with individuals with higher risks of contracting COVID-19 and for workers who have exposure to other sources of the virus in the course of their job duties. - Training medical staff on the latest WHO advice and recommendations on the specifics of COVID-19 - Contractor to ensure compliance with the requirements and procedures of the project Labor Management Procedure (LMP)			
9. **Impacts on public facilities**	- Planned and unplanned interruptions to water, gas, power, internet services: the Contractor must undertake prior consultation and contingency planning with local authorities about the consequences of a particular service failure or disconnection. - Coordinate with relevant utility providers to establish appropriate construction schedules. - Obtain the agreements with local authorities in using any public facilities and if any downgraded observations due to project activities have been found, the contractors have to fully compensate;	- Decree No. 167/2013/ND-CP on administrative penalty for violations related to social security, order and safety issues	Contractor	PMU, CSC, IEMC

	- Record the status of the existing infrastructures before construction and make proper compensation for the damages if any. - Providing the temporary/alternative service provisions for any interruptions during construction period (such as power supply, telecommunications lines, water supply pipes or irrigation canals). - Stop construction when existing facilities are damaged. Identify causes of related incidents and work out solutions. In case the damages are due to the Contractors' faults, the Contractors have to repair, recover, and compensate for all damages at their own expenses. The results of handling such damages must be approved by the Supervisor Engineer; - Provide information to affected households on working schedules as well as planned disruptions (at least 5 days in advance). - Reinstall the all affected public facilities as its origin status on construction sites after completion of construction works;			
10. **Impacts on urban landscape and beauty**	- Place the signboard "Sorry to disturb" at the construction sites located in popular areas; - Keep the disturbed areas to be minimal; re-establish vegetation covers as soon as construction is completed; - All facilities are maintained in neat and tidy conditions and the sites shall be kept free of litter; - Fence the construction sites with solid materials if the construction sites are exposed to sensitive sites or exposed to tourist areas; - Do not load construction materials or wastes within 10 m from the gates of any public buildings or cultural structures such as government offices, temples, schools, etc.; - Collect and transport excavated materials and construction wastes to the disposal sites within 24 hours; - Clean up the construction sites daily if the sites are located in populated areas; - Wash vehicles periodically to prevent dust dispersion onto roads.	- Law on environmental protection No. 55/2014/QH13 - TCVN 4447:1987 Construction regulation - Circular No. 22/2010/TT-BXD on construction safety	- Contractor	- PMU, CSC, IEMC
11. Community	- All workers shall be properly registered, and it is advised to train to migrated	Decree No.	Contractor	PMU,

health and safety risk	workers on local customs, practices and habits in order to avoid conflicts with local people - The contractors will provide information boards near the work sites to inform the public on how to approach the works. The contractors will provide warning signs at the periphery of the site warning the public not to enter - Inform the community of commencement date 02 weeks in advance. In case of water and power outage for construction, affected will be notified 02 days in advance by the PMU. - Limit construction activities at night. If construction at night is unavoidable or interruption to service supply (water and power cut-off), the community must be informed at least 02 days in advance and the information will be repeated 1 day. - Use local labors to implement simple jobs. Training on environmental sanitation, safety and health of workers before assigning jobs. Nonlocal workers must be introduced with custom, traditions in the area to avoid community conflicts. - Manage the worker force to any avoid the conflict with the local people and traders - Prepare conducts codes and request workers to comply with: - The following activities will be banned: ▪ Storing and using weapons and poisons ▪ Cutting trees outside the construction area, burning fire, burning waste and plants after clearing (except for invasive plants, but there must be agreed by the Environmental Specialist in the supervision consulting team and PMU) ▪ Using alcohol in working period ▪ Fighting ▪ Participating in gambling and social evils such as drugs, prostitution ▪ Littering waste ▪ Operate vehicles, motorbike and construction means without tasks assigned. ▪ Maintenance of vehicles, construction machines and equipment outside the permitted area;	167/2013/ND-CP on administrative penalty for violations related to social security, order and safety issues		CSC, IEMC
12. Social risks	- The Contractor will have to conform to regulations in Circular No. 04/2017/TT-	- Circular No.	Contractor	PMU,

and impacts related to labor influx	BXD by the Ministry of Construction on safety in construction. - The Project owner and contractor are to cooperate closely with the local government in performing effective community sanitation in case of epidemic symptoms breaking out in the area. - The Project owner and contractor are to cooperate with local authorities in preventing and fighting against social evils. - Do not disturb or cause trouble to community - Fence of excavation pits and open channels and make off with luminous cordon and warning signs. Provide sufficient lighting when carry out construction at night. - Limit the speed of transport means to 20km/h within 200m from the construction site so as to minimize dust and noise. - Keep noise-generating machines and vehicles at such suitable distances that noise transmitted to residential areas will not be higher than 70dBA. - Use static compacting when the road base is constructed near areas with many households and weak temporary works to restrict vibration. - The Project will cooperate with the local health agency in developing and implementing plans for control of diseases among workers. - Reconnect any power, water supply, telecommunications and irrigation systems interrupted by the works, if any. **Child labor and forced labor:** - The minimum age of project workers eligible for any jobs provided by Binh Duong WIDEP project (including construction works) is 18 - The contractor shall not employ child labor and forced labor, which consists of any work or service, not voluntarily performed, that is exacted from an individual under threat of force or penalty, and includes any kind of involuntary or compulsory labor, such as indentured labor, bonded labor or similar labor-contracting arrangements - To prevent the participation of underage workers, all contracts must integrate the provisions on worker's age commitment, including penalties for non-compliance. The contractor shall maintain a list of contracted workers with their age.	22/2010/TT-BXD on construction safety - Directive No.02 /2008/CT-BXD on safeguards and sanitation in construction units - TCVN 5308-91: Technical regulation on safety in construction - Decision No 96/2008/QD-TTg on clearance of UXOs		CSC, IEMC

	Gender equality: - Jobs of workers under Binh Duong city will be based on the gender equality and will have no discrimination for any gender-related employment, recruitment, conditions for recruitment (including jobs, salary and benefits), termination and access to training courses. - In order to address the risk of excluding vulnerable groups (such as women and people with disabilities) from employment opportunities, the Contractors are required to recruit such groups as part of unskilled employees. - Contractors will be required to comply with the National Law on gender equality in the workplace, which includes adequate and appropriate maternity and nursing leave; and restrooms and toilets must be separate from men and women. - Contractors will also be requested to address potential sexual exploitation or harassment issues in recruiting or keeping skilled or unskilled female workers for supporting the project. **The main supplier's workforce:** - Give priority to recruiting local labor. - Ensuring the workforce is contracted under the current regulations. Training and raising the awareness of the local people in traffic to limit risks and accidents. **Basic protective measures against COVID-19** 1. Health care settings • ***Minimize Chance of Exposure (to staff, other patients and visitors*)** - Upon arrival, make sure patients with symptoms of any respiratory infection to a separate, isolated and well-ventilated section of the health care facility to wait, and issue a facemask - During the visit, make sure all patients adhere to respiratory hygiene, cough etiquette, hand hygiene and isolation procedures. Provide oral instructions on registration and ongoing reminders with the use of simple signs with images in local languages - Provide alcohol-based hand sanitizer (60-95% alcohol), tissues and facemasks in waiting rooms and patient rooms			

	- Isolate patients as much as possible. If separate rooms are not available, separate all patients by curtains. Only place together in the same room patients who are all definitively infected with COVID-19. No other patients can be placed in the same room. • ***Adhere to Standard Precautions*** - Train all staff and volunteers to undertake standard precautions - assume everyone is potentially infected and behave accordingly - Minimize contact between patients and other persons in the facility: health care professionals should be the only persons having contact with patients and this should be restricted to essential personnel only - A decision to stop isolation precautions should be made on a case-by-case basis, in conjunction with local health authorities. • ***Training of Personnel*** - Train all staff and volunteers in the symptoms of COVID-19, how it is spread and how to protect themselves. Train on correct use and disposal of personal protective equipment (PPE), including gloves, gowns, facemasks, eye protection and respirators (if available) and check that they understand - Train cleaning staff on most effective process for cleaning the facility: use a high-alcohol based cleaner to wipe down all surfaces; wash instruments with soap and water and then wipe down with high-alcohol based cleaner; dispose of rubbish by burning etc. • ***Manage Visitor Access and Movement*** - Establish procedures for managing, monitoring, and training visitors - All visitors must follow respiratory hygiene precautions while in the common areas of the facility, otherwise they should be removed - Restrict visitors from entering rooms of known or suspected cases of COVID-19 patients Alternative communications should be encouraged, for example by use of mobile phones. Exceptions only for end-of-life situation and children requiring emotional care. At these times, PPE should be used by visitors. - All visitors should be scheduled and controlled, and once inside the facility, instructed to limit their movement. - Visitors should be asked to watch out for symptoms and report signs of acute			

	illness for at least 14 days. 2. Construction settings in areas of confirmed cases of COVID-19 • **Minimize Chance of Exposure** - Any worker showing symptoms of respiratory illness (fever + cold or cough) and has potentially been exposed to COVID-19 should be immediately removed from the site and tested for the virus at the nearest local hospital - Close co-workers and those sharing accommodations with such a worker should also be removed from the site and tested - Project management must identify the closest hospital that has testing facilities in place, refer workers, and pay for the test if it is not free - Persons under investigation for COVID-19 should not return to work at the project site until cleared by test results. During this time, they should continue to be paid daily wages - If a worker is found to have COVID-19, wages should continue to be paid during the worker's convalescence (whether at home or in a hospital) - If project workers live at home, any worker with a family member who has a confirmed or suspected case of COVID-19 should be quarantined from the project site for 14 days, and continued to be paid daily wages, even if they have no symptoms. • ***Training of Staff and Precautions*** - Train all staff in the signs and symptoms of COVID-19, how it is spread, how to protect themselves and the need to be tested if they have symptoms. Allow Q&A and dispel any myths. - Use existing grievance procedures to encourage reporting of co-workers if they show outward symptoms, such as ongoing and severe coughing with fever, and do not voluntarily submit to testing - Supply face masks and other relevant PPE to all project workers at the entrance to the project site. Any persons with signs of respiratory illness that is not accompanied by fever should be mandated to wear a face mask - Provide handwash facilities, hand soap, alcohol-based hand sanitizer and mandate their use on entry and exit of the project site and during breaks, via the use of simple signs with images in local languages			

	- Train all workers in respiratory hygiene, cough etiquette and hand hygiene using demonstrations and participatory methods - Train cleaning staff in effective cleaning procedures and disposal of rubbish • ***Managing Access and Spread*** - Should a case of COVID-19 be confirmed in a worker on the project site, visitors should be restricted from the site and worker groups should be isolated from each other as much as possible; - Extensive cleaning procedures with high-alcohol content cleaners should be undertaken in the area of the site where the worker was present, prior to any further work being undertaken in that area.			
13. Chance finds procedures	In case of archeological objects being unearthed during the implementation of earthwork, all parties will conform to the following procedures: - Suspend construction operations at the place of discovery; - Preliminarily describe the area where the archaeological objects are to be unearthed; - Strictly protect the area of the discovery so as not to damage or lose moveable objects. In case the unearthed objects are moveable or sensitive ruins, provide night protection until the local authorities, the Department of Culture, Sports and Tourism or the Institute of Archaeology takes over these unearthed objects; - Inform the Supervision Engineer of the event and who in turn will immediately inform the subproject owner, the local authorities in charge of the case and the Institute of Archaeology (within 24 hours or less); - Local relevant agencies and the Vietnam National Administration of Tourism will be responsible for protecting and preserving such archaeological relics before making decisions on the next suitable formalities. The Institute of Archaeology may be needed in the preliminarily assessment of the unearthed objects. The significance and importance of such discovered objects will be assessed by different criteria related to the nature of cultural heritages; such criteria would include aesthetic, historical, scientific, social or economic values; - Decisions on handling such discovered objects will be made by competent levels. Such decisions can result in changes in site arrangements (e.g. when the discovered item is a cultural relic which cannot be displaced or is	Law on Cultural Heritage (2002) Law on Cultural Heritage (2009) for supplementary and reformation Decree No. 98/2010/ND-CP for supplementary and reformation	Contractor	PMU, CSC, IEMC

	archaeologically important, it is necessary to preserve, recover and excavate it); - The implementation of such decision by competent agencies related to the management of discovered objects will be communicated in writing by local competent agencies; and - Only resume construction activities at the site after being permitted by the local competent agencies and the PMU in relation to safeguarding such relics			

Workers and Workforce Management

A Labor Management Procedure (LMP) was developed 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 2 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 Redressed Mechanism and Contractor Management are presented in the last two chapters 10 and 11 respectively, while Chapter 12 relates to primary supply workers.

A concern during construction phase of the project is the potentially negative impacts of the workforce interactions with the local communities. For that reason, a Code of Conduct shall be established to outline the importance of appropriate behavior, alcohol abuse, and compliance with relevant laws and regulations. Each employee shall be informed of the Code of Conduct and bound by it while in the employment of the Client or its Contractors. The Code of Conduct shall be available to local communities at the project information centers or other place easily accessible to the communities.

The Contractor is responsible for providing appropriate training to all staff according to their level of responsibility for environmental, health and safety matters.

The Code of Conduct (CoC) shall address the following measures (but not limited to them):

- All of the workforce shall abide by the laws and regulations of the Socialist Republic of Vietnam;
- Illegal substances, weapons and firearms shall be prohibited;
- Pornographic material and gambling shall be prohibited;
- Fighting (physical or verbal) shall be prohibited;
- Creating nuisances and disturbances in or near communities shall be prohibited;
- Disrespecting local customs and traditions shall be prohibited;
- Smoking shall only be allowed in designated areas;
- Maintenance of appropriate standards of dress and personal hygiene;
- Maintenance of appropriate standards hygiene in their accommodation quarters;
- Residing camp workforce visiting the local communities shall behave in a manner consistent with the Code of Conduct; and
- Failure to comply with the Code of Conduct, or the rules, regulations, and procedures implemented at the construction camp will result in disciplinary actions.

Prohibitions. The following activities are prohibited on or near the project site:

- Cutting of trees for any reason outside the approved construction area;
- Hunting, fishing, wildlife capture, or plant collection;

- Buying of wild animals for food;
- Use of unapproved toxic materials, including lead-based paints, asbestos, etc.;
- Disturbance to anything with architectural or historical value;
- Building of fires;
- Use of firearms (except authorized security guards);
- Use of alcohol by workers during working hours;
- Gambling should be strictly forbidden.
- Washing cars or machinery in streams or creeks;
- Doing maintenance (change of oils and filters) of cars and equipment outside authorized areas:
- Disposing trash in unauthorized places;
- Driving in an unsafe manner in local roads;
- Having caged wild animals (especially birds) in camps;
- Working without safety equipment (including boots and helmets);
- Creating nuisances and disturbances in or near communities;
- The use of rivers and streams for washing clothes;
- Indiscriminate disposal of rubbish or construction wastes or rubble;
- Littering the site;
- Spillage of potential pollutants, such as petroleum products;
- Collection of firewood;
- Poaching of any description;
- Explosive and chemical fishing;
- Latrine outside the designated facilities; and
- Burning of wastes and/or cleared vegetation.

Security. Some security measures shall be put into place to ensure the safe and secure running of the camp and its residents. Some of these security measures include:

- The list of workers must be registered to local authorities in accordance with existing Vietnamese regulations
- Children under 14 years of age will hot hired under the project
- Adequate, day-time night-time lighting shall be provided;
- Control of camp access. Access to the camp shall be limited to the residing workforce, construction camp employees, and those visiting personnel on business purposes;
- Prior approval from the construction camp manager for visitor's access to the construction camp;
- A perimeter security fence at least 2 m in height constructed from appropriate materials;

- Provision and installation in all buildings of firefighting equipment and portable fires extinguishers.

Any construction worker, office staff, Contractor's employees or any other person related to the project found violating theses prohibitions will be subject to disciplinary actions that can range from a simple reprimand to termination of his/her employment depending on the seriousness of the violation.

6.1.4.2. Site-specific Mitigation Measures in the construction phase

Depending on the scope of work and type of auxiliary items of each bid package, the Contractors will be required to comply with and implement the specific requirements described below. The cost for implementing these requirements shall be included in cost of each construction contract. The IEMC, CSC and PMU shall monitor the Contractor's compliance

Table 6.2. Mitigation measures of site-specific impacts during the construction phase

Site-specific impacts	Mitigation measures	Implementation	Supervision
Sub-component 1.1: Sewage collection and network expansions, including sewage pumping stations for Tan Uyen town, Thuan An and Di An cities			
1) Traffic disturbance and safety risk	- The contractors need to prepare traffic management plan which will be approved by PMU and CSC and agreed by local traffic management authorities before starting construction activities on the sites; - Coordinate with local traffic authorities to implement traffic diversion schemes to avoid inconvenience to road users and set up clear traffic signal boards and traffic advisory signs at the roads going in and out the road and bridge construction sites. - Provide signs advising road users that construction is in progress and that the road narrows to one lane using cones. - Construction activities on the surface the streets should be implemented section by section to reduce temporary encroachment of road surface; - Arrange and provide alternative access roads with safe and easy access for pedestrian and for people with disability and mobility issues especially the areas in proximity of schools, households, business, hospitals, shops along the intervened streets. - Employ flag persons to control traffic at the construction sites for safety reasons when construction equipment is entering or leaving the work area at all construction sites. - Restriction of using too many pieces of construction equipment at interchanges at rush hour. - Vehicle speed limit along the route and ensure conformity with each section having residential areas and intersections. - Limit transporting materials during the rainy season and avoid overloading vehicles compared to the load of the structure existing roads and bridges. - Install night lighting of all construction sites. - Repair damaged pavement of local road.	Contractor	PMU, CSC, IEMC

Site-specific impacts	Mitigation measures	Implement ation	Superv ision
2) Interruption on business activities	- Consult with shop owners at least two weeks before construction starts to agree on and provide temporary access to their businesses/production areas. Inform on the planned construction activities and likely impacts; - Apply appropriate construction methods (section by section) to avoid as much as possible to intervene existing roads; - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes, and to guard high risk operations - Provide adequate compensation for any obliviously impacts identified by the construction activities; - Provide safe and easy access to the household businesses putting clean and strong thick wood panels or steel plates over the open ditches. - Avoid storing raw materials or waste adjacent to of businesses or shops. Arrange traffic control staff for loading and unloading of raw materials and wastes; - Cleaning up construction areas at the end of the day, especially construction areas in front of business shops. - Resolve immediately any inconvenience caused by project activity.	Contractor	PMU, CSC, IEMC
3) Impacts on household accessibility	- Inform the community about construction time and schedule through informal public consultation or any local people meetings and notice board; - Provide safe and easy access to the household putting clean and strong thick wood panels or steel plates over the open ditches to all disturbed households. - Place sign boards near construction sites to direct and guidance movement for all households who are living along these under construction roads; - Reinstate access to affected households upon completion of the works items and road surface at the sections need to be excavated by construction activities.	Contractor	PMU, CSC, IEMC
4) Damage to public facilities infrastructure and services	- Planned and unplanned interruptions to water, power, internet services: the Contractor must undertake prior consultation and contingency planning with local authorities about the consequences of a service failure or disconnection. - Deploy a qualified technical staff to supervise construction activities near the pipelines, communication cables and other infrastructures	Contractor	PMU, CSC, IEMC

Site-specific impacts	Mitigation measures	Implementation	Supervision
	- Coordinate with relevant utility providers to establish appropriate construction schedules. - Record the status of the existing roads and other infrastructures before construction and make proper compensation for the damages if any. - Provide information to affected households on working schedules as well as planned disruptions (at least 5 days in advance). - Providing the temporary/alternative service provisions for any interruptions during construction period (such as power supply, telecommunications lines, water supply pipes or irrigation canals) - The contractor should ensure alternative water supply to affected residents in the event of disruptions lasting more than one day. - Any damages to existing utility systems of cable shall be reported to authorities and repaired as soon as possible; - Stop construction when existing facilities are damaged. Identify causes of related incidents and work out solutions. In case the damages are due to the Contractors' faults, the Contractors have to repair, recover, and compensate for all damages at their own expenses. The results of handling such damages must be approved by the Supervision Engineer. - Reinstall the road surface and sidewalks at construction sites after the construction of sewer lines has been completed. - All public facilities should be fully compensated as its origin after completion of construction works;		
5) Impacts on urban landscape	- Place the signboard "Sorry to disturb" at the construction sites located in popular areas; - Keep the disturbed areas to be minimal; re-establish vegetation covers as soon as construction is completed; - All facilities are maintained in neat and tidy conditions and the sites shall be kept free of litter; - Fence the construction sites with solid materials if the construction sites are exposed to sensitive sites or exposed to tourist areas; - Do not load construction materials or wastes within 10 m from the gates of any public buildings or cultural structures such as government offices, temples, schools, etc.; - Collect and transport excavated materials and construction wastes to the disposal sites within 24 hours; - Clean up the construction sites daily if the sites are located in populated areas;	Contractor	PMU, CSC, IEMC

Site-specific impacts	Mitigation measures	Implement ation	Superv ision
	- Wash vehicles periodically to prevent dust dispersion onto roads.		
6) Control of impacts on PCRs and other sensitive receptors	***<u>For the religious works</u>*** * *In Tan Uyen town:* Buu Lien and Ky Hoan pagodas; Hoi Nghia parish and Ben San churches; Binh Hoa, Binh Chanh, and Loi Loc temples; Ngoc Khanh monastery, martyrs' cemetery. * *In Di An city:* Thien Binh, Co Linh, Phap Hanh Tung Lam, Duc Hoa, Huynh Mai, Phap Tri, Truc Lam, Tan Hung, Nghia Son pagodas; Binh An, Phat Mau, Tan Quy, Binh Thang, Trung Buu Tu and Binh Duong temples * *In Thuan An city:* Ngoc Minh monastery, Phuoc Loc Tho pagoda, Bung parish church, Quach Lam Tho Mo religious house. - Inform the pagoda/temple/church of the construction activities and their potential impacts such, waste, dust, and noise, traffic, and construction schedule at least 01 month before start of the construction. - The contractor shall coordinate with local authorities (leaders of local wards or communes) for agreed schedules of construction activities at sensitive times (e.g. religious festival days). Avoid construction activities during religious events every first and 15th days of the lunar month and during festival days if possible. - Prohibit gathering of construction materials within 100 m in front of the pagoda/church and monastic. - Environmental training for the workers includes codes of conducts when working in public areas and sensitive receptors such as pagoda. - The contractor shall provide safety measures as installation of fences, barriers warning signs, lighting system against traffic accidents as well as other risk to local people and goers to pagoda. - Spray sufficient water to suppress dust during dry and windy days at least three times a day at the area of the pagodas. - Truck drivers shall restrict horning in areas close to the pagoda area. - Immediately address any issue/problem caused by the construction activities and raised by the pagoda. - The construction method shall include the measures to protect the foundation of the fence/gate/main building of the pagoda/temples, such as using supporting pillars or steel frame to prevent the risk on structure	Contractor	PMU, CSC, IEMC

Site-specific impacts	Mitigation measures	Implementation	Supervision
	collapse/cracking. - In case damages happen, the contractor should take full responsibility in compensating or reconstructing the broken facilities as agreed with the pagoda/temple. ***<u>For schools:</u>*** * *In Tan Uyen town:* Huynh Van Nghe high school; Uyen Hung B, Tan Hiep Primary School, Khanh Binh, Tan Phuoc Khanh B, Tan Phuoc Khanh, Tan Vinh Hiep A & B, Phu Chanh primary schools; Tan Phuoc Khanh, Tan Hiep, Khanh Binh, Nguyen Quoc Phu and Le Thi Trung secondary schools; Chuon Chuon Ot, Hoa Huong Duong, Khanh Binh, and Baby World kindergartens. * *In Di An city:* Mai Vang, Son Ca, Mimosa, Sao Mai, Hoa Sen, Anh Cau Vong, Anh Binh Minh, Huong Ngoc Lan, Hoa Thien Phu, Tuoi Tien, Mam Xanh, and Hoa Sen Do kindergartens; Tan Binh, Bui Thi Xuan, Doan Thi Diem primary schools; Binh Thang, Binh An, and Tan Binh secondary schools; and Binh An high school. * *In Thuan An city:* Binh Nham, Hoa Cuc 2, Hoa Mai 2, Hoa Cuc 6, and Hoa Cuc 8 primary schools - Inform the school management of the construction activities and their potential impacts such, waste, dust, and noise, traffic, and construction schedule at least 01 month before start of the construction. If possible, implement the construction activities during the school summer vacation. - Put and maintain bulletin boards at the construction site, containing the following information: full name and phone number of the Contractor, Site Manager, Supervision Consultants and Subproject Owner, duration and scope of work. - Cooperate with the school in management of school students, security, and safety during construction, such as teachers to be informed of construction operations to keep pupils off the site during their break time. - Assign security guards around the construction sites so as to warn pupils in due time against approaching the construction site. - Put fences warding off the site and warning signs. - Deploy staff to guide the traffic during construction, transportation, loading and unloading of construction materials and wastes, and to guard high risk operations, especially when school children go to and leave the school around construction area.		

Site-specific impacts	Mitigation measures	Implement ation	Superv ision
	- Prohibit gathering of construction materials within 100 m in front of the school. If possible, provide separate entrances and exits for waste and material trucks. - Avoid activities generating great noise or vibration such as demolition of concrete structures or driving of piles during class hours. - Provide environmental training for the workers includes codes of conducts when working in public areas and sensitive receptors such as school. - Collect any wastewater generated by the construction to a setting tanks before discharging to the outside of the school. - Cover the incomplete trenches under construction at end of the working day. - Provide night lighting system with luminously painted fence and night lamp. - Schedule trucks transporting waste and materials not to enter and exit the school before the start of class hours, during school time, or just after class hours. - Gather materials and wastes neatly during construction and dispose the wastes at the designated site within the soonest possible time and within less than 24 hours. - Immediately address any issue/problem caused by the construction activities and raised by the school management. - The construction method shall include the measures to protect the foundation of the fence/gate of the school, such as using supporting pillars or steel frame to prevent the risk on structure collapse/cracking. - In case damages happen, the contractor should take full responsibility in compensating or reconstructing the broken facilities as agreed with the school's management. ***For markets*** * *In Tan Uyen:* Quang Vinh 3, Hoi Nghia, Tan Hiep, Khanh Binh markets. * *In Di An:* Tan Binh and Tan Lap markets: - Try to schedule construction activity avoid the market hours - Minimize the number of trucks leaving construction sites during the peak hours.		

Site-specific impacts	Mitigation measures	Implement ation	Superv ision
	- Arrange staff to direct traffic on this section on peak hours during peak construction period (7h-7h30; 11h-11h30; 13h-13h30; 16h30 - 17h30) - Place warning and speed limit signs at the market - Water the transportation roads, if any, in a hot, dry day. Limit pressing horn when transporting through the market - Locations of the soil storage areas and construction equipment must be placed away from the fence of the identified market at least 100 m - Closely work with local community to ensure the best solution to issues and complaints related to the construction activities - Compensation for business households if the Project's activities cause interruption to their business in the long run. - Use of temporary market area (if required) to remain the trading activities of local people. - Repair damaged pavement of local road. ***<u>For medical centers</u>*** * *Tan Uyen town*: Tan Uyen town center, Hoi Nghia and Tan Hiep medical stations: - Contractors need to coordinate with medical center to consultant and agree with the detail construction schedule; - Spraying water to maintain certain moisture levels, and to prevent or minimize dust dispersion . - Provide safe and easy access to the hospital gates putting clean and strong thick wood panels or steel plates over the open ditches on all medical center. - Place sign boards near construction sites to direct and guidance movement; - Inform and training worker to provide the highest priorities and make way for the operation of any ambulance along the road section - Providing night lighting system with luminously painted fence and night lamp. - Cleaning up construction areas at the end of the day, especially construction around the medical stations		

Site-specific impacts	Mitigation measures	Implement ation	Superv ision
	- Prohibit use of construction methods that cause noise during the nighttime; - Install night lighting of construction sites. - The construction method shall include the measures to protect the foundation of the fence/gate/main building of the medical centers, such as using supporting pillars or steel frame to prevent the risk on structure collapse/cracking. - In case damages happen, the contractor should take full responsibility in compensating or reconstructing the broken facilities as agreed with the owner of the facilities.		
Sub-component 1.2 – Construction of Tan Uyen WWTP, upgrading Thuan An and Di An WWTPs			
a) Impacts on irrigation drains at Tan Uyen WWTP site	- The excavation or levelling activities or any intervention activities on the existing irrigation drains must be scheduled with consideration of the harvest time and in close coordination with the locality to provide set up a temporary alternative water way to ensure the normal irrigation tasks activities. - Any impacts on the inter-field irrigation canals, contractors need to fully compensate or give alternative water transfer to ensure the water supply/drainage in the surrounding cultivation areas; - Appropriate management of pollution sources from construction activities to ensure that the irrigation drains will not be polluted by wastewater or domestic waste and construction materials - Regularly check the affected on-field irrigation drains to ensure they are not blocked by construction spoils and wastes. - Immediately fix up damages caused to irrigation drains if it happens	Contractor	PMU, CSC, IEMC
b) Surrounding agricultural land surrounding Tan Uyen WWTP	- Informing the community of the construction schedule at least one week before the construction. - Arrange drainage and sediment pit around the construction sites to ensure no soil erosion and sedimentation to the rice fields and irrigation canals. - Disposal of solid wastes, construction waste into canals, agricultural field is prohibited; - The placement of construction equipment/vehicles on the agricultural field will not allowed avoiding the leaching of waste, sludge, soil and oil contaminated water and soil; - All activities of contractor are only allowed within site boundary	Contractor	PMU, CSC, IEMC

Site-specific impacts	Mitigation measures	Implement ation	Superv ision
c) Safety issues, disturbance to workers of existing facilities at Thuan An and Di An WWTPs	<u>*To address safety issues*</u> - Coordinate, consult, and inform the management units of the existing Thuan An and Di Anon the construction methods and schedules to minimize as much as possible the disturbances to these staffs and workers; - Provide fence around construction sites to separate construction areas with the existing facilities; - All activities of contractor are only allowed within the construction site boundaries; - Provide adequate safety warning and maintain light during nighttime on the construction site; - Use separated entrances for construction activities (material and waste transport); - Any impacts existing facilities contractors need to fully compensate; <u>*To minimize social disturbance*</u> - Prioritized recruitment and employment of the workforce available in the locality; - Carrying out procedures on declaring the personnel present at construction sites; - Setting up workshops on construction site rules & regulations for officers and workers; - Contractors' sanction measures against violations of construction site rules & regulations		
Sub-component 1.2 – improvement of Suoi Tre canal			
1) Impacts on water environment, aquatic life and downstream user	- Excavation activities must be carefully scheduled to avoid the rainy season - Strictly follow proposed construction method, the dredging activities of Suoi Tre is proposed section by section with dried dredged condition to reduce odor generation and in-sanitation condition and avoid polluting surface water quality. - Strictly prohibit contractors to discharge waste into canal and Dong Nai river; - Strictly apply dry excavation method to implement construction on the Suoi Tre canal; - Do not gather construction materials as well as machinery and equipment near the canal. - Gathering small quantities of materials fit with the schedule. Materials must be covered with tarpaulin, avoiding the upwind location, near the canal. - Strictly prevent hazardous waste, waste oils or particularly greasy rags from entering the flow.	Contractor	PMU, CSC, IEMC

Site-specific impacts	Mitigation measures	Implement ation	Superv ision
	- Construction supervision staff at site must carry out strict management of workers during construction processes in order to limit materials and waste from spilling into the canal. - Before operation, all construction means, and machines will be carefully checked in terms of technical parameters as well as operational performance to limit possible spills of oil, grease or fuel.		
2) Impacts due to excavated sludge (about 66,105 m^3)	- Excavation activities of the canal must be carefully scheduled to avoid the rainy season in order to ensure drainage of runoff water as well as sanitation for both local residents and workers; - According to the analyses, the sediments from the canal dredging work are not hazardous, with heavy metals lower than the acceptable limits. The sediments could then be used for perennial crops or planting tree for urban landscape purpose, based on the actual needs of local people. Otherwise, it will be transported and disposed at South Binh Duong SWP Complex. - The guidance for prepare dredged material management plan (DMMP) is included in the annex of the report, however, detailed design for canals dredging will include the update of DMMP with additional analysis of sediment quality as appropriate, detailed information on the amount of generated sediment, requirements on contractor's dredging method, transportation and disposal that are appropriate and cost-effective. The updated DMMPs will be incorporated into the related bidding documents and contracts. - Prior to construction, the contractors shall prepare a specific DMMP based on the updated DMMP. The contractor's DMMPs shall be submitted to the Construction Supervision Consultant for approval before starting the work. The dredging plan will indicate volumes, physical-chemical-biological properties of dredged material, dredging procedures, temporary gathering of dredged materials, and control of polluting material during temporary gathering and transportation, pollution control, and risks at disposal sites - Manage to ensure sediment will be disposed appropriately according to the approved DMMP;	Contractor	PMU, CSC, IEMC
3) Impacts of odors during dredging process	- On-site location for temporary gathering of sludge must be to the tail end of the wind, far from residential areas and sensitive works. - Sludge dredged from channels would give off stinking odors of such gases as CH4, H2S, and mercaptans. To mitigate the impact from malodor of dredged sludge, it is therefore imperative to provide face masks, boots and gloves for workers who will work directly with this source of waste. - EM (Effective Microorganisms) deodorants are to be sprayed every day as needed. These deodorants are able to	Contractor	PMU, CSC, IEMC

Site-specific impacts	Mitigation measures	Implement ation	Superv ision
	remove malodors from H2S and mercaptans. - Dredge activities need to strictly follow the approved DMMP and guidance of Construction Supervision Consultant on the sites - Avoid as much as possible to temporary storage of the excavated materials, in case need to temporary placement, which will be covered by the technical fabric and transported to disposal sites within the few days. - The specialized vehicles will be mobilized to transport the excavated sediments to avoid the leaking out of sludge on the transport routes and create environmental sanitation issues and odor along the transport routes		
4) Drainage capacity and localize flooding	- Construction activities of need to be scheduled to avoid rainy season to reduce the needs of drainage; - Alternative drainage system needs to provide during blocking the canal for excavation and improvement, contractors need to conduct site assessment and work with local authorities for temporary connecting with available drainage ditches along the construction sites; - PMU will ensure that detailed design will consider adequate temporary drainage to avoid potential flooding during construction - The contractors must apply the specific construction methods, and flood prevention and control alternatives during construction period or the flow diversion alternatives to ensure proper drainage in that area	Contractor	PMU, CSC, IEMC
5) Risks on local house/physical structure cracking	- Check the structure status of house located along the canal and record the status with house headers, the pictures should be taken. - Operation of several vibration equipment/machines need to avoid at the same time; - The construction method shall include the measures to protect the foundation of the fence/gate/main building of the local houses, such as using supporting pillars or steel frame to prevent the risk on structure collapse/cracking. - In case damages happen, the contractor should take full responsibility in compensating or reconstructing the broken facilities as agreed with the local people.	Contractor	PMU, CSC, IEMC

6.1.5. Measures to mitigate impacts in operation phase

6.1.5.1. Impacts and Risks during Operation of Sub-component 1.1

Table 6.3. Mitigation measures of impacts in operation phase

Site-specific impacts	Mitigation measures	Responsibility	Supervision	Budget
Sub-component 1.1: Sewage collection and network expansions, including sewage pumping stations for Tan Uyen town, Thuan An and Di An cities				
1) Pollution risks due to broken and blocked pipeline	In addition to the design measures as described in section 6.1.1., following measures taken into account: - Conducting the sufficient periodic cleaning and maintaining by using, specialized trucks and equipment (6 months usually); - Establish routine maintenance program, including: o Development of an inventory of system components, with information including age, construction materials, drainage areas served, elevations, etc. o Regular cleaning of grit chambers and sewer lines to remove grease, grit, and other debris that may lead to sewer backups. Cleaning should be conducted more frequently for problem areas. Cleaning activities may require removal of tree roots and other identified obstructions. o Inspection of the condition of sanitary sewer structures and identifying areas that need repair or maintenance. Items to note may include cracked/deteriorating pipes; leaking joints or seals at manhole; frequent line blockages; lines that generally flow at or near capacity; and suspected infiltration or exfiltration. o Monitoring of sewer flow to identify potential inflows and outflows. - Conduct repairs prioritized based on the nature and severity of the problem. Immediate clearing of blockage or repair is warranted where an overflow is currently occurring or for urgent problems that may cause an imminent overflow (e.g. pump station failures, sewer line ruptures, or sewer line blockages);	Operation units (BIWASE)	Relevant local authorities such as (MOC, DONRE, DOT…)	Including in the O&M cost

Site-specific impacts	Mitigation measures	Responsibility	Supervision	Budget
	- Review previous sewer maintenance records to help identify "hot spots" or areas with frequent maintenance problems and locations of potential system failure, and conduct preventative maintenance, rehabilitation, or replacement of lines as needed; - Emergency respond plans will be included in the operating manual, thus in case of broken and blocked pipelines is found, relevant equipment will be mobilized to manage the situation (they may include, robots, vacuum suction truck and mobile sewer jetting machine			
2) Management of noise generated from Pumping Stations	- Conducting the sufficient periodic maintenance to ensure properly operation of the pumps;	Operation units (BIWASE)		Including in the O&M cost
3) Incidents at pumping stations	- A standby pump will be provided to back up other when a pump stops other will automatically turns on; - Equip pumping stations with a backup power supply, such as a diesel generator, to ensure uninterrupted operation during power outages, and conduct regular maintenance to minimize service interruptions. Consider redundant pump capacity in critical areas. - Emergency response plans will be included in the operating manual to ensure the rapid response actions to incidents at the pumping stations including malfunctioning or power cutoff - Conducting the sufficient periodic maintaining to ensure properly operation of the pumps;	Operation units (BIWASE)		Including in the O&M cost
4) Impacts due to odor emission	- Odor emission at the collection pits and pumping stations will be mitigated by installation of exhaust fan. - O&M activities of collection pits and pumping station will be conducted by specialized equipment and workers will be equipped with specialized PPEs including scuba and masks	Operation units (BIWASE)	Relevant local authorities such as (MOC, DONRE,	Including in the O&M cost

Site-specific impacts	Mitigation measures	Responsibility	Supervision	Budget
5) Management of sludge	- Using specialized equipment sludge to remove sludge during maintenance activities to avoid sludge leakage; - The removed sludge will not be placed on the public roads, and will be put to truck directly; - Sludge will be transported to disposal site in South Binh Duong Solid Waste Treatment Complex for composting or brick production by specialized trucks - Ensure that the in the city's operations and maintenance plan and budget include the cost for periodical dredging management of dredged sludge	Operation units (BIWASE)	Relevant local authorities such as (MOC, DONRE, DOT…)	Including in the O&M cost
6) Safety for worker during O&M	- Establishment of work zones so as to separate workers from traffic and from equipment as much as possible. - Reduction of allowed vehicle speeds in work zones. - Use of high-visibility safety apparel for workers in the vicinity of traffic. - Provide appropriate personal protective equipment and training on its proper use. Provide adequate occupation health and safety trainings for worker; - Conduct periodic normal and occupation health checks for workers;	Operation units (BIWASE)	BIWASE	Including in the O&M cost
Sub-component 1.2 - Constructing and upgrading WWTPs				
a) Odor and air pollution control	- The workers shall be required to strictly follow the O&M Procedure of the WWTP - Cover emission points (e.g., aeration basins, clarifiers, sludge thickeners, tanks, and channels), and vent emissions to control systems (e.g., compost beds, biofilters, chemical scrubbers, etc.) as needed to reduce odors and otherwise meet applicable national requirements and internationally accepted guidelines. - The waste (sludge and domestic solid waste) will be contained in standardized containers to minimize dispersion and gases and solid waste into the environment before being transported South Binh Duong Solid Waste Treatment Complex for compost production or brickmaking. - A Sludge Management Plan shall be prepared and included in the O&M manual before the operation can start	Operation units (BIWASE)	Relevant local authorities such as (MOC, DONRE, DOT…)	Including in the O&M cost

Site-specific impacts	Mitigation measures	Responsibility	Supervision	Budget
	- There will be plans to periodically test and monitor air concentrations to obtain proper evaluation and control operation processes in a logical manner			
b) Noise pollution control	To reduce noise in treatment plant, besides green belt isolated to residential areas, it is necessary to apply additional measures such as: - Using 100% new equipment from well-known manufacturers; - Regularly carrying out maintenance of machinery by oiling and replacing parts; - Air pump, sludge dewatering, sludge pumps are put on pedestal attached to a large basement structure with rubber base; - Pumping stations are located in soundproof room, to minimize noise to surrounding areas from 10 to 15 dBA; - Workers in pumping station area are equipped with ear plugs to reduce noise; - Making routes of transporting sludge and schedule for sludge trucks activities to minimize noise caused by traffic	Operation units (BIWASE)	Relevant local authorities (MOC, DONRE, DOT…)	Including in the O&M cost
c) Mitigation measures to minimize water pollution risks and impacts to aquatic habitat and downstream water users	- The treatment process ensures that the wastewater reaches QCVN 14:2008/BTNMT, column A before the effluent will be discharged into the Dong Nai and Saigon rivers. In addition, the following measures will be implemented during operation of WWTP: - An online monitoring system is to be installed at the WWTP for controlling the wastewater inflow, quality of the influent and effluent at the WWTP. - The quality of sample effluent from the WWTP must be analyzed once every month - Treatment facilities are to be periodically checked and maintained to ensure highest performance of the system. - Troubleshooting plans must be prepared to respond promptly to incidents in due time (standby generators, standby pumps, discharge incident …) in order not to disrupt the operation of the plant. - Based on an assessment of risks to human health and the environment, consider re-use of	Operation units (BIWASE)	Relevant local authorities (MOC, DONRE, DOT…)	Including in the O&M cost

Site-specific impacts	Mitigation measures	Responsibility	Supervision	Budget
	treated effluent, especially in areas with limited raw water supplies. Treated wastewater quality for land application or other uses should be consistent with the relevant public health-based guidance from the World Health Organization (WHO)30 and applicable national requirements. - In case of serious incidents, the untreated wastewater will be temporary storage on incident ponds and pipeline system for three days, the Company shall immediately report this incident to the management agency, i.e. Binh Duong Department of Natural Resources and Environment (DONRE), and suspend production to fix the problem - Domestic wastewater from the WWTP operation will be pre-treated through 3 compartments of septic tanks before being discharged into combined sewers and will be directed to the treatment area. - O&M manual shall include procedure to inform local authority and other relevant stakeholders to minimize the impacts to downstream water user in case incidents happened - Technological wastewater and sludge arising from the lab are surveyed to the collecting tank for disposal; - Installing auxiliary pumps, air pump, generators to avoid stop operation; - Providing operational guidelines of each system, regularly organizing training sessions, operating instructions for plant workers;			

[30]WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater (2006).

Site-specific impacts	Mitigation measures	Responsibility	Supervision	Budget
d) Solid waste and sludge management	**** Sludge management*** - The sludge generated from the wastewater treatment plant is considered as biological sludge (biosolids) which will be placed in the specialized containers the sludge drying unit. The BIWASE will transport this volume of sludge to the South Binh Duong Solid Waste Treatment Complex for compost of brick production; - The sludge needs to be dried and discharged to specialized containers; - Sludge will be periodically monitored to identify any possible hazard. The quality of sludge is monitored periodically 3 months per time with heavy metal parameters are analyzed As, Cu, Cd, Pb, Zn according to QCVN050-MT:2013/BTNMT – national technical regulation on Hazardous Thresholds for Sludges from Water Treatment Process. - Processing, disposal and re-use of wastewater treatment plant residuals should be consistent with applicable national requirements. - A Sludge Management Plan shall be prepared and included in the O&M manual before the operation can start **** Domestic waste management:*** - Provision garbage tanks at in the building and daily collect the generated waste - Domestic solid waste generated by the workers during the operation will be stored in 2 containers each with capacity of 100 liters and waste standing on the storage will no longer than 48 hours. - Solid waste will be transported by BIWASE to the South Binh Duong Solid Waste Treatment Complex for treatment. ****Hazardous waste*** - The subproject owner will register as the owner of hazardous waste according to Circular No. 36/2015/TT-BTNMT dated 30 June 2015 on hazardous waste management. Containers of hazardous waste are to be placed on flat floors without tilting, tumbling, and must be free from stormwater infiltration. Collected hazardous waste will be stored in containers/houses	Operation units (BIWASE)	Relevant local authorities (MOC, DONRE, DOT…)	Including in the O&M cost

Site-specific impacts	Mitigation measures	Responsibility	Supervision	Budget
	and labelled as currently stipulated. Packaging materials for chemicals will be returned to the suppliers. - Once every 2-3 months, the BIWASE will transport the hazardous waste South Binh Duong Solid Waste Treatment Complex for treatment.			
e) Incidents from the operation of WWTP	** Malfunction of the WWTPs and the incident discharge* In addition to the construction of incident ponds as indicated in design of the WWTPs, the following measures shall be applied: - Prepare an emergency plan for incidental discharge of untreated wastewater and conduct emergency training for the operators. - O&M manual shall include procedure to inform local authority and other relevant stakeholders of the incident and repairing plan - The WWTP system includes the components of biological treatment tank, flocculation tank, biological aeration tank, and bio-filters which will be designed with the two modules running in parallel to remedy any incident when it happens, specifically: *In case of incidents with devices (wastewater pumps, air blowers, ...):* - All the devices in the WWTP system are equipped with one backup device. Thus, if case of errors occurring with a device, the Company will make use of the standby device and have the faulty one repaired. *In case of incidents caused by operation:* - When a problem occurs, the technical division and the operating worker will have to review all operational parameters and make adjustments in conformity with the design. - The incident ponds are provided in three WWTPs which could help to storage untreated wastewater within three days (include storage on the pipeline system) for any repair needed; - The operating control system are automatically and operating information in all stages in the treatment process are transferred to the control central which could help to find and fix any	Operation units (BIWASE)	Relevant local authorities (MOC, DONRE, DOT…)	Including in the O&M cost

Site-specific impacts	Mitigation measures	Responsibility	Supervision	Budget
	system failures in very early stage. - In case of serious incidents, e.g. the system is unable to work and the treated wastewater fails to meet the standards of discharging treated wastewater and anticipated to exceed the capacity of incident ponds, the Company shall immediately report this incident to the management agency, i.e. Binh Duong Department of Natural Resources and Environment (DONRE), and suspend production to fix the problem. The Company will employ an expert on wastewater treatment to make inspection and adjustments to the system. - Corrective measures are to be promptly carried out for the treatment plant to be operated again in the soonest possible time. - Generators must be always available * *The chemical leakage:* - The chemical used for wastewater treatment will be transported to the wastewater treatment plant in specialized means provided by the supplier. - The chemical will be stored at the minimum volume in the store within the WWTP, suitable with the production plan. - The procedures for storage and usage of the chemicals will be as instructed by the manufacturer. - The operators of the wastewater treatment plant will be trained on occupational health, safety and environment before started working. When being in contact with chemical, the workers will be required to wear the personal safety instruments such as mask, glass, gloves as appropriate. - First aid kits must be provided at the WWTP office, regularly checked and refilled. * *Explosion/fire incidents* - The operating control system are automatically and operating information in all stages in the treatment process are transferred to the control central which could help to find and fix any system failures in very early stage;			

Site-specific impacts	Mitigation measures	Responsibility	Supervision	Budget
	- WWTPs will coordinate with fire agencies in localities to establish specific measures for fire protection, calculate number of firefighting equipment needed, building regulations, the position of warning signs in each department, and conduct training sessions for fire protection for all workers in the factory. - For electrical equipment, safety rule will follow standard rules. High temperature areas or underground wires must be protected carefully. - Conduct periodic training on explosion/fire protection and prevention will be provide periodically for all staffs of the plants; - Fire safety emergency plan shall be in place and included in the O&M manual - When discovering fire and fire risk, following standard fire orders described in the fire - safety emergency plan. Phone and announce to the nearest local fire station, conducted emergency response with provided firefighting equipment (pressure pump,CO2 extinguisher, bottle of sand).			
f) Operational health and safety during WWTPs operation	- Ensuring that the personnel involved in the WWTP operation process have appropriate knowledge and qualifications. - Reasonable personnel arrangement, alternate operation of WWTP, ensuring continuous operation activities. - Ensure that WTTP operates properly according to technical procedures and instructions. - Arranging human resources and funding ensures the regular inspection, supervision and maintenance process. *Accidents and Injuries:* The following procedures required to prevent, minimize, and control accidents and injuries at water and sanitation facilities: - Install railing around all process tanks and pits. - Implement a confined spaces entry program that is consistent with applicable national	Operation units (BIWASE)	Relevant local authorities (MOC, DONRE, DOT…)	Including in the O&M cost

Site-specific impacts	Mitigation measures	Responsibility	Supervision	Budget
	requirements and standards. Valves to process tanks should be locked to prevent accidental flooding during maintenance. - Use fall protection equipment when working at heights. - Maintain work areas to minimize slipping and tripping hazards. - Implement fire and explosion prevention measures in accordance with the national regulation. - Ventilate enclosed processing areas and ventilate equipment, such as pump stations, prior to maintenance. *Chemical exposure and hazardous atmospheres:* - Implement a training program for operators who work with chlorine regarding safe handling practices and emergency response procedures. - Provide appropriate personal protective equipment (including, for example, self-contained breathing apparatus) and training on its proper use and maintenance. - Install safety showers and eye wash stations near the chlorine equipment and other areas where hazardous chemicals such as chlorine and soda (NaOH) are stored or used. - Use protective goggles, protective clothes and boots, chlorine masks, and personal gas detection equipment while working at the WWTP. - Periodically sample air quality in work areas for hazardous chemicals. If needed to meet applicable occupational health national requirements or internationally accepted standards, install engineering controls to limit worker exposure, for example collection and treatment of off-gases from air stripping; - Prohibit eating, smoking, and drinking except in designated areas. - Rotate personnel among the various treatment plant operations to reduce inhalation of air-stripped chemicals, aerosols, and other potentially hazardous materials. *Pathogens and Vectors:*			

Site-specific impacts	Mitigation measures	Responsibility	Supervision	Budget
	The measures to prevent, minimize, and control exposure to pathogens and vectors include: - Include in safety training program for workers, safe handling and personal hygiene practices to minimize exposure to pathogens and vectors. - Use vacuum trucks or tugs for removal of fecal sludge instead of manual methods. - Provide and require use of suitable personal protective clothing and equipment to prevent contact with wastewater (e.g., rubber gloves, aprons, boots, etc.). Especially provide prompt medical attention and cover any skin trauma such as cuts and abrasions to prevent infection and use protective clothing and goggles to prevent contact with spray and splashes. - Provide areas for workers to shower and change clothes before leaving work and provide laundry service for work clothes. This practice also helps to minimize chemical and radionuclide exposure; - Encourage workers at wastewater facilities to wash hands frequently. - Provide worker immunization (e.g. for Hepatitis B and tetanus) and health monitoring, including regular physical examinations. - Avoid handling screenings by hand to prevent needle stick injuries. - Maintain good housekeeping in sewage processing and storage areas. - Advise individuals with asthma, diabetes, or suppressed immune systems not to work at wastewater treatment facilities, especially composting facilities, facility because of their greater risk of infection.			
Sub-component 1.2– Improvement of Suoi Tre Canal				
Impact on social connectivity and safety	- Provide and maintain cross bridges on the canal to support for local people travel and maintenance activities - Provide sufficient safety warning signs along the canal in case risk could be observed;	Operation units (BIWASE)	Relevant local authorities (e.g. MOC, DONRE, DOT)	Including in the O&M cost

Site-specific impacts	Mitigation measures	Responsibility	Supervision	Budget
Damage of canal embankment	- Strictly management operation of private vehicles on the canal banks; - Ensure the city's operations and maintenance plan, and related budget, includes the work and resources required to maintain the embankment periodically - Closely monitor the construction of other infrastructures within the area that potentially affect the embankment structures	Operation units (BIWASE)	Relevant local authorities (e.g. MOC, DONRE, DOT…)	Including in the O&M cost
Wasted sludge from periodic dredging Suoi Tre canal	- Cooperating with the local government to disseminate information on hygiene practices to the people, and prohibiting to release wastes into the canals; BIWASE and DONRE should be in collaboration to impose much more serious penalty to polluter - Carrying out periodical dredging and clearing works of the canal before the rainy season; - Signing contracts with the responsible agencies on collecting, transporting and treating dredged sludge.	Operation units (BIWASE)	Relevant local authorities (e.g. MOC, DONRE, DOT…)	Including in the O&M cost

6.1.6. Measures to minimize cumulative impacts

a) Cumulative impacts in construction phase

Cumulative impacts such as air pollution, traffic safety and traffic congestion, generation of excavated/dredged materials, domestic solid waste, hazardous waste, and domestic wastewater must be managed in conformity with mitigation measures as outlined in section 6.1.4.3 (ESCOPs). The wastes must not be kept at the site for long periods and have to periodically transported to disposal sites.

Cumulative impacts of associated projects including (i) wastewater collection and treatment project in Ben Cat town, and (ii) renovating and upgrading the drainage system for Binh Hoa of Thuan An city which may have some overlaps on time schedule with the WEIP, however, on different catchment area without spatial overlapping of construction sites. The cumulative impacts are mainly caused by the combined emissions of exhaust gases, dust, solid waste, wastewater, traffic safety risks. On the part of the CCSEP project, these cumulative impacts would be limited by the mitigation measures presented in Sections 6.1.4.1 (ESCOPs).

For impacts at site-specific locations including PR746, PR747, PR745, PR746B, DR411 (in Tan Uyen), and National road 1A, Nguyen Chi Thanh, Nguyen Huu Canh, Binh Nham 07, Binh Nham 04, Binh Nham (in Thuan An city), the proposed mitigation measures in Section 6.1.4.2 need to be applied.

Besides, to mitigate the cumulative impacts caused by conflicts in the use of traffic infrastructure, electricity and water supply, etc. of the Project with other construction projects in the city during construction phase, contractors would need to share information about construction plans to each other and with the other projects. Good cooperation in information exchange would help to adjust appropriately their construction schedules and limit conflicts on overload usage of transportation roads and services.

b) Cumulative impacts in operation phase

The assessment indicates that the cumulative impacts of the project are mostly positive. The negatives cumulative impacts are minor to moderate and can be addressed individually at the project level.

Emergency procedures

During construction period, if there are environmental emergency or labor accidents, the Contractors have to make a report to describe in details the incidents and taken actions. The reports on the incidents have to be submitted to the CSC and BDSPMU for review and archive. The reports also have to be submitted to the concerned agencies if required. Please find below some risk response action plans:

a) Vehicle Accidents: Vehicle accidents may include, but are not limited to:

- Vehicle roll-over; and
- Vehicle crash with another vehicle, structure or with a person (worker or person from the local community).

Procedure:

- Stop work immediately;
- Turn off the vehicle, if possible;
- Help passengers of the vehicle(s) exit the vehicle and move to a safe place, if possible;
- If there is an injury, follow the procedure for medical emergencies (see below); and
- If there is a fuel/chemical spill, follow the procedure for spill emergency (see below).

b) Electrical faults/accidents: It is not safe to carry out the works within a 10m radius area of electrical cables, electrical accidents may happen as the result of:

- Collision with power cables and poles;
- Collapse of cable poles; and
- Hitting underground cables.

*Procedure**:*** When an electrical accident occurs:

- Stop work immediately;
- Isolate the power source, if possible and safe to do so (e.g. using a non-conductive rod to detach cables);
- If there is an injury/medical need, follow the procedure for medical emergencies (see below); and
- HSE Manager of the Contractor will inform EVN for further action (e.g. stopping power and conduct repairs), coordinate the authority inspection and facilitate the communication with authorities/media, if required.

c) Fire: Flammable hazardous materials and wastes will be present on site (including fuels, oils, etc.). A fire can also be caused by using ignition sources nearby (e.g. smoking or cooking by workers and residents) or engine incidents.

*Procedure**:***

- Upon identification of a fire incident, try to suppress the fire if it is deemed possible and safe to do so using the available suppression equipment);
- If it is not possible to do so, move to a safe location (up wind and sufficient distance) and report the fire to the fire brigade stating your name, location, the status of the fire;
- Report the fire to the Contractors' General Manager; and
- The Contractors' General Manager will inform all workers and on-site visitors and ensure that they are all accounted for and in safe locations. They shall also inform the BIWASE HSE Manager, who shall inform the applicable government department and any households on or off site who may be in danger and advise them to evacuate.

d) Chemical/Fuel Spill: A spill of chemical/fuel has the potential to cause soil and underground water contamination, if not controlled and cleaned up timely and properly. Chemical/fuel spills include, but are not limited to, the following:

- Fuel spill during refueling;

- Fuel/oil/grease leaks during vehicle parking or operating; and
- Breaking of fuel tanks on vehicles.

Procedure:

- When there is a spill, immediately use the absorbent materials to absorb the spilled materials and locate the drip tray to collect the spilled flow (if the spill continues);
- Collect used absorbent materials into an impermeable bag;
- Use the spade to collect the contaminated soil into the impermeable bag; note that there should be no contaminated soil left (stained soil must be collected to the full horizontal and vertical depth of the impact);
- If the spill is larger than one spill kit or person can handle, request another worker to support (e.g. to bring more spill kits);
- Use work gloves, safety glasses, long sleeved tops and trousers during the above response process and minimize direct contact with the spilled fuel/oil; and
- At and around the location of release, samples shall be taken to confirm whether any contaminated soil/underground water remains. The number of samples will depend on the scale of the release and the estimated impacted area. The parameters to be analyzed will depend on the substance released. Depths where samples are taken should be at the ground surface and immediately above the underground water table. These should be identified in a sampling plan prepared by the HSE Management and Monitoring Office in consultation with appropriately qualified technical staff. Response to any remaining contamination should be defined accordingly.

e) Adverse Weather: Potential adverse weather events include but are not limited to: Heavy rain; Strong wind; or Typhoon. The potential for an earthquake, tsunami and heavy flood happening at the site is considered unlikely.

Procedure: The Contractor General Manager will check the national and local weather forecast each morning prior to work commencing. Should adverse weather be predicted, depending on the severity and timing of the weather expected. If adverse weather is expected to be serious, lengthy and soon (e.g. in the case of a typhoon), the Contractor General Manager shall contact all workers not to come to work. If the weather is less serious and is not expected to last long, the Contractor Supervisor - Workers will cover this situation during the daily toolbox talk, continue to monitor the weather situation throughout the day and issue instructions as necessary to stop work, do their work sites safe, and find a safe sheltering location (either back at the site office, if sufficient time to return, or locally to the active works (in the case of the latter, the worker shall call the Contractor Supervisor – Workers to inform them where and when they are in the sheltering location). If the Contractor Supervisor – Workers do not hear from a worker(s) within 15 minutes of instruction to shelter, the Contractor Supervisor – Workers shall mobilize to the location by car to ensure the safety of the worker(s).

f) Broken water pipes: The existing water supply pipes on the routes may be broken due to the following reasons:

- During earthwork process for constructing foundation holes, inappropriate identification of the location or the wrong operating actions by the workers, non-

compliance with the technical design drawings may cause the collision between the construction equipment and the water supply pipes;

- The affecting force of the construction equipment focuses on one place, while the foundation of the construction area is weak, which creates the break of the water supply pipes;
- Such incidents if occur will create a loss of the huge water volume and an impact on the domestic water demand of the residents who access to this water supply source.

Procedure:

- Immediately turn off the valve/use the available facilities, materials in the site to seal the cracks, breaks temporarily;
- Inform immediately the functional agency in charge of the particular water supply pipes for timely repair; Excavate a ditch to lead the water flow to the drainage sewer/canals to limit the water spill out on the surface;
- Advice the residents in vicinity the water reserve alternative during repair, incident recovery time.

i) Sanitary Effluent Spill

- A spill of sanitary effluent has the potential to cause surface water, soil and underground water contamination and nuisance/health hazard to nearby households, if not controlled and cleaned up timely and properly. Sanitary effluent spills can occur during emptying and transportation of effluent from septic tanks being demolished on site.
- Spill response facilities: A spill kit shall be provided on each septic tank collection truck. A spill kit includes impermeable bags to collect contaminated soil and a small spade used for collecting contaminated soil.

Procedure:

- When there is a spill, immediately stop the flow;
- Use the spade to collect the contaminated soil into the impermeable bag; note that there should be no contaminated soil left (contaminated soil must be collected to the full horizontal and vertical depth of the impact);
- Transfer the filled impermeable bag to the Waste Storage Area for storage;
- If the spill is larger than one spill kit or person can handle, request another worker to support (e.g. to bring more spill kits);
- Use work gloves, safety glasses, long sleeved tops and trousers during the above response process and minimize direct contact with the spilled effluent.

6.2. ENVIRONMENTAL AND SOCIAL COMMITMENT PLAN

The project owner has developed and will implement an Environmental and Social Commitment Plan (ESCP), which will set out measures and actions required for the project to achieve compliance with the ESSs over a specified timeframe. The ESCP has been agreed

with the Bank and will form part of the legal agreement. The ESCP has been disclosed locally at the project sites and at the WB external website.

The ESCP considers the findings of the environmental and social assessment, the Bank's environmental and social due diligence, and the results of engagement with stakeholders. It is an accurate summary of the material measures and actions required to avoid, minimize, reduce or otherwise mitigate the potential environmental and social risks and impacts of the project. The ESCP also sets out a process that allows for adaptive management of proposed project changes or unforeseen circumstances.

The project owner will implement diligently the measures and actions identified in the ESCP in accordance with the timeframes specified and will review the status of implementation of the ESCP as part of its monitoring and reporting.

The project owner will notify the Bank promptly of any proposed changes to the scope, design, implementation or operation of the project that are likely to cause an adverse change in the environmental or social risks or impacts of the project. The project owner will carry out, as appropriate, additional assessment and stakeholder engagement in accordance with the ESSs, and propose changes, for approval by the Bank, to the ESCP and relevant management tools, as appropriate, in accordance with the findings of such assessments and consultation. The updated ESCP will be disclosed.

The project owner will monitor the environmental and social performance of the project in accordance with the legal agreement (including the ESCP). The extent and mode of monitoring will be agreed upon with the Bank and will be proportionate to the nature of the project, the project's environmental and social risks and impacts, and compliance requirements. The project owner will ensure that adequate institutional arrangements, systems, resources and personnel are in place to carry out monitoring. Where appropriate and as set out in the ESCP, the project owner will engage stakeholders and third parties, such as independent experts, local communities or NGOs, to complement or verify its own monitoring activities. Where other agencies or third parties are responsible for managing specific risks and impacts and implementing mitigation measures, the project owner will collaborate with such agencies and third parties to establish and monitor such mitigation measures.

6.3. ROLE AND RESPONSIBILITY FOR ESMP IMPLEMENTATION

6.3.1. Implementation arrangement

The tables and figures below summarize the roles and responsibilities of the key parties and their relationships regarding the implementation of the ESMP.

- Contractors will be responsible for implementing mitigation measures. These measures will be included in bidding documents and their costs are to be included in construction bid packages;
- CSC will be responsible for monitoring the day-to-day implementation of mitigation measures. Related costs are included in the CSC service contract;
- IEMC will be responsible for overall environmental monitoring which includes support to the PMU in implementing environmental supervision and monitoring, and responsible for reporting on the implementation through monitoring reports.

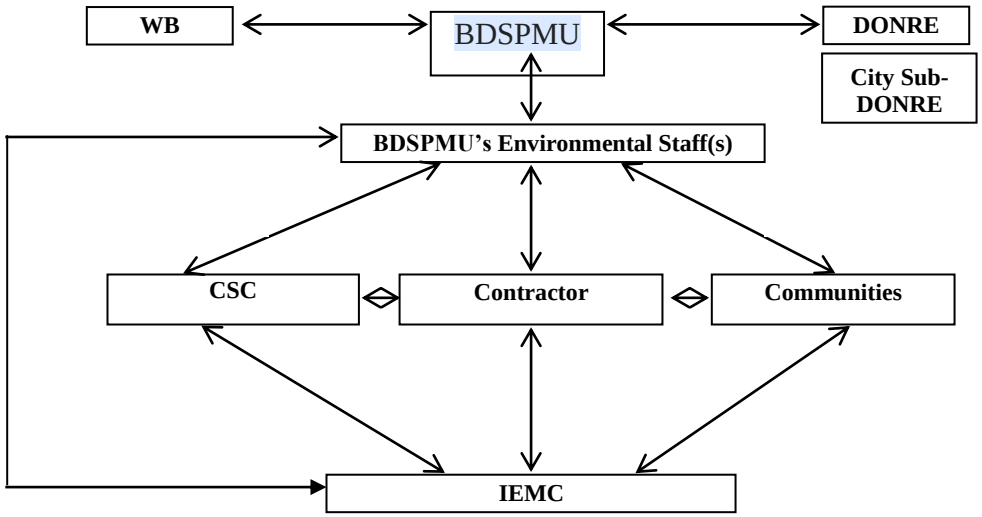


Figure 6.1. Organization chart for ESMP Implementation

6.3.2. Roles and responsibilities

Specific responsibility of stakeholders is shown in Table below.

Table 6.4. Specific responsibility of stakeholders

Stakeholder	Responsibilities
PPC	Overall responsible for environmental safeguard compliance of the Project
BDSPMU	Be responsible for monitoring the overall Project implementation, including environmental compliance. PMU will be responsible for ESMP implementation and environmental performance of the Project during the construction and operational phases: (i) closely coordinate with local authorities in the participation of the community during Project implementation; (ii) Ensure that the detailed design include all environment mitigation measures proposed in the ESMP; (iii) monitor and supervise to ensure adequate contents of ESMP are incorporated into bidding and contractual documents; (iv) ensure that an environmental management system is set up and functions properly; (v) Report on ESMP implementation to DONRE and the WB. (vi) Implement diligently the measures and actions identified in the ESCP in accordance with the timeframes specified and will review the status of implementation of the ESCP as part of its monitoring and reporting. PMU will assign Environmental Staff(s) (ES) to oversee and coordinate environmental aspects of the Project.

Stakeholder	Responsibilities
	PMU will assign two Social Staffs (SS). One social staff will oversee and coordinate social/resettlement aspects of the Project. The second staff will be the focal point for grievances and will also be in charge of relations with the community (i.e. street vendors).
PMU Environmental and Social Staff(s) (ES)	Be responsible for monitoring the implementation of the Project ESMP. Specifically, ES will be responsible for: (i) Monitor the incorporation of ESMP into the detailed technical designs and civil works bidding and contractual documents; (ii) Monitor the incorporation of ESMP and RAP monitoring and supervision into the TORs, bidding and contractual documents for the construction supervision consultant (CSC) and independent environmental monitoring consultant (IEMC); (iii) provide inputs to the consultant selection process; (iv) review reports submitted by the CSC and safeguard consultants; (v) conducting periodic site checks; (vi) propose solutions to handle social and resettlement issues of the Project; and (vii) prepare environmental and social performance section on the progress and review reports to be submitted to the DONRE and the World Bank.
Contractors	- Assign Environmental, Social Health and Safety (EHS) staff to monitor contractor's compliance to ESIA/ESMP. - Prepare Contractor ESMP (CESMP) for each construction site area, submit to PMU and CSC for review and approval before commencement of construction. - Obtain all permissions for construction (traffic control and diversion, excavation, labor safety, etc. before civil works) following current regulations. - Implement the mitigation measures specified in the ESMP, CESMP, bidding documents etc. - Actively communicate with local residents and authorities and take actions to address their ESHS concerns during construction. - Ensure that all staff and workers understand the procedure and their tasks in the environmental management program. - Report to the PMU and CSC on any difficulties and their solutions. - Report to PMU and CSC if environmental accidents occur and coordinate with agencies and keys stakeholders to resolve these issues. - Assign a Safety, Social and Environmental Officer (SEO) - Assign a focal point for grievances
Construction Supervision	- Assign qualified Environmental and Social Staff(s) to supervise the implementation of ESMP and ensure compliance

Stakeholder	Responsibilities
Consultant (CSC)	- The CSC will assign a social staff to oversee and coordinate social/resettlement aspects of the Project; - Be responsible for routine environmental supervision and reporting during construction phase. - Assist the PMU in reporting and maintaining close coordination with the local community. - Arrange, implement training on HIV/AIDs awareness raising for all workers, CSC team and PMU staff. The cost for this training included in the consulting service contract. - Carry out the periodical environmental quality monitoring during construction period and first-year-operation, prepare periodical environmental monitoring and supervision reports for submission to Vietnamese authorities.
Independent Environmental Monitoring Consultants (IEMC)	- Provide support to PMU to establish and operate an environmental management system, coordinate with the CSC team to provide trainings to the Contractors on project environmental management requirements - Provide trainings, implement capacity building activities for relevant agencies during Project implementation, carry out random field visits to certify compliance or recommend corrective/improvement actions. - Conduct ambient environmental quality monitoring during construction phase; - Prepare monitoring reports after each visit.
Local community	- Participate in volunteer community environmental and social monitoring.
Binh Duong DONRE	Monitoring compliance with the Government environmental requirements.
District Natural Resources and Environment Division of Binh Duong City PC	- Monitor and inspect environmental safety assurance activities in the project area - Check and handle violations. - Guide ward/communal staff in charge of environmental management in the locality. - Periodically report to the Department of Natural Resources and Environment on arising environmental issues. Coordinate with stakeholders, participate in research and inspection, and resolve arising environmental incidents.
Environmental police division	- Coordinate with relevant departments and agencies to monitor, control and resolve violations to the Environment Law. Handle serious violations, investigate responsibilities of related parties as well as take part in solving serious environmental incidents.

Stakeholder	Responsibilities
Public utility companies (electricity, water supply, drainage, telecommunications, etc.)	- Coordinate with the PMU and the Contractor to carry out relocation of underground works and set up temporary connections at proposed crossings to ensure the continuous provision of basic services for people's lives. Take part in dealing with related incidents (fire and explosion of electric cables, breaks of telecommunication cables, water pipe cracks, etc.

6.4. ENVIRONMENTAL COMPLIANCE FRAMEWORK

6.4.1. Environmental duties of the PMU/detail design consultants

During the preparation of TORs for consulting services and construction bidding documents, the PMU will also work closely with the consultants to ensure that: i) contract packaging and cost estimations includes ESMP implementation, including the services on independent safeguard monitoring, environmental sampling/monitoring and compliance supervision, reporting etc.; ii) ESCOPs and relevant common as well as site-specific mitigation measures are incorporated into the bidding documents; iii) environmental supervision and training are included in the scope of works assigned to the construction supervision consultant.

At feasibility study/detail engineering design stage, the Sewerage Project Management Unit Of Binh Duong Province (BDSPMU)shall work closely with the feasibility study consultants and detail design engineers to ensure that the greening/landscaping, environmental friendly solutions and relevant mitigation measures proposed in the ESIA/ESMP are considered and incorporated into the engineering design as appropriate.

During construction phase, the BDSPMU shall work closely with the supervision consultant to monitor the compliance of contractors and report to relevant authorities. BIWASE will also direct the supervision consultant and contractors on the actions to be undertaken in case when issues are arisen, incidents or accidents etc. The PMU is also responsible for ensuring effective implementation of the LMP during construction.

BDSPMU will assign at least one staff with suitable qualifications to be Environmental Officer (EO) and one staff with suitable qualification to be Social Officer (SO) throughout project implementation.

- The EO will oversee environmental issues and monitor safeguard compliance of the Project. The EO will be supported by the Independent Environmental Monitoring Consultant, the Environmental Officers of the construction supervision team as well as the contractors.
- The SO will oversee and coordinate social/resettlement aspects of the Project. The SO will be supported by the Independent Resettlement Monitoring Consultant, the social staffs of the construction supervision team/contractors.

6.4.2. Environmental duties of contractors

The contractor firstly shall adhere to minimize the impact that may be result of the project construction activities and secondly, apply the mitigation measures under ESMP to prevent

harm and nuisances on local communities and environment caused by the impacts in construction and operation phases.

Remedial actions that cannot be effectively carried out during construction should be carried out on completion of the works (and before issuance of the acceptance of completion of works)

The duties of the Contractor include but not limiting to:

- Compliance with relevant legislative requirements governing the environment, public health and safety;
- Work within the scope of contractual requirements and other tender conditions;
- Organize representatives of the construction team to participate in the joint site inspections undertaken by the Environmental Staff of the CSC;
- Carry out any corrective actions instructed by the Environmental Staff of the BDSPMU and CSC;
- In case of non-compliances/discrepancies, carry out investigation and submit proposals on mitigation measures, and implement remedial measures to reduce environmental impact;
- Stop construction activities, which generate adverse impacts upon receiving instructions from the Environmental Staff of BDSPMU and CSC. Propose and carry out corrective actions and implement alternative construction method, if required, in order to minimize the environmental impacts; Non-compliance by the Contractor will be cause for suspension of works and other penalties until the non-compliance has been resolved to the satisfaction of the ES of BDSPMU and CSC.
- In case the contractor proposes to use source of raw materials that have not been covered in Project ESIA, the contractor will report to the CSCs and BDSPMU and coordinate with them in carrying out due–diligence environmental review of these materials sources to assess their compliance to national environmental requirements. Only complied sources can be used under this project.
- The contractor shall be responsible for implementation of corrective measures at his costs. The contractor shall also be responsible for paying the costs of damages caused by non- compliance to ESMO and/or applicable environmental regulations

6.4.3. Contractor's environmental and social management plan (CESMP)

After contract signing, the contractor will be required to prepare and submit a contractor's site- specific Environmental and Social Management Plan (CESMP) for each contract package and submit to the CSC and BDSPMU for review and clearance.

The objective of the Contractor Environmental and Social Management Plan (CESMP) is to provide information for environmental management during the proposed works/activities on site of the Project. This is to ensure that the Contractor (and any subcontractors) have minimal impact on the environment. The CESMP will detail how the contractor will mitigate construction impacts and documents the contractor's response to inspecting, monitoring, verifying, internal auditing and correcting or improving environmental performance. The CESMP must be site-specific and should include details of control measures that will be

implemented on site to minimize any potential environmental impacts from the proposed works/activities. If the proposed works/activities contained within the CESMP are altered during the Contract, the CESMP will be required to be modified by the Contractor to reflect these changes or modifications. The contents of the CESMP should include the followings:

(i) A statement of policy, providing a definition of the Contractor's environmental policy and an indication of commitment to the execution of its Site Environmental Management Plan.

(ii) A brief document description; Date of issue; Revision status; Distribution list; and preparation personnel details and signoff.

(iii) Applicable laws and regulations associated with the requirements in the Project ESMP. Identification of the contractor licenses, permits and approval associated with the CESMP.

(iv) Details on how the environmental and social impacts identified in the Project ESIA will be managed on site, including: 1) the site-specific measures to mitigate impacts during construction; 2) ESCOPs; 3) the Contractor ESMP to be developed after the contractor is selected and before construction starts; and 4) the Contractor's Dredging Management Plan that the contractor is required to develop.

(v) Detailed environmental and social training that all site contractor personnel (including subcontractors) are required to undertake. As a minimum all contractor personnel working at the Project sites must: i) be familiar and understand the CESMP for the works; ii) be aware of their environmental responsibilities and legal obligations on site; and iii) undertake health and safety and emergency response training.

(vi) Specific capabilities, support mechanisms and resources necessary to satisfactorily implement the CESMP. Detailed environmental responsibilities of all contractor personnel including subcontractors working on site with appropriate knowledge, skills and training for specific tasks shall be identified.

(vii) The contractor shall be responsible for preparing monthly environmental reports, as a section within the Progress report required in the bidding document, including accidental report if any, for submitting to the Project owner. The contents of these reports may include following details:

- Implementation of the Contractor's CESMP complying with the agreed program;
- Any difficulties encountered in the implementation of the CESMP and recommendations for remedying them for the future;
- The number and type of non-compliances and proposed corrective actions;
- Reports from the Subcontractors involved in the implementation of the CESMP, including minutes of meetings and discussions held by the Contractor;
- Minutes of meeting from discussions held with the Project owner regarding implementation of the CESMP.

6.4.4. Contractor's safety and environment officer (SEO)

The contractor shall be required to appoint a competent individual as the Contractor's on-site safety and environment officer (SEO). The SEO must be appropriately trained in environmental management and must possess the skills necessary to transfer environmental management knowledge to all personnel involved in the contract. The SEO will be

responsible for monitoring the contractor's compliance with the ESMP requirements and the environmental specifications. The duties of the SEO shall include but not be limited to the following:

- Carry out environmental site inspections to assess and audit the contractors' site practice, equipment and work methodologies with respect to pollution control and adequacy of environmental mitigation measures implemented;
- Monitor compliance with environmental protection measures, pollution prevention and control measures and contractual requirements;
- Monitor the implementation of environmental mitigation measures;
- Prepare audit reports for the site environmental conditions;
- Investigate complaints and recommend any required corrective measures;
- Advise the contractor on environment improvement, awareness and proactive pollution prevention measures;
- Recommend suitable mitigation measures to the contractor in the case of non-compliance. Carry out additional monitoring of noncompliance instructed by the ES of BDSPMU and CSC
- Inform the contractor and ES (of BDSPMU and CSC) of environmental issues, submit contractor's ESMP Implementation Plan to the ES of BDSPMU and CSC, and relevant authorities, if required;
- Keep detailed records of all site activities that may relate to the environment.

6.4.5. Independent environmental monitoring consultant (IEMC)

In order to minimize the environmental impacts during construction phase of the Project, the Project owner shall ensure that environmental quality monitoring requirements are established for the project. An IEMC appointed by BDSPMU shall carry out the monitoring.

In order to minimize the environmental impacts during construction of the project, the Project Owner shall ensure that project-specific monitoring and compliance requirements are established for the project. The monitoring shall be carried out by an Independent Environmental Monitoring Consultant appointed by BDSPMU, the main responsibilities of IEMC will include

- Assist the BDSPMU, CSCs and contractors in performing their environmental duties on the site, including provision of technical advisories and guidance documents.
- Periodic site supervision to check compliance performance on relevant environmental policies, mitigation measures of relevant stakeholders which include the environment procedures, report system, resource allocation, training activities, and onsite environmental management practice;
- Monitoring environmental conflicts on the site, developing additional mitigation measures, and responding plans if needed
- IEMC will be responsible for carrying out environmental sampling, monitoring and marking report during all phases of the Project. Environmental quality monitoring will

be report periodically to BDSPMU and World Bank (respectively every 06 months for BDSPMU and WB in construction phase).

- IEMC will also supply specialized assistance to BDSPMU and ES in environmental matters.

PMU shall ensure that the above mentioned provisions on IEMC responsibility be included the relevant TORs for IEMC during project implementation.

6.4.6. Construction supervision consultant (CSC)

During construction phase, a qualified CSC reporting to the PMU shall carry out the environmental supervision. The CSC will assign environmental and social staff(s), will be responsible for inspecting, and supervising all construction activities to ensure that mitigation measures adopted in the ESMP are properly implemented, and that the negative environmental impacts of the Project are minimized. The CSC shall engage sufficient number of Environmental Supervision Engineers with adequate knowledge on environmental protection and construction project management to perform the required duties and to supervise the Contractor's performance. Specifically, ES of CSC will:

- Review and assess on behalf of the BDSPMU whether the construction design meets the requirements of the mitigation and management measures of the ESMP,
- Review and clear contractor's SEMP;
- Coordinate with BDSPMU Environmental Officer (EO) in reviewing environmental compliance at newly proposed borrow pits and quarries and advise PMU on whether these are eligible for use by the Project;
- Verify and confirm with BDSPMU environmental supervision procedures; parameters, monitoring locations, equipment and results;
- Supervise contractor's implementation of its CESMP including their performance, experience and handling of site environmental issues, and provide corrective instructions;
- Arrange, implement training on HIV/AIDs awareness raising for all workers, CSC team and BDSPMU staffs;
- Arrange, implement training on COVID-19 awareness raising for all workers, CSC team and BDSPMU staffs;
- Implement the environmental quality sampling and prepare periodical environmental monitoring reports, including reports on ESMP implementation status to the BDSPMU and prepare environmental supervision statement during the construction phase; and
- Review payment requests related to environmental mitigation costs if applicable.

PMU shall ensure that the above mentioned provisions on CSCs responsibility be included the relevant TORs for CSCs during project implementation.

6.4.7. Compliance with legal and contractual requirements

The constructions activities shall comply not only with contractual environmental protection and pollution control requirements but also with environmental protection and pollution control laws of the Socialist Republic of Viet Nam.

All the works method statements submitted by the Contractor to the CSC and BDSPMU for approval to see whether sufficient environmental protection and pollution control measures have been included.

The CSC and BDSPMU shall also review the progress and program of the works to check that relevant environmental laws have not been violated, and that any potential for violating the laws can be prevented.

The Contractor shall copy relevant documents to the SEO and the ES of CSC and BDSPMU. The document shall at least include the updated work progress report, the updated work measure, and the application letters for different license/permits under the environmental protection laws, and all the valid license/permit. The SEO and the ES shall also have access, upon request, to the Site Logbook.

After reviewing the documents, the SEO or the ES shall advise the BDSPMU and the contractor of any non-compliance with the contractual and legislative requirements on environmental protection and pollution control for them to take follow-up actions. If the SEO or the ES concludes that the status on license/permit application and any environmental protection and pollution control preparation works may not comply with the work measure or may result in potential violation of environmental protection and pollution control requirements, they shall advise the Contractor and the BDSPMU accordingly.

6.4.8. Environmental claims and penalty system

In the compliance framework, if non-compliance with environmental regulations are discovered by CSC/ES/IEMC/BDSPMU during the site supervision, following measures will be applied as specified in the General Conditions of Contracts

If the Contractor was, or is, failing to perform any Environmental and Social (E&S) obligations or work under the Contract, the value of this work or obligation, as determined by the PMU/CSC, may be withheld until the work or obligation has been performed, and/or the cost of rectification or replacement, as determined by the PMU, may be withheld until rectification or replacement has been completed. Failure to perform includes, but is not limited to the following:

(i) failure to comply with any Environmental and Social (E&S) obligations or work described in the Works' Requirements which may include: working outside site boundaries, excessive dust, failure to keep public roads in a safe usable condition, damage to offsite vegetation, pollution of water courses from oils or sedimentation, contamination of land e.g. from oils, human waste, damage to archeology or cultural heritage features, air pollution as a result of unauthorized and/or inefficient combustion;

(ii) failure to regularly review C-ESMP and/or update it in a timely manner to address emerging E&S issues, or anticipated risks or impacts;

(iii) failure to implement the C-ESMP;

(iv) failing to have appropriate consents/permits prior to undertaking Works or related activities;

(v) failure to submit E&S report/s (as described in Appendix C of the bidding document), or failure to submit such reports in a timely manner;

(vi) failure to implement remediation as instructed by the Engineer within the specified timeframe (e.g. remediation addressing non-compliance/s).

The Contractor will be given a grace period (determined by CSC?PMU) to repair the violation. If the Contractor performs the repairs within the grace period (confirmed by CSC/PMU), no penalty is incurred, and withheld money will be pay. However, if the Contractor fails to successfully make the necessary repairs within the grace period, the Contractor will pay the cost for a third party to repair the damages (deduction from withheld money).

If the contractors fail to make the remedial actions and withheld money is not adequate to pay for these, the E&S performance security will be recovered to mobilize 3rd party to repair the damage.

In case the E&S are serious, as determined by CSC/IEMC and mitigation could not be readily provided, the E&S performance security will be recovered, and the contractor will be subject to termination of the construction contract.

In case of IEMC/CSC/BDSPMU do not detected of non-compliance with environmental regulations of the contractor, they will be responsibility payment to repair the violation.

6.4.9. Reporting system

In order to establish a database for monitoring implementation of mitigation measures, and effectively implement the ESMP. The following reports related to the implementation of the ESMP will be prepared and submitted to relevant agencies. Frequencies and responsibilities are shown in table 6.5

Monthly progress reports by the contractors: Each works contractor will submit monthly progress reports to the CSC. These reports will include reporting on ESMP implementation performance.

Monthly progress reports by the contractors (to the CSC). The CSC will submit monthly project progress reports to the BDSPMU. These reports shall also include a comprehensive section on ESMP and CEMP implementation progress, grievances received, occupational accidents, and necessary corrective actions.

Semi-annual environmental monitoring reports by BDSPMU (to WB). The BDSPMU will submit semi-annual environmental monitoring reports to the WB for clearance and disclosure.

Table 6.5. Regular Reporting Requirements

No.	Report Prepared by	Submitted to	Frequency of Reporting

1	Contractor to the Employer	BDSPMU	Once before construction commences and monthly thereafter
2	Construction Supervision consultant (CSC)	BDSPMU	Weekly and monthly
4	Community Monitoring	BDSPMU	When the community has any complaint about the subproject safeguards implementation
5	BDSPMU	DONRE	Every six-month
6	BDSPMU	WB	Every six-month

6.5. ENVIRONMENTAL AND SOCIAL MONITORING PROGRAM

6.5.1. Objective and approach

The main objectives of environmental monitoring program are to ensure that all identified environmental impacts stated in Chapter 5 and other arising impacts during project implementation will be appropriately managed, performance of the project works will be enhanced, and complaints appropriately addressed. The environmental monitoring program should have the following objectives:

- Ensure the ESMP is effectively implemented
- Determine the actual extent of the impacts and propose additional adjustment if needed.
- Check and supervise implementation of proposed mitigation measures during project implementation and manage their effectiveness.
- Check the impacts of construction activities impacts on ambient environmental quality (such as air quality, surface water, noise, vibration…)
- Identify any outstanding environmental issues.
- Recommend additional mitigation measures.

6.5.2. Monitoring of contractor's safeguard performance

In general, all performance monitoring system will need internal and external monitoring. However, the contractor's compliance will be mainly conducted as the works are carried out by CSC, but the involvement of environmental officers of contractors, IEMC and BDSPMU in the monitoring process will also take importance roles. There are several levels and types of contractor' compliance monitoring, which could be listed as the below:

- Frequency (daily) monitoring: which will be taken place as internal monitoring by the EO of contractors and by the Construction Supervision Consultant (CSC) as mobilized by BDSPMU. The results of daily monitoring reports will be included in the construction diary of contractor and diary monitoring sheets of CSC. The main results will be compiled in monthly reports submitted to BDSPMU. The compliance monitoring of contractor will include:
    - Contractor's ESMP preparation and approved, which includes main specific

management plan such as DMMP, OHS plan…;

- Obtain all relevant permissions, licenses and agreements;
- Performance of ESMP on the construction site;
- Report preparation and achieves;
- Information discloses and working with the local authorities;

- Periodical monitoring (every six months): As part of the overall monitoring of the ESMP, the periodical monitoring will be taken by several stakeholder such as IEMC, BDSPMU and donors (the World Bank), local authorities. The main tasks will be undertaken by IEMC, which include ESPM performance monitoring and ambient environmental quality monitoring. The monitoring results of IEMC will be included in the semi-annual (quarterly) reports, which will be submitted to BDSPMU and WB.
- Community monitoring: Monitoring by local communities will be conducted following the Government practices with the technical and management support from the BDSPMU.

6.5.3. Environmental quality monitoring

Environmental quality monitoring will be carried out during construction phase of the project implementation, which should be implemented by the IEMC and the results will be included in the IEMC reports. The main objective of ambient environmental quality monitoring aims at assessing the impacts of construction activities on the ambient environmental quality in the project implementation area. The main contents of ambient environmental quality monitoring could be summarized as the below table.

Table 6.6. Location, parameters and frequency of monitoring

No	Monitored items	Preparation and construction phase
I	***Monitoring of air quality, Noise and Vibration***	
	1. Monitoring parameters	Noise, TSP, CO, NO_2, SO_2, Temperature
	2. Monitoring frequency	Pre-construction phase: one time before construction activities started on the site to establishment of base conditions. Construction phase: measurements taken every six-months
	3. Applied Regulation	QCVN 05 :2013/BTNMT, QCVN 06:2009/BTNMT
	4. Monitoring location	**1.Tan Uyen town** **KK1** – The construction area of Tan Uyen 2 Plant **KK2** – crossroads Le Quang Dinh – Trinh Hoai Duc (Khanh Binh ward, near the sewage water pumping station, the route of sluiceway expected) **KK3** – crossroads HL417 – PR746 (Tan Phuoc Khanh ward, near the sewage water pumping station, the route of sluiceway expected) **KK4** – Road junction PR746- Nguyen Tri Phuong (Tan Hiep ward, near the sewage water pumping station, the route of sluiceway expected) **KK5** - Road junction PR746- DR411 (Uyen Hung ward, near the

No	Monitored items	Preparation and construction phase
		sewage water pumping station, the route of sluiceway expected) **2.Di An city:** **KK6** – The area of Di An sewage water treatment plant **KK7** – crossroads Pham Van Dieu – Bui Thi Xuan (Tan Binh ward, near the sewage water pumping station, the route of sluiceway expected) **KK8** – Intersection point between Le Trong Tan street - Dao Trinh Nhat street (An Binh ward, the route of sluiceway expected) **KK9** –PR743A (Binh An ward, the route of sluiceway expected) **KK10- Road 30/4 (**Binh Thang ward**,** the route of sluiceway expected) **3.Thuan An city:** **KK11-** Intersection point between Cau Tau- August Revolution (Hung Dinh ward, the route of sluiceway expected) **KK12-** Intersection point between August Revolution -Nguyen Huu Canh (Binh Nham ward, the route of sluiceway expected) **KK13 –** The boundary embankment of Sai Gon (Binh Nham ward, the route of sluiceway expected, pumping station) **KK14-** The area of Thuan An sewage water treatment plant **KK15-** at the national road NR13-Vinh Phu 13 (Vinh Phu ward, the route of sluiceway expected)
II	***Surface Water Quality Monitoring***	
	1.Monitoring parameters	pH, DO, TSS, BOD5, COD, NH4+, Cl-, NH_4^+, NO_3^-, NO_2^-, PO_4^{3-}, Fe, As, Mn, total oil, coliform
	2. Monitoring frequency	Pre-construction phase: one time before construction activities started on the site to establishment of base conditions. Construction phase: measurements taken every six - months
	3. Applied Regulation	QCVN 08-MT:2015/BTNMT
	4. Monitoring location	**1.Tan Uyen town:** **NM1 –** At Suoi Tre canal, the location of discharge point of the expected sewage water treatment plant **NM2** – Surface water in the branch of Dong Nai river, (intersection with Rach Tre) is the source to receive the sewage water after treatment. **2.Di An city:** **NM3 –** The surface water sample of Siep stream (Cai Cau channel) the discharge point of the plant **NM4** – The surface water sample of Dong Nai river (intersection with Siep stream) is the source to receive the sewage water. **3.Thuan An city:** **NM5-** The discharge channel of Thuan An sewage water treatment plant **NM6-** surface water sample of Sai Gon river (is the source to receive the sewage water after treatment).

No	Monitored items	Preparation and construction phase
IV	***Sediment Quality***	
	1. Monitoring parameters	pH, As, Cd, Cr, Cu, Pb, Zn, Salinity
	2. Monitoring frequency	Pre-construction phase: one time before construction activities started on the site to establishment of base conditions Construction phase: measurements taken every six - months.
	3. Applied Regulation	QCVN 03-MT :2015/BTNMT
	4. Monitoring location	**TT1, 2-** The sediment sample at Suoi Tre
VI	***Monitoring of solid waste***	Monitoring volume of waste generated, and sludge dredged
VII	***Monitoring of hazardous waste***	Monitoring volume at storage location

The total samples of ambient environmental quality monitoring during construction phase could be summarized ad the below table

Table 6.7. Summary of number of monitoring samples

Total construction time	Monitoring frequency	Samples of air, noise	Surface water quality	Sediment quality
Construction of Tan Uyen WWTP and Suoi Tre canal				
30 months	Every 6 months	5	10	14
Construction of sewer system and pumping stations in Tan Uyen town				
45 months	Every 6 months	32	0	0
Expansion of Thuan An WWTP				
18 months	Every 6 months	3	6	0
Construction of sewer system and pumping station in Thuan An city				
18 months	Every 6 months	12	0	0
Expansion of Di An WWTP				
18 months	Every 6 months	3	6	0
Construction of sewer system and pumping station in Di An city				
36 months	Every 6 months	24	0	0
Total		**79**	**22**	**14**

6.6. CAPACITY BUILDING

6.6.1. Current PMU's capacity on environmental and social management

During the past period, BDSPMU - former under BIWASE had managed several projects which funded by ODA loans such as JICA, ADB and WB including:

(i) Southern Binh Duong Water Environment Improvement Project, phase I and II funded by JICA (2013 and 2017);

(ii) Drainage and wastewater treatment project in Di An area, Binh Duong province, WB fund (2018);

(iii) Drainage and wastewater treatment project in Di An - Thuan An - Tan Uyen area, ORIO fund(2019); and

(iv) Wastewater collection and treatment project for Ben Cat area (expected to be completed by 2024).

As such, they have good knowledge and experience on implementing project in accordance with the safeguard policies and international practices. But the capacity of BDSPMU is still needed to improve as existing staff do not have experience in projects applying new ESF of the WB. In addition, when the new Tan Uyen WWTP is constructed other environmental and technical staffs will be mobilized, who may not familiar with both safeguard policies and ESF of the WB. Therefore, there is a risk that the resources allocated for managing environmental and social issues of this Project may not be adequate, affecting the environmental performance/compliance to the ESSs. Although BDSPMU participated in a several trainings organized by the World Bank, new E&S capacity assessment conducted during project preparation revealed the need for further capacity building in specific ESSs during project implementation. Such gaps will be addressed through capacity building program as part of the ESMP.

6.6.2. Environmental and social capacity building program

The capacity of BDSPMU, CSC and contractors' staff responsible for ESMP implementation and supervision will be strengthened. All parties involved in implementing and supervising the ESMP must understand the goals, methods, and practices of project environmental management. The project will address the lack of capacities and expertise in environmental management through (i) institutional capacity building, and (ii) training

Institutional strengthening: The capacities of BDSPMU to coordinate environmental management will be strengthened through a set of measures. The appointment of a qualified environment specialist within the BDSPMU in charge of ESMP coordination, including GRM and coordination of environmental impact monitoring, training, reporting, etc. which will be strengthened capacity directly by the WB or by IEMC.

Training: Due to the project will be applied the new environmental and social standards of the WB. The World Bank will annually carry the typical safeguard policy training for all funded BDSPMU. Thus, all trainings relative to implementation of new WB safeguard policy will be provided BDSPMU environmental staff, CSC, and contractor's OHS as soon as possible once they are mobilized. Other trainings also provided for relevant stakeholders during construction phase, which could be summarized as the below table:

Table 6.8. Advanced training program on environmental monitoring management capacity

I. Targeted trainees	**Staffs of project management unit of BDSPMU**
Training course	WB safeguards policies and ESMP implementation
Participants	Staff in charge of environmental issues; environmental managers
Training frequency	Immediately after the project becomes valid, but at least one month prior to the first bid package. The next training will be planned on demand.
Duration	2 days
Content	WB policies requirements, implementation procedures, implementation of approved ESMP, supervision performance of relevant stakeholders Project-related general environmental management including the request from World Bank, Department of Natural Resources and Environment, in collaboration with competent authorities and concerned stakeholders; Environmental monitoring for the Subproject includes: - Requirements of environmental monitoring; - Monitoring and implementation of mitigation measures; - Community involvement in environmental assessment; - Guiding and monitoring contractors, CSC and community representatives in the implementation of environmental monitoring; - Forms used in environmental monitoring processes; - Reaction and risk control; - Manner of receiving and submit forms; - Other issues to be determined.
Responsibility	With the help of the WB, the IEMC and BDSPMU implement safety policies.
II. **Targeted trainees**	**CSC, contractors, representatives of local authorities (wards/communes), communities**
Training course	Implementation and supervision of ESMP
Participants	EO and site manager of contractors, EO and civil engineering of CSCs, relevant staffs of local authorizes (if any)
Training frequency	Shortly after awarding contracts to the contractors with updates on demand
Duration	Two-day training for CSC and contractors, and one-day training for others
Content	- Environmental impact principals and relevant process. - Environmental management principles - Overview of the overall environmental monitoring; - Requirements of environmental monitoring; - The roles and responsibility of the contractors and CSC; - The content and method of environmental monitoring;

	- Reaction and risk control; - Introducing monitoring forms and instructing on filling out forms and reporting incidents; - Other issues to be determined - Preparing and submitting reports
Responsibility	BDSPMU, the independent environmental monitoring consultant (IEMC)
III. **Targeted trainees**	**Workers**
Training course	ESMP implementation and Occupational health and safety training
Participants	Representatives of workers (team leaders) working directly for the project components and all workers on the sites
Training frequency	First time right after construction mobilization on the site, and monthly basic during construction sites
Duration	One day of presentation and one day of on-site presentation
Content	- Brief all requirements stated in the approved ESMP and contractor's ESMP; - Role and responsibilities of contractors on the site; - Understand about the hazards in operation and how to control them - Potential risks to health - Warnings to prevent exposure - Sanitary requirements - Wear and use clothing and protective equipment - Appropriate response to extreme operating conditions, accidents and incidents
Responsibility	Contractors, BDSPMU with the assistance of IEMC

6.7. ESTIMATED COST FOR ESMP IMPLEMENTATION

6.7.1. Estimated costs for environmental monitoring program

The BDSPMU will mobilize an independent environmental monitoring consultant to conduct ambient environmental quality monitoring during project implementation. Based on the design of the ambient environmental quality monitoring program, the cost estimation for implementing is shown in the table below.

Table 6.9.Estimated budget for conducting ambient environmental quality monitoring

No	Name of analysis index	Unit	Quantity	Price (VND)	Sub-Total
I	***Air, noise, vibration samples***	***sample***	*79*	2,072,228	163,706,012
II	***Surface water samples***	***sample***	*22*	4,650,872	102,319,184
III	***Sediment quality***	***sample***	14	2,588,600	36,240,400
Grand total (VND)					**272,265,596**
Grand total (USD)					**11,634**

6.7.2. Estimated cost for IEMC

The following table provides the estimated costs for environmental quality monitoring and IEMC (in accordance with national practices) for reference purposes. However, final costs will be updated in the detailed design phase.

Table 6.10. Estimated costs of IEMC (Exchange rate: 1 USD 23,270 VND)

No	Content	Unit	Amount	Unit price *(VND)*	Sub-total (*VND)*	Sub-total (*USD)*
1	Experts 'salary	person-month	32	40,000,000	1,280,000,000	54,701
2	Accommodation, expenses for business trip	person-day	336	350,000	117,600,000	5,026
3	Travel expenses	Trip/ person	48	9000,000	432,000,000	18,462
4	Site visit cost	person-day	336	500,000	168,000,000	7,179
4	Course organization	Table 6.11.			320,000,000	13,675
5	Stationery and communications	Monitoring session	8	5,000,000	40,000,000	1,709
6	Environmental quality monitoring	Table 6.9.			272,265,596	11,633
	Total				2,629,865,596	112,387

6.7.3. Estimated costs for training program

Estimated cost for training program on environmental/social monitoring management capacity is presented in table below

Table 6.11. Estimated Costs for Training and Capacity Building

(Exchange rate: 1 USD = 23,400 VND)

Training Item	Trainee	Unit	Quantity	Price	Total	
				VND	*VND*	*USD*
A. Capacity building programs on safeguard policies (trained by IEMC)						
I. WB safeguards policies and ESMP implementation						
BDSPMU	Staff in charge of environmental issues; environmental managers	course	2	10,000,000	20,000,000	855
II. Implementation and supervision of ESMP						
Total work items	CSC; Construction engineers, site manager	course	16	10,000,000	160,000,000	6,837
III. Safety and environmental sanitation						
Total work items	Representatives of workers	course	4	5,000,000	20,000,000	3,419
				Sub-total (A)	**200,000,000**	**8,547**
B. HIV /Aids, COVID-19 and GBV training (done by IEMC)						
Total work items	Workers, CSC team and Implementation and supervision of ESMP staff	course	6	20,000,000	120,000,000	5,128
				Sub-total (B)	**120,000,000**	**5,128**
				Total: (A)+(B)	**320,000,000**	**13,675**

6.7.4. Total estimated costs for ESMP implementation

The following table provides a cost estimate for the implementation of environmental management plan (ESMP). The cost of ESMP[31] implementation will include (i) the costs of implementing mitigation measures by the contractor, (cost of the independent environmental monitoring consultant (IEMC), (iv) the costs of environmental quality monitoring, (v) the cost of safety management for the BDSPMU, including both technical assistance in implementing safety policies and training programs. The costs of implementing mitigation measures during construction will be a part of the value of construction contracts, while the costs for a contractor's environmental monitoring plan (SEMP) by the construction supervision consultant (CSC) will be provided in construction supervision contracts. The costs of the BDSPMU operations relating to ESMP are allocated from the project management budget of the BDSPMU, including safety training programs, and basic allowances to participants in the monitoring programs. After the project has been completed, the costs of environmental monitoring of constructed works will be taken from the operation and maintenance budget of the city.

31Excluding costs for RP implementation and independent monitoring the performance of RP/EMP

It should be noted that the involvement of the community in the process of ESMP implementation is completely voluntary participation for the benefit of own community and households. Therefore, communities partaking in monitoring the ESMP will not get paid. However, in order to encourage community participation, it is necessary to allocate costs of materials and instruments for monitoring activities and some remuneration for a small number of members chosen by the public to participate in monitoring activities. As stipulated in the Prime Minister's Decision No. 80/2005 / QD-TTg dated 18 April 2005 promulgating the regulations on investment supervision by the community and Joint Circular guiding the implementation of Decision 80/2005 / QD-TTg, "expenses for the community' s investment monitoring in the commune/ward in are reflected in the cost estimates of the Communal Fatherland Front Committee's budget and allocated from the communal/municipal budget; support funds for the dissemination, organization of training courses, guidance, preliminary and final report on investment monitoring by the community at provincial and district levels are balanced in the cost estimates of the Fatherland Front Committee at provincial/district level and allocated from the provincial budget".

Table 6.12. Estimated costs of ESMP implementation (USD million)

Content	**Construction items (million USD)**	**Funded by**
Mitigation during construction	As a part of the contract	WB
Monitoring safety policies during construction	As a part of the cost for CSC	WB
BDSPMU's units in charge of environmental safety policies	As part of the costs for the BDSPMU	Counterpart funds
Environmental quality monitoring	0.0116	WB
Independent environmental monitoring consulting	0.0872	WB
Capacity building programs on safeguard policies	0.0136	WB

6.8. GRIEVANCE REDRESS MECHANISM (GRM)

Project Level GRM

Within the Vietnamese legal framework, citizen rights to complain are protected. As part of overall implementation of the project, a grievance redress mechanism (GRM) will be developed by the ESU of the PMU, according procedures, responsible persons and contact information will be developed. It will be readily accessible to ensure that grievances shall be handled and resolved at the lowest level as quickly as possible. The mechanism will provide a framework within which complaints about environmental and social issues can be handled, grievances can be addressed, and disputes can be settled promptly. The GRM will be in place before construction commencement.

During construction, the GRM will be managed by the contractors under supervision of the CSC. The contractors will inform the affected communities and communes about the GRM availability to handle complaints and concerns about the project. This will be done via the

community consultation and information disclosure process under which the contractors will communicate with the affected communities and interested authorities on a regular basis. Meetings will be held at least quarterly, monthly information brochures will be published, announcements will be placed in local media, and notices of upcoming planned activities will be posted, etc. The contractors should indicate contact for any complaints when the contractors announce construction schedule to local communities.

All complaints and corresponding actions undertaken by the contractors will be recorded in project safeguard monitoring reports. Complaints and claims for damages could be lodged as follows:

- Verbally: direct to the CSC and/ or the contractors' safeguard staff or representatives at the site offices.
- In writing: by hand-delivering or posting a written complaint to specified addresses.
- By telephone, fax, e-mails: to the CSC, the contractors' safeguard staff or representatives.

Upon receipt of a complaint, the CSC, the contractors' safeguard staff or representatives will register the complaint in a complaint file and maintain a log of events pertaining to it thereafter, until it is resolved. Immediately after receipt, four copies of the complaint will be prepared. The original will be kept in the file, one copy will be used by the contractor's safeguard staff, one copy will be forwarded to the CSC, and the fourth copy to the PMU within 24 hours since receipt of the complaint.

Information to be recorded in the complaint log will consist of:

- The date and time of the complaint.
- The name, address and contact details of the complainant.
- A short description of the complaint.
- Actions taken to address the complaint, including contact persons and findings at each step in the complaint redress process.
- The dates and times when the complainant are contacted during the redress process.
- The final resolution of the complaint.
- The date, time and manner in which the complainant was informed thereof.
- The complainant's signature when resolution has been obtained.

Minor complaints will be dealt with within one week. Within two weeks (and weekly thereafter), a written reply will be delivered to the complainant (by hand, post, fax, e-mails) indicating the procedures taken and progress to date.

The main objective will be to resolve an issue as quickly as possible by the simplest means, involving as few people as possible, and at the lowest possible level. Only when an issue cannot be resolved at the simplest level and/ or within 15 days, will other authorities be involved. Such a situation may arise, for example, when damages are claimed, the to-be-paid amount cannot be resolved, or damage causes are determined.

Grievance Redress Mechanism for affected person who lose means of income/livelihoods, are Summarized in table below.

Table 6.13. Grievance Redress Mechanism

First Stage – Ward/Commune People's Committee (WPC):	PAP may submit their complaint – either in written or verbal, to the office of the Ward/Commune People's Committee. W/C PC will receive the complaints and will notify the W/C PC leaders of the complaint. The Chairman of the W/C PC will meet the complainant in person and will solve it within 15 days following the receipt of the complaint.
Second Stage – City/District People's Committee (C/DPC):	After 15 days since the submission of the complaints, if the aggrieved person does not have any response from the W/C PC, or if the aggrieved person is not satisfied with the decision taken on his/her complaint, the PAP may take the case, either in written or verbal, to the Reception Unit of City/District People's Committee. The City/District People's Committee will have 30 days since the date of receipt of the complaint to resolve the case. The City/District People's Committee will register all the complaints submitted and will inform the District Board for Compensation and Land Acquisition of the City/District PC's resolution/assessment results. Aggrieved person may elevate the case to the Courts of Law if they wish.
Third Stage – Provincial People's Committee):	After 30 days, if the aggrieved PAP does not hear from the City/District PC, or if the PAP is not satisfied with the decision taken on his/her complaint, the PAP may escalate the case, either in writing or verbal, provincial People's Committee, or lodge an administrative case with the City/District People's Court for resolution. The provincial PC will have 45 days to resolve the complaint to the satisfaction of all the concerned. The provincial PC secretariat is also responsible for registering all complaints that are submitted. Aggrieved person may elevate the case to the Courts of Law if they wish
Final Stage - Courts of Law:	After 45 days following the submission of the complaint at provincial PC, if the aggrieved PAP does not hear from the provincial PC, or if PAP is not satisfied with the decision taken on his/her complaint, PAP may take the case to a Courts of Law for adjudication. Decision by the court will be the final decision. Decision on solving the complaints must be sent to the aggrieved PAPs and concerned parties and must be posted at the office of the People's Committee where the complaint is solved. After 3 days, the decision/result on resolution must be made available at ward level and after 7 days at the city/district level.

GRM for Workers: The project workers (all three categories, direct workers, contracted workers and primary supply workers) can directly register their complaints with the GRM for workers. The members of this GRM will be trained to be capable to address grievances by workers, including workplace complaints in an efficient and effective manner to meet national regulations on labors and World Bank ESS2.

Table 6.14. GRM for Workers

Complainants	GRM Functions	Timeframe
Workers or labor association will submit their grievance to the GRM for Workers through one of the channels	• Refer workers related complaints to the Workers GRM. • Registration, classification and analysis of grievances. • Convene the GRM for workers meeting to analyze and resolve the complaint. • Provide written response to the complainant/contractor. • Provide guidance with recommendations to the contractor to improve working condition/labor management issues.	10 days

The World Bank's Grievance Redress Mechanism: Communities and individuals who believe that they are adversely affected by a WB-financed project may submit complaints to the available project-level grievance redress mechanism or the WB's Grievance Redress Service (GRS). The GRS will ensure that complaints received are promptly reviewed to address project-related concerns. The affected communities and individuals of the project may submit their complaints to the WB's independent Inspection Panel that will determine whether harms occurred, or can occur, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at any times after concerns have been brought directly to the WB's attention, and the Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit www.worldbank.org/grs. For information on how to submit complaints to the World Bank Inspection Panel, please visit www.inspectionpanel.org.

CHAPTER 7. PUBLIC CONSULTATION AND INFOMRATION DISCLOSURE

7.1. PUBLIC CONSULTATION

7.1.1. Public consultation process

The World Bank's policy on Environmental and Social Standards No.5 (ESS5) and Environmental and Social Standards No.10 (ESS10) require consultation and notification to affected people and local authority on social and environmental issues during project preparation.

Public consultation for ESIA report must also comply with the requirements of Decree 18/2015/ND-CP dated February 14, 2015 and Circular No.40/2019/TT-BTNMT dated May 13, 2019 of Ministry of Natural Resources and Environment for environmental impact assessment and environmental protection plan.

Public consultation is conducted with the purpose of: (i) sharing information about the project's items and expected activities with the project area community and stakeholders; and (ii) collecting comments and concerns about local characteristics and environmental sensitive issues in the project area from the government and local communities. On that basis, public concerns will be included in the Environmental and Social Assessment Report and project mitigation measures.

Project stakeholders are defined as individuals, groups or other entities who: (i) are impacted directly or indirectly, positively or adversely by the Project (also known as 'affected parties'); and (ii) have an interest in the Project ('interested parties').

The project will mostly employ interviews, focus group discussions, open meetings, and workshops as a means of carrying out consultations. There will be conducted for three phases of project implementation i) preparation stage (before project appraisal); ii) Pre-construction and construction stage and iii) Post construction/maintenance stage. Public consultation strategy including targeted groups/attendees, subjects, formats, time frame, and responsibilities is shown in Table 7.1

Table 7.1. List Public consultation strategy for three implementation phases of the project

Project stage	Subjects	Format	Timetable: Locations/dates	Target stakeholders	Responsibilities
Before project implementation stage	Overall project design; Anticipated environmental and social impacts and proposed mitigation measures in ESIA and RPF;	Public meetings[32]; Leaflets; Posting at city/ward/ commune PCs. World Bank's website; HH questionnaires during ESIA	Affected Ward/ communes PC Before appraisal (i.e. April 2020) On the World Bank's website	All stakeholders	- BDSPMU; - Project preparation consultants.

[32]If necessary, a local person (of the same EM group) will be invited to join the consultation, in case local EM language is required to promote the free exchange of information between the EM peoples, and the consultant team.

Project stage	Subjects	Format	Timetable: Locations/dates	Target stakeholders	Responsibilities
		preparation.			
Pre-construction and construction stage	More site-specific environmental and social impacts and mitigation measures in ESIA, ESMP (including gender action plan), LMP and SEP. Awareness-raising on the GRM	Public meeting; Individual meetings through RAP process; Preconstruction site visits; GRM	Prior to start of civil work at ward/communes The GRM is maintained throughout the project life.	Project affected parties (PAPs); Community groups supporting PAPs Interested parties	BDSPMU; Social and environmental safeguard consultant teams (if any) Contractors
Post construction phase	Effectiveness of mitigation measures, impacts of operation, comments and suggestions	Public satisfaction survey	Once in the first year	Potentially affected households, ward PC representatives	BIWASE and Potential Operation Unit Consultants (if any)

7.1.2. Public consultation results

In the context of COVID-19 pandemic, small meetings were permitted, conduct consultations in small-group sessions, on the ESIA, were conducted in September and October, 2020 in different wards of Thuan An, Di An cities and Tan Uyen town: 22 consultation meetings were conducted in Binh Duong PPC and 17 wards in the project area with 159 participants in which female participation accounts for 48.4%.

About two weeks prior to public consultation, the consultants informed and cooperated with BDSPMU and the local authorities to invite representatives of the affected HHs, all identified stakeholders to attend public consultations. The public consultation meetings were conducted from Sep 11 – Sep 25, 2020at 17wards/communes in the project area with the following content:

- Introduced the project including project location, and alignment of proposed roads for development/improvement, ROW of all project implementation locations.
- Presented WB environmental and social standards, and relevant regulations of Vietnam government, anticipated environmental and social impacts and respective mitigation measures, the grievance redress mechanism for environmental and resettlement problems; and
- Seeking for the feedbacks from all attendees and provide clarifications or responds if needed.

The results of the public consultation meetings are described in the following table.

Table 7.1. Summary of Public Consultation Results

No.	Public consultation, workshops and meetings	Number of participants		Participants	Summary of consultation results	Project Owner's feedback
		Male	Female			
1.	Binh Duong DONRE (September 10, 2020) – via email	0	1	- Representative of PMU - Representatives of DONRE - E&S consultants	Collection information on provincial environmental status, wastewater discharge zones and climate change documents	PMU appreciate the contribution and supports from local authorities during project preparation
2.	DARD (September 10, 2020)	0	2	- Representative of PMU - Representatives of DARD - E&S consultants	Relevant information on irrigation	PMU appreciate the contribution and supports from local authorities during project preparation, during implementing period, the PMU will work close with DARD to manage impacts on irrigation canals.
3.	Working with the Provincial Women's Union (September 10, 2020)	3	7	- Representative of PMU - Representatives of the Binh Duong Provincial Women's Union - E&S consultants	Binh Duong has implemented the national strategy on gender equality (gender equality) for 10 years (2011-2020). Many models of gender equality, domestic violence prevention. "Trusted Address" model in the community has received a positive response from the society.	PMU appreciate the contribution and supports from local authorities. PMU will work close with Women's Union for further cooperation and consultation.

No.	Public consultation, workshops and meetings	Number of participants		Participants	Summary of consultation results	Project Owner's feedback
		Male	Female			
4.	Working with DOLISA (October 29, 2020)	2	2	- Representative of PMU - Representatives of DOLISA - E&S consultants	There are employment service centers in the province; Binh Duong implements and complies with relevant national laws and regulations; Project-affected households can participate in linked vocational training courses and be given priority in job at local facilities if they meet the requirements.	
5.	Working with Repres. of Binh Duong PPC, MOC, MPI, DONRE, DOF, DOST DARD, DOLISA, DOT, DOIC, Thuan An CPC, Di An CPC, Tan Uyen town PC, and PWU. (Sep-Oct. 2020)	7	4	- Representative of PMU - Representatives of MOC, MPI, DONRE, DOF, DOST DARD, DOLISA, DOT, DOIC, Thuan An CPC, Di An CPC, Tan Uyen town PC, and PWU. - E&S consultants	A Provincial Steering Committee for the Binh Duong WEIP needs to be established soon with members including but not limited to: - Repres. of Binh Duong PPC - Repres. of MOC - Repres. of MPI - Repres. of DONRE - Repres. of DOF - Repres. of DOST - Repres. of PMU-BIWASE - Repres. of Thuan An, Di An CPC and Tan Uyen TPC - Repres. of WU - The Provincial Project Steering Committee will coordinate the provincial agencies to ensure the timely implementation.	PMU will work closely with relevant authorities to maximize the benefits of the projects.

No.	Public consultation, workshops and meetings	Number of participants		Participants	Summary of consultation results	Project Owner's feedback
		Male	Female			
Tan Uyen Town						
6.	Khanh Binh WPC (September 11, 2020)	4	3	- E&S consultants. - PMU representatives. - Representative of the WPCs. - Representatives of local branches, mass organizations: Women's Union, Fatherland Front, Veterans Association, Youth Union, Land Administration Officer. - Representatives of affected households and beneficiaries in the	- People are very supportive of the project; - Basically, agree with the results of environmental and social impact assessment and proposed mitigation measures - Construction of sewer system need to implement mitigation measures to ensure traffic safety - Coordinate with local authorities in temporary residence registration, ensuring social security	PMU appreciate the contributions and suggestions from local authorities Traffic safety measures have been incorporated in ESIA, then PMU will coordinate with local authorities and contractor to implement during construction to ensure the traffic safety and travel condition. PMU commits to coordinate with local authorities to ensure security in the area.

No.	Public consultation, workshops and meetings	Number of participants		Participants	Summary of consultation results	Project Owner's feedback
		Male	Female			
7.	Tan Phuoc Khanh WPC (September 11, 2020)	3	3	project area.	- Support to implement the project - During construction phase, all impacts on public facilities need to be fully compensated - Implement the mitigation measure to reduce dust and other air pollution generation; - Ensure traffic condition and safety for local authorities.	PMU appreciate the contributions and suggestions from local authorities - Impacts on public facilities during construction phase have been considered in the final ESIA, and during construction activities if any impacts on these facilities will be fully compensated by the in-charge contractors. - Appropriate mitigation measures to control dust, have been included in the ESIA and will be implemented - Traffic safety measures have been incorporated in ESIA, then PMU will coordinate with local authorities and contractor to implement and minimize impacts on traffic condition during construction

No.	Public consultation, workshops and meetings	Number of participants		Participants	Summary of consultation results	Project Owner's feedback
		Male	Female			
8.	Hoi Nghia WPC (September 14, 2020)	3	2		- Support to implement the project - During construction phase, all impacts on public facilities need to be fully compensated	- PMU appreciate the contributions and suggestions from local authorities - Impacts on public facilities during construction phase have been considered in the final ESIA, and during construction activities if any impacts on these facilities will be fully compensated by the in-charge contractors.
9.	Phu Chanh WPC (September 14, 2020)	4	2		- Support to implement the project - Ensure the social safety and security - Strictly implement all proposed mitigation measures as commitment	PMU appreciate the contributions and suggestions from local authorities The measure to manage the risks of social safety and security have been included in the final ESIA and PMU, CSC enforce and monitor the contractors implement them during construction. - Relevant stakeholder of project with involvement of PMU, CSC, IEMC will conduct supervision and monitoring to ensure that all proposed mitigation measure will be implemented during construction of the project.

No.	Public consultation, workshops and meetings	Number of participants		Participants	Summary of consultation results	Project Owner's feedback
		Male	Female			
10	Tan Vinh Hiep WPC (September 15, 2020)	2	2		- Support to implement the project - Ensure implementing all activities of the project timely - Sewer excavations need to avoid impacts on other infrastructure	PMU appreciate the contributions and suggestions from local authorities Relevant stakeholder of project with involvement of PMU, CSC, IEMC will conduct supervision and monitoring to ensure that all proposed mitigation measure will be implemented timely during construction of the project. Impacts on other infrastructure during construction phase have been considered in the final ESIA, and during construction activities if any impacts on other infrastructure will be fully compensated by the in-charge contractors

No.	Public consultation, workshops and meetings	Number of participants		Participants	Summary of consultation results	Project Owner's feedback
		Male	Female			
11	Vinh Tan WPC (September 15, 2020)	3	3		- Provide infrastructure to collect wastewater is quite necessary to reduce environmental pollution - Implement the mitigation measure to reduce dust and other air pollution generation in the residential areas	The basic facilities to collect and treat wastewater during construction phase have been included in the ESIA. PMU, CSC enforce and monitor the contractors implement them during construction. The mitigation measure to reduce dust and other air pollution generation in the residential areas have been included in the ESIA and PMU commit to request contractors to implement all relevant mitigation measures on the sites.
12	Thanh Phuoc WPC (September 16, 2020)	4	3		- Basically, agree with the results of impact assessment and proposed mitigation action on social and environment - Construction of sewer system need to implement mitigation measures to ensure traffic safety	PMU appreciate the contributions and suggestions from local authorities Traffic safety measures have been incorporated in ESIA, then PMU, CSC will coordinate with local authorities and contractor to implement to ensure traffic safety during construction of sewer system

No.	Public consultation, workshops and meetings	Number of participants		Participants	Summary of consultation results	Project Owner's feedback
		Male	Female			
13	Tan Hiep WPC (September 16, 2020)	4	3		- Support to implement the project - Ensure traffic condition and safety, accessibility for local authorities.	PMU appreciate the contributions and suggestions from local authorities All suggestion and contribution during public consultations will be fully included in the relevant social and environmental assessment document of the project and will be implemented by the relevant contractors to ensure the travel condition and accessibility for local people and authorities. PMU, CSC will monitor the performance of contractors.

No.	Public consultation, workshops and meetings	Number of participants		Participants	Summary of consultation results	Project Owner's feedback
		Male	Female			
14	Uyen Hung WPC (September 25, 2020)	10	8		- Support to implement the project - Basically, agree with the results of impact assessment and proposed mitigation action on social and environment - Inform project implementation schedule and coordinate with local authorities during project implementation to ensure social safety and security - At the construction sites of WWTP, the material storage on the site need to be tidy to avoid its scattering out to surrounding areas and cause impacts on local people.	PMU appreciate the contributions and suggestions from local authorities Many public consultation meetings have been conducted during ESIA preparation and the final ESIA will be disclosed to local people for monitoring implementation. PMU commit to provide appropriate material storage on the site and ensure tidy areas

No.	Public consultation, workshops and meetings	Number of participants		Participants	Summary of consultation results	Project Owner's feedback
		Male	Female			
Di An city						
15	Tan Binh WPC (September 17, 2020)	3	2	- E&S consultants. - PMU representatives. - Representative of the WPCs. - Representatives of local branches, mass organizations: Women's Union, Fatherland Front, Veterans Association, Youth Union, Land Administration Officer. - Representatives of affected households and beneficiaries in the project area.	- Support to implement the project - In case of land acquisition temporarily affecting production and business activities of households, the project should have a reasonable support plan. - Meaningful participation of local authorities and people should be sustained throughout project planning, design and construction, and operation. - Strictly implement all proposed mitigation measures as commitment	PMU appreciate the contributions and suggestions from local authorities Impacts on business activities of households have been considered on the RAP and ESIA of the project. The sufficient plan also proposed to fully compensate for any impacts. PMU has been coordinated with local authorities during project implementation. All relevant information will be disclosed to local authorities and communities and other public consultations will be conducted during construction period. PMU commit to implement all proposed mitigation measures. PMU, CSC, IEMC will conduct supervision and monitoring to ensure that all proposed mitigation measure will be implemented during construction of the project.

No.	Public consultation, workshops and meetings	Number of participants		Participants	Summary of consultation results	Project Owner's feedback
		Male	Female			
16	Binh Thang WPC (September 17, 2020)	4	7		- The project brings many benefits to local communities - Ensure the social safety and security - Clean the construction site after each working day	PMU appreciate the contributions and suggestions from local authorities The measure to manage the risks of social safety and security have been included in the final ESIA and PMU, CSC enforce and monitor the contractors implement them during construction PMU commit to implement all relevant mitigation measures on keeping site clean after each working day.
17	An Binh WPC (September 18, 2020)	4	4		- Support to implement the project - Ensure implementing all activities of the project timely - Sewer excavations need to avoid impacts on other infrastructure	PMU appreciate the contributions and suggestions from local authorities PMU and CSC will work closely with local authorities and contractors to ensure the project implementation schedule Impacts on other infrastructure during construction phase have been considered in the final ESIA, and during construction activities if any impacts on other infrastructure will be fully compensated by the in-charge contractors

No.	Public consultation, workshops and meetings	Number of participants		Participants	Summary of consultation results	Project Owner's feedback
		Male	Female			
18	Dong Hoa WPC (September 18, 2020)	5	3		- Provide infrastructure to collect wastewater is quite necessary to reduce environmental pollution. - Implement the mitigation measure to reduce dust and other air pollution generation;	PMU appreciate the contributions and suggestions from local authorities The basic facilities to collect and treat wastewater during construction phase have been included in the ESIA. PMU, CSC enforce and monitor the contractors implement them during construction. The mitigation measure to reduce dust and other air pollution generation in the residential areas have been included in the ESIA and PMU commit to request contractors to implement all relevant mitigation measures on the sites.

No.	Public consultation, workshops and meetings	Number of participants		Participants	Summary of consultation results	Project Owner's feedback
		Male	Female			
19	Binh An WPC (September 21, 2020)	3	4		- Support to implement the project - Coordinate with local authorities during project implementation - Ensure to minimize impacts on local people.	PMU appreciate the contributions and suggestions from local authorities PMU will work closely with local authorities. All relevant information will be disclosed to local authorities and communities and other public consultations will be conducted during construction period and inform to local authorities and communities for any changes PMU commit to implement all proposed mitigation measure in ESIA to reduce the impacts on local people and encourage the participation of local people to monitoring the performance of contractors.
Thuan An city						
20	Vinh Phu WPC (September 22, 2020)	4	2	- E&S consultants. - PMU representatives. - Representative of the WPCs. - Representatives of local branches, mass organizations:	- People are very supportive of the project; - Safety assurance during construction stage: The construction activities must ensure environmental sanitation and air condition of nearby	PMU appreciate the contributions and suggestions from local authorities PMU commit to implement all relevant mitigation measures stated in the approved ESIA report. All suggestion will be included in the technical

No.	Public consultation, workshops and meetings	Number of participants		Participants	Summary of consultation results	Project Owner's feedback
		Male	Female			
21	Hung Dinh WPC (September 23, 2020)	4	3	Women's Union, Fatherland Front, Veterans Association, Youth Union, Land Administration Officer. - Representatives of affected households and beneficiaries in the	communities. - Implement the mitigation measure to reduce dust and other air pollution generation;	methods of the contractors The mitigation measure to reduce dust and other air pollution generation in the residential areas have been included in the ESIA and PMU commit to request contractors to implement all relevant

No.	Public consultation, workshops and meetings	Number of participants		Participants	Summary of consultation results	Project Owner's feedback
		Male	Female			
22	Binh Nham WPC (September 24, 2020)	6	4	project area.	- Ensure traffic condition and safety for local authorities. - Ensure the social safety and security - - People expect to be provided full information about the project from time to time or when there are any significant changes. - And the comments above received the consent of all participants.	mitigation measures on the sites. Traffic safety measures have been incorporated in ESIA, then PMU will coordinate with local authorities and contractor to implement and minimize impacts on traffic condition during construction The measure to manage the risks of social safety and security have been included in the final ESIA and PMU, CSC enforce and monitor the contractors implement them during construction All relevant information will be disclosed to local authorities and communities and other public consultations will be conducted during construction period and inform to local authorities and communities for any changes PMU commit considered all suggestions, and disclose to local people
TOTAL		**82**	**77**			

7.1.3. Consultation during the project implementation

Plans for public involvement during pre-construction, construction and post construction stages have been developed during project preparation. The BDSPMU has main responsibility for public participation during ESMP implementation, but will be supported by the IEMC, CSC. Affected communities will be involved and consulted through site visits, investigations of specific issues, interviews, and public meetings.

The project will continue to engage with, and provide information to, project-affected parties and other interested parties throughout the life-cycle of the project, in a manner appropriate to the nature of their interests and the potential environmental and social risks and impacts of the project.

After the project is approved, mass media will disseminate project information including objectives, components, and proposed investments. The PMU also coordinates with local authority for public consultation and information disclosure. Consultation will be conducted continuously in the process of project implementation.

With the outbreak and spread of COVID-19, people have been advised, or may be mandated by national or local law, to exercise social distancing, and specifically to avoid public gatherings to prevent and reduce the risk of the virus transmission. The GoV has taken various restrictive measures depending on the COVID pandemic control situation, some imposing strict restrictions on public gatherings, meetings and people's movement, and others advising against public group events. These restrictions have affected Bank requirements for public consultation and stakeholder engagement in the project. The Bank's Technical Note was issued to guide the public consultation and stakeholder engagement activities during COVID-19 (See Annex 4 of the project SEP for details). The Note offers suggestions to the client on managing public consultation and stakeholder engagement, with the recognition that the situation is developing rapidly, and careful regard needs to be given to national requirements and any updated guidance issued by the World Health Organization (WHO). It is important that the alternative ways of managing consultation and stakeholder engagement discussed with the client are in accordance with the local applicable laws and policies, especially those related to media and communication.

7.1.4. Public consultation plan

Plans for public involvement during pre-construction, construction and post construction stages have been developed during project preparation in the below table. The BDSPMU has main responsibility for public participation during ESMP implementation, but will be supported by the IEMC, CSC. Affected communities will be involved and consulted through site visits, investigations of specific issues, interviews, and public meetings.

Table 7.2. Public Consultation Plan

Organizer	Format	Frequency	Subject	Attendees
1. Pre-Construction Stage (if needed)				
BDSPMU and Consultant (if any)	Public meetings Interview	During detail design and updating other relevant documents	Project detail design information and any changes; updated anticipated impacts and mitigation	Potentially affected households, ward PC representatives

			measures (if any); GRM	Other interested stakeholders
2. Construction Stage				
Contractors	Public meetings	Prior to start of construction works; quarterly thereafter, any time if needed	Presentation of planned activities and schedule; anticipated impacts and mitigation measures; GRM	Potentially affected households, ward PC representatives
BDPMU, CSC	Public meetings & site visits and informal interviews	Once before construction commences and monthly thereafter	Presentation of planned activities and schedule; anticipated impacts and mitigation measures; GRM	Potentially affected households, ward PC representatives
BDPMU, IEMC	Public meetings & site visits and informal interviews	Semi- annually thereafter during construction (site visits and informal interviews)	Comments and suggestions on mitigation measures, public opinion	Potentially affected households, ward PC representatives
BDPMU, IEMC	Public meetings or workshops	As needed, based on public consultation	Comments and suggestions on mitigation measures, public opinion	Experts of various sectors, county or interested stakeholders
3. Post-Construction Stage				
BIWASE (with support from IEMC, if available)	Public opinion survey	Once at project completion stage and before totally handing over	Public satisfaction with ESMP implementation	Potentially affected households, ward PC representatives

7.2. INFORMATION DISCLOSURE

The first draft ESIA in Vietnamese were disclosed locally at the wards/communes within the project area, at the People's Committee of Thuan An, Di An City and Tan Uyen town and the PMU in September 2020 for public consultation. Based on the contents of ESIA, local people can get information of the Project and contribute their opinions/comments on environmental issues.

REFERENCE

1. Binh Duong province statistic year books 2018, 2019

3. Report on existing environmental status of Binh Duong province from 2011 - 2015

4. Climate change scenario of Binh Duong province 2018

5. Report on socio-economic conditions of Thuan An 2019

6. Report on socio-economic conditions of Di An 2019

7. Report on socio-economic conditions of Tan Uyen 2019

8. Integrated report on building regulations on wastewater discharge zoning in Binh Duong province, 2018

Appendixes

Appendix 1. Legal Documents of Project

Appendix 2. Environmental Quality Monitoring

Appendix 3. Survey Pictures on the Project Area

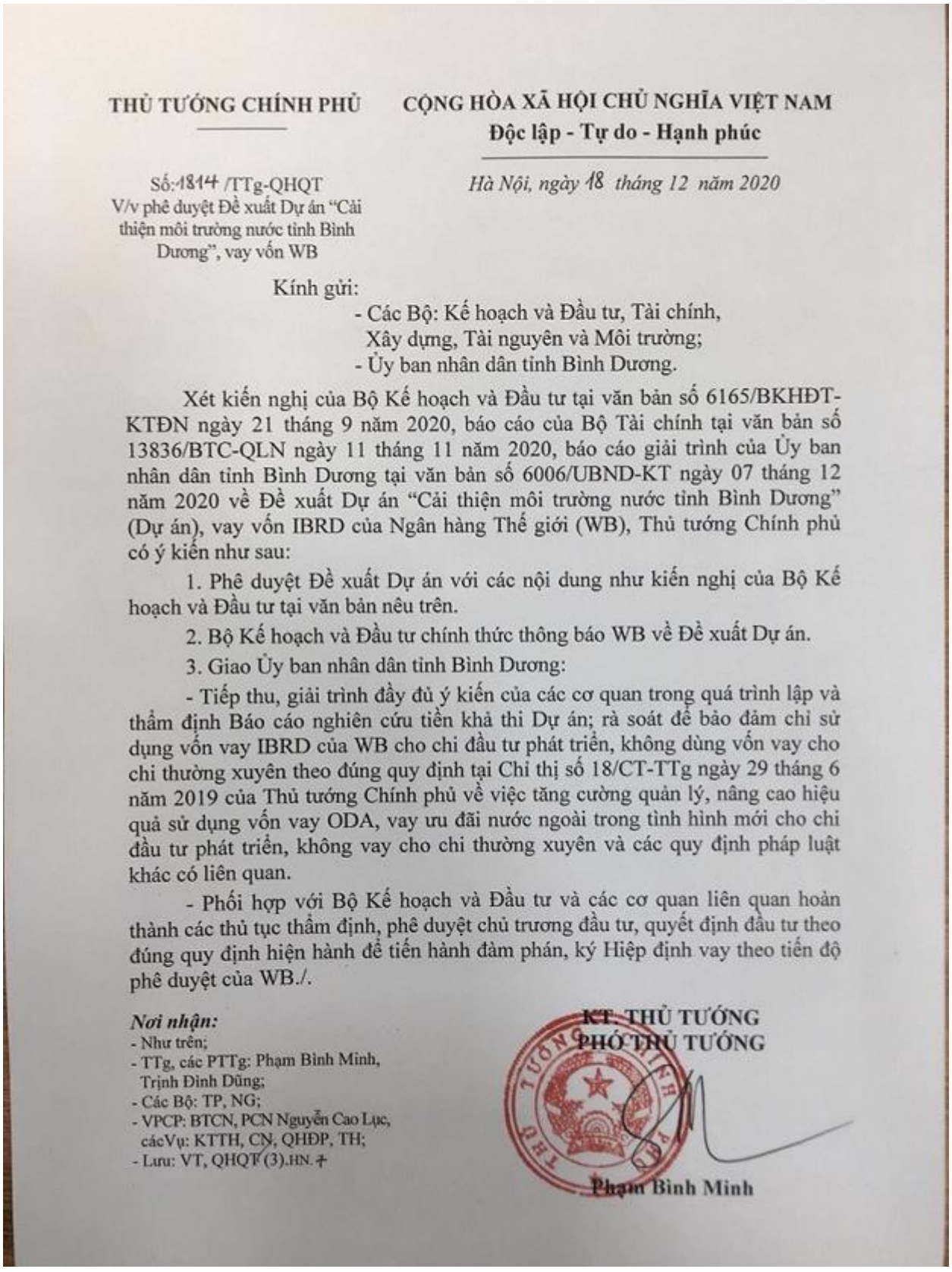
Appendix 4. Due Diligence

Appendix 5. Calculated Results for Incident of WWTP Operation

Appendix 6. Binh Duong WEIP Project Dredged Materials Management plan

APPENDIX

Appendix 1. Legal Documents of Project



THỦ TƯỚNG CHÍNH PHỦ

Số: 1814 /TTg-QHQT
V/v phê duyệt Đề xuất Dự án "Cải thiện môi trường nước tỉnh Bình Dương", vay vốn WB

CỘNG HÒA XÃ HỘI CHỦ NGHĨA VIỆT NAM
Độc lập - Tự do - Hạnh phúc

Hà Nội, ngày 18 tháng 12 năm 2020

Kính gửi:
- Các Bộ: Kế hoạch và Đầu tư, Tài chính, Xây dựng, Tài nguyên và Môi trường;
- Ủy ban nhân dân tỉnh Bình Dương.

Xét kiến nghị của Bộ Kế hoạch và Đầu tư tại văn bản số 6165/BKHĐT-KTĐN ngày 21 tháng 9 năm 2020, báo cáo của Bộ Tài chính tại văn bản số 13836/BTC-QLN ngày 11 tháng 11 năm 2020, báo cáo giải trình của Ủy ban nhân dân tỉnh Bình Dương tại văn bản số 6006/UBND-KT ngày 07 tháng 12 năm 2020 về Đề xuất Dự án "Cải thiện môi trường nước tỉnh Bình Dương" (Dự án), vay vốn IBRD của Ngân hàng Thế giới (WB), Thủ tướng Chính phủ có ý kiến như sau:

1. Phê duyệt Đề xuất Dự án với các nội dung như kiến nghị của Bộ Kế hoạch và Đầu tư tại văn bản nêu trên.

2. Bộ Kế hoạch và Đầu tư chính thức thông báo WB về Đề xuất Dự án.

3. Giao Ủy ban nhân dân tỉnh Bình Dương:

- Tiếp thu, giải trình đầy đủ ý kiến của các cơ quan trong quá trình lập và thẩm định Báo cáo nghiên cứu tiền khả thi Dự án; rà soát để bảo đảm chỉ sử dụng vốn vay IBRD của WB cho chi đầu tư phát triển, không dùng vốn vay cho chi thường xuyên theo đúng quy định tại Chỉ thị số 18/CT-TTg ngày 29 tháng 6 năm 2019 của Thủ tướng Chính phủ về việc tăng cường quản lý, nâng cao hiệu quả sử dụng vốn vay ODA, vay ưu đãi nước ngoài trong tình hình mới cho chi đầu tư phát triển, không vay cho chi thường xuyên và các quy định pháp luật khác có liên quan.

- Phối hợp với Bộ Kế hoạch và Đầu tư và các cơ quan liên quan hoàn thành các thủ tục thẩm định, phê duyệt chủ trương đầu tư, quyết định đầu tư theo đúng quy định hiện hành để tiến hành đàm phán, ký Hiệp định vay theo tiến độ phê duyệt của WB./.

Nơi nhận:
- Như trên;
- TTg, các PTTg: Phạm Bình Minh, Trịnh Đình Dũng;
- Các Bộ: TP, NG;
- VPCP: BTCN, PCN Nguyễn Cao Lục, cácVụ: KTTH, CN, QHĐP, TH;
- Lưu: VT, QHQT (3).HN.

KT. THỦ TƯỚNG
PHÓ THỦ TƯỚNG

Phạm Bình Minh

Appendix 2. Environmental Quality Monitoring

Table 1. Location of sampling

No.	Kinds of samples	Sampling location
I	**Ambient air and noise**	
	1. Parameters	CO, SO_2, NO_2, TSP, PM_{10}, $PM_{2,5}$, NH_3, H_2S, noise (LA_{eq}, LA_{max}, LA_{50}), microclimate (temperature, humidity, pressure, wind speed, and wind direction)
	2. Sampling locations	**<u>Tan Uyen town</u>** **KK1** – The construction area of Tan Uyen 2 Plant **KK2** – crossroads Le Quang Dinh – Trinh Hoai Duc (Khanh Binh ward, near the sewage water pumping station, the route of sluiceway expected) **KK3** – crossroads HL417 – DT746 (Tan Phuoc Khanh ward, near the sewage water pumping station, the route of sluiceway expected) **KK4** – Road junction ĐT746- Nguyen Tri Phuong (Tan Hiep ward, near the sewage water pumping station, the route of sluiceway expected) **KK5** – Road junction ĐT746- HL411 (Uyen Hung ward, near the sewage water pumping station, the route of sluiceway expected) **<u>Di An city</u>** **KK6** – The area of Di An WWTP **KK7** – crossroads Pham Van Dieu – Bui Thi Xuan (Tan Binh ward, near the sewage water pumping station, the route of sluiceway expected) **KK8** – Intersection point between Le Trong Tan street - Dao Trinh Nhat street (An Binh ward, the route of sluiceway expected) **KK9** – Road ĐT743A (Binh An ward, the route of sluiceway expected) **KK10** – **Road 30/4 (**Binh Thang ward**,** the route of sluiceway expected) **<u>Thuan An city</u>** **KK11** – Intersection point between Cau Tau- August Revolution (Hung Dinh ward, the route of sluiceway expected) **KK12** – Intersection point between August Revolution -Nguyen Huu Canh (Binh Nham ward, the route of sluiceway expected) **KK13 –** The boundary embankment of Sai Gon (Binh Nham ward, the route of sluiceway expected, pumping station) **KK14** – The area of Thuan An WWTP **KK15** – at the national road QL13-Vinh Phu 13 (Vinh Phu ward, the route of sluiceway expected)
II	**Surface water**	

No.	Kinds of samples	Sampling location
	1. Parameters	Temperature, pH, DO, TSS, BOD_5, COD, NH_4^+, NO_3^-, Cl^-, grease, Coliform
	2. Sampling locations	**<u>Tan Uyen town</u>** **NM1 –** At Rach Tre, the location of discharge point of the expected WWTP **NM2** – Surface water in the branch of Dong Nai river, (intersection with Rach Tre) is the source to receive the sewage water after treatment. **NM3 –** The surface stream water near Khanh Van bridge (near the location of the route of sluiceway expected, the expected WWTP) **NM4 –** Surface water in Dong Nai river (apart from point N2, 3 km far from downstream)
		<u>Di An city</u> **NM5 –** The surface water sample of Siep stream (Cai Cau channel) the discharge point of the plant **NM6** -The surface water sample of Siep stream (Cai Cau channel) 1km far from downstream **NM7** – The surface water sample of Dong Nai river (intersection with Siep stream) is the source to receive the sewage water. **NM8-** The surface water sample of Dong Nai river (intersection with Siep stream), a part 500m far from point NM7 toward downstream.
		<u>Thuan An city</u> **NM9-** The discharge channel of Thuan An WWTP **NM10-** surface water sample of Sai Gon river (body receiving source of treated wastewater). **NM11-** Bung river (near the area expected building the sluiceway route, Hung Dinh ward). **M12-** The channel in Binh Nham ward **(**near the area expected building the sluiceway route)
III	**Underground water**	
	1. Parameters	Temperature, pH, Permanganate index, TDS, Hardness, NH_4^+, NO_2^-, NO_3^-, Cl^-, Fe, Mn, As, Coliform, E.Coli
	2. Sampling locations	**<u>Tan Uyen town</u>** **NN1** – Uyen Hung ward, near the expected sluiceway, sewage water pumping plant. **NN2** – KhanhBinh ward, near the expected sluiceway, sewage water pumping plant.
		NN3 – Tan Phuoc Khanh ward, near the expected sluiceway, sewage water pumping plant. **NN4** – Tan Hiep ward, near the expected sluiceway, sewage water pumping plant.

No.	Kinds of samples	Sampling location
		<u>Di An city:</u> **NN5 –** 33/4 Bui Thi Xuan, Tan Binh ward (the project area) **NN6** – the gasoline station No.27, 305 ĐT 743, Binh An ward (the project area) **NN7** – 12/8, Binh Thang ward (the project area) **NN8-** Dao Trinh Nhat, An Binh ward (the project area) **<u>Thuan An city:</u>** **NN9** – A25B Nguyen Van Long, Binh Nham ward (the project area) **NN10 –** 206A, Hung Dinh ward (the project area) **NN11-** 4/6 KP Tay, Vinh Phu ward (the project area) **NN12 –**the gasoline station No.128, road ĐT 745 (near the WWTP)
IV	**Domestic wastewater**	
	1. Parameters	Temperature, pH, TSS, BOD_5, COD, NH_4^+, NO_2^-, NO_3^-, T-N, T-P, PO_4^{3-}, Cl^-, Pb, Cd, Fe, Cu, Zn, Mn, Total grease, Coliform
	2. Sampling locations	**<u>Tan Uyen town:</u>** **NT1** – the sluice along the road ĐT747 under Suoi Tre bridge (the project area) **NT2** – the sluice along the road 746 (the project area) **NT3** – the drainage sluice in the area of Tan Vinh Hiep ward (the project area) **NT4** – the drainage sluice in the area of Tan Hiep ward (the project area) **NT5** – the drainage sluice in the area of Thanh Phuoc ward (the project area)
		<u>Di An city:</u> **NT6** – the sluice on the road Nguyen DinhChieu (Dong Hoa ward) **NT7** – the sluice on the road QL1K –Dong Hoa ward **NT8** – the sluice on the road Nguyen Tri Phuong (An Binh ward) **NT9** – the sluice on the road QL1A – Binh Thang ward **NT10** – the input sewage water to the existing Di An treatment station
		<u>Thuan An city:</u> **NT11 –** the sluice on the road QL 13 (Vinh Phu ward) **NT12** – the input sewage water to the Thuan An treatment station **NT13** – the sluice on the area of Hung Dinh ward **NT14** – the sluice on the area of Binh Nham ward **NT15** – the sluice on the Nguyen Trai road (Lai Thieu ward)
V	**Soil quality**	

No.	Kinds of samples	Sampling location
	1. Parameters	As, Cd, Cr, Cu, Pb, Zn,
	2. Sampling locations	**<u>Tan Uyen town:</u>** **Đ1** – The area building Tan Uyen WWTP **Đ2** – The area building the pumping station expected (near Tan Uyen WWTP) **<u>Di An city:</u>** **Đ3, 4** –The sample of soil where building the expanded capacity of Di An WWTP **<u>Thuan An city:</u>** **Đ5, 6 -** The sample of soil where building the expanded capacity of Thuan An WWTP
VI	**Sediment quality**	
	1. Parameters	As, Cd, Cr, Cu, Pb, Zn,
	2. Sampling locations	**<u>Tan Uyen town</u>** **TT1** – The sediment sample at Suoi Tre (near Tan Uyen WWTP) **TT2** – At Suoi Tre, 150 m apart from the location of sample 1 downstream **TT3** – At Suoi Tre, 300 m apart from the location of sample 1 downstream **TT4** – The sediment sample in the branch of the Dong Nai river (is the source to receive the Tan Uyen sewage water after treatment) **TT5** – The sediment sample in the branch of the Dong Nai river , apart from the point TT3 1.0km toward downstream.
		<u>Di An city</u> **TT6** – The sediment sample in the Siep stream (is the discharge point of Di An WWTP) **TT7** – The sediment sample in the Siep stream apart from the point TT6 about 500m **TT8** –The sediment sample in the branch of the Dong Nai river (where intersection with the Siep stream)
		TT9 – The silt sample in the sluice on Nguyen Dinh Chieu road (Dong Hoa ward) **TT10** – The silt sample in the sluice on Nguyen Tri Phuong road (An Binh ward) **<u>Thuan An city:</u>** **TT11** – The sediment sample in the discharge channel of Thuan An WWTP **TT12** – The sediment sample in the Sai Gon river (where intersection between discharge channel with the Sai Gon river) **TT13 –** The sediment sample in the Bung river (Hung Dinh ward)

No.	Kinds of samples	Sampling location
		TT14 – The sediment sample in the channel in Binh Nham ward. **TT15** – The soil sample in the sluice on the national road QL13 (Vinh Phu ward)

Table 2. Meteorological conditions and noise level

Criteria / Location	Temp. °C	Humidity %	Wind speed m/s	Pressure mmHg	Wind direction	Noise dBA		
						LA_{eq}	LA_{max}	LA_{50}
Tan Uyen town								
KK01	34.3	67.7	1.7	756.2	Northeast	45.0	71.5	43.8
KK02	36.1	52.9	0.8	752.1	Southwest	63.9	72.9	55.2
KK03	32.1	65.3	1.2	751.5	Southwest	49.8	60.9	47.4
KK04	31.2	58.3	1.1	752.0	Southeast	58.4	76.0	52.6
KK05	33.2	65.4	0.6	755.6	Southwest	56.1	73.2	52.8
Di An city								
KK06	32.3	67.5	0.6	756.7	Southwest	41.1	73.8	39.3
KK07	33.3	64.9	0.8	755.1	Southeast	52.8	77.2	45.1
KK08	31.0	60.7	0.5	755.1	Southwest	47.6	71.9	44.4
KK09	34.5	62.1	1.2	752.3	Southwest	45.6	71.0	41.9
KK10	32.1	64.6	1.2	752.3	Southwest	45.1	74.9	42.2
Thuan An city								
KK11	33.3	59.6	0.8	755.3	Southwest	55.3	77.5	49.9
KK12	34.1	59.1	1.2	754.3	Southwest	57.5	79.6	51.5
KK13	33.2	61.5	2.6	755.6	Southwest	49.8	72.9	45.6
KK14	31.7	61.2	0.8	756.8	Northwest	47.9	73.9	42.9
KK15	34.2	53.3	2.7	753.5	Northwest	52.1	80.5	47.5
QCVN 26:2010/BTNMT	-	-	-	-	-	**≤ 70**		

Table 3. Monitoring results of air quality

Criteria / Location	TSP µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO µg/m³	NH_3 µg/m³	H_2S µg/m³	Dust PM_{10} µg/m³	Dust $PM_{2,5}$ µg/m³
Tan Uyen town								
KK01	185	65	54	< 5,000	KPH	KPH	KPH	KPH
KK02	241	71	56	< 5,000	KPH	KPH	KPH	KPH
KK03	208	67	59	< 5,000	KPH	KPH	96	KPH
KK04	196	66	49	< 5,000	KPH	KPH	98	KPH
KK05	202	72	60	< 5,000	KPH	KPH	79	KPH
Di An city								
KK06	179	65	51	< 5,000	KPH	KPH	KPH	KPH
KK07	212	72	55	< 5,000	KPH	KPH	KPH	KPH
KK08	224	73	61	< 5,000	KPH	KPH	KPH	KPH
KK09	208	79	62	< 5,000	KPH	KPH	79	KPH
KK10	219	75	65	< 5,000	KPH	KPH	82	KPH
Thuan An city								
KK11	241	69	60	< 5,000	KPH	KPH	125	KPH
KK12	235	75	62	< 5,000	KPH	KPH	97	KPH
KK13	263	78	68	< 5,000	KPH	KPH	112	KPH
KK14	189	71	67	< 5,000	KPH	KPH	KPH	KPH
KK15	275	79	63	< 5,000	KPH	KPH	96	KPH
QCVN 05:2013/BTNMT	**300**	**350**	**200**	**30,000**	**-**	**-**	**-**	**-**
QCVN 06:2009/BTNMT	**-**	**-**	**-**	**-**	**200**	**42**	**-**	**-**

(Legend: KPH - not detected)

Table 4. Monitoring results of soil environment quality

No.	Criteria	Unit	Tan Uyen town		Di An city		Thuan An city		QCVN 03-MT:2015/BTNMT
			MĐ01	MĐ02	MĐ03	MĐ04	MĐ05	MĐ06	
1	As	mg/kg	KPH	KPH	KPH	KPH	KPH	KPH	15
2	Cd	mg/kg	KPH	KPH	KPH	KPH	KPH	KPH	2
3	Pb	mg/kg	9.85	9.18	8.52	7.96	11.5	10.8	70
4	Cr	mg/kg	4.85	5.96	6.32	6.93	7.96	7.21	200
5	Cu	mg/kg	5.32	4.85	4.85	4.35	4.96	5.06	100
6	Zn	mg/kg	25.6	21.8	28.2	27.9	30.9	29.6	200

Table 5. Monitoring results of groundwater quality

No.	Parameters	unit	Tan Uyen town				Di An city				Thuan An city				QCVN 09 – MT:2015/BTNMT
			NN01	NN02	NN03	NN04	NN05	NN06	NN07	NN08	NN09	NN10	NN11	NN12	
1	Temperature	^oC	25.6	26.3	25.9	25.7	26.1	26.9	25.5	25.5	25.6	26.1	25.2	25.7	-
2	pH	-	6.78	6.96	7.02	6.99	7.01	6.96	7.35	7.08	6.99	6.91	7.06	7.02	5.5-8.5
3	Total Hardness	mg/l	16.5	21.0	13.6	16.2	22.3	24.5	18.9	15.2	25.3	21.0	24.8	30.9	500
4	TDS	mg/l	125	121	145	103	172	152	135	128	196	143	158	175	1500
5	KMnO4 value	mg/l	KPH	0.96	1.09	0.91	1.05	KPH	0.91	KPH	1.15	0.96	0.92	KPH	4
6	$N\text{-}NH_4^+$	mg/l	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	1
7	$N\text{-}NO_2^-$	mg/l	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	1
8	$N\text{-}NO_3^-$	mg/l	3.21	2.51	2.96	2.05	3.14	2.42	2.42	3.45	2.24	2.42	2.68	3.01	15
9	Chloride (Cl^-)	mg/l	56.2	45.8	46.3	55.8	62.3	58.2	45.2	49.6	62.3	58.2	60.2	53.2	250
10	Mangan (Mn)	mg/l	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	0.5
11	Arsenic (As)	mg/l	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	0.05
12	Ferrite (Fe)	mg/l	KPH	KPH	KPH	0.186	0.242	KPH	0.178	0.196	0.246	KPH	0.574	0.241	5
13	E.Coli	MPN/100 ml	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH
14	Coliform	MPN/100 ml	KPH	KPH	KPH	KPH	KPH	KPH	**4**	KPH	3	KPH	**4**	**9**	3

(Legend: KPH - not detected)

Table 6. Monitoring results of surface water quality

No	Parameters	Unit	Tan Uyen town				Di An city				Thuan An city				QCVN 08-MT:2015/BTNMT – B1
			MN1	MN2	MN3	MN4	MN6	MN6	MN7	MN8	MN9	MN10	MM11	MN12	
1	Temperature	^oC	27.1	27.5	28.0	28.5	27.5	27.4	27.3	27.1	27.8	27.7	27.5	27.5	-
2	pH	-	7.17	7.24	6.85	7.18	7.24	7.14	7.32	7.23	7.08	7.24	7.19	7.12	5.5-9
3	DO	mg/l	5.01	4.85	4.51	4.86	4.75	4.87	4.63	4.14	4.01	4.18	4.14	4.75	≥4
4	TSS	mg/l	**54**	**56**	**53**	**75**	**63**	45	**59**	**61**	**76**	28	45	48	50
5	COD	mg/l	24	**38**	**44**	**36**	**44**	**35**	**46**	**42**	**45**	29	**41**	**39**	30
6	BOD_5	mg/l	**16**	**25**	**26**	**23**	**28**	**21**	**32**	**28**	**26**	**18**	**27**	**24**	15
7	$N\text{-}NH_4^+$	mg/l	KPH	0.285	0.542	0.296	0.298	0.217	0.126	0.175	0.189	KPH	0.175	0.128	0.9
8	$N\text{-}NO_3^-$	mg/l	1.85	2.63	2.05	2.58	1.45	2.24	2.86	2.13	4.52	2.75	2.96	3.66	10
9	Chloride	mg/l	56.2	66.4	68.3	62.5	46.5	41.8	55.9	49.3	48.9	40.3	46.2	51.0	350
10	Total grease	mg/l	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	1
11	Total Coliform	MPN/100ml	$2.6x10^3$	$4.4x10^3$	$3.9x10^3$	$3.4x10^3$	**$9.3x10^3$**	$7.5x10^3$	$5.3x10^3$	$6.4x10^3$	$7.5x10^3$	$4.5x10^3$	$5.3x10^3$	$7.5x10^3$	7500

(Legend: KPH - not detected)

Table 7. Monitoring results of wastewater quality

No.	Parameters	Unit	Tan Uyen town					Di An city					Thuan An city					QCVN 14:2008/BTNMT
			NT1	NT2	NT3	NT4	NT5	NT6	NT7	NT8	NT9	NH10	NT11	NT12	NT13	NT14	NT15	
1	Temperature	^oC	27.1	27.5	28.0	28.5	28.9	27.5	27.6	28.1	27.9	27.5	27.5	27.6	28.1	27.9	27.5	-
2	pH	-	7.17	7.24	6.85	7.18	7.26	7.35	7.18	7.15	7.01	6.99	7.24	7.35	7.09	6.98	6.75	5-9
3	TSS	mg/l	**94**	**86**	**124**	**136**	**96**	**135**	**119**	**129**	**102**	**141**	**96**	**121**	**75**	**125**	**115**	50
4	COD	mg/l	124	138	144	174	156	142	175	178	158	186	75	135	96	135	157	-
5	BOD_5	mg/l	**81**	**96**	**79**	**115**	**96**	**99**	**120**	**119**	**103**	**124**	**48**	**76**	**59**	**85**	**101**	30
6	$N\text{-}NH_4^+$	mg/l	KPH	3.85	3.54	2.96	1.98	1.52	2.96	3.42	2.01	1.42	KPH	1.85	KPH	2.96	3.15	5
7	$N\text{-}NO_3^-$	mg/l	6.85	5.63	5.05	7.58	7.12	5.35	4.52	6.33	5.98	8.52	5.42	5.63	7.52	6.91	6.32	30
8	$N\text{-}NO_2^-$	mg/l	KPH	KPH	KPH	0.056	0.046	0.078	0.063	0.042	0.051	0.036	0.071	0.086	0.052	0.063	11.9	-
9	T-N	mg/l	8.96	12.2	10.9	11.9	11.6	10.2	11.6	12.5	9.75	12.9	8.52	10.6	9.63	11.9	12.9	-
10	T-P	mg/l	0.854	1.24	0.751	0.854	0.265	0.362	0.758	0.574	1.02	0.985	0.754	0.175	0.362	0.632	1.06	-
11	$P\text{-}PO_4^{3-}$	mg/l	0.810	1.09	0.641	0.814	0.244	0.321	0.698	0.496	0.962	0.854	0.685	0.135	0.320	0.578	0.968	6
12	Cl^-	mg/l	36.4	35.1	36.9	42.5	29.3	41.0	35.9	39.6	44.1	35.2	42.5	37.5	37.9	42.3	36.5	-
13	Total grease	mg/l	KPH	KPH	KPH	KPH	KPH	2.01	KPH	KPH	1.52	1.32	1.52	KPH	1.25	1.52	1.96	10
14	Mn	mg/l	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	-
15	Fe	mg/l	KPH	0.194	KPH	0.186	0.284	0.214	0.191	KPH	0.175	0.385	0.285	0.199	KPH	0.185	0.314	-
16	Pb	mg/l	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	-

No.	Parameters	Unit	Tan Uyen town					Di An city					Thuan An city					QCVN 14:2008/BTNMT
			NT1	NT2	NT3	NT4	NT5	NT6	NT7	NT8	NT9	NH10	NT11	NT12	NT13	NT14	NT15	
17	Cd	mg/l	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	-
18	Cu	mg/l	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	-
19	Zn	mg/l	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	-
20	Total Coliform	MPN/100ml	$2.6x10^4$	$4.4x10^3$	$3.9x10^4$	$9.3x10^3$	$6.4x10^5$	$3.2x10^4$	$1.1x10^4$	$1.9x10^5$	$2.1x10^4$	$9.5x10^4$	$1.3x10^4$	$1.4x10^5$	$2.1x10^5$	$2.1x10^4$	$1.1x10^6$	3000

(Legend: KPH - not detected)

Table 8. Monitoring results of sediment quality

No	Par.	Unit	Tan Uyen town					Di An city					Thuan An city					QCVN 43-MT:2017/BTNMT
			TT01	TT02	TT03	TT04	TT05	TT06	TT07	TT08	TT09	TT10	TT11	TT12	TT13	TT14	TT15	
1	As	mg/kg	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	17
2	Cd	mg/kg	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	3.5
3	Pb	mg/kg	11.2	14.5	13.2	9.66	12.0	14.2	14.1	9.85	9.24	7.85	15.2	14.9	13.6	9.75	7.96	1.3
4	Cr	mg/kg	6.32	8.54	9.63	10.1	5.99	5.63	7.85	7.54	KPH	KPH	6.96	7.01	7.75	6.32	KPH	90
5	Cu	mg/kg	7.21	6.85	7.02	5.99	8.21	8.21	7.85	7.16	KPH	KPH	8.96	8.21	6.52	KPH	KPH	197
6	Zn	mg/kg	34.1	36.2	41.0	35.2	36.4	31.5	35.2	36.9	28.5	24.8	32.5	36.3	35.2	36.3	41.0	315

(Legend: KPH - not det

Table 9: Locations of additional sediment quality samples taken on 11/11/2020

No.	Sample code	Sampling locations
1	TT1-1	Suoi Tre canal (discharge location of TanUyen WWTP)
2	TT1-2	discharge point of Tan Uyen WWTPNMXLNT at depth of 0.5m
3	TT2-1	Suoi Tre canal with150m from location TT1-1 on downstream
4	TT2-2	TT2-1 at depth of 0.5 m
5	TT3-1	Suoi Tre canal with150m from location TT1-1 on upstream
6	TT3-2	TT3-1 at depth of 0.5 m

Table 10: Monitoring result of additional sediment quality samples

No.	Paramters	Unit	Results						QCVN 43-MT:2017/BTNMT
			TT1-1	TT1-2	TT2-1	TT2-2	TT3-1	TT3-2	
1	pH	-	7,21	7,20	7,17	7,19	7,22	7,22	-
2	Salinity	‰	0,00099	0,000103	0,000984	0,000985	0,000994	0,000996	-
3	As	mg/kg	KPH	KPH	KPH	KPH	KPH	KPH	17
4	Cd	mg/kg	KPH	KPH	KPH	KPH	KPH	KPH	3,5
5	Pb	mg/kg	10,9	11,5	14,1	14,2	10,3	10,5	1,3
6	Cr	mg/kg	6,28	6,37	8,35	8,41	5,84	5,91	90
7	Cu	mg/kg	7,15	7,19	6,69	6,72	8,11	8,15	197
8	Zn	mg/kg	33,2	33,8	35,2	35,8	32,4	33,1	315

Appendix 3. The surrounding objects in the project Area

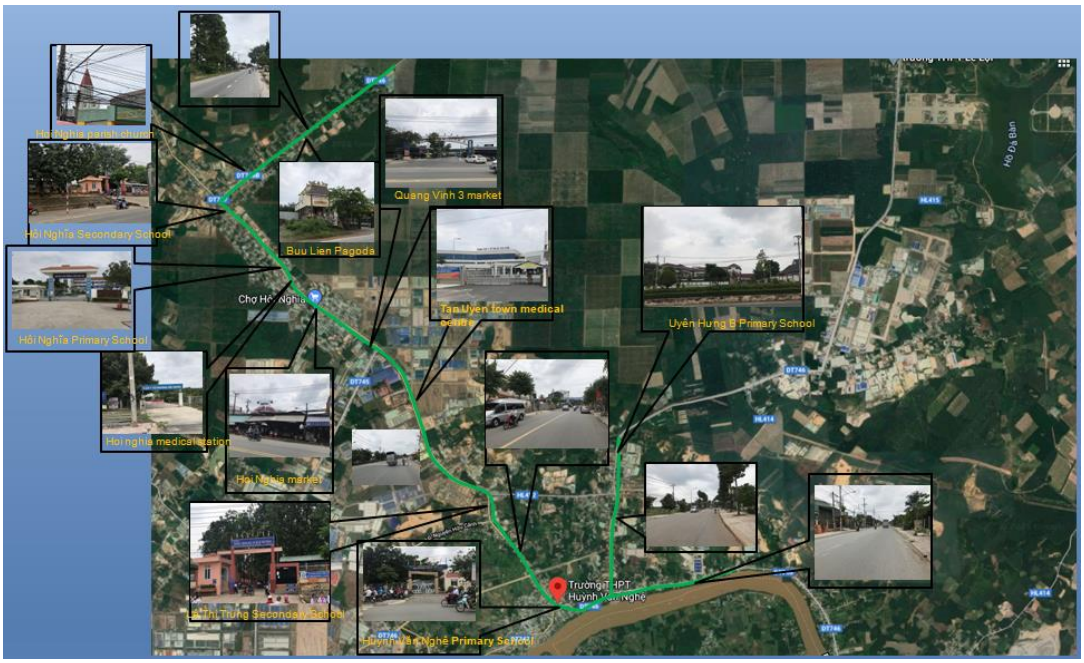


Figure 1: The surrounding objects in Tan Uyen area

igure 2: The surrounding objects in Tan Uyen area (continued

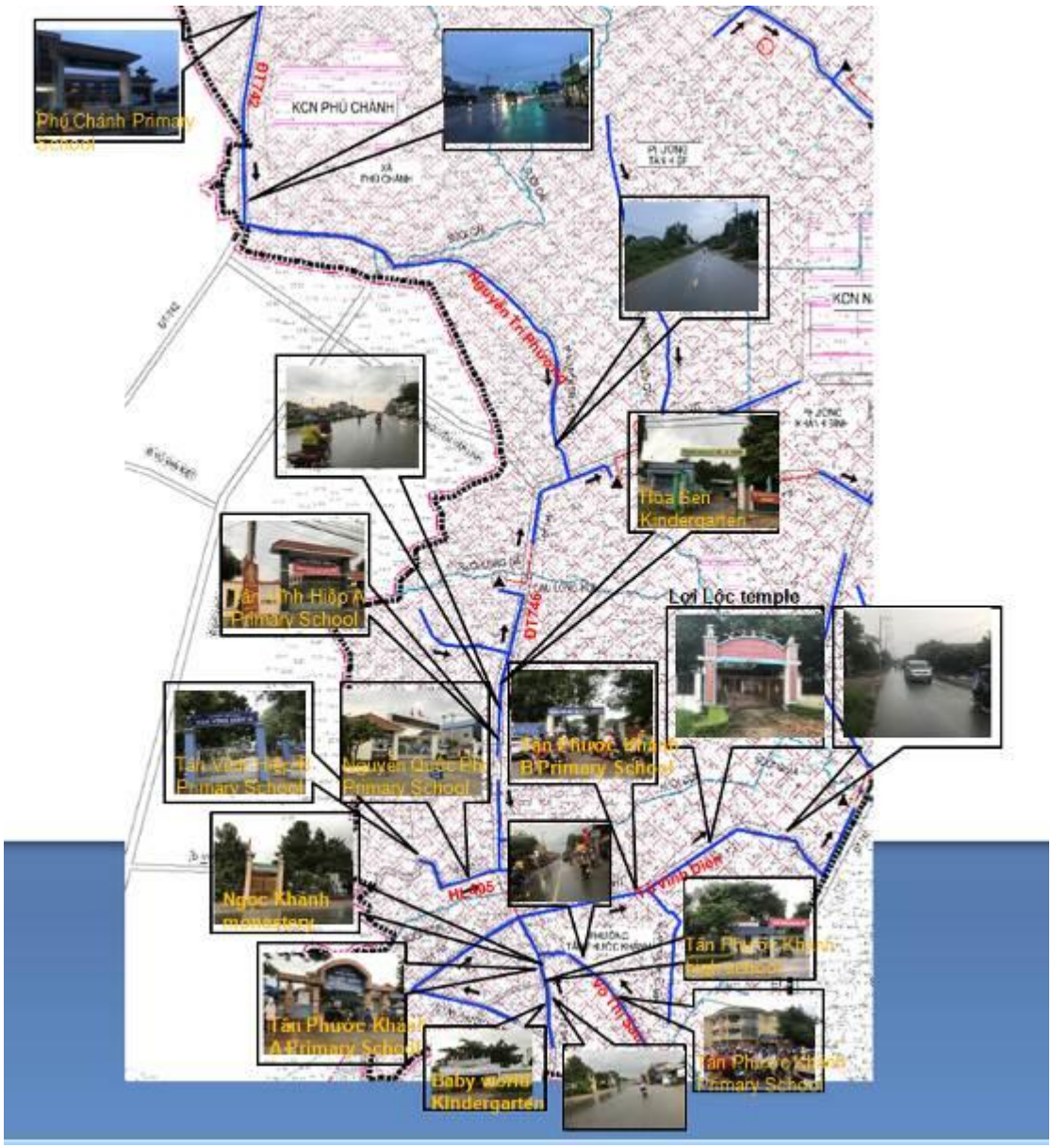


Figure 3: The surrounding objects in Tan Uyen area (continued)

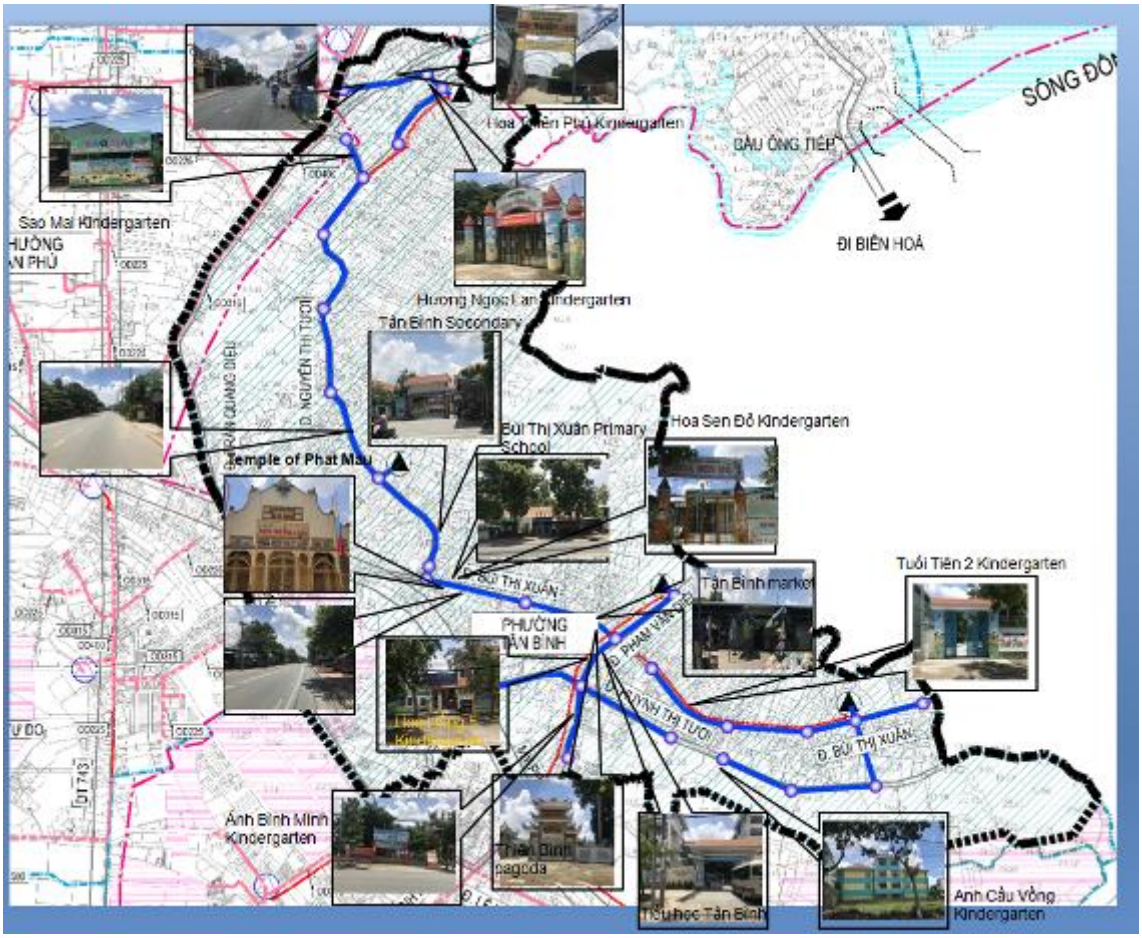


Figure 4: The sewer pipelines in Tan Binh ward area and structures on the route

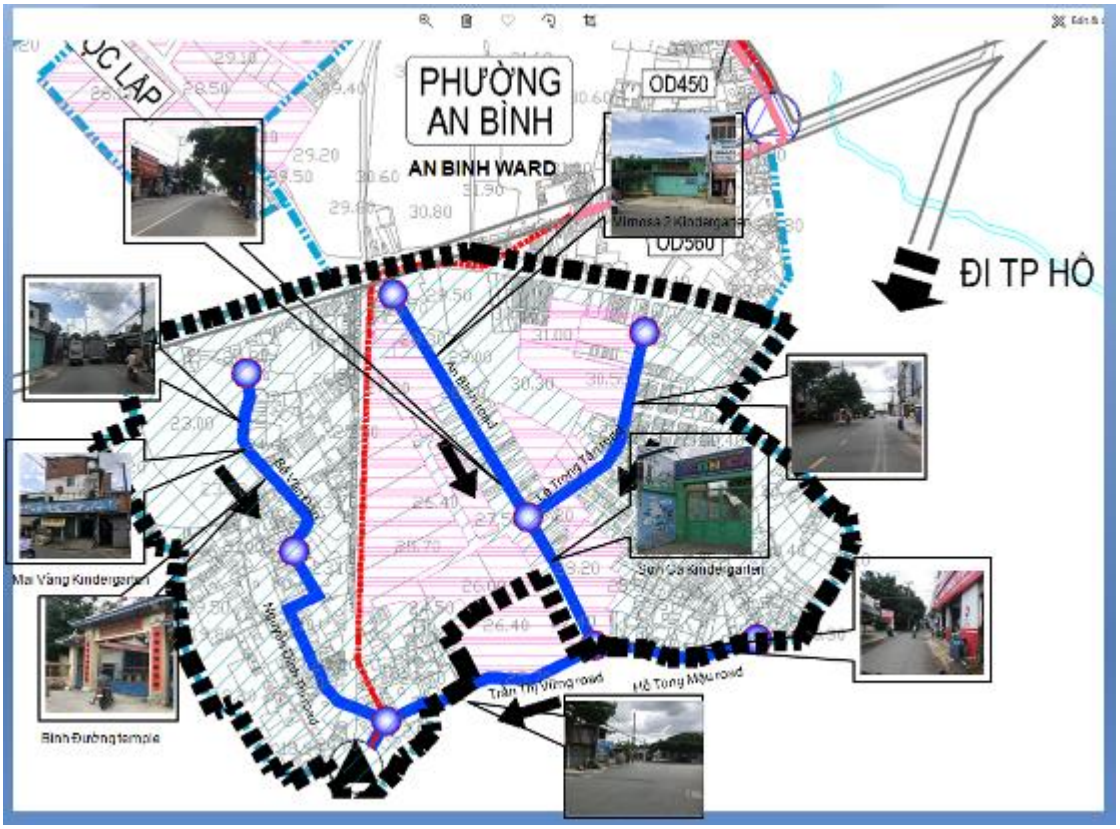


Figure 5: The sluiceway and surrounding structures in An Binh ward

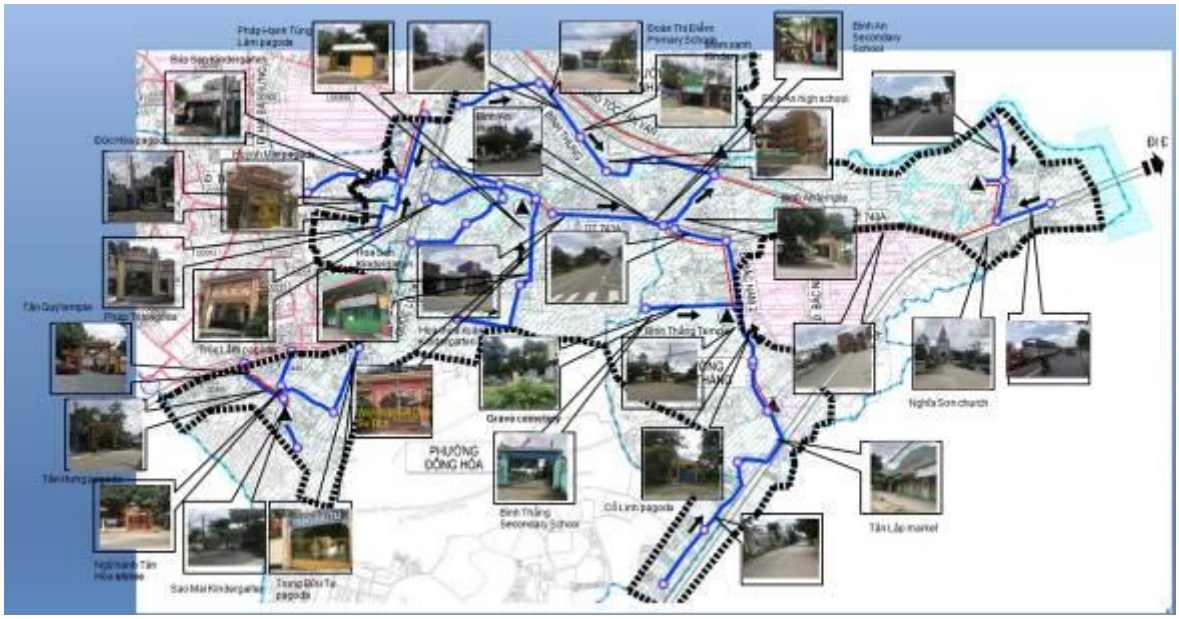


Figure 6: The sewer pipelines and surrounding structures in Binh Thang, Dong Hoa, Binh An wards

Figure 7: The sluiceway in Hung Dinh ward, BinhNham and surrounding structures

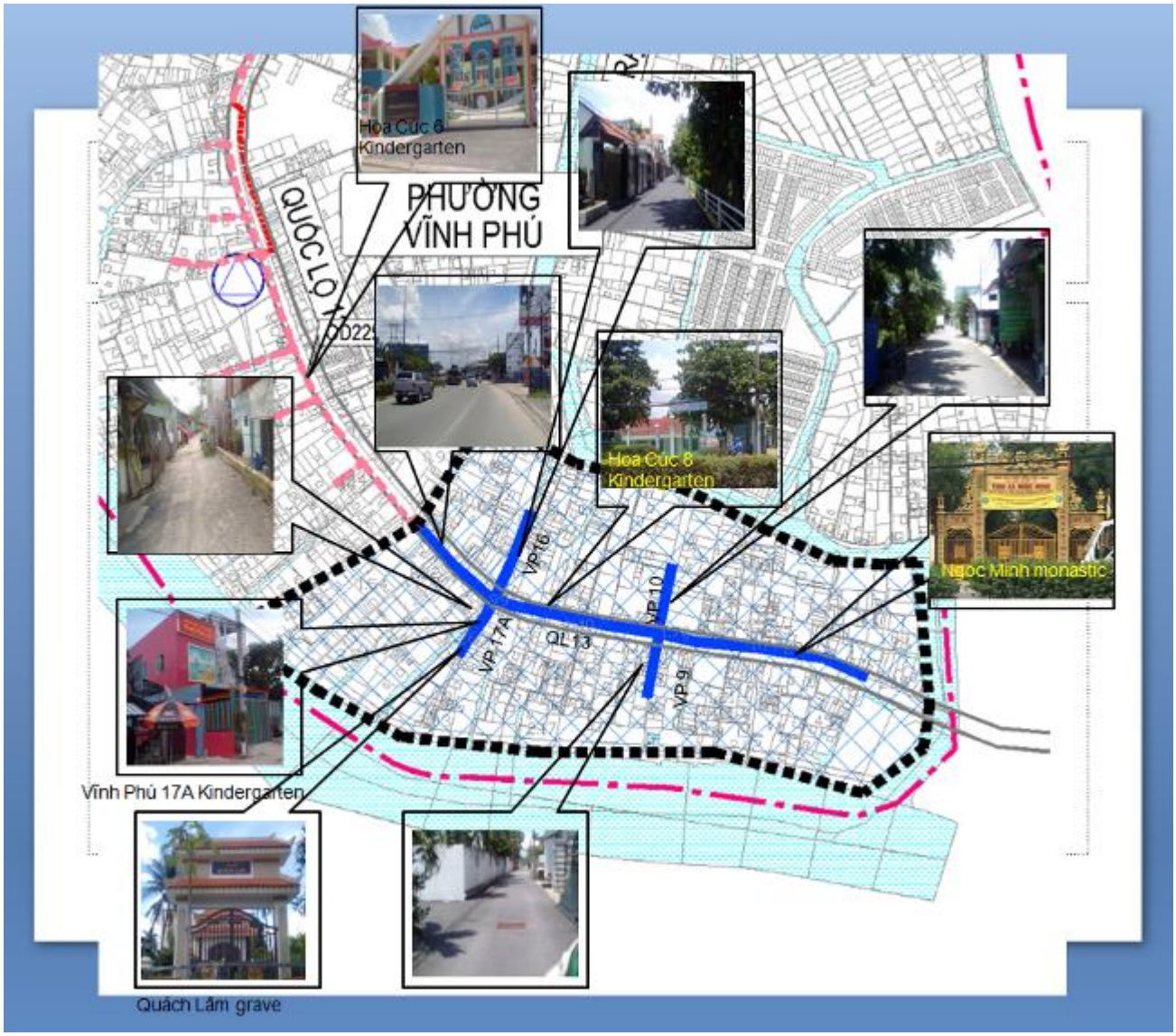


Figure 8: Location map of the sluiceway in Vinh Phu ward and surrounding structures

Appendix 4. DUE DILIGENCE

- **Drainage and Wastewater Treatment Project in Di An city, funded by WB**
- **Southern Binh Duong Water Environment Improvement Project, funded by JICA**
- **The South Binh Duong Solid Waste Treatment Complex**

I. Drainage and Wastewater Treatment Project in Di An city, Binh Duong province

The environmental impact assessment (EIA), prepared to meet the requirements of Vietnam government, had been approved by MONRE under Decision No. 296/QĐ-BTNMT dated 04/2/2016, and the environmental and social impact assessment (ESIA), prepared as the WB's policies, was disclosed on WB's web in February 2016.

The project included: 1) construction of sewers collection system in Di An Town, which covered four wards include Di An, Tan Dong Hiep, Dong Hoa and An Binh, 7 pumping stations, and 179.5 km sewer pipeline of D150-D1000; 2) Construction of a wastewater treatment plant capacity 20,000 m^3/day, in Tan Dong Hiep Ward. Wastewater will be treated using combines physical, chemical and ASBR biological treatment processes; 3) construction of a drainage system, the scope of work includes construction of new boxed culverts along T4, T5B and Tran Hung Dao Streets; improvement of the existing Cai Cau stream (other name Siep stream) from Km0 to Km2 + 020) and the Lo O Stream. Total serviced area is 1690 ha. The main objectives of project is water quality improvement and protection for Dong Nai river which taken place as main water supply sources for Binh Duong, Dong Nai and HoChiMinh city and sufficient collection of wastewater and treatment to meet Vietnamese National Standard on Treated Wastewater Quality QCVN 14: 2008/BTNMT.

Construction works were started in 2017 and turned into operating in 2018. The project was financed by the World Bank and GOV counterpart fund.

By June 2020 treatment capacity has reached more than 41% of designed capacity (with about 8565 m^3/day). The connection coverage of nearly 10% with 2,300 customers/23,300 connection boxes already being installed.

Pictures of Di An WWTP

Total land required for WWTP is 6.8 ha in Tan Dong Hiep ward ,which consisted 62,906 m^2 of agricultural land (92.2%), 4214.5 m^2 of transportation and stream land (6.18%), 1105.8 m^2 of residential land (1.62%). Acquired land for pumping stations and sewer pipeline is public and transportation land under management of local authotires.

Almost environmental baseline quality (air, noise, surface water, ground water, and sediment) in project area was within the limitation value of relevant standards[33]. Some monitored noise level was exceeded permission standard at several location of pumping stations and indicators of COD, BOD_5, Coliform was also exceeded permission standard on T4 canal, Tan Van canal and Lo O stream. There are no biological or economic species of flora and fauna have been recorded in the project area

57 households, one company and five organizations were affected due to land acquisition in which 03 households relocated. The affected by land acquisition were compensated through Decision No. 2749/QĐ-UBND dated 25 October 2015 of Binh Duong PC approving compensation and support plan for the proposed Di An WWTP, and relocated household were resettled at Tan Binh urban area. Unexploded materials that may be left at the WWTP site from the warrwas removed. The resettlement and compensation avtivites and UXO clearance completed before started construction works on the sites.

Construction-related potential impacts and risks were identified and assessed short-term and from low to moderate level, included i) dust, noise, vibration, ii) increased sediments in surface water, water pollution risk (5,67m^3/day of domestic wastewater); iii) construction waste generation and hhazardous waste (21 kg/day of domestic waste, 20000 m^3 of organic soil from WWTP, 1.7 million m^3 of other soil and sludge and 41-82 little/month of discharged oil), iv) traffic disturbance and safety risk, v) damage or interrupt existing infrastructure/ services, vii) health and dafety risks for worker and for local residents, viii) social disturbance, etc.

The excavated and dredging materials was reused for ground levelling at the Tan Binh resettlement site and Tan Dong Hiep quarry. The set of appropriate mitigation measures included in the environmental management plan of the project. And as per WB's requirements, the a comprehensive environmental specifications for inclusion into bidding documents and construction contracts. The mitigation measure included: i) provide safety and environmental training for the workers including informing them about the projects worker's codes of practices, provide adequate protective clothing such as hats, shoes, gloves etc. for the workers to use; ii) protect the disturbed areas with signboards and fences, and restrict access to these areas; iii) implement measures for dust control and maintain sanitation conditions such as cover the trucks during transportation, water dusty areas, daily clean up the access road; iv) control surface runoff within WWTP construction site to prevent water pollution and sedimentation in nearby drains and streams; v) periodically maintain construction plants and equipment; vi) provide and maintain temporary access to roadside buildings if access is disrupted; schedule construction activities to avoid sensitive hours and days at schools, markets, churches, pagodas etc., Prepare chance find procedures; vii) reinstate the sites after construction. Registering the list of workers to local authorities and informing affected communities about construction schedules, consultation and coordinate with local authorities/communes were some measures to manage potential social impacts.

Other potential social and environmental impacts and incidents during operation WWTP had been assessed include: i) odor from WWTP, ii) Noise, iii) Domestic wastewater (22 m^3/day) and night), iv) Generated sludge (4133 kg/day), domestic waste (90-120 kg/day), v) Hazardous waste (1086 kg year), vi) Chemical leaks, pipe blockages, unsatisfactory treatment performance, waste discharge incidents. To prevent these impacts, mitigation measures implemented including planting trees around the plant (1.2 ha), a system to collect and treat odors in WWTP, strictly comply with the operation procedure to minimize the incidents risks. The domestic wastewater

[33] Relevant technical standards: Ambient air quality: QCVN 05:2013/BTNMT; Vibration: QCVN 27:2010/BTNMT; Noise: QCVN 26:2010/BTNMT; Surface water: QCVN 08-MT:2015/BTNMT (column B1); sediment: QCVN 43:2012/BTNMT; ground water: QCVN 09-MT:2015/BTNMT, soil quality: QCVN 03-MT:2015/BTNMT

is connected to the receiving facility of the WWTP, the sludge transported to the South Binh Duong Solid Waste Treatment Complex for treatment.

An supervision and monitoring plan to comply with ensure environmental requirement during construction and operation phases had been established. Which include: i) Construction phase: monitoring the contractor's implementation of mitigation measures, monitoring of surface water quality, air quality conducted by CSC and IEMC, the period monitoring reports had been prepared and submitted to WB and other relevant local authorities, (ii) Operation phase: monitoring of surface water quality, air quality, exhaust gas, wastewater, chemical storage, solid waste, and hazardous waste. Funding for the environmental management and monitoring program during construction phase was VND 148,848,984.

During construction period: there was not complaints from local people, incidents were recorded.

During operation: Operation unit of Di An WWTP is Binh Duong Water, Sanitation and Environment joint stock Company (BIWASE). The WWTP has been allowed to discharge wastewater into water sources through a license No. 298 / GP-BTNMT dated November 20, 2019 by MONRE. BIWASE established automatically and continuously monitoring requirements for some indicators to stabilization ponds and outlets and wastewater volume at the intake and periodically monitoring on 11 indicators (excluding automatically monitoring indicators) for every three months. All monitoring results during operation phase, show that the quality of treated wastewater meets QCVN 14:2008/BTNMT-column A - National wastewater Quality into the receiving source for the purpose of supplying domestic water. Generated domestic waste and sludge have been transported to South Binh Duong Solid Waste Treatment Complex for treatment. And no unforeseen issues, incidents and complaints have been recorded during operation time of the WWTP.

Annually WWTP operation reports have been prepared and submitted to MONRE, Binh Duong DONRE as per requested.

Conclusion: The project has been complied with relevant regulations of Vietnam government and the WB's policies. And not further corrective actions need to be developed and implemented.

II. Southern Binh Duong Water Environment Improvement Project, phase II funded by JICA

The environmental impact assessment (EIA) prepared to meet the requirement of Vietnam government had been approved by Binh Duong PCP under Decision No. 609/QĐ- UBND dated 09/3/2012.

The project, phase II, involved in construction of Thuan An WWTP in Vinh Phu ward Thuan An city, with capacity of 17.000 m^3/day. Construction works were started in 2015 and turned into operating in 2017. The project was financed by the JICA and GOV counterpart fund. By 2020 treatment capacity has reached more than 57% of designed capacity (with about 9714 m^3/day).

The project component included: Construction of a wastewater treatment plant capacity 17,000 m^3/day, in Vinh Phu ward Thuan An city. Wastewater will be treated using combines physical, chemical and ASBR biological treatment processes; construction of sewers collection system in and 73,3 km of primary pipeline, and 216,7 km of sewer pipeline of D100-D150, 1,719 manholes and 19,587 connection kits and a set of equipment for O&M of sewer pipeline system. The main objectives of project is water quality improvement and protection for Sai Gon river and sufficient collection and treatment wastewater to meet Vietnamese National Standard on Wastewater Quality QCVN 14: 2008/BTNMT.

Total land required for WWTP is 3.5 ha, which are agricultural land for cultivating coconut and garden land. Acquired land for pumping stations is public land under management of ward's PC.

Almost environmental baseline quality (air, noise, surface water, ground water, and sediment) in project area was within the limitation value of relevant standards[34]. Some monitored value of noise level was exceeded permission standard at along Binh Duong avenue and COD, BOD_5, NH_4^+, Coliform were also exceeded permission standard on Cau Mien canal, some indicators of ground water NH_4^+, Coliform was over standard. Soil in the area of Thuan An WWTP is acidic and alkaline. There are no biological or economic species of flora and fauna have been recorded in the project area.

57 households in the WWTP area and 16 households in pumping stations and 03 households were relocated and affected to 0,17ha of coconut, 1,05ha of melaleuca tree and UXO clearance completed before started construction works on the sites. To manage the impacts during pre-construction phase, a compensation and resettlement plan had been prepared with total cost of 111.9 billion VND. The relocated household had been resettled at group 3, Chanh Nghia ward, Thu Dau Mot city. Compensation and resettlement activities completed before starting construction works on the sites.

Construction-related potential impacts and risks were identified and assessed short-term and from low to moderate level, included i) dust, noise, vibration, ii) increased sediments in surface water, water pollution risk (1.6 m^3/day of domestic wastewater); iii) construction waste generation and hhazardous waste (17 kg/day of domestic waste, 33293 m^3 of organic soil from WWTP, 1190m^3 of other soil and sludge and 3,51 litter/day of discharged oil), iv) traffic disturbance and safety risk, v) damage or interrupt existing infrastructure/ services, vii) health and safety risks for worker and for local residents, viii) social disturbance.

The excavated materials reused for ground levelling at several locations and transported to South Binh Duong Solid Waste Treatment Complex for treatment. The set of appropriate mitigation measures included in the environmental management plan of the project. The mitigation measure included: i) provide safety and environmental training for the workers including informing them about the projects worker's codes of practices, provide adequate protective clothing such as hats, shoes, gloves etc. for the workers to use; ii) protect the disturbed areas with signboards and fences, and restrict access to these areas; iii) implement measures for dust control and maintain sanitation conditions such as cover the trucks during transportation, water dusty areas, daily clean up the access road; iv) control surface runoff within WWTP construction site to prevent water pollution and sedimentation in nearby drains and streams; v) periodically maintain construction plants and equipment; vi) provide and maintain temporary access to roadside buildings if access is disrupted; schedule construction activities to avoid sensitive hours and days at schools, markets, churches, pagodas etc.,. Registering the list of workers to local authorities and informing affected communities about construction schedules, consultation and coordinate with local authorities/communes were some measures to manage potential social impacts.

Other potential social and environmental impacts and incidents during operation WWTP had been assessed include: i) odor from WWTP, ii) Noise, iii) Domestic wastewater (3.2 m^3/day) and night), iv) Generated sludge (117 m^3/day in WTP and 6750 m^3/year on the pipeline system), domestic waste (35 kg/day), v) Hazardous waste (1.8-2 kg/day), vi) discharged activated carbon (51,2 m^3/year), vii) Chemical leaks, pipe blockages, unsatisfactory treatment performance, waste discharge incidents. To prevent these impacts, mitigation measures implemented including provided a system to collect and treat odors in WWTP, strictly comply with the operation

[34] Relevant technical standards: Ambient air quality: QCVN 05:2013/BTNMT; Vibration: QCVN 27:2010/BTNMT; Noise: QCVN 26:2010/BTNMT; Surface water: QCVN 08-MT:2015/BTNMT (column B1); sediment: QCVN 43:2012/BTNMT; ground water: QCVN 09-MT:2015/BTNMT, soil quality: QCVN 03-MT:2015/BTNMT

procedure to minimize the incidents risks, domestic wastewater is connected to the receiving facility of the WWTP, sludge transported to the South Binh Duong Solid Waste Treatment Complex for treatment.

An supervision and monitoring plan to comply with ensure environmental requirement during construction and operation phases had been established. Which include: i) Construction phase: monitoring the contractor's implementation of mitigation measures, monitoring of surface water quality, air quality conducted by CSC and IEMC, the period monitoring reports had been prepared. (ii) Operation phase: monitoring of surface water quality, air quality, exhaust gas, wastewater, chemical storage, solid waste, and hazardous waste. Funding for the environmental management and monitoring program during construction phase was VND 27,83 million/year and during opeation phase is VND 94,74 million/year.

Public consutation activities had been carried out during EIA report preparation to Vinh Phu, Lai Tian, Than Giao, An Phu, Binh Hoa, An Thanh wards PC and local people in the project areas.

During operation: Operation unit of Thuan An WWTP is BIWASE. The WWTP has been allowed to discharge wastewater into water sources through a license No. 2388/GP-BTNMT dated November 20, 2019 by MONRE. BIWASE established automatically and continuously monitoring requirements for some indicators to stabilization ponds and outlets and wastewater volume at the intake and periodically monitoring on 11 indicators (excluding automatically monitoring indicators) for every three months. All monitoring results during operation phase, show that the quality of treated wastewater meets QCVN 14:2008/BTNMT-column A - National wastewater Quality into the receiving source for the purpose of supplying domestic water. Generated domestic waste and sludge have been transported to South Binh Duong Solid Waste Treatment Complex for treatment. And no unforeseen issues, incidents and complaints have been recorded during operation time of the WWTP.

Annually WWTP operation reports have been prepared and submitted to MONRE, Binh Duong DONRE as per requested.

Conclusion: The project has been complied with relevant regulations of Vietnam government and the is compatible with the WB's policies. And not further corrective actions need to be developed and implemented.

III. The South Binh Duong Solid Waste Treatment Complex

The South Binh Duong Solid Waste Treatment Complex (hereinafter referred to the Complex) has land area of 75ha. It is located at Quarter 1B, Chanh Phu Hoa ward, Ben Cat town, Binh Duong province. The Complex has been licensed with Binh Duong PPC and the Ministry of Natural Resources and Environment (MONRE), as the following documents:

- Business Registration Certificate No 3700145694 dated 7/2/2006 issued by Binh Duong Provincial Department of Planning and Investment. The 10th Revision dated of this Certificated was dated 19/11/2012;
- Decision No 237/QĐ-BTNMT dated 02/03/2005 by MONRE approving environmental impact assessment (EIA) report of the project "Southern Binh Duong's Solid Waste Treatment Complex"
- Decision No 2449/QĐ-BTNMT dated 28/12/2011 by MONRE approving the EIA report of the project "Investment of a New Industrial Wastes Incinerators in South Binh Duong's Solid Waste Treatment Complex"
- Decision No 541/QĐ-UBND dated 18/02/2011 by Binh Duong PPC approving the project "Raising capacity of South Binh Duong's Solid Waste Treatment Complex by 420 ton/day";

- Decision No 171/QĐ-BTNMT dated 07/02/2013 by MONRE approving the EIA report of the project "Raising capacity of Southern Binh Duong's Solid Waste Treatment Complex by 420 ton/day"
- Decision No. 43/QĐ-BTNMT dated 08 January 2016 of MONRE approving EIA for the project "Increasing the Capacity of the Nam Binh Duong Solid Waste Treatment Complex"
- Hazardous Wastes Management License No: 5-7-8.028.VX (original) dated 19/10/2012 by MONRE;
- Permission for discharging wastewater into water sources under License No. 130/GPUBND dated December 28, 2018 of Binh Duong Provincial People's Committee
- Environmental protection facilities have been checked and verified by the Vietnam Environment Administration, Ministry of Natural Resources and Environment in Certification No. 45/GXN-TCMT dated May 24, 2016 and Certification No. 117 / GXN-BTNMT dated 15 / 10/2018

The complex has a treatment capacity of 1,575 tons/day for domestic waste; 1000 tons/day for normal industrial waste; 600 tons/day for hazardous waste. The technical facilities in the complex include: 3 compost processing lines with a total capacity of 1,260 ton /day (420 tons/day/1 line); an incinerator + industrial waste drying system 11,500 kg/hour; treatment system for distillation, solvent recovery 200 liters/hour; packaging washing system; solidification system (concrete mixer) 40 tons/day; industrial wastewater treatment plant with capacity of 250 m^3/day; brick production plant 120,000 bricks/day, unburnt bricks 1,000 bricks/day; Producing PO oil from nylon 40 tons of raw materials/day. According to its opration plan, the complex will operate until the end of 2030. Currently, Complex are receiving 1,200 ton/day of domestic solid waste, 200 ton/day of industrial waste and 3 ton/day of medical waste.

This Complex is currently under the management of BIWASE, which plan to be operation unit of the project facilities (including two existing Thuan An and Di An WWTPs and sewers collection system). The sludge generated from operation of existing Thuan An WWTP and Di An WWTP have also being transported to the complex for disposal.

During the operation, the complex has taken sufficient measures to protect the environment, specifically as follows:

Solid waste:

Municipal waste is collected and classified for recycling, composting, brick production and burial in burial slots.Domestic waste is collected and classified for recycling, composting, brick production and burial in burial compartments. Residual for composting and non-recyclable waste is transported to landfills for sanitary landfill or for burning at incinerators. Waste generated from brick production will be crushed before disposal. The ash from incinerators is tested for hazardous level according to regulation in QCVN 07: 2009/BTNMT. If it is considered as hazardous waste will be buried in a hazardous waste burial house, it is not hazardous waste, which will be buried in a solid waste disposal process.

Exhausted gases:

- The exhaust gas generated from the incinerator is treated to meet Vietnamese standards QCVN 30: 2012 - National technical regulation on industrial waste incinerators, column B, according to the process: Exhausted gases → thermal exchanger → Absorption tower (add NaOH solution) → Dispersion through the chimney;

- Emissions from brick production are treated to meet QCVN 19: 2009 / BTNMT - National standard on industrial exhausted gases for dust and inorganic substances, column A, according to the process: exhausted gas → centrifugal exhaust fans → Absorption tower (add NaOH solution) → the chimney with 20m of height.

Wastewater treatment:

All wastewater including rainwater, leachate, domestic water is transferred to to the centralized wastewater treatment station with a capacity of 960 m3/day, where wastewater is treated to meet QCVN 25: 2009/BTNMT column A and QCVN 40: 2011/BTNMT column A before discharging into the environment.

Oil contaminated wastewater from cleaning equipment during PO oil production is collected and transferred to an industrial wastewater treatment station with a capacity of 250 $m^{3/}$day, where wastewater is treated to meet QCVN 40: 2011/ BTNMT (column A) – National standard industrial wastewater quality

Sludge treatment: Sludge from wastewater treatment is pumped into sludge presses and buried

The environmental quality at the complex is also monitored every 3 months: The quality of the exhaust gases after the gas treatment system meets the permission value stated in QCVN 30: 2012 BTNMT and QCVN 19: 2009/BTNMT (CO ranges from 188- 236 mg/Nm^3, SO2 concentration <26 mg/Nm^3, NOx from 60-92 mg/Nm^3, dust from 5-9 mg/Nm^3). The quality of wastewater are within the allowed values regulated in QCVN 40: 2011/BTNMT column A, QCVN 25: 2009/BTNMT column A (average BOD5 is about 3 mg O_2/l, COD is about 7 mgO_2/l, NH_4^+ about 0.17 mg/l, content heavy metals are small or not detected). The quality of soil in the complex is within the permission of QCVN 03: 2008/BTNMT with Cu content from 2-4.5 mh/kg, ZN from 2.6-8.7 mg/kg, No content of As, Pb is detected. content <8 mg/kg, Cd <0.5 mg/kg

In general, appropriate and sufficient mitigation measures have been taken to ensure that the Complex is operated continuously, in accordance with the designed technical specification, efficient, and hygienic procedures.

Some pictures at the complex as below:

Collection

Separation

Combustion

Brick production

Composting

Landfill site

Power generated by using biogas from solid waste treatment

South Binh Duong Solid Waste Treatment Complex

Appendix 5. Calculated Results for Incident of WWTP Operation

Incidents of WWTP operation - Waste discharge incidents due to possible emergencies and WWTP failure)

During the operation of WWTP, incidents such as equipment damage, clogged pipes, improper operation may happen. If the problem occurs, the efficiency of WWTP will be decreased. In this case, untreated wastewater may be discharged to received water courses, increasing levels of organic matter in rivers and stream and canals; increasing algal development or eutrophication status of these water resources. The incidents may occur during the operation of the WWTP as follows:

- The fire incidents may be due to electrical short-circuiting or power outage resulting in subsequent in operation of the WWTPs.
- One of the treatment facilities breaks down and stops working affecting the entire wastewater collection system of the city. This would most likely result in overflow at the wastewater pumping stations and rising onto the pavement causing local flooding, affecting the landscape and environmental pollution.
- Other incidents can stop the operation of the WWTP such as in emergencies, when there is a need to discharge untreated wastewater into the environment. The impacts from operating incidents, as per guidance in Circular No, 76/2017/TT-BTNMT dated 29/12/2017 of Ministry of Environment and Natural Resources, in three WWTPs could be estimated as the below

Tan Uyen WWTP:

The calculated results for Tan Uyen WWTP could be summarized as the below

Table 1. The concentration of pollutants in intake and outlet of the WWTP

Indicators	Unit	Tan Uyen WWTP	
		Intake (untreated wastewater)	Outlet (Treated wastewater)
BOD_5	mg/l	93.4	30
TSS	mg/l	107.2	50
$N\text{-}NH_4^+$	mg/l	3	0.3
$N\text{-}NO_3^-$	mg/l	6.4	5

Table 2. Load of pollutants discharged into Dong Nai river

Indicators	Unit	Totally discharging to the river (without treatment)	Total treated (100%)
BOD_5	kg/day	1868	600
TSS	kg/ day	2144	1000
$N\text{-}NH_4^+$	kg/ day	50	6
$N\text{-}NO_3^-$	kg/ day	128	100

To assess the risk of contamination by untreated wastewater on Dong Nai river, in the case of an equipment failure, the wastewater would be discharged directly into the river, should determine the capacity of receiving wastewater by Dong Nai river. (According to the guidance in 02/2009/TT-BTNMT 19/3/2009 regulatory assessment of wastewater receiving water).

Wastewater receiving capacity of the Dong Nai river depends on the quality of the water in the river and amount of pollutants in the wastewater. Some of the specific environmental criteria for receiving water and wastewater sources are shown in the below table:

Table 3. Background environmental parameters to determine the capacity of receiving wastewater

Indicators	Unit	Receiving water body (Dong Nai river) (Cs, max)*	Permission standard value	
			QCVN 08:2015 (A2)	Safety factor (Fs)
BOD_5	mg/l	24	6	0,3
TSS	mg/l	65.5	30	0,3
$N\text{-}NH_4^+$	mg/l	0.29	0,3	0,3
$N\text{-}NO_3^-$	mg/l	2.6	5	0,3

*Noted: *Monitored results*

Capacity of the wastewater treatment plant is 20.000m^3/day (0,23 m^3/s)

The smallest flow of the receiving Dong Nai river is Qs = 45,93 m^3/s ,

a) The formula for calculating the maximum pollution load is:

$$L_{td} = Q_s * C_{qc} * 86,4$$

Where:

- L_{td}(kg/day) is the maximum pollution load of water for pollutants
- Q_s (m^3/s) is the flow rate in the river section
- Q_t (m^3/s) is the wastewater flow
- C_{tc}(mg/l) is the concentration limit values of pollutants
- 86,4 is unit conversion factor from (m^3/s)*(mg/l) to (kg/day)..

Table 4. Maximum pollutant load in received water sources (Dong Nai river)

Indicators	BOD_5	TSS	Ammonia	Nitrate
L_{td}(kg/day)	23810	119050	1190,5	19842

b) The formula for calculating the amount of the pollutant loads of the receiving water is:

$$Ln = Qs * Cs * 86,4$$

Where:

C_s (mg/l) is the maximum value of the concentration of pollutants in the river water before receiving wastewater

The load of pollutants which are available in water sources will be as follows:

Table 5. Calculated results of current pollutant load in receiving water body

Indicators	**BOD_5**	**TSS**	**Ammonia**	**Nitrate**
L_n (kg/day)	95240	259927	1151	10318

c) The formula for calculating the pollutants load from wastewater into water sources is:

$$L_t = Q_t * C_t * 86,4$$

Where:

- Q_t (m^3/s) is the largest wastewater flow
- C_t (mg/l) is the maximum value of pollutants concentration in wastewater

will be as follows:

Table 6. Calculated results of pollutant load in wastewater

Indicators	BOD_5	TSS	Ammonia	Nitrate
L_t (kg/day)-without treatment	1856	2130,3	49,7	127,2
L_t (kg/day)- with treatment	596,2	993,6	5,96	99,4

d) The formula for calculating the capacity of receiving pollution load of water source for pollutants is

$$L_{tn} = (L_{tđ} - L_n - L_t)*Fs$$

The receiving capacity of the receiving water will be respectively as follows:

Table 7. Receiving capacity of the water sources

Indicator	**BOD_5**	**TSS**	**Ammonia**	**Nitrate**
L_{tn}(kg/day)- without treatment	-21986	-42902	-3	2819
L_{tn}(kg/day)- with treatment	-21608	-42561	10,1	2827,4

Therefore, if the incidents occur in 1 day, 20,000 m^3 of untreated wastewater will be discharged directly into Dong Nai river. And Dong Nai river, in this case, still have able capacity to dilute the Nitrate concentration in the wastewater but it will not be able to carry high volume of BOD_5 , TSS, COD in untreated wastewater. The receiving capacity of the Dong Nai river over time is calculated as follows

Table 8. Calculate the capacity of receiving wastewater of Dong Nai River

Indicators	**BOD_5**	**COD**	**TSS**	**Ammonia**
Lt n(kg/day)- without treatment	-21986	-42902	-3	2819
Lt (kg/day)- without treatment	1856	2130,3	49,7	127,2
Incident (day)	-	-	-	22.2

Based on the data on the volume of pollutants from the wastewater discharged into Dong Nai river, if the incident happens the number of days when Dong Nai river is still capable of receiving the Nitrate will be 22.2 days

The change of pollutant concentration in Dong Nai river in all cases could be evaluated as the below:

$$C= (C_{nt}*Q_{nt}+C_s*Q_s)/(Q_{nt}+Q_s)$$

Table 9. The change of pollutant concentration in Dong Nai river

Indicator	Unit	C pollutants (without treatment)	C pollutants (with treatment)	Dong Nai river (Cs, max)*	Concentration	
					Without treatment	With treatment
BOD_5	mg/l	93.4	30	24	24.3	24.0
TSS	mg/l	107.2	50	65.5	65.7	65.4
$N\text{-}NH_4^+$	mg/l	3	0.3	0.29	0.3	0.3
$N\text{-}NO_3^-$	mg/l	6.4	5	2.6	2.6	2.6

As above calculated results, the water quality in Dong Nai river will not be changed significantly. However, water quality in Dong Nai river will be much better in case wastewater will be treated before discharging to the river. It is noted that BOD_5 concentration will exceed the permission standards. Thus, the dilution capacity of Dong Nai river will be to be calculated, the change of BOD_5 concentration in downstream of Dong Nai river could be estimated by using simple calculation (Curi K., 1980):

$$BOD_t = BOD_o *10^{-kt}$$

Where:

- BOD_t: concentration of BOD (mg/L) reduction by time;
- BOD_o: Concentration of BOD (mg/L) at discharging point (24mg/l)
- t : Time (day);
- k : Reduction coefficient BOD, as 0.04 (day^{-1}).

The average flow rate in the Dong Nai river in dry season is 45,93 m^3/s, with 260m in width, and in depth, then flow speech will be 0,05m/. The change of BOD_5 concentration in downstream of Dong Nai river is presented in the below table

Table 10. The change of BOD5 concentration by time and distance

Time (hours)	Distance (km)	BOD_5 (mg/L O_2)
0	0	24
8	1.44	17.7
16	2.88	13.0
24	4.32	9.6
32	5.76	7.0

40	7.2	5.2

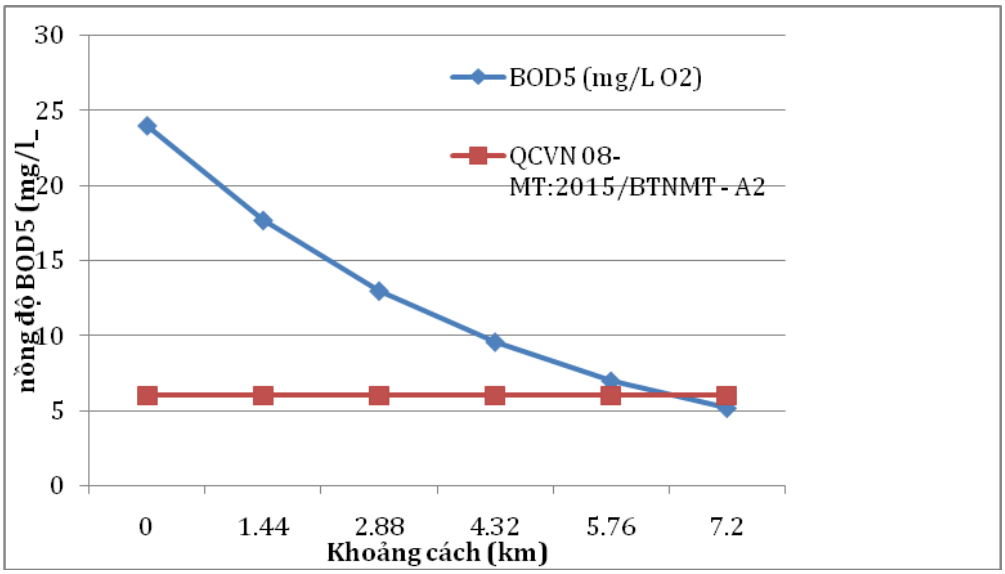


Figure 1. The change of BOD5 concentration by distance

By the time of 40 hours, BOD_5 concentration in will meet the allowed value in standard. (QCVN 08:2015/BTNMT column A2)

Di An WWTP:

The calculated results for Di An WWTP could be summarized as the below

Table 11. The concentration of pollutants in intake and outlet of the WWTP

Indicators	Unit	Di An WWTP	
		Intake (untreated wastewater)	Outlet (Treated wastewater)
BOD_5	mg/l	96.36	4.74
TSS	mg/l	126.6	1.8
$N\text{-}NH_4^+$	mg/l	17.34	1.06
$N\text{-}NO_3^-$	mg/l	4.06	1.24

Table 12. Load of pollutants discharged into Dong Nai river

Indicators	Unit	Totally discharging to the river (without treatment)	Total treated (100%)
BOD_5	kg/day	3854.4	189.6
TSS	kg/ day	5064	72
$N\text{-}NH_4^+$	kg/ day	693.6	42.4

$N\text{-}NO_3^-$	kg/ day	162.4	49.6

To assess the risk of contamination by untreated wastewater on Dong Nai river, in the case of an equipment failure, the wastewater would be discharged directly into the river, should determine the capacity of receiving wastewater by Dong Nai river. (According to the guidance in 02/2009/TT-BTNMT 19/3/2009 regulatory assessment of wastewater receiving water).

Wastewater receiving capacity of the Dong Nai river depends on the quality of the water in the river and amount of pollutants in the wastewater. Some of the specific environmental criteria for receiving water and wastewater sources are shown in the below table:

Table 13. Background environmental parameters to determine the capacity of receiving wastewater

Indicators	Unit	Cai Cau canal	Receiving water body (Dong Nai river) (Cs, max)*	Permission standard value	
				QCVN 08:2015 (A2)	Safety factor (Fs)
BOD_5	mg/l	25,5	30	6	0,3
TSS	mg/l	54	60	30	0,3
$N\text{-}NH_4^+$	mg/l	0,26	0,15	0,3	0,3
$N\text{-}NO_3^-$	mg/l	1,85	2,9	5	0,3

Noted: * *Monitored results*

Capacity of the wastewater treatment plant is 40.000m^3/day (0,46 m^3/s)

The smallest flow of the receiving Dong Nai river is Qs = 45,93 m^3/s , and Cai Cau canal is 2 m^3/s.

Apply the same methodology as calculating for Tan Uyen WWTP, the results for Di An could be summarized as the below

a) The maximize load of pollutants which are available in water sources will be as follows:

Table 14. Maximum pollutant load in received water sources (Dong Nai river)

Indicators	BOD_5	TSS	Ammonia	Nitrate
L_n (kg/day)	23810	119050	1190,5	19842

b) The load of pollutants is available in the water sources will be as follows:

Table 15. Calculated results of current pollutant load in receiving water body

Indicators	BOD_5	TSS	Ammonia	Nitrate
L_n (kg/day)	119051	238101	595,3	11508
Lr (kg/day)	4406	9331	44,9	319,7

c) The load of pollutants from the WWTP discharged into water sources

Table 16. Calculated results of pollutant load in wastewater

Indicator	BOD_5	TSS	Ammonia	Nitrate
L_{tn}(kg/day)- without treatment	3829,7	5031,6	689,2	161,4
L_{tn}(kg/day)- with treatment	188,4	71,5	42,1	49,3

d) The receiving capacity of the receiving water will be respectively as follows::

Table 17. Receiving capacity of the water sources

Indicator	BOD_5	TSS	Ammonia	Nitrate
L_{tn}(kg/day)- without treatment	-31043	-40024	-41,6	2356
L_{tn}(kg/day)- with treatment	-29951	-38536	152	2389

Therefore, if the incidents occur in 1 day, 40,000 m^3 of untreated wastewater will be discharged directly into Dong Nai river. And Dong Nai river, in this case, still have able capacity to dilute the Nitrate concentration in the wastewater but it will not be able to carry high volume of BOD_5 , TSS, COD in untreated wastewater. The receiving capacity of the Dong Nai river over time is calculated as follows

Table 18. Calculate the capacity of receiving wastewater of Dong Nai River at discharge location

Indicator	**BOD_5**	**COD**	**TSS**	**Ammonia**
Lt n(kg/day)- without treatment	-31043	-40024	-41,6	2356
Lt (kg/day)- without treatment	3829,7	5031,6	689,2	161,4
Incident (day)	-	-	-	14,6

Based on the data on the volume of pollutants from the wastewater discharged into Dong Nai river, if the incident happens the number of days when Dong Nai river is still capable of receiving the Nitrate will be 14.6 day.

The change of pollutant concentration in Dong Nai river in all cases could be evaluated as the below:

$$C= (C_{nt}*Q_{nt}+C_{rạch}*Q_{rạch}+C_s*Q_s)/(Q_{nt}+Q_{rạch}+Q_s)$$

Table 19. The change of pollutant concentration in Dong Nai river

Indicator	Unit	C pollutants (without treatment)	C pollutants (with treatment)	Cai Cau canal	Dong Nai river (Cs, max)*	Concentration	
						Without treatment	Without treatment
BOD_5	mg/l	96.36	4.74	25,5	30	30.4	29.6

TSS	mg/l	126.6	1.8	54	60	60.4	59.2
$N\text{-}NH_4^+$	mg/l	17.34	1.06	0,26	0,15	0.3	0.2
$N\text{-}NO_3^-$	mg/l	4.06	1.24	1,85	2,9	2.9	2.8

As above calculated results, the water quality in Dong Nai river will not be changed significantly. However, water quality in Dong Nai river will be much better in case wastewater will be treated before discharging to the river. It is noted that BOD_5 concentration will exceed the permission standards. Thus, the dilution capacity of Dong Nai river will be to be calculated, the change of BOD_5 concentration in downstream of Dong Nai river could be estimated by using simple calculation (Curi K., 1980):

$$BOD_t = BOD_o * 10^{-kt}$$

Where:

- BOD_t concentration of BOD (mg/L) reduction by time;
- BOD_o: Concentration of BOD (mg/L) at discharging point (29,6 mg/l)
- t : Time (day);
- k : Reduction coefficient BOD, as 0.04 (day^{-1}).

The average flow rate in the Dong Nai river in dry season is 45,93 m^3/s, with 260m in width, and in depth, then flow speech will be 0,05m/s. The change of BOD_5 concentration in downstream of Dong Nai river is presented in the below table

Table 20. The change of BOD_5 concentration by time and distance

Time (hours)	Distance (km)	BOD_5 (mg/L O_2)
0	0	29.6
8	1.44	22.0
16	2.88	16.2
24	4.32	11.9
32	5.76	8.8
40	7.2	6.4
44	7.92	5.5

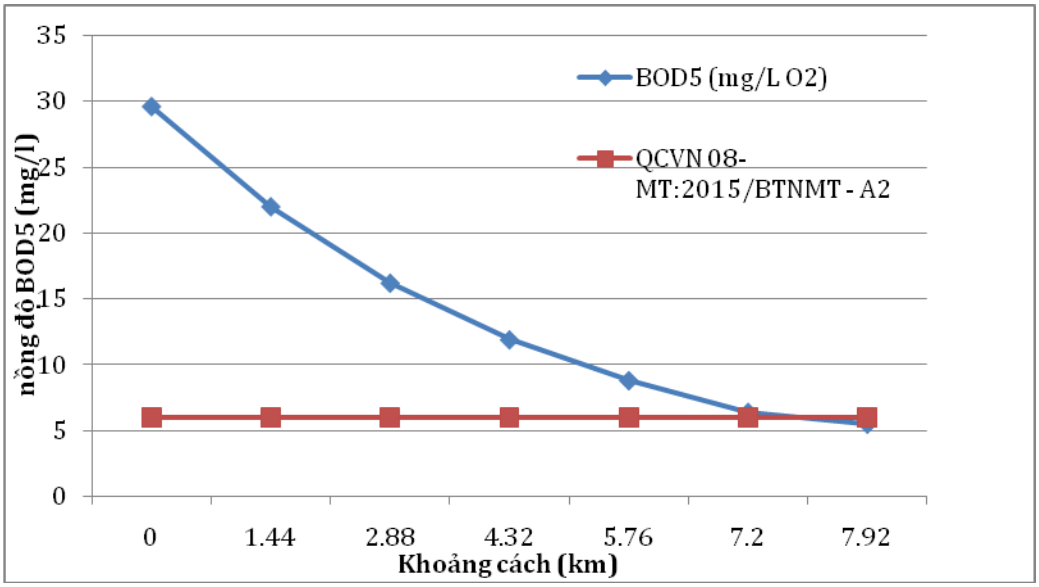


Figure 2. The change of BOD5 concentration by distance

By the time of 40 -44 hours, BOD_5 concentration in will meet the allowed value in standard. (QCVN 08:2015/BTNMT column A2)

Thuan An WWTP:

The calculated results for Thuan An WWTP could be summarized as the below

Table 21. The concentration of pollutants in intake and outlet of the WWTP

Indicators	Unit	Thuan An WWTP	
		Intake (untreated wastewater)	Outlet (Treated wastewater)
BOD_5	mg/l	72.50	2.75
TSS	mg/l	308.75	7.25
$N\text{-}NH_4^+$	mg/l	27.13	0.87

Table 22. Load of pollutants discharged into Sai Gon river

Indicators	Unit	Totally discharging to the river (without treatment)	Total treated (100%)
BOD_5	kg/day	1450	55
TSS	kg/day	6175	145
$N\text{-}NH_4^+$	kg/day	542.5	17.45

To assess the risk of contamination by untreated wastewater on Sai Gon river, in the case of an equipment failure, the wastewater would be discharged directly into the river, should determine

the capacity of receiving wastewater by Sai Gon river. (According to the guidance in 02/2009/TT-BTNMT 19/3/2009 regulatory assessment of wastewater receiving water).

Wastewater receiving capacity of the Sai Gon river depends on the quality of the water in the river and amount of pollutants in the wastewater. Some of the specific environmental criteria for receiving water and wastewater sources are shown in the below table:

Table 23. Background environmental parameters to determine the capacity of receiving wastewater

Indicators	Unit	receiving water body Sai Gon river (Cs, max)*	Permission standard value	
			QCVN 08:2015 (A2)	QCVN 08:2015 (A2)
BOD_5	mg/l	18	6	0,3
TSS	mg/l	28	30	0,3
$N\text{-}NH_4^+$	mg/l	0.05	0,3	0,3

Noted: * *Monitored results*

Capacity of the wastewater treatment plant is 37.000m^3/day (0,43 m^3/s)

The smallest flow of the receiving Sai Gon river is Qs = 31 m^3/s ,

Apply the same methodology as calculating for Tan Uyen WWTP, the results for Thuan An could be summarized as the below

a) The maximize load of pollutants which are available in water sources will be as follows:

Table 24. Maximum pollutant load in received water sources (Sai Gon river)

Indicators	BOD_5	TSS	Ammonia
L_{td}(kg/ day)	16070	80352	1190,5

b) The load of pollutants is available in the water sources will be as follows:

Table 25. Calculated results of current pollutant load in receiving water body

Indicators	BOD_5	TSS	Ammonia
L_n (kg/day)	48211	74995	133,9

c) The load of pollutants from the WWTP discharged into water sources:

Table 26. Calculated results of pollutant load in wastewater

Indicator	BOD_5	TSS	Ammonia
L_{tn}(kg/day)- without treatment	2693,5	11471	1008

L_{tn}(kg/day)- with treatment	102,1	269,3	32,4

d) The receiving capacity of the receiving water will be respectively as follows:

Table 27. Receiving capacity of the water sources

Indicator	BOD_5	TSS	Ammonia
L_{tn}(kg/day)- without treatment	-10450	-1834	-101,4
L_{tn}(kg/day)- with treatment	-9673	1526	191

Therefore, if the incidents occur in 1 day, 37,000 m^3 of untreated wastewater will be discharged directly into Sai Gon river. And Sai Gon river, in this case, still have able capacity to dilute the Nitrate and TSS and o BOD_5. The receiving capacity of the Sai Gon river over time is calculated as follows

The change of pollutant concentration in Dong Nai river in all cases could be evaluated as the below:

$$C= (C_{nt}*Q_{nt}+C_s*Q_s)/(Q_{nt}+Q_s)$$

Table 28. The change of pollutant concentration in Sai Gon river

Indicator	Unit	C pollutants (without treatment)	C pollutants (with treatment)	Sai Gon river (Cs, max)*	Concentration	
					Without treatment	Without treatment
BOD_5	mg/l	72.50	2.75	18	18.7	17.8
TSS	mg/l	308.75	7.25	28	31.8	27.7
$N\text{-}NH_4^+$	mg/l	27.13	0.87	0.0	0.4	0.01

It is noted that BOD_5 concentration will exceed the permission standards. Thus, the dilution capacity of Sai Gon river will be to be calculated, the change of BOD_5 concentration in downstream of Sai Gon river could be estimated by using simple calculation (Curi K., 1980):

$$BOD_t = BOD_o *10^{-kt}$$

Where:

- BOD_t: concentration of BOD (mg/L) reduction by time;
- BOD_o: Concentration of BOD (mg/L) at discharging point (24mg/l)
- t : Time (day);
- k : Reduction coefficient BOD, as 0.04 (day^{-1}).

The average flow rate in the Sai Gon river in dry season is 31 m^3/s, with 200m in width in Thuan An section, and 3,5-4m in depth, then flow speech will be 0,044m/s. The change of BOD_5 concentration in downstream of Sai Gon river is presented in the below table

Table 29. The change of BOD5 concentration by time and distance

Time (hours)	Distance (km)	BOD_5 (mg/L O_2)
0	0	17.8
8	1.24	13.1
16	2.47	9.6
24	3.71	7.1
32	4.94	5.2

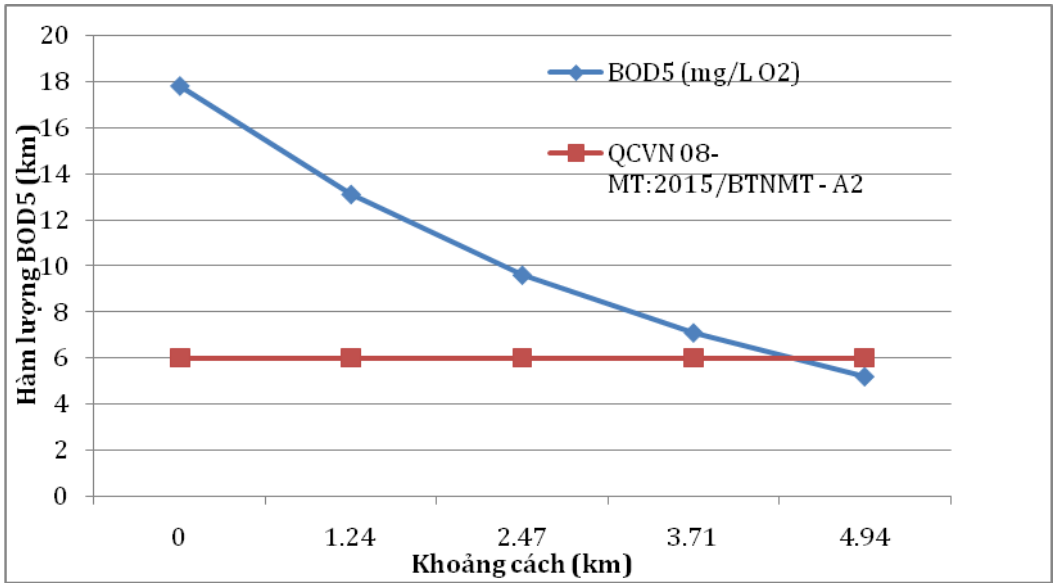


Figure 3. The change of BOD5 concentration by distance

By the time of 32 hours, BOD_5 concentration in will meet the allowed value in standard. (QCVN **08:2015/BTNMT column A2)**

Assessment:

Tan Uyen WWTP :Based on the data on the volume of pollutants from the wastewater discharged into Dong Nai river, if the incident happens the number of days when Dong Nai river is still capable of receiving the Nitrate will be 22.2 days. By the time of 40 hours, BOD_5 concentration in will meet the allowed value in standard. (QCVN 08:2015/BTNMT column A2) at the distance of 7.2km, therefore, the impacts will cause for Tan Hiep supply water plant.

Di An WWTP: Since incidents occur in 1 day, 40,000 m^3 of untreated wastewater will be discharged directly into Dong Nai river. And Dong Nai river, in this case, still have able capacity to dilute the Nitrate concentration in the wastewater but it will not be able to carry high volume of BOD_5 , TSS, COD in untreated wastewater. By the time of 40 -44 hours, BOD_5 concentration in will meet the allowed value in standard. (QCVN 08:2015/BTNMT columnA)at the distance of 7.92km in downstream

Thuan An WWTP: If the incidents occur in 1 day, 37,000 m^3 of untreated wastewater will be discharged directly into Sai Gon river. And Sai Gon river, in this case, still have able capacity to

dilute the Nitrate and TSS and o BOD_5By the time of 32 hours, BOD_5 concentration in will meet the allowed value in standard. (QCVN 08:2015/BTNMT column A**),** at the distance of 4.5 km in downstream

Appendix 6: BinhDuong WEIP Project Dredged Materials Management plan

1. Location of Dredging, Volume and Characteristics of Dredged Materials

- Dredging and rehabilitation of 1.3 km of canals: The total volume of sludge dredged is about 66,015 m^3

2. Final Disposal Site

According to the analyses in chapter 3, the sediments from the canal dredging work are not hazardous, with heavy metals lower than the acceptable limits. The sediments could then be used for perennial crops or planting tree for urban landscape purpose, based on the actual needs of local people. Otherwise, it will be transported and disposed at South Binh Duong Solid Waste Treatment Complex, which the distance to construction site is about 25km

Although a separate management plan is prepared for the excavated materials of the entire project, disposals of the excavated materials will also follow the above principles. During construction phase additional tests for deeper layer will also be carried out by the contractors.

3. Contractor's Dredging Management Plan

The Contractor is required to prepare a Contractor's Dredging Management Plan (CDMP) and submitted to the Environmental Consultant of the Construction Supervision team and the PMU Environmental Officer for review and approval. The CDMP will include, but not limited to the followings:

- The Scope of Works in the Contract package, construction method and schedule
- Volume and quality of water quality and sediment quality in the dredging area covered by the contract
- Water users that may be affected by the dredging and embankment lining
- Materials uploading and transportation method: indicate proposed route of the transport from the dredged site to the disposal area, time of operation, type of vehicles/trucks and proposed measures to reduce the leakage of the dredged materials from the transport trucks,
- Schedule to inform the nearby communities about the project, disclosure of name and contact number for possible complaints.
- Potential social and environmental impacts, including the site-specific impacts and risks
- Mitigation measures to address the potential impacts and risks. The mitigation measures should be proposed based on ESIA/ESCOP, ESMP, SEMP, the potential impacts and mitigation measures presented in Section 4 and 5 of this Plan and the following requirements:
- Environmental Quality Monitoring plan carried out by the contractor (particularly pH, DO, TSS, BOD_5, for water and heavy metals including pH, Hg, As, Cd, Cu, Pb, Zn and Cr, Organic Materials and Mineral Oils for sediments and soil
- For soil and sediment: The number of samples taken will follow the following guidelines

Table 1: The number of Sediment samples

Volume of dredged (m3)	No of Sediment Samples
Up to 25,000	3

25,000 to 100,000	4-6
100,000 to 500,000	6-10
500,000 to 2,000,000	10-20
For each 1,000,000 above 2,000,000	Additional 10

At least one water, soil and sediment sample must be taken for each contract package

- Consultation with affected community about the draft CDMP
- Excavated soil is separated from dredged materials from source. Excavated soils will be reused on-site and off-site as much as possible and transported to the nearest disposal site appraised under ESIA, or identified and approved during detail engineering design or construction phase;
- The mitigation measures are adequate to address the potential social and environmental impacts associated with various steps and activities, areas of influence and receptors of dredging, temporary storage, transportation and final disposal of the dredged materials.
- Field survey are carried out by the Contractor during the preparation of the CDMP in order to identify if there are additional sensitive receptors not identified previously under Binh Duong WEIP project and proposed additional site-specific mitigation measures accordingly.
- Contractor's environmental monitoring plan are included
- Commitments to carry out corrective actions when excessive pollution is determined, or when there are complaints about environmental pollution, social impacts from any stake holders

4. Potential Impacts and Mitigation Measures for Dredging and Embankment lining

Impacts and Description	Mitigation Measures
AT DREDGING and TEMPORARY LOADING AREAS	
Odor and air pollution, nuisance Decomposition of organic matters under anaerobic conditions generates strong odor-generated gases such as SO_2, H_2S, VOC etc. When the muds are disturbed and excavated, these gases are released much faster into the air. Exposure to odor pollution affect the health of workers, local residents and cause public nuisance	- Inform the community at least one week before dredging is started - Minimize the duration of temporary loading of dredged materials on-site - temporary loading materials must be transported to the disposal site within 48 hours - Load the materials on-site tidily - Do not load the materials temporarily outside the construction corridor determined for each canal section - Avoid loading the sludge in populated residential areas or near public buildings such as kindergarten. Load the sludge as far from the

Impacts and Description	Mitigation Measures
	houses and buildings as far as possible - Cover the temporary sludge loads when loading near sensitive receptors or longer than 48 hours unavoidable
Dust and nuisance Temporary loading of sludge at the construction site cause nuisance to the public Dry and wet mud may be dropped along the dredging area and on transportation route causing nuisance to the public and traffic safety risks	- Avoid temporary loading of dredged materials on-site - Dredged materials must be transported to the final disposal sites earliest possible and no later than 48 hours from dredging. - Use truck with water-tight tank to transport wet/damp dredged materials; - All trucks must be covered tightly before leaving construction site to minimize dust and mud dispersion along the road
Traffic Disturbance The placement and operation of dredging equipment and construction plants on the ground, temporary loading of the dredged materials may obstruct or disturb traffic and cause safety risks for the people travelling on the canal-side road, particularly on canal-crossing bridges which are usually very narrow	- Arrange worker to observe and direct excavators' driver when traffic is busy
Social Disturbance Concentration of workers and equipment, construction plants, temporary loading of materials and wastes, traffic disturbance, dusts and odor pollution etc. will disturb daily activities and the lives of local residents Conflicts may also be arisen if workers, waste, materials, equipment etc. are present outside the construction corridor	- Inform the community at least one week before construction is started - Monitor to ensure that physical disturbances are within the construction corridors only - Contractor recruit local labors for simple works, brief them about project environmental and safety requirements before started working - Contractor register the list of workers who come from other localities to the commune at the construction site - Led the water leaked from wet/damp dredged materials going back to the river, not to affect garden or agricultural land - Keep the areas to be disturb minimal - Enforce workers to comply with codes of

Impacts and Description	Mitigation Measures
	conducts
Landslide and soil subsiding risks at dredging area Relative deep excavation or cut and fills on the embankments that create slopes may lead to landslide and soil subsiding at the slops or excavated areas, particularly in rainy weather Deep excavation also causes risks to the existing buildings nearby, particularly the weak structures or located too close to the deep excavation area.	- During field survey for the preparation of CDMP, the contractor in coordination with the Environmental Officer of PMU and the Environmental Consultant of the CES identify weak structures that may be at risk and determine appropriate mitigation measures accordingly - Consider and select appropriate dredging method that allow minimizing soil subsiding risks, for example carry out stepped excavation, stabilize slops in parallel to dredging - Apply protective measures such as sheet piles at risky locations
Water Quality Degradation Turbidity in water will be increased when the mud is disturbed; Water leaked from dredged material and surface runoff through disturbed ground also contain high solid contents. Muddy water entering irrigation ditch will cause sedimentation. Aquatic lives in the canal would also be affected by turbid water.	- Build coffer dams surrounding the dredging area and pump the water out before starting dredging - If dredging is carried out directly onto the water, dredge at intervals to allow suspended materials to resettle before continuing. Observe water color at 20 m upstream and stop dredging when water color there started to change
Increased Safety risk for the Public	- Place stable barriers along the construction corridor boundary to separate the site with nearby structures - Place warning signs and reflective barriers along the construction area, at dangerous locations and within sensitive receptors - Ensure adequate lighting at
Health and Safety risk to the workers The health of workers may be affected due to exposure to odor and other contaminants from sludge Risk of being drown	- Within two weeks before dredging is started, the contractor will coordinate with local authority to identify good swimmers or those who can dive in the locality and hire at least one of them at each canal construction site deeper than 3 m and there are workers working on or near water surface. - Provide and enforce the workers to use masks. If and when working in the water, protective cloths, rubber boots, gloves and hats

Impacts and Description	Mitigation Measures
	must be wearing.
Others	- Other relevant measures specified in ESCOP or proposed by the contractors as necessary
MATERIAL LOADING AND TRANSPORTATION	
Dust and nuisance, traffic safety risks Dust or wet materials may be dropped along the transportation route	- Use water-tight tank trucks for transporting wet/dam materials - Cover the materials tightly before leaving the construction site - Do no overload material on the trucks
AT FINAL DISPOSAL SITE	
Landslide and soil subsiding risks at final Disposal site Landslide and subsiding risk may happen on slopes created at the final disposal site of dredged materials if the slopes created are too high, steep or unstable	- Level the materials after being disposed off - Slopes of the dumps will not be steeper than 45^o - Build/create the walls to protect slopes - Create and maintain drainage at the foot of each dump higher than 2 m
Soil and Water Quality Pollution The disposal of salty soil would not affect the existing soil quality No risks of subsidence and landslide for residential areas around this area No impacts on river water quality.	- Apply measures that ensure rainwater onto the materials is not mix with the surface runoff from the surrounding to overflow uncontrolled at the site; rainwater will be infiltrated onto the ground on-site. This can be done by the following mitigation measures: - Build drainage ditches surrounding the designated disposal area - Use impermeable materials to cover the walls surrounding the materials to isolate it with the surrounding - Other measures proposed by the contractors to meet pollution control targets

5. Specific Guidance for Dredging at Suoi Tre canal

- Dredging methods

The dredging activities will be is carried out on the principle of section by section and will be organized in the following order:

- The length of each section will be about from 50-100 m
- Excavation activates canals must be carefully scheduled to avoid the rainy season and will be stopped during rainy days;
- The lake and canals should be dewatered and dried before implementing dredge activities as the following step:
    - Reinforce embankments;
    - Block the flow at the two ends of the section with a temporary dikes by using melaleuca sheet pile or sandbag on the canal at the beginning and end of the dredging section.
    - Use a pump to dry the water at the blocked sections;
    - Provide temporary drainage ditch system for the canals and regulating lake;
    - Use specialized equipment combined with manual techniques to conduct dry dredge on the blocked sections;
    - Sludge will be temporary storage at the construction sites for further drying and at reducing the volume and will be transported by trucks to the landfill;

Dredged sludge management

Before implementing the dredge activities, the typical samples will be taken on two canals and regulating lakes to define the characteristics of dredged materials. The sludge management manual will be proposed based on the characteristics of dredged materials, the detail dredged sludge management will be specified in the Contractor's DMP, general sludge management could be proposed as the below:

- Dredged materials will be transported to South Binh Duong Solid Waste Treatment Complex for treatment and disposal;
- Appropriate agreements between PMU, contractors with South Binh Duong Solid Waste Treatment Complex need to be obtained before conducting the dredge activities with confirmation from local authorities;
- Strictly follow the technical guidance of the South Binh Duong Solid Waste Treatment Complex;
- It is strongly recommended that the specialized trucks of South Binh Duong Solid Waste Treatment Complex could be mobilized to transport these type of dredged materials

Sludge temporary storage on the construction site

- Avoid as much as possible to temporary storage of the sediment materials, in case need to temporary placement, which will be covered by the technical fabric and transported to disposal sites as soon as possible.
- Location of temporary areas need to be within the boundary of construction site
- Storage areas need to be kept distance with the households, and watercourses;
- Disposal of sediments materials into canals, stream, other watercourses, agricultural field and public areas shall be prohibited
- Limit the period of temporary storage as much as possible.

- Reuse or remove excavated materials to the disposal site as soon as possible

Sludge transportation

- All trucks need to follow the requirements to manage dust, noise and traffic safety of transport vehicles stated in the ESIA
- The specialized vehicles (Use truck with water-tight tank) will be mobilized to transport the excavated sediments to avoid the leaking out of sludge on the transport routes and create environmental sanitation issues and odor along the transport routes.
- All trucks must be covered tightly before leaving construction site to minimize dust and mud dispersion along the road

Final Disposal Site

South Binh Duong Solid Waste Treatment Complex which have been operating several year and managed by BIWASE. Thus, disposing the dredged materials in these sites need to strictly follow technical regulation of the Solid Waste Treatment Complex